



# Partnership

To End Malaria

## Insecticide resistance in *Anopheles arabiensis*, the primary malaria vector in Sudan

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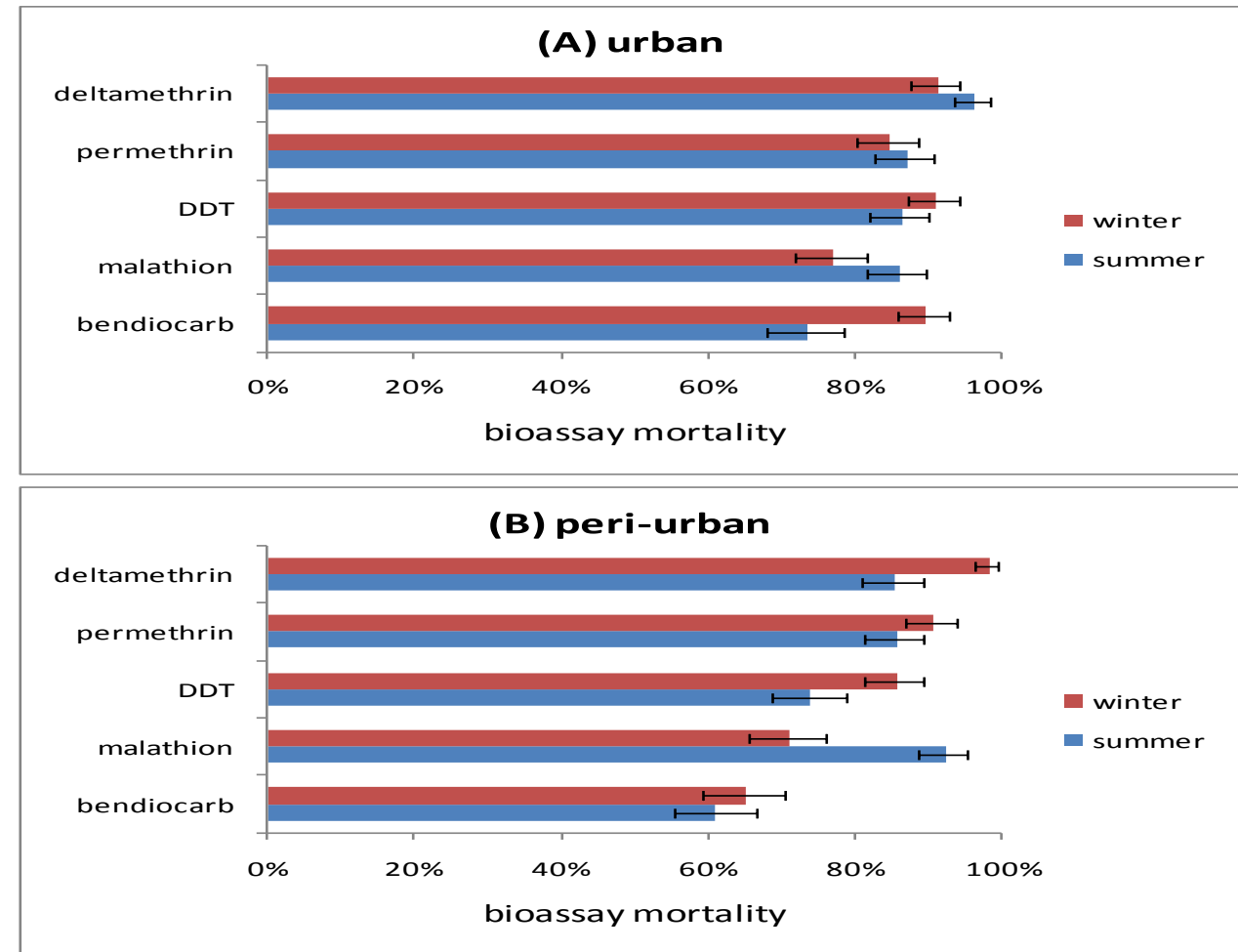
# Malaria in Sudan:

- Sudan is considered a high-burden and high-risk country for malaria.
- 1.5 million estimated cases of malaria and about 3,885 deaths.
- Sudan's contributing by 35% of the estimated malaria cases within EMRO in 2017.
- Control program rely heavily on IR and ITNs.

# IR in Sudan:

Study conducted in 2012 showed that resistance of the Khartoum population of *Anopheles arabiensis* to the four class of insecticides used for IRS.

Abuelmaali, et al. 2013.



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PLOS ONE

## Impacts of Agricultural Practices on Insecticide Resistance in the Malaria Vector *Anopheles arabiensis* in Khartoum State, Sudan

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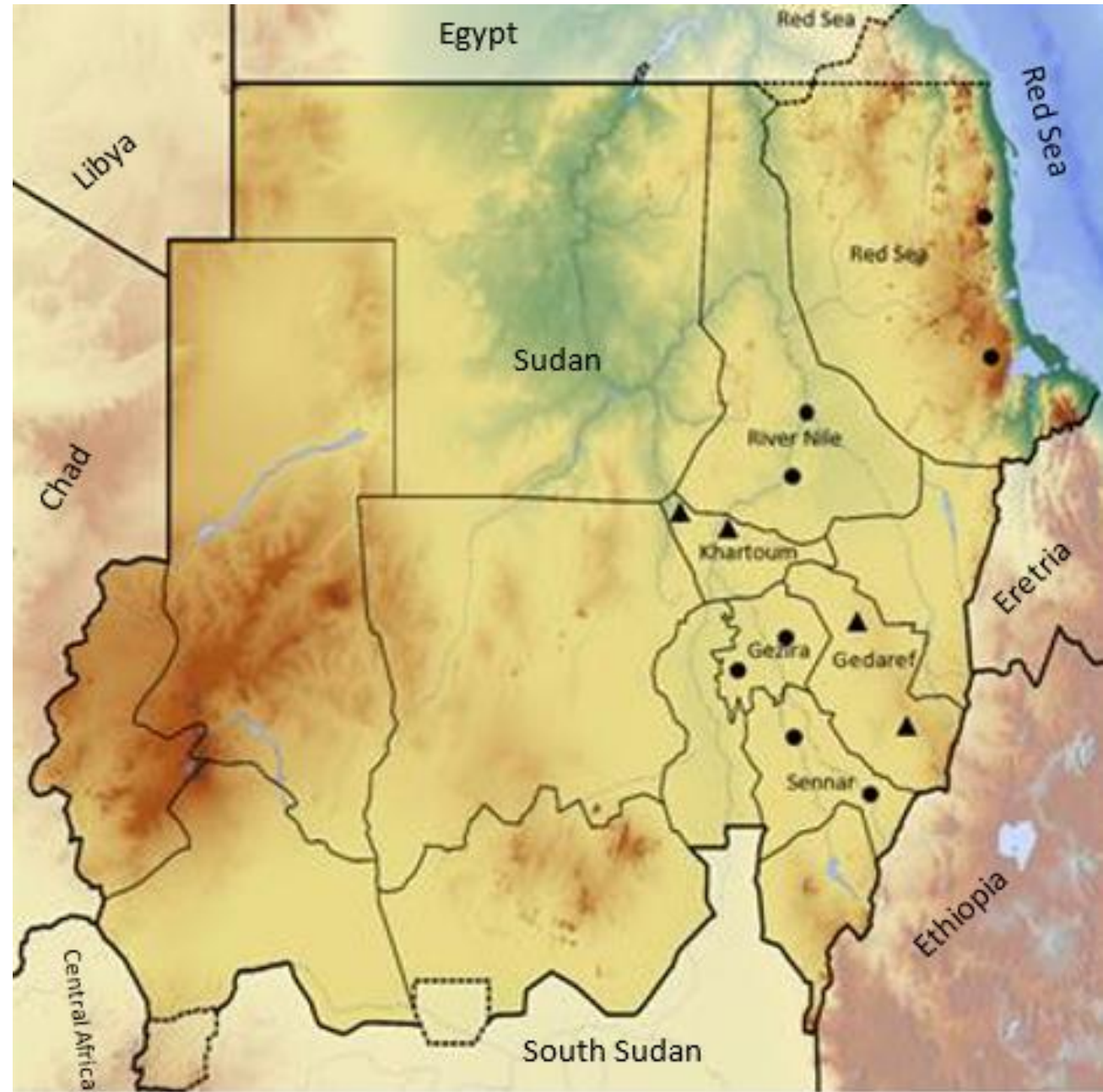
# What is our question?

- We had two concerns in mind:
  - 1) The public health use of insecticide is not the only source for IR.
  - 2) Organophosphates and carbamates are the main option for IRS in Sudan.

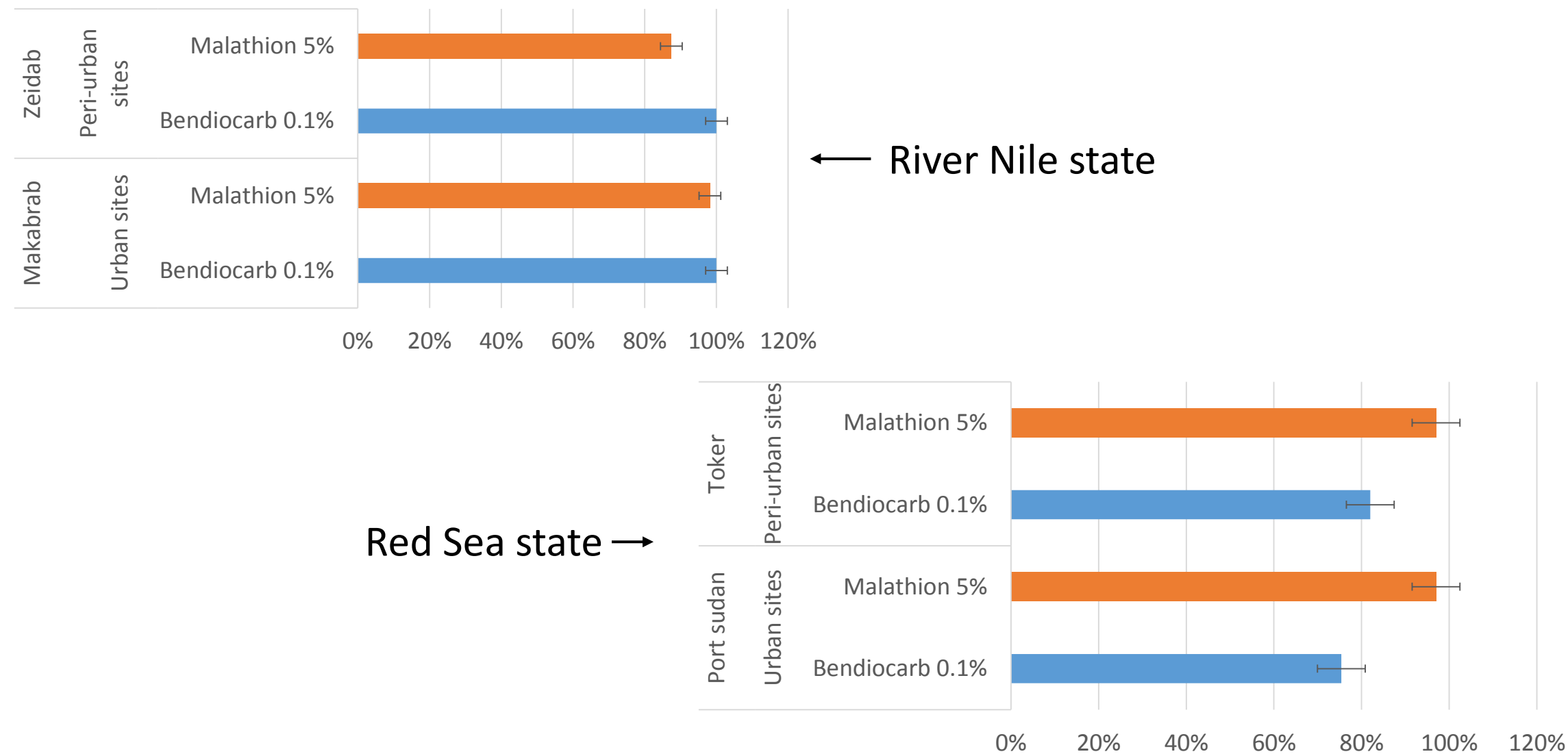


# Scale of the study:

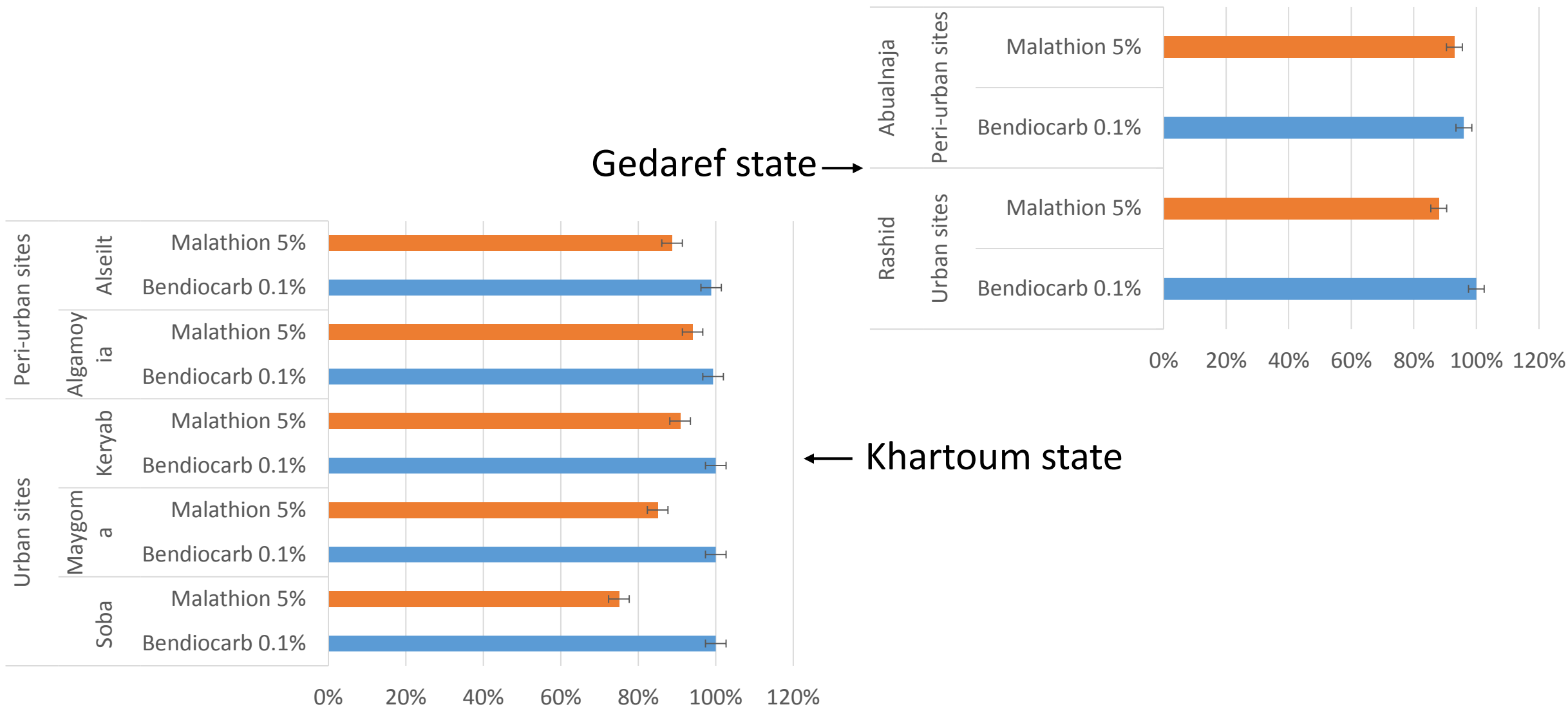
- We investigated the carbamate and organophosphate resistance in *An. arabiensis*.
- 2725 and 2825 samples were tested for Bendiocarb 0.1% and Malathion 5% resistance respectively.
- Countrywide across the three ecological zones of the country (transmission varies per zone).



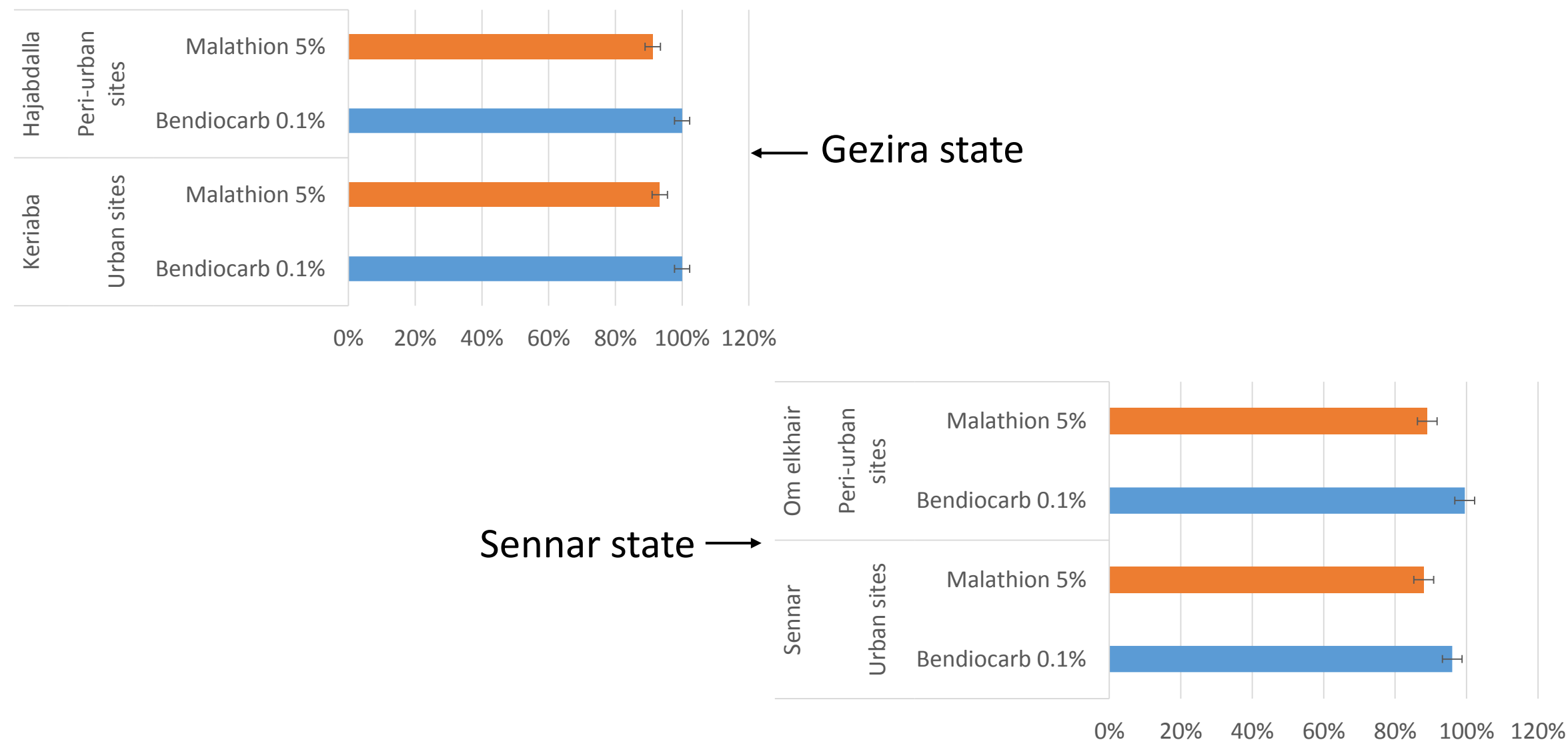
# Major findings: Sites of the desert/semi desert region



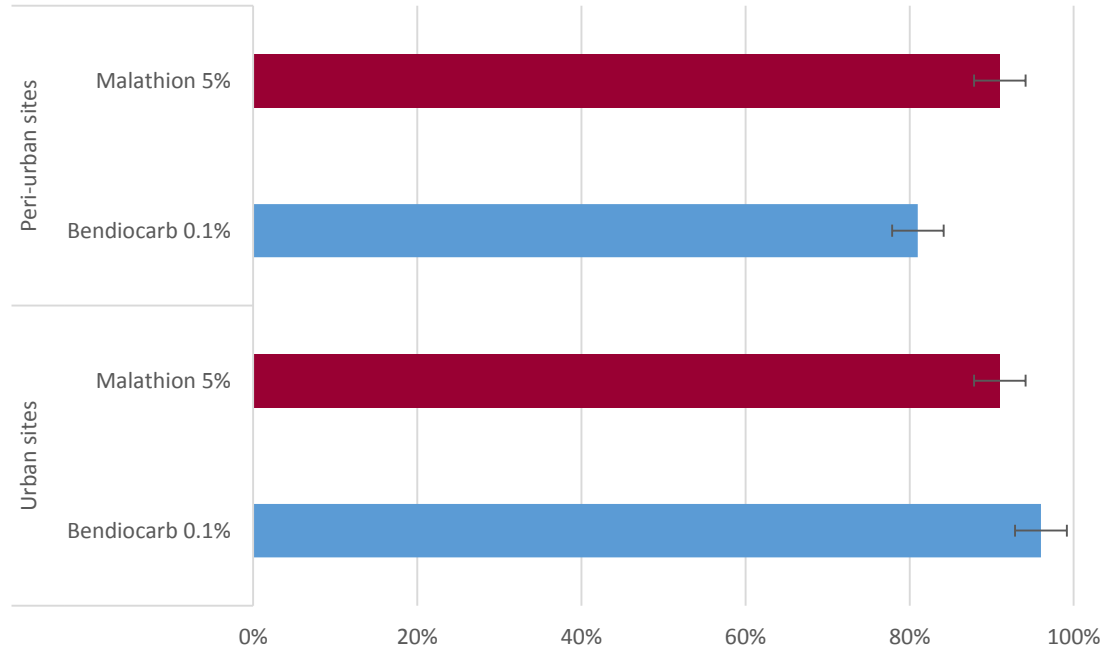
# Sites of the poor Savanna region:



# Sites of the rich Savanna region:







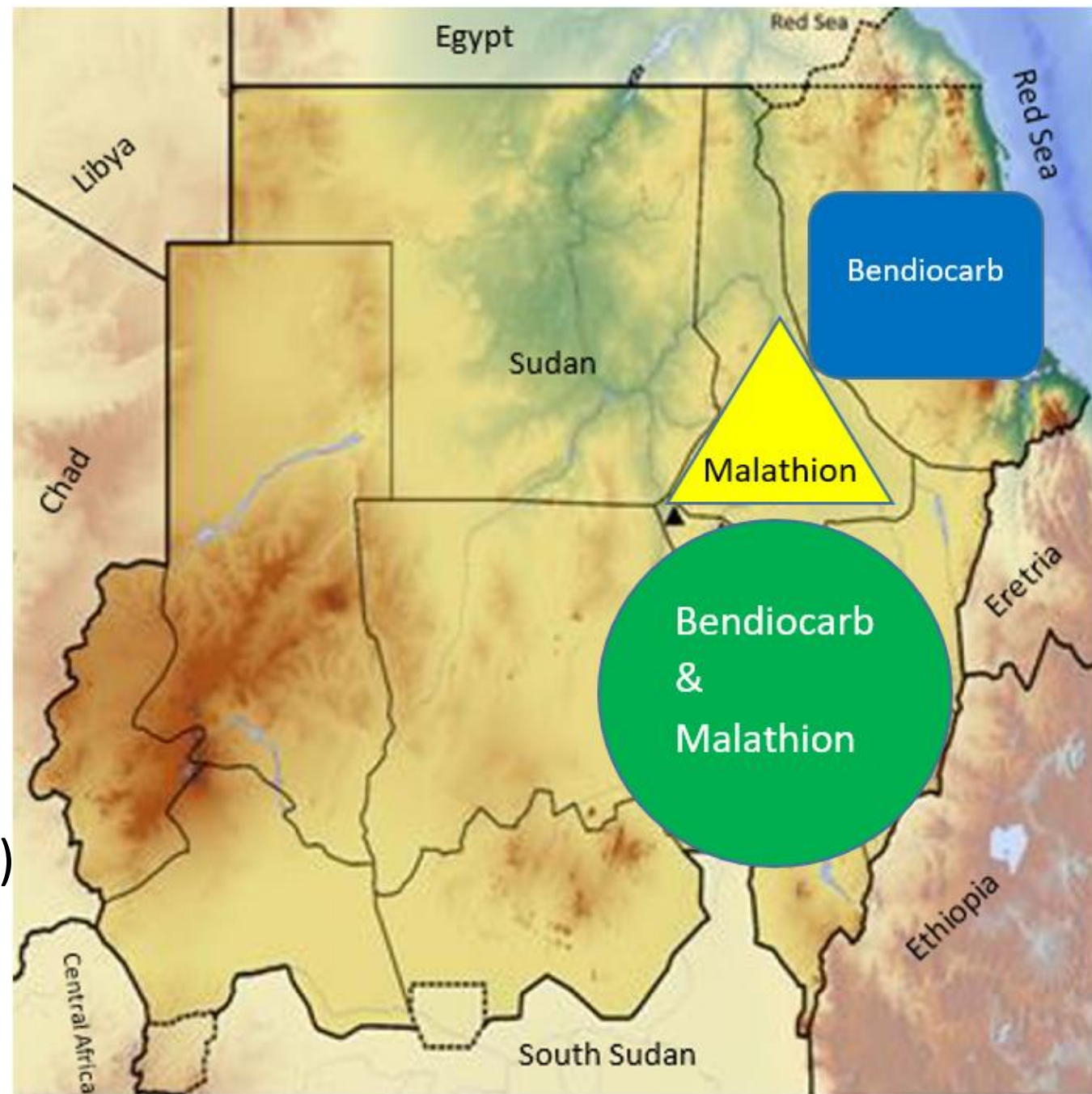
**Bendiocarb** is significantly associated with Peri-Urban sites.

$$\chi^2 = 121.46, df = 2, P < 0.00001$$

An effect size = 21%, 95% C.I. (17% - 25%)

Malathion is not:

$$\chi^2 = 0.13, df = 2, P = 0.722939$$



# Conclusion:

- We confirmed the absence of Ace-1 mutation in the population of *An. arabiensis* across all states.
- IR of the Sudanese population of *An. arabiensis* is heterogeneous. Possibly, due to the barriers of the harsh environment.
- We are working on validating the genes associated with resistance.
- Our morphological and molecular investigation suggesting the possible involvement of cuticle resistance (Melanic form).

# Recommendations:

- We recommend investigating the temporal and spatial variation of IR in the mosquito population at small distance and time frequency.
- Investigating the role of cuticle resistance as well as barriers for the genes follow.
- The coordination between the ministry of health and ministry of agriculture for the early detection of resistance among pests, better use of insecticides, and improve the management of IR.

# Big thanks for my Supervisors and supporters:





**The Institute of Endemic Diseases**  
**University of Khartoum**



**LSTM**  
LIVERPOOL SCHOOL  
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