Directory of African Institutions with Existing Capacity for Training in Integrated Vector Management (IVM)

Prepared by:

Clifford M. Mutero, Consultant
E-mail: c.mutero@mweb.co.za

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Box: Four types of capacities needed in a systems-based approach to health research and development
1. Background

The U.S. Agency for International Development (USAID) offers technical and financial support at the global and country levels for the implementation of malaria and other vector-borne disease control activities. Under the Integrated Vector Management Task Order II (IVM 2), the Research Triangle Institute (RTI) International is providing technical assistance resources to institutionalize best practices, conduct operational research and strengthen the management capacities of country programs. The objective is to facilitate and sustain the effective management and control of disease vectors in order to reduce local disease burdens. IVM 2 complements the overall strategy of the President’s Malaria Initiative (PMI) in Africa. However, although the greatest focus is on malaria, it is hoped that the financial support for the specific skills-training and institutional strengthening envisaged in IVM2 will also indirectly contribute to the overall strengthening of health systems among the recipient countries.

A primary area of work for IVM2 is to design, implement and evaluate training in key skill areas. An immediate goal under this work area is to institutionalize courses on IVM for Anglophone and Francophone countries, to provide practical competencies in specific technical areas (e.g. entomology, pesticide management) and in the management of vector control programs (i.e. planning, implementation, monitoring and evaluation). In addition to helping build the relevant human capacity, the financial support will invariably contribute to other aspects of capacity building (see Box).

The first step in the IVM institutionalization process has been to take stock of existing capacities and opportunities for training in vector control in Africa. Towards this end a comprehensive review of institutions and establishments involved in the training of medical entomologists and general vector control was initiated in April 2008. The institutions include universities, research institutes, public health training outfits, non-governmental organizations, private sector, and international organizations conducting entomological training in Africa.

The main objective of the review is to prepare a directory from which suitable institutions can be selected and supported to host IVM training in Anglophone and Francophone countries. The selecting team would include representatives of major partners in IVM capacity building, including WHO, CDC, RTI International, USAID, and other educational and research organizations. A more general purpose of the directory will be to serve as a source of institutional and contact information, often needed by individual researchers, research organizations, donors and other groups interested in collaborating and networking on issues of IVM. The directory is a work in progress and will be continually updated as new information becomes available.

Data-collection method:
Institutional information was in the first instance gathered from online internet searches, published documents and any available secondary data. For the online searches, various key words were used singly and in combination including: integrated vector
management; Africa; medical entomology; vector control; national malaria control programmes; President’s Malaria Initiative (PMI); PMI countries; Roll Back Malaria; needs assessment in vector control; IVM workshops in Africa; among many others.

Secondly, an e-mail letter was circulated among vector research and control specialists working in African countries, seeking standardized information from their respective institutions regarding the following:

- Institutional mandate and focus;
- Medical entomology staff capacity;
- Facilities and equipment;
- Past and ongoing training activities in IVM and medical entomology;
- Role in regional and country vector-borne disease control programs;
- National, regional and international collaboration and partnerships.

The e-mails provided information that augmented data from the internet searches. More importantly, direct correspondence with researchers helped to standardize the institutional profiles in a way that would facilitate rational comparisons among the various institutions.

**Box: Four types of capacities needed in a systems-based approach to health research and development**

**Human capacity** is the individual skills, creativity, and motivation available for conducting research. This capacity could be built through partnerships and collaborative research, individual grants to researchers in developing countries, and international training.

**Physical capacity** comprises the laboratories, offices, and equipment used in conducting research. This is an important pre-requisite to most biomedical research and also an incentive for researchers to work in their home countries, thus pre-empting brain-drain.

**Organizational capacity** includes management, strategies, and decision-making that contributes to the research process. These skills are needed to help researchers, clinicians, and program directors to use resources effectively, assemble teams, network and form partnerships.

**Social/governmental capacity** is the economic, social, and political support that is a pre-requisite to research. In order for research infrastructure to be sustainable, the research must be valuable to outsiders. This ensures that the end-user communities will consider results and be financially supported by government and non-governmental organizations.

Besides conducting a desk review by internet searches and e-mail correspondence, visits were also made to a number of institutions for additional information on the most recent activities and first-hand assessment of facilities and equipment. Countries visited so far include Zambia, Uganda, Benin, Ghana and Kenya.

2. General observations

Training of medical entomologists in Africa is usually geared towards the fulfillment of requirements for post-graduate (Masters and PhD) degrees. In many countries there is no systematic or routine training of medical entomologists in practical and comprehensive skills that are needed to implement, scale-up and monitor vector control programmes and activities. Thus, most universities and international research institutions while generating new research knowledge do not necessarily have their programmes designed to address immediate needs of vector control or integrated vector management.

Consequently, the information currently available on IVM in Africa is mainly inferred from research projects on vector behavior and population dynamics, or evaluation of single vector control interventions in different ecological settings. The objective of such projects is to generate knowledge that may ultimately contribute to development of IVM, most notably for malaria vectors. However, the projects are often short-lived and dwell on only a few aspects of IVM without clearly articulating how the results can be incorporated into a robust framework for application of the strategy in real-life situations.

Among programmatic initiatives currently involved in capacity-building for practical vector control is a five-year project of WHO African region (WHO-AFRO) supported by the Gates Foundation. The project is aimed at strengthening systems for malaria vector control in seven African countries including: Tanzania, Kenya, Mali, Madagascar, Mozambique, Cameroon, and Senegal. The inception workshop for the initiative was held in Cameroon in February 2008, with the objective of assessing vector control and training needs, building consensus and developing work plans. The meeting report which is available on the internet contains useful questionnaire-generated information on the training needs identified for the national malaria control programs (NMCPs) and national reference units (NRUs) for each of the participating countries. Owing to similarities in the goals and certain activities of the WHO/Gates and the RTI-International /USAID IVM capacity-building initiatives, the information-gathering visits to training institutions conducted by the latter initiative targeted countries that were additional to those already covered by the WHO/Gates project. Ultimately the institutional information derived from actual visits or participatory workshops was available for a larger number of PMI countries.
3. Profiles of IVM training institutions in Africa

The following sections provide descriptions of formal institutions involved in IVM training. Effort was made to standardize the information for comparison purposes. However, while it is hoped that many of the key IVM institutions have been well represented in the report, it is worth noting that reviews of this nature can rarely be exhaustive, not least because of the dynamic nature of institutions. The database will therefore need to be updated periodically. A summary of the IVM training institutions and contact persons is provided in Annex 1 for quick reference while a list of the key people met during institutional visits and who shared their views and ideas regarding the proposed training in IVM is provided in Annex 2.

3.1 Benin:

3.1.1 Centre de Recherche Entomologique de Cotonou - CREC (= Centre for Entomological Research, Cotonou)

**Focus and Mandate**

The Center for Entomological Research of Cotonou (CREC) is specialized in biology, ecology and resistance problems of malaria vectors and in malaria vector control. Some of CREC’s past and current work include: trial of impregnated bednets, 1993-1996 (20,000 persons involved in study); study of malaria morbidity in southern Benin (WHO/TDR); surveillance of *Plasmodium falciparum* drug sensitivity; study of population structure of *Anopheles gambiae* complex in Benin and Togo (WHO/TDR); study of anti-sporozoite antibodies in blood and antisporozoite antigens in mosquito thoraxes (WHO/TDR and Aupelf-Uref); resistance of *An. gambiae* to pyrethroid insecticides.

**Medical entomology staff capacity**

*Researchers:*
5 Medical Entomologists (PhD level);  
Biochemist;  
Health Communication Researcher.

*Support staff:*  
9 technicians and 3 administrative staff

**Facilities and equipment**

Two functional insectaries (need upgrading to among other things prevent mosquitoes from escaping from the holding cages and rearing chambers);  
Animal rearing section;  
Entomological laboratory with dissection benches and many dissecting microscopes;  
A cytogenetics bench;
A molecular laboratory for advanced research work at molecular levels on vectors (PCR-species, PCR-forms, PCR-Kdr).

**Past and ongoing training activities in IVM and medical entomology**
Current training activities in IVM and medical entomology include:
i. MSc. in Applied Entomology in collaboration with the University of Abomey-Calavi, Benin, with 2 sections (medical entomology and agricultural entomology);
ii. International Master in Medical Entomology;
iii. BSc. in Biology with special reference to Medical Entomology;
iv. PhD training: 3 PhD undergoing training in 2008 in medical entomology.

CREC also organizes short term courses of 2-3 month entomological courses for technicians from Benin and some neighbouring countries. These courses are held on the basis of demand and not on a regular basis.

**Role in regional and country vector-borne disease control programs**
CREC plays a key role as the main entomological institution back-stopping the National Malaria Control Program (NMCP). Thus, CREC is involved in the collection and analysis of entomological data before, during and after the implementation of malaria vector control activities. CREC collaborates closely with the following institutions in Benin:

- **Advanced Biomedical Sciences Institute (ISBA):** This institution has competencies in immunological work related to malaria control. Among ISBA’s recent inputs to the NMCP is the assistance with the selection of Bendiocarb as the insecticide for use in indoor residual spraying (IRS) being implemented by RTI International. ISBA is also undertaking immunological studies related to intermittent preventative treatment (IPT) among pregnant women, and generally on toxicological issues of pesticide use;
- **Department of Parasitology and Parasitic Diseases, Faculty of Sciences and Health, University of Benin:** The department is currently involved in a pilot evaluation of larviciding for malaria control using *Bacillus thuringiensis israelensis*. This work is being carried out with support and collaboration of the German Mosquito Control Association (KABS). Regional collaboration in this activity involves institutions in several neighbouring countries including Burkina Faso, Togo and Ivory Coast;
- **National Malaria Control Programme (NMCP):** CREC is the main institution providing entomological support to the work of NMCP.

**National, regional and international collaboration and partnerships**
Presently three institutions are involved in CREC activities: CREC; London School of Hygiene and Tropical Medicine (LSHTM) and IRD. The Centre also has good collaboration with Centres for Disease Control (CDC) Atlanta, Liverpool School of Tropical Medicine, (LSTM), NMCP and many universities and research institutions. CREC has during the last few years received several grants from WHO/TDR,
WHO/MIM; WHO/RBM, Pal+ Programme, and the LSHTM. These grants have strengthened research capabilities of the institute in terms of materials, equipments and logistics for field trips. CREC is also currently collaborating in the activities of the Integrated Vector Control Consortium (IVCC) being coordinated by LSHTM with funding from Gates Foundation.

3.2 Burkina Faso:

3.2.1 Centre Muraz - Laboratoire de Parasitologie Entomologie

Institutional mandate and focus
Centre Muraz was one of the research centers of the Organization for Coordination and Cooperation Against Endemic Diseases (OCCGE). Founded in 1960, the organization was an expression of the will of eight french-speaking countries of West Africa (Benin, Burkina Faso, Côte d'Ivoire, Mali, Mauritania, Niger, Senegal and Togo) to unite their efforts to reduce the burden of transmissible diseases in the region. Since 2000, OCCGE is dissolved and Centre Muraz is now a national research centre working under the guidance of the health ministry. Centre Muraz scientific policy has been reoriented, following three main axis: malaria and other parasitic infections; HIV and associated diseases; immunization and health interventions. The malaria department of Centre Muraz/IRSS comprises 10 senior researchers. The institute supports the development of a comprehensive and integrated malaria control programme through research on malaria transmission dynamics, assays on parasite drug resistance, alternative therapeutics, assessing susceptibility of vectors to insecticides and piloting new malaria control measures that include impregnated bed nets.

Medical entomology staff capacity
The entomology staff of Centre Muraz comprises 2 seniors medical entomologists, 1 senior social scientist, 4 students, and 10 skilled technicians.

Facilities and equipment
The medical entomology laboratory has:

- Molecular biology and biochemistry equipment for mosquito genotyping and biochemical analyses;
- Excellent insectary, where various mosquito species and several strains of *Anopheles gambiae* are maintained for insecticide resistance studies, and also for *Plasmodium* experimental infection;
- Three experimental field stations comprising a total of 24 experimental huts, to test the efficacy of new insecticide formulations, bednets and new insecticide combinations year around. The ecological specificity of the field sites available for insecticide resistance studies and resistance management is exceptional since
most of the insecticide resistance genes (Kdr, Rdl, Ace1) are present. The laboratory is equipped to genotype these different genes.

**Past and ongoing training activities in IVM and medical entomology**
The malaria group of Centre Muraz has already hosted in the past a training session on malaria and that includes a specific module on malaria transmission, vector bio-ecology, insecticide resistance and Integrated Vector Management. In the framework of two granted studies on insecticide resistance by the Multilateral Initiative on Malaria (1999 and 2003), Centre Muraz has hosted 2 sessions of training on insecticide resistance. The two senior entomologists (Dr. Diabaté Abdoulaye and Dabiré K Roch) are involved as lecturers in three different entomological masters programs (two in Burkina Faso and one in Benin known as International Master in medical Entomology). Muraz Centre receives the students of the International Master in medical Entomology every year for 2 weeks of training in vector biology and IVM.

**Role in Regional and country vector-borne disease control programs**
The medical entomology staff of Centre Muraz works in close collaboration with the national malaria control program in a technical advisory capacity. The Centre has monitored insecticide resistance in Burkina Faso over the past 12 years and therefore has a comprehensive updated map of insecticide resistance distribution of the country. The Centre is also currently helping the national malaria control program to launch Indoor Residual Spraying (IRS) in the country.

**National, regional and international collaboration partnerships**
The medical entomology staff of Centre Muraz has established fruitful collaboration with different partners in Africa, Europe and in the US. Ongoing or past collaborative works on insecticide resistance exist(ed) between Centre Muraz and several partners in Africa, including:

- Centre National de Recherche et de Formation sur le Paludisme (CNRFP/Burkina Faso);
- Centre de Recherche en Entomologie de Cotonou (CREC/Benin);
- Institut de Recherche en Santé Publique (IRSP/Benin);
- Malaria Research and Training Center (MRTC/Mali);
- OCEAC/Cameroun;
- IPR Bouaké/Côte d’Ivoire;
- Institute de Recherche pour le Développement (IRD/France);
- Liverpool School of Tropical Medicine (UK);
- National Institute of Health (NIH/USA);
- Notre Dame University (USA).
3. 3 Cameroon:

3.3.1 The Biotechnology Centre, University of Yaounde

Institutional mandate and focus
The Biotechnology center is a specialized research and teaching unit of the University of Yaounde. It serves as a center of excellence in complementing government’s effort in popularizing science and contributing to development in the areas of health, agriculture and the environment. This is achieved mainly through the application of modern biotechnology to investigate tropical disease pathogens (Malaria parasites, *Onchocerca volvulus*, *Trypanosoma sp*, *Schistosoma sp*, and *Mycobacterium tuberculosis*), tropical soil biology and fertility for agriculture, and plant pathogens.

The center is staffed by a multidisciplinary team of researchers and scientists. It comprises three main sections as follows:

a) The Animal biotechnology section with laboratories for Immunology, Public Health Biotechnology, Molecular Biology and Biochemistry.

b) The Plant Biotechnology section with laboratories for Soil Microbiology and laboratory for Phyto-protection and valorisation of Plant Resources.

c) National Reference Unit (NRU) for Vector Biology and Control,

The Centre is Renowned for its research activities on malaria and has contributed much both to science and public health. The major work areas of health research include:

- Immunology of malaria for vaccine development;
- Molecular diversity of malaria parasites and vectors;
- Insecticide resistance and vector control;
- Clinical Trials and Dynamics of Drug tolerance of parasites;
- Bio-reagent and Drug Development.

The vector biology and control unit which initially operated as a component of the Immunology laboratory is gradually being set up as an independent unit. It has been designated by the ministry of Public Health to serve as the National Reference Unit (NRU) for vector control in Cameroon, and will provide technical assistance to the National Malaria Control Programme, and subsequently to other disease vector control programs.

Medical Entomology Staff Capacity
The institution has two senior Entomology staff (one PhD holder trained by WHO/TDR and one MPhil holder trained by the African regional Post Graduate Programme in Insect Science (ARPPIS), University of Ghana). Three technicians are in the process of being trained to man the NRU activities. Meanwhile, the University of Yaounde will this year recruit two more technicians to assist in the activities of the laboratory. The institution also works in collaboration with specialist medical entomologists at OCAEC and technicians of the National Malaria Control Programme. However, there is a great need to fortify the skills of those present and train many more in laboratory medical entomology research methods.
Facilities and equipment
Presently there is some equipment for field, ELISA and Molecular biology studies. However, with the support of the WHO/GATES foundation project on vector biology and control, the Unit will soon be receiving a consignment of some field and laboratory equipment for more complete molecular and immunological investigations on the malaria vectors to provide information on how to better implement control and surveillance activities. The capacity of the institution needs to be strengthened further in terms of equipment and personnel training on standard up-to-date research methods in medical entomology.

Past and ongoing training activities in IVM and medical entomology
In collaboration with the National malaria control program and under the WHO/GATES project, the institution will be training 20 provincial field staff and some 50 district field staff on vector intervention and surveillance methods beginning June 2008. Within the same framework, the institution will in the next four years train at least three graduate students for the Master’s degree and at least one student for the PhD in medical entomology. It will also organize training workshops for volunteers and NGOs involved in vector control and insecticide monitoring activities. Training will cover:

- Vector collection and identification methods,
- Vector Biology and transmission studies,
- Insecticide resistance and vector control,
- Insecticide resistance management and vector surveillance methods
- Bio control of malaria vectors etc

Role in regional and country vector-borne disease control programs
At the country level, the institution which now serves as a national reference unit for vector control works intimately with the Ministry of Health and provides technical assistance to the NMCP. This will extend to other vector borne diseases. The institute has seen some of its major findings being exploited by the ministry of health for designing vector control activities in some areas of the country.

National, regional and international collaboration and partnerships
- National collaboration exists with the Ministry of Health, the National Malaria Control Program, OCEAC and other disease vector control departments in the country such as river blindness and trypanosomiasis.
- There is little as far as regional collaboration is concerned. However, through the Gates project, the laboratory will serve as a regional center for training in medical entomology in central Africa, and will work in close collaboration with experts from OCEAC.
- Internationally, the institute has been collaborating with the Vector Control Reference Unit of the National Institute for Communicable Diseases (NICD), Johannesburg, South Africa. Other malaria research projects at the institution collaborate with The Universities of Hawaii and Georgetown in the USA and The London School of Tropical Medicine and Hygiene.
3.4 Ethiopia:

3.4.1 Addis Ababa University

Institutional mandate and focus

The Aklilu Lemma Institute of Pathobiology is the sole research center in Addis Ababa University for conducting biomedical research. During the last three decades of its existence the institute has made significant contributions to scientific knowledge in general and specifically to the study of national problems of public health importance. It has generated a wealth of information on the epidemiology, parasitology, vectors, prevention and control of schistosomiasis and leishmaniasis in the country. The discovery of Endod, *Phytoleca dodecandera*, as a plant molluscid and the development of irradiated vaccine against sheep lungworm, *Dictyocaulus filariae*, have been some of the major contributions of the institute.

The missions and goals of the institute are as follows:

- Engages in applied biological and paramedical research that fits with overall national health plan;
- Utilizes professional staff for teaching specialized subjects to senior university students and graduate students;
- Offers supervision and advanced laboratory and field training to M.Sc and PhD students who are engaged in dissertation research;
- Initiates, plans and organizes research proposal for grant application to achieve the institute’s objectives;
- Publishes and exchanges, where useful, experience, scientific data, reports and publications, and collaborates on joint educational and research projects with other universities and research institutes.

Vector biology and control staff capacity

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<tr>
<th>Academic Research Staff</th>
<th>Associate Staff</th>
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<tbody>
<tr>
<td>1. Teshome Gebre-Michael, PhD</td>
<td>1. Dr. Habte Tekie</td>
</tr>
<tr>
<td>2. Messay Fettene Gebremariam, PhD</td>
<td>2. Dr. Mamuye Hadis</td>
</tr>
<tr>
<td>4. Abebe Animut, PhD Candidate</td>
<td>4. Dr. Nigatu Kebede</td>
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Technical Staff

1. Yohannes Negash,
2. Zerihun Tesfaye
3. Wossen Sisay
Facilities and equipment
The Vector Biology and Control Unit has been conducting research for the past 4 decades in vectors of medical and veterinary importance. The unit has:

- laboratory facility;
- insectary with colonies of malaria vectors and sandflies;
- field equipment;
- laboratory materials;
- modest collections of arthropods of wide ranging importance.

Past and ongoing training activities in IVM and medical entomology
- Teach post graduate courses in entomology and integrated vector management;
- Conduct research in the biology, taxonomy, ecology, behaviour and vectorial importance of arthropods;
- Establish insect collection museum (emphasis on arthropod vectors) to serve as a reference for teaching and research;
- Adopt/introduce molecular tools for vector identification;
- Conduct research in molecular biology and population genetics of vector species;
- Carry out laboratory bioassays and field efficacy trials on potential repellent and insecticidal plants;
- Conduct community based pilot trials of selected insecticides/repellents and net materials;
- Develop, introduce and adapt new tools and strategies for arthropod vector management that are environmentally safe, affordable, appropriate and socially acceptable (e.g. ITNs, plant based repellents);
- Monitor insecticide resistance and study mechanisms of resistance in order to provide necessary recommendations to the MoH based on the available evidence;
- Liaise with other departments to develop new post graduate training programmes in vector biology and control;
- Maintain laboratory colonies of medically important vector species for teaching and research purposes;
- Offer short term practical training in vector biology and control.

Role in regional and country vector-borne disease control programs
Staff of the department are engaged in training national malaria control staff in malaria entomology and international training courses organized by WHO Regional office for Africa. The institute recently participated in a training course organized by WHO: Planning and management of malaria control for Anglophone countries in Africa.

National, regional and international collaboration and partnerships
The institute collaborates with the following national and international organizations in training and research activities:
3. 5 Ghana:

3.5.1 Noguchi Memorial Institute for Medical Research

Institutional mandate and focus
Founded in 1979 with assistance from Japan, the Noguchi Memorial Institute is located at the University of Ghana in Accra. Mission: to become centre of excellence for research into the diseases of public health importance, and to contribute to manpower development for scientific research and health service, especially in Ghana.

The mandates of NMIMR are:

- To conduct research into the major communicable and non-communicable diseases of the tropics;
- To provide training opportunities in medical research for undergraduates and postgraduate students in tertiary institutions;
- To provide high end laboratory diagnostic and monitoring services in support of public health programmes.

In 2003 the Institute became a constituent member of the College of Health Sciences, University of Ghana.

Entomological staff capacity
Senior Researchers - 4
Research Assistants - 5
Technicians - 9

Facilities and equipment
The Institute has nine scientific departments: Animal Experimentation; Bacteriology; Clinical Pathology; Electron Microscopy and Chemical Pathology; Epidemiology; Immunology; Nutrition; Parasitology; Virology. The present staff in all the departments is 289, comprising of 104 scientists, 65 technical staff and 120 non-technical staff.

Facilities and equipment include: insectary, conference and seminar rooms, internet facilities, training laboratory, field sites, stereo-dissecting microscopes, compound microscopes, teaching microscopes, thermocycler (PCR machines), ELISA plate reader, and DNA sequencer ABI 3130 real-time PCR machine.

Past and ongoing training activities in IVM and medical entomology
NMIMR has been involved in:
- WHO-organized international training in IVM for middle level staff;
- Training in entomology and parasitology for Ghana’s ministry of health regional biologists;
- Post-graduate training in medical entomology for the African Regional Postgraduate Programme in Insect Science (ARPPIS);
- PhD training in medical entomology supported by WHO;
- Training of community members in treatment of nets with insecticides.

Role in regional and country vector-borne disease control programmes
Noguchi has played a key research and advisory role in the following major disease control programmes:

- Onchocerciasis control programme (WHO and Ministry of Health): identification of disease vectors; vector control using insecticides; disease transmission studies; monitoring of control activities;
- Malaria control (Ministry of Health): identification of malaria vectors; insecticide resistance studies; disease transmission studies; monitoring of disease control; monitoring centres for the insecticide treatment of nets;
- Malaria control (AngloGold Ashanti – Obuasi): Technical advisory role and training for the vector studies in the programme;
- Lymphatic filariasis (WHO and MOH): Monitoring of effect of mass drug administration on disease transmission;
- Leishmaniasis (MOH): Training of field technicians in sandfly collection; determination of vectors of leishmaniasis in an outbreak area of Ghana.

National, regional and international collaboration and partnerships
The following are among the key collaborating partners of NMIMR:

- Ministry of Health, Ghana;
- Kumasi Centre for Collaborative Research, Kwame Nkrumah University of Science and Technology;
- Malaria Control Centre, Obuasi, Ghana;
- West African Network for Insecticide Resistance (Benin);
- International Masters in Medical and Veterinary Entomology (Benin);
- South Africa National Institute for Communicable Diseases (NICD);
- National Institute of Health (USA);
- Naval Medical Research Unit, Cairo, Egypt;
- Michigan State University, USA;
- African Programme for Onchocerciasis Control (APOC) Ouagadougou, Burkina Faso;
- Liverpool School of Tropical Medicine;
- Malaria Research Training Centre (Mali)
- Centre for Research in Entomology of Cotonou (Benin);
- African Regional Postgraduate Programme in Insect Science (ARPPIS).
3.5.2 AngloGold Ashanti - Obuasi

In January 2006 AngloGold Ashanti put into practice an integrated malaria control programme in Obuasi and the outlying areas within the Obuasi Municipal Assembly area, with the aim of halving malaria incidence over the next two years. To maximise successful outcomes, the plan included multiple intervention methods to prevent the transmission of malaria and to effectively treat those already infected.

The key elements of the integrated malaria control programme for Obuasi are:

- **Vector control**: Indoor residual spraying of over 134,000 structures in the Obuasi municipality, mine and surrounding villages was coupled with the distribution of long lasting insecticide-treated bed nets to places most susceptible to infection, such as orphanages, maternity and children’s wards. Additionally, temporary and permanent water bodies where mosquitoes breed are being treated with larvicides.

- **Effective disease management**: Standard treatment protocols for rapid and early detection and diagnosis of malaria are in place at the hospital and health facilities of the Obuasi Mine Medical Services. The use of drug treatment regimens aligned with the Ghanaian National Treatment Protocol, and which includes the mandatory use of the new Artesunate drugs, has improved cure rates. AngloGold Ashanti has put in place measures to monitor the diagnosis and treatment of malaria for consistency and effectiveness.

- **Surveillance and monitoring**: A comprehensive malaria information system was installed to monitor and evaluate the programme for consistent high performance according to World Health Organization standards.

- **Information, education and communication**: Volunteer community advocates have been trained to present health information on malaria symptoms, prevention and treatment and to dispense educational material in the form of pamphlets and posters.

The programme has elicited active engagement from the community with educational campaigns being disseminated by community committees, radio and other relevant media to inform the public of the symptoms and treatment of malaria. A spin-off of the programme is the creation of 127 permanent jobs, in the form of spray operators, who have received intensive training on the techniques of indoor residual spraying.

A malaria control centre was opened in April 2006 by the President of Ghana, John Kufuor, and AngloGold Ashanti’s Chief Executive Officer, Bobby Godsell, in the Sansu area at Obuasi. Although primarily the headquarters for the Obuasi programme, it also serves as a training centre for AngloGold Ashanti’s malaria projects at other mines. With key capabilities such as an insectary and laboratory, a planning and strategy centre and training facilities it will be a valuable asset for Ghana and Africa in the fight against
malaria. It will also be used as a satellite research centre by the Noguchi Memorial Institute for Medical Research at the University of Ghana, government departments and other agencies.

The first round of the indoor residual spraying was completed in April 2006 in the town, including both mine community infrastructure and surrounding villages with 134,000 structures sprayed. Of these, approximately 27,000 were dwellings. The second round of spraying started in September. By November AngloGold Ashanti achieved a 50% reduction in malaria cases seen at the Edwin Cade Memorial Hospital.

3.6 Kenya:

3.6.1 Kenya Medical Research Institute (KEMRI)

Institutional mandate and focus
KEMRI's mandates as outlined in the Science and Technology (Amendment Act of 1979 have been further) translated to be in harmony with the Institute's current health research development realities and the envisaged future direction. KEMRI's mandates are as follows:-

- To conduct research in human health.
- To co-operate with other organizations and institutions of higher learning in training programmes and on matters of relevant research.
- To Liaise with other relevant bodies within and outside Kenya carrying out research and related activities.
- To disseminate and translate research findings for evidence-based policy formulation and implementation.
- To co-operate with the Ministry of Health, the Ministry for the time being responsible for research, the national Council for Science and Technology and the Medical Science Advisory Research Committee on matters pertaining to research policies and priorities.
- To do all such things as appear necessary, desirable or expedient to carry out its functions.

These mandates do not in any way alter the core contents of any of the mandates as contained in the said Act.

Entomological staff capacity
PhD Level 10
MSc. Level 4
Technologists/ technicians 6

Distribution:
Nairobi (CBRD) -- 4 PhD level scientists, 1 PhD candidate, 5 junior technicians
Kilifi (CGMR-C) -- 3 PhD level scientists, 2 MSc level scientists, 1 technologist
Kisumu (CGHR) -- 3 PhD level scientists, 1 MSc level scientists

Facilities and equipment
- Training Centre, The Eastern and Southern African Centre for International Parasite Control, ESACIPAC; lecture halls and laboratory available;
http://www.kemri.org/esacipac.html

- An Anopheles mosquito insectary measuring 271.8 square feet, divided into three insulated chambers each measuring 36 square feet and an outer working area. Only one of the chambers has humidity control and controlled lighting for dusk and dawn simulation, but funding is available for renovations of the insectary through the Gates-funded programme “Malaria vector control: Filling the gap between product development and effective delivery”.

- Laboratories with reliable electricity and water supply; some with air-conditioning
- Dissecting microscopes
- Compound light microscope
- Computers
- PCR equipment: Thermocycler; Electrophoresis equipment; Microcentrifuge; Gel recording system (UV transilluminator and Polaroid camera); 70 deep freeze; 20 deep freeze; Refrigerators; pH meter; Water bath; Pipettes; Weighing Balance; Autoclave; Incubator; Microwave oven; ELISA reader.

Past and ongoing training activities in IVM and medical entomology
- Training in Medical Parasitology and Entomology at MSc. and PhD levels through the Institute of Tropical Medicine and Infectious Diseases, ITROMID. ITROMID is a collaborative effort between KEMRI and the Jomo Kenyatta University of Agriculture and Technology. All teaching under this programme is undertaken at KEMRI.

- Training Course on Malaria Vector Biology and Control, 2nd June – 4th July, 2008. This ongoing training is being carried out under the Gates project on “Malaria vector control: Filling the gap between product development and effective delivery”. The target audience is technical staff of the national malaria control programme. The main objective of the course is to develop entomological skills to facilitate the collection, analysis and interpretation of basic entomological information.

- KEMRI has been involved in training activities on IVM and Vector Biology since its inception in the seventies. During the last 5 years it has collaborated with International Centre of Insect Physiology and Ecology (ICIPE) in WHO supported training in IVM.

- KEMRI is also involved and chairs the Research Technical Working Group at the Division of Malaria Control of Kenya’s Ministry of Health.

Role in regional and country vector-borne disease control programs
• Regional: A number of KEMRI staff are members of the AMANET and are involved in both scientific committees and the Advisory Board. KEMRI is also involved in the many training activities conducted by AMANET on malaria every year. In 2002, KEMRI joined the African Network on Vector Resistance (ANVR) which contributes to the acceleration of malaria control in the African region through the strengthening of vector control capacities at National and regional levels.

• Country: Development of the National Reference Unit in progress; will provide vector surveillance support and scientific backstopping for the National Malaria Control Program

National, regional and international collaboration and partnerships
KEMRI has, over the years developed fruitful collaborative links with a large number of institutions locally and abroad, and these links are constantly changing or increasing. The current collaborators include the following:

• Local Collaborators
  Ministry of Medical Services
  Ministry of Education, Science and Technology
  Kenyatta National Hospital
  National Universities and Tertiary Institutions
  - Kenyatta University - www.ku.ac.ke
  - Moi University - www.mu.ac.ke
  - University of Nairobi - www.uonbi.ac.ke
  - Egerton University - www.egerton.ac.ke
  - Maseno University - www.maseno.ac.ke
  - Jomo Kenyatta University of Agriculture & Technology - www.jkuat.ac.ke
  - Masinde Muliro University of Science & Technology - www.wust.ac.ke

• Regional Collaborators
  Noguchi Memorial Institute of Medical Research-Ghana
  National Institute of Medical Research- Tanzania
  Ethiopia Health and Nutrition Research Institute -Ethiopia
  Makerere University Medical School
  University of Zambia Medical School-Zambia
  Blair Research Centre-Zimbambwe
  Medical Research Council of South Africa
  Suez Canal University-Egypt

• International Collaborators
  World Health Organization (WHO)
  Japan International Cooperation Agency (JICA)
  Centres for Diseases Control and Prevention (CDC)
  Walter Reed Army Institute of Medical Research (WAIR)
  KEMRI- WellcomeTrust
  International Development Research Centre (IDRC)
  United States Agency for International Development (USAID)
3.6.2 University of Nairobi - School of Biological Sciences,

The School of Biological Sciences (SBS) is located in the University of Nairobi College of Biological and Physical Sciences (CBPS) situated off riverside drive in Nairobi, Kenya. The School was established in 2006 by merging the then 50 year old Departments of Botany and Zoology. The SBS is structured into nine thematic areas each with a head. The thematic areas include: (i) Ethno-biology and Taxonomy, (ii) Biological Natural Products, (iii) Genetics and Biotechnology, (iv) Microbiology, Parasitology and Immunology, (v) Fresh Water and Marine, (vi) Ecology and Environmental Sciences, (vii) Insect Science, (viii) Physiology and Biochemistry, and (ix) Research Development and Production.

The SBS has 46 members of the academic staff. These comprise of five Professors, eight Associate Professors, 15 Senior Lecturers, ten Lecturers, five Assistant Lecturers, two Tutorial Fellows and one Graduate Assistant. In addition, the school has 34 technical staff members who comprise two Chief Technologists, one Senior Scientific Illustrator, 12 Senior Technologists, 13 Technologists and six Technical Assistants. The administrative staff in the school comprise of a Director, a Senior Administrative Assistant, two Senior Secretaries and one Assistant Secretary.

Institutional Mandate and Focus

Institutional Mandate:
The University of Nairobi Act lists the University’s objects and functions as follows:

— To provide directly, or in collaboration with other institutions of higher learning, facilities for university education, including technological and professional education, and for research;

— To participate in the discovery, transmission and preservation of knowledge and to stimulate the intellectual life and cultural development of Kenya;

— To conduct examinations and grant academic awards as provided for in the statutes;

— Subject to the Universities Act, to co-operate with the Government in the planned development of university education and, in particular, to examine and approve proposals for new Faculties, new Departments, new degree courses, or new subjects of study submitted to it by constituent colleges or other post-secondary institutions;

— To determine who may teach, what may be taught and how it may be taught in the University.
The School of Biological Sciences whilst providing specialized training in the plant and animal sciences does so within the limits of the University of Nairobi Act.

Focus:
Activities of the School of Biological Sciences revolve around three strategic issues i.e.:

a) Training and Communication
b) Research and Development
c) Resource Generation and Management,

Arising from these strategic issues, the following 5 strategic objectives are pursued:

- To continuously produce holistic graduates who meet the needs of the market. This is achieved through enhanced quality of the examination process, review of academic programmes to ensure relevance and applicability and through teaching, practicals, tutorials and field courses.

- To conduct high quality, relevant research and consultancy. This is achieved through mainstreaming consultancy into the core business of the school, establishing linkages with industry in research and development, and publications.

- To realize increased revenue and fiscal health. This is achieved through asking thematic areas to develop programs that are income generating.

- To promote the image of the school locally and internationally, and to establish partnerships and linkages with industry in research and development. This is achieved through publications, attendance of conferences and community service.

- To actively promote diversified modes of delivery. This is achieved through use of technology in pedagogical practices and introduction of open and distance education in all programs in the school.

Medical Entomology Staff Capacity
The SBS has five PhD-level Medical Entomologists consisting of two Professors (Prof. C.P.M. Khamala and Prof. L.W. Irungu) and three senior lecturers (Dr. F. Oyieke, Dr. P. Ndegwa and Dr. W.R. Mukabana). In addition, the SBS has two Agricultural Entomologists (Dr. Nyamasyo and Prof. Sayed El-Banhawy), two Physiological Entomologists (Prof. R.W. Mwangi and Dr. J. Kabaru) and four entomological technicians (Mr. P. Thimbu, Ms. J. Shilavula, Mr. M. Mwadama and Mr. P. Ambundo).

Facilities and Equipment
a) Email and web access: Staff and students at the University of Nairobi have 24-hour free internet access that is facilitated through a leased line provided by Telkom Kenya’s Jambonet. The University has three servers dedicated to internet connectivity: (i) Mail server: handles all university email accounts under the uonbi.ac.ke domain. There are over 3000 user accounts, (ii) Proxy server: is used for internet access and authentication of users, (iii) DNS server: This domain name server
is a machine name registry of other servers which are accessed by users internally and externally.

b) Literature Access: The University library coordinates access to scientific literature in Kenya through the Programme for Enhancement of Research Information (PERI). It is possible, working through the University’s network, to directly access (without needing passwords) scientific literature from diverse databases including Blackwell, EBSCO, AGORA etc.

c) Field facilities: The SBS has modernized its field facilities in coastal Kenya [Malindi and Diani beach (Moana)] for use in teaching and research. The University of Nairobi also bought the former British Council Offices in Kisumu and converted them into a distance learning facility. These examples are cited assuming that work will be based in malaria endemic areas - other field facilities elsewhere exist.

d) Space: The SBS has over 2,000 square meters of laboratory space, about 1,000 square meters of office space and about 500 square meters worth of lecture theatre space.

e) Teaching: The SBS is equipped with five modern LCD projectors, an illustration unit employing one senior scientific illustrator and a science workshop.

f) Equipment: Available equipment includes compound microscopes, weighing balances, bench lamps, ovens, hot plates, freezers, distillers, centrifuges etc.

g) Insectary: The SBS has an insectary where mosquitoes, cockroaches and locusts are currently reared.

Past and Ongoing Training Activities in IVM and Medical Entomology
The SBS currently offers a M.Sc. course in Medical and Veterinary Entomology with lessons in: Research methodology; Principles of Arthropod Classification & Morphology; Comparative Arthropod Physiology; Statistical Methods and Modelling; Arthropod Histology, Cytology & Genetics; Arthropod Behaviour & Ecology; Entomological Techniques; Geographical Information Systems & Remote Sensing; Biology and Classification of Arthropod Vectors and human Disease Parasites; Management and Control of Vector & Parasite Populations of Human Diseases; Vector-parasite Interactions; Epidemiology and Control of Arthropod-borne Human Diseases; Biology and Classification of Arthropod Vectors and Parasites of Livestock and Domestic Animal Diseases; Management of Vector and Parasite Populations of Livestock and Domestic Animal Diseases; Epidemiology and Control of Communicable Arthropod-borne Diseases of Livestock and Domestic Animals.

Two undergraduate level entomology course units are offered.
In the last five years a member of the SBS (Dr. Mukabana) has been involved in developing an IVM training package for communities along with Dr. Ulrike Fillinger of the Durham University, United Kingdom, and others.

Also Dr. Mukabana recently produced an outline for a basic entomology course (targeting junior malaria control staff) in liaison with the Department of Entomology of the US Army Medical Research Unit, Kenya (USAMRU-K). Dr. Mukabana now has all PowerPoint Presentations (lectures) of the course topics.

**Role in Regional and Country Vector-Borne Disease Control Programs**

a) **2006-2007 Rift Valley Fever (RVF) outbreak**: Members of the SBS formed part of the team that coordinated the 2006-2007 RVF outbreak surveillance and control in Kenya. Other partners included the Ministry of Health (MoH), the Kenya Medical Research Institute (KEMRI), the US Centers for Disease Control and prevention (CDC), USAMRU-K, USAMRIID and the Naval Medical Research Unit (NAMRU-3).

b) **Urban Malaria Control Program (UMCP), Dar es Salaam, Tanzania**: A collaborative link with the Ifakara Health Research and Development Centre (IHRDC) has resulted in participation by staff and students in the UMCP, Dar es Salaam, Tanzania. Four M.Sc. students from SBS are currently based in Dar es Salaam for their research. One more student is based in Kilombero, south eastern Tanzania.

c) **CDC IVM activities in western Kenya**: The longstanding collaboration between SBS and CDC has recently led to involvement of staff and students in CDC’s ongoing Integrated Vector Management (IVM) activities in western Kenya. These activities entail malaria control through use of long lasting insecticide impregnated nets (LLINs) and larviciding (using the microbial insecticide *Bacillus thuringiensis var israeliensis* or Bti).

**National, Regional and International Collaboration and Partnerships**

a) **Belgium Inter-University Council (VLIR)**: This is a collaborative link between the Flemish Inter-university Council (Vlaamse Interuniversitaire Raad or VLIR) programme for Institutional University Collaboration (IUC) and the University of Nairobi. The VLIR-IUC programme emanates from the specific agreement signed by the Belgian State secretary for development co-operation and the VLIR on 16 May 1997. The IUC program is focused on the institutional needs and priorities of partner Universities in the south. The VLIR linkage is coordinated through the SBS.

b) **International Centre of Insect Physiology and Ecology (ICIPE)**: The University of Nairobi has had longstanding collaborative ties with the ICIPE which was born in the University’s then Department of Entomology. Dr. Richard Mukabana of the SBS is the link coordinator at the University of Nairobi.
c) **International Atomic Energy Agency (IAEA):** Dr. Richard Mukabana of the SBS is one of the core scientists on one of IAEA’s five year Coordinated Research Project (CRP) on mosquito mass rearing. One M.Sc. student (Mr. Jared Yugi) has been trained through this cooperation - his thesis is about a new larval diet for *Anopheles arabiensis* mosquitoes. This cooperation continues till 2010.

d) **Vector Ecology course, Tanga, United Republic of Tanzania:** The SBS senior lecturers Drs. Paul Ndegwa and Richard Mukabana are among the core teaching staff of the annual vector control course based at the National Institute for Medical Research (NIMR), Tanga, Tanzania. This international course is funded by the Danish Bilharziasis Laboratory (DBL).

e) **Ifakara Health Research and Development Centre (IHRDC):** In 2006 the SBS signed a five-year Memorandum of Understanding with the IHRDC, United Republic of Tanzania. The goal of this linkage is to improve south-south collaboration between Kenya and Tanzania with regard to training on insect-borne tropical parasitic diseases. Seven M.Sc. students (three Tanzanian and four Kenyan) are currently undergoing training through this linkage.

f) **Belowground Biodiversity (BGBD) program:** This is a multiple year global research program involving several institutions around the world. The SBS is the participating partner in Africa.

g) **Sussex University, United Kingdom:** This is a longstanding collaborative link between the School of Biology of Sussex University (UK) and the School of Biological Sciences, University of Nairobi, which has had extensive staff exchanges.

Detailed information about the University of Nairobi’s linkages and partnerships can be found at: [http://www.uonbi.ac.ke/university_collaborations.php](http://www.uonbi.ac.ke/university_collaborations.php)

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**3.6.3 International Centre of Insect Physiology and Ecology (ICIPE)**

**Institutional mandate and focus**
The International Centre of Insect Physiology and Ecology (ICIPE), based in Nairobi, Kenya, was established in 1970 as an advanced research institute amidst growing global concern about the misuse and overuse of synthetic pesticides. ICIPE was registered as an intergovernmental organization in 1986, with governance through a 16-member international Governing Council.

ICIPE continues to follow its original mandate of developing technologies to alleviate world poverty and to ensure food security and good health for the peoples of the tropics through management and control of both harmful and useful arthropods. The Centre's current objectives aim at improving and promoting the activities of the "4H's" (human, animal, plant and environmental health) interdisciplinary teams of scientists engaged in
research related to ecosystems science, behavioral biology and chemical ecology, molecular biology and biotechnology and social sciences.

**Entomological staff capacity**
ICIPE has about 360 employees including more than 30 insect scientists originating from 19 countries in Africa and other parts of the world. Scientific programs are mainly focused on plant pest management, disease vector management, insect biodiversity conservation and utilization, and capacity building from post-doctoral to farmer level.

**Facilities and equipment**
ICIPE has state-of-the-art facilities in virtually all aspects of insect science. These include functional insectaries for malaria vectors and equipment for molecular identification of mosquito species, their infections as well as sources of blood-meals. Research support at ICIPE is provided by biomathematics, animal breeding and quarantine and biosystematics units, and computer and information services.

**Past and ongoing training activities in integrated vector management**
The African Regional Postgraduate Programme in Insect Science (ARPPIS) is the cornerstone of icipe’s capacity building activities. ARPPIS is a training programme implemented in partnership with African universities, national and international institutions and academies of science, the donor community, and an ARPPIS alumni network within national institutions. Established in 1983, ARPPIS currently involves some 34 participating universities in Africa. An ARPPIS Academic Board of prominent professors from the participating universities closely supervises scholarship in the programme. ARPPIS is composed of two major programmes, the ARPPIS Regional Doctoral Programme hosted by icipe and the ARPPIS Sub-Regional Masters Programme hosted by three collaborating universities in Ghana, Zimbabwe and Ethiopia.

Capacity building in IVM is undertaken within the Human Health Division. It includes both short courses involving partners such as WHO-AFRO and UNEP, among many others. Most of capacity building and research in the Division is however oriented towards the acquisition of masters and PhD theses. The overall goal of icipe’s research in human health is to contribute to the reduction of malaria and other vector-borne diseases by developing tools and strategies that control the vectors and break the cycle of transmission and that can be integrated with disease management efforts. The focus is on mosquito ecology, mosquito behaviour and malaria transmission, with emphasis on developing new tools for integrated malaria control that go beyond bednets and traditional insecticide-based approaches.

**Role in regional and country vector-borne disease control programmes**
ICIPE is a key institution in training medical entomologists in the African region and internationally. As a research and knowledge generating institution, ICIPE has over the years significantly contributed to building scientific capacities for the control of important disease vectors including mosquitoes, sandflies and tsetse.
National, regional and international collaboration and partnerships
ICIPE collaborates with 45 universities throughout the world, including 30 African universities in ARPPIS programme, other international agricultural research centres (IARCs), centres of the Consultative Group on International Agricultural Research (CGIAR), more than 20 advanced research institutions, national agricultural research systems (NARS) in Africa and beyond, and non-governmental organizations (NGOs).

In terms of capacity development, icipe is currently working with the following networks and partner institutions:

- African Academy of Sciences (AAS) www.aasciences.org
- African Association of Insect Scientists (AAIS) www.icipe.org
- African Association of Universities (AAU) www.aau.org/
- African Economic Research consortium (AERC) www.aercafrica.org
- African Forestry Research Network (AFRONET) www.afornet.org
- African Institute for capacity Development (AICAD) www.aicad.or.ke
- African Network for Agriculture Agroforestry and Natural Resources Education (ANAFE) www.anafeafrica.org
- African Network of Scientific and Technology Institutions (ANSTI) www.ansti.org
- Agricultural Information and Communication Management (AICM) www.asareca.org/rain
- ARPPIS Scholars Association (ASA) www.icipe.org
- Building Africa’s Scientific and Institutional Capacity for Agriculture and Natural Resources (BASIC) www.natura-net.eu
- Collaborative Master of Science in Agricultural and Applied Economics (CMAAE) www.agriculturaleconomics.net
- East African Regional Programme and Research Network for Biotechnology, Biosafety, and
- Biotechnology Policy Development (BIO-EARN) www.bio-earn.org
- International Foundation for Science (IFS) www.ifs.se
- Lake Victoria Research (VicRes) Initiative www.vicres.net
- Natural Products network for Eastern and Central Africa (NAPRECA) www.napreca.net
- Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) www.ruforum.org

3.7 Madagascar:

3.7.1 National Malaria Control Programme (NMCP), Ministry of Health, Family Planning and Social Protection (MOHFSP)

Institutional mandate and focus
Entomological surveillance
- Mosquito collection and preservation
- Morphological identification
- Vector incrimination
- Sporozoites ID by microscopy
- Determination of infection rate
- Vector susceptibility testing
- Identification of operational research needs
- Selection of sentinel sites
- Analysis of data
- Insecticide bioassays
- Assessment of vector behavior, biting, resting, host preference

Medical entomology staff capacity
- 3 medical entomologists, M Sc (DEA)
- 1 Technologists

Facilities and equipments
- A room used as lab and office, with electricity and water supply, no air conditioning
- Dissecting and compound microscopes, torches, identification keys,
- Preservatives
- Dissection kits
- Susceptibility kits
- WHO cones
- A room designated as insectary

Past and ongoing training activities in IVM and medical entomology
- Training of the staff of sentinel site of malaria epidemiological surveillance
- Training of medical students

Role in regional and country vector borne disease control programme
- Surveillance
- Implementation of vector control activities
- Assessment of vector control activities

National, regional and international collaboration and partnership
- National:
  - Collaboration and partnership with the Ministry of agriculture, environment and other sectors in the planning of an IVM project, in the pesticide management;
• Instiut Pasteur as national reference Unit for a project funded by the Bill and Melinda Gate Foundation;
• World Bank project (CRESAN) in the implementation of IRS activities;
• Global fund project: entomological surveillance, IRS.

- International:
  • RTI International/PMI: IRS implementation in the Central high lands of Madagascar;
  • International Red Cross, Canadian Red Cross, Global Fund, Global fund, WHO, UNICEF, … : mass distribution of ITNs during an integrated campaign measles immunization and malaria prevention;

3.8 Mali:

3.8.1 Malaria Research and Training Centre (MRTC)

Mandate and focus
The Malaria Research and Training Center (MRTC) of the Faculty of Medicine Pharmacy and Odonto-Stomatology, University of Bamako, Mali, is one of the primary research resources in Africa for malaria epidemiology and vector control studies as well as cytogenetic and molecular studies of several insect vectors of human diseases (leishmaniasis, filariasis) and tick born diseases. The Malaria Research and Training Centre (MRTC) was initiated in 1989 as part of a collaborative effort between the Faculty of Medicine and the National Institutes of Health, USA with support from the partnership program of the Rockefeller Foundation and the WHO. Subsequently, the Center received significant support from USAID and other partners. The center has developed collaborations/partnership with many established universities and research institutions around the world. MRTC has three main entities: the Department of Medical Entomology and Disease Vector Ecology (DMEVE) under the leadership of Pr. Sekou Traoré, the Department of Parasitology and malaria vaccine development under Pr. Ogobara Doumbo and HIV/tuberculosis interactions under Dr. Anatol Tounkara. The training will be organized by the DMEVE/MRTC.

The MRTC is involved in the development and testing of appropriate strategies for the control of malaria and other vector borne diseases and seeks to bring to bear the best available methodologies and cutting edge technologies to achieve these goals including:

• Training Malian and African scientists in the field of medical entomology and vector borne disease epidemiology;
• Conducting research both in basic sciences and operational methodologies on vector borne diseases and to generate data for rational public health decisions;
• Testing new control strategies of vector borne diseases including but not limited to malaria, leishmaniasis, filariasis and tick borne diseases;

• Providing technical support to Mali National control programs on vectors borne diseases and other Organizations involved vector borne diseases control activities;

• Building and strengthening research capacity of others national institutions in Mali;

• Maintaining and expanding collaborative research programs with NIH and other developing countries research and academic institutions;

• Facilitating the establishment of a network of vector-borne diseases research and control between African scientists and international partners.

**Medical entomology staff capacity**
The Medical Entomology Division has a staff of eight senior and ten junior scientists 10 technicians. Seniors have different backgrounds and hold one or two doctorate degrees and or other distinctions. Below is the list of the staff:

**Seniors scientists:**
- Traoré Sékou F., MSc, PhD Entomology (Director)
- Seydou Doumbia, MD. PhD, Epidemiology (deputy director) Malaria epidemiology, Monitoring and Evaluation
- Abdoulaye M. Toure, MD, Ph D, Parasitology
- Guimogo Dolo, MSc, PhD, Entomology
- Djibril Sangaré MSc, PhD, Molecular Entomology
- Mamadou B Coulibaly PharmD D, PhD, Molecular genetics
- Nafomon Sogoba, MSc, Ph.D, Epidemiology, Geographical Information Systems and Vector Ecology
- Mahamadou Diakité Ph.D., PharmD, Parasitology and Immuno- genetics

**Junior scientists:**
- 6 MSc: (3 Entomology, 1 Molecular entomology, 1 Biochemistry, 2 Epidemiology)
- 5 MD & 1 PharmD: All graduated from the University of BAMAKO.

**Facilities and equipment**
The medical entomology facilities are located in several buildings on the campus of the Faculty of Medicine at Point G.

Recently, the MRTC has been developing a new program on functional human and vector genomics.. Standard laboratory equipment are available in the labs. All equipment are linked to an emergency power system to maintain operations in event of local power failure.
The medical entomology program and facility in Bamako are described below. Specific facilities and capabilities include the following units:

- Vector ecology unit equipped with dissecting scopes, light microscopes, microcentrifuges and PCR machines.
- Vector and parasite interaction unit equipped with dissecting scopes, light microscopes, PCR machines, microcentrifuges and an insectary
- Molecular entomology unit equipped with dissecting scopes, light microscopes, PCR machines, microcentrifuges and an insectary.
- Parasitology and Immuno-genetics unit equipped with PCR machine, a hood (safety cabinet grade 2), an ELISA Elispot reader, light microscopes, microcentrifuges, CO2 incubators, freezers (-20°C, -75°C) and refrigerators
- Leishmaniasis unit equipped with PCR machines, a hood, light microscopes, microcentrifuges, CO2 incubators, freezers (-20°C, -75°C) and refrigerators, a bench top shaker-incubator.
- Vector genomics and proteomics units equipped with PCR machines, a hood, light microscopes, dissectingscopes, microcentrifuges, a CO2 incubator, freezers (-20°C, -75°C) and refrigerators, a ELISA reader (VersaMax), a real time PCR machine and a Beckman Coulter sequencer (CEQ8000).
- Bioinformatics unit equipped servers, desktop and laptop computers.
- Filariasis unit equipped with PCR machines, a hood, light microscopes, microcentrifuges, CO2 incubators, freezers (-20°C, -75°C) and refrigerators.

-Hematology and malaria pathogenesis unit equipped with PCR machines, a hood, light microscopes, microcentrifuges, CO2 incubators, freezers (-20°C, -75°C) and refrigerators.

- GIS and GPS Unit with adequate materials.
- Informatics unit with database management, biostatistics, epidemiology -
- Anthropological expertise and experience with Knowledge-Attitude-Practice surveys capability, E-mail and Internet connectivity.

MRTC-Entomology currently maintains two insectaries and plans to build new ones according to the needs.

The MRTC group has satellite (V-SAT) internet connection through The NIH (National Institutes of Healths, United States of America).

The MRTC also has a guest house with eight rooms.

The MRTC/DMEVE is comprised of about 30 staff members including scientists and technician, with both research and teaching duties. The staff at MRTC/DMEVE has ongoing projects that employ all of the techniques that will be taught, and has the principal resources necessary to support them. The strength of our research resides in four main program areas carried out in a dozen of different laboratories: 1] Molecular entomology; 2] vector population genetics 3] Vector-Parasite -Interactions, 4] Vector Ecology/, 5] Epidemiology and GIS, 6] Genomics/Bioinformatics, .... This provides a
unique opportunity for post-doctoral and graduate students to acquire a broad knowledge in these fields. The laboratories are fully equipped and house studies on the molecular biology of vectors and parasites. Equipment for PCR, ELISA, and in vitro malaria parasite cultivation are available and the MRTC staff has been trained in a broad range of laboratory and field techniques. There is an animal facility to support research activities. In addition, the laboratories include 2 insectaries with temperature, humidity and photoperiod control installed for the colonization and maintenance of mosquitoes of diverse chromosomal forms. A field station is located 25 km from the Center and is accessible throughout the year and others are scattered throughout the country. 4-wheel drive vehicles are available for field studies. A lecture room of about 50 seats fully equipped with video and audio devices is available. There are also two libraries; a small one managed by MRTC highly specialized for parasitic diseases and much larger one for the entire Faculty of Medicine and Pharmacy. All of them have internet connection allowing electronic bibliographical search. All the laboratories, insectaries, offices and conference room have been recently renovated.

**IT/LAN infrastructure**

The MRTC counts more than 120 desktops (Pentium 4 or >) computers and laptops in excellent condition, including more than 40 desktops or laptops at the MRTC/DMEVE alone. All computers are connected to an excellent and robust Internet connection (VSAT) through the NIH in Bethesda, MD, USA. All the computers at MRTC have installed current versions of productivity software such as Microsoft Office. They are maintained by a team of 4 computer technicians on site.

**Electrical power** is relatively stable in Bamako. Nevertheless, the MRTC has two electrical generators of 35 KVA and one of 110 KVA for emergencies so that laboratories experiments and computer labs activities will not be affected in case of power shortage.

**Housing**, the MRTC has a guest house fully equipped with Internet access and can accommodate up to 15 visitors adjacent to the laboratories.

**Past and ongoing training activities in IVM and medical entomology**

The MRTC fills a number of important roles. First and foremost, it has provided an opportunity for Malian scientists to grow and develop one of the most important research centers in Africa. The MRTC has gone a long way toward proving that given adequate training and sufficient support may have a great impact on public health. The MRTC offers many possibilities for training of Malians and other African, European and American students. More than 40 international students (master or PhD) or post-doctoral fellows have received training at MRTC. African researchers can lead the fight against the diseases that most afflict their people. Secondly, the MRTC provides the sites needed for African scientists to demonstrate the feasibility of applying new strategies, particularly vaccines, to fight age-old diseases. MRTC has been designated as one of the international centers of excellence in research (ICER). In addition, since 2004 the MRTC has hosted the African insect vector functional genomics courses in collaboration with World Health Organisation. The MRTC has been designated as a Center of Excellence by the WHO and is a WHO regional training center for West African countries.
Current research activities of the DMEVE/MRTC cover a large spectrum of disease insect vector studies, including spatial and temporal modeling malaria transmission studies across different ecosystem of Mali and adjoining countries, technical support to the Malian National Malaria Control Programme for vector control strategies, monitoring vector resistance to insecticides, malaria vaccine development and field testing, and research on lymphatic filariasis, leishmaniasis and tick-borne diseases. Malian scientists are currently PI’s or Co-PI’s in several NIH and TDR grants for vector research making the DMEVE/MRTC one of the primary research resources in Africa for vector mosquito population genetics studies (cytogenetic) and molecular studies of the *Anopheles gambiae* complex. Over the past decade, the DMEVE/MRTC has developed a network of researchers to study *Anopheles gambiae* complex population genetics and molecular genetics, which may be a model for developing and strengthening vector genomic research in Sub-Saharan Africa. Research activities of this network include 1] study of “Population Genomics of the mosquito *Anopheles gambiae* in Africa” to provide a background for malaria control strategies based on genetic manipulation of vectors. This study seeks to characterize the spatial changes in genetic structure of populations of *Anopheles gambiae* throughout continental Africa by determining the distribution of chromosomal and molecular polymorphisms. 2] Study of the genetics and genomics of mosquito immunity and parasite resistance in the context of the natural malaria transmission system. 3] The “Niono Irrigation Project and Malaria: A Computer Model”. The goal of this study is to develop mathematical models and simulation tools to explain the paradox between high density of mosquitoes and low level of malaria transmission in large irrigation projects in the region around Niono, in Mali. The MARA/ARMA initiative, Mapping Malaria Risk in Mali and across Africa using entomological and epidemiological data, GIS and satellite data to predict malaria risk transmission. MRTC is a regional center for West and Central Africa in the MARA network.

**Currently:** In an effort to prepare for indoor residual spraying (IRS) in Mali within the scope of the Presidents Malaria Initiative (PMI), the DMEVE/MRTC is responsible for conducting:

- Insecticide resistance assays on the malaria vectors in the districts of Bla and Koulikoro. The objective is to conduct field work to assess the malaria vectors present and the insecticide resistance levels in the two districts.

- Entomological monitoring and evaluation of ten sentinels sites
- Larviciding at Koulikoro and Bla
- Monitoring and evaluation of these interventions

The DMEVE/MRTC is the regional entomological training center for West Africa for the WHO/AFRO /Bill and Melinda Gates project starting this year and entitled: Malaria vector control: Filling the gap between product development and effective delivery.

**Role in regional and country vector-borne disease control programs**

Ever since its creation the center has conducted many studies of paramount importance in different areas of malariology. Areas such as Immuno-pathology, drug resistance of the parasite, malaria in pregnant women, vector-parasite interactions, population genetics of
the vectors, vector control strategies including the use of insecticides (ITNs, indoor residual sprays etc.), and insecticide resistance monitoring of vectors, have all been subject of investigation. The results and experience from these and other studies have enhanced the center’s capacity for research.

The MRTC has achieved a critical mass of trained scientists, multiple research foci, and the infrastructure and resources to address the problems of vector borne diseases in Africa..

**National, regional and international collaboration and partnerships**

The medical entomology is a technical partner for the National Malaria Control Program (NMCP). The two have years of collaboration on all aspect of malaria control on what the entomology group has expertise. The following are among the regional and international collaboration partners:

- University of California at Davis;
- University of Minnesota;
- NIH/NIAD/DIR/LPD/LMVR;
- WHO/TDR;
- University of Columbia;
- University of California at Los Angeles;
- University of Rome “la Sapienza” Italy
- Oxford University, UK;
- University of Notre Dame;
- University of Colorado State;
- University of Alabama;
- John Hopkins University;
- UCAD/Pasteur Institute/IRD Senegal;
- CNFRP Burkina Faso

### 3.9 Nigeria:

#### 3.9.1 Nigerian Institute of Medical Research and the Vector Biology and Control Research Unit

**Institutional mandate and focus**

*Vision statement* - To be an institution of excellence in basic, applied and operational research for the promotion of national health and development in Nigeria.

*Mission statement* - To conduct research into diseases of public health importance in Nigeria and develop structures for the dissemination of research findings while providing the enabling environment and facilities for health research and training in cooperation
with the Federal and State Ministries of Health, Universities, Allied Institutions and Organized Private Sector nationally and internationally.

The broad corporate mandate of the Institute under the enabling Act of 1977 stipulates that the Institute shall:

- Conduct research on communicable and non-communicable diseases of public health importance in the country in collaboration with medical schools, universities and other national and international health-related institutions.
- Initiate and implement basic, applied, operational and clinical research for the prevention and control of diseases endemic in the country in collaboration with the Federal, State Ministries of Health and other stakeholders in Health.
- Develop human capacity for health research and specialized health care in the country through relevant training.
- Disseminate important results of health research in the country and facilitate the translation of health research findings into policies, actions and strategies.

Organogram
The Institute implements its various programmes through the following five Research Divisions: Division of Biochemistry and Nutrition, Division of Clinical Sciences, Division of Microbiology, Division of Molecular Biology and the Division of Public Health.

Institute’s Research projects/programmes
The current on-going programmes of the Institute are in the areas of HIV/AIDS, Tuberculosis, Malaria, Schistosomiasis, Onchocerciasis, Sexually Transmitted Diseases, Childhood Infections, nutritional background of some of the endemic diseases and molecular biology studies on some of the causative agents of these diseases.

Medical Entomology staff capacity:
- Staff Strength: 12
  - 2 Senior Research Entomologist (with more than 12 years postdoctoral research experience in vector biology and control)
  - 3 postdoctoral Fellow (with specialty in vector biology and control)
  - 3 intermediate Scientists (Research Fellow) with specialty in vector control and Insecticide resistance
  - 2 Entomology Technicians
  - 2 Insectary Assistants

Facilities and equipment:
The Institute is strategically located, easily accessible and equipped for research and training in vector biology and control. The laboratory and team assets include:

(i) Reference Molecular Entomology laboratory with facility for research and training in:
  - Vectors identification, population and transmission dynamics
  - Testing, detection and monitoring insecticide resistance
- Basic laboratory training in microscopy and application of Polymerase Chain Reaction (PCR) for detection of vectors and parasites belonging to species complexes.

(ii) Insectaries (with live mosquito colonies for training and quality control of treated nets)
(iii) Established and characterized field sites with experimental huts for phase II trials of LLNs and study on mosquito behaviour

**Past and ongoing training activities in IVM and medical entomology**
Over the past five years the Institute has been actively involved in the development of human capacity, essentially to provide a critical mass of human resources in support of the National Malaria Control IVM Program.

From 2003 to 2008, series of training courses were conducted in our entomology laboratories in the following areas:
- Microscopy and PCR identification of malaria vectors;
- Detection and monitoring insecticide resistance using standard WHO protocols;
- Training on Indoor residual insecticide spraying;
- Phase 1 trial and bioassay tests for quality assurance of treated nets;
- Project management.

The Unit also conducts training courses on project management: an initiative of WHO-TDR.

**Role in regional and country vector-borne disease control programs**
The research team at the institute works in close contact with the National Malaria Control Program for routine vector identification, operational research, and in training field workers. In pursuance of capacity building for IVM in Nigeria, the laboratory was involved in the following roles:
- Training Principal Investigators identified by the NMCP for the World Bank Booster Project on IRS and developed the malaria entomology profile for Nigeria;
- Participated in the IVM partners meeting organized by the NMCP between 2005 and 2008 and was selected as a key member of the Nigerian IVM task force;
- Participated in the development and finalization of the IVM strategic plan for Nigeria;
- Presented a framework for Integrated Vector Management to the Lagos State Ministry of Health and currently facilitating vector control interventions using LLNs, IRS, larviciding and health education in south western Nigeria.

Members of the research team also play a key role in vector control in the sub-region. Dr. Sam. Awolola is a WHO consultant/Temporary Advisor for Malaria Entomology. He is a member of the African Network for Vector Resistance to Insecticide (ANVR) and facilitated a number of training courses at the NICD Johannesburg between 2002 and 2005.
National, regional and international collaboration and partnerships.

- Collaboration with the National Malaria Control Program and the Roll Back Malaria initiative to identify key operational research associated with IVM in Nigeria (Ongoing);
- Assessment of the impact of Treated Net on community malaria indices in Ondo State - supported by the UNDP Millennium Development project, (completed in 2007);
- Capacity building in characterization of Malaria vector and transmission dynamics - supported by the Wellcome Trust in collaboration with the Vector Control Reference Unit, NICD, Johannesburg, South Africa. (completed in 2006);
- Field and laboratory investigation on insecticide resistance supported by WHO/MIM-TDR, Geneva (completed in 2005);
- Detection and monitoring the molecular basis of insecticide resistance in Nigeria: Supported by WHO/MIM-TDR, Geneva. (completed in 2009);
- Phase I trial of long lasting nets (Permanent 2.0 and Olyset): Supported by Vestergaard Frandsen, Switzerland (ongoing);
- Innovative method of malaria control: European Network for Advance Research in Olfactory of Malaria transmitting Insect: Supported by the European Union (to start in 2010).

3.9.2 University of Jos

Institutional Mandate and Focus:

- To encourage the advancement of learning, promoting scholarship and community service. Providing an environment in which staff can develop their potential, contributing optimally to the University so that students can acquire academic and professional competence in their respective disciplines. Judicious allocation of resources to achieve strategic objectives and enhancing the character moulding of students within the context of the University’s motto.

- To nurture a University of the highest international standard so that the quality of the institution is rated among the best in Nigeria.

Medical Entomology Staff capacity:

- Prof H.B. Mafuyai, B.Sc., M.Sc. (Jos), PhD (Salford, UK), FRES (London);
- Prof. N.N. James-Rugu, B.Sc., M.Sc., PhD (Jos);
- Mr D.D. Pam, B.Sc., (ABU), M.Sc (Jos), PhD in view;
- Mr Petrus Inyama, B.Sc., M.Sc., MPhil. (Jos), PhD awaiting viva;
- Mr Samdi Lazarus Musa, DVM, M.Sc., (PhD student);
- Two Readers in Entomology whose current focus is not Medical Entomology.

Facilities and Equipment:
• Insectary with controlled temperature and relative humidity room (needs to be fixed);
• Entomology Laboratory;
• Parasitology Laboratory;
• Access to APIN Laboratory in the Jos University Teaching Hospital (JUTH) for molecular studies;
• Amino acid laboratory.

Past and ongoing training activities in IVM and Medical Entomology:
M.Sc Programme in applied Entomology and Parasitology sponsored by WHO/TDR between 1978-1999) to train medical entomologists for West Africa. Students were received from Sierra Leone, Ghana, Liberia, Cameroon etc from East African countries such as Tanzania. Although the sponsorship has ceased, the programme is still running with the same objectives of WHO and the Federal Government of Nigeria. Among some of the graduands of the programme who are active in IVM programmes across Africa include Prof. B.E.B. Nwoke, Prof O.B. Akogun and Prof D.A. Boakye in Ghana.

Role in Regional and country vector–borne disease control programmes:
Researchers from the University of Jos have collaborated with the national Malaria and Vector Control division, Federal and state Ministries of Health in various training, monitoring and evaluation of programmes notably:

1. Indoor Residual Spraying programmes (IRS) against malaria vectors in Barkin Ladi, in Plateau state in North Central Nigeria, November 27-December 8, 2006 sponsored by Federal Ministry of Health and WHO;
5. USAID/WHO/FGN workshop/planning on integrated management (IVM) July 20-23, 2005, Obudu, Cross River state, Nigeria;
6. World bank/Gombe state Malaria Control Booster Project workshop on Global positioning systems (GPS) for indoor Residual Spraying (IRS) July 15-17, 2009;
7. Indoor residual Spraying training workshop held at Barkin Ladi, Plateau, North Central Nigeria, November 30-December 1, 2006. Sponsored by the National Malaria and Vector Control Division, Federal Ministry of Health, Malaria Control programme;
8. Integrated vector Management (IVM) stake holders meeting held at Jos, Plateau state, January 29-february 2, 2007. Sponsored by the National
Malaria and Vector Control Division, Federal Ministry of Health, Malaria Control programme;

9. Training Workshop for Indoor Residual Spraying (IRS) at Barkin Ladi, August 12, 2007. Sponsored by the National Malaria and Vector Control Division, Federal Ministry of Health, Malaria Control Programme/RollBack Malaria (RBM) Initiative of WHO;

10. Training of Trainers (TOT) workshop on Indoor Residual Spraying (IRS) for programme officers and IRS officers from seven states of the Federation held at Jos, October 13-17, 2008 organized by the Division of Malaria and Vector Control, Federal Ministry of Health under the RBM initiative of WHO;

National, Regional, International collaborations and Partnerships.

- WHO/TDR re-entry Grant (Prof. H.B. Mafuyai, PI) 1993-1995 ID 930332. This grant enabled collaboration with Wageningen Agricultural University in the Netherlands;
- Wellcome Trust (London) Grant (Prof. H.B. Mafuyai) for the Taxonomy of disease vectors on the Jos Plateau (1993-1998). Collaboration was with Keele University, Staffordshire, United Kingdom.

3.9.3 University of Port Harcourt

Institutional mandate and focus

The University of Port Harcourt, established in 1975, under the supervision of the National Universities Council (NUC), is the leading University in the Niger Delta. Academic activities are organized in 50 departments of 11 faculties; three of these constitute the College of Health Sciences. In addition, there are 4 specialised Institutes and a School of Graduate Studies. With a student population of 25,000 and 1200 academic staff, it was rated the best university in academic programmes in 2003 by the National Universities Commission (NUC).

Over the past 3 decades, the entomology and parasitology units of the department of Animal and Environmental Biology had been involved in research projects on the epidemiology of some tropical diseases: malaria, filariasis, schistosomiasis, trypanosomiasis, among others. However, the emphasis on studies in Rivers State was on the parasitology component. Some of these studies include: - prevalence, morbidity and control of malaria and urinary schistosomiasis, - parasitological and entomological aspects of the epidemiology of filariasis. Studies in other States include: - applications of geographic information system (GIS) and insecticide treated bed nets (ITN) in community-based malaria control, - population ecology of Glossina species in the southern Guinea savannah and, - the epidemiology of filariasis in the Imo River Basin.
Medical entomology staff capacity:
Prof S. N. Okiwelu (medical/veterinary entomologist- tsetse)
Prof O.C. Umeozor (aquatic entomologist)
Dr G. B. Awi-Waadu, (parasitologist, specialist on snail vectors: intermediate hosts)
Prof (Mrs) Omotayo O. Ebong (pharmacologist, specialist in phytomedicine) Head,
Malaria Research Laboratory, College of Health Sciences
Noutcha, M.A.E., Ph.D. (molecular entomologist, specialized in malaria vectors)
Mr. Otufu P. P. Field Technician (Aquatic Ecosystems)
Mr. Akpan A. J. Laboratory Technician (Insect taxonomist)

Facilities and equipment:
An entomology research laboratory, Dept. of Animal and Environmental Biology; the
World Bank Malaria Laboratory, College of Basic Medical Science and the Faculty of
Science Central Laboratory (including equipment for molecular biology).

Past and on-going training activities in IVM and medical entomology:
Various research projects in diseases vectors have been supervised in the Dept of Animal
and Environmental Biology using classical entomological techniques (morphology,
microscopy). In addition to malaria and schistosomiasis, recent studies have confirmed
Port Harcourt, Nigeria). Foci of Human African Trypanosomiasis (HAT) have been
confirmed in Delta State. The key States in the Niger Delta are Bayelsa, Delta and Rivers.

Role in regional and country vector-borne disease control programs:
Dr M.A.E. Noutcha surveyed malaria vectors in Nigeria: Oyo State (Igbo-Ora), Borno
State (Bama) and Cameroon: Far-north Province (Mora) and West Province (Fokoué)
during her PhD programme; she has initiated this inventory in Rivers State in
collaboration with the Indoor Residual Spraying Project of the Rivers State Ministry of
Health/ Federal Ministry of Health.

National, regional, international collaboration and partnerships:
The research group is already collaborating with the malaria research group in the
department of Pharmacology, College of Health Sciences, University of Port Harcourt
and the Roll back Malaria programme, Rivers State Ministry of Health. It also
collaborates with the National Institute for Medical Research (NIMR), Lagos for the
World Bank-funded Indoor Residual Spraying (IRS) project in 7 States (including Rivers
State) in Nigeria. It envisages collaboration with the Sheda Research Institute, Abuja,
Nigeria.

3.10 Senegal:

3.10.1 Laboratoire d’Ecologie Vectorielle et Parasitaire (LEVP) : University of Dakar
Institutional mandate and focus

Research and Training:

✓ Research on vector borne diseases (VBD), mainly Malaria, Onchocerciasis, Lymphatic filariasis, Yellow fever, Chikungunya, and Leishmaniasis.
  • Vector taxonomy, bioecology, population dynamic
  • Parasite transmission and vector control
✓ Training on zoology, entomology including vector control.
  • Bachelor of Natural Sciences
  • Master of Parasitology
  • Master of Entomology
  • Environment/Hygiene Technicians Diploma

Medical entomology staff capacity

✓ Two senior teachers/researchers
✓ Seven Entomologists, researchers or managers in ministry of health and local research institutes
✓ One associate researcher and one entomology technician
✓ Two PhD students in malaria entomology

Facilities and equipment

✓ Three (3) insectariums (*Anopheles gambiae*);
✓ 4 laboratories with ELISA (CSP, Blood meals) facilities;
✓ 3 laboratories with PCR (*Anopheles gambiae* species and molecular forms, Kdr) facilities
✓ Training course rooms in University (Dakar) and the field station SLAP (Thies)

Past and ongoing training activities in IVM and medical entomology

✓ Training on malaria entomology and nets insecticide treatment of 150 district staff in Guinea (3 weeks WHO mission in June/July 1997);
✓ Training on malaria entomology and vector control of Angola technicians staff (one month WHO mission, 1998);
✓ Training on malaria entomology and insecticide susceptibility tests of NMCP staff from Burkina Faso, Mali, Cote d'Ivoire, DRC, Guinea, Comoros (one month WHO mission in 2000, Bobo Dioulasso, Burkina Faso)
✓ WHO Regional training of IVM Managers in Nairobi (Kenya). Facilitator for one week in 2002
WHO Malariology Course (IRSP, Benin) Facilitator of the Entomology and vector control modules (2003)
WHO Regional training course on Yellow fever (Dakar, 2006)
Training of Senegal vector control national trainers (core group at central level in 2007)
Support to the RTI district training of trainers and training of applicators on IRS (2008)
Development of entomology country profile (Senegal)

Role in regional and country vector-borne disease control programs
Support to countries in Central and West Africa for malaria vector control planning, monitoring and evaluation (Benin, Burkina Faso, Cote d’Ivoire, Gabon, Guinea, Guinea Bissau, Gambia, Ghana, Mali, Niger, Sao Tome & Principe, Senegal, Togo);
WHO workshops for the development of the IVM framework and guidelines for Vector Control needs assessment and IVM;
Support to countries (Benin, Burkina Faso, Cap Verde, Central Africa Republic, Ghana, Mali, Nigeria, Senegal) for the development of national policy and guidelines for IVM;
Support for arbovirus epidemics control to Comoros (2005), Madagascar, Mauritius, Seychelles (2006);
Support for the Global Funds for Aids, Tuberculosis and Malaria Round 7 Madagascar Malaria proposal development in May 2007;
Development of entomology country profile (Senegal)

National, regional and international collaboration and partnerships
As a National Reference Unit (NRU) of the Senegal NMCP for Entomology and Vector Control, the LEVP is coordinating a team of 10 medical entomologists and 4 entomologist technicians with at least 10 years experience in research and training on VBD and working in 4 collaborating institutions:

- NMCP: Senegal National Malaria Control Program.
- SLAP: Ministry of Health service based in Thies, NMCP basic entomology laboratory.
- IPD: Institut Pasteur de Dakar (Entomology laboratory)
- IRD: Institut de Recherche pour le Développement (Malariology laboratory)

8 staff members experienced in IVM planning, implementation, monitoring and evaluation, including:

- one former regional (AFRO) vector control adviser (Central Africa and West Africa)
• four as consultants/experts in vector control training (Malaria, Onchocerciasis & Yellow fever) and vector control situation analysis and planning (Cap Verde, Nigeria, Rwanda…)

• one Onchocerciasis and Lymphatic filariasis National Control Programs Manager

✓ two experts in malaria control management, PhD in medical entomology

The LEVP is coordinating the Monitoring and Evaluation of the PMI IRS intervention in the Senegal three selected district with part of the staff listed above. The Entomology component of the “large-scale implementation of Intermittent Preventive Treatment in Children delivered through health services with community participation in the Sahel”, a Gates Foundation / Department of Medical Parasitology (UCAD) Project is also coordinated by the LEVP.

At regional and international levels, the LEVP is working closely with WHO/AFRO, research institutions as the MRC (Gambia), MRTC (University of Bamako, Mali), IRSP (Mauritania), CREC (Benin), and NMCP in West Africa for vector control.

3.11 South Africa:

3.11.1 Medical Research Council (MRC) - Malaria Lead Research Programme

**Institutional mandate and focus**

The malaria Research Lead Programme (MRLP) has national, regional and continental research priorities. The MRLP focuses on malaria vector and parasite research which involves the monitoring and evaluation of both insecticide and drug resistance. It is also involved initiatives to extend malaria vector control beyond South African borders.

**Entomological staff capacity**

PhD entomologists
Laboratory manager: Both vector and parasitology laboratory
Chief research technologist: Laboratory animal, technology and insectary management
Two research technologists: Laboratory species identification
Two research technicians and one assistant: Insectary management

**Facilities and equipment**

Research facilities:
Standard molecular laboratory for analyzing malaria vectors and parasite species
Standard insectary for rearing malaria vectors and for doing bioessays
Geographic information systems laboratory (GIS) for evidence based planning
Malaria information System (MIS) with spray database and malaria case data linked to GIS for monitoring and evaluating the impact of control activities

Laboratory equipment:
Molecular laboratory – dissecting microscope x 3, Light microscope x 2, conventional
Polymerase chain reaction (PCR) x 10, real time PCR x 2 one for malaria vector processing.
Insectary –, environmentally controlled cubicles for housing mosquitoes x 6 and animal room x 1, mosquito harvester, dissecting microscope x 1
GIS – Geographic positioning systems (GPS) x 12, computers x 5, AO printer, scanner and laminator

**Past and ongoing training activities in IVM and medical entomology**
The MRLP has capacity development as a key objective and this is attained through degrees and development of specific skills necessary to research objectives. This has involved local and international training of staff. A number of training courses for collaborators has been run in insecticide resistance, molecular biology.

These include:
Regional training workshop on molecular and biochemical mechanisms of insecticide resistance though the Liverpool School of Tropical Medicine (LSTM) under the auspices of Multilateral Initiative on Malaria (MIM) which include seven Southern African countries; training workshop on integrated approaches to improving malaria vector control conducted by LSTM; PhD in the development and implementation of biochemical and molecular tools for detection and management of insecticide resistance in malaria vectors in Southern Africa at LSTM (the candidate has since left MRLP).

**Role in regional and country vector-borne disease control programs**
On a country level collaborative research with government and other research institutions has resulted in a policy change from Sulfadoxine-pyrimethamine to Co-artem as drug of choice for malaria treatment. The programme also influenced insecticide policy as part of the Malaria Advisory Group (MAG) at the provincial and national level. On a regional level the MRLP has played a significant role in the reduction of malaria in the Konkola Copper Mines (KCM plc) in Zambia as well as in the Mozal Aluminium Smelter in Maputo, Mozambique. It is currently involved in capacity development in malaria vector control in neighbouring countries through the Lubombo Spatial development Initiative (LSDI), a tri-nation malaria control programme between South Africa, Swaziland and Mozambique aimed at facilitating development, particularly agriculture and tourism in the area. This programme has significantly reduced the level of malaria transmission in the Lubombo region. As a result malaria control activities are being extended to the northern parts of the Maputo region in Mozambique. Furthermore, the confirmation of pyrethroid resistance by *Anopheles funestus* through the LSDI initiative led to policy change in respect to malaria vector control in Mozambique. The MRLP is involved in initiating similar regional co-operation between countries in Southern African.

**National, regional and international collaboration and partnerships**
- National Malaria Control Programme (NMCP);
- Lubombo Spatial Development Initiative (LSDI);
- South East African Combination Antimalarial Therapy (SEACAT);
- Bioko Island Malaria Control Project (BIMCP);
- Innovative Vector Control Consortium (IVCC);
3.11.2 National Institute for Communicable Diseases (NICD) – Vector Control Reference Unit

The National Institute for Communicable Diseases (NICD) came into being in January 2002 following on the restructuring of the public sector medical laboratory services of South Africa and the creation of the National Health Laboratory Service (NHLS) from the previous South African Institute for Medical Research (SAIMR) together with various governmental and provincial laboratories.

The previous National Institute for Virology (NIV) has, in effect, now been replaced by the NICD and has been supplemented by the addition of microbiology, parasitology and entomology laboratories from the former SAIMR to create a comprehensive public health communicable diseases institution. The NICD falls under the umbrella of the NHLS but has a degree of autonomy in its administration of the budget and human resources.

**Brief mission statement**

The NICD will be a resource of knowledge and expertise in regionally relevant communicable diseases to the South African Government, to SADC countries and the African continent, in order to assist in the planning of policies and programmes and to support appropriate responses to communicable disease problems and issues.

**Objectives of the NICD**

1. To be the national organ for South Africa for public health surveillance of communicable diseases.
2. To collect, analyse and interpret communicable diseases data on an ongoing and systematic basis.
3. To continuously and systematically monitor for the emergence of new infectious diseases and for the re-emergence or re-appearance of previously controlled infectious diseases or the importation of exotic infectious diseases.
4. To detect outbreaks or epidemics at an early stage in order to be able to promptly and effectively respond to them, or to anticipate imminent outbreaks or epidemics by investigation, research and analysis of data.

5. To engage in directed and relevant research to answer questions related to regional public health communicable diseases problems and their surveillance and management.

6. To establish formal structures for the rapid and continuous dissemination of data and information generated from NICD to all who need to know.

7. To build capacity in communicable diseases nationally and regionally.

8. To provide a reference function to communicable diseases laboratories in the public and private sectors nationally and regionally.

**Vector Control Reference Unit, NICD**

**Entomological staff capacity:**
Dr Lizette L. Koekemoer, Head of Department  
Dr Basil Brooke, Senior Medical Scientist  
Ms Shune Oliver, Medical Scientist  
Ms Riann Naguran, Medical Scientist  
Mr Zilindile Zulu, Laboratory Assistant  
Mr Zacharia Mnizi, Laboratory Assistant  
Ms Marche Martheze, Unit Secretary  
Prof Maureen Coetzee, Honorary Consultant to the VCRU. Professor of Medical Entomology & Vector Control, University of the Witwatersrand  
Prof Richard Hunt, Honorary Professor, School of Animal, Plant & Environmental Sciences, University of the Witwatersrand.

**Facilities and equipment**
The VCRU has state of the art insectaries to house numerous colonies for research and training purposes. Fully equipped laboratories for molecular, biochemical and pesticide studies are available. Each member of staff and all students have access to a computer with email and internet connectivity.

**Past and ongoing training activities in IVM and medical entomology**
The VCRU is involved in the teaching of medical entomology as part of the course for the Diploma in Tropical Medicine and Hygiene at the University of the Witwatersrand, Johannesburg. We participate in a module on Medical Entomology offered to 3rd year Zoology students. Currently 12 postgraduate students, from BSc Honours level to PhD, and post-doctoral fellows are supervised by members of the Unit.

A two-week course is offered on an ad hoc basis to train researchers and malaria control personnel in the basic principles of insectary design and management and to provide them with the necessary skills to enable them to identify their local anopheline mosquito fauna at the morphological level.
The VCRU ran three 5-week courses for WHO/AFRO in 2000-2003 on insecticide resistance management, monitoring and surveillance, covering all basic aspects of mosquito rearing, identification, blood meal and parasite analysis, and insecticide susceptibility testing.

**Role in regional and country vector-borne disease control programmes**

Prof Maureen Coetzee is a member of the Ministry of Health's Malaria Advisory Group which provides advice and guidance to the National and Provincial Malaria Control Programmes on all aspects of malaria control and treatment. The VCRU provides a mosquito diagnostic service to the Provincial control programmes as well as training of their entomologists.

The VCRU is strongly supportive of WHO and WHO/AFRO programmes pertaining to vector control and IVM and is involved in all the latest initiatives being implemented with Gates funding. The role of the VCRU is to provide a regional reference laboratory where specimens can be processed and where appropriate training can be given to entomologists from neighbouring countries.

**National, regional, and international collaboration and partnerships**

Prof J Hemingway, Director, Liverpool School of Tropical Medicine, UK
Dr H Ranson, Liverpool School of Tropical Medicine, UK
Prof W Takken, University of Wageningen, Netherlands
Dr B Knols, University of Wageningen, Netherlands
Dr M Thomas, Penn State University, USA
Dr D Norris, Johns Hopkins University, USA
Prof F Collins, University of Notre Dame, USA
Prof K Louis, IMBB, Crete
Prof D Boakye, Noguchi Memorial Research Institute, Accra, Ghana
Dr T S Awolola, MRC, The Gambia
Mr B Kandeh, Malaria Control Programme, The Gambia
Dr H T Masendu, Malaria Control Programme, Botswana
Mr B Ntomwa, Malaria Control Programme, Namibia
Mr J Chiphwanya, Malaria Control Programme, Malawi

### 3.12 Sudan:

#### 3.12.1 University of Gezira

In June 2008, the Blue Nile National Institute for Communicable Diseases (BNNICD), University of Gezira, Sudan will launch a Master of Science Degree Programme in Medical Entomology and Vector Control. This is in collaboration with:

- World Health Organization, Regional Office for the Eastern
Mediterranean, Cairo, Egypt
• London School of Hygiene and Tropical Medicine, London, United Kingdom
• National Institute for Communicable Diseases (NICD), Johannesburg, South Africa
• Liverpool School of Tropical Medicine, Liverpool, United Kingdom
• Istituto Superiori di Sanità, Rome, Italy
• Institut de Recherche pour le Développement (IRD), France and Centre for Research in Entomology, Cotonou (CREC), Benin

The duration of the course is 1 year beginning the end of June, 2008. The course will be conducted in English.

**Programme Objectives**
Upon completion of the course, participants should be able to:
• Identify vector-borne disease problems in relation to the general health situation of their countries
• Plan, implement, monitor and evaluate vector control programmes based on integrated vector management (IVM) approaches in accordance with the prevailing epidemiological, social and economic conditions of their countries.

**Course Structure and Syllabus**

**First Semester**
Module 1: Vectors and Vector-borne Diseases - introduction to vector-borne diseases and their burden, vector biology and ecology, modelling and dynamics of disease transmission.

Module 2: Epidemiological Investigations and Statistics - introduction to general epidemiology, statistics principles and methods, computer based applications in vector-borne disease control and study design.

Module 3: Entomological Investigations - sampling and rearing methods, vector identification, vector incrimination and vector surveillance.

Module 4: Vector Control - principles of vector control: methods and approaches, the integrated vector control approach, pesticides and their management and insecticide resistance management.

**Second Semester**
Module 5: Essential Principles of Programme Management in the context of Integrated Vector Management (IVM) - programme management, political and institutional frameworks in vector control, planning vector control programmes, monitoring and evaluation, resource mobilization and advocacy, social mobilization, partnership and inter-sectoral collaboration.
Module 6: Field training (2 months).

Third Semester
Module 7: Dissertation (3 months minimum).

3. 13 Tanzania:

3.13.1 National Institute for Medical Research (NIMR)

Institutional mandate and focus
The National Institute for Medical Research (NIMR) is a parastatal institution, which was established by the Act of Parliament No. 23 of 1979 (in October 1979) and became operational a year late. The Institute is mandated to: (i) to carry out, and promote the carrying out of, medical research designed to alleviate disease among the people of Tanzania (ii) to carry out, and promote the carrying out of research into various aspects of local traditional medical practices for the purpose of facilitating the development and application of herbal medicine; (iii) in co-operation with the Government or any person or body of persons, to promote, or provide facilities for, the training of local personnel for carrying out scientific research into medical problems; (iv) to monitor, control and coordinate medical research carried out within Tanzania, or elsewhere on behalf of or for the benefit of the Government of Tanzania, and to evaluate the findings of that research; (v) to establish a system for the registration of, and to register, the findings of medical research carried out within Tanzania, and promote the practical application of those findings for the purposes of improving or advancing the health and general welfare of the people of Tanzania; and (vi) to establish and operate system of documentation and dissemination of information on any aspect of the medical research carried out by or on behalf of the Institute. NIMR is made up six research centres in Dar es Salaam, Muheza, Mwanza, Tabora, Tanga and Tukuyu. The Institute also runs a training centre, the Centre for Enhancement of Effective Malaria Interventions located in its headquarters in Dar es Salaam.

The vision of the National Institute for Medical Research, Tanzania, is a Tanzania where people enjoy quality health and wellbeing. Its mission is to conduct, coordinate, regulate and promote scientifically and ethically sound, high quality health research in order to deliver evidence-based information that is responsive to the broader needs of the Tanzanian community.

Since its inception in 1979 NIMR has evolved from a disease specific approach research to the current wider mandate that includes all health research at the local, regional, zonal and national levels. In order to meet the mandate given by the government of the United Republic of Tanzania, NIMR has undergone major transformations in order to acquire the necessary strength and level of quality of its research activities and be better positioned to provide the required support and advice to the Government through the Ministry of Health to meet the challenges ahead.
NIMR has grown in strength and capacity from 25 in 1980 to 130 research scientists in 2007. Two of its research centres (Amani and Tukuyu) carry out research on vectors and vector control including:

- Mosquito vector biology and ecology
- Malaria and filariasis transmission
- Insecticide susceptibility and resistance monitoring
- Simulium biology and Onchocerciasis transmission

The Centre for Enhancement of Effective Malaria Interventions conducts training for middle cadre including district malaria focal persons.

**Medical entomology staff capacity**

<table>
<thead>
<tr>
<th>Name</th>
<th>Highest Qualification</th>
<th>Research specialization</th>
<th>Current Research Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Stephen Magesa</td>
<td>PhD</td>
<td>Vector control</td>
<td>Integrated Vector Management</td>
</tr>
<tr>
<td>Dr. Leonard Mboera</td>
<td>PhD</td>
<td>Mosquito Chemical Ecology</td>
<td>Mosquito Ecology and Ecohealth</td>
</tr>
<tr>
<td>Dr. Bertha Maegga</td>
<td>PhD</td>
<td>Systematics, Ecology and Control of Simulium</td>
<td>Vector control</td>
</tr>
<tr>
<td>Dr. Abraham Muro</td>
<td>PhD</td>
<td>Simulium biology</td>
<td>Environmental Health</td>
</tr>
<tr>
<td>Dr. William Kisinza</td>
<td>PhD</td>
<td>Epidemiology of Tick borne relapsing fever and malaria</td>
<td>Highland malaria</td>
</tr>
<tr>
<td>Mr. Robert Malima</td>
<td>PhD Candidate</td>
<td>Vector Control</td>
<td>Insecticide susceptibility</td>
</tr>
<tr>
<td>Mr. Victor Mwingira</td>
<td>PhD Candidate</td>
<td>Mosquito Larval Ecology</td>
<td>Mosquito Ecology</td>
</tr>
<tr>
<td>Mr. Bilali Kabula</td>
<td>MPhil</td>
<td>Vector Control</td>
<td>Vector Control</td>
</tr>
<tr>
<td>Mr. Clement Mweya</td>
<td>MSc Candidate</td>
<td>Vector Ecology</td>
<td>Vector Ecology</td>
</tr>
<tr>
<td>Ms. Basiliana Emidi</td>
<td>MSc</td>
<td>Mosquito Ecology</td>
<td>Mosquito Ecology</td>
</tr>
<tr>
<td>Mr. Patrick Tungu</td>
<td>PhD Candidate</td>
<td>Vector Control</td>
<td>Vector control</td>
</tr>
<tr>
<td>Mr. Yahya Athuman</td>
<td>BVM</td>
<td>Vector Control</td>
<td>Molecular Entomology</td>
</tr>
<tr>
<td>Mr. Denis Massue</td>
<td>BVM</td>
<td>Vector Control</td>
<td>Vector Control</td>
</tr>
<tr>
<td>Ms. Theresia Nkya</td>
<td>BSc</td>
<td>Vector Control</td>
<td>Vector Control</td>
</tr>
</tbody>
</table>

**Facilities and equipment:**

**Laboratories**

Laboratories at Amani Medical Research Centre are equipped with all the basic facilities including work benches, facilities for light microscopy (i.e. dissecting and compound microscopes). The laboratories do regularly carry out basic microscopy including reading of blood slides detection of parasites and other parameters, dissecting mosquitoes and reading them for malaria sporozoite detection, ageing mosquitoes, detecting filarial and other parasites etc.
**Insectary**
A new insectary for rearing mosquitoes has recently been commissioned aimed at facilitating several experimental studies including studies on mosquito susceptibility to insecticides, testing various insecticides, ecological and behaviour studies. The insectary currently stocks three strains of *Anopheles gambiae* and two strains of *Culex quinquefasciatus*.

**Animal house**
An animal house is available for keeping laboratory animals used for feeding the mosquito colony as well other experimental purposes requiring use of laboratory animals. Currently guinea pigs and rabbits are available.

**Experimental facilities**

*Experimental huts:* The Station has put up a suite of 12 experimental huts based on the East African Design, and another one of two experimental huts based on a West African Design. These are used as standard facilities for testing vector control tools including ITNs, LLINs, Insecticides, repellents etc.

*Experimental platforms:* In addition, a set of two platforms meant for testing insecticide treated materials targeting those in complex emergency situations such as tents and other shelters.

*Mosquito Spheres:* To link experimental hut studies to field (community) studies, we have put up an additional facility: a set of three Mosquito Spheres. The structures provides a setting that has the advantage that it can be used for high through-put testing of mosquito traps, repellents and other control devices with non-infected colony reared mosquitoes in a more realistic environment than that of the laboratory and a more controlled environment than that of the field. The Spheres are even suitable for safe experimental release of transgenic mosquitoes as soon as they are available for the competitiveness trials.

**Past and on-going training Activities in IVM and medical Entomology**


2. Mosquito Ecology and Vector Control Course (2005-2008). For 4 consecutive years, The National Institute for Medical Research in collaboration with the American Biophysics Corporation and later DBL-Centre for Health Research and Development of Denmark, has been conducting a 2-week course on Mosquito Ecology and Vector Control. The objective of this 2-week course is to strengthen the capacity of scientists on basic mosquito ecology and vector control, focusing on principles of behavioural ecology including essential theory and applied field research methodologies on mosquito ecology and control. During the past 4 years, the course has attracted participants from local and overseas universities, national disease control programmes and research institution. These include Institutions in United States of America, The Netherlands, Denmark, Kenya,
Mozambique, Rwanda, Tanzania, Zanzibar, Zambia and Uganda. A total of 63 participants have attended the course.

Course facilitators have been drawn from American Biophysics Corporation, Wageningen University and Research Centre (The Netherlands), DBL-Centre for Health Research (Denmark), University of Nairobi (Kenya), London School of Hygiene and Tropical Medicine (UK), Durham University (UK), Ministry of Health (Kenya), Kenya Medical Research Institute (Kenya), Ifakara Health Research and Development Centre (Tanzania) and National Institute for Medical Research (Tanzania).

3. Advanced Diploma in Vector Control: This is Ministry of Health 2-year regular course run by the Ministry of Health since 1986. NIMR scientists form the core staff in the training and supervision of the student’s research projects.

**Role in regional and country vector-borne disease control programmes**
At the national level, NIMR Centre’s major responsibilities include supporting the Ministry of Health in disease control activities and building zonal and district capacities for health research and service delivery. NIMR scientists have provided technical support to malaria control programmes regionally, focusing on vector control aspects. This has included support to Tanzania, Uganda, Namibia, Rwanda and Eritrea.

**National, regional and international collaboration and partnerships**
NIMR has been very successful in implementing collaborative projects involving both internal and external partners. Internal partners include the Ministry of Health and Social Welfare, African Medical Research Foundation, Bugando Medical Centre, Bugando University College of Health Sciences, Muhimbili University of Health and Allied Sciences, KCMC College of Tumaini University. External partners are London School of Hygiene and Tropical Medicine, DBL-Centre for Health Research and Development of Denmark, Liverpool School of Tropical Medicine and World Health Organization.


3.13. 2 Ifakara Health Institute
**Institutional mandate and focus**

Ifakara Health Institute is a non-for profit, district based health research and resource Centre whose mission is to sustain a rural district based health research and resource center capable of generating new knowledge and relevant information, regarding priority problems in health systems at the district, national and international level through research, training and services aiming at better health and community development.

The Institute has been operational since 1956, as the first biomedical field research station established by the Swiss Tropical Institute (‘STI’). Over the years, the Institute has steadily evolved into a national health and resource center for applied, operational and health systems research. Training and direct health sector support, are now also part of the Institute’s activities.

**Public Health Entomology (PHE)Unit**

Entomology at the institute currently focuses upon mosquitoes and *Anopheles* vectors of malaria in particular. Entomology has a long tradition at Ifakara and the Kilombero Valley is one of the best characterized malaria transmission systems in Africa. The unit undertakes entomological research relevant to public health priorities in Tanzania and other malaria-afflicted African nations.

**Goal of PHE Unit**

To develop, evaluate and promote the delivery of malaria vector control interventions and complementary methodological tools that are affordable and effective in African settings.

**Objectives**

The unit pursues its goal and objectives through three programmes with distinct research directions:

1) Fundamental ecological and evolutionary studies of malaria vectors and sporogonic-stage parasites.

2) Technology and methodology development directed towards the invention and improvement of cost-effective tools for controlling, monitoring and understanding malaria transmission.

3) Public health systems research to enable the effective and sustainable delivery of new and existing vector control tools to afflicted communities.

**Strategies**

To enable the most productive outcome from pursuing these research objectives, the unit implements three essential strategies in all projects it undertakes:

1) All research must be implemented through training and technology transfer mechanisms that strengthen capacity in Tanzania and at the Institute in particular.

2) All projects must integrate with, support and complement the broader medical and public health activities of the Institute.

3) All projects with external partners must be carried out in balanced partnership that leads to long-lasting, productive and mutually beneficial collaboration.

**Medical entomology staff capacity**
Most of the activities of the unit are undertaken in collaboration with numerous scientists and students from within the Institute and partner institutions. Below is a list of full time research staff members and associate students whose research is hosted by the Public Health Entomology Unit

**Research Staff**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Mswia, PhD</td>
<td>Senior Research Scientist</td>
</tr>
<tr>
<td>K Ng’habi, MSc</td>
<td>Research Scientist (PhD Candidate, Wageningen University)</td>
</tr>
<tr>
<td>B Huho, MSc</td>
<td>Research Scientist (PhD Candidate, Swiss Tropical Institute)</td>
</tr>
<tr>
<td>I Lyimo, MSc</td>
<td>Research Scientist (PhD Candidate, University of Glasgow)</td>
</tr>
<tr>
<td>L Ladslaus, MSc</td>
<td>Research Scientist (PhD Candidate, Wageningen University)</td>
</tr>
<tr>
<td>P Chaki, BSc</td>
<td>Research Assistant (PhD Candidate, Durham University)</td>
</tr>
<tr>
<td>N Govella, BSc</td>
<td>Research Assistant (PhD Candidate, Durham University)</td>
</tr>
<tr>
<td>D Nyika, H.Dip.</td>
<td>Research Assistant (Co-affiliation: Ministry of Agriculture)</td>
</tr>
<tr>
<td>V Mayagaya, BSc</td>
<td>Research Assistant (MSc Candidate, Univ. of Dar es Salaam)</td>
</tr>
<tr>
<td>D Maliti, BSc</td>
<td>Research Assistant</td>
</tr>
<tr>
<td>A Lutambi, MSc</td>
<td>Research Scientist (PhD Candidate, Swiss Tropical Institute)</td>
</tr>
<tr>
<td>V Mwakalinga, MSc</td>
<td>Research Scientist</td>
</tr>
<tr>
<td>B Chipazwa, MSc</td>
<td>Research Scientist</td>
</tr>
<tr>
<td>D Wilson, BSc</td>
<td>Research Assistant</td>
</tr>
</tbody>
</table>

**Academic Support Staff**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
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<tbody>
<tr>
<td>Gerry Killeen, PhD</td>
<td>Training Fellow (Co-affiliation: Durham University)</td>
</tr>
<tr>
<td>Sarah Moore, PhD</td>
<td>Training Fellow (Co-affiliation: Durham University)</td>
</tr>
<tr>
<td>Tanya Russell, PhD</td>
<td>Training Fellow (Co-affiliation: Durham University)</td>
</tr>
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**Associate Students**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Dongus, MSc</td>
<td>Swiss Tropical Institute, PhD Candidate; University of Basel</td>
</tr>
<tr>
<td>F Oketch, BSc</td>
<td>Moi University; MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>G William, Dip</td>
<td>Dar es Salaam City Council; MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>J Ndaro, Dip</td>
<td>Dar es Salaam City Council; MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>A Omari, Dip</td>
<td>Dar es Salaam City Council; MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>S Ogoma, BSc</td>
<td>MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>J Saya, BSc</td>
<td>MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>M Sikulu, BSc</td>
<td>MSc Candidate, Univ. of Nairobi</td>
</tr>
<tr>
<td>Z Mtema</td>
<td>MSc Candidate, Durham University</td>
</tr>
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</table>
Research programmes and projects

The PHE unit is broadly composed of three programmes, each corresponding to a research objective as described above. Each programme is composed of projects that are harmonized within the broader IHRDC portfolio by the senior staff. The unit provides core analytical services such as polymerase-chain reaction identification of Anopheles gambiae sibling species and training in a range of relevant research methodologies to IHRDC staff and collaborators.

Programme 1: Malaria vector and parasite ecology
Projects:
- Male mating competitiveness in Anopheles arabiensis
- A systems biology approach to vector-borne disease transmission: linking individuals, populations and ecosystems
- Feasibility study of the sterile insect technique for the control/eradication of Anopheles arabiensis

Programme 2: Tools for malaria epidemiology, surveillance and control
Projects:
- Spatial analysis of impact of insecticide-treated nets for malaria control in Tanzania
- Malaria transmission intensity and mortality burden across Africa (MTIMBA)
- Disruption of Malaria Transmission by Chemical Manipulation of Anopheline Olfactory Responses
- Entomopathogenic fungi as biocontrol agents for malaria vector mosquitoes
- Integration of earth observation-derived water resources products into malaria control initiatives in Tanzania:
- Rational Integration of Indoor Residual Spraying and Insecticide-Treated Nets

Programme 3: Public health systems development
Projects:
- The Dar es Salaam Urban Malaria Control Program
- Participatory natural resource management to mitigate health inequities in Africa
- Health promotion for Ngara with focus on malaria control, sanitation and water management

Recent achievements of PHE Unit
Important achievements over the last 5 years include the following:
1. Developed in-house research capacity in vector biology from very modest levels to a team of 17 Tanzanian and Kenyan research scientists registered for higher degrees, supported by a team of 3 full time research fellows holding PhDs with an annual funding base of approximately $2 million.
2. The unit has now established a reputation for insightful research into the fundamental biology of mosquitoes and the sporogonic stages of the malaria parasite.

3. The unit has also established a reputation for ground-breaking innovation in the development of new tools for understanding, evaluating and controlling malaria transmission.

4. Demonstrated why coverage of entire populations with ITNs is essential to deliver their full impact and how coverage of entire populations with ITNs can be achieved in practice, even with very modest subsidies. This body of evidence has promoted broad discussion accompanied by policy dialogue and change in relation to all four above-mentioned achievements at national and global levels.

5. In urban Dar es Salaam PHE Unit has shown that mosquito behavior has changed so that ITNs confer reduced levels of personal protection. More encouragingly, the unit has shown that community-based larviciding can be both affordable and highly effective on large programmatic scales in urban Africa with considerable potential for further improvement.

3.14 UGANDA:

3.14.1 Vector Control Division, Ministry of Health

**Institution mandate and focus**
Vector Control Division (VCD) was created in early 1920s to address malaria vector control in urban areas where most non immune colonial settlers and Asian traders and labourers were living. Available records show that VCD successfully performed these functions and reduced malaria endemicity patterns and transmission dynamics in various zones of the country. As a result VCD mandate was expanded to cover research and control of all other vector borne diseases including mosquito borne diseases, schistosomiasis, onchocerciasis, lymphatic filariasis, human trypanosomiasis, leishmaniasis, plague and louse borne typhi. The control of pests of public health importance such as rats, bats, fleas, bedbugs, cockroaches etc also formed part of VCD mandate and todate, VCD still holds the same mandate. In addition VCD fulfils the role of a centre for research on all the above vector borne diseases including malaria and intestinal worms. To handle its mandate, VCD employs medical entomologist, parasitologists, medical officers, vector control officers, biostatistician and other support staff. The Division is headed by a principal entomologist who reports to the Director of Health services of communicable diseases.

**Entomological staff capacity**
As stated above, the Division is headed by a principal entomologist who is a holder of PhD degree. It has two senior entomologists one a PhD holder and the other a Msc. Graduate. It has 5 other entomologists one of whom also has PhD degree in malacology and the other is currently pursuing hers at Copenhagen University, Denmark. The remaining 3 entomologists posses Msc qualifications. The Division has a single
biostatistician with a Msc in clinical epidemiology and she is now pursing a PhD degree in schistosomiasis epidemiology. The Division also employs 3 medical officers one of whom is a PhD holder and the rest posses Msc qualifications. The technical staff is comprised of 18 vector control officers. The basic qualifications for the Vector Control Officers is a Diploma in medical entomology/parasitology but a few of them also posses a Bsc degree especially in laboratory technology, two have gone on to having Msc qualifications and one is pursuing a PhD degree.

**Facilities and Equipment**
VCD is fairly well equipped with microscopes both compound and dissecting, and spraying equipment. Each officer purchases his/her own dissecting kit. There is a training school with a laboratory and it awards Diploma certificates in Entomology/Parasitology. To join the school, one must first complete a high school with at least a principal pass in Biology. Other than small private laboratories which also double serve as offices, there is one general laboratory where both stool and blood specimens are processed and examined and one modern well equipped PCR laboratory. The Division has over 10 strong vehicles for field work, a conference hall for meetings and several GPS pieces for collecting coordinates for mapping disease distribution. VCD has internet connections, several computers including laptops and desktops.

**Past and ongoing training activities in IVM and medical entomology**
Twice each year, we have a one month of accelerated reduction of child hood morbidity and mortality and also to address the neglected diseases. In preparation for this campaign VCD offers in-service training to district Vector Control Officers regarding integrated approach of disease control including IRS, net retreatment and general home and personal hygiene. Focal snail control especially in ponds, valley dams and paddy rice growing schemes and dosing streams against simulium flies are also discussed. Drainage and sanitary requirements to illiminate breeding sites for mosquitoes, flies, rats especially in urban settings are some of the skills taught during such courses. The trained Vector Control Officers are expected to sensitize and mobilize communities for integrated control of vector borne diseases at the grassroot.

**Role in regional and country vector-borne disease control programmes**
As already stated above, the control of Vector Borne Diseases in Uganda is a mandate of Vector Control Division. Consequently VCD houses four active disease control programmes including bilharzia and worm control programme, control of LF, onchocerciasis, and human African trypanosomiasis. In addition, VCD participates actively in the control of trachoma, plague and malaria. Guinea worm has recently been eliminated in Uganda with active participation of VCD. In collaboration with several national and international institutions, VCD carries out operational research on the above diseases and on others such as leishmaniasis and bruli ulcers.

Several VCD staff offer consultancy services in the region and also to WHO, APOC, Carter Center etc…. Furthermore the staff participate in postgraduate training of students at Msc and PhD levels in several local universities and institutions of higher learning.
National, regional and international collaboration and partnership
The main international collaborating institutions include:-
Danish Bilharziasis Laboratory, London School of Hygiene and Tropical Medicine,
Cambridge University, Imperial College London, the British Natural History Museum,
and Kenya Medical Research Institute (KEMRI). VCD also has strong collaboration
with several local Universities and Institutions of higher learning. In Disease control,
VCD has strong links to “Schistosomiasis Control Initiatives of Imperial College London,
APOC, Carter Centre, Sight Savers, GTZ and bilateral organizations especially WHO,
WFP and UNICEF.” VCD also has a strong inter-ministerial collaboration especially to
ministries of Education, Agriculture, Water supply and local governments.

3.14.2 School of Entomology and Parasitology: Affiliated to Vector Control
Division (VCD), Uganda

Institutional mandate
The School of Entomology and Parasitology provides quality training for assistant
entomologists, commonly known as Vector Control Officers (VCOs) in Uganda. The
VCOs are responsible for technical support to medical entomologists and also coordinate
the control of vector borne diseases at the district and sub-district levels. The School
awards diploma certificates in medical entomology and parasitology after successfully
passing examinations at the end of a 3 year course. Entrants to this course are high
school leavers who have had at least a single principal pass in Biology. Chemistry and
Physics are other preferred subjects.

The School is headed by a graduate professional trained tutor in community education,
medical entomology and parasitology. The core teaching staff comprise of one trained
tutor in biomedical laboratory sciences and medical entomology and parasitology, and
two trained tutors in medical entomology and parasitology at the diploma level. Since
the school is based at VCD, highly resourceful staff of the division participate in part-
time teaching. Some of them are members of the school’s examination board. Most of
the trained VCO’s are Ugandans but in the recent years, the school also admits students
from neighbouring states notably Rwanda, Sudan and Ethiopia.

Gulu University presently hosts the chairmanship of the examination Board. Others on
examination Board include:-
- Makerere University zoology department.
- Makerere University public Health Institute
- Makerere University microbiology department
- Uganda virus Research Institute.
- Prince Leopold Institute of Tropical Medicine Antwerp Belgium.
- DBL Denmark
- NTD programme in Uganda
- Quality chemicals Uganda
- Malaria consortium Uganda
- Vector Control Division.

**School Facilities:**
1. Laboratory
2. Two class rooms – at Mulago campus
3. Microscopes mainly from Vector Control Division
4. Entomological Dissecting kits (students to provide)
5. A 27 seater bus
6. Overhead Projector
7. Slide Projector
8. Specimens (of various vectors and parasites)
9. Laboratory sitting stools
10. Principal’s office
11. 1 computer with a printer
12. some textbooks

**Past and ongoing activities in IVM and medical entomology:**
The institution has established field stations attached to local government programmes, and it is in those upcountry field station that IVM is done yearly. The stations include:-
- Schistosomiasis research station in Butiaba which caters for schistosomiasis, soil transmitted helminths, malaria and IRS.
- Fort portal vector control Unit caters for onchocerciasis surveys, stream dosing against simullium flies and skin snipping, health education and IRS.
- Eastern Region Unit at Jinja / Iganga caters for sleeping sickness, lymphatic filariasis, schistosomiasis and IRS.
- Northern Training Unit based at Lira caters for IRS, lymphatic filariasis, schistosomiasis, soil transmitted helminths.
- Main campus Kampala caters for theory work and laboratory practices.
- Mulago Hospital caters for general laboratory techniques to general laboratory practicals and management.

It is worth noting that before any student completes their 3 year diploma course, one must go through training in all the above mentioned IVM field stations.

**Training:**
- Community mobilization and sensitization with staff of Vector Control on importance of IVM.
- Net retreatment exercises with malaria consortium Uganda.
- IRS mainly DDT and ICON with RTI Uganda office in Northern Uganda.

**National and International collaborations:**
- Teach students from other paramedical schools in integrated vector management systems.
- Our school offers training vacancies for students from other neighbouring countries notably Rwanda, Sudan and Ethiopia.
3.14.3 Uganda Virus Research Institute

Institutional mandate and focus

Mission
UVRI is a Government Institution under the Ministry of Health whose broad mission is to carry out scientific investigations concerning communicable diseases especially viral diseases of public health importance and to advise government on strategies for their control and prevention.

Since its inception, research has been the central focus of the Institute. The Institute also carries out diseases outbreak rapid response investigation and control.

Entomological staff capacity

3 PhD level entomologists - Dr. Lutwama J. J.; Dr. Kayondo, J; Dr. Birungi J.

+ 1 retired PhD holder Entomologist: Dr. L G Mukwaya

3 experienced field staff for collection of specimens

Facilities and equipment

I. There several rooms which make the entomology Department at the Institute. There are also an additional number of rooms in the Arbovirology Department which works closely with the Entomology Department.

II. There is an Insectary mostly with Aedes mosquitoes

III. There is a vehicle for field work

IV. There are several microscopes

V. There are PCR set ups for molecular biology studies

VI. There are facilities for sequencing at the institute

Past and ongoing training activities in IVM and medical entomology
Dr. J. Lutwama has been involved in training and supervising some students. For a number of years he has been offering Postgraduate courses in Entomology including:
Integrate pest management and control,

- Insecticide/Pesticide application and Toxicology;
- Principles of Vector Control,
- Insect ecology,
- Biological Control,
- Biostatistics, etc.

**Role in regional and country vector-borne disease control programs**
Presently only limited involvement through collaborations with those in the programs

**National, regional and international collaboration and partnerships**
Malaria control program
Malaria Consortium
RTI International
Vector Control Department of the MOH
Onchocerciasis Control Program
Makerere University, Department of Zoology and also the Veterinary Faculty
Gulu University, Faculty of Science
Mbarara University

KEMRI- Kenya
NIMRI- Tanzania

CDC Fort Collins USA
CDC Atlanta, USA
Notre Dame University, USA
Colorado State University, USA
Ben Gurion University of the Negeb, Israel

### 3.15 Zambia:

#### 3.15.1 Zambia National Malaria Control Centre (NMCC)

The National Malaria Control Centre (NMCC), located on the grounds of the Chainama Hills College of Health Sciences in Lusaka, assumed responsibility for coordinating Zambia malaria control activities in December 1997. The NMCC, which is a department under the directorate of Public Health and Research of the Ministry of Health, provides technical support and coordination for a wide range of partners including research and training institutes and Provincial and District Health Offices.

The NMCC links closely with partners in the commercial sector such as the Konkola Copper Mine, churches and mission hospitals, NGOs, and service groups such as Zambia Red Cross, Zambia Scouts, Zambian Association of Chambers of Commerce and Industry, and Rotary. For instance, the Konkola Copper Mine as a major stakeholder has been successful in controlling malaria in mining areas. The Mine was the first establishment in Zambia to use indoor residual spraying and has continued to support programs for malaria control. Multilateral and other partners of NMCC include: WHO; UNICEF; USAID-MACEPA, PMI; Zambia Malaria Foundation; World Bank.
In addition to coordinating malaria control activities in the country, the NMCC is involved in the day-to-day implementation of malaria prevention and control interventions in an effort to significantly reduce morbidity and mortality due to malaria in line with the global Roll Back Malaria goal of reducing the malaria burden by half by the year 2010.

NMCC has two entomologists at the national level (Emmanuel Chanda - in charge of IVM, and Chandwick Sikaala – in charge of Sikaala). However there is an acute shortage of entomological staff at provincial and district levels. Entomological training is normally offered at the University of Zambia’s main campus (systematics, general entomology etc.), and at the Medical School (medical entomology). Training of trainers in IRS is however conducted on a regular basis for provincial and district personnel. IVM is still not developed beyond IRS and ITNs. Past efforts at building capacity in IVM include the training of 66 staff in concepts of IVM in December 2006.

3.15.2 Macha Malaria Research Institute

The Macha Malaria Research Institute, Inc., (MMRI) was incorporated as a non-profit (501(c)3) organization in the State of Pennsylvania, U.S.A. in 1997. The administrative office is currently located in Dillsburg, Pa at 23 E Welty Ave.

Zambia Office:

The Zambia Office of MMRI was formally established in 1998, although prior to this date malaria research had been conducted in Zambia under the direction of Doctors Victor Gordeuk and Philip Thuma for a number of years.

The Zambia Office of MMRI consists of a field site located at the Macha Mission Hospital, where various malaria research projects are carried out. As of 2003, this is now incorporated in the Malaria Institute at Macha (MIAM), a collaborative effort between the Johns Hopkins Malaria Research Institute, MMRI, the Zambian government and the Macha Mission Hospital/Zambian Brethren in Christ Church.

Macha Mission Hospital was established in 1957 as a mission hospital under the Brethren in Christ Church of North America, and has functioned within the program of the Ministry of Health of the Zambian government since that time. In 1990 its administration was fully turned over to the Zambian Brethren in Christ Church, and it has had Zambian administrators and a local oversight board since that time. It currently is considered a district general hospital by the Zambian government.

The hospital is located in the Southern province of Zambia, 80 kilometers from the nearest town of Choma. It is accessible by an all weather gravel road, and has 24-hour electricity available from the national grid with a back-up generator available.
Communication is available by a radio link with Choma, and a VSAT-based full broadband system with email and internet access.

**Laboratory:** Clinical laboratory facilities have recently been upgraded with the completion of a new laboratory building, housing hematology, parasitology/microbiology and biochemistry sections. An automated cell counter for hematology is in place (Cobas-Micros - Roche Diagnostics) as well as a spectrophotometer (Spectronics 20D) and an automated dry chemistry analyzer (Reflotron). In addition to 4 binocular microscopes, there is equipment for routine bacterial cultures, blood banking, slide staining and basic ELISA testing methods. The lab has liquid nitrogen storage as well as a minus 80-degree and a regular freezer for specimen storage.

### 3.15.3 Tropical Diseases Research Centre (TDRC)

**Institutional mandate and focus**

TDRC was established in 1975 by the Special Program of World Health Organization (WHO), World Bank, and United Nations Development Program (UNDP) on Research and Training in Tropical Diseases (TDR) as one of the regional centres in the world. The other two centres were in Brazil and Thailand. At the time of its creation, the Centre’s focus of research was on the three diseases that were targeted for elimination by WHO. These were malaria, scistosomiasis, and human African trypanosomiasis (HAT). In 1981, the Centre became a national institute through an Act of parliament. The government took over the funding of the institutions in terms of salaries and operations. Funding for research and training has continued to come from external funding agents such as the WHO. Since the Centre became a national institute, the scope of its research activities has been widened to include micronutrient deficiency disorders, Tuberculosis, HIV/AIDS and diarrhea diseases. All the research laboratories fall under Biomedical Sciences Department which comprises the following units: Parasitology; Biochemistry; Immunology; Microbiology and Tuberculosis; Nutritio; Haematology; Molecular Biology and Vector Biology.

The vision of TDRC is to be a Centre of excellence in the promotion of health in Zambia and the African Region through research. The objectives of the Centre are to:

- Conduct research in disease of public health importance in the region;
- Develop and evaluate tools, technologies and strategies for the prevention and control of diseases and related conditions;
- Collect and disseminate scientific information including the publication of scientific reports, journals and other such documents and literature relating to the work of the Centre;
- Serve as a regional research and training Centre in Africa.

**Medical entomology staff capacity:**
Currently TDRC has two persons trained in entomology in the unit of vector biology. One of these two has vast experience in malaria medical entomology. The unit also employs two assistants who help out with field work and run the insectary. Long term and short term training will further strengthen the staff capacity of the institution.

Facilities and equipment:
The administrative offices and those for other staff are in the Ndola Central Hospital building. Additional offices for scientists are at the new Tuberculosis Regional Reference Laboratory and the animal house, located within the hospital premises but in separate buildings. The animal house has capacity to rear mosquitoes and animals to support the insectary and other research work. There are plans currently to strengthen this insectary to support malaria vector control in two mining districts of Zambia.

The laboratory equipment at TDRC range from microscopes (fluorescent, compound, teaching and dissecting), monitors, PCR machines, HPLC, electrophoresis machine, incubators, balances, ELISA readers, fridges and freezers, centrifuges (micro and macro), UV tansilluminator, shakers, heaters, humidifiers, insecticide susceptibility test kits and many others. Other equipment specific to vector biology include light traps and natural light stereoscopic microscopes.

The Centre has a boardroom which is used to host training sessions. Information and communication technology (ICT) include desk top computers, printers, an overhead projector, LCD projector, TV, VCR and laptops. The institution has a local area network and reliable internet connectivity to facilitate research and training.

Past and ongoing training activities in IVM and medical entomology
The institution has participated in the planning for strengthening of national IVM in the past. IVM remains at the core of the Centre’s training activities for vector control. TDRC still remains well placed to play a lead role in training for vector control in the country.

Role in regional and country vector-borne disease control programmes
The institution provides technical support to the malaria control programmes in the country. With the renewed efforts by the national malaria control programme through IRS and other vector control strategies since 2003, TDRC has provided support in terms of vector identification, vector behavior, and susceptibility status to insecticide use. At the moment, vector control efforts emphasize chemical insecticide use either as IRS, impregnated nets or larviciding. Bioassays to guide these control efforts remain underutilized. The other non-chemical control strategies within the framework of IVM will be highly appreciated.

Collaboration and partnerships
The institution has established collaboration with various research and academic institutions both nationally and internationally. It has has signed memoranda of understanding with the following:

National:
• University of Zambia, Copperbelt University;
• National Malaria Control Centre;
• Malaria Institute at Macha and Ndola College of Biomedical Sciences.

International:
• Centres for Disease Control (CDC) in Atlanta, Georgia;
• Institute of Tropical Medicine, Antwerp, Belgium;
• European and Developing Countries Clinical Trial Partnership (EDCCTP);
• Bill and Melinda Gates Foundation;
• African Malaria Network Trust (AMANET);
• National Institutes of Health (NIH), USA;
• WHO-TDR through the Research Network for Schistosomiasis in Africa (RNSA);
• Boston University, USA;
• Duke University, USA;
• Danish Bilharziasis Laboratory, through RNSA;
• East Africa Network for Tsetse and Trypanosomiasis (EANETT);
• East and Southern Africa Centre for International Control of Parasites (ESACIPAC).

TDRC has also established partnerships with district management boards and the private sector in the control of malaria. Currently TDRC, under the GDA PPP malaria campaign is collaborating with the Zambian National Malaria Control Programme (NMCP), Community HIV/AIDS Mobilization Project (CHAMP), NewFields LLC, First Quantum Minerals Limited to carry out parasite prevalence and entomological surveys in two mining towns of Zambia. TDRC is member of the African Network for Vector Resistance (ANVR).
Annex 1: Summary of contact information for institutions with existing capacity for IVM training in Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>Organization</th>
<th>Address</th>
<th>Contact Person/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>Centre for Research in Entomology in Cotonou (CREC). Organisation de Coordination de la Cooperation pour la Lutte Centre les Grandes Endemies (OCCGE).</td>
<td>OCCGE BP 06 2604, Cotonou, Benin Tel. +229 33 0825/331608/334239</td>
<td>Prof. Martin Akogbeto (Director) E-mail: <a href="mailto:akogbeto@leland.bj">akogbeto@leland.bj</a></td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Centre Muraz - Laboratoire de Parasitologie Entomologie</td>
<td>BP 390 Bobo Dioulasso Burkina Faso Tel. +226 20 97 01 02</td>
<td>Dr. Abdoulaye Diabate Email: <a href="mailto:a_diaate@hotmail.com">a_diaate@hotmail.com</a></td>
</tr>
<tr>
<td>Cameroon</td>
<td>The Biotechnology Centre, University of Yaounde</td>
<td>P.O. Box 3851-MESSA, Yaounde Tel: +237 22237429</td>
<td>Dr. Jude Bigoga <a href="mailto:judebigoga@yahoo.com">judebigoga@yahoo.com</a></td>
</tr>
<tr>
<td></td>
<td>DPS/SDHA</td>
<td>BP 8447 ou BP22 Bazou Tel +237 99641854</td>
<td>Dr. Emmanuel Kouagang <a href="mailto:emakou@yahoo.fr">emakou@yahoo.fr</a></td>
</tr>
<tr>
<td></td>
<td>Adjoint Programme National de Lutte contre le Paludisme</td>
<td>BP7 14386, Yaounde Tel : +237 77 786714</td>
<td>Dr. Fondjo Etienne <a href="mailto:fondjoetienne@yahoo.fr">fondjoetienne@yahoo.fr</a></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Addis Ababa University</td>
<td>Akilulu Lemma Institute of Pathobiology Addis Ababa University, Ethiopia Tel: +251 911 990284</td>
<td>Dr. Messay F. Gebremariam <a href="mailto:messayg@yahoo.com">messayg@yahoo.com</a></td>
</tr>
<tr>
<td>Ghana</td>
<td>Noguchi Memorial Institute of Medical Research</td>
<td>University of Ghana, Legon, P.O. Box LG581, Accra Tel: +233 21 7012284/5; +233 24 2650948</td>
<td>Prof Mike Wilson (Deputy Director) E-mail: <a href="mailto:mwilson@noguchi.mimcom.net">mwilson@noguchi.mimcom.net</a></td>
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<tr>
<td></td>
<td>Ghana National Malaria Control Programme (NMCP)</td>
<td>NMCP Disease Control Dept. Division of Public Health, Ghana Health Service Ministry of Health P.O. Box M-44, Accra Tel: +233 2443228483</td>
<td>Dr. Aba Baffoe-Wilmot Email: <a href="mailto:ababaffoe@hotmail.com">ababaffoe@hotmail.com</a></td>
</tr>
<tr>
<td></td>
<td>AngloGold Ashanti - Obuasi</td>
<td>AngloGold Ashanti Obuasi, Ghana Tel.: +233 21 761300</td>
<td>Steve Knowles <a href="mailto:sknowles@anglogoldashanti.com.ph">sknowles@anglogoldashanti.com.ph</a></td>
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<tr>
<td>Kenya</td>
<td>*Kenya Medical Research Institute (KEMRI)</td>
<td>KEMRI P.O. Box 54840 Nairobi Tel: +254 20 2722541</td>
<td>Dr. Luna Kamau E-mail: <a href="mailto:l.kamau@ke.cdc.gov">l.kamau@ke.cdc.gov</a></td>
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<tr>
<td></td>
<td>University of Nairobi</td>
<td>School of Biological</td>
<td>Dr. Richard Mukabana E-mail:</td>
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<tr>
<td>Country</td>
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<tr>
<td>Sciences, University of Nairobi, P.O. Box 30197-00100 GPO, Nairobi</td>
<td><a href="mailto:rmukabana@yahoo.co.uk">rmukabana@yahoo.co.uk</a></td>
<td></td>
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<tr>
<td>*NMCP, Division of Malaria Control</td>
<td>P.O. Box 20750-00202, Nairobi Tel: +254 20 2716934</td>
<td>Mr. Kiamo Ngagi <a href="mailto:nkngasi@domckenya.or.ke">nkngasi@domckenya.or.ke</a></td>
<td></td>
</tr>
<tr>
<td>International Centre of Insect Physiology and Ecology (ICIPE)</td>
<td>P.O. Box 30772, Nairobi Tel: +254 20 802501</td>
<td>Dr. John Githe <a href="mailto:gjithure@icipe.org">gjithure@icipe.org</a></td>
<td></td>
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<tr>
<td><strong>Madagascar</strong></td>
<td>Lot II 558 Anjanahary, Antananarivo Tel: +261 33 1174208</td>
<td>Dr. Jean Desire rakotoson <a href="mailto:jrktsnd@yahoo.fr">jrktsnd@yahoo.fr</a></td>
<td></td>
</tr>
<tr>
<td>*Division Lutte antivectorielle Service de lutte contre le paludisme</td>
<td>BP 1274, Antananarivo 101 Tel: +261 20 2240165</td>
<td>Dr. Jocelyn Ratovonjato <a href="mailto:ratov@pasteur.mg">ratov@pasteur.mg</a></td>
<td></td>
</tr>
<tr>
<td><strong>Mali</strong></td>
<td>BP 6057, Bamako Tel: +223 6 230190</td>
<td>Dr. Traore Sitan <a href="mailto:sitan@yahoo.com">sitan@yahoo.com</a></td>
<td></td>
</tr>
<tr>
<td>*Malaria Research and Training Centre, University of Bamako</td>
<td>BP 1805, Bamako +223 6 753394</td>
<td>Prof. Traore Sekou <a href="mailto:cheick@mrtschko.org">cheick@mrtschko.org</a></td>
<td></td>
</tr>
<tr>
<td><strong>Mozambique</strong></td>
<td>Av. Eduardo Mondlane CP 264, Maputo Tel: +258 823296490</td>
<td>Dr. Samuel Mabunda <a href="mailto:sjamabunda@yahoo.com.br">sjamabunda@yahoo.com.br</a></td>
<td></td>
</tr>
<tr>
<td>*National Malaria Control Programme, Ministerio da Saude, DNPSCD/PNCM</td>
<td>BP 1274, Antananarivo 101 Tel: +261 20 2240165</td>
<td>Dr. Jocelyn Ratovonjato <a href="mailto:ratov@pasteur.mg">ratov@pasteur.mg</a></td>
<td></td>
</tr>
<tr>
<td><strong>Nigeria</strong></td>
<td>Public Health Division PMB 2013, Yaba, Lagos Tel: +234 806 0702</td>
<td>Dr. Sam Awolola <a href="mailto:awololas@hotmail.com">awololas@hotmail.com</a></td>
<td></td>
</tr>
<tr>
<td>University of Jos</td>
<td>Department of Zoology Bauchi Road 930001, Jos Plateau State Tel: +234 8037021184</td>
<td>Prof. H.B. Mafuyai <a href="mailto:mafuyaih@unjios.edu.ng">mafuyaih@unjios.edu.ng</a></td>
<td></td>
</tr>
<tr>
<td>University of Port Harcourt</td>
<td>Entomology and Pest Management Unit Faculty of Science PMB 5323, Choba, Port Harcourt, Rivers State Tel: +234 8035779250</td>
<td>Dr. M.A.E. Noutcha <a href="mailto:naemekeu@yahoo.com">naemekeu@yahoo.com</a></td>
<td></td>
</tr>
<tr>
<td><strong>Senegal</strong></td>
<td>BP 25270, Dakar Tel: +221 33 8690799</td>
<td>Dr. Diop Abdoulaye <a href="mailto:diopabsh@yahoo.fr">diopabsh@yahoo.fr</a></td>
<td></td>
</tr>
<tr>
<td>*Laboratoire d’Ecologie Vectorielle et Parasitaire</td>
<td>University Cheick Anta Diop, Dakar 221 77 5471171</td>
<td>Prof. Ousmane Faye <a href="mailto:jognomaye@yahoo.fr">jognomaye@yahoo.fr</a></td>
<td></td>
</tr>
<tr>
<td><strong>South Africa</strong></td>
<td>NICD, Box X4 Sandringham 2131 Tel: +27 011 3866480 / 27082 8073559</td>
<td>Prof. Maureen Coetze <a href="mailto:maureen@nicd.ac.za">maureen@nicd.ac.za</a></td>
<td></td>
</tr>
<tr>
<td>Vector Control Reference Unit – National Institute of Communicable Diseases (NICD)</td>
<td>MRC 491 Ridge Road Overport, 4067, Durban South Africa</td>
<td>Dr. Rajendra Maharaj <a href="mailto:raj.maharaj@mrc.ac.za">raj.maharaj@mrc.ac.za</a></td>
<td></td>
</tr>
<tr>
<td>Malaria Lead Research Programme – Medical Research Council (MRC)</td>
<td>P.O. Box 101 Wad Medani University of Gezira</td>
<td>Prof. Sayed Elbushra <a href="mailto:bnsrti@hotmail.com">bnsrti@hotmail.com</a></td>
<td></td>
</tr>
<tr>
<td><strong>Sudan</strong></td>
<td>Blue Nile National Institute of Communicable Diseases</td>
<td>Dr. Gerry Killeen <a href="mailto:gkilleen@ihrdc.or.tz">gkilleen@ihrdc.or.tz</a></td>
<td></td>
</tr>
<tr>
<td><strong>Tanzania</strong></td>
<td>Ifakara Health Institute Tel: +255232625164</td>
<td>Dr. William Kisinza <a href="mailto:wkisinza@niror.or.tz">wkisinza@niror.or.tz</a></td>
<td></td>
</tr>
<tr>
<td>*National Institute for Medical Research</td>
<td>P.O. Box 9653, Dar es Salaam Tel: +255 22 2121400</td>
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<tr>
<td>Institution</td>
<td>Address</td>
<td>Contact Person</td>
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<tr>
<td>Ministry of Health and Social Welfare</td>
<td>P.O. Box 9083, Dar es Salaam Tel: +255 754974798</td>
<td>Dr. Azma Simba</td>
<td><a href="mailto:azmatan@yahoo.com">azmatan@yahoo.com</a></td>
</tr>
<tr>
<td><strong>Uganda</strong></td>
<td>Vector Control Division (VCD)</td>
<td>VCD Ministry of Health P.O. Box 1661 Kampala Tel: +256 41251927</td>
<td>Dr. Narcis Kabatereine</td>
</tr>
<tr>
<td></td>
<td>Virus Research Institute</td>
<td>P.O. Box 49 Entebbe Tel: +256 41320387</td>
<td>Dr. J.J. Lutwama</td>
</tr>
<tr>
<td><strong>Zambia</strong></td>
<td>National Malaria Control Centre (NMCC)</td>
<td>NMCC Ministry of Health P.O. Box 32509 Lusaka Tel: +260 211 282427</td>
<td>Dr. Elizabeth Chizema</td>
</tr>
<tr>
<td></td>
<td>MACHA Malaria Research Institute</td>
<td>P.O. Box 630166, Choma, Zambia</td>
<td>Dr. Phil Thuma</td>
</tr>
<tr>
<td></td>
<td>Tropical Diseases Research Centre (TDRC)</td>
<td>Ndola Central Hospital Ndola Tel: +260 212 620737</td>
<td>Dr. Modest Mulenga</td>
</tr>
</tbody>
</table>

* Institution participating in ongoing WHO-AFRO/Gates Foundation project on institutional strengthening for vector control.

# Institutional profile pending.
Annex 2. List of key people met and discussed with by RTI International Consultant during visits to Benin, Ghana, Kenya, Uganda and Zambia

Benin:
Martin Akogbeto, Director, Centre de Recherche Entomologique de Cotonou (CREC)
Alex Asidi, Medical Entomologist, CREC
Amos Johnson, Director, Benin Global Business
Dorothee Kindz-Gazard, Ministry of Health
Pascal Zinzindohoue, Family Health Team Leader, USAID Benin
Seydou Doumbia, Chief of Party & Head IRS Project, RTI International Benin

Ghana:
Michael Wilson, Deputy Director, Noguchi Memorial Institute of Medical Research (NMIMR)
Maxwell Appawu, Senior Researcher, NMIMR
Rosina Kijerematen, Department of Zoology, University of Ghana
Dominic Edoh, Department of Zoology, University of Ghana
Ebenezer Onusu, Department of Zoology, University of Ghana
David Wilson, Department of Zoology, University of Ghana
Aba Baffoe-Wilmot, Medical Entomologist, National Malaria Control Programme
Steve Knowles, Malaria Control Programme Manager, AngloGold Ashanti
Paul Psychas, Senior Advisor, President’s Malaria Initiative, USAID Ghana
John Mullenax, USAID Ghana
Peter Wondergem, HIV/AIDS Advisor, USAID Ghana
Nap Kwesi Graham, Chief of Party IRS Project, RTI International Ghana
Tito RTI International (HQ)

Kenya:
G.M. Mkoji, Director Centre for Biotechnology Research and Development, Kenya Medical Research Institute (KEMRI), Nairobi
Luna Kamau, Head, Molecular Entomology Research, KEMRI
Richard Mkabana, Senior Lecturer, School of Biological Sciences, University of Nairobi

Uganda:
Ambrose Onapa, Neglected Tropical Diseases Control Program, RTI International
Michael Okia, Senior Entomologist, Ministry of Health
Kabatereine Narcis, Ag. Director, Vector Control Division (VCD)
T. L. Lakwo, Senior Entomologist, VCD
Kirunda James, Health Tutor, School of Medical Entomology
Kagwa Sperito, Health Tutor, School of Medical Entomology
J.J. Lutwama, Uganda Virus Research Institute
Gunawardena Dissanayake, Senior Malaria Technical Advisor, USAID Uganda
Benjamin Atwine, Program Management Specialist, USAID Uganda

Zambia:
Fred Masaninga, National Professional Officer, World Health Organization Zambia
Emanuel Chanda, Entomologist, National Malaria Control Centre (NMCC)
Chandwick Sikaala, Entomologist, NMCC
Allen Craig, CDC & Resident Advisor, President’s Malaria Initiative – USAID
Mark J. Maire, USAID Global Health Fellows Program
Oliver Lulembo, Senior Health Advisor, USAID
Abdi Mohamed, Malaria Control and Evaluation Partnership in Africa (MACEPA)