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PROJECT TITLE : MALARIA VECTOR CONTROL

"Filling the gap between product development and effective delivery"

BILL & MELINDA GATES *foundation*

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MALARIA VECTOR CONTROL: "FILLING THE GAP BETWEEN PRODUCT DEVELOPMENT AND EFFECTIVE DELIVERY"

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Contents

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Executive Summary

There was a significant increase in the amounts of insecticides used for malaria control in Africa following both the expansion of indoor insecticide residual house spraying (IRS) and the distribution of long-lasting insecticidal nets (LLINs). This massive use of public health insecticides stems directly from an increased selective pressure on insecticide resistance of malaria vector mosquitoes. This will, in turn, contribute to accelerating the development and spread of resistance of malaria vectors and potentially jeopardize the long-term benefit of existing and newly developed insecticides. As countries are ill-equipped to address the above issues and are implementing vector control from a weak evidence-base, this project entitled "Malaria Vector Control: Filling the Gap between Product Development and Effective Delivery was submitted to the Bill and Melinda Gates Foundation, by WHO in 2007. This project is intended to strengthen national capacities for effective delivery of vector control interventions in order to safeguard the efficacy of current tools and ensure a smooth introduction of newly-developed tools into malaria control packages.

The project was launched in February 2008, implemented in Cameroon, Kenya, Madagascar, Mali, Mozambique, Senegal and Tanzania over a four-year period and ended in December 2011. The major challenges that these countries were facing included: weak infrastructural, technical and institutional capacities in national vector control services for effective vector control and weak collaboration between centres and networks of excellence in vector control and national malaria control programmes, leading to suboptimal use of entomological information for decision-making.

The project contributed to filling the gaps in skills, expertise, infrastructure and working procedures and strengthened the entomological skills of national malaria control programmes and local research institutions in the participating countries. Seven national reference entomology laboratories were renovated and fully equipped; more than 300 national technicians were trained in basic entomology and vector control in the seven participating countries; 20 graduate students in four countries were sponsored through the project to complete their BSc, MSc, and PhD courses. In addition, the project supported the establishment of functional sentinel sites for vector surveillance within the countries. Insectaries equipped with vector sampling and rearing facilities were built to facilitate and intensify vector resistance monitoring activities. One of the most important outcomes in the area of insecticide resistance monitoring was the development of a regional database comprising over 1909 bioassay results covering 364 different sites in 30 countries.

The project contributed to formalizing and fostering collaboration between national malaria control programmes (NMCP) and national and international research institutes. Subsequently, entomology and vector control have been re-established as a core function in NMCPs. It has been observed that the demand for external technical support from the project countries has declined as these countries are now able to undertake advanced entomological surveillance including molecular-based vector species differentiation and resistance mechanisms ascertainment.

In the context of the African Network on Vector Resistance to insecticides (ANVR), the project outcomes were used to develop or update tools and methodologies to support evidence that inform malaria control in the Region. These include:

- Standard operating procedures (SOPs) for vector surveillance in the context of Integrated Diseases Surveillance and Response (IDSR) and Integrated Vector Management (IVM).
- A prototype of a computer-based Vector Control Decision Support tool (VCDS).
- A regional database on Insecticide Resistance database (IRbase).
- The Atlas of insecticide resistance in malaria vectors in the WHO African Region.
- An updated version of the standardized protocol for testing malaria vector susceptibility to insecticides in the WHO African Region.
- Country-specific malaria entomological profiles.

As with many pilot projects, key challenges remain especially the sustainability of the project outcomes and the replication of its modus operandi in other countries of the Region. Before the project ended, implementing partners anticipated establishing mechanisms for sustaining the project's achievements. This was to be achieved by including the project's major activities into national malaria control strategic plans as well as forging collaboration with other financial and technical partners working on malaria control at country level. Such partners included Centers for Disease Control and Prevention (CDC), the President's Malaria Initiative (PMI), and Global Fund to fight Aids, Tuberculosis and Malaria (GFATM).

The capacity building approach piloted in this project indicates that it is possible to harness existing local resources to expand the expertise base of control programmes, if an opportunity is provided for research institutions to contribute to programme implementation. The business model of this project will serve as a springboard for the deployment of the Global Plan for Insecticide Resistance Monitoring (GPIRM) in the African Region through the African Network of Vector Resistance.

Abbreviations

ANVR	African Network on Vector Resistance
CDC	Centers for Disease Control and Prevention
CREC	Centre de Recherche entomologique de Cotonou
DDT	dichloro-diphenyl-trichloroethane
DFID	Department for International Development
DHIS	District Health Information System
ELISA	Enzyme-linked Immunosorbent Assay
FORTH	Foundation for Research and Technology of Heraklion
GFATM	Global Funds to fight Aids, Tuberculosis and Malaria
GPIRM	Global Plan for Insecticide Resistance Monitoring
GPS	Global Positioning System
IDSR	Integrated Disease Surveillance and Response
IMBB	Institute for Molecular Biology and Biotechnology
INSP	Institut National de Santé publique
IPR	Institut Pierre Richet
IRbase	Insecticide Resistance database
IRD	Institut de Recherche pour le Développement
IRS	Indoor Residual Spraying
IVCC	Innovative Vector Control Consortium
IVM	Integrated Vector Management
KEMRI	Kenya Medical Research Institute
LBMA	Laboratory of Applied Molecular Biology

LEVP	Laboratoire d'Ecologie vectorielle et parasitaire
LLIN	Long-lasting Insecticidal Net
MIM	Multilateral Initiative on Malaria
MIRO	Mosquito Insecticide Resistance Ontology
MOH	Ministry of Health
MRTC	Malaria Research and Training Center
NICD	National Institute for Communicable Diseases
NIMR	National Institute for Medical Research
NMCP	National Malaria Control Programme
NRU	National Reference Unit
NTD	Neglected Tropical Diseases
OCEAC	Organisation de Coordination pour la lutte contre les Endémies en Afrique centrale
PCR	Polymerase Chain Reaction
PMI	Presidential Malaria Initiative
SOP	Standard Operating Procedures
UCAD	Université Cheick Anta Diop
VBC	Vector Biology and Control
VCDS	Vector Control Decision Support tool
VCRU	Vector Control Reference Unit
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme.

1 Project Rationale, Goal and Objectives

The project was prepared in 2007 on the basis that there was a rapid increase in the amounts of insecticides used for malaria control in Africa This was due to the expansion of both Indoor Residual House Spraying (IRS) and distribution of long-lasting insecticidal nets. One of the consequences of this massive scale up of vector control interventions was an increased selective pressure for resistance of malaria vector mosquitoes. There were fears that this would, in turn, contribute to accelerated development and spread of resistance of malaria vectors and potentially jeopardize the long-term benefit of existing and newly-developed insecticides.

It was therefore critical to set the basis for judicious use of insecticide products so as to ensure optimal and long-term benefit and returns to the investments made towards developing new insecticide products. The project strategy was based on five key elements:

1. basic vector surveillance capacities of national malaria control programmes;
2. existence of a local research institute or laboratory with at least advanced capacity in vector surveillance;
3. established and ongoing collaboration between the above two entities;
4. existence of an advisory body to recommend policy changes and adjustments in vector control technical options on the basis of evidence generated by vector surveillance;
5. availability of regional networks for harmonization and coordination.

The project's goal was to strengthen national capacities for effective delivery of vector control interventions in order to safeguard the efficacy of current tools and ensure a smooth introduction of newly-developed tools into malaria control packages.

The project's specific objectives were the following:

- To strengthen infrastructural, technical and institutional capacities for effective vector control in malaria-endemic countries with particular emphasis on resistance management.
- To develop up-to-date country databases on the status on malaria vector resistance to insecticides and facilitate the use of this information for selection of the insecticides to be used for malaria vector control.

- To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control.
- To strengthen country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies.

In order to achieve the above objectives, the following major activities were planned:

development of the entomological skills of national malaria control programmes;

The project was formally launched in February 2008 and implemented over a four-year period in the following seven selected countries: Cameroon, Kenya, Madagascar, Mali, Mozambique, Senegal and Tanzania. It ended in December 2011.

2 Technical Report

This report presents the project achievements by objective.

Objective 1: To strengthen infrastructural, technical and institutional capacities for effective vector control in malaria-endemic countries with particular emphasis on resistance management.

Major Activity 1
Develop entomological skills of national malaria control programmes.

Photo: Inception meeting; February 2008, Yaounde, Cameroon

The following five milestones were set to ensure the development of the entomological skills of national malaria control programmes (NMCPs):

(a) Undertake needs assessment to establish the baseline situation in terms of capacity and determine gaps.

(b) Provide local-level, hands-on field training for district and provincial staff in basic field entomology.

(c) Train national level supervisors in intercountry or subregional training courses.

(d) Prepare and implement workplans for surveillance activities.

(e) Provide supplies and equipment.

All the above milestones were reached during the first three years of implementation. The summary of achievements in Activity 1 is set forth below and shows that all the milestones were attained:

Countries' baseline situation in terms of vector surveillance capacity was established at an inception meeting held in Yaoundé, Cameroon, in 2008. The needs of national malaria control programmes (NMCP) and national reference units (NRU) in terms of staffing, training, equipment and supplies were assessed.

The assessment revealed that challenges hampering appropriate selection and application of available vector control measures included: weak infrastructural, technical and institutional capacities of national vector control services and weak collaboration between vector control centres and networks of excellence and national malaria control programmes, leading to suboptimal use of entomological information for decision-making. The assessment also showed that the critical role of local research institutes in the implementation of control programmes was not formally recognized, clearly defined and endorsed by the ministry of health and its partners.

Photo: a National entomological training in field and laboratory procedures (source: KEMRI, Kenya).

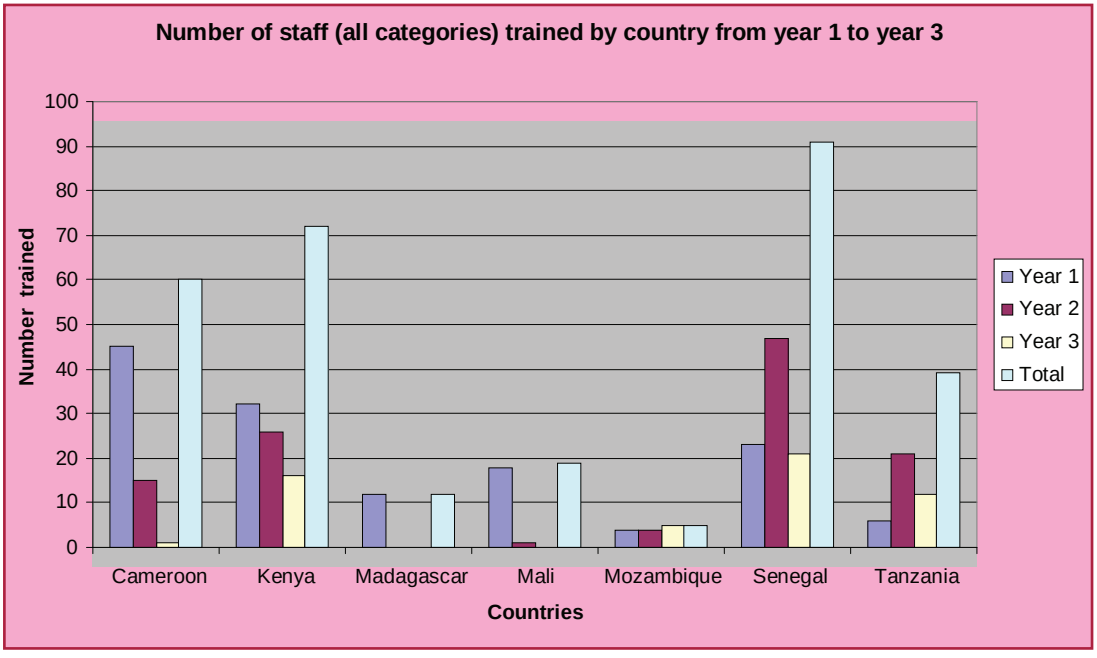
In total 300 national technicians selected at central, provincial and district levels were trained in basic entomology and vector control in the seven countries through hands-on training workshops on basic entomology and insecticide resistance monitoring (Photo- a and Figure 1). These newly-trained personnel have created the critical mass needed to perform vector surveillance activities in all the seven project countries.

In 2008, 27 participants from seventeen countries including the seven Gates project countries received hands-on training in vector surveillance, with particular emphasis on mosquito insecticide resistance ontology (MIRO) and the use of the global insecticide resistance database (IRbase).

Fully functional insectaries, equipped with complete sets of resistance monitoring kits, mosquito collection devices, deep freezers, and dissection microscopes were established or renovated in the seven countries. (Annex 2: List of equipment procured for project countries).

Photo: Insectary re-furbished and running in Kenya (source: Evan Mathenge)

Figure 1: Number of trainees by country from 2008–2010



Major Activity 2: Strengthen the research capabilities of local research institutions that would be national reference units (NRUs) and facilitate collaboration with NMCPs.

The following four milestones were set for this activity:

(a) Identify appropriate research institutions.

(b) Undertake needs assessment.

(c) Support training of national scientists

(d) Provide supplies and equipment.

The following research institutions were officially designated by ministries of health to serve as national reference units for entomological research and vector control (NRU):

(a) Cameroon (Biotechnology Centre, University of Yaoundé I);

(b) Kenya (Kenya Medical Research Institute, KEMRI);

(c) Mali (Malaria Research and Training Centre, MRTC);

(d) Madagascar (Institut Pasteur de Madagascar);

(e) Mozambique (National Institute of Health);

(f) Senegal (Faculty of Sciences, Université Cheick Anta Diop);

(g) Tanzania (National Institute for Medical Research).

Although some capacities existed in these NRUs, an assessment revealed that additional equipment and skilled personnel were needed. Most importantly, the assessment showed that a key impediment to effective implementation of vector surveillance was the weak collaboration between NRUs and NMCPs in the same countries. A major accomplishment of this project was the reinforcement and formalization of collaboration between NRUs and NMCPs in all countries.

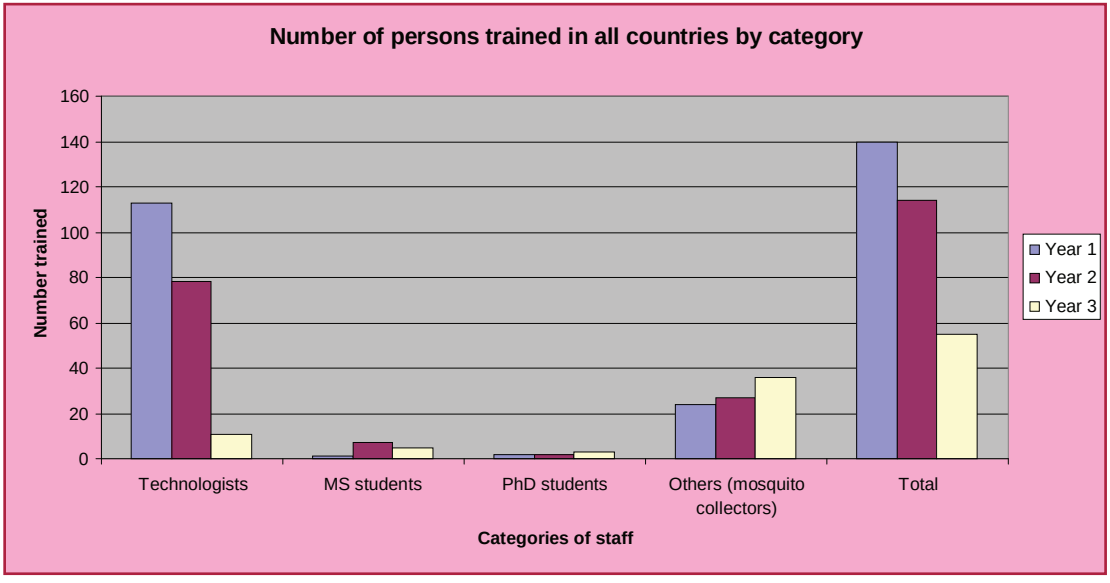
A total of 20 graduate students including BSc, MSc and PhD students were sponsored by the project in Cameroon, Kenya, Mali, Mozambique, Senegal and Tanzania. Details on staff trained in each country are shown on Figure 2. In addition, in 2008, 27 scientists from 17 countries received hands-on training in mosquito insecticide resistance ontology (MIRO) and the insecticide resistance database (IRbase). In June 2010, 15 scientists from the project countries received hands-on training on the concept and methodology for the development of malaria entomological profile. In 2009, 15 junior scientists were sponsored to attend the 5th MIM Pan-African Malaria conference in Nairobi. Kenya.

Capacities of NRUs were supplemented through procurement of adequate equipment and laboratory supplies and training of laboratory technicians in the use of the newly acquired devices. The procured equipment included ELISA and PCR machines and inherent accessories,

laboratory reagents, microscopes as well as four-wheel drive vehicles to support field activities. As a result, adequate capacities were established to undertake advanced or high level vector surveillance activities including biochemical and molecular assays for vector incrimination, determination of the genetic structure of vector populations, characterization of resistance mechanisms, data analysis and interpretation, and operational research. As a backup to NMCPs, the NRUs received funds for processing mosquito samples and assessing the quality of ongoing vector control activities (insecticide-treated nets and indoor residual spraying).

Photo: A training session of lab technicians in progress

Figure 2: Number of trained national scientists by category from 2008 to 2010 in the seven project countries



The capacity building objective of the project was achieved. The project contributed to filling the gaps in skills, expertise, infrastructure and working procedures and helped strengthen the entomological skills of national malaria control programmes and local research institutions in the participating countries. It also contributed to formalizing and fostering collaboration between national malaria control programmes (NMCP) and national and international research institutes. Subsequently, entomology and vector control have been re-established as a core function in NMCPs. It has been observed that the demand for external technical support from the project countries has declined as the countries are now able to undertake advanced entomological surveillance activities including molecular-based vector species differentiation and resistance mechanisms ascertainment.

Objective 2: To develop up-to-date country databases on the status of malaria vector resistance to insecticides and facilitate the use of this information for the selection of insecticides to be used for malaria vector control.

Activity 1: Finalization of the "EntomoBase" Database

The following two milestones were set for this activity:

(a) recruit software developers and webmasters;

(b) develop the "EntomoBase" internet access system.

Ten years ago, the WHO Regional Office for Africa initiated an entomological database (Entomobase) for the preparation of national malaria entomological profiles. This activity aimed at finalizing this database and ensuring its harmonization with existing databases on disease vectors.

The Mosquito Insecticide Resistance Ontology (MIRO), developed by the Institute of Molecular Biology and Bioinformatics (IMBB) of the Foundation for Research and Technologies of Heraklion (FORTH) in Crete, Greece, was adopted as schema. Malaria Research and Training Centre (MRTC, Mali) was identified to become the regional data hub responsible for maintaining and updating the database. A scientist from MRTC, Nafomon Sogoba, was sponsored for training in the theoretical concept of ontological databases and the concepts of MIRO in the IMBB from July to August 2010. Thus, Entomobase was harmonized with a MIRO-compliant database on insecticide resistance (IRbase) that uses VectorBase website as a portal.

Financial support was provided for regional reference centres to collect and collate entomological data in a harmonized manner to build a database called "EntomoBase". One of the most important outcomes of this work was the

preparation of the Second Atlas on insecticide resistance in malaria vectors in the African Region. *See in Annex 1.* A total of 1909 bioassay results covering 364 different sites in 30 countries were collated, included in IRbase, analyzed and mapped. The data set covers the period from 2004 to 2010. The atlas presents trends in major malaria vector resistance to the insecticides commonly used in public health.

Analysis of the database shows that in the majority of surveyed localities in Central Africa, East Africa and especially West Africa, An. gambiae is resistant to DDT (Figure 3a) and pyrethroids (Figure 3b). Data from East and Southern Africa suggest that resistance of An. gambiae s.s. to DDT and pyrethroids in these areas is much less critical compared to Central and West Africa. Resistance to carbamate (carbosulfan), detected earlier, in Côte d'Ivoire, is now widespread (Bendiocarb) across West Africa. Resistance to organophosphates (Fenitrothion) was observed in very few localities.

Resistance of An. Arabiensis to DDT has been found in different parts of Africa. In Africa as a whole, An. funestus remains generally susceptible to insecticides except in Southern Africa (South Africa and Mozambique) where it remains resistant to pyrethroids but susceptible to DDT.

Photo: Vector sampling in the field

Figure 3a: Status of DDT resistance in *Anopheles gambiae sensu lato* in the WHO African Region

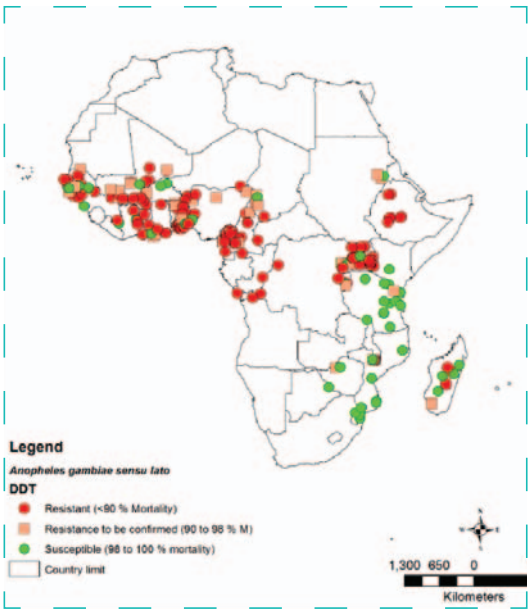
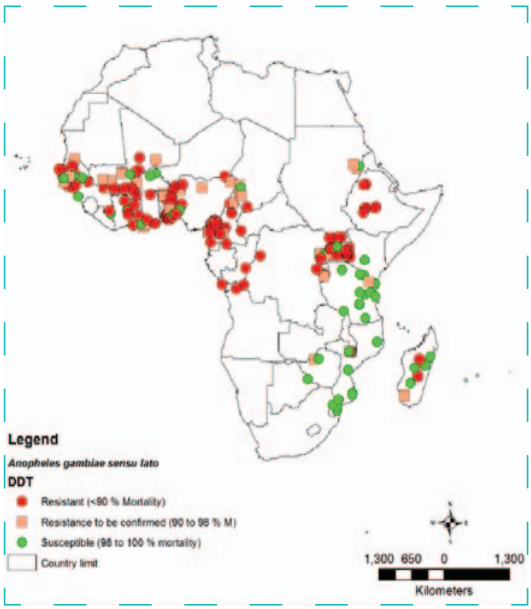


Figure 3b: Status of Deltamethrin *resistance in Anopheles gambiae sensu lato in the* WHO *African* Region in 2010



Activity 2: Establish country-specific databases

The following two milestones were set for this major activity:

(a) Train NRUs and NMCPs in management of the database.

(b) Generate country-specific resistance reports.

In 2010 a hands-on training was provided for 15 scientists from the project countries on the concept and methodology of development of malaria entomological profiles. These were drilled on the practical guidelines and the state-of-the art methodology on how to fill the data collection proforma, use the database and analyze the data to build the profile documents that were validated and approved locally for decision making.

They were also briefed on the concepts of geo-referencing and its usefulness for study site locations. They were equally informed of other useful electronic and web-based resources (GPS, Google earth, Encarta, Geoname) that could be used for geo-referencing. These scientists from both NMCPs and NRUs acquired practical experience and mastered how to

develop entomological profiles, take geographic coordinates for data point localization, create data points and generate survey location and thematic maps of entomological studies in MapInfo software. A copy of the entomological and insecticide resistance relational databases was given to country participants for completion.

Countries established 5 to 12 sentinels sites for vector surveillance activities. Susceptibility of major malaria vectors to commonly-used public health insecticides was monitored throughout these sites on yearly basis.

databases were established at both regional and national levels. Entomobase was redesigned and made MIRO-compatible, using an open access program and hence has become the data curation and submission avenue for African scientists. This database has the following two components: (1) insecticide resistance component aimed at supporting decision makers in the choice of appropriate insecticide for control intervention; and (2) malaria transmission component aimed at supporting the preparation of malaria entomological profile. The insecticide resistance

Group photo of the participants in the international Training Workshop on the development of malaria entomological profile, Yaoundé, Cameroon 21-25 June 2010

The resistance data generated served to build the national databases and to produce national malaria entomological profiles for evidence-informed malaria control.

The objective pertaining to resistance data collection, database development and management was attained. Entomological

component, comprising over 1909 bioassay results covering 364 different sites in 30 countries, was aligned with IRbase (an ontology-compliant insecticide resistance database) and rolled out to the countries. Using the newly established national databases, each project country produced a national entomological profile which has become

a reference document for decision-making. The entomological profile is a synthesis report that combines historical and recent data on the bionomic of malaria vectors, disease transmission and resistance to insecticides.

Objective 3: To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control.

Activity 1: Develop, harmonize, validate and roll out decision support systems.

The milestones for achieving this activity were the following:

(a) Organize standardization workshops.

(b) Finalize the WHO VCDS.

(c) Undertake country validation missions.

(d) Provide country support for adoption and use.

Three standardization workshops were held in 2008, bringing together international institutions reputable in the areas of insecticide resistance monitoring and/or bioinformatics.

The first meeting, held in South Africa, brought together database coordinators to discuss ways of integrating the various databases. The participating institutions included Liverpool School of Tropical Medicine, South African Medical Research Council (MRC), University of Notre Dame (USA), and Institute for Molecular Biology and Biotechnology (IMBB) of the Foundation for Research and Technology of Heraklion (FORTH), Greece.

The outcomes of this meeting were as follows:

(a) Ontology and data entry forms designed by Kitsos' group (Crete) were adopted as the schema.

(b) Consensus reached on specific issues such as the type and format of the data to be collected, type of products and mechanism of dissemination into the public domain to improve decision-making in vector control.

The second meeting that brought together the same institutions above took place at the Liverpool School of Tropical Medicine. It enabled agreement on the modus operandi for the development of the Global Interactive Database on insecticide resistance in human disease vector (IRbase). The third data harmonization workshop, held in Heraklion, Crete, Greece, in October 2008, enabled agreement on better ways for further developing existing entomological database (Entomobase) and making it ontology-compatible.

(a) Ontology and data entry forms designed by Kitsos' group (Crete) were adopted as the schema.

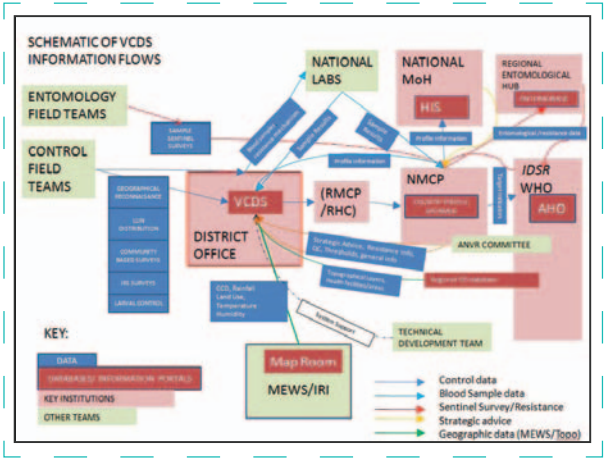
(b) Consensus reached on specific issues such as the type and format of the data to be collected, type of products and mechanism of dissemination into the public domain to

Participants in the workshop on Insecticide resistance data harmonization, Liverpool, July 2008

improve decision-making in vector control.

The second meeting that brought together the same institutions above took place at the Liverpool School of Tropical Medicine. It enabled agreement on the modus operandi for the development of the Global Interactive Database on insecticide resistance in human disease vector (IRbase). The third data harmonization workshop, held in Heraklion, Crete, Greece, in October 2008, enabled agreement on better ways for further developing existing entomological database (Entomobase) and making it ontology-compatible. Subsequent to these three meetings, the mosquito resistance ontology (MIRO) and an ontology-compliant insecticide resistance database, so-called IRbase, was developed. Presently, IRbase includes resistance data collected and collated by the ANVR over the previous eight years. At country level, harmonization workshops were held with the support of regional reference institutions to produce and adapt national standard procedures for vector surveillance (SOPs). A mock database *(IRbase off-line data submission form)* was disseminated to the countries for data submission.

In 2009, WHO initiated the development of a vector control decision support system to facilitate evidence-based decision making at the local level, where entomological capacities are often lacking. This tool aims at assisting district health teams to plan and manage their control operations more effectively. The development of VCDS was planned in three phases: development of a



Schematic of VCDS information flows

prototype, pilot testing and roll out. In order to finalize the tool, WHO hired specialized external institutions (Allan Mills consulting, UK, and the University of Oslo). Between 2010 and 2011, substantial progress was made in the development of the VCDS. The prototype phase was completed (Figure 4.) and preparations for field-testing were initiated. The prototype adapted the District Health Information System (DHIS) as a platform for providing tools to manage data and produce output for vector control activities.

The tool which is user-friendly has functions and options to , inter alia, create a repository for entering data on geographical reconnaissance, vector control operations (IRS and LLIN distribution), background information (e.g. rainfall), and community-based survey to evaluate the efficacy of control, and user-controlled planning data, and can integrate health statistics showing malaria incidence. It also allows thresholds and parameters to be set (called constants in the system) for decision support tools including the ability to calculate key indicators from combinations of data to create M&E reporting statistics such as roll back malaria targets.

The system is inherently hierarchical and can be scaled up from district to national and regional levels, and data exchange between levels is possible. It can work standalone over an internal network or internet. The framework created is flexible and can be adapted to the data gathering and reporting needs of district, national and regional offices (to be determined early in the pilot phase) and is structured in a modular form adaptable to changing priorities over time.

A consortium composed of scientists, national programme managers, and software developers assessed and validated the prototype of the VCDS during a technical consultation meeting on malaria vector control, held at the WHO Regional Office in Brazzaville, Congo, in October 2011. Finally, the VCDS roll out and sustainability plans were prepared and agreed upon.

The Prototype of VCDS is ready to be pilot-tested and rolled out in selected countries. WHO, countries and other partners should mobilize funds to carry out this activity.

Activity 2: Harmonize procedures and protocols

The following two milestones were set for this activity:

(a) Organize two standardization workshops.

(b) Disseminate new and standardized protocols.

The trial edition of "Standard Operating Procedures (SOPs) for vector surveillance in the context of integrated disease surveillance (IDSR) and integrated vector management (IVM)" was produced, translated into French and Portuguese and adapted by countries to their national contexts.

After the pilot phase, a first standardization workshop bringing together scientists and vector control focal persons in the Region was held in Dakar, Senegal in October 2010. This meeting provided an opportunity to share experiences, and discuss and harmonize various entomological methods and procedures. As an outcome, consensus was reached on the final version of the SOP for malaria vector surveillance. The meeting recommended further development of components dealing with disease vectors other than malaria. The meeting also recommended, as a project exit strategy, the mobilization of additional resources to expand ongoing malaria vector surveillance activities to other vector-borne diseases in the context of control and elimination of Neglected Tropical Diseases (NTD).

A second workshop was held in July 2011 in Cotonou, Benin, to update the "WHO standard protocol for testing malaria vector susceptibility to insecticides in the African Region, published in 2001". An updated version was produced and it complements the WHO global recommendations on methods of testing insecticide resistance in vectors, currently being updated. A key amendment in the protocol was the change in the criteria for classification of insecticide resistance. It was observed that in order to proactively detect early development of resistance, there is a need to raise the threshold for resistance from 80% to 90%. It was recommended that a new criterion for classification of WHO insecticide resistance be adopted. It was agreed that the criteria for susceptibility (98%–100% mortality) remain the same while the resistance suspected should change to 90%–97%, and <90% for resistance (Table 1). However, these changes should be harmonized at the global and regional levels.

WHO insecticide susceptibility test kits

The SOP document has been disseminated to countries and partners. The developed/updated protocol for resistance testing is being edited.

Objective 4: To develop country capacities to introduce new tools in malaria vector control and manage insecticide resistance.

Activity 1: Organize national training workshops on WHOPES guidelines and procedures.

The milestones for this activity were the following:

(a) Organize training workshops.

(b) Undertake field projects to test newly-developed insecticides.

All participating countries organized national training workshops on WHOPES norms and procedures for pesticide management. Subsequently, national standard operating procedures (SOPs) were produced and disseminated within the countries.

The project allowed testing of some new insecticide products.

- In Tanzania for example, the NRU, using its staff trained on WHOPES guidelines and procedures, has continued evaluating Syngenta Long Lasting Nets (LN) and Icon Maxx products. The Syngenta LN trial is the WHOPES phase II trial to assess whether this product meets WHO criteria for long-lasting nets while Icon Maxx is in Phase I trial to evaluate its efficacy as treatment kit for different netting materials.

- In Mali, the National Malaria Control Programme, in collaboration with the Laboratory of Applied Molecular Biology (LBMA) of the faculty of science at the University of Bamako, field-tested the efficacy of K-Othrine and bendiocarb for indoor residual spraying.

- In Kenya, the project team, in collaboration with CDC and PMI, carried out field trials of alternatives to pyrethroids as a resistance management strategy. The protocol for this trial has been successfully reviewed by the Kenya Scientific Review Committee (at KEMRI).

Activity 2: Information sharing and recommendations for policy-making

"*The ANVR annual review and planning meeting*" was the only milestone set for this activity.

Annual project review and planning meetings were held. These meetings provided opportunities to share the project results and formulate recommendations for improving project implementation.

The first review meeting was held in Maputo, Mozambique, in January 2009. During the meeting stakeholders were briefed on the project management tools proposed by the donor. The guidelines and format for harmonized planning and reporting were shared with the project officers.

Photo: First review and Planning meeting, January 2009, Maputo, Mozambique

The second annual review and planning meeting of the WHO/Gates VBC project was held back-to-back with the ANVR workshop and the 5th MIM Conference in Nairobi on 31 October 2009. It brought together 36 participants including national project officers, representatives of National Malaria Control Programmes, scientists from National References Units (NRUs) in the seven countries, the project steering committee members, WHO vector control staff as well a representative of the Gates Foundation. The review revealed that tangible progress had been made, so far, since the project's official launch in 2008.

Countries were advised to explore alternative project exit strategies to ensure its sustainability. All the participants in the ANVR meeting were sponsored to attend the MIM meeting. This provided an opportunity for 13 junior scientists to present their scientific works to the malaria control community.

During the third project review and planning meeting held in Tanzania in November 2010, the project's products, including the final version of the SPOS, an updated version of vector resistance atlas, country-specific malaria entomological profiles, the regional database (IRbase) and VCDS were portrayed, amended and adopted.

The project's final evaluation meeting brought together over 30 scientists and contributed to the following:

(a) Implementation of project activities was reviewed and the level of attainment of project objectives and targets at both regional and country levels were validated.

(b) Countries' experiences in the project's management including ownership, partnership, resources and sustainability, and information flow among implementing partners were shared.

(c) A project exit strategy was discussed and a sustainability plan was proposed.

This meeting provided an opportunity to share the following products: printed copies of country-specific entomological profiles, printed copies of country-specific SOPs, countries' final reports, the resistance atlas and the database.

The project provided more evidence for revising existing recommendations. In October 2011, the project supported an expert consultation to revise current WHO recommendations on malaria vector control and further clarify the technical basis upon which the recommended vector control methods and products were to be used, especially in pursuance of the malaria elimination goal in the WHO African Region.

The participants in this consultative meeting were from national malaria control programmes, African research institutes, WHO and regional economic communities. They reviewed existing WHO recommendations

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[1] Resolution AFR/RC59/R3, Accelerated malaria control: Towards elimination in the African Region. In: Fifty-nith session of the World Regional Committee for Africa, Kigali, Rwanda, 31 August–4 September 2009, Final report, Brazzaville, World Health Organization, Regional Office for Africa, 2009 (AFR/RC59/19), pp. 9–11.

- Malaria vector control and personal protection, WHO Technical Report Series 936, WHO 2006.
- The technical basis for coordinated action against insecticide resistance: preserving the effectiveness of modern malaria vector control, GMP meeting report, WHO 2011.
- WHO, Malaria vector control: determinants for decision-making on interventions that may be considered for large-scale application in the WHO African Region.

and guidelines on malaria control[1] and made several recommendations (Annex 3). These recommendations were disseminated to the 46 countries of the WHO African Region. The recommendations pertaining to resistance management that were supported by the outputs of this project were the following:

(a) IRS and LLINs may be deployed in combination for epidemiological reasons (e.g., to speed up reduction of transmission), and/or as a means of resistance management and, in this regard:

(i) if IRS and ITNs are combined, a non-pyrethroid insecticide must be used for IRS in such circumstances;

(ii) the use of pyrethroids should be reserved for LLIN intervention only if both interventions are deployed concomitantly;

(iii) in countries with high coverage with LLINs, pyrethroids should not be used for IRS.

(b) Every malaria control programme should include monitoring and evaluation of epidemiological and entomological indices, based on existing WHO standard operating procedures.

(c) Monitoring of vector resistance to insecticides should be a routine activity of every malaria control programme and every project using an insecticidal intervention, including LLINs.

(d) An insecticide resistance management strategy should be implemented pre-emptively in any sustained vector control programme relying on the use of insecticides. Consequently, new WHO criteria for classification of insecticide resistance (the 98%–100% mortality criterion for susceptibility should remain the same while the resistance suspected criterion should change to 90%–97% and the resistance criterion to < 90%) should be adopted.

3 Monitoring, Evaluation, and Dissemination

The monitoring and evaluation milestones were the following:

(a) Undertake mid-term project evaluation.

(b) Undertake final project evaluation.

1. Mid-term project evaluation

In accordance with the project implementation framework, a mid-term evaluation was conducted at the end of the second project fiscal year. In order to achieve this activity, two consultants were recruited to simultaneously review the project in the project countries as follows:

(a) Dr Nabie Bayoh (KEMRI) for Madagascar, and the three Anglophone countries: Kenya, Mozambique and Tanzania.

(b) Dr Patrick Bitsindou (MoH, Congo) for Francophone countries: Cameroon, Mali and Senegal.

The following objectives were set for the mid-term review:

(a) To assesses the status of implementation of the project's major activities at both regional and country levels.

(b) To validate the level of attainment of project objectives and targets.

(c) To review the programming and policy environment of the project including country ownership, partnership and advocacy, alignment of the project's objectives with current national malaria control and research strategies, resources and information flow among implementing partners and sustainability issues.

(d) To identify gaps in relation to project milestones and recommend ways and means of filling them.

The work consisted of desk review of the project with the WHO National Professional Officer in charge of Malaria, VBC Project Officer and NMCP focal person. The reviews included perusal of documentations, protocols, workplans, reports, presentations and the National Malaria Control Strategy. Visit to the NRU, tour of facility, discussion with focal person, and field visit to sentinel sites. Discussions were held with technical staff at the NMCP and NRU in addition to interviews with trained personnel at the sentinel sites and students undergoing training. At the Regional Office, the review process included discussion with the regional project officer based at the WHO Regional Office

for Africa and review of project reports and tools. The external reviewers made the following recommendations to improve management of the project:

(a) Improve the level of interaction and cooperation with other malaria stakeholders.

(b) Strengthen the reporting system so that reports outline the policy implications for any significant changes detected in vector numbers and insecticide resistance.

(c) Strengthen the involvement of other partners as part of the exit strategy to ensure sustainability of project activities.

(d) Facilitate timely flow of funds and supplies/equipment.

(e) Assist countries in implementing project exit strategies.

2. Final project evaluation

The final evaluation meeting was organised in Yaoundé, Cameroon, in February 2012. The meeting brought together all the project implementation stakeholders including the national project officers, representatives of National Malaria Control Programmes, scientists from National References Units (NRUs) in the seven project countries, the project steering committee member, representatives of the Bill and Melinda Gates Foundation as well as WHO vector control staff at both global and regional levels.

The objectives of the meeting were:

(a) To assess the status of implementation of the major activities of the project at all levels.

(b) To validate the level of attainment of project objectives and targets.

(c) To share countries' experiences in the project management including challenges, opportunities as well as issues pertaining to the sustainability of achievements.

(d) To examine and agree on suitable project exit strategies and propose a sustainability plan based on the project achievements and lessons learnt.

The method of work consisted of plenary sessions with presentations followed by discussions and group work. Each country prepared and presented a comprehensive report covering the entire project period and describing the following:

(a) activities and achievements;

(b) strength, weakness and challenges;

(c) lessons learnt.

The outcomes of the meeting were:

(a) Project implementation status reviewed and the level of attainment of project objectives and targets at both regional and country levels validated.

(b) Countries' experiences in the project's management including ownership, partnership, resources and information flow among implementing partners and sustainability issues shared.

(c) Project exit strategy explored and sustainability plan proposed.

During this final evaluation, the enabling factors and constraints were highlighted and the project exit strategy and sustainability plan were proposed.

Enabling factors

(a) Effective implementation of the project was facilitated by the renewed interest in vector control in pursuance of the malaria elimination goal set by endemic countries and their partners.

(b) Availability, in the Region, of a number of institutions able to undertake capacity building and make sophisticated laboratory analysis.

(c) Availability of well-qualified trainers in each project country (only few requests for external expertise were made by project countries).

(d) Willingness of other reputable institutions to collaborate in or contribute to the development of a Global Interactive Database on insecticide resistance (IRbase): IMBB (Crete University), IVCC (Liverpool School), Vector Base, Anobase (Notre Dame University).

(e) Momentum gained by ANVR in the Region.

(f) Synergy between this project and other malaria control activities supported by other partners especially GFATM, PMI, World Bank booster programme.

(g) Preparation of second generation national malaria control strategic plans that provided an opportunity to include and scale up vector surveillance activities initiated through the project.

Constraints and Challenges

Operational problems encountered during the project's implementation included:

(a) Delay in the procurement of some project equipment including resistance monitoring test kits in some countries.

(b) Delay in the disbursement of funds allocated at country level (lengthy local disbursement procedures and slow flow of funds in some countries).

(c) Interruption of the contract of some project officers.

(d) Weakness of reporting from national project officers (inadequate information flow at all levels).

(e) Lack of vector control focal person/ entomologist in some NMCPs.

Proposed Exit Strategies and Sustainability

During the project's final evaluation meeting, there was a brainstorming and discussion session on how to sustain the gains of the project and continue with its activities in the context of the national malaria control programme.

In the light of this discussion, the following were proposed to countries and their partners:

(a) provide quality data from the sentinel sites even before data collection expansion countrywide;

(b) use this project platform to support GPIRM and other countries;

(c) make insecticide resistance monitoring management part of the NMCPs routine activities as opposed to only operational research:

(i) This should be included in the workplans and be budgeted for.

(ii) There is also a need to strengthen surveillance.

(d) update data bases continually:

(i) Data extraction and transcription to submission forms.

(ii) Production of continuous maps instead of dots.

Conclusion

The capacity building approach piloted in this project shows that it is possible to harness existing local resources to expand the expertise base of control programmes, if research institutions are given an opportunity to contribute to programme implementation. This project also revealed that by having better information, countries will be sufficiently able to support their programmes by improving the efficiency and effectiveness of delivering vector control interventions. The business model of this project will serve as a springboard for the deployment of the Global Plan for Insecticide Resistance Monitoring (GPIRM) in the African Region through the African Network of Vector Resistance.

Recommendations

(a) Use the achievements of this project to advocate for entomological surveillance and insecticide resistance monitoring.

(b) Develop and disseminate, to countries, a comprehensive and well-packaged project document.

(c) Share the project final reports and products with potential donors (DFID and PMI) through ANVR.

(d) Explore the possibilities of funding and fund-raising at country level.

(e) Formalize and maintain collaboration between NMCP and national research institutes.

(f) Foster country ownership to maintain and strengthen the capacity built through this project as well as continuity in in-service training.

(g) Insecticide resistance monitoring and management should be part of the NMCP's routine activities as opposed to only operational research.

(h) Replicate the capacity building approach experimented in this project in other malaria-endemic countries in the African Region.

(i) Mobilize additional resources in order to sustain and scale up the project's achievements.

4 Financial Report

The Global Health Division Programme of the Bill & Melinda Gate Foundation (also referred to herein as "the Foundation") gave the World Health Organization (WHO) a project support grant in a total amount of US$ 4 943 750.00 for the period from 10 October 2007 to 10 October 2011.

The use of funds of this grant was restricted to filling the gap between product development and effective delivery for African countries by consolidating and strengthening the medical entomology, vector control structure and technical resources within each country as described in the foregoing narrative report.

Total grant amount:	US$ 4 943 750
Total amount received:	US$ 4 950 890
Total amount disbursed:	US$4 950 216
Balance:	US$ 674

(a) Payment of grant funds

Payments of grant funds were received as follows:

Payment dates	Payments ount (in US$)
Receipt of counter-sign	1 758 640
29 June 2008	1 440 750
03 December 2009	988 750
11 February 2010	762 750
Total	4 950 890

(b) No-cost Extension

The grant financial cycle (October to August) was not aligned with WHO planning cycle (calendar year). Similarly, the project reporting cycle was not aligned with malaria transmission seasons in the project countries. In spite of the timely disbursement of funds, countries had to wait for the rainy season to start vector sampling. These constraints sometimes delayed the submission of interim reports by various countries. Subsequently, a request for a "no-cost extension" was submitted to the Foundation. This request was approved and the project end date was changed from 10 October 2011 to 31 December 2011. The reporting schedule was therefore revised as follows:

i) *Final Narrative and End-of -Project Financial Report: 1 February 2012.*

(ii) *Final Financial Report: 1 May 2012.*

(c) Financial summary

Interim financial reports were prepared and submitted by the project manager during the project period. This end-of–project report is based on expenditures made by incumbent budget centres namely WHO headquarters, WHO Regional Office for Africa and the WHO country offices of the seven countries. The detailed budget and finance reporting frames are attached herewith as Annex 1.

Budget Line Items	Year 1 (budgeted)	Year 1 (spent)	Year 2 (budgeted)	Year 2 (spent)
Personnel	235 800	163 400	275 940	217 572
Fringe benefits	26 200	18 156	30 660	24 174
Travel	374 000	355 043	302 236	325 349
Consultants	576 000	432 558	202 099	188 358
Supplies	50 000	552 146	145 298	118 706
Contracted Services	0	0	53 960	18 341
Total Direct Costs	1 762 000	1 491 609	1 063 000	869 387
Programme Support Costs (WHO) 13%	229 060	193 909	138 190	113 020
Grand Total Costs	1 991 060	1 685 518	1 201 190	982 407

Note: that the values in this table have been updated for the following reasons:

1. The values for PSC costs were wrongly reported for in previous years.
2. There was a formula problem which translated into an underestimation of 50 000 for both budgeted and spent amounts in year 3 report (see Y3 budget spread sheet, activity 3, supplies category in annexes).

(ii) The effective financial system in AFRO enables tracking of expenditures since 1 January 2011.

c) Financial summary – c'tnd

Budget Line Items	Year 3 (budgeted)	Year 3 (spent)	Year 4 (budgeted)	Year 4 (spent)	Total (spent)
Personnel	375 755	357 461	327 269	339 383	1 077 816
Fringe benefits	40 000	29 986	37 000	37 000	109 316
Travel	523 720	505 954	193 732	154 919	1 288 458
Consultants	178 867	173997	34 000	31 800	826 713
Supplies	75 500	75 500	75675	63 074	809 426
Contracted Services	160 556	156 922	96 500	87 994	263 257
Total Direct Costs	1 354 398	1 299 820	764 176	714 170	4 374 986
Programme Support Costs (WHO) 13%	176 072	168 977	99 343	99 324	575,230
Grand Total Costs	1 530 470	1 468 797	863 519	8 3 494	4 950 216

(d) Constraints

The preparation of this financial report was hampered by the two GSM transitions that occurred during the grant life (transition of WHO headquarters, beginning 2008, and transition of WHO African Region, beginning 2011). GSM transition of the African Region occurred during the reporting period. All information related to 2011 expenditures were reflected properly in GSM. In contrast, information related to activities/expenditures effected before GSM went live were in the old ROAFI system and needed to be tracked:

(e) Enabling factors

(i) GSM go live enabled monitoring of funds/expenditures in real time.

(ii) The effective financial system in AFRO enables tracking of expenditures since 01/01/2011.

(f) Conclusion and recommendation

The review showed that all the planned activities were successfully implemented. More than 95% of the overall grant funds were used as planned. This performance reflects collaboration among

the project's implementing partners at all levels (the national malaria control programme and the national reference unit for vector control).

A final certified financial report will be submitted by GMG in May 2012 as per the grant agreement. It is important to note that any discrepancies in expenditure by budget item between this financial report prepared by the project team and the Final Certified Financial report which will be provided by WHO GMG/ACT should be due to the fact that expenditures were not recorded in GSM in the same way. For example, though staff costs should be recorded in GSM with code 501 (fixed terms staff) or 502 (Short Terms staff) or 503 (supplementary costs), some project officers were paid under expenditure code 513, which is usually used for APW (Agreement for Performance of Work, Technical Services Agreements, etc).

When WHO is negotiating a project with the Gates Foundation, it is recommended to request the Foundation to align their project fiscal years with the financial cycles of WHO. This would facilitate smooth financial running of the project, as well as the narrative and financial reporting.

ANNEXES: MALARIA VECTOR CONTROL

"Filling the gap between product development and effective delivery"

1 Atlas of insecticide resistance in malaria vectors of the WHO African Region

Contents

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1 Atlas of insecticide resistance in malaria vectors of the WHO African Region

1. Introduction

In the African Region, there is a renewed interest in vector control and in the use of insecticide treated nets and indoor residual spraying.

The repeated application of insecticides for malaria vector control is now happening on an unprecedented scale. This has saved a lot of lives: it is estimated that in the last ten years, vector control interventions have prevented more than 700,000 deaths due to malaria, 90% of these in Africa. However, it has also caused the appearance and spread of insecticide resistance. In each of the major vector species, a variety of resistance genes have been reported, and some are already widespread throughout the Region. Control failure associated with insecticide resistance has already been seen in South Africa, and insecticide choice is constrained by resistance in operations in many places, including Ethiopia, and parts of Eastern, Central and Southern Africa.

In 2000, the WHO Regional Director for Africa approved the establishment of a regional network to address issues related to disease vector control and to support countries in the monitoring and management of insecticide resistance. Multi-centric studies technically supported by the network contributed to generate data on vector resistance to insecticide in the African region. In 2005, a regional database on vector resistance was created and the first ever Atlas of vector resistance to insecticides was produced.

The present Atlas is the updated version of the 2005 document. It is built up from data gathered by countries in the frame work of African Network on Vector Resistance (ANVR) from 2004 to 2010. It presents trends on vector resistance in major malaria vectors to the commonly used insecticides in public health. This overview of resistance status at regional level will be complemented by country specific entomological profiles.

The objectives of this Atlas are:

- To retrocede to African countries mapped data that can be easily used,
- To update countries and the international community on the current status of insecticide resistance in Africa,

- To ensure vector resistance status is taken into consideration when selecting vector control interventions and insecticides,
- To share available information at regional and global levels,
- To stimulate and assist National Malaria Control Programmes (NMCP), partners and funding agencies in the adoption of locally adapted tactics for management of vector resistance in the context of integrated vector management.

This document targets policy makers, NMCP managers, researchers, as well as all partners involved in malaria control in Africa.

2. ANVR framework

All NMCP are *de facto* members of ANVR, and the network is coordinated by the WHO Regional Office for Africa. The following scientific institutions are founding members of the network:

- Centre Muraz, Bobo Dioulasso, Burkina Faso.
- Centre de Recherche Entomologique de Cotonou (CREC), Benin.
- Institut Pierre Richet (IPR), Bouaké, Côte d'Ivoire.
- Institut de Recherche pour le Développement (IRD), Montpellier France.
- Liverpool School of Tropical Medicine (LSTM), Liverpool, UK.
- National Institute for Communicable Diseases (NICD), Johannesburg, South Africa.
- Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC), Yaoundé, Cameroon
- Malaria Research and Training Center (MRTC), Mali.
- Kenya Medical Research Institute (KEMRI), Kenya
- National Institute for Medical Research (NIMR), Tanzania
- Laboratoire d'Ecologie Vectorielle et Parasitaire (LEVP), Université Cheick Anta Diop (UCAD), Sénégal

Additional institutions have joined the network. ANVR institutions are involved in training of national staff, development and standardization of protocols and new tests methods. They also provide when and where needed technical assistance (identification of biological material, biochemical and molecular assays, consultant ships).

3. Methodology

Resistance data were collected and collated by the ANVR sub-regional network coordinating

institutions[1] from published articles, thesis, and technical reports. Row data were submitted to MRTC for curation, geo-referencing and mapping.

- Resistance data were generated by WHO bioassay method (ref) performed on young female mosquitoes emerged from field collected larvae and pupae or from F1 progeny of wild caught blood-fed females.

Data curation process included examination for completeness, quality control and formatting for compliance to the Mosquito Insecticide Resistance Ontology (MIRO) database. When coordinates were not given in the report, Geo-referencing was carried out using alternatively Geonet (ref), Google map and coordinates given in the reports. Resistance maps were produced using ArcGIS 9.3, and interpretation based on the new WHO insecticide resistance classification as shown below:

Status	At least 80 mosquitos tested per bioassay
Susceptible	Mortality 98 – 100 %
Resistance suspected (to be confirmed)	Morality 90 – 98 %
Resistance	Mortality < 90 %

Priority has first been given to DDT and pyrethroids which are most in use for malaria control. Data have been mapped per insecticide (DDT, permethrin, deltamethrin, lambdacyhalothrin, Bendiocarb, Fenitrothion and Malathion) and per vector species. Much fewer tests have been carried out with *An. funestus* because this species is far more difficult to collect and to breed than species of the *An. gambiae* complex.

Tested mosquitoes have been identified morphologically, and when possible, species, and resistance mechanisms have been identified using molecular markers. The *kdr* mutation responsible for pyrethroid and DDT cross-resistance has been detected using specific primers (Martinez-Torres et al., 1998; Lynd et al., 2005). Modified acethylcholinesterase (AchE), a major mechanism for organophosphate and carbamate resistance, has been identified using both biochemical (Hemingway et al., 1998) and molecular assays (Weill et al., 2004).

Results of molecular assays (*kdr* and AchE) have been mapped using allelic frequencies (%) of the genes responsible for the mutation in countries where data were available.

4. Results

4.1 Survey locations

In total, 1909 tests over 30 countries covering 364 different sites have been reported through (Map 1). This result shows an increase in the number of

[1] Centre de Recherche Entomologique de Cotonou (CREC), Benin. Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC), Yaoundé, Cameroon ; Kenya Medical Research Institute (KEMRI), Kenya

surveys conducted, countries covered as well as sentinel sites compared to the previous Atlas. The evolution of vector resistance status is provided below. For detailed information by country, readers should refer to the corresponding map(s) displayed by major vector species and insecticide.

4.2 Distribution of malaria vectors in the African Region

A regional data base on the geographical distribution of vectors belonging to the Anopheles gambiae complex has been developed in the previous Atlas. Three main vector species (An. gambiae s.s. An. arabiensis, and An. melas) belonging to this complex have quite different distribution patterns. Anopheles gambiae s.s., globally the most important vector, is widely distributed in low lands throughout inter-tropical Africa. Commonly associated with An. funestus, this species is responsible for intense transmission either seasonal or perennial depending on local climatic conditions and opportunities for larval breeding. In some areas, two other important vectors of local importance can also be found (Anopheles nili and Anopheles moucheti), especially in Central Africa.

Anopheles arabiensis has a wide distribution but is found predominantly in fringes and highlands: Southern and Eastern Africa, highlands, Sahelian areas of Western and Central Africa. In these areas, it is commonly associated with Anopheles funestus and, to a lower extent, to Anopheles gambiae s.s. These areas are characterized by very seasonal transmission, most commonly of low intensity and by occurrence of outbreaks whose frequency and intensity are closely related to climatic conditions. Anopheles melas in the Western Africa and An. merus in the East are mostly found in coastal areas where they can be locally important vectors, especially when associated with An. gambiae s.s.

Vector species distribution presented in the 2010 Atlas may not reflect the same situation of the 2005 one because data represent only species encountered in sentinels sites where samples were collected for resistance testing (Map 2), while the 2005 distribution map include data generated through various sources (transmission studies, historical data etc..)

4.3 Resistance of Anopheles gambiae complex to DDT and pyrethroids

In the majority of surveyed localities in West, Central, and Eastern Africa, An. gambiae has been found resistant to DDT (Map 3). Pyrethroid resistance is also widespread, especially in West Africa (Map 4 to 6). Occurrence of Deltamethrin and Lambdacyhalothrin resistance is apparently lower than that of Permethrin. However, this difference is likely due to the relative "strength" of the discriminative concentrations used than a lower resistance to these specific insecticides.

In West Africa, the presence of the kdr mutation is clearly associated with cross-resistance between DDT and all public health pyrethroids. Kdr is widely distributed and allelic frequencies of the gene in several areas are very high, commonly higher than 80 % (Map 7). Although the two kdr mutations are responsible for DDT resistance, the West African one is responsible for higher

resistance to pyrethroids than the East African one. It can be safely deducted from existing data that the kdr mutation is present in almost all countries west of Cameroon. It has been found in both the S and M molecular forms of An. gambiae s.s. Frequency within the S form is much higher and distribution more widespread than within the M form, except on the coastal areas of Côte d'Ivoire. The kdr mutation has not been found so far in An. arabiensis. The Eastern Africa mutation is likely responsible for DDT and pyrethroid resistance that has been found e.g. in Uganda. In Ethiopia, An. gambiae s.l. is resistant to DDT but susceptible to pyrethroids. A resistance mechanism different from kdr is likely involved, that is specific to DDT (e.g. glutathione transferase).

Although data available for Eastern and Southern Africa have been so far limited, they suggest that situation of DDT and pyrethroid resistance of An. gambiae s.s. in these areas is much less critical than in Central and West Africa.

4.4 Resistance to carbamates and organophosphate (OP)

Resistance to carbamate (carbosulfan) was already detected in Côte d'Ivoire earlier (Chandre et al., 2003) and is now wide spreading (Bendiocarb) across West Africa (Map 8). Resistance to OP (Fenitrothion) was observed in very few localities (Map 9). The mechanism involved is a modified acethylcholinesterase (AchE). A molecular diagnostic test has been recently developed.

AchE has been found more widespread than expected (Map 10) with relatively high allelic frequencies already observed in different localities. AchE is a major mechanism responsible for organophosphate (OP) and carbamate resistance (LIN/IRD unpublished data). Its implication in OP resistance in the concerned areas has not yet been established. There has been no recent evidence for OP resistance in malaria vectors from Africa.

4.5 Resistance of Anopheles gambiae s.s.

Resistance of Anopheles gambiae s.s. to the different commonly used insecticides is shown in Map 11 to 16. In West Africa An. gambiae s.s. is the predominant species of An. gambiae s.l. Therefore the resistance distribution pattern in the complex and An. gambiae s.s. is quite similar.

4.6 Resistance of Anopheles arabiensis

Insecticide resistance has been found much less frequent in An. arabiensis than in An. gambiae s.s. (Maps 17 to 22). In several countries of Southern Africa, this species is fully susceptible to DDT and pyrethroids. However, DDT resistance has been reported in South Africa. There is also evidence of DDT resistance in Eritrea and Ethiopia and of cross resistance between DDT and pyrethroids in An. arabiensis from northern Cameroon.

4.7 Resistance of Anopheles funestus s.l.

Only few data on susceptibility of An. funestus s.l. have been collected through ANVR. Except in Ghana, Nigeria and Kenya where a possible resistance to lambdacyhalothrin has been detected that needs to be confirmed, full susceptibility to DDT and pyrethroids has been found in all tested localities (Map 23 to 28). However, these data do not include tests carried out in South Africa and Mozambique where resistance to Deltamethrin has been found that has got important operational consequences. On the basis of the usually dramatic impact that residual spraying and ITNs have got on An. funestus s.l. populations throughout Africa (published data and grey literature), it is reasonable to assume that outside Southern Africa, this species is mostly susceptible to insecticides, including DDT and Pyrethroids. However, more detailed information on resistance status of this species is needed.

5. Overall situation analysis, potential impact of insecticide resistance, and selection of interventions

Although there are important gaps in the resistance mapping, some general conclusions can be already drawn and practical recommendations made. Detailed analysis country by country should be made by readers themselves on the basis of maps presented in this document.

5.1 Resistance in major vectors

- An. gambiae s.s. DDT and Pyrethroid resistance are already widespread throughout Western and Central Africa. According to other sources of information, it is also present in several parts of Eastern Africa. Carbamate resistance has been detected in West Africa involving a major resistance mechanism that has been found already spread over several countries. The situation of "multiple-resistance" observed in West Africa most likely results from the intensive use of agricultural insecticides which induce a selection pressure on An. gambiae s.s. populations, especially in the "cotton belt" of Western and Central Africa. It can be safely assumed that kdr resistance is also present in south-eastern Mali, Ghana and Nigeria.
- An. arabiensis. DDT resistance in An. arabiensis has already been found in different parts of Africa. The kdr mutation has not yet been detected in this species and DDT resistance is likely due to a specific mechanism. Pyrethroid resistance in An. arabiensis has been found in Northern Cameroon.
- An. funestus s.l. At continent level, An. funestus remains globally susceptible to insecticides except in Southern Africa (South Africa & Mozambique) where it is resistant to pyrethroids (but susceptible to DDT). This resistance is due to a mechanism other than the kdr mutation (detoxification). This resistance is spreading in this part of the continent. For instance Pyrethronoid resistance has been observed or suspected in some localities in Tanzania, Malawi and Kenya. More studies are required to confirm this resistance.

5.2 Resistance is an evolving process

Significant changes in resistance patterns have been observed over the past 10 years in West Africa. The situation presented in this document has evolved compared to the previous atlas and will likely continue evolving in the near future because of the massive use of pyrethroids for malaria control. When planning any vector control intervention, it is essential to assess the resistance status of local vector populations in order to select a suitable insecticide. It is also essential to ensure subsequent regular monitoring. When possible, the potential of resistance on the efficacy of intervention(s) should be assessed.

5.3 Resources for resistance monitoring

Monitoring of insecticide and drug resistance should be considered as integral component of any malaria control program. Financial resources for insecticide resistance monitoring can be obtained from funding partners on condition it has been included in national action plans and funds have been requested. ANVR now provides technical assistance to National Programs for this planning.

5.4 Operational consequences of resistance

- Insecticide treated nets (ITNs). Fortunately, when pyrethroid resistance is induced by the kdr mutation, it does not dramatically reduce efficacy of ITNs. Even in areas with very high prevalence of this resistance, ITNs still efficiently prevent malaria. The potential impact of resistance mechanisms other than kdr has not yet been fully assessed.

- Residual spraying. Very little information is available on the potential impact of the kdr mutation on indoor residual spraying of DDT and pyrethroids. However, there is a fear that kdr resistance might reduce its efficacy since it relies largely on mass killing of vectors. Potential impact of resistance mechanisms other than kdr on residual spaying has already been documented in several occasions. In South Africa e.g., the development of a non-kdr pyrethroid resistance in An. funestus has dramatically reduced efficacy of the spraying program and resulted in a sharp increase in the number of malaria cases.

The way forward. Further extension of DDT and pyrethroid residual spraying in Africa would most likely face difficulties because of widespread insecticide resistance. In any case, spraying operations should be planned based on a detailed assessment of resistance (distribution, intensity, and mechanisms involved) and the adoption of resistance management tactics. Massive deployment of ITNs might further exacerbate pyrethroid resistance and worsen the current situation. A possible scenario could

be that personal protection provided by ITNs will be maintained despite resistance while the community protection expected from high coverage of this intervention might be reduced because of resistance. As far as residual spraying is concerned, an impact of resistance should a priori be expected unless absence of such impact has been shown. Only insecticides to which local vectors are susceptible should be selected for residual indoor spraying. Resistance management policies should be progressively adopted by all residual spraying programs to prolong the use-life of existing insecticides. The arsenal of insecticides that are currently available for residual spraying is already very limited.

5.5 Choice of malaria vector control interventions

ITNs. In most lowlands of Africa with intense transmission, an interruption or a dramatic reduction of transmission through residual spraying or ITNs interventions would be technically difficult to achieve because of intensity of transmission, widespread insecticide resistance or the absence of operational vector control services. It would also be financially difficult to sustain. On the contrary, a significant reduction in malaria incidence can be achieved through personal protection of vulnerable groups by mass distribution of ITNs, including in areas where vectors are resistant to pyrethroids. ITNs are effective also in low transmission areas (unstable malaria). However, to benefit from the full potential of this intervention, programs should target the highest possible coverage in order to protect the whole community through a mass impact on the vector population. It is yet unclear to which extent pyrethroid resistance may reduce the impact of ITNs on vector populations.

6. Recommendations

To countries

- To initiate and/or strengthen insecticide resistance monitoring as a component of the national malaria control plans. The necessary resources (human and financial) should be made available, eventually obtained from funding partners.
- To fill gaps in the current knowledge of resistance in malaria vectors (distribution, mechanisms involved) and to start testing susceptibility to insecticides other than DDT and pyrethroids (carbamates, organophosphates).
- To share and disseminate information on insecticide resistance. The present Atlas offers opportunity for rapid dissemination of information. It will easily be updated.
- To select vector control interventions and insecticides taking into account, among other important factors, the resistance status of local vector populations.
- To ensure continuous resistance monitoring.
- To adopt insecticide resistance management as part of national policies for vector control.

To funding partners

- To ensure resistance assessment and monitoring is included in requests for funding related to malaria vector control and is adequately funded.
- To support the adoption of insecticide resistance management policies.

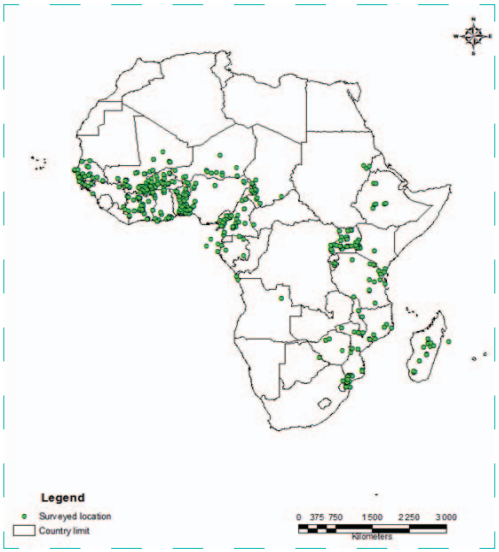
To WHO

- To further build capacity for resistance monitoring at country level and coordinate resistance monitoring activities in the African region, in the framework of ANVR.
- To develop regional guidelines for insecticide resistance management and promote adoption and implementation of resistance management tactics.
- To update and complete the present document, collecting and incorporating data obtained at country level as well as published information.
- On request of national programs, to review country by country the situation of insecticide resistance and to provide technical advice on the selection of insecticides and implementation of locally adapted vector control strategies.
- To further stimulate research on the operational impact of insecticide resistance on the efficacy of vector control interventions.
- In view of the situation of insecticide resistance in malaria vectors, to further promote the adoption of integrated vector management principles, with the objective to further reduce reliance on single insecticide and intervention.

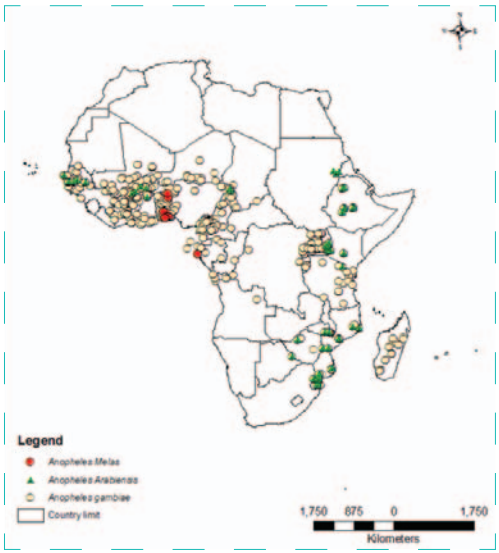
To WHO and Industry

- To promote the search for new insecticides alternative to DDT and pyrethroids.

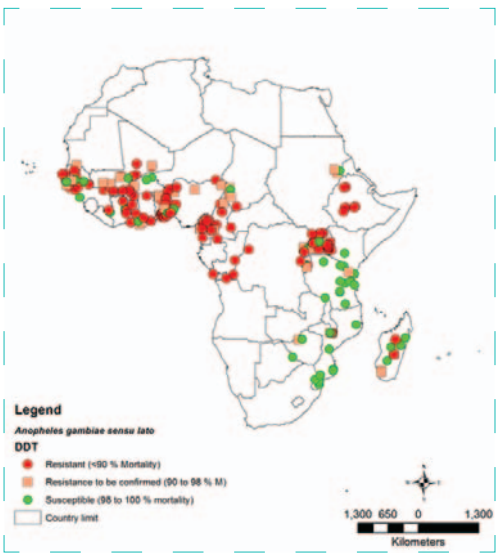
The surveys were repeatedly carried out in the same locations in most countries. In total data were collected in 364 localities with geographic coordinates across the continent as shown on the map.



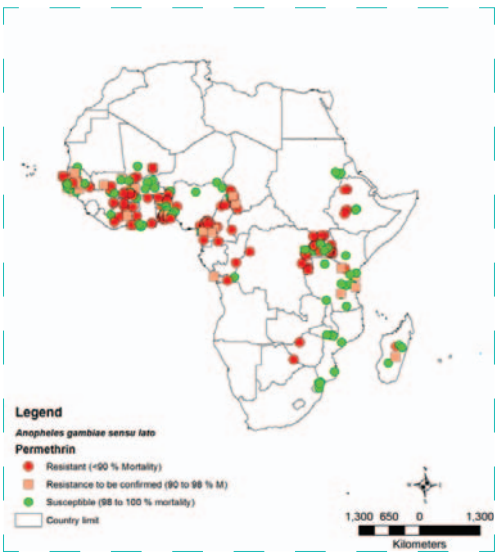
Map 1: Distribution of sentinel sites and surveyed locations



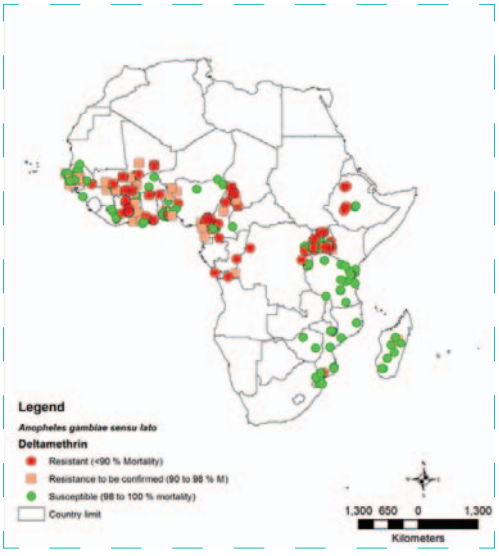
Map 2: Geographical distribution of vectors belonging to the Anopheles gambiae complex in Africa (ANVR Data Base)



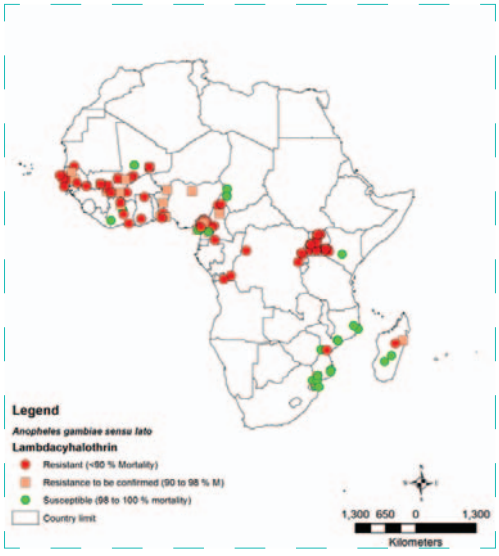
Map 3: Distribution of DDT resistance in Anopheles gambiae sensu lato.



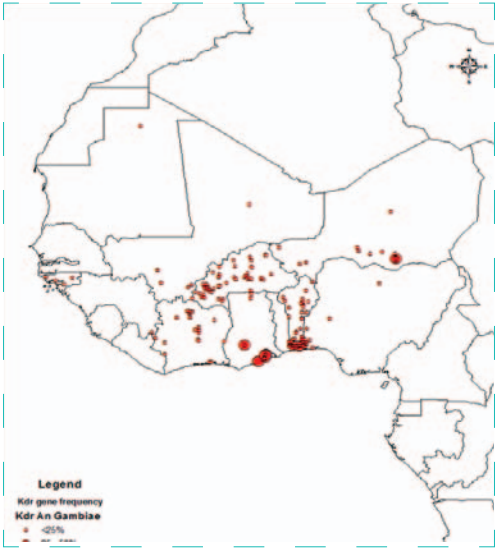
Map 4: Distribution of Permethrin resistance in Anopheles gambiae sensu lato.



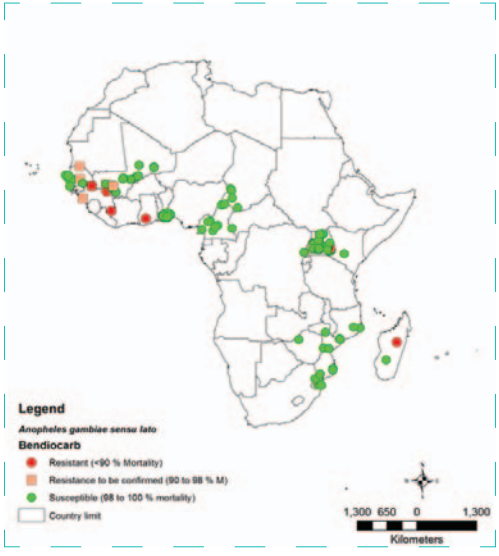
Map 5: Distribution of Deltamethrin resistance in Anopheles gambiae sensu lato.



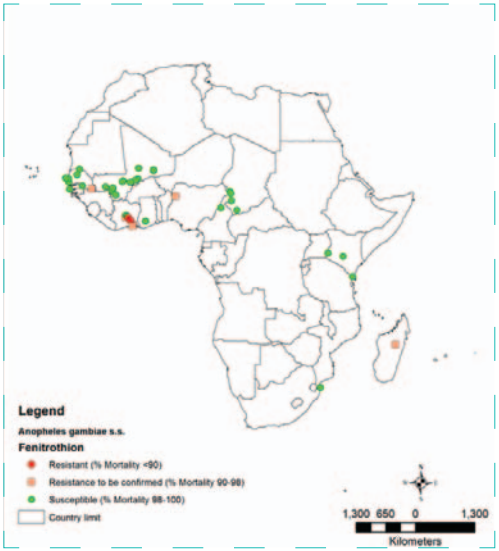
Map 6: Distribution of Lamdacyhalothrin resistance in Anopheles gambiae sensu lato.



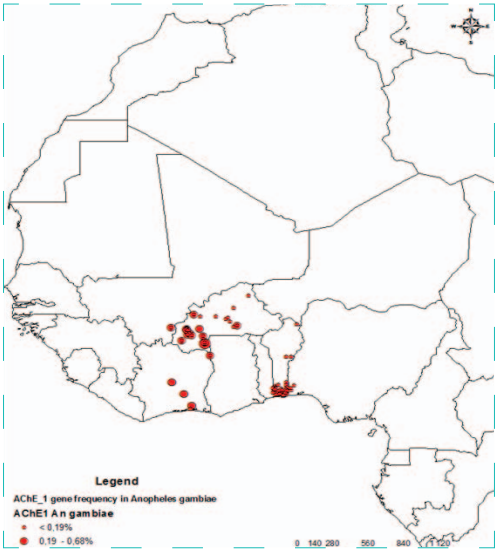
Map 7: Frequency of kdr gene in Anopheles gambiae sensu lato. and the S form of Anopheles gambiae sensu stricto in West (conferring resistance to DDT and Pyrethronoids)



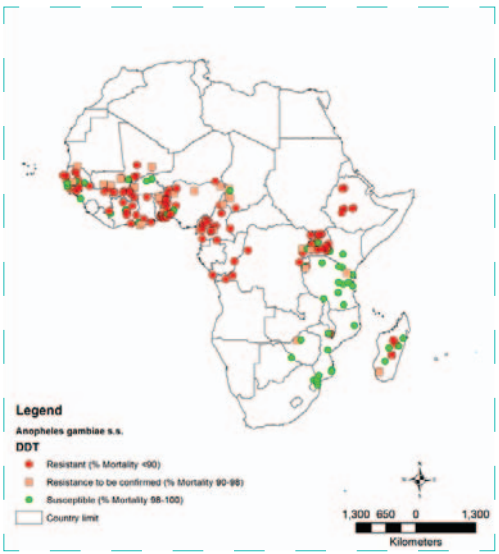
Map 8: Frequency of Kdr gene in Anopheles gambiae s.l. in West Africa (conferring resistance to DDT and Pyrethronoids)



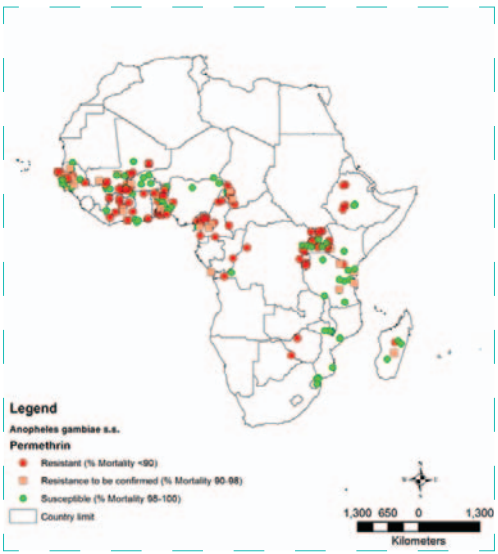
Map 9: Distribution of Fenitrothion resistance in Anopheles gambiae sensu lato.



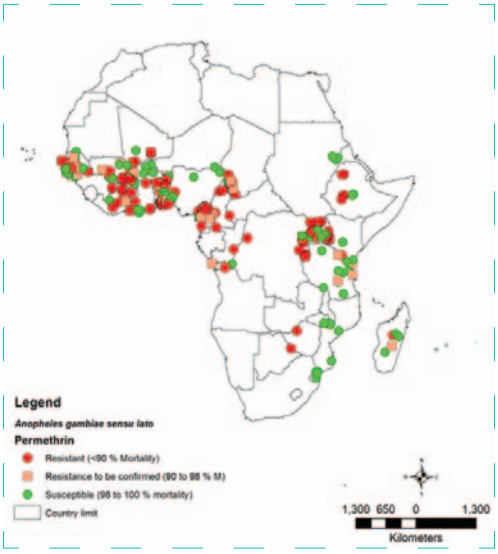
Map 10: Distribution of modified acethylcholinesterase resistance in Anopheles gambiae s.l. of West Africa (normally confering resistance to carbamate and organophosphate insecticides).



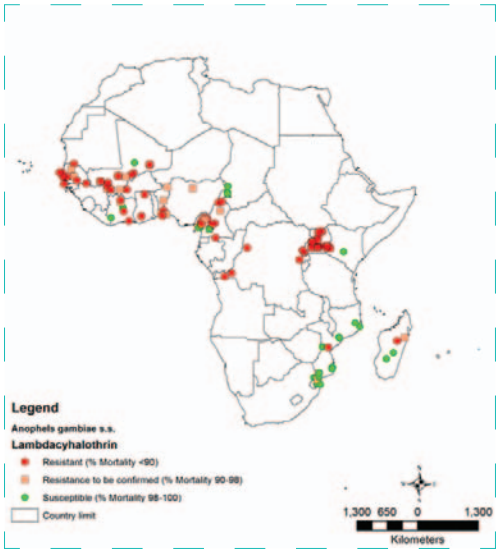
Map 11: Distribution of DDT resistance in Anopheles gambiae sensu strict



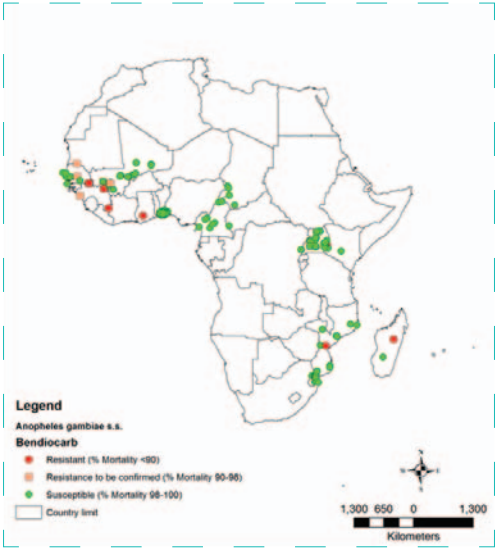
Map 12: Distribution of Permethrin resistance in Anopheles gambiae sensu stricto



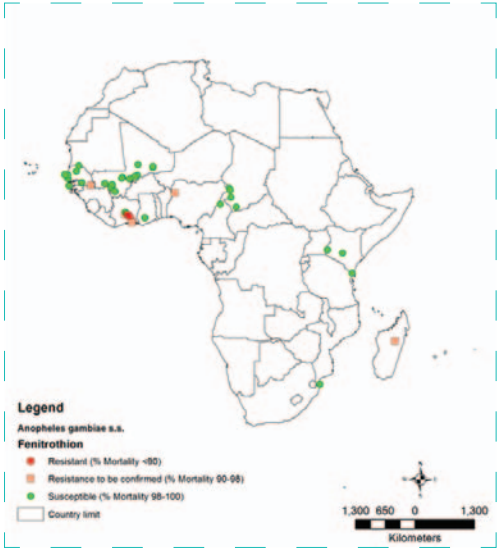
Map 13: Distribution of Deltamethrin resistance in Anopheles gambiae sensu strict



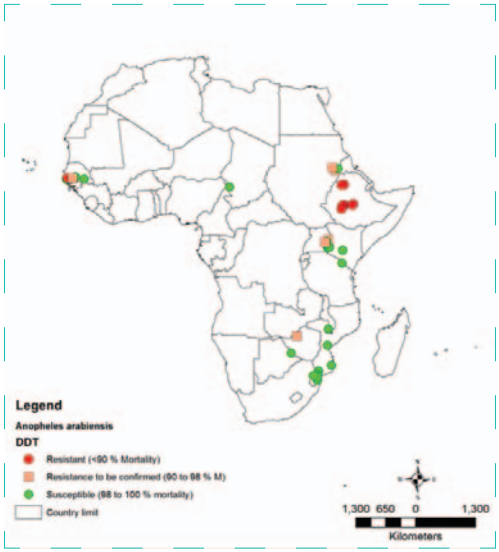
Map 14: Distribution of Lamdacyhalothrin resistance in Anopheles gambiae sensu stricto



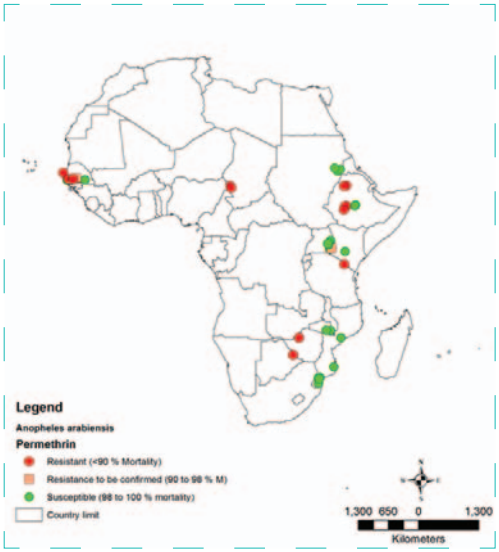
Map 15: Distribution of Bendiocarb resistance in Anopheles gambiae sensu stricto



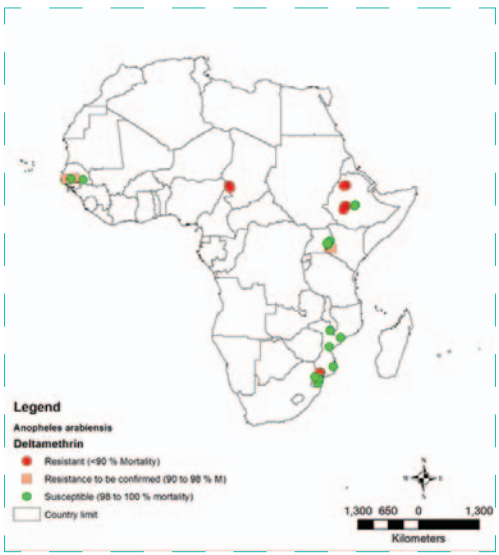
Map 16: Distribution of Fenitrothion resistance in Anopheles gambiae sensu stricto



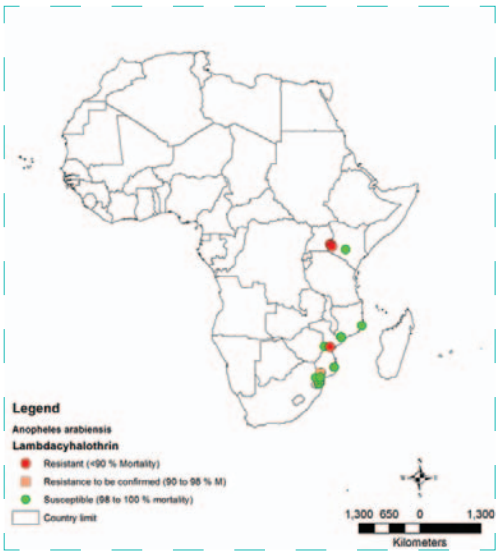
Map 17: Distribution of DDT resistance in Anopheles arabiensis.



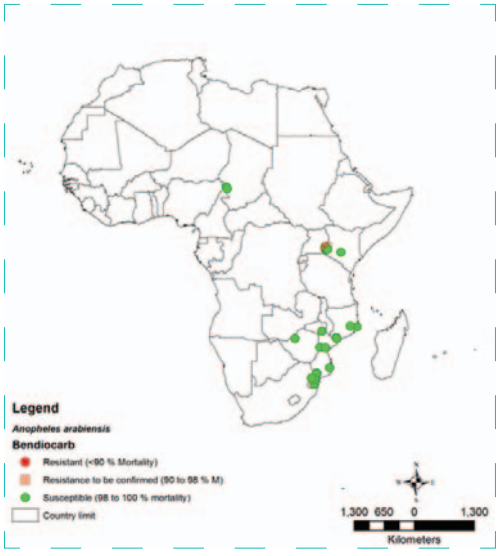
Map 18: Distribution of Permethrin resistance in Anopheles arabiensis.



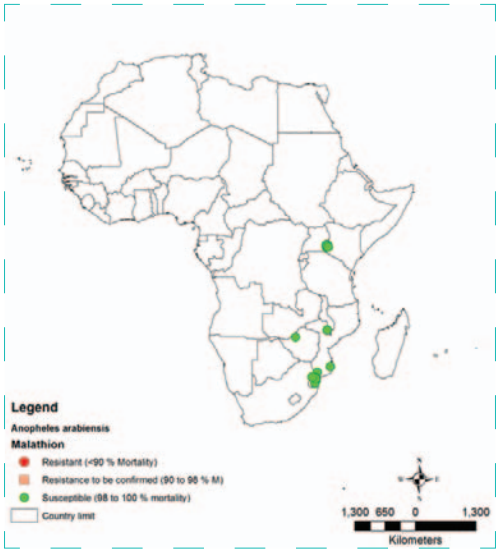
Map 19: Distribution of Deltamethrin resistance in Anopheles arabiensis



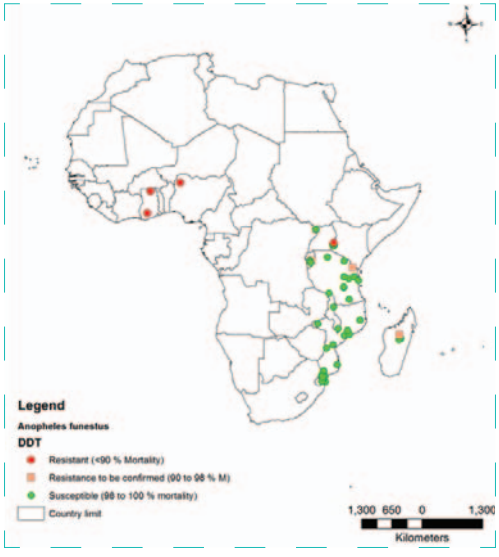
Map 20: Distribution of Lamdacyhalothrin resistance in Anopheles arabiensis.



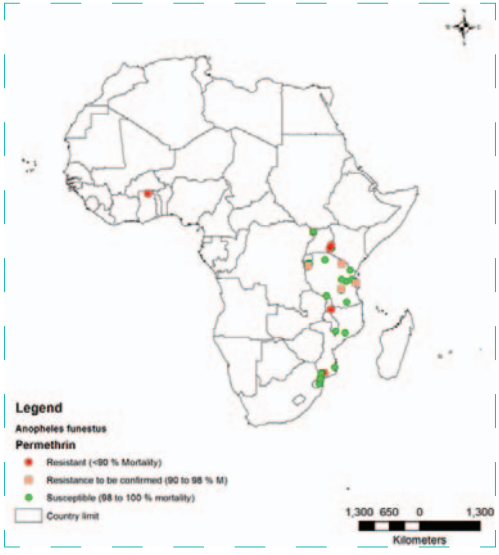
Map 21: Distribution of Bendiocarb resistance in Anopheles arabiensis.



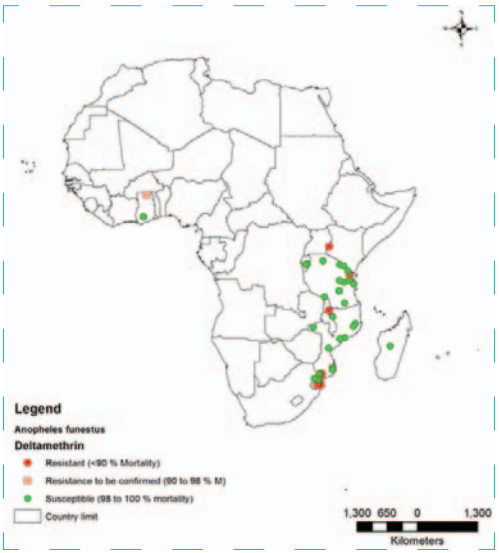
Map 22: Distribution of Malathion resistance in Anopheles arabiensis



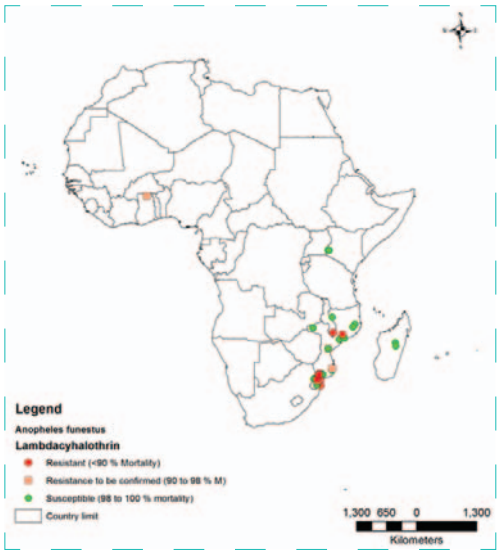
Map 23: Distribution of DDT resistance in Anopheles funestus



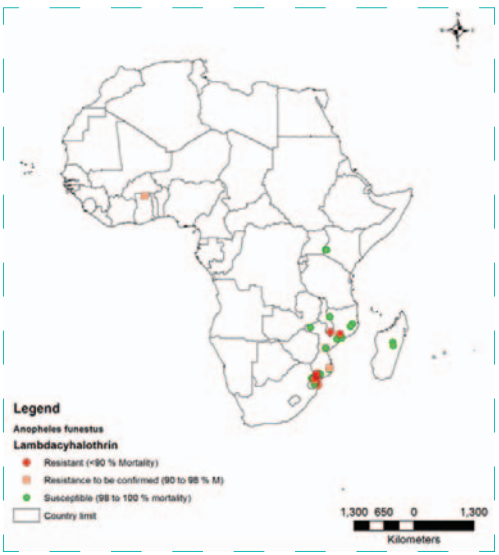
Map 24: Distribution of Permethrin resistance in Anopheles funestus



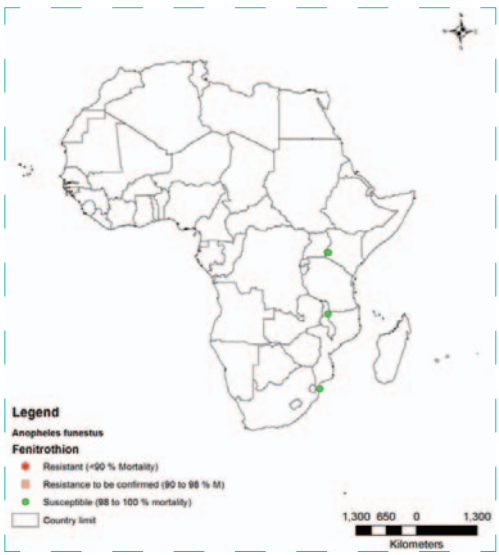
Map 25: Distribution of Deltamethrin resistance in Anopheles funestus



Map 26: Distribution of Lamdacyhalothrin resistance in Anopheles funestus



Map 27: Distribution of Bendiocarb resistance in Anopheles funestus



Map 28: Distribution of Fenitrothion resistance in Anopheles funestus

2a : Budget reporting frames Y4, May 2012

	ACTIVITY TYPE	ACTIVITIES	HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 1:	To strengthen infrastructure technical and institutional capacities for effective vector control in malaria endemic countries with a particular emphasis on resistance management	9 698	221 840	25 964	30 371	21 706	17 285	4 500	43 599	26 056	401 019
1.1	Personnel		0	209 840	25 964	22 171	12 906	17 285	0	33 290	23 056	344 512
		1 international professional staff		209 840								209 840
		10 National project officers		0	25 964	22 171	12 906	17 285	0	33 290	23 056	134 672
1.2	Travel		0	5 000	0	0	0	0	0	4 332		9 332
		Project coordination and management		5 000						2 071		7 071
		Annual review and planning meetings								2 261		2 261
1.3	Consultants											0
1.4	Supplies		9 698	7 000	0	2 500	1 500	0	4 500	477	3 000	28 675
		Professionel staff office supplies	9 698	7 000		2 500	1 500		4 500	477	3 000	28 675
1.5	Contracted services					5 700	7 300			5 500		18 500
1.6	Sub-grant to Other Organizations											0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
-	Major Activity 4:	To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	4 000	8 000	2 000	16 396	9 729	2 000	4 000	8 032	54 157
4.1	Personnel	-					8 896	6 829			4 032	19 757
4.2	Travel	-	0	0	0	0	0	400	0	0	0	400
		Workshop SOP (travel) [manuel pre-testing¨]						400				400
4.3	Consultants	-		4 000								4 000
		Workshop SOP (consultants) [manuel pre-testing¨]		4 000								
4.4	Supplies	-	0	0	6 000	0	4 500	2 500	0	0	0	13 000
		Local cost for final evaluation workshop (cameroun)			6 000							6 000
		Implemenataion of harmonization national workshop					4 500	2 500				7 000
4.5	Contracted services		0	0	2 000	2 000	3 000	0	2 000	4 000	4 000	17 000
		Test newly developed insecticides										
		Organize stardardization workshops (2 days)										
		Editing and printing of tools (Country profiles & SOPs)			2 000	2 000	3 000	0	2 000	4 000	4 000	17 000

Annex 2 a: Budget reporting frames Y4, May 2012- Cont'd

		Disseminate new and stardardised protocols (Vector surveillance SPOs)										0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 5:	Coordination and evaluation	0	60 000	0	34 000	0	0	0	0	0	94 000
5.1	Personnel											0
5.2	Travel											0
		ANVR annual meetings										
		Mid-Term and final project evaluation										0
5.3	Consultants	Vector Resistance data collection		30 000								30 000
5.4	Supplies	Lab equipment and reagents				34 000						34 000
5.5	Contracted services	Vector control Desison support tool development		30 000								30 000
5.6	Sub-grant to Other Organizations											0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 6:	Harmonize procedures and protocols	0	32 000	0	0	0	2 000	0	0	0	34 000
6.2	Travel	Workshop to finalize resistance test protocol and Atlas (Cotonou Benin)		32 000								32 000
6.5	Contracted services	Disseminate new and standardized protocols						2 000				2 000
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 7:	Organize national training workshops on WHOPES guidelines and procedures	0	0	4 500	0	0	2 000	0	12 500	0	19 000
7.1	Personnel											0
												0
												0
	Contracted services	Production of Vector resistace atlas			4 500			2 000		12 500		19 000
												0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 8:	Information sharing and recommendations for policy making	17 000	145 000	0	0	0	0	0	0	0	162 000
8.1	Personnel											
8.2	Travel	Technical consultation on malaria vector control		65 000		0				0		65 000
		project final evaluation	17 000	70 000								87 000
	Contracted services	support to ANVR regional Centers		10 000				0				10 000
	TOTAL		26 698	462 840	38 464	66 371	38 102	31 014	6 500	60 099	34 088	764 176

Annex 2b: Reporting Frame for Year 4

	ACTIVITY TYPE	ACTIVITIES	HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 1:	To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	9,698	222,335	25,964	30,442	21,777	17,285	-6,581	43,749	26,056	390,725
1.1	Personnel		0	209,840	25,964	22,171	12,906	17,285	0	33,290	23,056	344,512
		1 international professional staff		209,840								209,840
		10 National project officers		0	25,964	22,171	12,906	17,285	0	33,290	23,056	134,672
1.2	Travel		0	5,315	0	0	0	0	0	4,332		9,647
		Project coordination and management		5,315						2,071		7,386
		Annual review and planning meetings								2,261		2,261
1.3	Consultants											0
1.4	Supplies	Lab reagents and resitance test kits	9,698	7,180	0	2,500	1,500	0	-6,581	477	3,000	17,774
		Professionel staff office running cost	9,698	7,180		2,500	1,500		-6,581	477	3,000	17,774
1.5	Contracted services					5,771	7,371			5,650		18,792
1.6	Sub-grant to Other Organizations											0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 4:	To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application	0	3,800	7,040	1,500	15,464	10,011	1,500	3,000	4,982	47,297
4.1	Personnel						8,896	6,829			4,032	
4.2	Travel		0	0	0	0	0	490	0	0	-2,050	-1,560
		Workshop SOP (travel) [manuel pre-testing¨]						490			-2,050	-1,560
4.3	Consultants			3,800								3,800
		Workshop SOP (consultants) [manuel pre-testing¨]		3,800								3,800
4.4	Supplies		0	0	6,040	0	4,568	2,692	0	0	0	13,300
		Local cost for final evaluation workshop (cameroun)			6,040							6,040
		Implmenataion of harmonization workshop					4,568	2,692				7,260
4.5	Contracted services		0	0	1,000	1,500	2,000	0	1,500	3,000	3,000	12,00
		Test newly developed insecticides										
		Organize stardardization workshops (2 days)										
		Editing and printing of tools (Country profiles & SOPs)			1,000	1,500	2,000	0	1,500	3,000	3,000	12,000

		Disseminate new and stardardised protocols (Vector surveillance SPOs)										0
4.6	Sub-grant to Other Organizations											0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 5:	Coordination and evaluation	0	54,000	0	32,000	0	114	0	0	0	86,114
5.1	Personnel							114				114
5.2	Travel		0		0	0	0	0	0	0	0	0
		ANVR annual meetings (9th ANVR meeting, Tanzania)										0
		Mid-Term and final project evaluation										0
5.3	Consultants	Resistance data collection										28,000
5.4	Supplies	Lab equipment and reagents										32,000
5.5	Contracted services	Vector control Desison support tool development										26,000
5.6	Sub-grant to Other Organizations											0
	Major Activity 6:	Harmonize procedures and protocols		RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
			0	5,500	4,500	5,000	0	4,033	0	2,000	5,000	26,03
6.1	Personnel											0
6.2	Travel	Workshop to finalize resistance test protocol and Atlas (Cotonou, Benin)		5,500	4,500	5,000		2,000		2,000	5,000	24,000
6.5	contracted services	Disseminate new and standardized protocols						2,033				2,033
	Major Activity 7:	Organize national training workshops on WHOPES guidelines and		RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
			0	0	4,658	0	0	2,006	0	22,605	0	29,269
7.1.	Personnel	Extension of Project oficer salaries								12,000		12,000
												0
												0
	contracted services	Production of Vector resistace atlas			4,658			2,006		10,605		17,269
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 8:	Information sharing and recommendations for policy making	12,967	68,765	12,000	6,000	8,000	8,000	5,000	8,000	6,000	134,732
8.1.	Personnel											0
8.2.	Travel	Technical consultation on malaria vector control		46,865								46,865
		Undertake project final evaluation	12,967	10,000	12,000	6,000	8,000	8,000	5,000	8,000	6,000	75,967
8.5	contracted services (APW TSA CONSULT DFC)			11,900								11,900
	TOTAL		22,665	354,400	54,162	74,942	45,241	41,449	-81	79,354		714,170

Appendix B: Budget Spreadsheet

Organization Name: World Health Organization
Project Title: Mlaria Vector control: Filling the gap between product development and effective delivery
Total Requested: US$ 4 989 533
Date :
Are there Indirect Costs ? (Enter : Yes or No) :
Type of organization. (Enter: University, Other or Government):

								REPORT ON YEAR 4 EXPENDITURES					
Budget Line Items	Year 1 (revised)	Year 2 (revised)	Year 3 (revised)	Year 4 (Revised)	Year 5	Total	% of Total	Actual expendit-ures	%	Unexp ended funds	Varia-nce		NOTES
Total Personnel	235,800	275,940	313,211	327,269	0	1,152,220	23%	339,383	104%	-12,114	-4		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	235,800	275,940	313,211	307,512	0	1,132,463		307,512	100%	0	0		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	19,757	0	19,757		19,757	100%	0			
Coordination and evaluation	0	0	0	0	0	0		114		-114			
Harmonize procedures and protocols										0			
Standardization Workshops								12,000		-12,000			
Information sharing and recommendations for policy making										0			
Total Fringe Benefits	26,200	30,660	40,000	37,000	0	133,860	3%	37,000	93%	0			
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	26,200	30,660	40,000	37,000	0	133,860		37,000	93%	0	8		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0		0			
Coordination and evaluation	0	0	0	0	0	0		0		0			

Appendix B: Budget Spreadsheet cont'd

Harmonize procedures and protocols										0			
Standardization Workshops										0			
Information sharing and recommendations for policy making										0			
Total Travel	374,000	308,043	341,546	193,732	0	1,217,321	24%	154,919	80%	38,813	20		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	50,000	117,413	136,358	9,332	0	313,103		9,647	103%	-315	-3		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	154,000	164,580	161,188	0	0	479,768		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	70,000	20,000	14,000	0	0	104,000		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	50,000	6,050	0	400	0	56,450		(1,560)	-390%	1,960			
Coordination and evaluation	50,000	0	30,000	0	0	80,000		0		0			
Harmonize procedures and protocols				32,000				24,000	75%	8,000			
Standardization Workshops								0		0			
Information sharing and recommendations for policy making				152,000				122,832	81%	29,168			
Total Consultants	576,000	202,099	80,000	34,000	0	892,099	18%	31,800	94%	2,200	6		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	0	0	0	0	0		0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	551,000	179,075	45,000	0	0	775,075		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	20,000	35,000	0	0	55,000		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	25,000	3,024	0	4,000	0	32,024		3,800	95%	200			
Coordination and evaluation	0	0	0	30,000	0	30,000		28,000	93%	2,000			
Harmonize procedures and protocols										0			
Standardization Workshops										0			
Information sharing and recommendations for policy making										0			
Supplies										0			
Medical and Laboratory	550,000	143,972	12,000	62,675	0	768,647	15%	49,774	79%	12,901			
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	0	0	28,675	0	28,675		17,774	62%	10,901			

Appendix B: Budget Spreadsheet cont'd

To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	550,000	143,972	12,000	0	0	705,972		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0		0			
Coordination and evaluation	0	0	0	34,000	0	34,000		32,000	94%	2,000			
Harmonize procedures and protocols								0		0			
Standardization Workshops								0		0			
Information sharing and recommendations for policy making								0		0			
Other Supplies	0	1,326	35,300	13,000	0	49,626	1%	13,300	102%	-300	-2		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	1,326	35,300	0	0	36,626		0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	13,000	0	13,000		13,300	102%	-300			
Coordination and evaluation	0	0	0	0	0	0				0			
Harmonize procedures and protocols										0			
Standardization Workshops										0			
Information sharing and recommendations for policy making										0			
Subtotal of Modified Direct Costs	1,762,000	962,040	822,057	667,676	0	4,213,773		626,176	94%	41,500	6		
Indirect Costs on Modified Direct Costs	0	0	0	0	0	0	0%	0		0			
Subtotal of Modified Direct Costs and Indirect Costs	1,762,000	962,040	822,057	667,676	0	4,213,773		626,176	94%	41,500	6		
										0			
Total Contracted Services	0	28,960	68,000	96,500	0	193,460	4%	87,994	91%	8,506			

Appendix B: Budget Spreadsheet cont'd

To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	0	0	18,500	0	18,500		18,792	102%	-292			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	54,000	0	0	54,000		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	28,960	14,000	17,000	0	59,960		12,000	71%	5,000	29		
Coordination and evaluation	0	0	0	30,000	0	30,000		26,000	87%	4,000	13		
Harmonize procedures and protocols				2,000				2,033	102%	-33			
Standardization Workshops				19,000				17,269	91%	1,731			
Information sharing and recommendations for policy making				10,000				11,900	119%	-1,900			
Total Sub-grants to Others Organizations	0	0	0	0	0	0	0%	0		0	0		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	0	0	0	0	0				0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0				0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0				0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0				0			
Coordination and evaluation										0			
Harmonize procedures and protocols										0			
Standardization Workshops	0	0	0	0	0	0				0			
Information sharing and recommendations for policy making										0			
Subtotal of Sub-grants/contracts	0	28,960	68,000	96,500	0	193,460		87,994	91%	8,506	9		

Appendix B: Budget Spreadsheet cont'd

Allowable Indirect Costs on Sub-grants/ contracts 2, 3	0	0	0	0	0	0	0%	0		0			# of Sub-grants and Sub-contr-acts 4
Subtotal of Sub-grants/contracts and Allowable Indirect Costs	0	28,960	68,000	96,500	0	193,460		87,994	91%	8,506	9		
										0			
Total Equipment	0	0	0	0	0	0	0%	0		0			
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis	0	0	0	0	0	0				0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0				0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0				0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0				0			
Coordination and evaluation	0	0	0	0	0	0				0			
Harmonize procedures and protocols										0			
Standardization Workshops										0			
Information sharing and recommendations for policy making										0			
Total Direct Costs	1,762,000	991,000	890,057	764,17	0	4,407,233	87%	714,170	93%	50,006	7	$0	
Total Indirect Costs	0	0	0	0	0	0	0%	0		0			
Programme Support Costs (WHO) 13%	229,060	138,190	115,707	99,343	0		13%	99,324					
Grand Total Costs	1,991,060	1,129,190	1,005,764	863,519	0	4,989,533	100%	813,494	94%	50,025	6	$0	
				1,869,283	1,005,764								

[1] All amounts must be in US $
[2] Indirect rates are only applicable to the first $25,000 for sub-grants and certain sub-contracts (see narrative)
[3] Indirect allocation is not allowed on equipment costs
[4] Please insert the total number of subcontractors and sub grantees for all years in the space highlighted in yellow. The modified indirect cost will be calculated using this number.

Budget Line Items	Year 1 (revised)	Year 2 (revised)	Year 3	Year 4	Year 5	Total	% of Total	Actual expendi tures	Per centage		Vari -ance	Non-U.S.	
Total Personnel	235,800	275,940			0		25%	217,572	79%	58,368	21		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	235,800	275,940	360,000	360,000	0	1,231,740		217,572	79%	58,368	21		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0					
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0					
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0					
Coordination and evaluation	0	0	0	0	0	0		0					
Total Fringe Benefits	26,200	30,660	40,000	40,000	0	136,860	3%	24,174	79%	6,486	21		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	26,200	30,660	40,000	40,000	0	136,860		24,174	79%	6,486	21		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0		0			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0		0			
Coordination and evaluation	0	0	0	0	0	0		0		0			

Total Travel	374,000	355,043			0		23%	302,236	85%	52,807	15		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	50,000	117,413	25,000	25,000	0	217,413		105,238	90%	12,175	10		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	154,000	164,580	75,000	0	0	393,580		133,948	81%	30,632	19		
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	70,000	20,000	0	0	0	90,000		10,000	50%	10,000	50		
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	50,000	6,050	88,385	50,000	0	194,435		6,050	100%	0	0		
Coordination and evaluation	50,000	47,000	50,000	100,000	0	247,000		47,000	100%	0	0		
Total Consultants	576,000	202,099			0		21%	188,358	93%	13,741	7		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0		0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	551,000	179,075	75,000	50,000	0	855,075		165,334	92%	13,741	8		
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	20,000	50,000	50,000	0	120,000		20,000	100%	0	0		
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	25,000	3,024	11,615	0	0	39,639		3,024	100%	0	0		
Coordination and evaluation	0	0	0	0	0	0		0		0			
Supplies													
Medical and Laboratory	550,000	143,972	0	0	0	693,972	14%	131,358	91%	12,614	9		

To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0		0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	550,000	143,972	0	0	0	693,972		131,358	91%	12,614	9		
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0							
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0							
Coordination and evaluation	0	0	0	0	0	0							
Other Supplies	0	1,326	100,000	0	0	101,326	2%	1,326	100%	0	0		
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	1,326	0	0	0	1,326		1,326	100%	0	0		
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0							
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	100,000	0	0	100,000							
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0							
Coordination and evaluation	0	0	0	0	0	0							
Subtotal of Modified Direct Costs					0			865,024	86%	144,016	14		
Indirect Costs on Modified Direct Costs	0	0	0	0	0	0	0%	0					
Subtotal of Modified Direct Costs and Indirect Costs					0			865,024	86%	144,016	14		
Total Contracted Services	0	53,960	0	0	0	53,960	1%	18,341	34%	35,619	66		

To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0						
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0						
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	25,000	0	0	0	25,000		0	0%	25,000	100	
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	28,960	0	0	0	28,960		18,341	63%	10,619	37	
Coordination and evaluation	0	0	0	0	0	0		0		0	100	
Total Sub-grants to Others Organizations	0	0	0	0	0	0	0%	0		0	0	
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0						
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0						
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0						
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0						
Coordination and evaluation	0	0	0	0	0	0						
Subtotal of Sub-grants/contracts	0	53,960	0	0	0	53,960		18,341	34%	35,619	**66**	

Allowable Indirect Costs on Sub-grants/ contracts 2, 3	0	0	0	0	0	0	0%	0		0	100		# of Sub-grants and
Subtotal of Sub-grants/contracts and Allowable Indirect Costs	0	53,960	0	0	0	53,960		18,341	34%	35,619	66		
Total Equipment	0	0	0	0	0	0	0%	0		0			
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0							
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0							
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0							
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0							
Coordination and evaluation	0	0	0	0	0	0							
Total Direct Costs	1,762,000	1,063,000	875,000	675,000	0	4,375,000	87%	883,365	83%	179,635	17	$0	
Total Indirect Costs	0	0	0	0	0	0	0%	0					
Programme Support Costs (WHO) 13%	229,060	138,190	113,750	87,750	0	568,750	13%	138,190	100%	0	0		
Grand Total Costs	1,991,060	1,201,190	988,750	762,750	0	4,943,750	100%	1,021,555	85%	179,635	15	$0	
[1] All amounts must be in US $													

[2] Indirect rates are only applicable to the first $25,000 for sub-grants and certain sub-contracts (see narrative)

[3] Indirect allocation is not allowed on equipment costs

[4] Please insert the total number of subcontractors and sub grantees for all years in the space highlighted in yellow. The modified indirect cost will be calculated using this number.

BUDGET FRAME FOR YEAR 3

	Activity type	Activities	HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 1:	To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	320,461	46,700	48,100	39,254	44,900	12,000	56,844	62,500	630,759
1.1	Personnel		0	220,000	30,700	33,600	22,755	25,900	0	33,300	39,500	405,755
		1 international professional staff	0	220,000	0	0	0	0	0	0	0	220,000
		National project officers	0	0	30,700	33,600	22,755	25,900	_	33,300	39,500	185,755
1.2	Travel		0	100,461	16,000	13,000	14,499	19,000	10,000	23,544	23,000	219,504
		Project coordination and management	0	13,461	0	2,500	1,499	0	0	1,044	0	18,504
		International workshop on the development of national entomological profile in Cameroon	0	16,000	10,000	3,000	4,500	8,000	3,000	6,000	3,000	53,500
		International workshop on the finalization of SOPs for vector surveillance, Dakar, Senegal	0	26,000	3,000	4,500	5,500	3,000	4,000	8,500	0	54,500
		ANVR and Project annual review and planning meetings in Tanzania	0	45,000	3,000	3,000	3,000	8,000	3,000	8,000	20,000	93,000
1.3	Consultants		0	0	0	0	0	0	0	0	0	0
1.4	Supplies		0	0	0	1,500	2,000	0	2,000	0	0	5,500
		Professionel staff office running cost	_	0	_	0	_	_	_	_	_	0
		Lab supplies and reagents	0			1,500	2,000		2,000			5,500
1.5	Contracted services		0	0	0	0	0	0	0	0	0	0
1.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL

	Major Activity 2:	To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate the use this information for the selection of insecticides to be used for malaria vector control	0	103,200	38,049	31,800	25,060	41,000	28,500	41,829	36,625	346,063
2.1	Personnel		0	0	0	0	0	0	0	0	0	0
2.2	Travel		0	18,500	38,049	31,800	15,760	30,000	21,500	29,829	26,625	212,063
		Inception meeting and needs assessment in NMCPs and NRUs	–	–	–	–	–	–	–	–	–	0
		Workshop to develop training curriculum and materials for field officer in NRUs (travel)	–	–	–	–	–	–	–	–	–	0
		ANVR annual meeting focusing on rolling out IRbase and finalize entomo profiles	–	18,500	–	–	–	–	–	–	–	18,500
		Country training workshops on WHOPES procedures (travel 2/3)	–	–	0		–		–			0
		Field training on basis enthomology and technical training (travel 2/3)	–	–		12,000						12,000
		Surveillance activities in sentinel sites and technical support to lab (travel 2/3)	–	–	38,049	19,800	15,760	30,000	21,500	29,829	26,625	181,563
2.3	Consultants		0	84,700	0	0	9,300	3,000	7,000	0	10,000	114,000
		Updating the atlas on vector resistance		55,000								55,000
		1 external consultant per country to support field training activities and project monitoring	–	–	–	–	–	–	–	0	–	0
		Workshop to develop training curriculum and materials for field officer in NRUs (consultant)	–	–	–	–	–	–	–	–	–	0
		Country training workshops on WHOPES procedures (consultant 1/3)	–	–			–					0
		Field training on basis enthomology and technical training (consultant 1/3)	–	–			–					0

		Surveillance activities in sentinel sites and technical support to lab (consultant 1/3)	–	–	–							0
		Redesign Entomobase to make it MIRO compliant	–	25,000	–	–	–	–	–	–	–	25,000
		ANVR annual meeting (consultant 1/3)	–		–	–	–	–	–	–	–	0
		Country support amd monitoring missions (replaced by the Mid-term review)	–	4,700	–	–	9,300	3,000	7,000	0	10,000	34,000
2.4	Supplies			0	0			8,000	0	12,000		20,000
		Provision of laboratory equipment and supplies		–	–			8,000		12,000		20,000
2.5	Contracted services	Provision of laboratory equipment and supplies	0	0	0	0	0	0	0	0	0	0
2.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 3:	To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	198,367	6,500	10,000	18,000	17,000	8,000	0	16,000	273,867
3.1	Personnel		0	0	0	10,000	0	0	0	0	0	10,000
		Undertake field trial to test new products/or products in use for malaria vector control	0	0	0	10,000	0	0	0	0	0	10,000
3.2	Travel		0	0	0	0	8,000	7,000	3,000	0	6,000	24,000
		Meetings to develop roadmap towards global database	0	0	0	0	0	0	0	0	0	0
		Technical support of regional reference centers	–	0	–	–	8,000	7,000	3,000	0	6,000	24,000
3.3	Consultants		0	23,367	6,500	0	10,000	10,000	5,000	0	10,000	64,867
		Consultants for country support in database management and preparation of country entomo profiles	0	23,367	6,500	–	10,000	10,000	5,000	–	10,000	64,867
3.4	Supplies		0	50,000	0	0	0	0	0	0	0	50,000

		Assessing GIS options: ESRI ArcGIS Engine, HealthMapper, platform, DHIS,AHO	0	50,000	0	0	0	0	0	0	0	50,000
3.5	Contracted services		0	125,000	0	0	0	0	0	0	0	125,000
		Scoping for VCDSS programme development		25,000								25,000
		Development of the prototype(designing and computer-base programming, DHIS)		75,000								75,000
		Contractual services with software developers	–	25,000	–	–	–	–	–	–	–	25,000
3.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 4:	To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	18,990	5,000	23,000	0	0	6,719	0	53,709
4.1	Personnel		0	0	0	0	0	0	0	0	0	0
4.2	Travel		0	0	11,434	0	0	0	0	6,719		18,153
		Workshop SOP (travel) [manuel pre-testing¨]	–	–	11,434	–	–	–	–	–		11,434
		Country support missions for validation and use of systems	–	–	–	–	–	–	–	6,719		6,719
4.3	Consultants		0	0	0	0	0	0	0	0		0
		Workshop SOP (consultants) [manuel pre-testing¨]	–	–		–	–	–	–	–		0
4.4	Supplies		0	0	0	0	0	0	0	0	0	0
4.5	Contracted services		0	0	7,556	5,000	23,000	0				35,556
		Test newly developed insecticides			3,778		17,000					20,778
		Organize stardardization workshops (2 days)	–	–	–	3,000	3,000					6,000
		Technical assistance including translation of instruments	–	–	–	–	–	–		–	–	0

		Disseminate new and stardardised protocols (Vector surveillance SPOs)	_	_	3,778	2,000	3,000	_		_	0	8,778
4.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 5:	Coordination and evaluation	0	50,000	0	0	0	0	0	0	0	50,000
5.1	Personnel		0	0	0	0	0	0	0	0	0	0
5.2	Travel		0	50,000	0	0		0	0	0	0	50,000
		ANVR annual meetings	_	_	_	_		_	_	_	0	0
		Mid-Term and final project evaluation	_	50,000	_	_	_	_	_	_	_	50,000
5.3	Consultants		0	0	0	0	0	0	0	0	0	0
5.4	Supplies		0	0	0	0	0	0	0	0	0	0
5.5	Contracted services		0	0	0	0	0	0	0	0	0	0
5.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
												0
		TOTAL	0	672,028	110,239	94,900	105,314	102,900	48,500	105,392	115,125	1,354,398

REPORTING FRAME FOR YEAR 3												
	Activity type	Activities	HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 1:	To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	301,420	41,735	42,323	31,071	39,121	19,336	50,406	68,104	593,515
1.1	Personnel		0	220,000	25,736	30,000	17,685	20,160	0	25,366	38,500	377,447
		1 international professional staff	0	220,000	0	0	0	0	0	0	0	220,000
		National project officers	0	0	25,736	30,000	17,685	20,160	_	25,366	38,500	157,447
1.2	Travel		0	81,420	15,999	10,823	11,386	18,961	17,336	25,040	29,604	210,568
		Project coordination and management	_		_	2,500	1,499		7,966	1,040	6,559	19,564
		International workshop on the development of national entomological profile in Cameroon		16,578	9,999	2,323	3,887	8,116	3,271	6,000	3,045	53,218

		International workshop on the finalization of SOPs for vector surveillance, Dakar, Senegal	0	16,722	3,000	3,000	3,000	2,845	3,499	10,000	0	42,066
		ANVR and Project annual review and planning meetings in Tanzania	0	48,120	3,000	3,000	3,000	8,000	2,600	8,000	20,000	95,720
1.3	Consultants		0	0	0	0	0	0	0	0	0	0
1.4	Supplies		0	0	0	1,500	2,000	0	2,000	0	0	5,500
		Professionel staff office running cost	–	0	–	0	–	–	–	–	–	0
		Lab supplies and reagents	0			1,500	2,000		2,000			5,500
1.5	Contracted services		0	0	0	0	0	0	0	0	0	0
1.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 2:	To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate the use this information for the selection of insecticides to be used for malaria vector control	0	103,200	38,049	29,800	25,060	41,000	28,500	42,668	35,000	343,277
2.1	Personnel		0	0	0	0	0	0	0	0	0	0
2.2	Travel		0	18,500	38,049	29,800	15,760	30,000	21,500	30,668	25,000	209,277
		Inception meeting and needs assessment in NMCPs and NRUs	–	–	–	–	–	–	–	–	–	0
		Workshop to develop training curriculum and materials for field officer in NRUs (travel)	–	–	–	–	–	–	–	–	–	0
		ANVR annual meeting focusing on rolling out IRbase and finalize entomo profiles	–	18,500	–	–	–	–	–	–	–	18,500
		Country training workshops on WHOPES procedures (travel 2/3)	–	–	0		–		–			0
		Field training on basis enthomology and technical training (travel 2/3)	–	–		10,000				839		10,839
		Surveillance activities in sentinel sites and technical support to lab (travel 2/3)	–	–	38,049	19,800	15,760	30,000	21,500	29,829	25,000	179,938

2.3	Consultants		0	84,700	0	0	9,300	3,000	7,000	0	10,000	114,000
		Updating the atlas on vector resistance		55,000								55,000
		1 external consultant per country to support field training activities and project monitoring	–	–	–	–	–	–	–	0	–	0
		Workshop to develop training curriculum and materials for field officer in NRUs (consultant)	–	–	–	–	–	–	–	–	–	0
		Country training workshops on WHOPES procedures (consultant 1/3)	–	–			–					0
		Field training on basis enthomology and technical training (consultant 1/3)	–	–			–					0
		Surveillance activities in sentinel sites and technical support to lab (consultant 1/3)	–	–	–							0
		Redesign Entomobase to make it MIRO compliant	–	25,000	–	–	–	–	–	–	–	25,000
		ANVR annual meeting (consultant 1/3)	–		–	–	–	–	–	–	–	0
		Country support and monitoring missions (replaced by the Mid-term review)	–	4,700	–	–	9,300	3,000	7,000	0	10,000	34,000
2.4	Supplies			0	0			8,000	0	12,000		20,000
		Provision of laboratory equipment and supplies		–	–			8,000		12,000		20,000
2.5	Contracted services		0	0	0	0	0	0	0	0	0	0
2.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 3:	To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	193,430	5,919	10,000	18,000	17,000	7,078	0	16,000	267,427
3.1	Personnel		0	0	0	10,000	0	0	0	0	0	10,000

		Undertake field trial to test new products/or products in use for malaria vector control				10,000						10,000
3.2	Travel		0	0	0	0	8,000	7,000	3,000	0	6,000	24,000
		Meetings to develop roadmap towards global database	–	–	–	–	–	–	–	–	–	0
		Technical support of regional reference centers	–	0	–	–	8,000	7,000	3,000	0	6,000	24,000
3.3	Consultants		0	20,000	5,919	0	10,000	10,000	4,078	0	10,000	59,997
		Consultants for country support in database management and preparation of country entomo profiles	0	20,000	5,919	–	10,000	10,000	4,078	–	10,000	59,997
3.4	Supplies		0	50,000	0	0	0	0	0	0	0	50,000
		Assessing GIS options: ESRI ArcGIS Engine, HealthMapper, platform, DHIS,AHO		50,000								50,000
3.5	Contracted services		0	123,430	0	0	0	0	0	0	0	123,430
		Scoping for VCDSS programme development		23,430								23,430
		Development of the prototype(designing and computer-base programming, DHIS)		75,000								75,000
		Contractual services with software developers	–	25,000	–	–	–	–	–	–	–	25,000
3.6	Sub-grant to Other Organizations		0	0	0		0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 4:	To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	13,883	5,000	23,000	0	0	6,719	0	48,602
4.1	Personnel	-	0	0	0	0	0	0	0	0	0	0
4.2	Travel	-	0	0	8,391	0	0	0	0	6,719		15,110

		Workshop SOP (travel) [manuel pre-testing¨]	–	–	8,391	–	–	–	–	–		8,391
		Country support missions for validation and use of systems	–	–	–	–	–	–	–	6,719		6,719
4.3	Consultants	-	0	0	0	0	0	0	0	0		0
		Workshop SOP (consultants) [manuel pre-testing¨]	–	–		–	–	–	–	–		0
4.4	Supplies	-	0	0	0	0	0	0	0	0	0	0
4.5	Contracted services	-	0	0	5,492	5,000	23,000	0				33,492
		Test newly developed insecticides			2,746		17,000					19,746
		Organize stardardization workshops (2 days)	–	–	–	3,000	3,000					6,000
		Technical assistance including translation of instruments	–	–	–	–	–	–		–	–	0
		Disseminate new and stardardised protocols (Vector surveillance SPOs)	–	–	2,746	2,000	3,000	–		–	0	7,746
4.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
			HQ	RO	CAE	KEN	MAD	MAI	MOZ	SEN	TAN	TOTAL
	Major Activity 5:	Coordination and evaluation	0	47,000	0	0	0	0	0	0	0	47,000
5.1	Personnel		0	0	0	0	0	0	0	0	0	0
5.2	Travel		0	47,000	0	0		0	0	0	0	47,000
		ANVR annual meetings	–	–	–	–		–	–	–	0	0
		Mid-Term and final project evaluation	–	47,000	–	–	–	–	–	–	–	47,000
5.3	Consultants		0	0	0	0	0	0	0	0	0	0
5.4	Supplies		0	0	0	0	0	0	0	0	0	0
5.5	Contracted services		0	0	0	0	0	0	0	0	0	0
5.6	Sub-grant to Other Organizations		0	0	0	0	0	0	0	0	0	0
		TOTAL	0	645,050	99,586	87,123	97,131	97,121	54,914	99,793	119,104	1,299,821

Appendix B: Budget Spreadsheet

Organization Name:
World Health Organization
Project Title:
Malaria Vector control: Filling the gap between product development and effective delivery
Total Requested Amount (US $)[1]: $5,403,970
Date:
Are there Indirect Costs? (Enter: Yes or No):
Type of organization. (Enter: University, Other or Government):

Budget Line Items	Year 1 (revised)	Year 2 (revised)	Year 3 (revised)	Year 4	Year 5	Total	% of Total	Actual expend itures	%		Varia-nce
Total Personnel	235,800	275,940	375,755	360,000	0	1,247,495	23%	357,461	95%	18,294	5
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	235,800	275,940	365,755	360,000	0	1,237,495		347,461	95%	**18,294**	5
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	10,000	0	0	10,000		10,000			
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0			
Coordination and evaluation	0	0	0	0	0	0		0			
Total Fringe Benefits	26,200	30,660	40,000	40,000	0	136,860	3%	29,986	75%	10,014	25
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	26,200	30,660	40,000	40,000	0	136,860		29,986	75%	**10,014**	25
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0		0			
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0		0			

To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0		0			
Coordination and evaluation	0	0	0	0	0	0		0			
Total Travel	374,000	355,043	523,720	175,000	0	1,427,763	26%	505,954	97%	17,766	3
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	50,000	117,413	219,504	25,000	0	411,917		210,568	96%	**8,936**	4
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	154,000	164,580	212,063	0	0	530,643		209,277	99%	**2,787**	1
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	70,000	20,000	24,000	0	0	114,000		24,000			0
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	50,000	6,050	18,153	50,000	0	124,203		15,110	83%	**3,043**	17
Coordination and evaluation	50,000	47,000	50,000	100,000	0	247,000		47,000	94%	**3,000**	6
										0	
Total Consultants	576,000	202,099	178,867	100,000	0	1,056,966	20%	173,997	97%	4,870	3
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	551,000	179,075	114,000	50,000	0	894,075		114,000			0
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	20,000	64,867	50,000	0	134,867		59,997	92%	**4,870**	8

To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	25,000	3,024	0	0	0	28,024		0			
Coordination and evaluation	0	0	0	0	0	0		0			
Supplies											
Medical and Laboratory	550,000	143,972	20,000	0	0	713,972	13%	20,000		0	0
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0		0			
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	550,000	143,972	20,000	0	0	713,972		20,000		**0**	0
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0					
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0					
Coordination and evaluation	0	0	0	0	0	0					
Other Supplies	0	1,326	5,500	0	0	6,826	0%	5,500			0
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	1,326	5,500	0	0	6,826		5,500			0
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0					
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0					
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0					

Coordination and evaluation	0	0	0	0	0	0					
Subtotal of Modified Direct Costs	1,762,000	1,009,040	1,143,842	675,000	0	4,589,882		1,092,898	96%	**50,944**	4
Indirect Costs on Modified Direct Costs	0	0	0	0	0	0	0%	0		0	
Subtotal of Modified Direct Costs and Indirect Costs	1,762,000	1,009,040	1,143,842	675,000	0	4,589,882		1,092,898	96%	**50,944**	4
										0	
Total Contracted Services	0	28,960	160,556	0	0	189,516	4%	156,922	98%	3,634	2
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0					
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0					
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	125,000	0	0	125,000		123,430	99%	**1,570**	1
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	28,960	35,556	0	0	64,516		33,492	94%	**2,064**	6
Coordination and evaluation	0	0	0	0	0	0		0			100
Total Sub-grants to Others Organizations	0	0	0	0	0	0	0%	0			0
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0					
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0					
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0					
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0					

Coordination and evaluation	0	0	0	0	0	0					
Subtotal of Sub-grants/contracts	0	28,960	160,556	0	0	189,516		156,922	98%	**3,634**	2
Allowable Indirect Costs on Sub-grants/contracts 2, 3	0	0	0	0	0	0	0%	0			
Subtotal of Sub-grants/contracts and Allowable Indirect Costs	0	28,960	160,556	0	0	189,516		156,922	98%	**3,634**	2
										0	
Total Equipment	0	0	0	0	0	0	0%	0			
To strengthen infrastructure, technical and institutional capacities for effective vector control in malaria endemic countries, with a particular emphasis on resistance management	0	0	0	0	0	0					
To develop up to date country databases on the status on malaria vector resistance to insecticides and facilitate	0	0	0	0	0	0					
To facilitate the development, harmonization and use of methodologies and decision support systems in malaria control	0	0	0	0	0	0					
To develop country capacities to evaluate and introduce new tools in malaria vector control including new insecticides and application technologies	0	0	0	0	0	0					
Coordination and evaluation	0	0	0	0	0	0					
Total Direct Costs	1,762,000	1,038,000	1,304,398	675,000	0	**4,779,398**	87%	1,249,821	96%	54,577	4
Total Indirect Costs	0	0	0	0	0	**0**	0%	0			
Programme Support Costs (WHO) 13%	229,060	138,190	169,572	87,750	0	**624,572**	13%	138,190	81%	31,382	19
Grand Total Costs	1,991,060	1,176,190	1,473,970	762,750	0	5,403,970	100%	1,388,011	94%	85,959	6

[1] All amounts must be in US $

[2] Indirect rates are only applicable to the first $25,000 for sub-grants and certain sub-contracts (see narrative)

[3] Indirect allocation is not allowed on equipment costs

[4] Please insert the total number of subcontractors and sub grantees for all years in the space highlighted in yellow. The modified indirect cost will be calculated using this number.

CAMEROON		Year 1	Year 2	Total			
Summary of total needs	NMCP	30 800	44 240	75 040			
	NRU	50 200	33 970	84 170			
	TOTAL	81 000	78 210	159 210			

		Year 1		Year 2			
Item type	**Price/Unit (USD)**	**Qty**	**Price**	**Qty**	**Price**	**Beneficiary**	**Buyer**
Air conditioning	800	1	800	0	0	NMCP	NMCP
Deep freezer -20	1200	0	0	1	1200	NMCP	NMCP
Dissection Kits	50	0	0	3	150	NMCP	NMCP
ELISA (consum.)	2000	0	0	1	2000	NMCP	NMCP
Impregnated papers (6 insecticides)	120	0	0	5	600	NMCP	NMCP
Consumables (other)	1000	0	0	1	1000	NRU	NRU
Deep freezer -20	1200	0	0	1	1200	NRU	NRU
Dissection Kits	50	0	0	6	300	NRU	WHO
ELISA (consum.)	1500	0	0	1	1500	NRU	NRU
Impregnated papers (6 insecticides)	120	0	0	6	720	NRU	WHO
Microwave Oven	500	0	0	1	500	NRU	NRU
PCR (consum.)	2000	0	0	1	2000	NRU	NRU
Refrigerator	1200	1	1200	0	0	NRU	NRU
TOTAL STICKER			2000		11 170		
Aspirators (bent) WHO Malaysia	5	0	0	50	250	NMCP	WHO
Balance	4000	0	0	1	4000	NMCP	WHO
Clean distilled water	2500	1	2500	0	0	NMCP	WHO
Compound microscope	3500	0	0	1	3500	NMCP	WHO
Computer laptop & printer	2000	0	0	2	4000	NMCP	WHO
Dissection microscope	3500	0	0	1	3500	NMCP	WHO
Electrophoresis equipment	3800	1	3800	0	0	NMCP	WHO
Gel recording system	12 000	0	0	1	12 000	NMCP	WHO
GPS	200	0	0	5	1000	NMCP	WHO
Humidifier (insectary)	1000	1	1000	0	0	NMCP	WHO
Incubator	1600	1	1600	0	0	NMCP	WHO
Light traps	300	0	0	6	1800	NMCP	WHO
Micro centrifuge	8500	1	8500	0	0	NMCP	WHO
pH Meter	900	1	900	0	0	NMCP	WHO
Plate reader	10 000	0	0	1	10 000	NMCP	WHO

Susceptibility kit WHO	60	0	0	4	240	NMCP	WHO
Thermocycler	10 200	1	10 200	0	0	NMCP	WHO
Water bath	1500	1	1500	0	0	NMCP	WHO
Aspirators (bent) WHO Malaysia	5	0	0	30	150	NRU	WHO
Autoclave	8500	0	0	1	8500	NRU	WHO
Balance	4000	0	0	1	4000	NRU	WHO
Compound microscope	3500	1	3500	0	0	NRU	WHO
Computer laptop & printer	2000	2	4000	0	0	NRU	WHO
Electrophoresis equipment	3800	1	3800	0	0	NRU	WHO
Gel recording system	12 000	1	12 000	0	0	NRU	WHO
Humidifier (insectary)	1000	0	0	1	1000	NRU	WHO
Light traps	350	0	0	8	2800	NRU	WHO
pH Meter	900	1	900	0	0	NRU	WHO
Pipettes (complete range, 5)	1500	1	1500	0	0	NRU	WHO
Pipettes 8 channels	1100	1	1100	0	0	NRU	WHO
Plate reader	10 000	0	0	1	10 000	NRU	WHO
Refrigerated microcentrifuge	8500	1	8500	0	0	NRU	WHO
Stereo microscope	3500	1	3500	0	0	NRU	WHO
Susceptibility kit WHO	60	0	0	5	300	NRU	WHO
Thermocycler	10 200	1	10 200	0	0	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			79 000		67 040		

			81 000		78 210		159 210

KENYA		Year 1	Year 2	Total			
Summary of total needs	**NMCP**	38 500	40 150	78 650			
	NRU	37 090	36 310	73 400			
	TOTAL	75 590	76 460	152 050			

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price	Beneficiary	Buyer
Communication	1000	1	1000	1.5	1500	NMCP	NMCP
Consummables	500	1	500	1	500	NMCP	NMCP
Data management	3000	0	0	1	3000	NMCP	NMCP
Refrigerator	1200	0	0	1	1200	NMCP	NMCP
Vehicle maintenance and fuel	1000	1	1000	1.5	1500	NMCP	NMCP
Communication	1000	1	1000	2	2000	NRU	NRU
Consumables	1000	1	1000	2	2000	NRU	NRU
ELISA (consum.)	1500	1	1500	1	1500	NRU	NRU
Impregnated papers (six insecticides)	120	8	960	8	960	NRU	NRU
Insectory shelves and lighting	4000	1	4000	0	0	NRU	NRU
Microwave Oven	500	1	500	0	0	NRU	NRU
PCR (consum.)	2000	1	2000	1	2000	NRU	NRU
Vehicle maintenance and fuel	1500	1	1500	1	1500	NRU	NRU
TOTAL STICKER			14 960		17,660		
Aspirators (bent) WHO Malaysia	5	0	0	10	50	NMCP	WHO
Compound microscope	3500	0	0	4	14 000	NMCP	WHO
Computer laptop and printer	2000	1	2000	1	2000	NMCP	WHO
Dissection microscope	3500	0	0	4	14 000	NMCP	WHO
GPS	200	5	1000	0	0	NMCP	WHO
Light traps	300	8	2400	6	1800	NMCP	WHO
Susceptibility kit WHO	60	10	600	10	600	NMCP	WHO
Vehicle	30 000	1	30 000	0	0	NMCP	WHO
Aspirators (bent) WHO Malaysia	5	6	30	10	50	NRU	WHO
Compound microscope	3500	1	3500	0	0	NRU	WHO
Computer laptop and printer	2000	0	0	1	2000	NRU	WHO
Deep freezer -70	13 700	0	0	1	13 700	NRU	WHO
Pipettes (complete range, 5)	1500	4	6000	0	0	NRU	WHO
Pipettes 8 channels	1100	1	1100	0	0	NRU	WHO
Plate reader	10 000	0	0	1	10 000	NRU	WHO
Stereo microscope	3500	4	14 000	0	0	NRU	WHO
Susceptibility kit WHO	60	0	0	10	600	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			60 630		58 800		
			75 590		76 460		

MADAGASCAR			Year 1	Year 2	Total		
Summary of total needs		NMCP	28 085	44 500	72 585		
		NRU	48 200	20 200	68 400		
		TOTAL	76 285	64 700	140 985		

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price	Beneficiary	Buyer
Communication	1500	1	1500	0	0	NMCP	NMCP
Consummables	2000	1	2000	0	0	NMCP	NMCP
Dissection Kits WHO	50	6	300	0	0	NMCP	NMCP
Impregnated papers (6 insecticides)	120	4	480	0	0	NMCP	NMCP
Communication	1000	1	1000	0	0	NRU	NRU
Consumables	1000	1	1000	0	0	NRU	NRU
ELISA (consum.)	1500	1	1500	0	0	NRU	NRU
PCR (consum.)	2000	1	2000	0	0	NRU	NRU
TOTAL STICKER			9780		0		
Aspirators (bent) WHO Malaysia	5	5		0		NMCP	WHO
Compound microscope	3500	1	3500	0	0	NMCP	WHO
Computer desktop	1500	1	1500	0	0	NMCP	WHO
Computer laptop & printer	2000	1	2000	0	0	NMCP	WHO
Dissecting microscope	3500	1	3500	0	0	NMCP	WHO
Electrophoresis equipment	3800	0	0	1	3800	NMCP	WHO
ELISA (complete)	10 000	1	10 000	0	0	NMCP	WHO
Gel recording system	12 000	0	0	1	12 000	NMCP	WHO
GPS	200	5	1000	0	0	NMCP	WHO
Light traps	300	6	1800	0	0	NMCP	WHO
Plate reader	10 000	0	0	1	10 000	NMCP	WHO
Refrigerated microcentrifuge	8500	0	0	1	8500	NMCP	WHO
Susceptibility kit WHO	60	8	480	0	0	NMCP	WHO
Thermocycler	10 200	0	0	1	10 200	NMCP	WHO
Autoclave	8500	1	8500	0	0	NRU	WHO
Deep freezer -70	13 700	1	13 700	0	0	NRU	WHO
Gel recording system	12 000	1	12 000	0	0	NRU	WHO
Plate reader	10 000	0	0	1	10 000	NRU	WHO
Refrigerated microcentrifuge	8500	1	8500	0	0	NRU	WHO
Thermocycler	10 200	0	0	1	10 200	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			66 505		64 700		
			76 285		64 700		

MOZAMBIQUE		Year 1	Year 2	Total			
Summary of total needs	NMCP	31 550	0	31 550			
	NRU	54 480	39 400	93 880			
	TOTAL	86 030	39 400	125 430			

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price	Beneficiary	Buyer
Collection kits	3000		9000	0	0	NMCP	???
Dissection Kits	50		250	0	0	NMCP	NMCP
Consumables	4000		0	1	4000	NRU	NRU
Dissection Kits	50		250	0	0	NRU	NRU
ELISA (consum.)	2500		0	1	2500	NRU	NRU
Deep freezer -20	1200		1200	0	0	NRU	NRU
Impregnated papers (6 insecticides)	120		480	0	0	NRU	NRU
PCR (consum.)	5000		0	1	5000	NRU	NRU
Refrigerator	1200		1200	1	1200	NRU	NRU
Statistical Software License	3000		3000	0	0	NRU	NRU
Vehicle maintenance & fuel	3200		3200	1	3200	NRU	NRU
TOTAL STICKER			18 580		15 900		
GPS	200		1000	0	0	NMCP	WHO
Microscope	3500		10 500	0	0	NMCP	WHO
Stereo microscope	3500		10 500	0	0	NMCP	WHO
Susceptibility kit WHO	60		300	0	0	NMCP	WHO
Aspirators (bent) WHO Malaysia	5		50	0	0	NRU	WHO
Computer laptop & printer	2000		4000	1	2000	NRU	WHO
Electrophoresis equipment	3800		3800	0	0	NRU	WHO
Light traps	350		3500	0	0	NRU	WHO
Microscope	3500		3500	0	0	NRU	WHO
Pipettes (complete range, 5)	1500		0	1	1500	NRU	WHO
Plate reader	10 000		0	1	10 000	NRU	WHO
Refrigerated microcentrifuge	8500		0	1	8500	NRU	WHO
Susceptibility kit WHO	60		300	0	0	NRU	WHO
Vehicle	30 000		30 000	0	0	NRU	WHO
Water bath	1500		0	1	1500	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			67 450		23 500		
			86 030		39 400		

MALI		Year 1	Year 2	Total			
Summary of total needs	NMCP	19 650	34 100	53 750			
	NRU	48 000	3800	51 800			
	TOTAL	67 650	37 900	105 550			

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price		Buyer
Comsummables	2000	1	2000	1	2000	NMCP	NMCP
Deep freezer -20	1200	1	1200	0	0	NMCP	NMCP
Dissection Kits	50	0	0	0	0	NMCP	WHO
Impregnated papers (6 insecticides)	120	0	0	0	0	NMCP	NMCP
Refrigerator	1200	1	1200	0	0	NMCP	NMCP
Shelving	200	1	200	0	0	NMCP	NMCP
Vehicle maintenance & fuel	1500	1	1500	1	1500	NMCP	NMCP
Consumables (other)	1000	1	1000	0	0	NRU	NRU
Dissection Kits	50	10	500	10	500	NRU	WHO
Impregnated papers (6 insecticides)	120	10	1200	10	1200	NRU	NRU
PCR (consum.)	3200	1	3200	0	0	NRU	NRU
Vehicle maintenance & fuel	1500	1	1500	1	1500	NRU	NRU
TOTAL STICKER			13 500		6700		
Aspirators (bent) WHO Malaysia	5	10	50	0	0	NMCP	WHO
Compound microscope	3500	1	3500	0	0	NMCP	WHO
Computer laptop & printer	2000	2	4000	0	0	NMCP	WHO
Dissection microscope	3500	1	3500	0	0	NMCP	WHO
GPS	200	5	1000	0	0	NMCP	WHO
Light traps	350	0	0	0	0	NMCP	WHO
pH Meter	900	1	900	0	0	NMCP	WHO
Susceptibility kit WHO	60	10	600	10	600	NMCP	WHO
Turn key insectory	30 000	0	0	1	30 000	NMCP	WHO
Water bath	1500	0	0	0	0	NMCP	WHO
ELISA (complete)	10 000	1	10 000	0	0	NRU	WHO
Susceptibility kit WHO	60	10	600	10	600	NRU	WHO
Vehicle	30 000	1	30 000	0	0	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			54 150		31 200		
			67 650		37 900		

SENEGAL		Year 1	Year 2	Total			
Summary of total needs	NMCP	21 900	6520	28 420			
	NRU	63 000	24 700	87 700			
	TOTAL	84 900	31 220	116 120			

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price		Buyer
Consummables	2000	1	2000	1	2000	NMCP	NMCP
Impregnated papers (6 insecticides)	120	10	1200	14	1680	NMCP	NMCP
Consumables	1000	1	1000	1	1000	NRU	NRU
Deep freezer -20	1200	1	1200	0	0	NRU	NRU
Microwave Oven	500	1	500	0	0	NRU	NRU
PCR (consum)	2000	1	2000		0	NRU	NRU
Refrigerator	1200	1	1200	0	0	NRU	NRU
TOTAL STICKER			9100		4680		
Aspirators (bent) WHO Malaysia	5	0	0	0	0	NMCP	WHO
Computer laptop & printer	2000	2	4000	0	0	NMCP	WHO
Data management	2000	1	2000	1	2000	NMCP	WHO
ELISA (complete)	10 000	1	10 000	0	0	NMCP	WHO
GPS	200	5	1000	0	0	NMCP	WHO
Pipettes 8 channels	1100	1	1100	0	0	NMCP	WHO
Susceptibility kit WHO	60	10	600	14	840	NMCP	WHO
Autoclave	8500	1	8500	0	0	NRU	WHO
Balance	4000	1	4000	0	0	NRU	WHO
Compound microscope	3500	0	0	0	0	NRU	WHO
Deep freezer -70	13 700	0	0	1	13 700	NRU	WHO
Electrophoresis equipment	3800	1	3800	0	0	NRU	WHO
Gel recording system	12 000	1	12 000	0	0	NRU	WHO
Incubator	1600	1	1600	0	0	NRU	WHO
Light traps	350	10	3500	0	0	NRU	WHO
pH Meter	900	1	900	0	0	NRU	WHO
Pipettes (complete range, 5)	1500	1	1500	0	0	NRU	WHO
Pipettes 8 channels	1100	1	1100	0	0	NRU	WHO
Plate reader	10 000	0	0	1	10 000	NRU	WHO
Refrigerated microcentrifuge	8500	1	8500	0	0	NRU	WHO
Stereo microscope	3500	0	0	0	0	NRU	WHO
Thermocycler	10 200	1	10 200	0	0	NRU	WHO
Water bath	1500	1	1500	0	0	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			75 800		26 540		
			84 900		31 220		

TANZANIA			Year 1	Year 2	Total		
Summary of total needs		NMCP	0	70 280	70 280		
		NRU	71 100	71 970	143 070		
		TOTAL	71 100	142 250	213 350		

		Year 1		Year 2			
Item type	Price/Unit (USD)	Qty	Price	Qty	Price		Buyer
Consummables	2000	0	0	1	2000	NMCP	NMCP
Deep freezer -20	1200	0	0	1	1200	NMCP	NMCP
Dissection Kits	50	0	0	6	300	NMCP	NMCP
Impregnated papers (6 insecticides)	120	0	0	16	1920	NMCP	NMCP
Refrigerator	1200	0	0	1	1200	NMCP	NMCP
Shelving	200	0	0	3	600	NMCP	NMCP
Telecommunication & post	5000	0	0	1	5000	NMCP	NMCP
Vehicle maintenance & fuel	1500	0	0	1	1500	NMCP	NMCP
Consumables	1000	0	0	1	2000	NRU	NRU
Deep freezer -20	1200	1	1200	0	0	NRU	NRU
Dissection Kits	50	0	0	16	800	NRU	NRU
Impregnated papers (6 insecticides)	120	0	0	16	1920	NRU	NRU
Microwave Oven	500	1	500	0	0	NRU	NRU
PCR (consum.)	3200	0	0	1	3200	NRU	NRU
Refrigerator	1200	1	1200	0	0	NRU	NRU
Vehicle maintenance & fuel	1500	0	0	1	1500	NRU	NRU
TOTAL STICKER			2900		23 140		

Aspirators (bent) WHO Malaysia	5	0	0	20	100	NMCP	WHO
Compound microscope	3500	0	0	3	10 500	NMCP	WHO
Computer laptop & printer	2000	0	0	1	2000	NMCP	WHO
Dissection microscope	3500	0	0	3	10 500	NMCP	WHO
GPS	200	0	0	5	1000	NMCP	WHO
Light traps	300	0	0	5	1500	NMCP	WHO
Susceptibility kit WHO	60	0	0	16	960	NMCP	WHO
Vehicle	30 000	0	0	1	30 000	NMCP	WHO

Aspirators (bent) WHO Malaysia	5	0	0	10	50	NRU	WHO
Autoclave	8500	0	0	1	8500	NRU	WHO
Balance	4000	1	4000	0	0	NRU	WHO
Compound microscope	3500	1	3500	0	0	NRU	WHO
Deep freezer -70	13 700	1	13 700	0	0	NRU	WHO
Electrophoresis equipment	3800	1	3800	1	3800	NRU	WHO
ELISA (complete)	10 000	0	0	1	10 000	NRU	WHO
Gel recording system	12 000	1	12 000	0	0	NRU	WHO
Incubator	1600	1	1600	0	0	NRU	WHO
Light traps	350	0	0	16	5600	NRU	WHO
pH Meter	900	1	900	1	900	NRU	WHO
Pipettes (complete range, 5)	1500	1	1500	0	0	NRU	WHO
Pipettes 8 channels	1100	0	0	1	2200	NRU	WHO
Refrigerated microcentrifuge	8500	1	8500	0	0	NRU	WHO
Stereo microscope	3500	1	3500	0	0	NRU	WHO
Stereo microscope	3500	1	3500	0	0	NRU	WHO
Susceptibility kit WHO	60	0	0	0	0	NRU	WHO
Thermocycler	10 200	1	10 200	0	0	NRU	WHO
Vehicle	30 000	0	0	1	30 000	NRU	WHO
Water bath	1500	1	1500	1	1500	NRU	WHO
TOTAL TO BE PURCHASED BY WHO			68 200		119 110		
			71 100		142 250		