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# Distribution and spread of pyrethroid and DDT resistance among the *Anopheles gambiae* complex in Tanzania

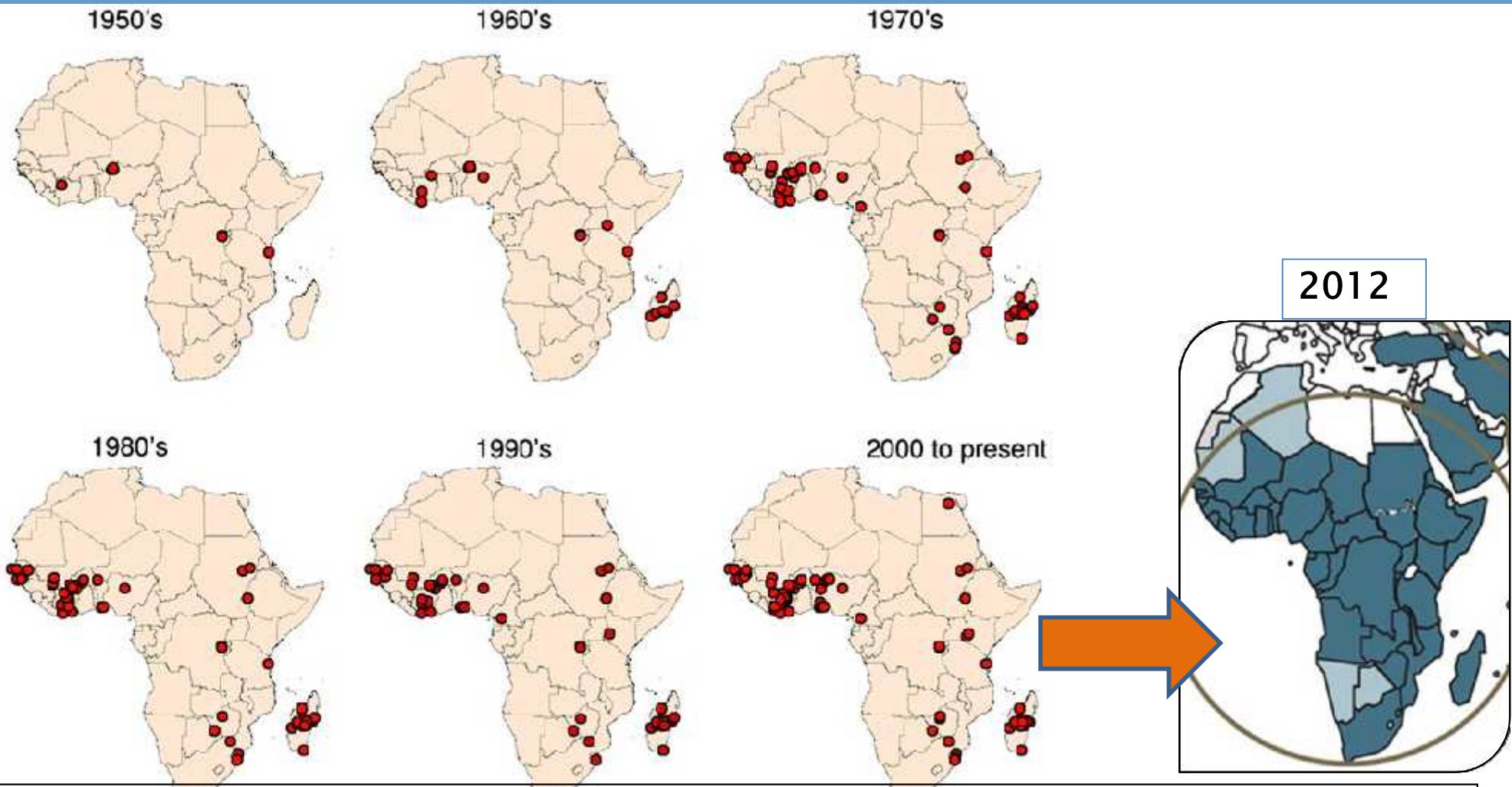
B. Kabula, P.Tungu, R.Malima, M. Rowland, J. Minja, R. Wililo, M. Ramsan, P. D.McElroy, J. Kafuko, M.Kulkarni, N.Protopopoff, S. Magesa, F. Mosha and W. Kisinja

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# Introduction

- In malaria control Chemical insecticides used against Anopheles mosquitoes for many years
  - Insecticide use is the mainstay of malaria vector control interventions
- Large scale use of insecticide for malaria control started after WWII
  - Eradication era: discovery of DDT & establishment of WHO
  - Stopped after DDT resistance
- Use of pyrethroid insecticides has increased dramatically in the past decade
  - scale-up of ITN/LLINs & IRS
- Malaria vectors are developing resistance to insecticides used for malaria control

# Introduction....

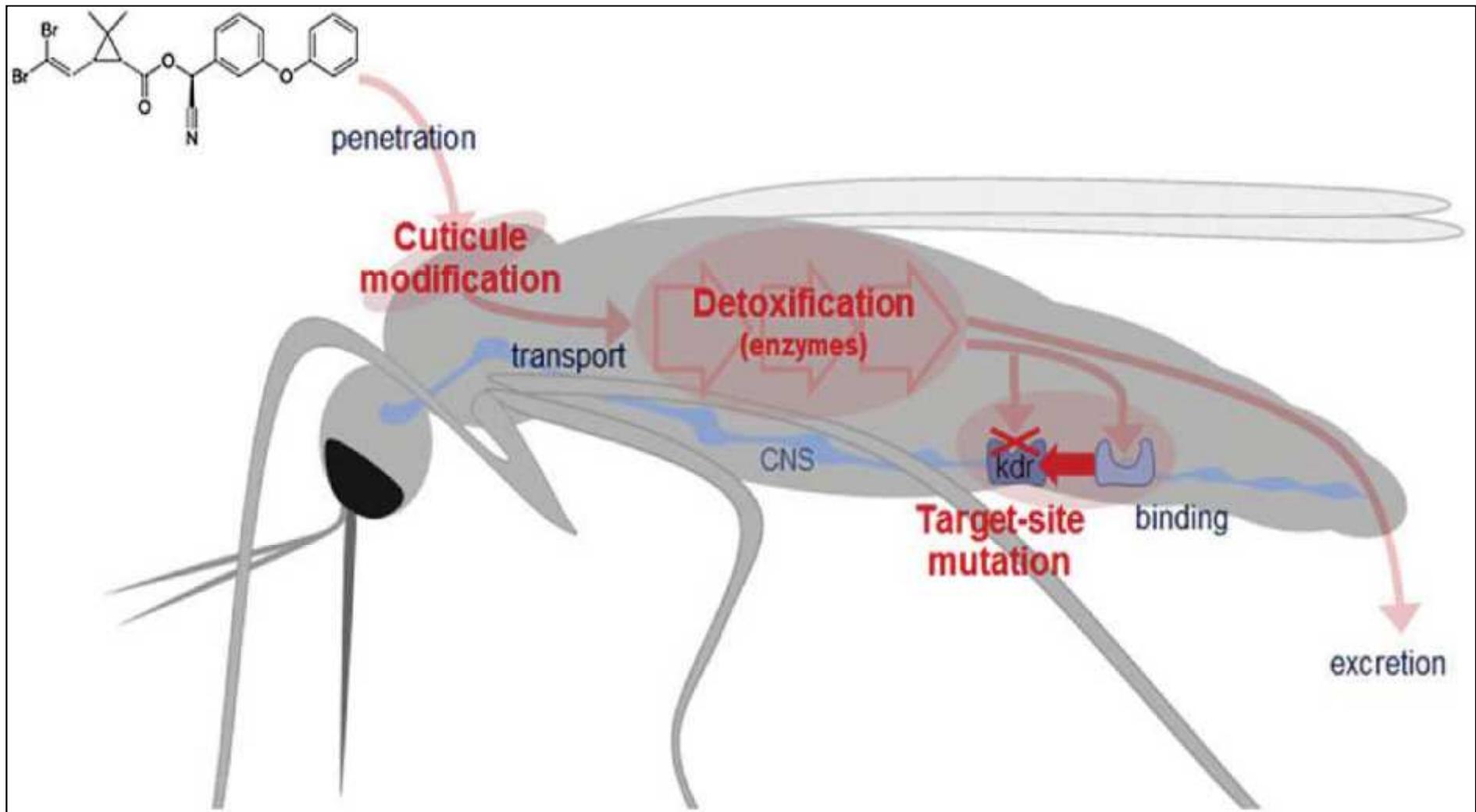


Time series showing the sites that have reported insecticide resistance (Coleman *et al.*, 2006 & WHO, 2012)

- Resistance spreading at an exceptionally rapid rate throughout Africa

# Introduction...

## Resistance mechanisms



Source: Nkya, T., Kisinza et al., Malaria Journal 2014, 13:28

# Objective

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To determine the susceptibility status of  
*Anopheles gambiae s.l.* to commonly used  
insecticides in Tanzania

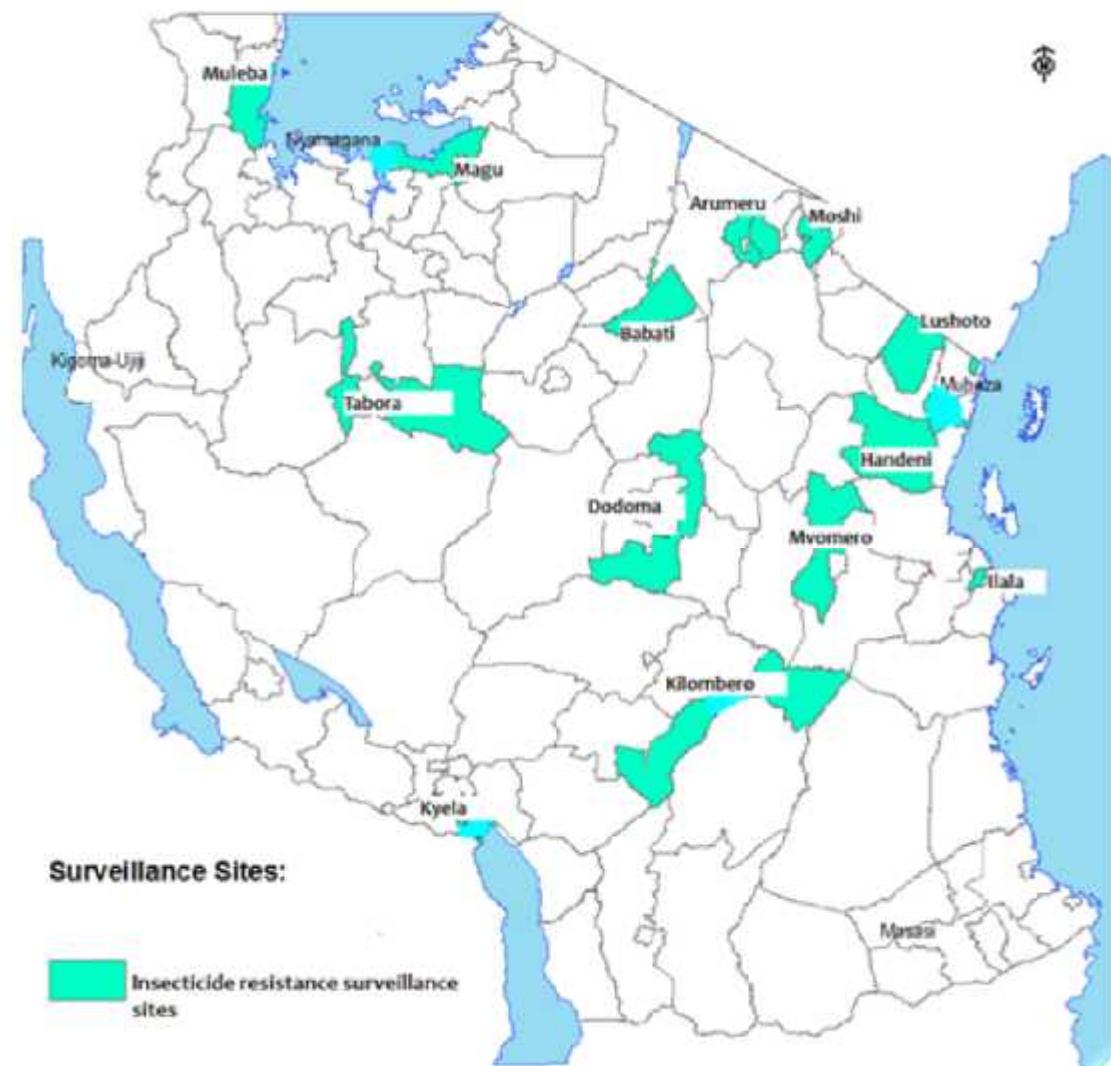
# Methodology

## Study area:

- Mosquito samples collected from 14 sites located in different ecological zones

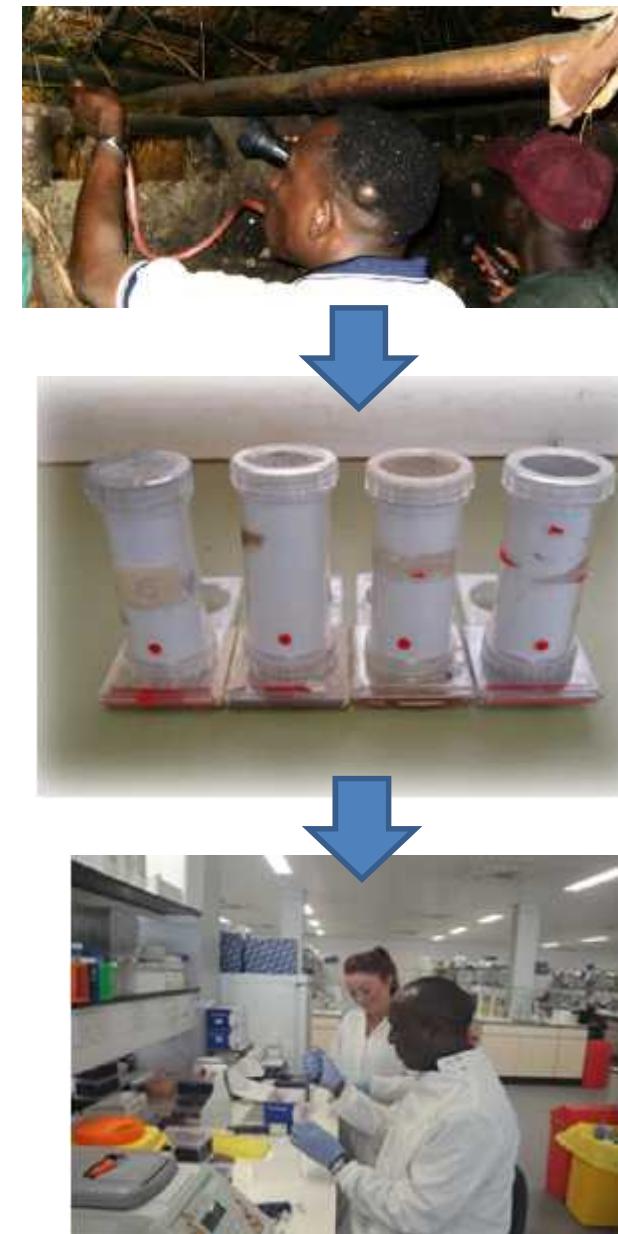
- Criteria

- Ecological zones
- Demographic settings(Urban/Rural)
- Previous related studies sites
- History of insecticide use

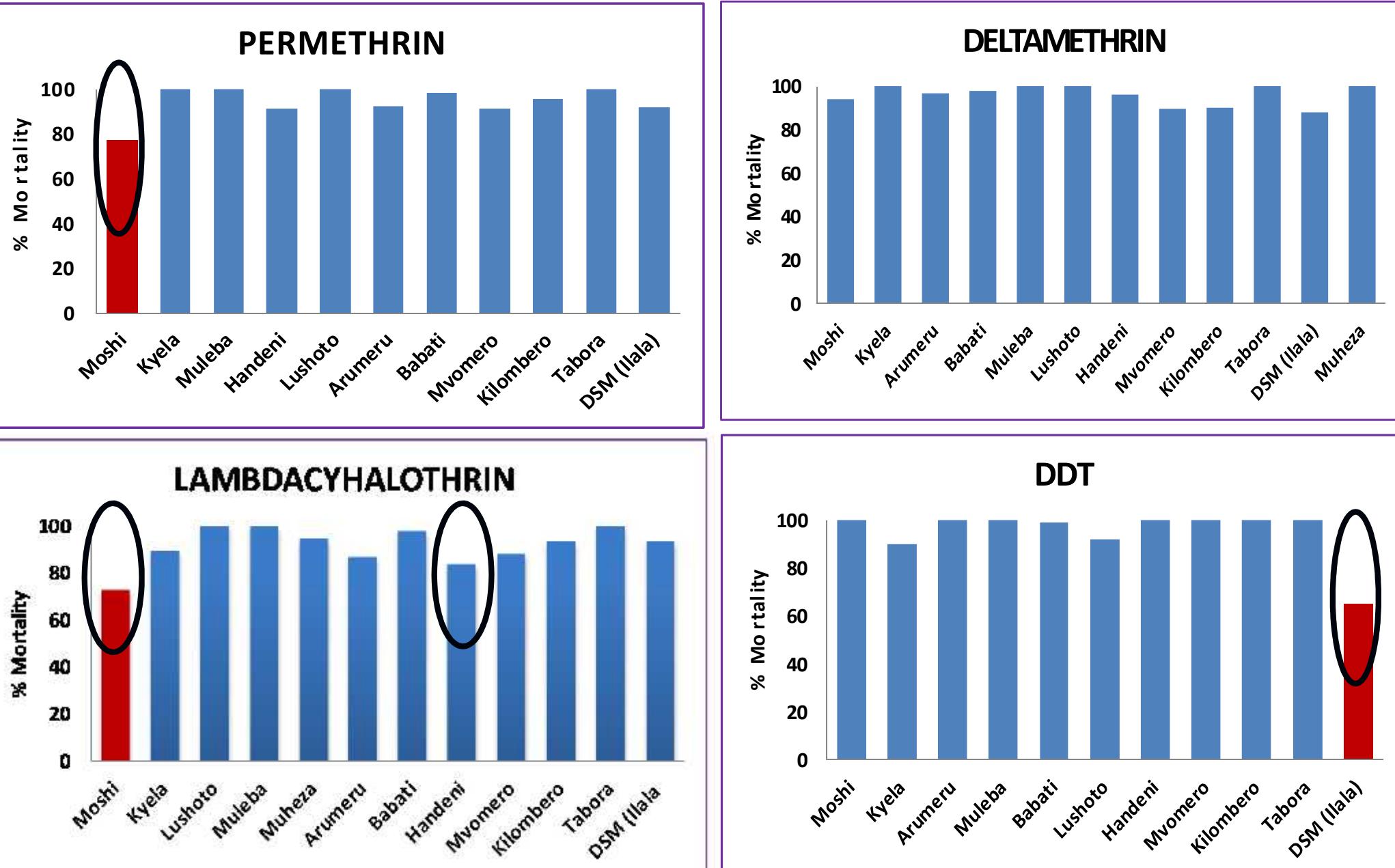


# Methodology...

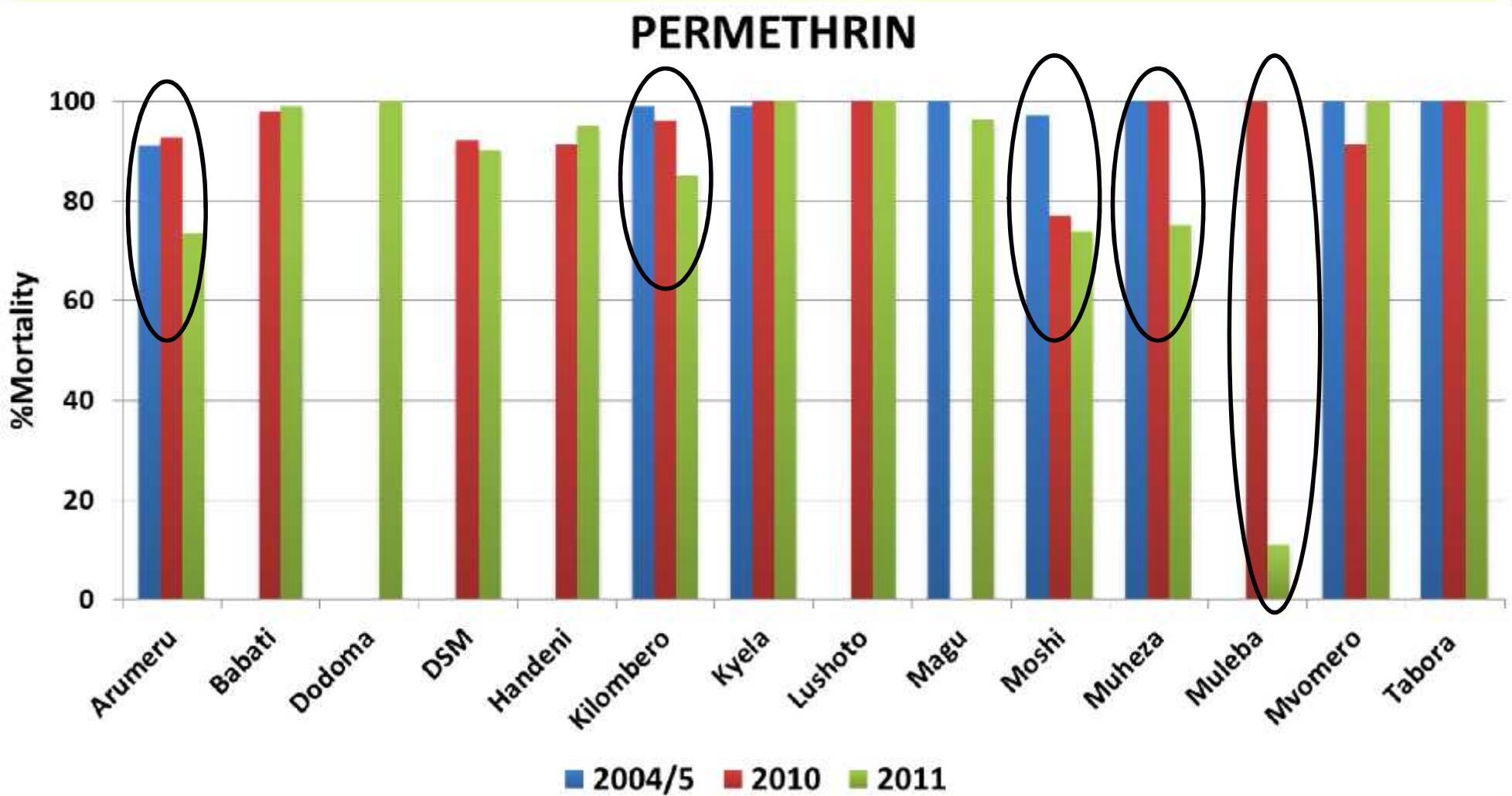
- Mosquitoes collected by resting catch
- Anopheles mosquitoes separated from others using morphological key
- The susceptibility tests carried-out using the WHO standard method
  - **Insecticides:** Deltamethrin, Permethrin, Lambdacyhalothrin, Fenitrothion, Propoxur &DDT
  - **Cut-points:** mortality  $\leq 90\%$ =Resistance  
mortality 91-97% = Suspected resist  
mortality 98-100% = susceptible
- Molecular diagnostics used to genotype mosquitoes and detecting resistance mechanisms



# RESULTS-2010

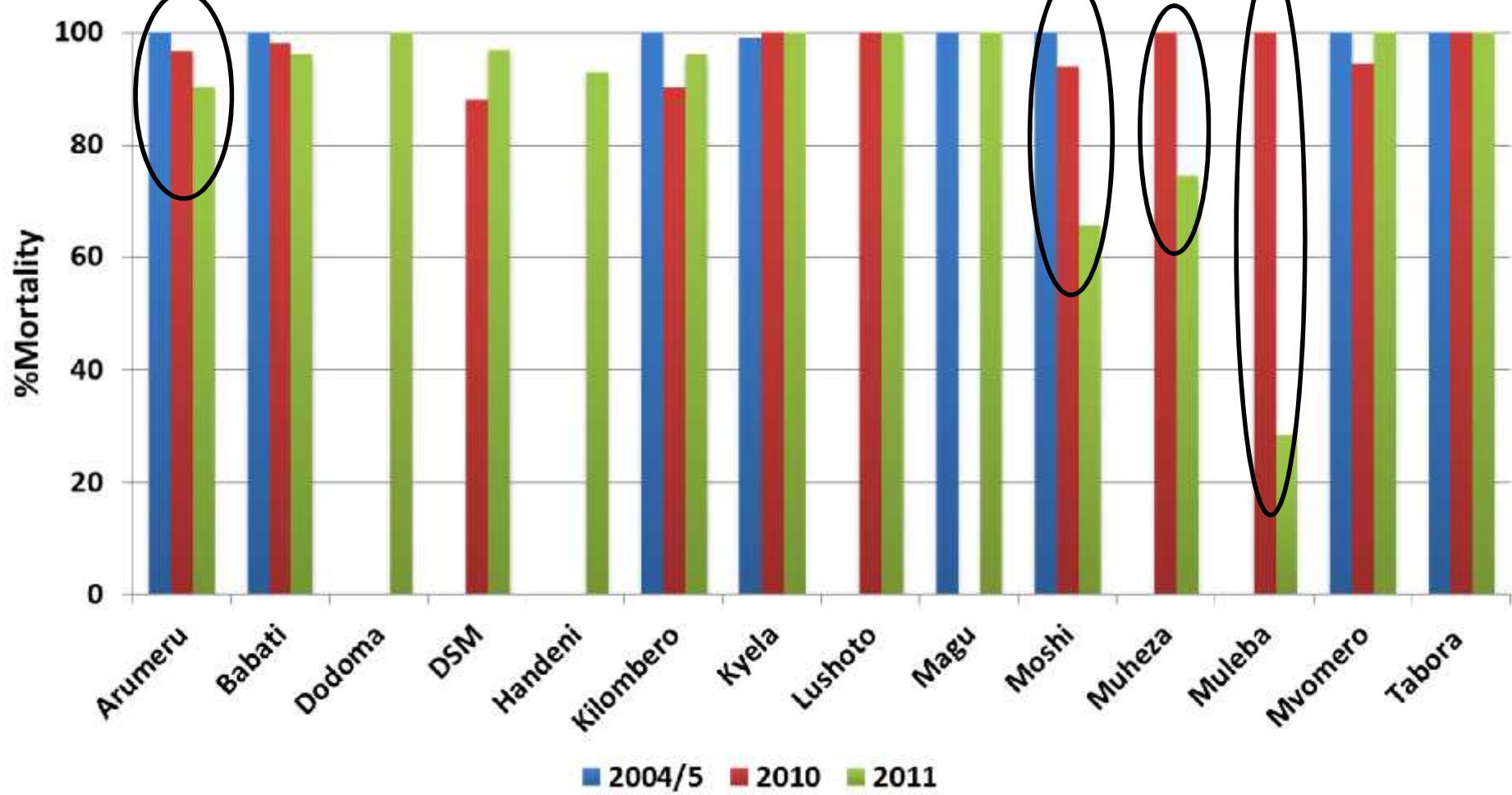


# RESULTS-2011



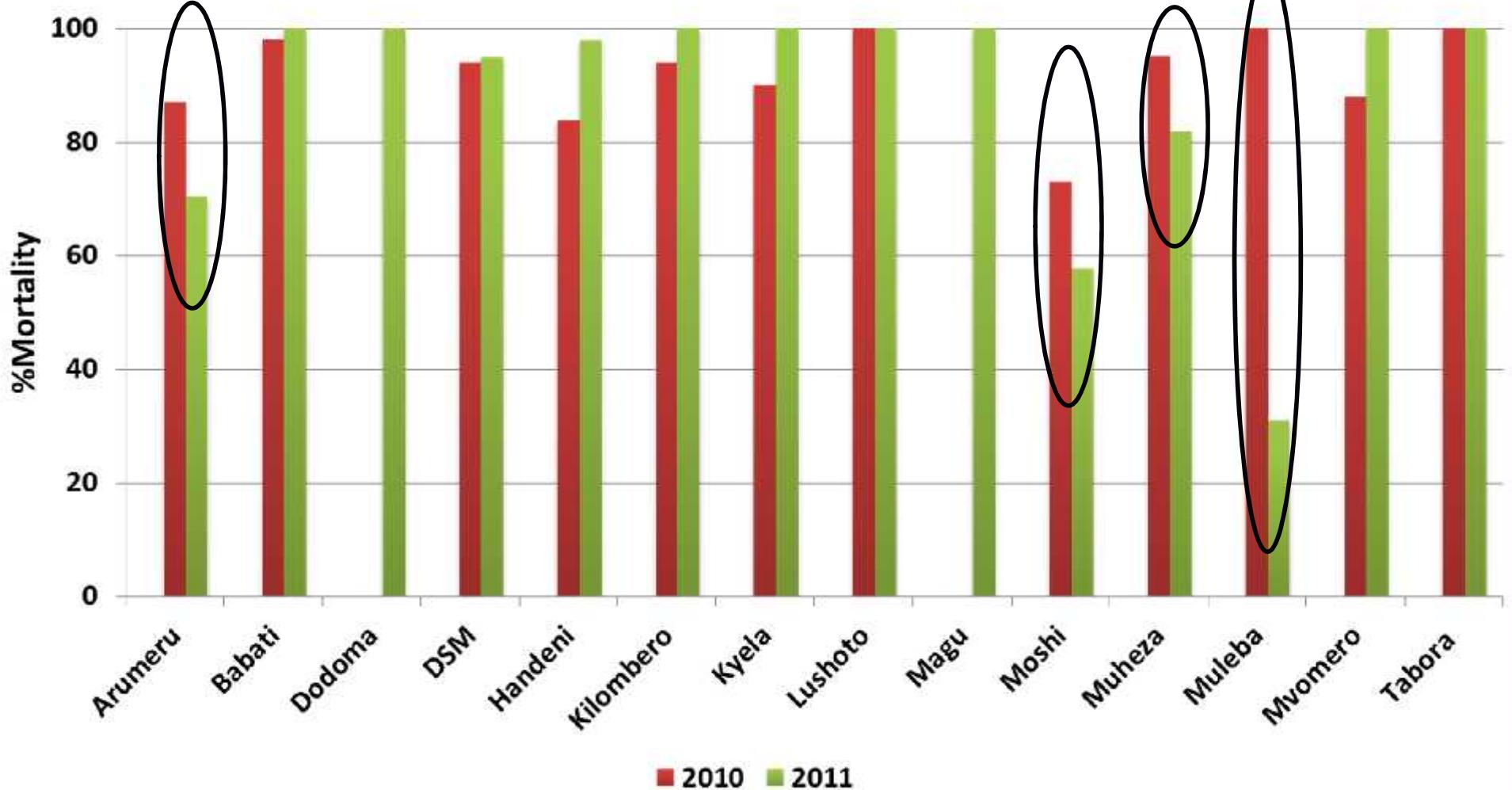
□ Significant resistance detected in Arumeru, Kilombero, Moshi, Muheza and Muleba

## DELTAMETHRIN

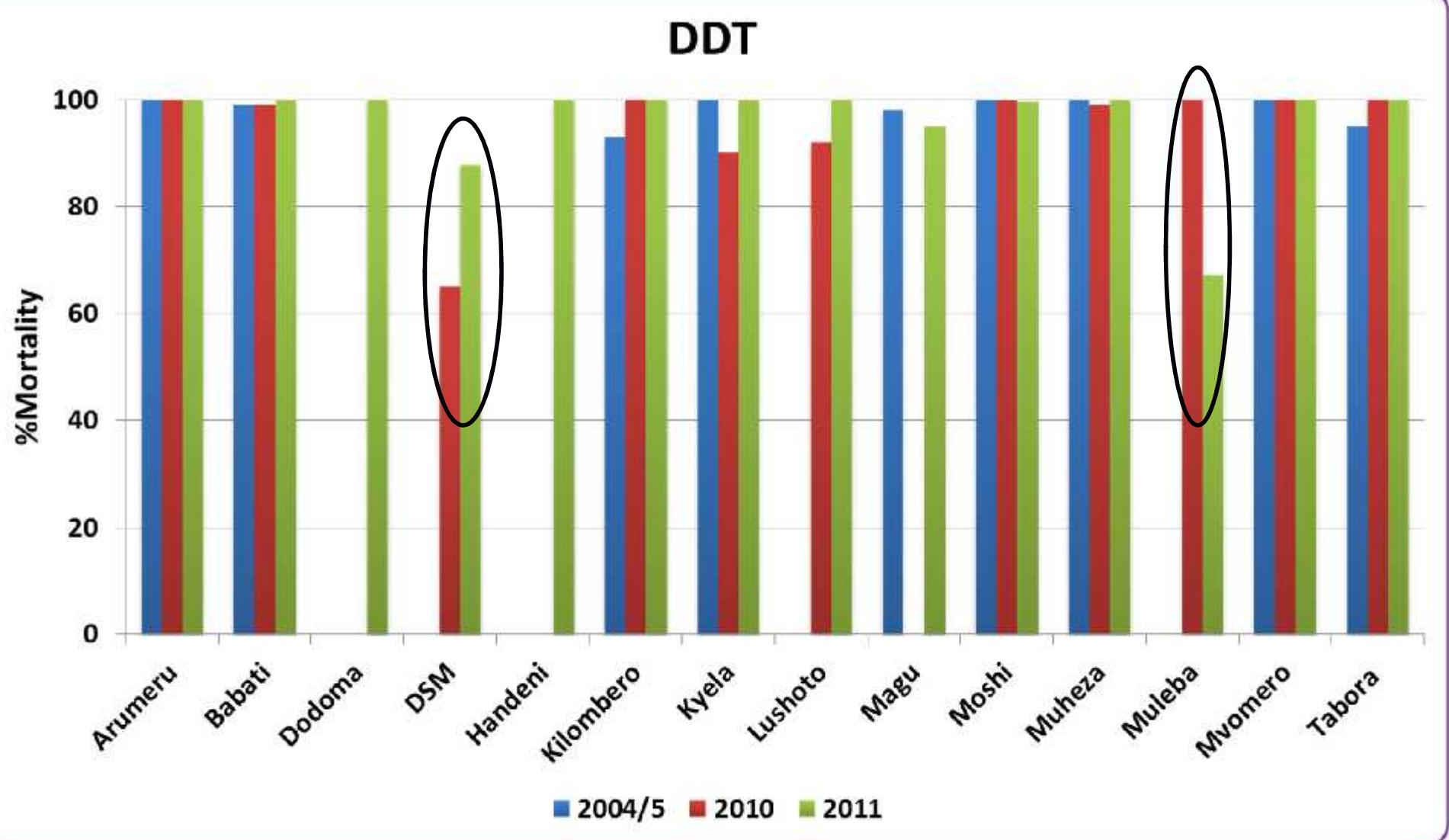


□ Significant resistance detected in Arumeru, Moshi, Muheza & Muleba

## LAMBDA CYHALOTHIN

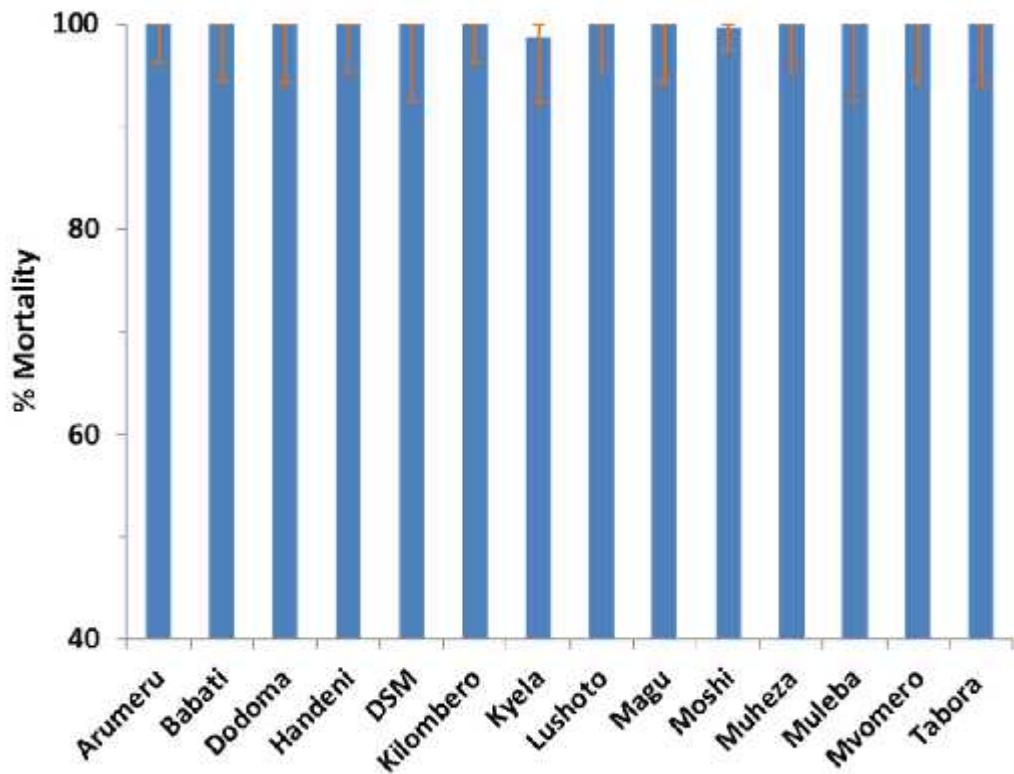


Significant resistance detected in Arumeru, Moshi, Muheza & Muleba

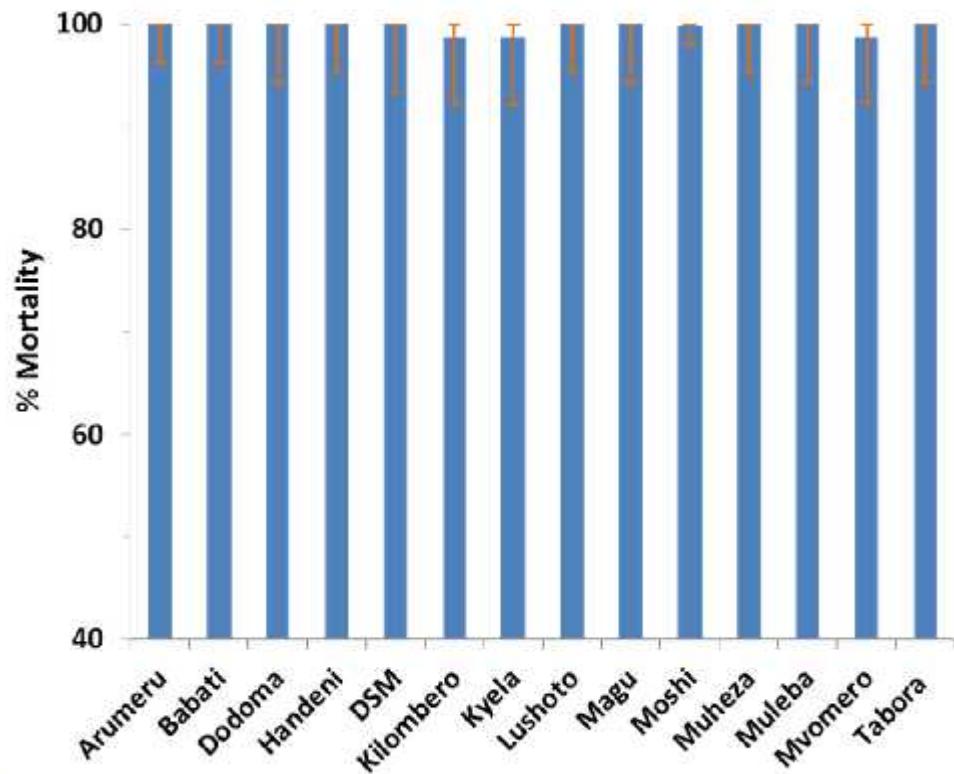


Evidence of DDT resistance in DSM & Muleba

### FENITROTHION



### PROPOXUR

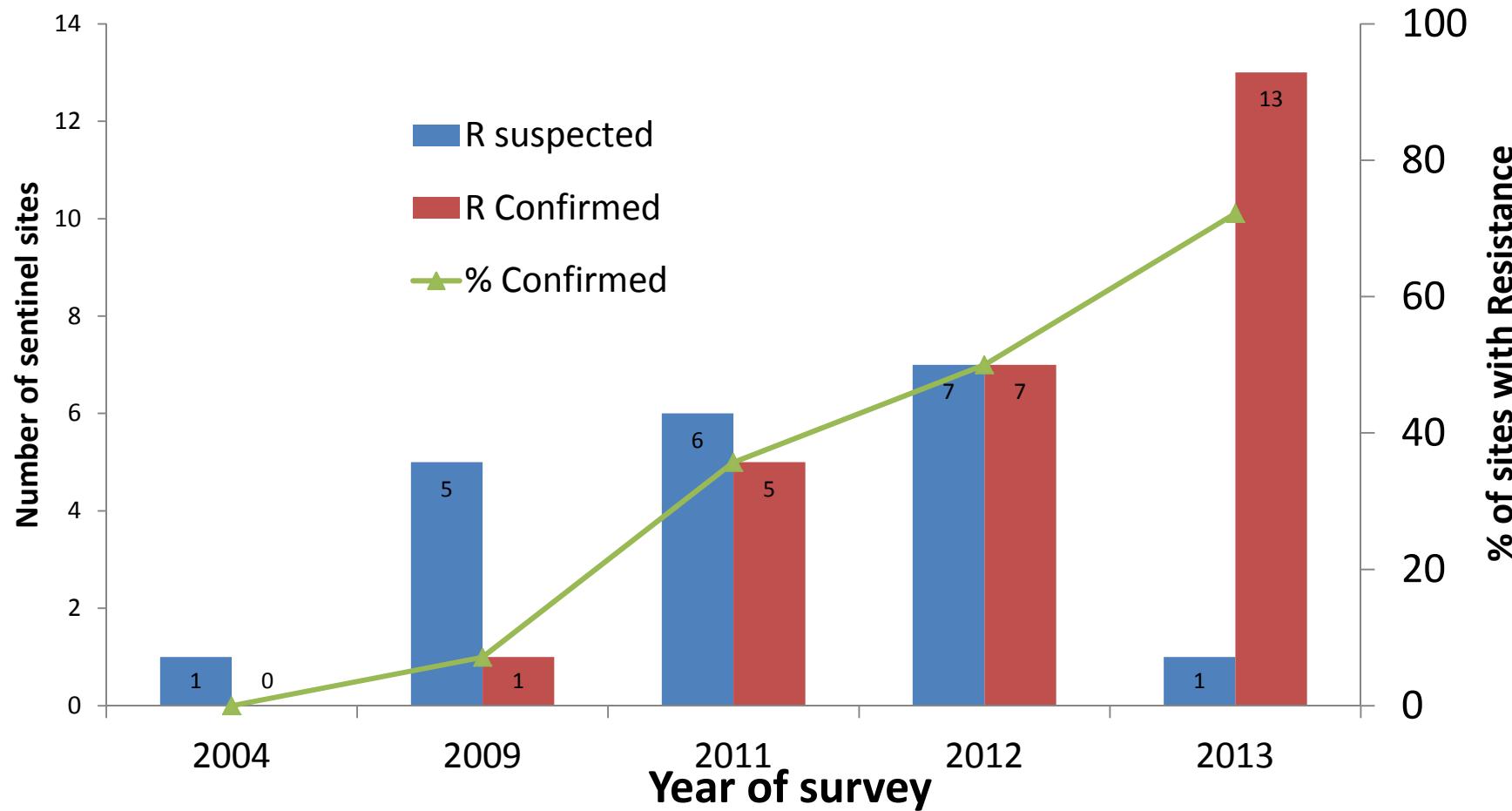


No evidence of resistance to fenitrothion and propoxur

Kabula et al., 2012 Trop Med Int Health, 17 (6): 742–750

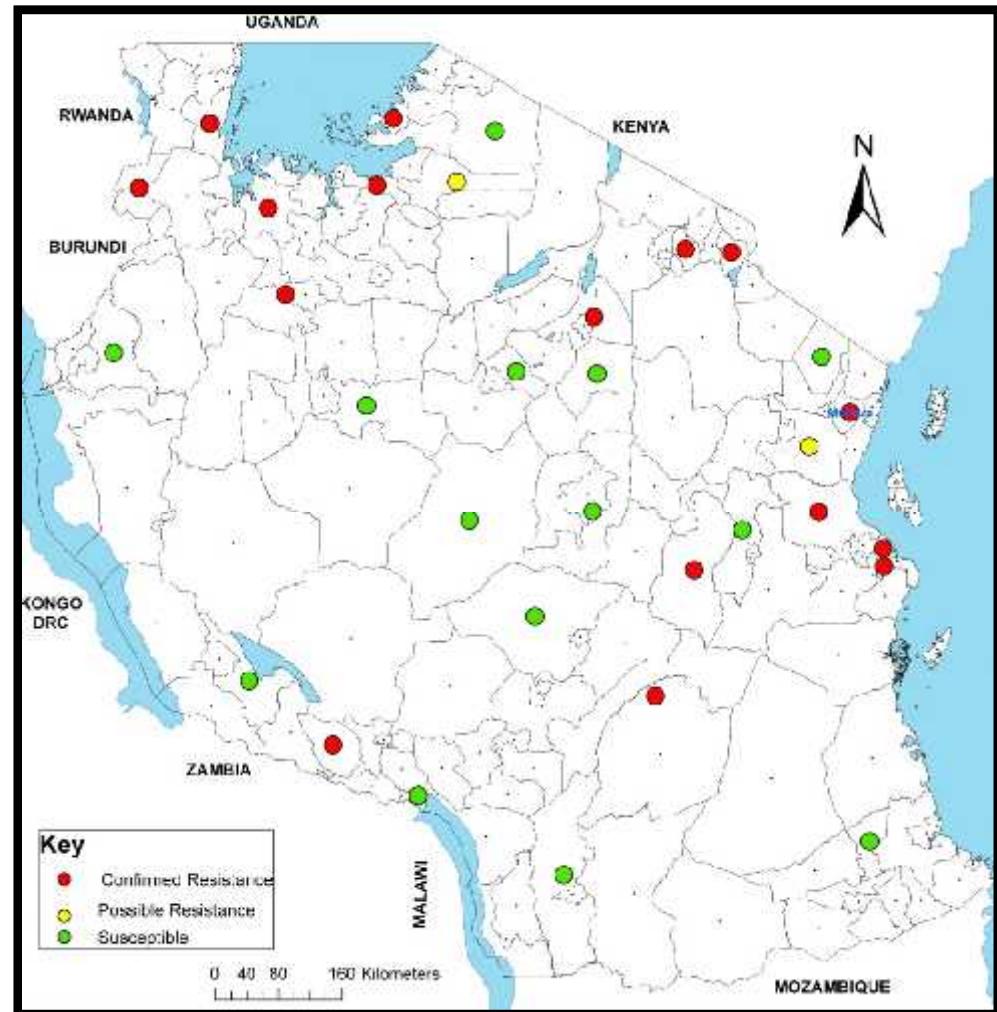
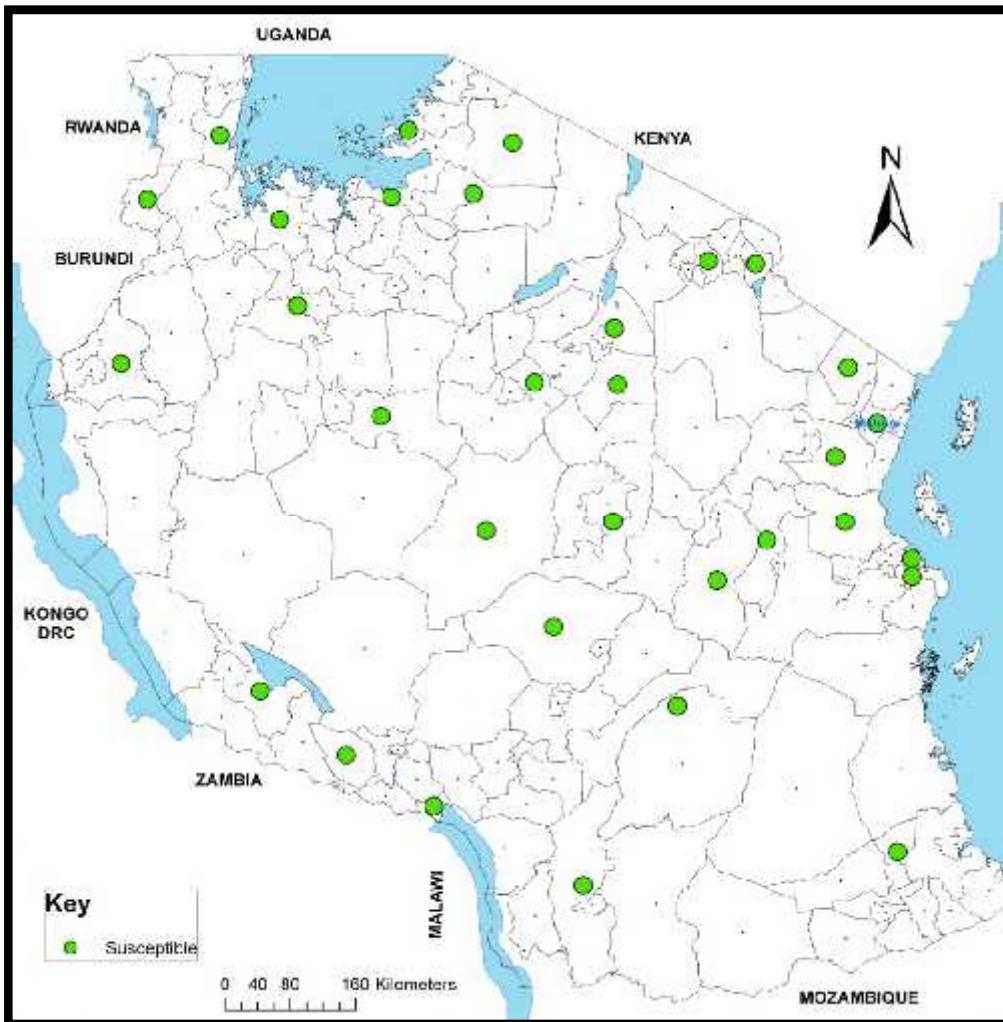
Kabula et al., 2014 Med Vet Entomol, 28(3):244–52

# Insecticide Resistance Trend 2004- 2013

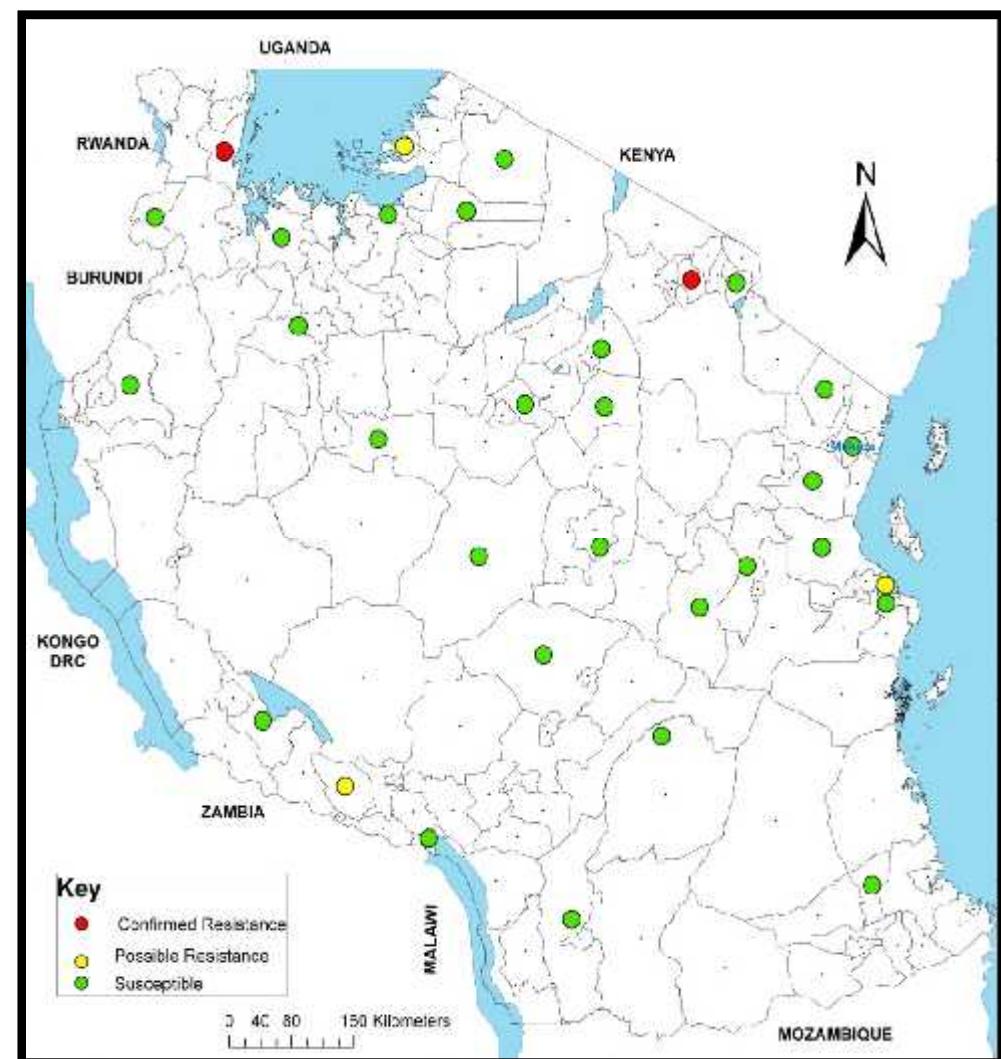
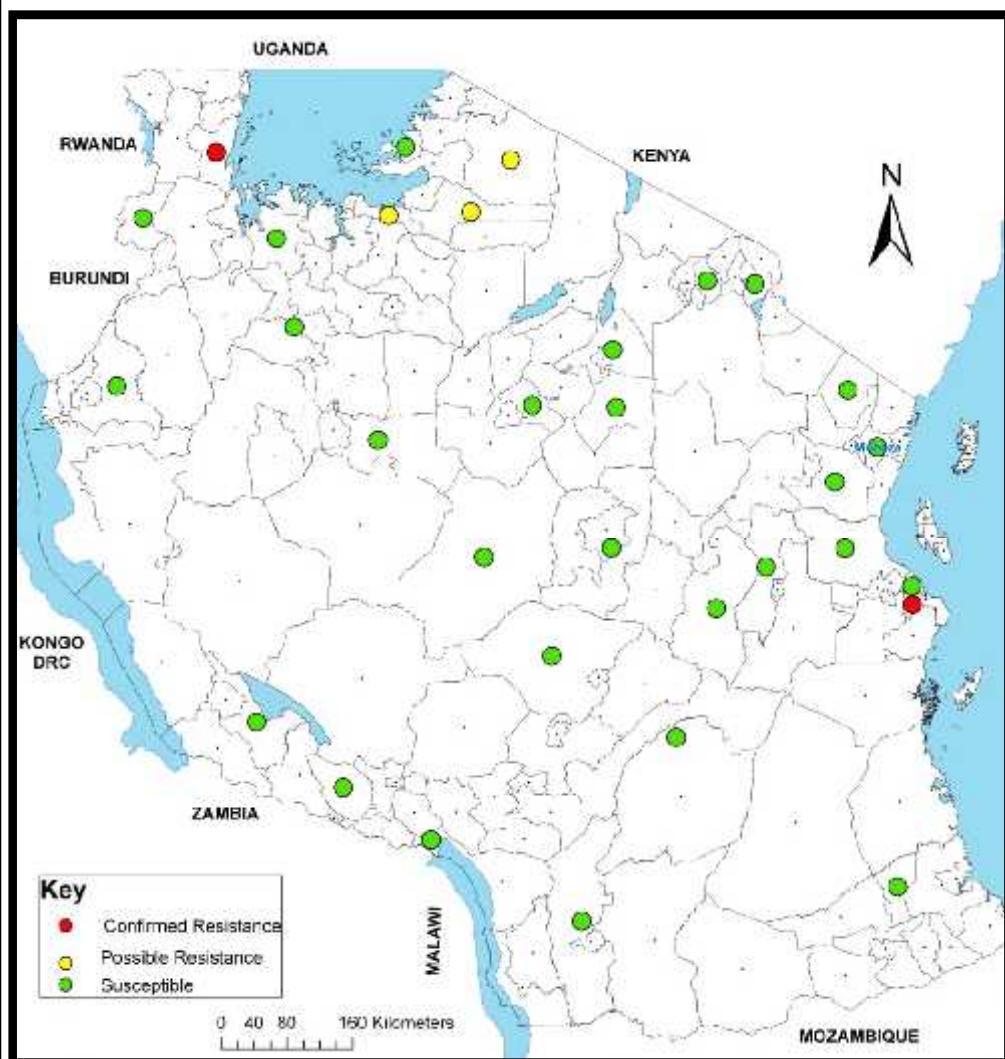


Source: NMCP, 2014

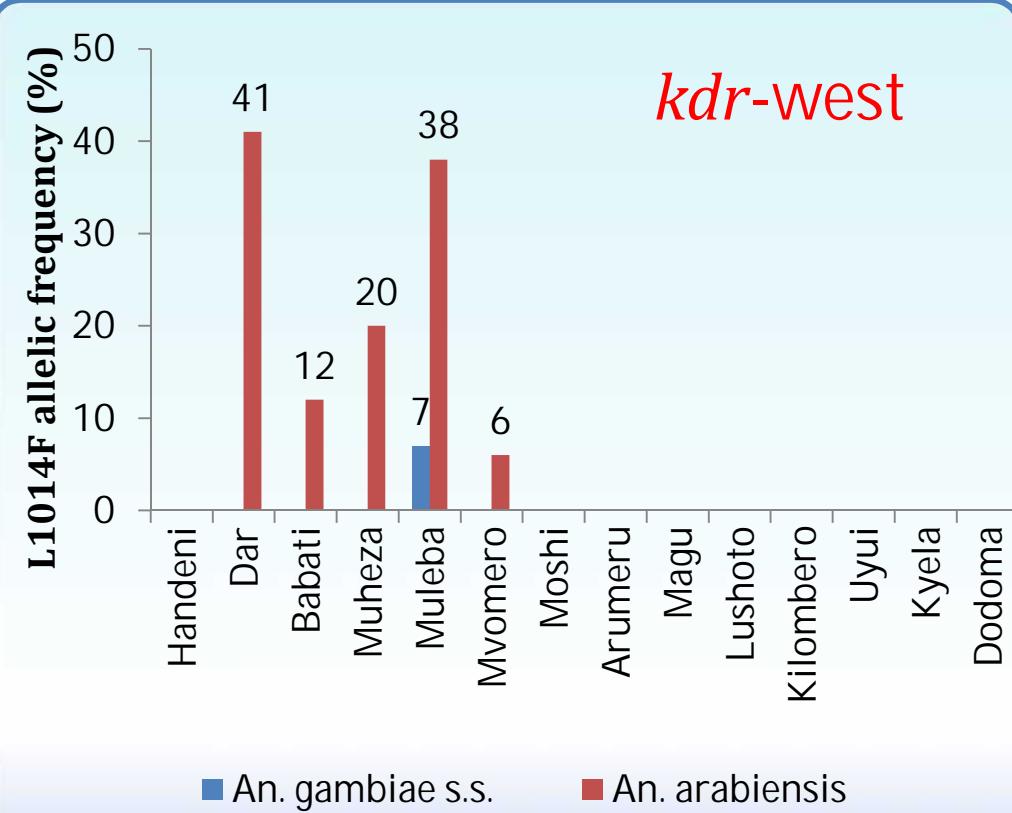
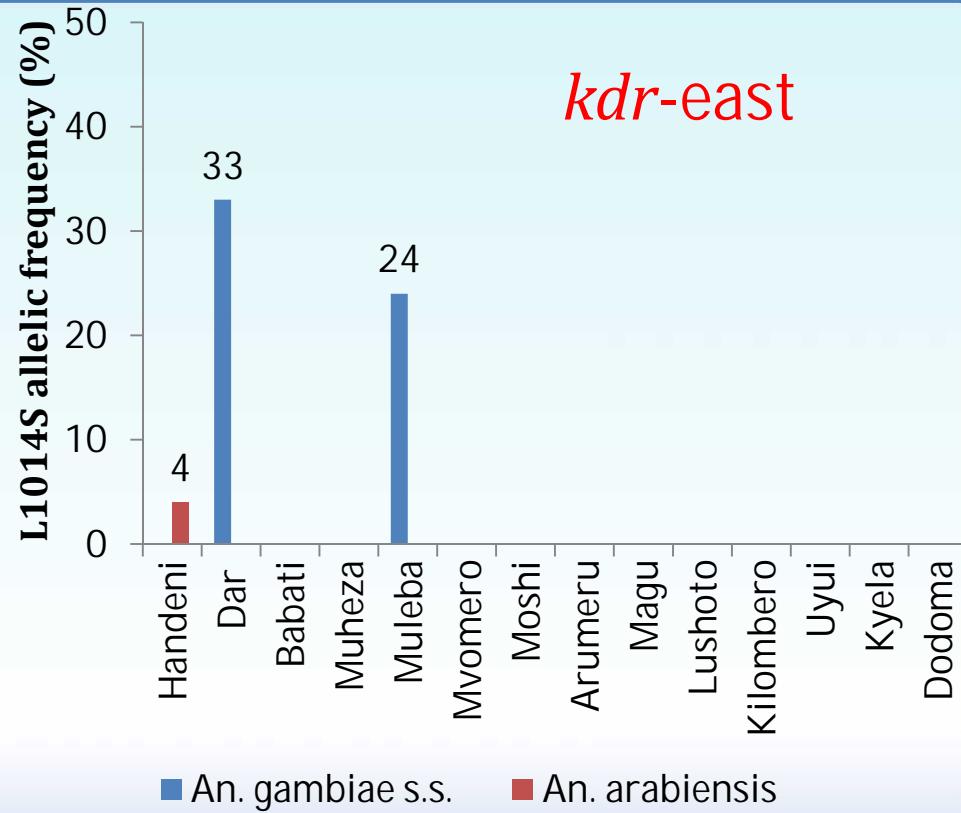
# Pyrethroid Resistance 2004 - 2013



# DDT & CARBAMATE

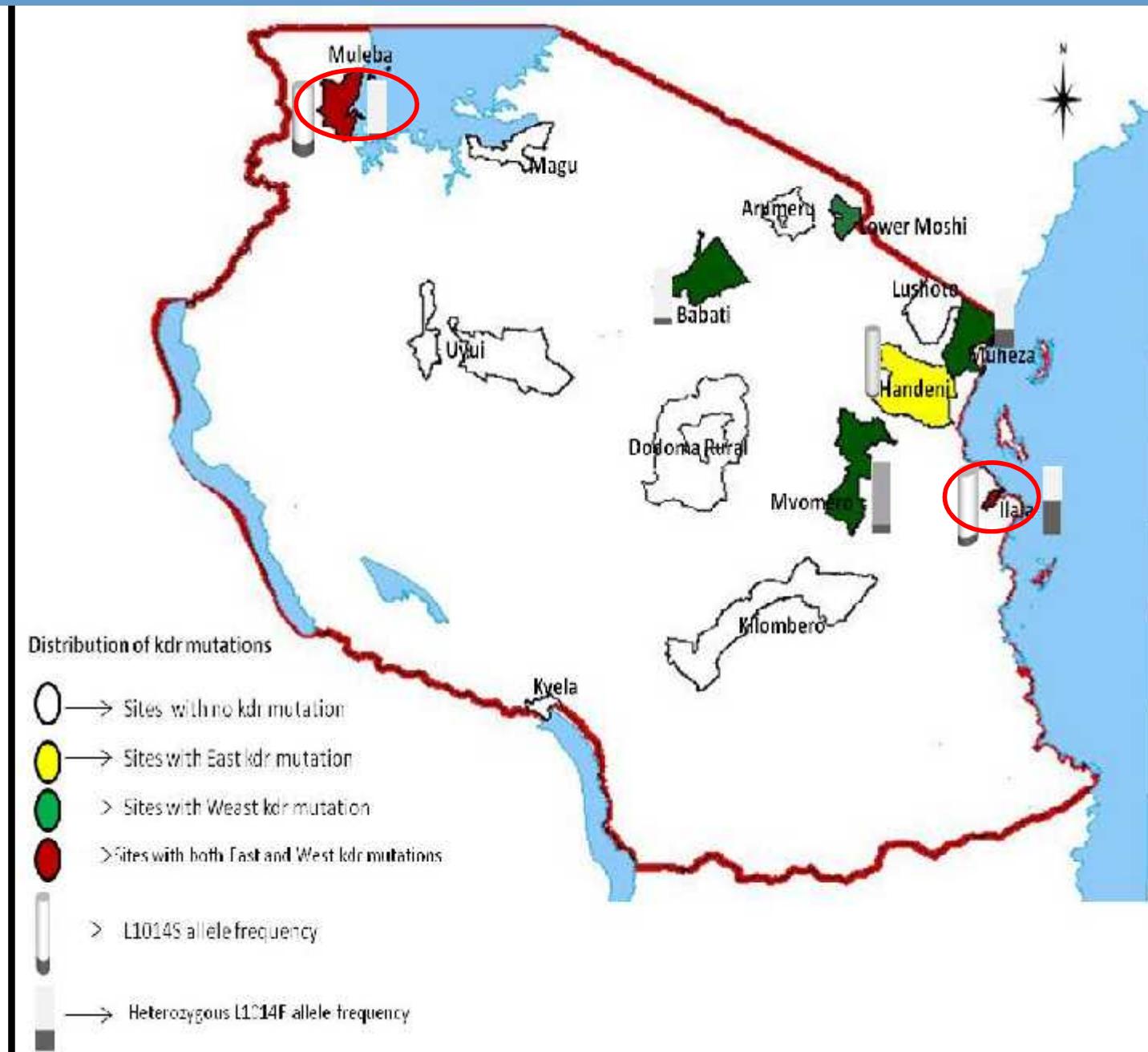


# Target Site Resistance- *kdr* mutations



- L1014S and L1014F mutations detected in both *An. gambiae s.s.* & *An. arabiensis*
- L1014S associated with *An. gambiae s.s.* ( $\chi^2 = 23.41$ ;  $P < 0.0001$ )
- L1014F associated with *An. arabiensis* ( $\chi^2 = 11.21$ ;  $P = 0.0008$ )

# Distribution of kdr mutation



# Conclusions

- *Anopheles gambiae s.l.* is becoming resistant to pyrethroids and DDT in several parts of Tanzania.
- Co-occurrence of L1014S and L1014F mutations
- This has coincided with the scaling up of vector control interventions-ITNs & IRS
- Co-occurrence of L1014S and L1014F mutations coupled with DDT & pyrethroid resistance suggest that insecticide resistance is becoming a widespread phenomenon
- Resistance may impair the effectiveness of vector control interventions

# Conclusions...

- Deploy resistance management and monitoring plan so as to prevent the spread of resistance and prolong the use of the current insecticides
- Explore further on the operational implications of insecticide resistance on malaria epidemiology

# Acknowledgment

NIMR

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**Thank you**