National Strategic Plan on Integrated Vector Management—Rwanda

Integrated Vector Management (IVM) Task Order 2

Contract GHA-I-02-04-00007-00

Prepared for:

United States Agency for International Development

Prepared by:

RTI International
3040 Cornwallis Road

Post Office Box 12194
Research Triangle Park, NC 27709-2194

June 2012

Republic of Rwanda

Ministry of Health

National Strategic Plan

on

Integrated Vector Management (IVM)

(2012 - 2017)

27 June 2012

Foreword

The burden of malaria in Rwanda has decreased dramatically over the past few years following the scale-up of interventions supported by the Global Fund, the USAID President's Malaria Initiative and other partners. A recent review of the Malaria Program (MPR 2011) reported a 66% decline in malaria morbidity to an average of 19% test positivity rate (TPR) between 2001 and 2010. Malaria case fatality rate also declined from 5.8% to 0.6% between 2005 and 2008 (DHS 2008). A new 5 year Malaria Strategic Plan (MSP) (2012-2017) has set a goal “To reduce malaria morbidity to pre-elimination level of less than 5% test positivity rate and mortality rate by 50% by 2017”. This is an ambitious goal but nevertheless achievable if the current interventions are sustained and scaled up over the coming years.

The above successes, notwithstanding, there are significant challenges to vector control that could hinder the desired positive progression. For example, the observed phenomenon where mostly indoor resting and biting malaria vectors are being replaced by populations with increasing preference for outdoor biting and/or resting in areas where long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS) are being implemented could undermine the continued utility of the two interventions to further reduce disease burdens in the affected areas. We know that mosquitoes are very resilient and are bound to develop resistance to the insecticides used on LLINs and in IRS as a result of increasing selective pressure. Insecticide resistance has been reported in the neighboring countries and denotes an urgent need to establish an effective resistance management scheme in Rwanda. Lack of effective inter-sector collaboration, a less-than-desirable level of community involvement in vector control and over-reliance on external support are some of the other challenges that need to be addressed, if the set Goal is to be achieved and sustained. These challenges will even be more critical when the disease prevalence and incidence lowers further towards pre-elimination phase, when malaria will be less of a public health problem. With all these challenges, there is a need, therefore, to establish a sound vector management framework that will maintain focus on vector ecology as transmission dynamics evolve.

Partly in recognition of the above challenges, strong recommendations were made by a stakeholders meeting on national vector control needs assessment (VCNA) in 2011, as well as the 2011 Malaria Program Review, for the Ministry of Health to adopt integrated vector management (IVM) as a sustainable national strategic approach for malaria control. As stated in WHO reports, the principles and attributes of IVM provide a comprehensive framework that

enables a national program to strengthen legislative and regulatory aspects of vector control, inter-sectoral collaboration, integration of methods, capacity building, monitoring and evaluation.

The transition to IVM in Rwanda started with a vector control needs assessment in 2010/11. The assessment identified gaps and priorities that the country could institute to streamline the vector control program. Recommendations were made to develop policy guidelines on IVM and a Strategic Plan on IVM to promote the integration of various interventions, address regulatory mechanisms and encourage participation of other non-health sectors and communities towards vector control. Implementation of IVM will entail establishing, strengthening and reorganizing the existing vector control services to ensure that national assets are mobilized at all levels for a multidisciplinary and joint action by all relevant sectors. There will be a conscious effort on the part of the Government to develop the requisite competencies and skills to facilitate full national transition to IVM and integration of IVM into the existing framework of national health policies.

It is projected that this Strategic Plan will enable more cost-effective, ecologically sound and sustainable vector control interventions to speed up malaria elimination in Rwanda and also ensure that the country has a well-developed capacity and capability to prepare and respond to malaria and the other vector- borne diseases. The Ministry of Health fully supports this Strategic Plan and I am confident that the IVM implementation will continue to receive support from all relevant administrative levels, as well as from stakeholders, development partners and the communities towards achieving zero deaths attributable to malaria.

Dr. Agnes BINAGWAHO

Minister of Health

Acknowledgements

The formulation and development of this IVM Strategic Plan arises from the recommendations made in the vector control needs assessment (VCNA) that was conducted in 2010/2011 and the Malaria Program Review that was conducted in March 2011. IVM implementation in Rwanda was viewed as necessary to sustain and further build on the current vector control efforts against malaria and other vector borne diseases. The IVM strategy, which will be implemented at all levels in the country, will bring together all stakeholders and communities under the auspices of the Malaria and Other Parasitic Diseases Division (MOPDD) of the Ministry of Health, which has been mandated to harmonize and coordinate national efforts to control and prevent vector borne diseases in Rwanda. It is for this reason that I would like to express my gratitude to all who have been involved in this very important milestone in our health sector.

I would like to extend my appreciation to our key national stakeholders and Development Partners for their active participation and support to the IVM Strategic Plan development process. I also wish to thank the 58 stakeholders who represented various sectors, namely, the Ministry of Health, other government sectors, non-governmental organizations, development partners and the media who validated and adopted the IVM Policy and Strategic Plan on 7 June 2012. I would in particular like to sincerely thank the US President Malaria Initiative (PMI) for the financial and technical support provided through RTI International. It is anticipated that this Strategy will be a living document that undergoes periodic review and updates based on the country's needs and changing malaria landscape. This will ensure adequate and ongoing guidance on effective control and prevention of vector borne diseases in Rwanda, particularly malaria. I look forward to active participation by all relevant stakeholders in the execution of this Strategic Plan, and re-dedication to providing a healthier livelihood to our communities by ridding the country of malaria and other vector borne diseases that hamper our socio-economic development. I appeal to all stakeholders to do their part and collaborate with the MOPDD to ensure that the vision of transforming Rwanda into a malaria-free country, as espoused in the new Malaria Strategic Plan (2012-2017), will be realized within the next few years.

Dr. Corine KAREMA

Head,
Malaria and Other Parasitic Diseases Division

Table of Contents

Acronyms and Abbreviations

CDC	Centers for Disease Control and Prevention, USA
CHWs	Community health workers
CIP	Crop Intensification Program
FAO	Food and Agricultural Organization
GFTAM	Global Fund to fight Tuberculosis, Aids and Malaria
GEF	Global Environmental Facility
HMIS	Health Management Information Systems
IEC/BCC	Information, Education and Communication/Behavioral Change Communication
IRS	Indoor residual spraying
IVM	Integrated vector management
KHI	Kigali Health Institute
LLINs	Long lasting insecticide treated nets
M&E	Monitoring and Evaluation
MINAGRI	Ministry of Agriculture and Animal Resources
MOH	Ministry of Health
MoEnv	Ministry of Environment
MOPD	Malaria and Other Parasitic Diseases Division
MPDD	Medical Procurement and Distribution Division
MPR	Malaria Programme Review
NGOs	Non-Governmental Organizations
NISC	National Inter-sectoral Steering Committee
NTD	Neglected Tropical Diseases
NUR	National University of Rwanda
PTF	Pharmacy Task Force of the Ministry of Health
RADA	Rwanda Agricultural Development Authority
RBC	Rwanda Biomedical Centre
RBS	Rwanda Bureau of Standards
RDT	Rapid diagnostic test
REMA	Rwanda Environmental Management Authority
RTI	Research Triangle International
SPH	School of Public Health, Kigali
TRAC*Plus*	Center for Treatment and Research on AIDS, Malaria, Tuberculosis and Other Epidemics
UNEP	United Nations Environment Programme
USAID/PMI	United States Aid for International Development/President's Malaria Initiative
VBDs	Vector borne diseases
VCNA	Vector control needs assessment
VCTWG	Vector control technical working group
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

1.0 Introduction

There are a number of vector borne diseases prevalent in Rwanda, of which malaria is the most important in terms of the impact on the socio-economic development of the entire population. Vector control is one of the major strategies for malaria control and prevention currently being undertaken in the country. When well-planned and coordinated, vector control interventions can help to significantly reduce the incidence and prevalence of malaria and other vector borne diseases. Rwanda has mounted effective vector control interventions using long lasting insecticide nets (LLINs) and indoor residual spraying (IRS) targeting. These two interventions may, however, not be sufficient, in the long run to sustain the control and ultimate elimination of malaria. Implementation of these two interventions should be part of an integrated vector management (IVM) strategy, which effectively addresses all the local eco-epidemiological drivers of malaria transmission in a cohesive and coordinated national endeavor that appropriately mobilizes all relevant national assets. IVM, defined as, "*A rational decision-making process for the optimal use of resources for vector control*" (WHO 2008), is a strategy that builds onto the existing structures while strengthening linkages between communities, partners and health systems at all levels to improve the efficiency, effectiveness and ecologically soundness of vector control interventions anchored on well-developed policies and sound monitoring and evaluation.

Policy guidelines have been developed for Rwanda, which will be instrumental in ensuring a conducive environment for the implementation of IVM. This IVM Strategic Plan has been developed in line with WHO IVM Handbook (WHO, 2011) and is aimed at enabling joint action by the Ministry of Health and other government sectors, non-governmental organizations, development partners, private sectors, civil society and communities, to enhance cost-effectively address vector borne disease control in Rwanda.

1.1 Situation analysis

Summary of Vector Borne Diseases in Rwanda

There are several vector borne diseases (VBDs) in Rwanda as reported in the VCNA 2010 report. They are summarized below:

Malaria: This is the major vector borne disease and a leading cause high morbidity and mortality. The disease is endemic in 19 out of the 30 districts in the country, with the main foci in

the eastern and south eastern parts where the altitude is generally below 1500m above sea level and characterized by marshy plains, rice cultivation and brick–making, all of which create suitable breeding sites for mosquitoes. The major vectors of malaria are *Anopheles gambiae, An. arabiensis* and *An. funestus*.

The other vector borne diseases reported to be present in the country are not well-studied and their distribution and prevalence not well-understood. The diseases include:

Lymphatic filariasis: This disease is also transmitted by mosquitoes. It is endemic in eastern provinces and the districts bordering Democratic Republic of Congo (DRC) and Burundi. This is a debilitating, but non-fatal disease, which if left untreated causes swelling and deformity of limbs, breasts and genital organs. The vectors, prevalence levels and extent of distribution of the disease have not been well studied, although *An. gambiae, An. funestus* and *Culex. quinquefasciatus* are known major vectors in this general region of Africa. There is currently no active filariasis control program in place.

Human African Trypanosomiasis: Although the prevalence of this diseases is not well-understood in Rwanda, it is believed that the disease is present around the Akagera National Park where high infection rates of tsetse fly vectors have been reported. This is also a debilitating disease that affects the nervous system and causes the victim to feel drowsy, hence the name, sleeping sickness.

*Onchocercia*sis*:* is another debilitating disease believed to be prevalent in Rwanda. Although a 1999 nationwide evaluation by the Africa Programme on Onchorcerciasis Control (APOC, 2009) indicated very low endemicity of the disease, the current situation is unclear as the disease could well be both under-detected and under-reported. The black flies (*Simulium damnosum)* that breed along rapid rivers systems are the primary vectors. Infection with this disease can affect the eyes and cause blindness, hence its popular name, river blindness.

Dengue hemorrhagic fever has not to-date been reported in Rwanda. However, several epidemics have been reported in the neighboring countries of DRC and Uganda, putting Rwanda at high risk due to cross border movements of populations as well as the high populations in the at-risk areas. *Aedes aegypti* mosquitoes are the primary vectors.

Schistosomiasis is prevalent in districts located near lakes, rivers and swamps where vector snails are abundant. This is also a chronic debilitating disease that affects the intestinal organs and urinary tract. Children are the most vulnerable because of their behavioral activities near water bodies that harbor the vector snails. A 2007/8 study indicated national prevalence of about 2.7% among children with some schools located near lakes and swamps with a prevalence above 30% (GOR Report, 2008).

The prevalence of arboviruses such as Rift Valley fever and Yellow Fever, both of which are mosquito-borne, is currently not documented in Rwanda. However, the reported cases of these diseases in the neighboring countries (e.g. Rift Valley fever in Tanzania and Kenya) poses a potential risk for Rwanda. As such, cross-border collaboration and regional surveillance of these diseases are necessary to mount coordinated planning and control efforts.

The above listed VBDs, most of which are transmitted by mosquitoes, impose unacceptable levels of morbidity and mortality in the region, but in the case of Rwanda, malaria is the most important and as such this Strategic Plan will give emphasis to this disease. However, it is recognized that the vector control interventions currently used for malaria control have the potential to impact other VBDs. The investments in infrastructure and related health system strengthening linked to malaria control, could also provide synergistic support to the control of other VBDs. An integrated and multi-disease approach, as advocated under IVM, presents a unique opportunity to mobilize stakeholders' efforts to improve the overall efficiencies in the utilization of resources for diseases control.

1.2 Vector control needs assessment (VCNA)

Rwanda initiated efforts to adopt integrated vector management in 2010, and as a first step towards this direction, a vector control needs assessment was conducted in accordance with the WHO guidelines (WHO 2003). A detailed review of the framework and status of vector control in the country identified challenges and key gaps and requirements for vector borne diseases control and redefined operations to increase efficiencies and maximize sustainable efforts to reduce the disease burden. The gaps in policy, structural arrangements, operational, inter-sectoral collaboration and community mobilization were recommended for follow-up towards IVM implementation (VCNA report, 2011). A stakeholders meeting in which over 40 participants met in Kigali on 3 Feb 2011 reviewed and validated the VCNA report and agreed on the following:

- The VCNA report should be adopted as a reference document for establishment of an IVM Strategic Plan in Rwanda.
- IVM should be adopted as the strategy for all vector borne diseases control in Rwanda.
- The Malaria Unit of *TRACPlus* should spearhead the IVM strategic plan development and implementation process.
- An inventory of stakeholders who show interest in collaboration and supporting vector control activities should be established.
- A national IVM focal point should be designated.
- A formal national inter-sectoral coordination mechanism for IVM should be established.
- There is need for high level advocacy and resource mobilization for IVM implementation.
- Human and infrastructure capacities to implement IVM should be strengthened at central, district, sector and village levels.
- There is need to take advantage and exploit the existing community structures and networks for IVM implementation.

2.0 Strategic Plan

This strategic plan herein outlined seeks implementation consistent with the 6 key principles of IVM described by WHO, 2004. The elements are: *i) Advocacy and social mobilization, ii) Legislation and regulation, iii) Collaboration within the health sector and with other sectors iv), Integrated approach v) Evidence-based decision-making, and vi) Capacity-building.* A comprehensive adoption of these principles will improve the ecological soundness cost-effectiveness and sustainability of vector control interventions in the country.

2.1 General objective

- *To mobilize sustainable and coordinated national efforts and resources to accelerate the control and ultimate elimination of malaria and other vector borne diseases in Rwanda*.

.

2.2 Specific objectives

- Embed in the development policies of all relevant sectors, organizations and civil society, IVM guidelines to prevent or minimize the negative impacts of natural resource development on vector borne diseases.

- Establish appropriate legislative and regulatory regimes for public health insecticides to promote judicious use, safeguard human health and the environment, and enable effective management of insecticide resistance.
- Establish an appropriately mandated inter-sectoral coordination mechanism to ensure empowerment and active involvement of all stakeholders, including the private sector, for joint planning, resource mobilization and to oversee the implementation of vector control activities.
- Foster a rational decision making process in the choice, diversification, and deployment of vector control interventions. Efforts will focus on the generation and management of relevant knowledge of the local disease eco-epidemiology, to promote the ecological soundness of interventions, appropriate integration of chemical and non-chemical vector control tools/methods and multi-disease control approaches.
- Identify and build at all levels, relevant capacities including essential physical infrastructure, technical human competencies, and empowered communities, for an effective management of malaria and other vector borne diseases.
- Promote cross-border vector borne disease control initiatives aimed at harmonizing and coordinating interventions across the border areas with neighbouring countries.

3.0 IVM Implementation Strategies

3.1 Advocacy and Social Mobilization for IVM

Effective advocacy and communication (A/C) is central to the national transition to IVM. The targets of A/C efforts will be as multivariate as there are stakeholder groupings.

MOPDD will coordinate the advocacy and communication on IVM under the guidance of the mandated National Inter-sectoral Steering Committee (NISC) and with due consultation with major primary stakeholders (e.g. Ministry of Agriculture and Animal Resources, Ministry of Environment, as well as within the Ministry of Health). There will be advocacy and communication targeting various groups:

- *Policy makers*: Although the commitment of central government for IVM has been clarified, there will still be a need for continued A/C to create and sustain an enabling environment for IVM implementation over the years. The goal will be to inform on the successes/benefits, experiences/lessons, and requirements/needs for IVM. Projecting

funding requirements by the MOH will provide a basis for forward planning and in-country annual resource allocation for vector control. As the country moves towards the pre-elimination phase of malaria, the policy makers will require continuous advocacy to ensure that resources continue to be allocated for vector control even as malaria transmission become less of a public health problem.

- *Communities and general public:* The focus will be to empower and elicit proactive participation in IVM activities. A/C will be in local dialects and through various public media, meetings and direct personal communication by implementing stakeholders. The aim will be to provide information on IVM, the various interventions to be/are being deployed; anticipated roles and compliance issues for community and households to understand their role in vector suppression.
- *Technical staff implementing intervention*: These will be at all levels - central, through to districts and sector level-involving appropriate technical and non-technical information. The goal will be to facilitate sound decision-making and reporting at the various program administration levels.
- *Other stakeholders* (e.g. private sector, NGOs and civil society): A/C will aim at soliciting participation and contribution (technical, financial, materials and supplies, etc) to the national program. Advocacy may also aim at providing advisories for private sector-driven social corporate responsibility initiatives in vector control.
- *Donors and developmental partners*: Keeping partners informed is important to effective resource mobilization and continued commitment. Advocacy will be on the goals, plans and progress on IVM implementation (for example, population protected through various interventions and methods and lives saved) as well as gaps in funding and other resources.

3.1.1 Implementation plan for advocacy and social mobilization

- The NISC will provide overall guidance to all aspects of IVM implementation.
- MOPDD will provide day-to-day leadership in sensitization, advocacy and communication efforts, with close consultation and inputs from relevant stakeholders, particularly those with noted expertise in this area. Mass Media will be part of the stakeholders that will support IVM advocacy and communication.
- The MOPDD will work with partners to integrate appropriate IEC/BCC in vector control interventions.

- The following entities will be targeted in efforts to empower communities in vector control: mosques, churches, community health workers, rice farmers, brick makers, local authorities, schools, and local environmental committees.
- The MOPDD and all stakeholders will participate in mobilization of human and financial resources towards advocacy for vector control.

3.1.2 Indicators

- Advocacy meetings on IVM at the national and district level in place.
- Advocacy materials for IVM produced.
- Number of targeted stakeholders that have allocated resources for vector control.
- Number of targeted cells/sectors that have received advocacy information on IVM.
- Number of targeted cells/sectors where communities have been mobilized and engaged in vector control.

3.2 Legislation and Regulation for IVM

An appropriate legislative and regulatory environment is important for effective national scale-up of vector control. The objective of such legislation and regulation (L&R) in vector control is two-fold:

i) To prevent or mitigate negative impacts from human activities on local disease transmission. Human activities such as irrigated agriculture, dams, sand weaning, road construction and other building projects may inadvertently create significant breeding habitats that can alter the local transmission of vector-borne diseases. Currently, there are regulations in Rwanda stipulating the conduct of an environmental impact assessment prior to any major developmental project. Opportunities to further strengthen these regulations by ensuring adequate consideration of health impacts and inclusion of safeguards against diseases will be fully explored.

ii) To protect the environment and human health against potential adverse effect from improper handling and non-recommended use of public health insecticides. Effective management of public health insecticides is a basic requirement for deploying any insecticide-based intervention. Public health insecticides will be fully regulated to protect human health and the environment. A comprehensive assessment of the adequacy of existing national legislation and regulations covering the use of public and agricultural health pesticides will be made and appropriately strengthened and enforced. Rwanda

already has strict procedures for registering, licensing and importation of WHOPES approved insecticides for IRS, larviciding and other vector control products. Criteria for approving local vendors of public health insecticides will include capacity for transmitting all appropriate information on the handling, safe use and disposal of insecticide products.

The widespread use of an insecticide for vector control will be preceded by a detailed risk assessment of the potential risks to human health and the environment and peculiarities of the intended ecological zone or operational area and the verifiable implementation of safeguards. This will be to ensure compliance with the national regulations on public health insecticides, as well as relevant recommendations of the WHO and FAO. The selection of specific public health insecticides for vector control interventions (e.g. IRS, larviciding) will be based on clear evidence for the selection criteria including adequate consideration of impact on pre-existing tolerance/ resistance in vector populations and safety to humans and the environment. There will be appropriate educational, advisory, extension and health-care services linked to use of insecticides for IRS.

3.2.1 Implementation plan for Legislation and Regulation

- Relevant pesticide management laws, regulations and institutional arrangements will be regularly reviewed and updated to provide adequate protection of human health and the environment in vector control operations. The Pharmacy Task Force (PTF) of the Ministry of Health and partners will establish a framework, involving the local authorities and other relevant agencies, for national enforcement of regulations on public health insecticides. Penalties for breaking laws regulating the use of insecticides will be clarified and broadcasted, and access to public health insecticides will, at all times, be restricted to authorized persons/outfits.
- Selected insecticides for vector control will be procured by the Medical Procurement and Distribution Division (MPDD), from internationally recognized/ certified manufacturers and/ or their certified and authorized local agents. There will be a verifiable chain of custody within country, and country capacity for assuring the quality of procured insecticides will be enhanced in collaboration with advanced laboratories.
- All categories of insecticide handlers, particularly spray operators and drivers, will be appropriately trained and certified on Best Practices covering the whole insecticide life cycle – including storage, transportation, end-use and disposal. All

spray operators must be certified based on completion of stipulated training or periodic refresher training. Insecticide handlers (transporters, store keepers, spray operators, etc.) will use approved personal protective equipment (PPE) at all times during the handling of insecticides.

- Harmonized pesticide storage and inventory practices will be established and informed by national regulations and relevant recommendations of WHO and FAO. There will be a certification scheme for all insecticide application equipment.
- The broadcast use of insecticides in vector control (e.g. IRS, larviciding) will involve trained environmental compliance inspections as an integral part of programming to monitor IRS field operations to promptly correct anomalies.
- Health facilities in the target areas will be selected and equipped as reference points for adverse effects and insecticide poisoning monitoring.
- The Pharmacy Task Force (PTF) of the MoH will establish a framework for national enforcement of regulations of public health pesticides.
- MPDD and RBS will ensure that appropriate procurement, quality control and distribution of pesticides is enforced.
- REMA and RDB will ensure environmental health impact assessments are conducted on all development projects.

3.2.2 Indicators

- Environmental Health Impact Assessment conducted in all development projects
- Insecticide resistance management strategy in place
- Insecticide management regulations enforced
- Tax exemption on vector control products enforced

3.3 Collaborative Arrangements for IVM

A central principle of IVM is the recognition that the drivers of local transmission of VBDs cuts across several sectors, thus requiring cross-sectoral action. Under the coordination by the NISC and leadership of the MOPDD, vector control will assume a multi-sectoral approach, where non-health sectors, such as agriculture and environment, will play proactive roles to ensure that factors affecting disease transmission are addressed. National development activities such as expansion of rice cultivation and other resource development agendas will be safeguarded against contribution to proliferation of mosquito and snails, for example. Collaboration between

the Health and Agriculture Sectors is also critical to promoting judicious use of pesticides, safeguarding human and environmental health, and insecticide resistance management.

One of the first activities in the process of national transition to IVM will be the establishment of a robust coordination mechanism to provide oversight and guidance to the IVM implementation. This is a prerequisite to active participation within the health sector and by other sectors and stakeholders.

(i) *Intra-sectoral collaboration*

Intra-sectoral collaboration within the Ministry of Health departments - that is, between the MOPDD, the Emerging Infectious Diseases Unit, the Environmental Health Desk, the Community Health Workers Desk, the Neglected Tropical Diseases Unit and the National Reference Laboratory, all of which have currently very limited collaboration.

3.3.1 Implementation plan for intra-sectoral collaboration

- The MoH will lead the development of a formal mandate, terms of reference and commissioning of an NISC to oversee the national implementation of IVM.
- The MoH shall appoint senior-level staff for the NISC and identify major stakeholders to invite as members. The MoH will promote adequate consultations on the IVM Strategy by all stakeholders.
- The MOPDD will recruit additional senior entomologists to incorporate capacity to address other vectors apart from malaria vectors. As needed, entomologists in other sectors will also be mobilized to support specific vector control efforts.
- The MOPDD will facilitate development of district work plans for IVM.

3.3.2 Indicators

- National IVM Policy and Strategy in place.
- The MOPDD fully functional and linkage with NTD Unit to address all VBDs in the country.
- Number of institutions and stakeholders that participate in vector control activities.
- Number of districts that have annual work plans for IVM.

(ii) *Inter-sectoral collaboration*

Inter-sectoral collaboration between sectors (e.g. Agriculture, Environment, Infrastructure) and other national stakeholders (communities, private sector and other non-governmental groupings, etc.) will be strongly advocated. The VCNA validation meeting held in February 2011 brought together potential collaborators who expressed their interest in participating in vector control as outlined in Table 1. A formal National Inter-sectoral Steering Committee (NISC) will be formed to provide national coordination – advising and guiding the MOPDD and other participating partners on IVM process. Sectoral/ stakeholder functions and roles will be clarified to foster transparency and accountability in the collaboration.

Table 1. Institutions and their anticipated roles in vector control *(culled from VCNA Report 2011)*

Sector/Department	Roles in vector control
Ministry of Agriculture and Animal Resources	Advise farmers on best practices for rice cultivation and pesticide use
Ministry of Infrastructure	Ensure environmental compliance in housing, roads, dams and other infrastructure
Ministry of Natural Resources	Ensure environmental compliance and conservation
Ministry of Education	Create awareness on vector borne diseases control
Ministry of Finance and Economic Planning	Ensure financial sustainability towards vector control
Ministry of Local Government, Community Development and Social Affairs	Ensure public health sanitation, promote and advocate for vector control strategies
Rwanda Bureau of Standards	Ensure compliance with international standards on various vector control products and tools
Medical Procurement and Distribution Department	Ensure procurement, storage and equitable distribution of vector control products and tools
Rwanda Revenue Authority	Implement tax exemption and tariffs on public health products including mosquito nets
Rwanda Agricultural Development Authority	Ensure judicious use of pesticides on animal trypanosomiasis control
Rwanda Environmental Management Authority	Ensure environmental health policies are followed
Meteorological Center	Gather climate data for forecasting and prediction
NGOs: USAID/PMI, WHO, FAO, UNEP/GEF, GFTAM	Technical and financial support for vector control
Private sector: Agro Tech, Afrishem and UTEXRWA, etc	Collaboration and support for vector control
Training centres: KHI, NUR, SPH, Access Project, etc	Operational research and training in vector control
Local NGOs: farmers Cooperatives, civil societies	Promote end use compliance of insecticide and environmental management best practices among farming communities

National Inter-sectoral Steering Committee (NISC)

A National Inter-sectoral Steering Committee (NISC) will be established under the leadership of the Minister of Health, who will appoint a senior staff designee as chair, a position that will be filled on an annual rotational basis. The potential mandate of the NISC will include the following:

- Review national policies relevant to vector borne diseases control and develop a unified action plan for their control.
- Coordinate and provide oversight to the implementation of national IVM strategy and work plans, ensuring cost-effectiveness, efficiencies and sharing of lessons/ experiences.
- Coordinate the mobilization of resources for inter-sectoral action consistent with national aspirations for VBD control, ensuring transparency and accountability.
- Facilitate rationalized roles and responsibilities among stakeholders and evolve mechanisms to promote/ ensure accountability.
- Undertake regular review of the implications of policies, strategies and work plans on VBDs and make recommendations to the Government and appropriate authorities to enhance the achievements of national objectives on vector control.
- As may be required, establish technical working groups drawing upon national and international expertise to address priority issues of concern through operational research or surveys.
- Create opportunities for generating broad-based national consensus on issues and ensure that the genuine concerns of at-risk populations and communities are adequately considered.

The NISC will strive to balance sectoral/partner expectations with the broader national VBDs goals and ensure that all VBDs risks are given appropriate consideration. It will ensure that individuals partner agenda fits and is integrated into the overall national strategic objective and actions. Roles and responsibilities of stakeholders will be established to facilitate collaboration (Table 2). The inter-sectoral arrangements at the national level will be reflected within the decentralized districts to enable effective joint action on vector control at all levels.

There will be strong competency-focused groups, pooled from relevant stakeholders to support IVM. These grouping will include focal areas of epidemiology, entomology, environmental management, and program management and will work as *ad hoc* subcommittees under the auspices of the NISC and day-to-day leadership of the MOPDD through the IVM focal point. These specialists will advise on the management of VBDs programs; make recommendations for the enhancement of national policy for VBDs; technical organization, monitoring and evaluation of national programs; training intermediate level staff, and conducting priority research on VBDs. At the national level, the MOPDD will provide overall strategic and technical guidance to district level planning, implementation, monitoring and evaluation of the IVM strategy, ensuring a multidisciplinary, multi-disease approaches and proactive inter-sectoral action.

Table 2: Potential functions and roles for inter-sectoral action in health

Health Sector Functions
• Periodic eco-epidemiologic evaluation & surveillance • Document and disseminate lessons • Update priority R&D needs and agenda • Establish and update institutional and operational frameworks • Harmonize relevant sectoral policies and legislation • Evaluate policy, institutional and operational framework • Identify sector-specific vector control measures, quality control of activities and monitor compliance • Capacity building
Functions of Other Sectors
• Include health criteria in sectoral operational frameworks and procedures • Undertake health impact assessment for new development projects and ensure the implementation of mitigation measures proposed for potential negative health impact • Implement vector control measures in line with sectoral mandates • Participate in joint activities of an integrated nature • Inform health sector on new technical and project developments

3.2.3 Implementation plan for inter-sectoral collaboration

- The sectors, partners and stakeholders will designate senior staff representation to the NISC. The representative should be senior enough to make decisions on behalf of their respective institutions and ensure partner commitment and implementation of NISC decisions.

- The NISC in consultation with MOPDD will establish a vector control technical working group (VCTWG) to monitor IVM implementation, follow-up of actions, and report back to NISC.
- The NISC will designate an IVM focal point for day-to-day operations of IVM. The focal point will be staff of MOPDD.
- The MoH and NISC will organize regular formal and informal consultation meetings with all key stakeholders to discuss relevant issues, provide feedback, strategic orientation, technical support and resource mobilization for vector control.
- The NISC will identify and build the necessary technical capacity of the partner sectors to ensure participation and sustainability of desired actions within those sectors.
- The MoH and NISC will facilitate cross-border collaboration for disease surveillance and control.

3.3.4 Indicators

- Fully functional NISC in place.
- An active VCTWG in place.
- A national IVM focal point designated.
- Number of joint planning sessions held with communities, MOH and other stakeholders.
- Number of target subjects of training identified amongst collaborators.
- Number of non-health sectors contributing resources towards vector control.
- Number of senior level meetings held with neighbouring countries for joint planning and implementation of vector control across the borders.

3.4 Integrated Approach and Choice of Interventions

Interventions used for malaria control can also have an added impact on other vector borne diseases such as filariasis, dengue fever and plague that are present in the country. Table 3 below summarizes different types of interventions that target the vectors and the diseases they transmit. It is noted that some interventions could target the vectors of more than one disease – either because both diseases have the same vector, or that the different vectors have similar behaviours (feeding and/or resting) which can be exploited by a single intervention (e.g. LLINs or IRS (targeting indoor feeding and indoor resting mosquitoes). Therefore, where such diseases overlap, a multi-disease approach in the deployment of interventions is desirable. In practical terms - where there are two separate (vertical) disease control programs, the objective,

under IVM, will be for the two programs to undertake joint planning and implementation to promote synergies, maximize the use of available resources and achieve the highest levels of impact possible.

Table 3. Vector control interventions and target diseases in Rwanda

Type	Interventions	Target vectors	Diseases
Chemical	LLINs	Mosquitoes, bedbugs, lice	Malaria, filariasis, typhus
	IRS	Mosquitoes, fleas, cockroaches	Malaria, filariasis, plague
	Larviciding	Mosquitoes, black flies	Malaria, filariasis, onchorcerciasis
	Space spraying	Mosquitoes, tsetse flies, ticks	Malaria, filariasis, dengue fever, trypanosomiasis, relapsing fever
	Household insecticides	Mosquitoes, house flies, fleas, cockroaches	Malaria, filariasis, plague, trachoma
Mechanical	House modification and screening	Mosquitoes, house flies	Malaria, filariasis, trachoma
	Baited traps	Tsetse flies, cockroaches	Trypanosomiasis,
	Sticky paper traps	Houseflies	Trachoma
Biological	Larvivorous fish	Mosquitoes	Malaria, filariasis,
	Predators	Mosquitoes, snails	Malaria, filariasis, schistosomiasis
Environmental	Environmental management and sanitation, habitat management	Mosquitoes, snails, tsetse flies, house flies, cockroaches	Malaria, filariasis, dengue fever, schistosomiasis, trypanosomiasis, trachoma

The main vector control interventions currently implemented in Rwanda are LLINs and IRS, with limited use of larval source management for malaria control.

3.4.1 Long Lasting Insecticidal Nets (LLINs)

The use of LLINs is recommended in all malarious areas especially to protect children, pregnant women, people living with HIV/AIDS, and socio-economically vulnerable groups. Rwanda has set a universal coverage goal of one LLIN for two persons, which it intends to maintain. Mass campaigns will continue to be utilized to rapidly scale-up LLINs coverage. Routine services, such as ante-natal clinics (ANC) and the expanded program on immunization (EPI) will continue to be high priority and complementary modes of LLINs distribution. There will be dedicated efforts to monitor and evaluate field performance of distributed LLINs, to enable proper determination of replacement regimes and related public advisories. There will be on-going efforts for IEC/BCC to sustain high utilization rates for LLINs. Distribution channels to reach disadvantaged households and institutions will be emphasized to identify, assess and

strengthen the delivery services. Delivery of LLINs through military services, police and boarding schools has proven to be very effective methods for mass distribution and will continue to be an important model for Rwanda. To ensure sustained universal coverage, a procurement plan and resource mobilization plan for LLINs will be enhanced.

A longitudinal study on LLINs field effectiveness began in October 2010. It is anticipated that the study will establish proof of principle for evaluating field effectiveness of LLINs to enable routine evaluation and assist in determining the development of LLINs replacement plan.

3.4.1.1 Implementation plan for LLINs

- The MOPDD will develop and regularly update guidelines for LLIN distribution to sustain universal coverage.
- The MOPDD will track net ownership, gaps in coverage, and new sleeping spaces through a national household database regularly updated by CHWs.
- The MOPDD will conduct behavior change communication (BCC/IEC) to increase proper use of LLINs.
- The MOPDD will develop guidelines on personal protection.
- The MOPDD will monitor the rate of loss, physical condition, and insecticide residual on distributed LLINs.
- The MOPDD will institute adequate planning for procurement and replacement of LLINs after every 3 years, or at a time interval as may be established through the on-going LLINs field effectiveness study.
- The MOPDD will liaise with WHO on the environmentally safe disposal mechanism of old nets.
- The MOPDD will conduct BCC/IEC campaigns to discourage misuse of nets by communities for other purposes, such as fishing or chicken housing.

3.4.1.2 Indicators

- National LLIN distribution guidelines in place.
- Number of LLINs distributed.
- % of population covered with LLINs.
- % of population using LLINs.
- Personal protection guidelines for community including travelers in place

- Number of nets stockpiled for disposal.
- A procurement plan and resources available for LLINs.

3.4.2 Indoor Residual Spraying (IRS)

WHO recommends IRS for all types of malaria endemicity. The strategic objective of IRS operations is two-fold: i) to focus on high risk and intense malaria transmission areas, and ii) for prevention and control of malaria epidemics. The recommended coverage of IRS is over 80% of the housing structures in a targeted geographical area. The IRS operations in Rwanda began in August 2007 in a few high malaria endemic districts covering about 152,000 structures which has continued every year to date with a coverage of about 325,000 structures by August 2011.

Selecting IRS target sites and determining spray rounds

As malaria transmission continues to decline in Rwanda, stratification by epidemiological data from annual incidence of test positivity rate will be used to determine the high malaria transmission foci which will be targeted for IRS. The current malaria stratification is based on test positivity rate (TPR) indicating the level of transmission, number of districts, and the population targeted as shown in Table 4. To obtain a more complete picture of endemicity and transmission and how vector control will bring changes, human capacities will be further strengthened to obtain values on entomological parameters, including, where appropriate, entomological inoculation rates (EIR).

Table 4: Example of malaria stratification based on parasite prevalence rates [1]

Strata	***Parasite prevalence***	***Malaria Annual incidence or Annual Parasite incidence (API)***	***Altitude***	***Number of districts***	***Population size***
Low transmission *Western Province + Gakenke and Nyamagabe: Zone 1*	< 1%	Zone 1a: < 1 ‰ Zone 1b: 1-5 ‰	1460 – 3000 m	9	3,210,461
Lower moderate transmission*: North, Kigali, upper South Zone 2*	1-5 %	Zone 2a: 1-5 ‰ Zone 2b: 5 - 10 ‰ Zone 2c: ≥10‰	1500 – 2000 m	10	2,902,556
Upper Moderate transmission*: East and lower South Zone 3:*	> 5%	Zone 3: ≥10‰ (except Ngoma district 5 - 10 ‰)	1000 – 1500 m	9	2,936,596

Zone 1 is a low transmission area extended from Lake Kivu to the Congo Nile ridge with an altitude varying from 1460 to 3000m. The parasite prevalence is less than 1% and the annual parasite incidence (API) is less than 1‰ in districts in Zone 1a and between 1-5‰ in districts in Zone 1b. It covers the Western province and the districts of Gakenke and Nyamagabe.

Zone 2 is the lower moderate transmission area that covers the Northern to the upper Southern Province including Kigali province with an altitude between 1500-2000m. The parasite prevalence in Zone 2 is between 1-5% and the API allows the definition of 3 sub-zones: Zone 2a: 1-5 ‰, Zone 2b: 5 - 10 ‰, Zone 2c: ≥10‰

[1] It is noted that the strata shown in the table may change as local disease ecology and transmission changes, either through natural ecological changes or as a result of vector control, as well as human activity. The stratification presented here is not to be taken as a permanent feature. It will require periodic verification and subsequent adjustment, as necessary.

Zone 3 is the upper moderate transmission area that covers the Eastern province and the lower Southern province with an altitude between 1000-1500m. The parasite prevalence in Zone 3 is above 5% and the API is in general above 10‰ with exception to the district of Ngoma.

In 2011, five districts with high malaria transmission levels were targeted for district-wide spraying. Decisions on the geographical areas to target with IRS, and the number of spray rounds per year will be based on local evidence, and which decisions will change over time as the local eco-epidemiology of malaria changes. This IVM strategy therefore does not prescribe or anticipate those decisions in advance. Consistent with the concept of IVM as a rational decision making process, however, the objective of any future decisions on the targeting and timing of IRS spray rounds will be to provide maximal protection for the maximum numbers of those that are most at risk, given the available resources. This will be based on three primary principles: soundness of ecological basis of the decision through evidence collected, cost-effectiveness, and sustainability of the intervention. Issues for consideration will therefore include, susceptibility of local vectors in the geographic area, as well as the length of residual effectiveness of the insecticide compared with the window-period of transmission that is targeted. On this basis, it is essential that all IRS operations are fully backed by reliable regular frequency of residual efficacy evaluations (wall bioassays) to establish the actual field performance on the targeted surface types.

Given the length of the rainy seasons in Rwanda, a minimum residual efficacy length of 6-8 months is required. The most desirable timing for IRS is that which enables the initial period of the residual action of the IRS insecticide to coincide with the peaking of the local malaria cases – ensuring that the height of the killing effect of the insecticide coincides with periods of highest transmission risk. IRS also requires at least six months advance preparations since it involves a considerable amount of logistics (e.g. procurement of insecticide, training and transporting spray operators, equipment and accessories and insecticides accompanied by IEC that requires households to move items out of spray rooms). Because of the above reasons, IRS is therefore best conducted in drier logistical seasons and just before the onset of the rainy season. With the current policy of universal coverage of LLINS, it will be increasingly prudent that IRS is used as a strategic tool to; i) accelerate the suppression of high malaria transmission in districts and local areas as LLINs is rolled in and coverage and utilization rates increase, and ii) prevent and control epidemic outbreaks where transmission is suppressed and become focalized.

Reorientation of IRS operations to prevent malaria resurgence will require a different organization of field operations. In areas where pre-elimination will have been achieved (1 case per 1000 persons at risk), IRS operations will transition to surveillance-driven and focalized operations and will require decentralized decision making on deployment and response. IRS under malaria pre-elimination conditions is further discussed under Section 4.0.

Selection of insecticides

- Insecticides that are selected must be recommended by WHOPES for IRS. All selected insecticides for IRS must be duly registered for that purpose in Rwanda. The local vector populations in the IRS target areas must be susceptible to the insecticide formulation and class selected. This shall be ascertained through standardized WHO or CDC protocols on susceptibility. WHO guidance for the interpretation of susceptibility rates will be followed. Where resistance exists, an insecticide with a different mode of action will be used to manage the resistant vector strain(s).
- Newer insecticide reformulations with longer residual efficacy, or new formulations of recommended insecticides entering into the market place, will be proactively assessed for suitability.
- Other factors to be considered include cost of insecticide, as well as peculiar operational costs associated with specific insecticides compared to alternatives; acceptability by targeted households (certain insecticides may have a peculiar smell which could undermine acceptance by households).

3.4.2.1 Implementation plan for IRS

- The MOPDD will develop national IRS guidelines consistent with the guidance in this IVM strategy.
- Based on the WHO recommended insecticide used and the universal coverage with LLINs in Rwanda, the MOPDD will assess through operational research whether to implement one or two rounds of IRS per year in high malaria transmission foci.
- The MOPDD will conduct monthly wall bioassay tests to determine the levels and length of residual efficacy of IRS insecticides, the results of which will be considered in the determination of the number of spray rounds per year.

- The MOPDD will conduct annual vector susceptibility tests to WHOPES approved insecticides at selected sentinel sites to inform on switch to alternatives if resistance is detected. A resistance monitoring and management scheme will be established. (see Section 3.4.4) to inform decisions on alternatives or switches to other insecticides.
- The MoH and MPDD will ensure adequate stocks of insecticides, pumps and personal protection equipment (PPE).
- The MOPDD and partners will support maintenance and service workshops for spray pumps and soak pits.
- The MoEnv and MoH will ensure that all IRS operations will include Best Practices and recommendations of WHO and FAO to safeguard the environment and human health.
- The MOPDD will decentralize IRS operations and build capacity at district levels for epidemics preparedness and response.

3.4.2.2 Indicators

- A national IRS strategy in place.
- % of targeted structures covered with IRS.
- % of targeted population protected by IRS.
- Amount of insecticides used.
- Insecticide resistance profile known.
- National policy on pesticide management strengthened.
- Compliance with international standards on safe handling and disposal of wastes.
- Number of districts and sectors conducting IRS.
- Number of people trained on safe use of pesticides.
- Number of PPE distributed.
- Amount of resources allocated for IRS.

3.4.3 Larval Source Management (LSM)

Larval source management may be an important vector control option in situations where mosquito breeding places are well defined and amenable to environmental management, for example, in urban areas, as well as valley areas where human activities (sand harvesting /brick making and agriculture) tends to create significant breeding habitats. Where such well-defined and significant breeding places exist, LSM may be an important complementary method to

address outdoor biting vectors[2] as the major tools (LLINs and IRS) are both predicated on indoor biting and indoor resting behavior of malaria vectors. Biological control using larvivorous fish in confined water bodies such as fishponds, brick making pits, peri-domestic habitats and water containers have been found effective in malaria vector control in parts of Africa as well as use of microbicides, such as *Bacillus thuringiensis israelensis* (Bti) in urban areas (Fillinger and Lindsay, 2011).

It is noted that the Rwanda Crop Intensification Program (CIP) aims at increasing food security by the expansion of rice and maize growing areas through reclamation of marshlands. Additionally, the improvement of farmers' social welfare where most farmers are now moving towards brick houses and erecting water storage containers has created mosquito breeding habitats that sustain vector populations. These human activities are likely to increase suitable vector breeding habitats, and as such, there is a need to include adequate mitigation measures to prevent disease vector proliferation.

A prerequisite for effective LSM is a thorough understanding of the ecology of vectors and their breeding sites so as to map these habitats to allow for targeted and community-based LSM. The utility of LSM will be carefully evaluated and policy subsequently developed to ensure that any investment in this method is cost-effective and sustainable. The incorporation of LSM in community activities and especially during the monthly community works (*Umuganda*) is highly recommended.

3.4.3.1 Implementation plan for LSM

- Conduct detailed ecological investigations to identify and map out vector breeding habitats and determine feasibility of LSM as a cost-effective measure to reduce disease transmission.
- Strengthen collaboration with sectors such as Agriculture, CIP, Infrastructure and Human Settlements to mitigate the effects of their operations towards creating suitable habitats for mosquito breeding.
- Mobilize farmers, school children, communities and stakeholders through IEC/BCC and community-based initiatives to reduce mosquito breeding by use of appropriate

[2] A 2009 evaluation by the Malaria Unit (now MOPDD) revealed significant outdoor biting in certain local areas, including Kigali, Cyunuri, and Kabuye districts where outdoor biting was determined to be about 50%, 58%, and 38% respectively.

larvicides and environmental management. Opportunities provided by the monthly community *Umuganda* throughout the country, will be fully exploited.

3.4.3.2 Indicators

- Maps of larval breeding habitats.
- Number of larval habitats targeted for control.
- Number of community leaders and decision makers trained in basic IVM, including role of LSM in VBDs control
- Number of cells/sectors with established mechanisms for community participation in larval source management
- Number of CIP projects incorporating mitigation factors against VBDs
- Proportion of land and water harvesting plans/ construction integrating vector control mitigation
- Number of sectors formally engaged in LSM.

3.4.4 Insecticide Resistance Management

The national scale up of vector control interventions, coupled with increasing use of pesticides in agriculture, add to selection pressure for development of insecticide resistance which has been reported in the African Region, including the neighboring countries. Rwanda currently relies on two vector control interventions (LLINs and IRS), both of which utilizes the same class of insecticide (pyrethroids). Pyrethroid insecticides are also used in agriculture and horticulture. The development of insecticide resistance in the local vector(s) of malaria will directly threaten the continued viability of these vector control tools and will negatively impact on malaria control. The MOPDD has mounted a surveillance system at sentinel sites and in the IRS districts to track vector susceptibility to insecticides. This is being done for the IRS insecticides, as well as for LLINs distributed in the community. Plans are also in place to further strengthen national capacity to conduct monitoring of resistance mechanisms.

The establishment of a management plan to prevent or control the development of insecticide resistance is a primary consideration for Rwanda. There are standard guidelines by PMI, WHO, Insecticide Resistance Action Committee (IRAC) and other sources on insecticide resistance management that will be referenced to guide the development of a resistance management plan based on results of susceptibility/ resistance tests obtained from the sentinel sites. The plan will

include rotation of different classes of insecticides and mosaic application of two different classes of insecticides in the same geographical area or site.

Cross-resistance patterns in different classes of insecticides exist, but as a general rule, insecticides that share a common target site, such as DDT and pyrethroids, should not be rotated back-to-back. An ideal rotation would deploy insecticides with different modes of action such as a carbamate or an organophosphate. In case of emergency situations, such as a sudden upsurge of insecticide resistance to available insecticides of choice, limited or temporary use of new insecticide particularly of a different mode of action can be used as a resistance management tool awaiting full recommendation by WHOPES. Vector susceptibility or resistance data will be shared with WHO to assist region-wide strategies to manage insecticide resistance.

3.4.4.1 Implementation plan for insecticide resistance management

- MOPDD will continue to monitor the residual efficacy of insecticides on sprayed structures and on distributed LLINs.
- The MOPDD will conduct susceptibility tests of malaria vectors against different classes of insecticides annually.
- The MOPDD, in consultation with relevant partners, will evaluate the insecticide resistance profile and recommend appropriate interventions and switch to alternative insecticides.
- The MOPDD, in close coordination with MINIAGRI, will establish an insecticide resistance management plan.

3.4.4.2 Indicators

- An insecticide resistance management plan in place
- Reports on susceptibility evaluations
- Reports on biochemical/molecular evaluations of resistance mechanisms
- Annual review of insecticide resistance data for evidence-based decision making
- Collaboration with international laboratories and organizations on molecular identification of sibling species of mosquitoes and insecticide resistance

3.5 Strengthen Infrastructure for Entomological Monitoring

To get representative entomological data throughout the country and to produce a vector profile map, more sentinel sites will be established. The MOPDD will expand geographical representatives sentinel sites from the current seven to 12 sites (Fig. 1 and Table 5) for

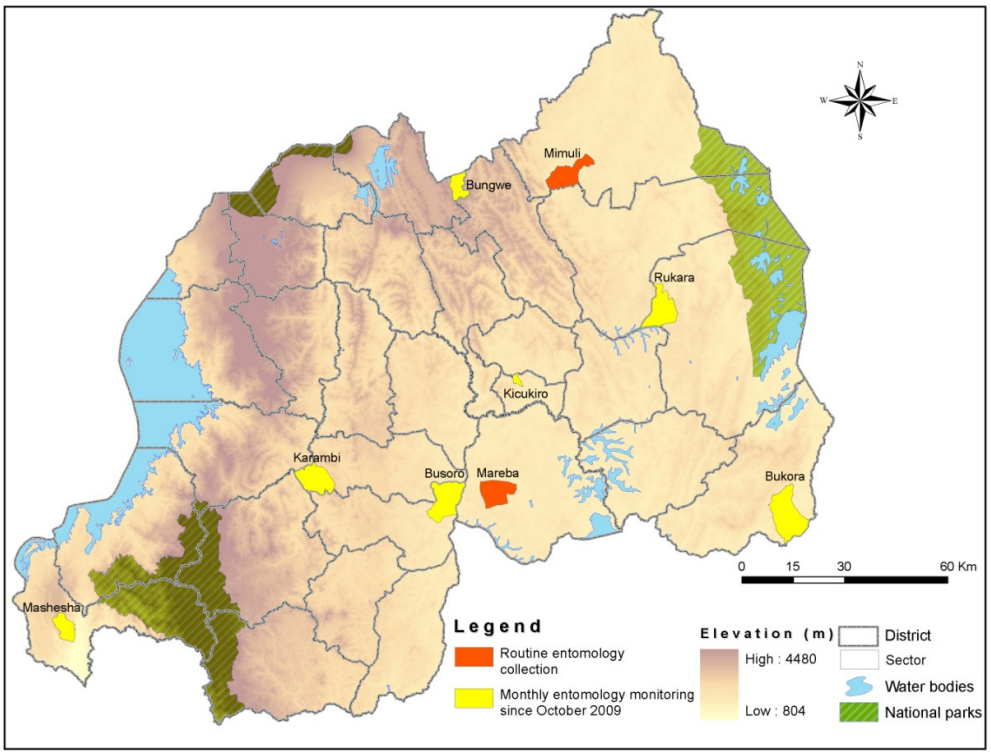
entomology surveillance where information on vector density, resting behavior, species composition, larval habitats, infection rate, blood feeding index, parity, etc, will be collected. These sites will form a national network to capture relevant data on the eco-epidemiological settings of malaria transmission in the country.

A central insectary and associated entomology laboratory will be established at the School of Public Health (SPH) in Kigali. The facility will operate under the MOPDD to support a full range of entomological evaluations and assist the coordination of assessments by sentinel field stations (ref: Section 3.7.1). The facility will also support training of post-graduate students at SPH as part of the national capacity strengthening efforts for vector control.

3.5.1 Implementation plan for entomological monitoring

- The MOPDD will establish and strengthen the sentinel sites in different eco-epidemiological zones for entomological monitoring.
- The MOPDD and partners will strengthen the insectary capacity to produce enough mosquitoes to assist with monthly wall bioassays and annual insecticide susceptibility tests (Box 2).
- The MOPDD will support entomological monitoring systems to inform the management of insecticide resistance. This will be a top-most priority.
- The MOPDD and the SPH will refurbish and equip the laboratory at the SPH campus to support ELISA and molecular PCR techniques for assessment of impact of vector control interventions.

Fig. 1 Location of the current 7 sentinel sites in Rwanda (areas highlighted)



Rwanda Malaria Program Review 2011

Table 5. Twelve selected sentinel sites (endemicity representation)

Strata/Endemicity	Sentinel sites	District	Province
High transmission	Mimuli (New)	Nyagatare	Eastern
	Mashesha	Rusizi	Western
	Busoro	Nyanza	Southern
	Bukora	Kirehe	Eastern
	Mareba (New)	Bugesera	Eastern
Medium transmission	Mubuga (New)	Karongi	Western
	Karambi	Ruhango	Southern
	Rukara	Kayonza	Eastern
Low transmission	Kivumu (New)	Rutsiro	Western
	Bungwe	Bulera	Northern
	Rwaza (New)	Musanze	Northern
Urban low transmission	Kicukiro	Kicukiro	Kigali City

3.5.2 Indicators

- A vector distribution map developed and updated.

- Insecticide resistance profile updated.
- Qualified technicians in charge of sentinel sites.
- Number of sentinel sites with fully functional vector surveillance and insecticide resistance monitoring.
- Fully functional and well-equipped insectary and laboratory used for evidence-based decision-making.
- Reliable entomological data from eco-epidemiological zones available for evidence-based decision-making.

3.6 Strengthen Human Capacity for IVM Implementation

To enable effective IVM implementation, the vector control functions at various levels (National, District and Sector) will be assessed to identify the skills/ competencies needed for IVM implementation. Table 6 provides a generic outline of some envisaged functions in IVM implementation. Entomological, epidemiological and environmental skills will be required to provide overall strategic and technical guidance for planning, implementation, monitoring and evaluation of IVM strategy. The national and district level staff will be trained to provide technical advice on vector-borne disease epidemiology, surveillance and control interventions. The WHO core curriculum (WHO 2011b) and other training resources on IVM will be adapted for country use. Training manuals will be developed targeting district level staff from various government sectors as well as field technicians and laboratory technicians. Designated insectary, laboratory and field technicians have already undergone entomological training to enable monitoring and evaluations in support of IVM implementation. It is anticipated that the collaboration between the MOPDD and the SPH in running the new laboratory facility will encourage young graduates to take interest in vector control and IVM, thereby boosting the human capacity in this area.

Dedicated IVM coordination teams in the districts will be established/ strengthened to support inter-sectoral action and oversee IVM implementation at the district level. The teams will work under the supervision of the MOPDD.

Table 6: Core functions at different administrative levels of national vector control

National/Central Level

• Strategic direction to programs • Policy development • Standard settings, norms and M&E indicators • Programme funding/resource mobilization • Prioritize and allocate financial resources • Epidemiologic analysis • Quality assurance • Training and support for district/sector programs and vector control	• Coordination of emergency response • Evaluation & validation of operational research • Decision-making and planning of region programs/activities • Determine human resource needs • Monitor and evaluate district/sector IVM implementation
District and appropriate lower levels	
• Local planning of IVM implementation • Resource prioritization and allocation • Disease surveillance • Programme monitoring • Health education	• Train field staff/village health volunteers • Undertake vector control activities, assist in operational research • M&E: collection and initial collation of local data on various vector control aspects

3.6.1. Implementation plan for capacity building

- The MOPDD will develop comprehensive vector control functions at the Central, District, Sector and Community levels, and outline corresponding staff competences/ skills requirements for those levels.
- The MOPDD will develop IVM training manuals for different cadres of personnel and outline a multi-year capacity building plan to systematically strengthen national capacity for the range of competences required for effective IVM implementation.
- The MOPDD will provide training skills on supervision of IVM implementation to staff from various sectors at national and district levels.
- The MOPDD and the SPH will train young public health graduates and field technicians in vector control.
- The MOPDD will train district health teams and communities to conduct disease surveillance and epidemic preparedness and response.
- The MOPDD will conduct training on data management and reporting.

3.6.2 Indicators

- Number of personnel with job descriptions that make reference to vector control.
- Training curriculum on IVM in place.
- Number of targeted personnel trained on IVM strategy.

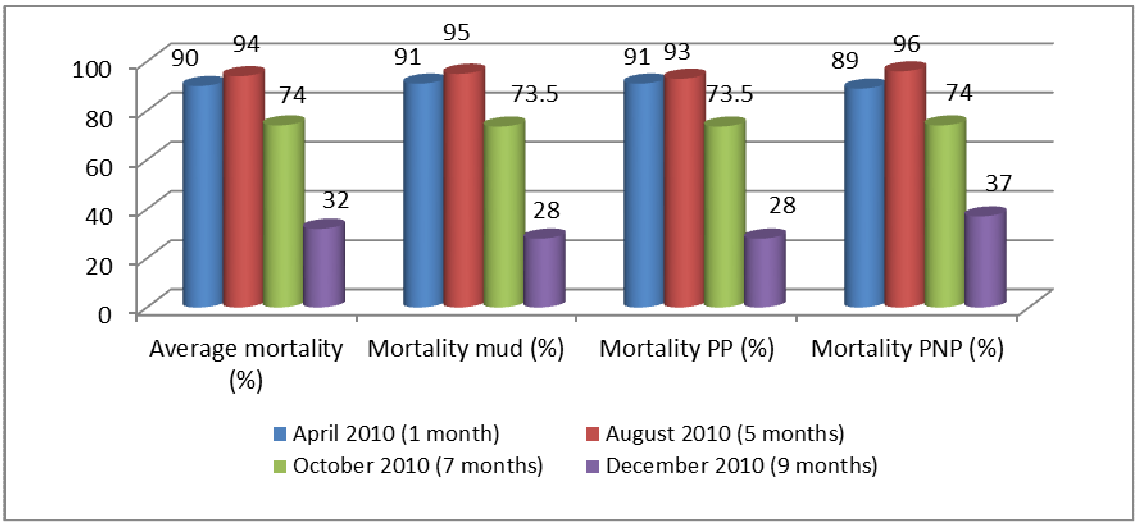
- Number of targeted communities implementing vector control activities.

3.7 Generating data for evidence-based decision-making

Operational research is essential in generating information to support decision-making aimed at improving efficacy, cost-effectiveness, ecological soundness and sustainability of vector control interventions. Rwanda has limited expertise in this area and there is therefore a need to collaborate with international research organizations to strengthen this capacity. Through the collaboration, a number of research questions on vector control can be addressed on an ongoing basis as local disease eco-epidemiology changes. An example of current need is the determination whether one round of IRS per year is sufficient and more-cost effective than the current plan of two rounds per year. This is in view of the nationally implemented universal coverage policy on LLINs. Typically, the country experiences two malaria transmission peaks and the current IRS insecticide (Deltamethrin WG) is listed by WHOPES with a recommended residual effect of 3 - 6 months. Bioassay results from the field in Rwanda have shown an average mortality of more than 90% for the first 5 months and decreasing to 74% by the seventh month (Fig. 2).

A related question requiring resolution is that given the current limited resources for IRS, whether the intervention should i) be targeted in high transmission sectors only, and ii) whether the current strategy of targeting areas (sectors) considered hot spots within districts, should be replaced by full coverage of entire districts. Based on the current IRS support by PMI, it will mean a reduction of the districts that will benefit from this intervention per spray cycle.

Fig. 2 Wall bioassays on Deltamethrin after 9 months of spraying in Kicukiro and Gasabo districts.



Another area of operational research is whether larval source management (environmental management, sanitation and larviciding) to control immature mosquito stages in water habitats would be cost-effective or have a significant impact on malaria and other VBDs.

As needs arise, other programmatic questions that affect vector control interventions will be identified by the vector control technical working group which will work under the NISC. Proposals will be developed and studies conducted in collaboration with academic/ research institutes (e.g. NUR and SPH) and other partners.

3.7.1 Implementation plan for operational research

- The MoH will strengthen collaboration with regional and international research institutions.
- The NISC will establish a VCTWG under its auspices to provide expert counsel on quality control of vector control tools and products (insecticides, LLINs, spray pumps, personal protection equipment).
- The VCTWG will identify programmatic issues and gaps in knowledge and operations that require surveys and/ or operational research for consideration by MOPDD and NISC.

- The MOPDD will assess the additional impact of IRS, one or two rounds per year in the context of universal coverage with LLINs including targeted versus district-wide coverage.
- The MOPDD will assess the feasibility of LSM by use of ecologically sound larviciding and environmental management for vector control.
- The MOPDD will conduct investigations on the ecology and behavior of malaria vectors.
- The MoH and VCTWG will conduct entomological and epidemiological surveys of other vector borne diseases in the country.

3.7.2 Indicators

- Number of operational research priorities that have been addressed.
- Number of encounters and meetings with research institutions.
- Number of research outcomes that have been used for decision-making and updating policies, guidelines and work plans.
- Concrete information on the ecology of malaria and other vector borne diseases in the country available.
- Amount of reliable data available for decision-making.

3.7.3 Entomological Monitoring

A national scheme on entomology surveillance and monitoring from the sentinel sites will be strengthened. The twelve sentinel sites will have the following attributes:

- They will be linked to the central insectary and entomology laboratory at the SPH, Kigali.
- They will be manned by entomology field technicians who will have received formal training and attained proficiency on all the required methodologies and assessments to be conducted at the site.
- The technicians will mobilize and train persons in nearby communities to provide temporary support to field assessments as may be described in the sentinel site manuals.
- Information on vector density, resting behavior, species composition, larval habitats, infection rate, blood feeding preference, parity, entomological inoculation rate, insecticide resistance, etc., will be gathered in each site to track local vectors and evaluate impact of ongoing vector control interventions on malaria transmission using the indicators listed in Box 2.

- Other ecological/ environmental factors with direct impact on the vector populations (e.g. rainfall, temperature) will also be recorded.

Box 2: Desirable entomological monitoring indicators

Basic Entomological ***evaluations (measured monthly) – Category 1 (sentinel sites):***

i. *Insecticide residual effectiveness (Cone bioassay)* – on major wall surface types (Mud, cement – painted or unpainted, and wood) in the localities where indoor residual activity is conducted and on LLINs. Provides rate of decay of the insecticide determined for (a) IRS by 24 hour mortality of mosquitoes exposed to sprayed walls for 30 minutes and (b) for LLINs as 24 hour mortality of mosquitoes exposed to LLINs for 3 minutes.

ii. *Human landing catches (indoor & outdoor)* - provides insight into biting behavior of local vectors

iii. *Pyrethrum spray catches* – Done between 6am and 9am at pre-selected houses. Indicator provides insight into vector entry into sprayed rooms over time. Compared with unsprayed homes and other higher category 2 evaluations on the catches (e.g. parity, sporogony, and blood meal analysis) provides insight on effectiveness of interventions and indicate transmission risk changes in sprayed rooms.

iv. *Species identification (morphological) and composition*)- from monthly catches listed above. It will enable mapping of vector distribution and tracking of any changes in species composition within the year.

v. Insecticide susceptibility evaluation done once a year for WHOPES approved insecticides.

Entomological evaluations - Category 2 (Insectary/Entomology laboratory at SPH)

The Category 2 evaluations require advance training and access to relevant ELISA and PCR equipment.

The following indicators will be assessed:

i. *Sporozoite rates* (quarterly) - provides insight into risk of getting malaria

ii. Entomological inoculation rates (quarterly) – measure risk of getting malaria through infective mosquito bites

iii. *Blood meal analysis* (half yearly) – provides insight into feeding preference of malaria vectors

iv. *Age grading* evaluations (quarterly) – especially from room catches denote how effective the intervention is in killing vectors

v. *Resistance mechanism* by molecular techniques (annually)

3.7.4 Epidemiological information

To effectively target and monitor the impact of IVM, the Monitoring and Evaluation unit of MOPDD will collate parasitologically confirmed morbidity data to provide ongoing data and detailed micro-stratification of disease prevalence. When effectively combined with entomological data and other parameters, it will enable progressive refinement of vector control interventions in terms of districts that require special attention in vector control so as to improve overall effectiveness.

3.8 Monitoring and Evaluation of IVM Implementation

A number of processes and outcome indicators in the implementation of the strategies listed above have been highlighted. These indicators will be used by the NISC as the basis for M&E of the IVM implementation. In addition, an overall monitoring and evaluation plan to assess the impact of IVM implementation and sustainability of vector control interventions will be established by the Ministry of Health in line with the WHO guidelines on M&E of IVM implementation (Draft). This exercise will be facilitated by the IVM focal person and the VCTWG, who will report to the NISC that is charged with the responsibility of reporting and documenting achievements, challenges and bottlenecks in IVM implementation to the stakeholders.

3.8.1 Implementation plan for monitoring and evaluation

- The MoH and the NISC will carry out monitoring on a continuous basis and evaluate the progress on all the strategies in terms of achievements, constraints, resource allocation against the set targets and indicators every six months in conjunction with stakeholders, partners and external reviewers.
  The MoH and the NISC will assure Best Practices for vector control are used.
- The MoH, with the coordination of the NISC, will collate and submit progress reports to stakeholders and development partners.

3.8.2 Indicators

- Number of coordination meetings held by the NISC.
- Progress reports available.
- Number of rational decisions influenced by operational research.
- Strategy in place that ensures continuous mobilization of resources for vector control.
- Vector level impact indicators (vector infectivity/sporozoite rates, IER, biting rates)
- % reduction of morbidity and mortality due to malaria and other VBDs.

3.9 Resource Mobilization and sustainability of vector control interventions

The NISC, once established, will coordinate the development of a multi-year national work plan for IVM, with stakeholders input. The work plan will detail and cost all aspects of planning, managing, deployment, training, and monitoring and evaluation, including staffing at the various levels (both long term and temporary field workers). The national IVM work plan will:

(i) Enable mobilization of national action. Roles of sectors and partners, as well as pledges on stakeholder contribution towards the implementation of the work plan will be clarified and therefore incorporated into individual sectoral/ partner plans.

(ii) Properly contextualize and streamline collaboration and support by developmental partners in national VBDs control.

(iii) Enable the development of a more comprehensive resource mobilization plan to assist forward planning by government on the allocation of in-country resources and to facilitate targeted submission of proposals to the country's developmental partners, such as, USAID/PMI, Global Fund, World Bank, African Development Bank, Private Sector, etc.

(iv) Enhance community participation in vector control.

(v) Encourage decentralization of vector control activities and decision making process.

(vi) Establish inter-sectoral collaboration including cross border partnership towards vector control.

(vii) Boost resource mobilization efforts.

(viii) Include entomological surveillance and operational research for evidence based decision making.

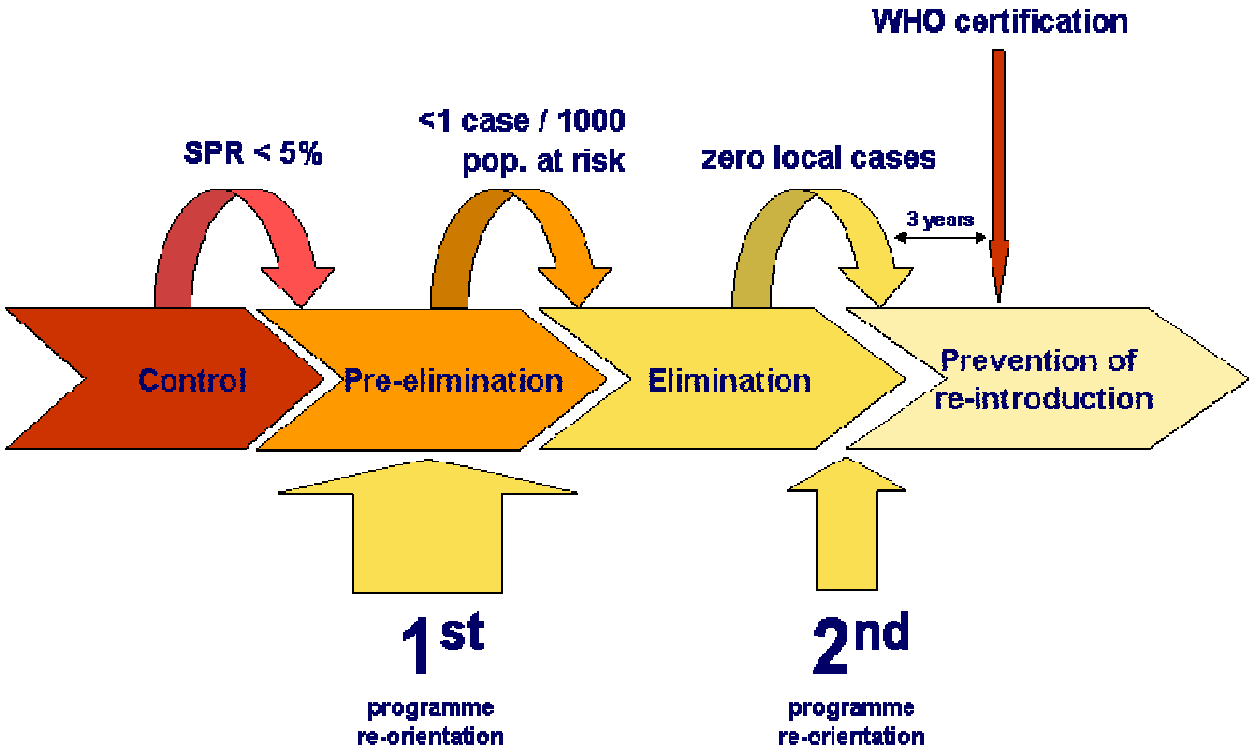
(ix) Enhanced capacity for epidemic preparedness and response

4.0 Transitioning from control phase to pre-elimination of malaria transmission

There has been a steady decline in test positivity rate (TPR) from 56% in 2001 to 14% in 2008 (75% decline) with an average national TPR of 19% in 2010. The pre-elimination phase of malaria will be achieved when the TPR from fever cases reported in health facilities reaches less than 5% (Fig. 3). To achieve this goal, preventive measures, early detection and prompt management of all malaria cases, and behavior change communication will have to be intensified. On attainment of pre-elimination phase, the country will have moved from high malaria transmission to low malaria endemicity. If the pressure to break the transmission cycle is not sustained, there is a likelihood of frequent malaria outbreaks among populations with lowered immunity or perhaps non-immune sub-populations, resulting in high mortality. Under

these conditions, the aim of vector control will be to utilize epidemic prediction and early detection tools to prevent/ reduce spread from areas of residual transmission or new active foci, back into areas where transmission has been disrupted.

Fig. 3 From malaria control to elimination



Source: World Malaria Report 2009

Focus will need to be put on reducing the time between validating field data and deployment of appropriate interventions to prevent or control an outbreak. Entomology and epidemiological competencies will be required to assess residual transmission and quickly detect outbreaks, while effective tracking of environmental precursors, such as rainfall, temperature and land use change will also be critical to assessing and predicting epidemic outbreaks.

4.1 Decentralization of vector control

Decentralized capacities that enable appropriate decision making at the district level will be critical in reducing the lag time between early detection of a malaria outbreak and the deployment of interventions currently done from the central level. Districts will be adequately prepared, as part of epidemic prevention and response strategy. For IRS, which is the most indispensable method in epidemic control and prevention, stocks of all relevant IRS

equipment, supplies and insecticides, as well as trained IRS teams will need to be available on standby, ready to be mobilized and on location at short notice. IRS operations will therefore need to be decentralized - ceding responsibility for field operations and supervision to the districts, with the central level (MOPDD) providing time-sensitive epidemic confirmation, and guidance, insecticide monitoring, quality control and M&E functions.

5.0 Conclusion: Towards improved health outcomes

A full implementation of IVM in Rwanda will assist to consolidate the gains made in controlling malaria over the last 6 years, and significantly contribute to further reductions in the heavy and unacceptable burden of malaria, in particular, and VBDs, in general. The IVM strategy herein outlined assumes a focused national agenda that is deliberate and reflective in its approach – a learning and therefore self-correcting effort (adaptive management), aimed at progressive refinement to enhance efficiencies and maximize disease level impacts. Reduction of local malaria transmission to pre-elimination and elimination phases is feasible in Rwanda. It will however, require careful evaluation of preventive measures including vector control priorities and thoughtful investment of resources and efforts. The deliberate processes inherent in an IVM approach, provides a robust framework for success and sustained efforts in vector control. The following outcomes are anticipated upon successful implementation of IVM in Rwanda:

5.1 Programmatic/Operational outcomes

- A dynamic and self-improving national system for vector control will be established that maximizes the utilization of existing resources through progressive improvement of efficiencies.
- Conducive policy environment for vector control and appropriate collaborative framework and systems established.
- Enhanced legislative and regulatory environment leading to effective safeguards of the environment and public health in natural resource development, and management and judicious use of insecticides.
- Effective collaboration by all stakeholders including empowered farmers and communities in the planning, implementation and evaluation of VBDs.
- Well-coordinated resource mobilization for malaria and other VBDs, facilitated by fully costed and multi-year IVM work plans developed at central and district levels and aimed at enhancing in-country budgeting.

- Adequate technical capacity established at national, district and community levels on the broad range of functional competencies/ skills and critical infrastructure required for evidence-based decision-making on vector control.
- All stakeholders fully informed on IVM and able to use appropriate information to progressively enhance participation and contribution to a coordinated national effort in vector control.
- Better targeting of the support from developmental partners, as a result of clarified vector control objectives and priorities.

5.2 Disease level outcomes

- Ecologically sound, cost-effective and sustainable management of the local vectors of human diseases, especially malaria.
- Significant and sustainable reductions in VBDs, particularly malaria, in the short- to medium term, with consequential further drops to near zero in morbidity and mortalities.
- Accelerated attainment of the pre-elimination phase in malaria transmission and subsequent feasible strategies for local elimination.

6.0 Next steps

The IVM strategy is a very important step taken by the Ministry of Health to move the current control efforts towards pre-elimination phase of malaria. The development process of this strategy was informed by the vector control needs assessment conducted in 2010, the Malaria Program review conducted in March 2011, the new Malaria Strategic Plan (2012-2017) and several other fora that emphasized on the need to strengthen preventive measures. Similarly to the VCNA validation and adoption by stakeholders, a one day meeting of all the relevant stakeholders was held on 7 June 2012 to validate and adopt national implementation of IVM. The report of the IVM Stakeholders meeting highlights the recommendations towards implementation of IVM as listed below:

1. To nominate sectors and their representatives to be appointed to the National Inter-sectoral Steering Committee by the Minister of Health
2. To draft a memorandum of understanding (MoU) for all stakeholders

3. To draft a Ministerial position statement on IVM
4. To submit the IVM Strategic Plan for inter-ministerial level endorsement
5. To establish relevant Technical Working Groups to inform IVM process
6. To develop an Insecticide Resistance Management plan
7. To develop IVM training manual for district teams
8. To conduct trainings of trainers (ToTs) on IVM for districts
9. To develop annual district work plans on IVM
10. To conduct M&E of IVM implementation.

7.0 References

1. APOC. August 1999. *Nation-wide rapid [sic] epidemiological mapping of onchocerciasis (REMO) in Rwanda, July 24 – August 22, 1999.*
2. Government of Rwanda, Ministry of Health, TRAC Plus. June 2008. *National prevalence survey on soil-transmitted helminth and schistosomiasis in school-aged children.* Prepared by Access Project.
3. Rwanda Health Management Information System (HMIS) report 2008
4. Rwanda Malaria Program Review report, March 2011.
5. Rwanda Malaria Strategic Plan 2008-2012.
6. Rwanda Malaria Strategic Plan (draft) 2012-2017.
7. Rwanda Demographic Health Survey (DHS) reports, 2005, 2008, 2010
8. Ulrike Fillinger and Steven Lindsay (2011). Larval source management for malaria control in Africa. Malaria Journal, 10:353
9. van den Berg, Henk, and Takken Willem (2007). A framework for decision making in integrated vector management to prevent disease. *Tropical Medicine and International Health* 12, 1230-1238.
10. VCNA stakeholders meeting report February, 2011, Rwanda
11. WHO 2003 Guidelines for vector control needs assessment. World Health Organization Regional Office for Africa, http://www.afro.who.int/vbc/framework
12. WHO (2004) Global strategic framework for integrated vector management. Geneva, World Health Organization, 2004 (WHO/CDS/CPE/PVC/2004.10).
13. WHO (2008) Statement on integrated vector management. WHO/HTM/NTD/VEM/2008.2). World Health Organization.
14. WHO (2009) Report of the WHO consultation on development of a global action plan for integrated vector management (IVM). WHO/HTM/NTD/VEM/2009.1. World Health Organization.
15. WHO 2011a Handbook on integrated vector management. World Health Organization.
16. WHO 2011b Core training curriculum on integrated vector management. World Health Organization.

ANNEX 1 Estimated Budget for IVM Implementation and Entomological Monitoring activities (in US$ x 1000)

Note the estimated budget does not include the cost of implantation of individual tools and methods (IRS, LLIN or LSM). It is to support the management and operational processes for effective IVM implementation, including cost-effective and sound implementation of the vector control tools and methods.

Strategy	Planned Activities	Yr1	Yr2	Yr3	Yr4	Yr5	Total
1. Advocacy and social mobilization for IVM	Develop an advocacy strategy for IVM	5	0	0	0	0	**5**
	Facilitate advocacy meetings for IVM	20	15	5	5	5	**50**
	Facilitate development of national and district annual work plans for vector control	15	15	15	15	15	**75**
	Advocate for resource sharing and budget line allocation by stakeholders	0	0	0	0	0	**0**
	Promote community participation in vector control	12	5	5	5	5	**32**
	Support legislation and regulation of public health pesticides	5	0	0	5	0	**10**
	Sub total	**47**	**35**	**25**	**30**	**25**	**167**
2. Enhance collaboration for IVM	Support inter-ministerial endorsement of IVM and issuance of a Ministerial Statement	0	0	0	0	0	**0**
	Support development of a Memorandum of Understanding for relevant stakeholders	0	0	0	0	0	**0**
	Establish a national inter-sectoral steering committee (NISC) and facilitate its meetings	10	3	3	3	3	**22**
	Facilitate national and district stakeholders planning meetings	24	12	12	12	12	**72**
	Support inter-ministerial meetings on cross-border collaboration	10	12	12	15	15	**64**
	Encourage inter-governmental resource mobilization for vector control	0	0	0	0	0	**0**
	Facilitate regional joint planning and implementation of vector control meetings	5	5	5	5	5	**25**
	Sub total	**49**	**32**	**32**	**35**	**35**	**183**

ANNEX 1 (cont'd): Estimated Budget for IVM Implementation and Entomological Monitoring activities (in US$ x 1000)

Strategy	Planned Activities	Yr1	Yr2	Yr3	Yr4	Yr5	Total
3. Integrated approach and choice of vector control interventions	Develop and update LLINs distribution guidelines	3	0	0	3	0	**6**
	Develop and update IRS guidelines for districts	3	0	0	3	0	**6**
	Develop insecticide resistance management strategy	40	0	0	10	0	**50**
	Sub total	**46**	**0**	**0**	**16**	**0**	**62**
4. Capacity building for IVM - Human	Develop and update IVM training manuals for district teams	4	0	0	4	0	**8**
	Train ToTs in 30 districts on IVM strategy	30	0	30	0	5	**65**
	Train insectary and laboratory technicians at SPH	5	0	5	0	0	**10**
	Conduct training of district health teams for IRS implementation in 19 high malaria endemic districts	30	30	30	39	30	**159**
	Conduct refresher training of field technicians at the 14 sentinel sites	22	0	0	22	0	**44**
	Sub total	**91**	**30**	**65**	**65**	**35**	**286**
5. Capacity building for IVM - Infrastructure	Equip 14 sentinel sites for entomological monitoring	25	10	10	0	0	**45**
	Furnish and equip the Insectary/Laboratory at SPH	25	25	10	0	0	**60**
	Sub total	**50**	**35**	**20**	**0**	**0**	**105**
6. Evidence-based decision-making	Facilitate consultative meetings with local and international research organizations	3	3	3	3	3	**15**
	Establish inter sectoral pesticide management working group and facilitate its quarterly meetings	4	4	4	4	4	**20**
	Establish inter sectoral vector control working group and facilitate its quarterly meetings	4	4	4	4	4	**20**
	Support LLIN monitoring to determine net procurement and replacement plan	120	0	0	5	0	**125**
	Conduct operational research on impact of IRS *vis a vis* universal coverage with LLINs in 4 districts	50	50	0	0	0	**100**

ANNEX 1 (cont'd): Estimated Budget for IVM Implementation and Entomological Monitoring activities (in US$ x 1000)

Strategy	Planned Activities	Yr1	Yr2	Yr3	Yr4	Yr5	Total
6. Evidence-based decision-making (cont'd)	Conduct pilot operational research on larval source management in 2 urban and 2 rural sites	40	40	0	0	0	**80**
	Conduct monthly wall bioassays for quality control and efficacy of IRS for 6 months	25	25	25	25	25	**125**
	Conduct annual insecticide susceptibility tests of different classes of insecticides 14 sites	50	50	50	50	50	**250**
	Determine residual decay of Carbamates and Organophosphates in experimental huts	10	0	10	0	10	**30**
	Conduct studies on the ecology and behavior of *Anopheles* mosquitoes to determine outdoor malaria transmission	15	0	0	15	0	**30**
	Develop and update country profile of vectors and insecticide resistance for resistance management	0	20	0	20	0	**40**
	Conduct pilot study on personal protection against mosquitoes using plant repellents in experimental huts	0	70	0	100	0	**170**
	Conduct mapping of malaria vectors and other vectors in Rwanda	0	25	0	0	0	**25**
	Establish and maintain an entomological data base	10	5	5	5	5	**30**
	Sub total	**331**	**296**	**101**	**231**	**101**	**1,060**
7. Monitoring and Evaluation of IVM implementation	Facilitate NISC quarterly meetings with technical working groups	12	12	12	12	12	**60**
	Facilitate NISC biannual meetings with stakeholders and donor partners	8	8	8	8	8	**40**
	Support NISC, MoH and MOPDD documentation of IVM implementation	2	2	2	2	2	**10**
	Sub total	**22**	**22**	**22**	**22**	**22**	**110**
	Grand Total	**636**	**450**	**265**	**399**	**218**	**1,968**