**GOAL 4** Develop non-chemical products and approaches for vector control

# The applicability of available technologies for adaptive integrated malaria vector management in Africa

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## Introduction

Several tools are in use to control malaria vectors in Africa[1,2,3]. These tools include use of Insecticide Treated Nets (ITN), larval control, Indoor residual Spraying (IRS) and Environmental Management (EM). Vector control interventions against adult mosquitoes using ITNs or IRS, combined with improved access to effective diagnosis and treatment, have enormous potential in reducing malaria morbidity and mortality[4]. Although these tools have been shown to be useful in impacting malaria transmission, they have been used in a rational combination in a few countries where they have greatly reduced malaria transmission. Nevertheless, a more efficient, effective and ecologically sound approach could be achieved through a combination of approaches, the IVM strategy[5]: having decisions increasingly based on local evidence; using a range of interventions; considering multiple diseases; and harnessing the existing systems and local human resource. The main goal is to improve human health through reduction of malaria by using ecologically and environmentally friendly malaria control approaches.

## Methods

Two sites in Kenya, urban Malindi and rural Nyabondo were selected for the implementation of IVM strategies as alternative vector control tools. A third site in Gibhe Valley in Tolay, Ethiopia was selected in 2008 to use the same principles that were developed in projects in Kenya (Nyabondo and Malindi) and because of its long history on the use of DDT for malaria control and the high childhood mortality. Scaling up of different malaria vector interventions techniques in these 3 sites was based on ecological, entomological and epidemiological assessments. Three pillars of IVM strategies were adopted; scaling of bednets (LLINs), control of mosquito immature using microbial larvicides and/or botanicals, and environmental management (draining and filling) in addition to active community participation.

Microbial larvicide (*Bacillus thuringiensis var*. *Israelensis* (Bti)) and *Bacilus sphaericus* (Bs) was applied weekly for one year in all sites and then regularly on a monthly basis through community based delivery system. Vector surveillance activities relied on 2 major activities; 1) mapping and surveillance of potential larval habitats, and 2) monitoring on adult mosquito densities inside houses. Local community resource persons (CORPs) or mosquito scouts were trained in basic simple tools for monitoring mosquitoes, guidance on environmental management (EM), correct use of bednets and advocacy in order scaling them up. Additionally, we have tested the effectiveness of crude neem products (*Azadirachta indica*) for larvicidal activity


*Plate 1: Water management and Larval source reduction*

## Result

Environmental management (filling, draining and water management) was successfully conductd by the community.

Overall, a significant reduction in Anopheline larvae was 55.7%, 72.9%, and 60% in Malindi, Nyabondo and Tolay respectively. Subsequently, overall reduction in *Anopheles* resting indoors was 60.9% in Malindi and 28% in Nyabondo (Fig 1).

Fewer *Anopheles* mosquitoes were observed and none of them was found positive for *Plasmodium falciparum* circumsporozoites suggesting a reduction in human -vector contact and transmission.

A high larval mortality of more than 90% was recorded when using crude neem extract. Larval habitats treated with a single application of crude neem products were free of larvae after 3-4 weeks.

Epidemiological assessment of malaria cases show a 62% and 51.5% reduction in Malindi and Nyabondo respectively (Figure 2).

## Discussion

Our findings using IVM approach through routine application of microbial larvicides, EM, scaling of ITNs in combination with active community participation resulted in dramatic reduction in larval and adult mosquito density and subsequently on malaria morbidity and mortality[6,7,8]. These non-chemical malaria control approaches were found to be highly effective. This coupled with a comprehensive monitoring and surveillance system for entomological, epidemiological and meteorological information will help guide decision making process for effective vector control. In order to monitor breeding sites and effectively tackle them, regular assessment of larval development and updated larval distribution maps in real time is necessary. Our results show that crude neem extract products have high larvicidal activity against mosquito larvae. These results are very promising in creating new effective and affordable approaches to the control of vector mosquitoes and can be utilised holistically for sustainable development[9,10]. Active participation of the communities in mosquito and malaria control is the cornerstone of an effective IVM[11,12,13].

## Conclusion

Our results demonstrate success with bioenvironmental malaria control in rural and urban settings. Large scale application with microbial larvicides and larval source management has the potential to be integrated into control programmes using ITN/LLINs or IRS and can be considered in the management of insecticide resistance and outdoor transmission. Further the development of innovative botanicals such as neem products for the control of vectors of diseases is required.

*Figure 1 : Mean Anopheline larval densities following monthly application of bti in Malindi and Nyabondo, Kenya.*

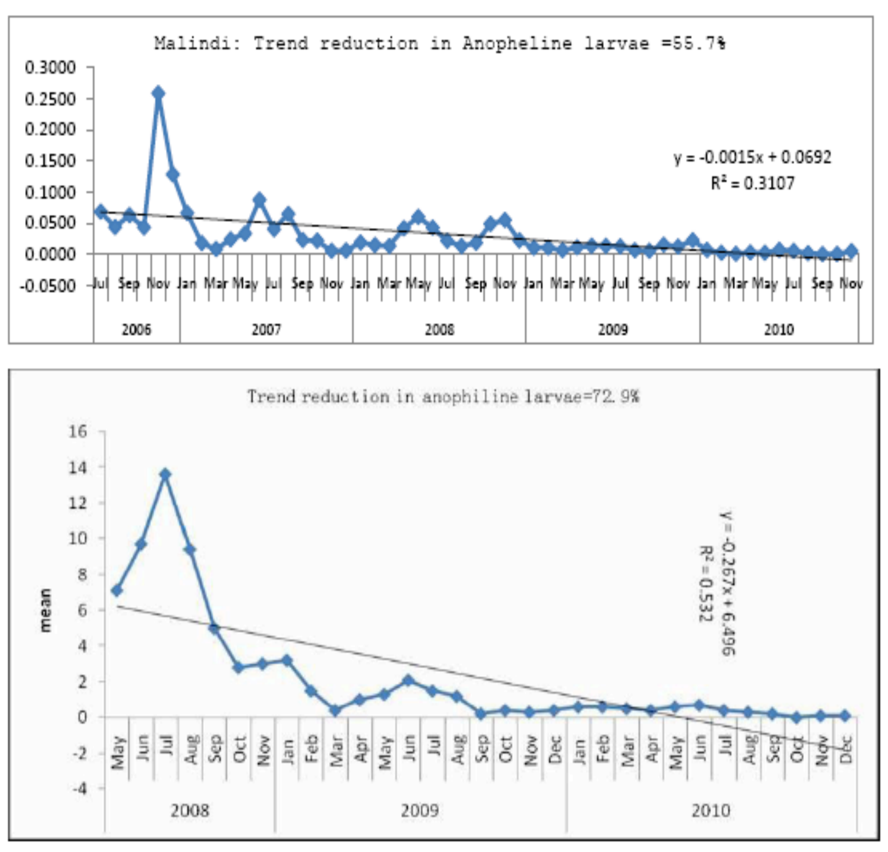
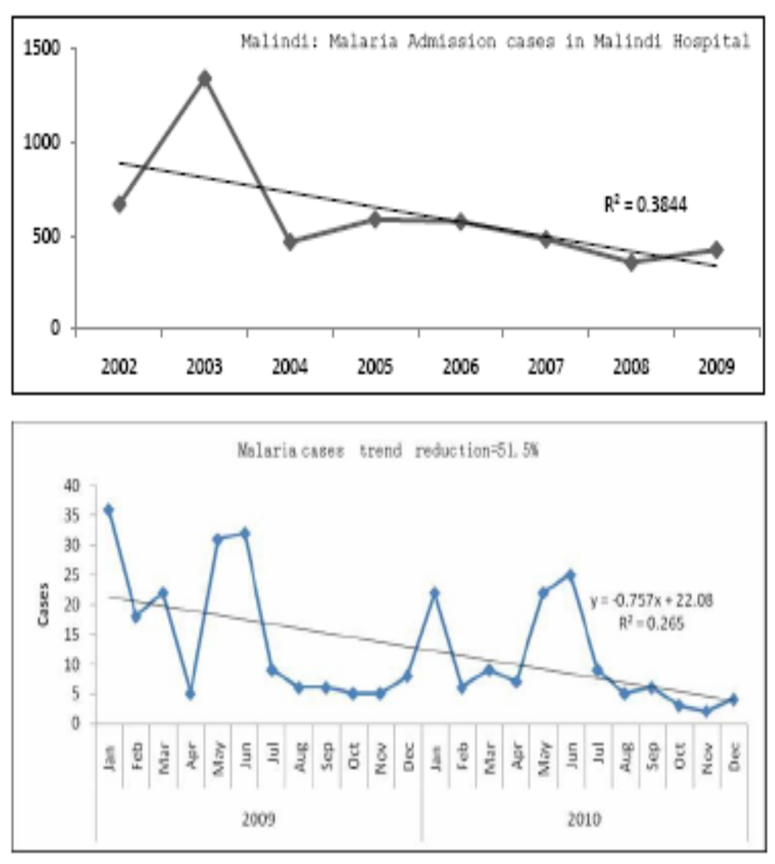



*Figure 2: Trend reduction in malaria cases at Malindi, Nyabondo in Kenya and Tolay Hospital in Ethiopia*

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