

**RBM**  
**Vector Control Working Group (VCWG)**  
**12<sup>th</sup> Annual meeting**  
**Geneva- Switzerland**  
**8<sup>th</sup>-10<sup>th</sup> February 2017**

# **Lessons learned in Malaria Elimination in Sri Lanka**

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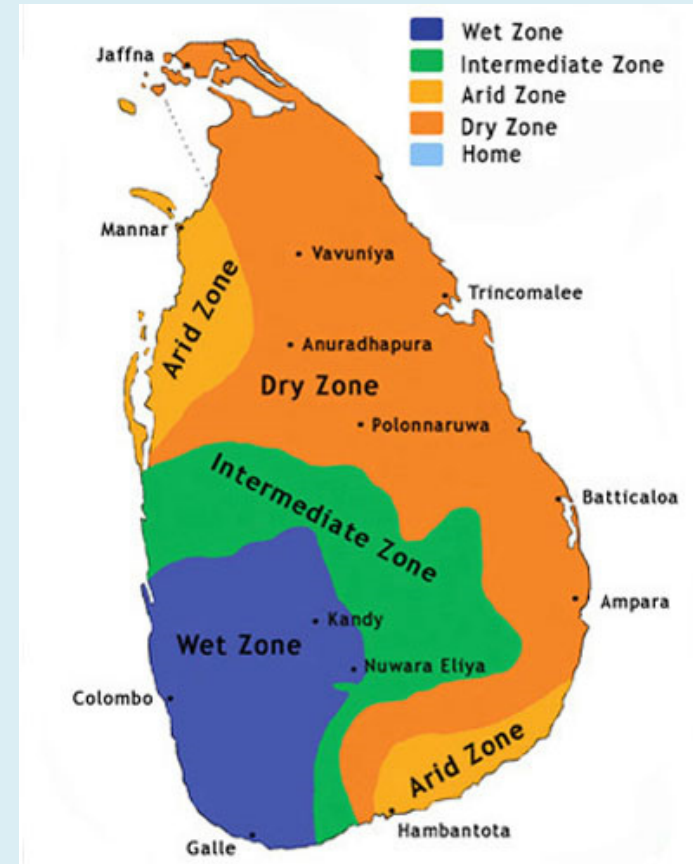
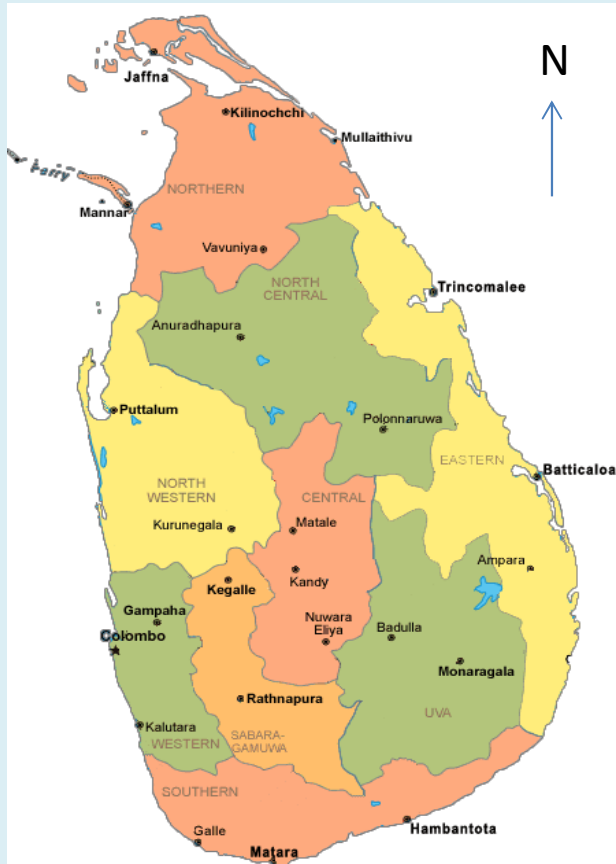
Anti Malaria Campaign, Ministry of Health

Sri Lanka

## SRI LANKA – “PEARL OF INDIAN OCEAN”



# Country Profile



Total Land Area  
Populations  
No of Provinces  
No of districts  
Capital city  
Commercial city

- 65,610 km<sup>2</sup>
- 21,324,791
- 09
- 25
- Sri Jayewardenepura
- Colombo



# Vectors of Malaria in Sri Lanka

## Primary (Major)

- *Anopheles culicifacies* “E” responsible for over 80% of transmission

## Secondary Vector

- *An. subpictus*

## Potential Vectors

- *An. aconitus*
- *An. annularis*
- *An. barbirostris*
- *An. varuna*
- *An. vagus* etc.



# Malaria Vector Breeding Sites



River margins



Down stream of dam



River bed pools



Brick pits



# Malaria Vector Breeding Sites



Irrigation canals



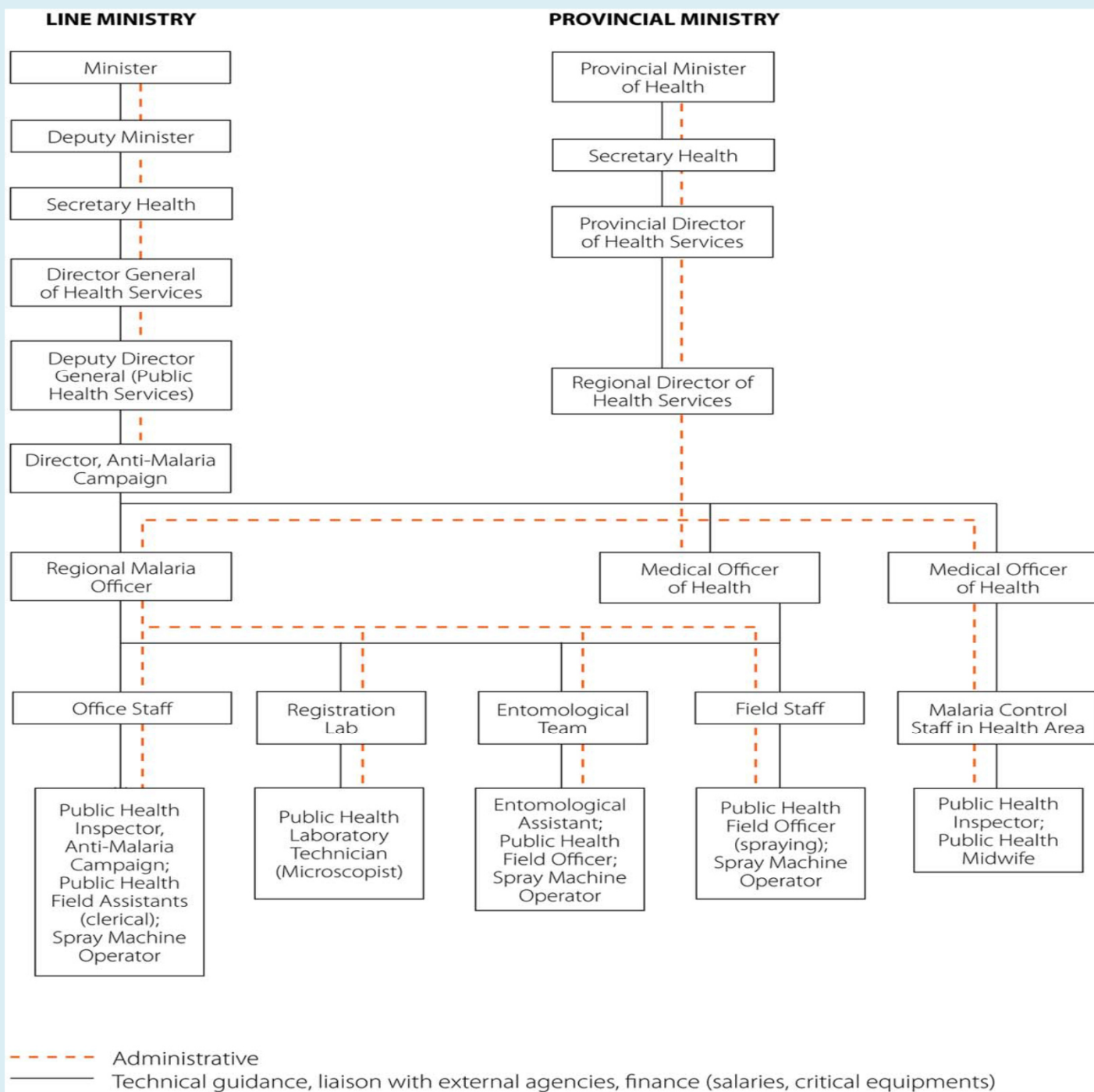
Agro wells



Tanks



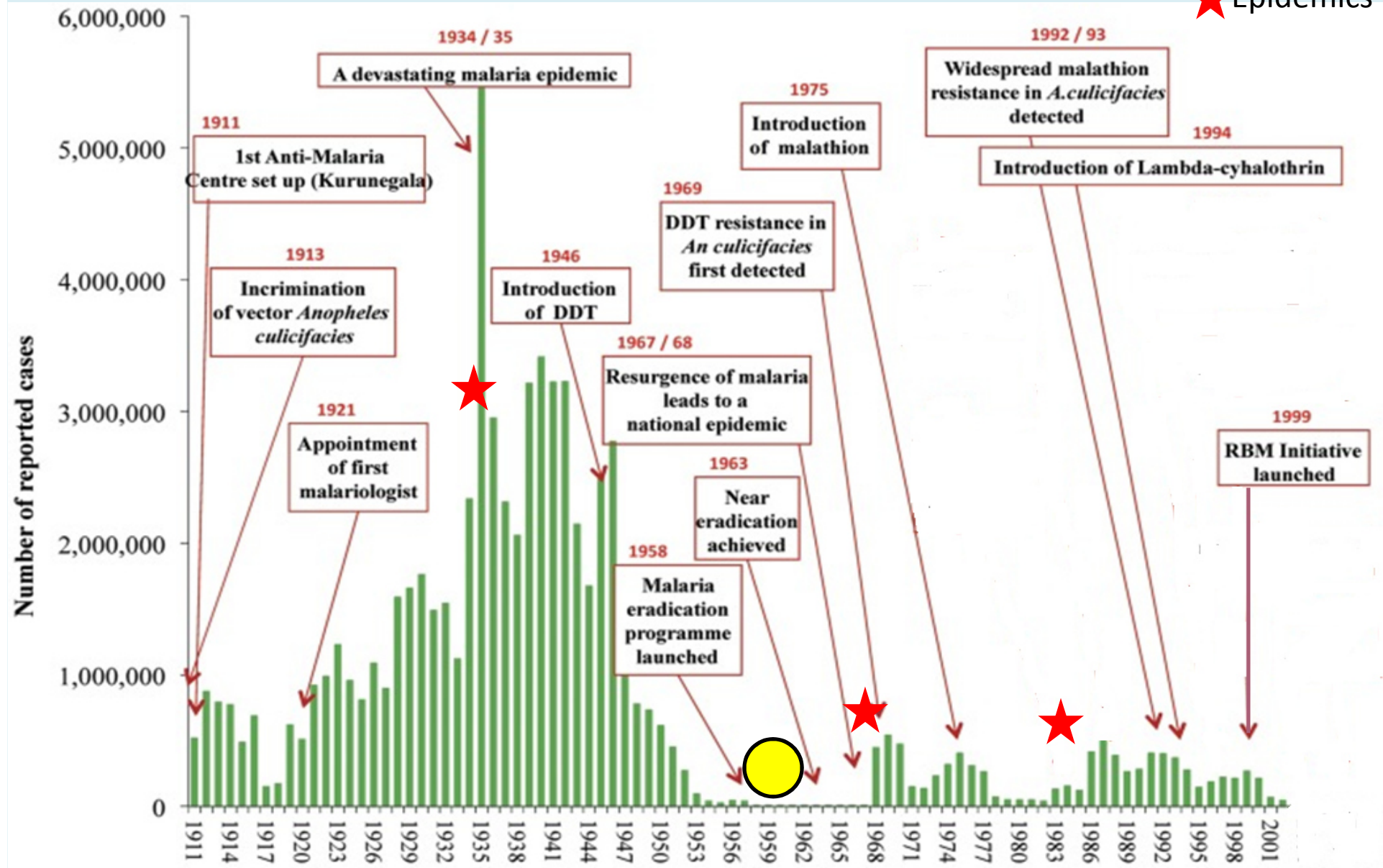
Quarry pits





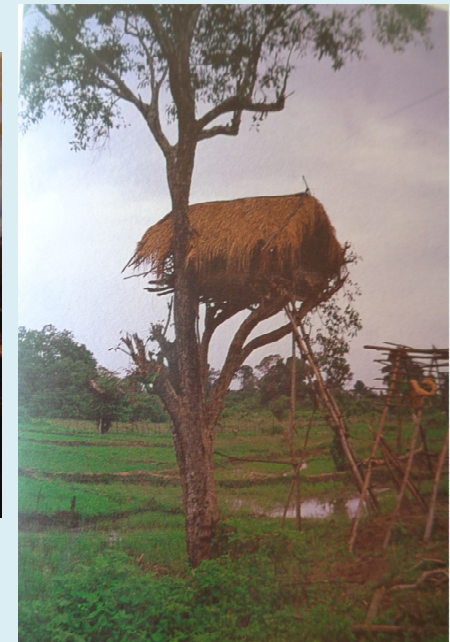
# History of Malaria Vector Control and Malaria Incidence – 1911-2001

★ Epidemics



# Factors contributed to the 86/87 and 92/93 epidemics

- Non-immune migratory population settled in endemic areas, poor housing
- Occupation – slash & burn cultivation, paddy cultivation, brick making, etc.



- New irrigation system created vector breeding sites
- Spread of CQ resistant *P. falciparum* strains

# Introduction of “New Global Malaria Control Strategies” recommended by WHO in 1994

## Strategy 1.

### Early detection and prompt treatment

- Strengthen diagnostic facilities in medical institutions,
- Conduct MMC
- Chemoprophylaxis to selected groups





# Introduction of “New Global Malaria Control Strategies” recommended by WHO in 1994 cont.....

## Strategy 2.

### Plan and implement selective and sustainable preventive measures

- Vector control measures were targeted /selectively
- High quality/high coverage IRS in selected localities
- Area-wise rotational use of chemically unrelated insecticides for IRS to delay the development of resistance
- Large scale village trials were conducted in different districts to test the efficacy and acceptance of pyrethroid insecticides – Del, Cyf, Eto, Bif





# IVM continues to be used for vector control

**Introduction of larvivorous fish into breeding sites**



**Intermittent flushing of major canals and waterways**



**Space spraying during festivals**





b) Insecticide treated nets  
(Mosquito net impregnation prog.)



Introduction of “New Global Malaria Control Strategies” recommended by WHO in 1994 cont.....

### Strategy 3.

#### To forecast and prevent epidemics

- Entomological surveillance activities were strengthened.

### Strategy 4.

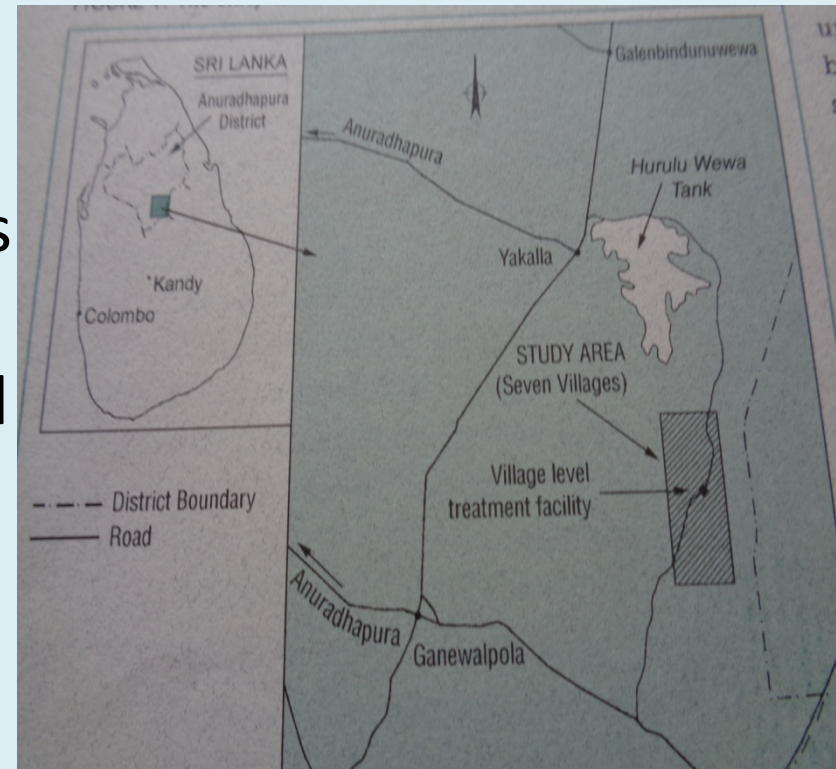
- Capacity building
- Operational research
- Regular assessment of malaria situation

# Research projects

IWMI, UP, and Mahaweli Authority and AMC – (1994-1998)  
Huruluwewa watershed

Series of studies were conducted :

- Rainfall and malaria
  - Economic burden to households
  - Risk factors for malaria
  - Water management as a control measure
  - Treatment seeking behavior
  - Cost of malaria control
- 
- *An. barbirostris* was incriminated as a potential vector





1. Van der Hoek, W., Konradsen, F., **Perera, D.**, Amerasinghe, F.P., Amerasinghe, P.H. (1997). Correlation between rainfall and malaria in the dry zone of Sri Lanka. *Annals of Tropical Medicine & Parasitology*, 91, 945-949
2. Konradsen, F., Steele, P., **Perera, D.**, Van der Hoek, W., Amerasinghe, P.H., Amerasinghe, F.P. (1999). Cost of malaria control in Sri Lanka. *Bulletin of the World Health Organization*, 77(4), 301-309
3. Konradsen, F., Amerasinghe, P.H., **Perera, D.**, Van der Hoek, W., Amerasinghe, F.P. (2000). A village treatment centre for malaria: community response in Sri Lanka. *Social Science & Medicine*, 50, 879-889
4. Konradsen, F., Amerasinghe, P., Van der Hoek, W., Amerasingh, F. **Perera, Devika**, Piyaratne, M. (2003). Strong association between house characteristics and malaria vectors in Sri Lanka. *American Journal of Trop. Med & Hyg.* 68(2), 177- 181
5. Van der Hoek, W., Konradsen, F., Amerasinghe, P.H., **Perera, Devika**, Piyaratne, M. K., Amerasinghe, F.P. (2003). Towards a risk map of malaria for Sri Lanka: the importance of house location relative to vector breeding sites. *International Journal of Epidemiology*. 32, 280-285

What was the change from 1999  
onwards that leads to elimination

# Roll Back Malaria Initiative launched in 1999

## Six Elements in RBM

1. Early Detection

2. Rapid Treatment

3. Multiple means on prevention

4. Well Coordinated action

5. A dynamic global movement

6. Focused research



# Roll Back Malaria Initiative launched -1999

Highest Level Political commitment was secured

National Action Group & Technical Support Group, Malaria Research Committee were established.

Five year National Strategic Plan Developed. POA were developed for 5 pilot project districts and implemented with the support of donor agencies (WHO, IDA/WB etc.)

Malaria control activities were targeted based on epidemiological stratification



# Stratification for Vector Control

## High Risk Areas

- API > 100
- > 30% *P.f.* infections
- CQ resistant *P.f.*
- IDP
- Development project areas
- Areas with special occupational groups
- Localities situated in river basins

Perennial /Seasonal  
IRS

ITN,  
Chemical larviciding

## Moderate Risk areas

- API 50-100
- 20-30 % *P.f.* infections
- Presence of significant number of breeding sites

Seasonal / Focal IRS

ITN ,  
Chemical larviciding

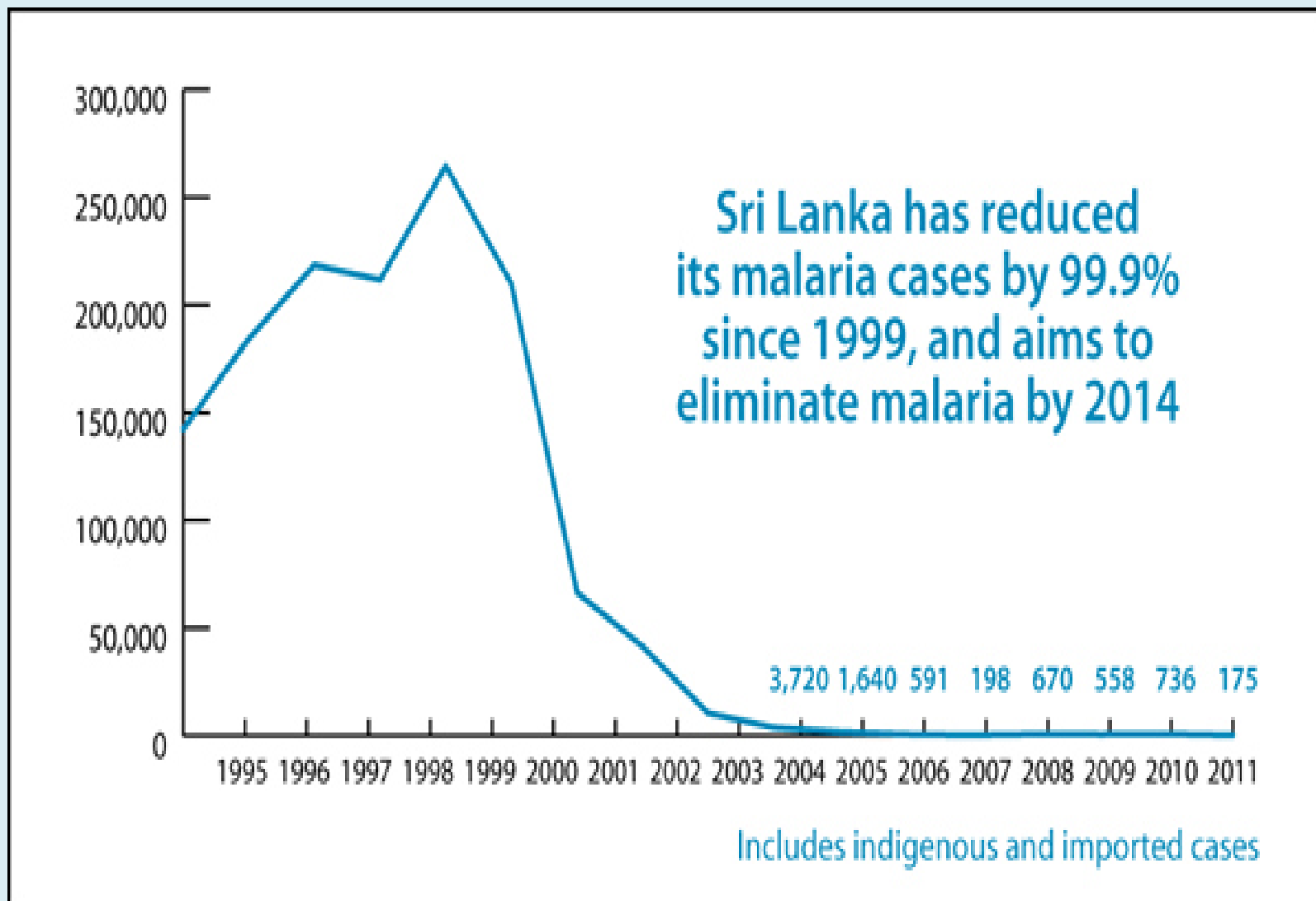
## Low risk areas

- API <50
- < 20% *P.f.* infections
- No obvious risk of sudden transmission

No IRS

ITN,  
Biological control

## Malaria incidence 1995-2011



## Strategy used for combining IRS and LLIN

- IRS with proven efficacy was limited to highest transmission areas. Use was limited, based on distribution of disease burden and seasonality
- LLIN were introduced in 2005. The early strategy for LLIN distribution was to target moderate transmission areas where IRS was withdrawn after blanket distribution of one net per family in selected villages
- LLINs were also targeted for IDP families living in temporary shelters (often not suitable for IRS), conflict affected areas where regular IRS operations were not possible and areas which were difficult to access routinely.

Work towards elimination started in 2008

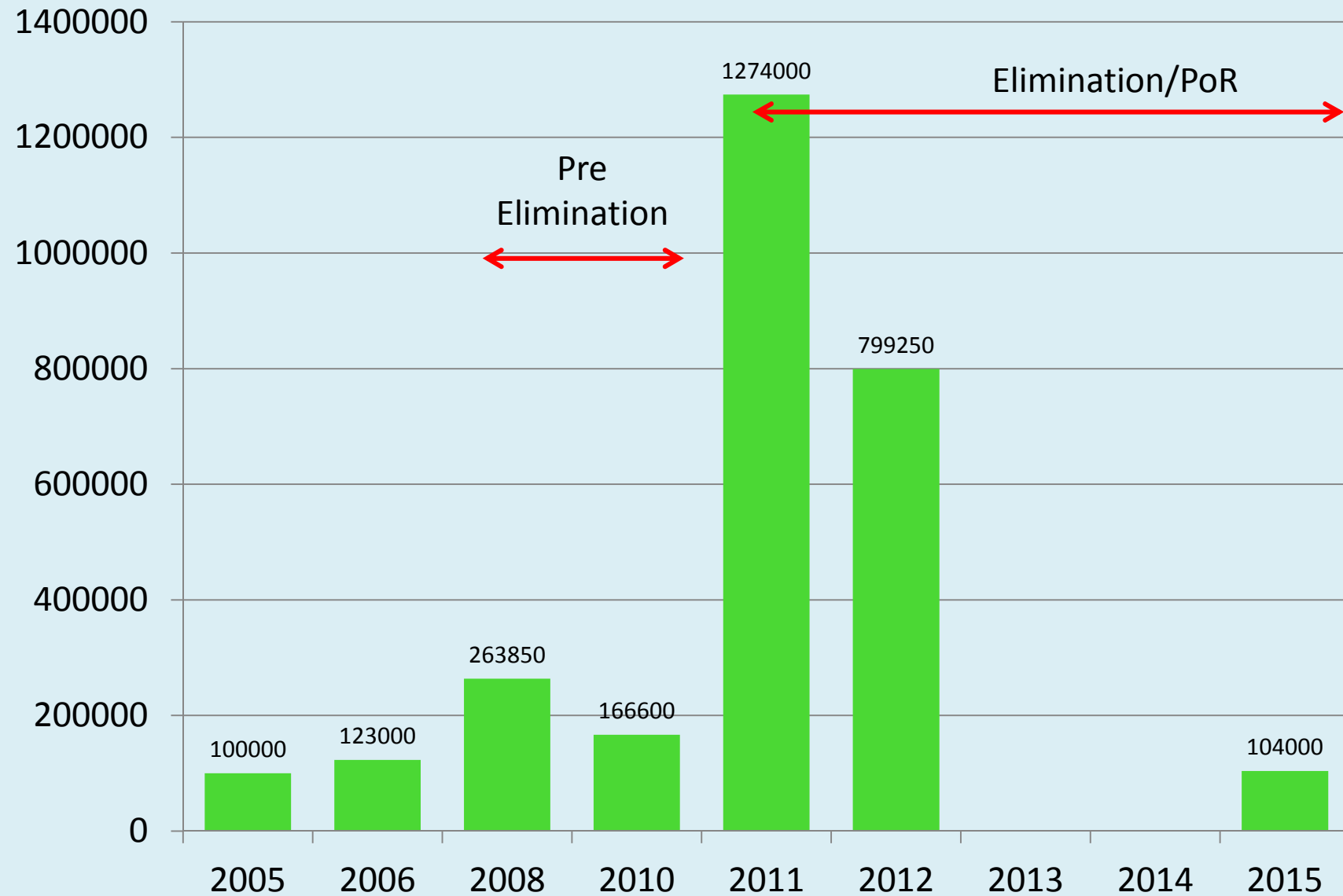
Goal

Sri Lanka with no indigenous malaria

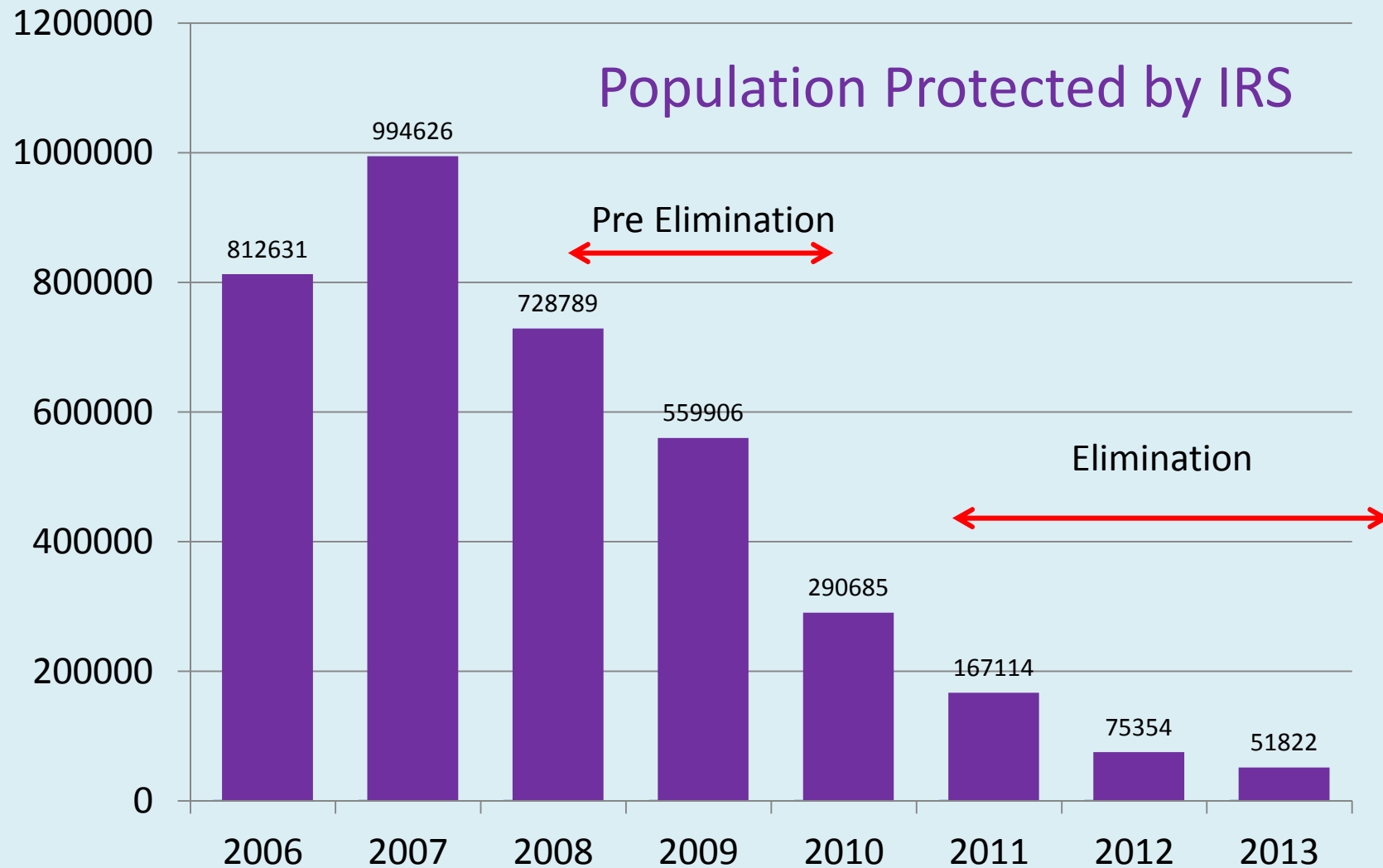
Objectives of Anti Malaria Campaign 2010-2014

- ❖ To interrupt indigenous transmission of *P.falciparum* malaria by end of year 2012
- ❖ To interrupt indigenous transmission of *P. vivax* malaria by end of year 2014
- ❖ To maintain zero mortality from malaria in Sri Lanka
- ❖ To prevent reintroduction of malaria into Sri Lanka
- ❖ To obtain WHO Certification “Malaria free status”

# Mass scale distribution of LLIN



# IRS in selected localities



## Disease burden due to malaria, 1999-2016

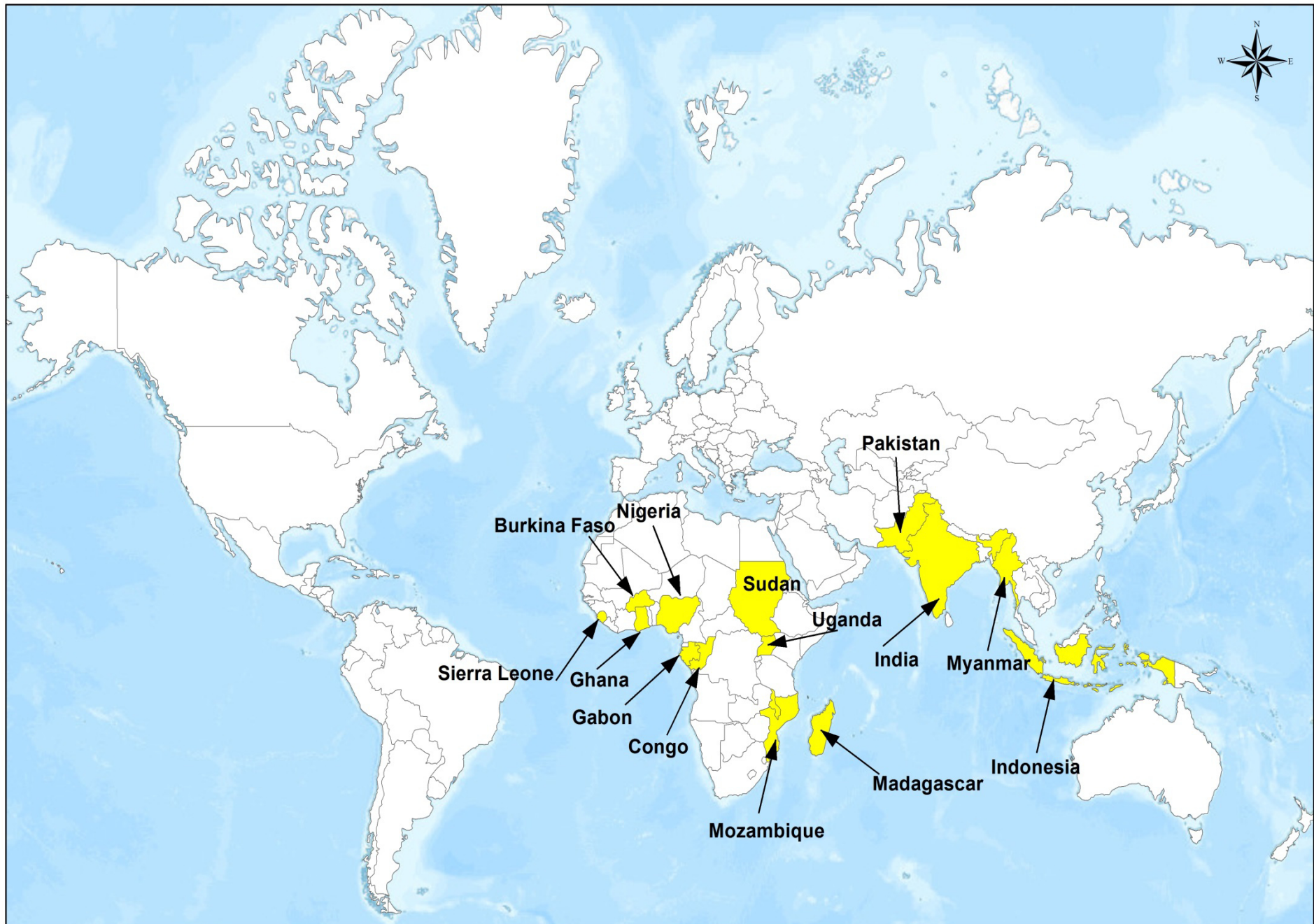
Year	Indigenous cases	Imported cases	Deaths
1999	264,549		102
2000	210,039		76
2001	66,522		53
2002	41,411		30
2003	10,510		4
2004	3,720		1
2005	1,640		-
2006	591		-
2007	198		1
2008	649	23	-
2009	531	27	-
2010	684	52	-
2011	124	51	-
2012	23	70	-
2013	-	95	-
2014	-	49	-
2015	-	36	-
2016		41	

Pre Elimination

Elimination

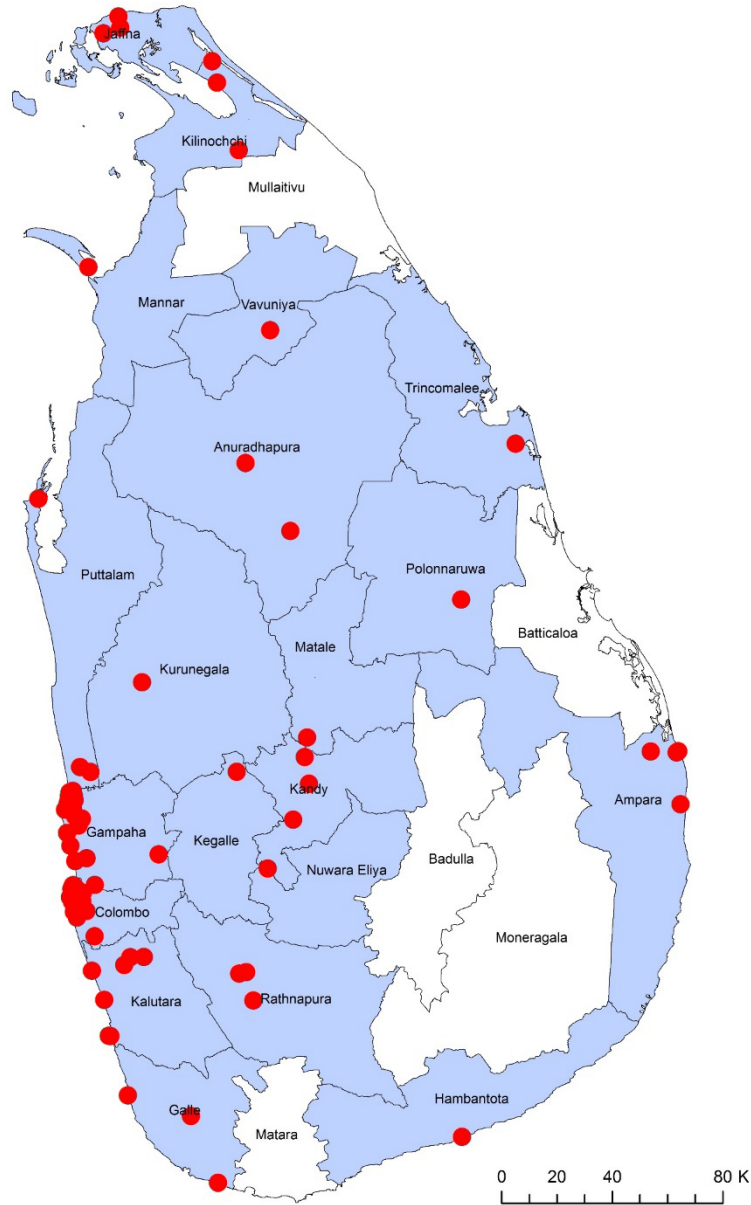
## Country of Origin Imported Malaria Cases

(2014)

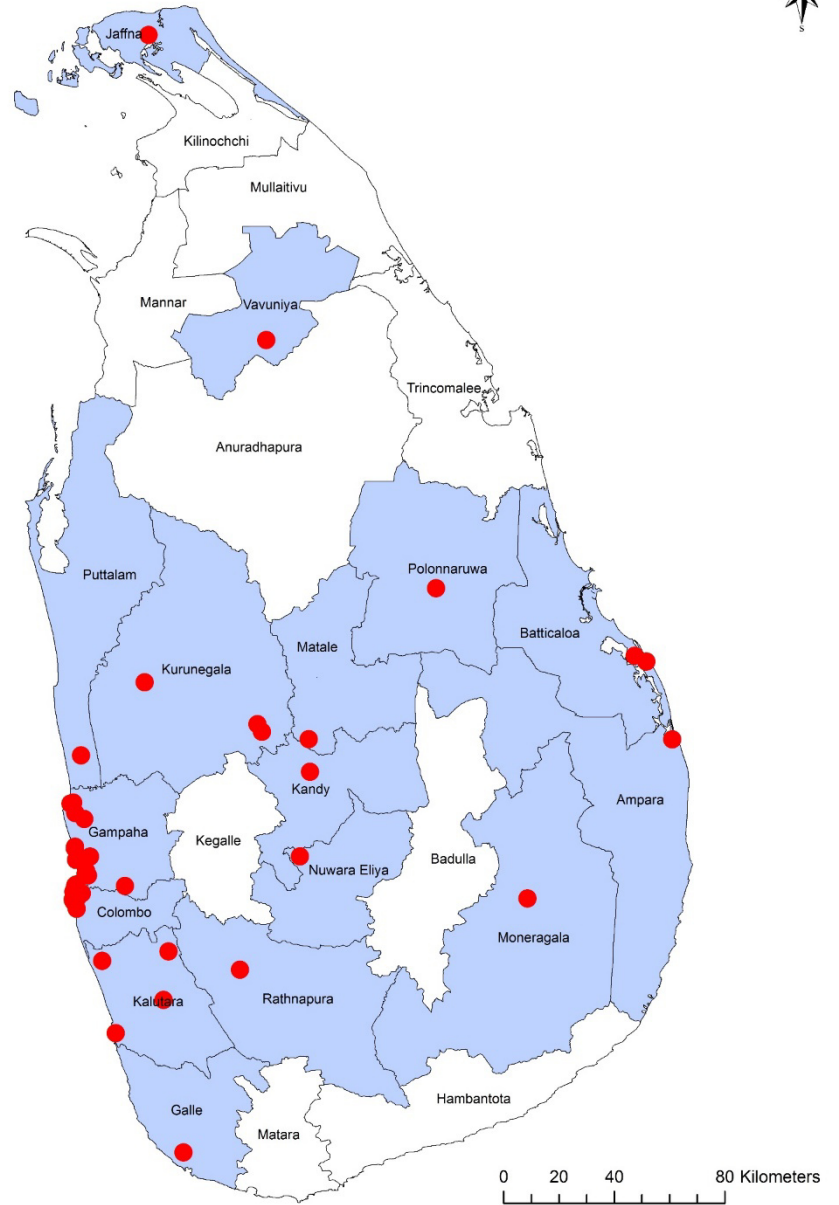




Distribution of Imported Malaria Cases in Sri Lanka 2013



Distribution of Imported Malaria Cases in Sri Lanka 2014



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 Anti Malaria Campaign - Public Health Complex 555/5, Elvitigala Mawatha, Colombo 5.



මෙහිදී මැදිහත් වන්නා - මෙහිදී සෞඛ්‍ය සංවිධානය 555/5, අලුත්විල මාවත, කොළඹ 5.  
 ජාතික මැදිහත් වන්නා - පොදු සෞඛ්‍ය ප්‍රතිපත්ති 555/5, මහලංගා මාවත, කොළඹ 5.  
 Anti Malaria Campaign - Public Health Complex 555/5, Elvitigala Mawatha, Colombo 5.

Factors contributed to the success

- **Disease Surveillance and Response**

- Screening of individual through – APCD/ACD/MMC
- Investigation of cases and classify as indigenous and imported
- Maintain National malaria case register and malaria database at all levels

- **Case management and follow up**

- New National Treatment Guideline was developed and distributed to public/private sectors
- Introduction of ACT as 1<sup>st</sup> line drug of choice for *P. falciparum*
- QC/QA malaria microscopy and RDT
- Involvement of private health sector – Notification of cases to AMC,
- Anti malarial drugs only available with the AMC
- *P.vivax* 1 year, *P. falciparum* 42 days

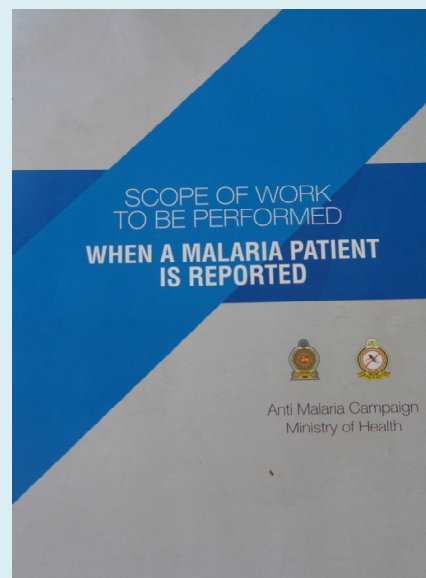
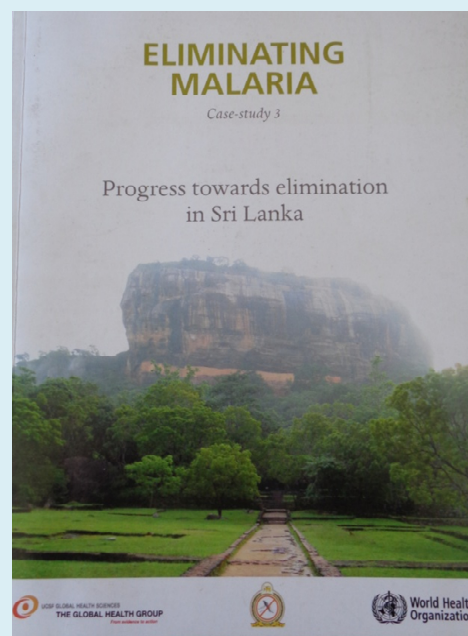
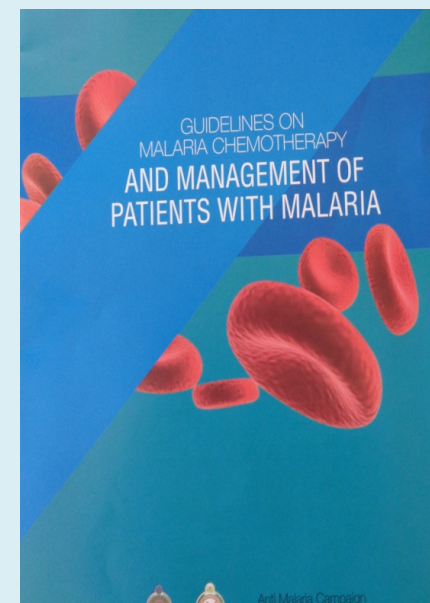
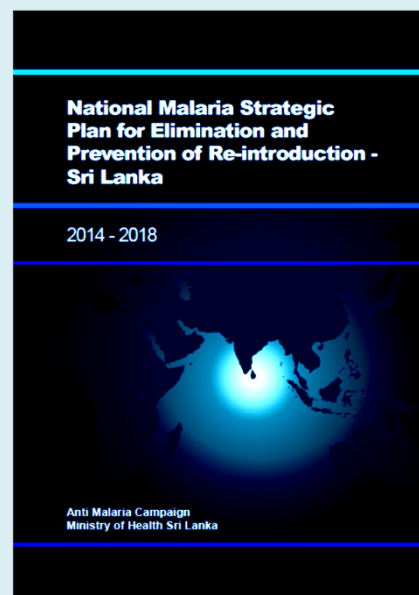
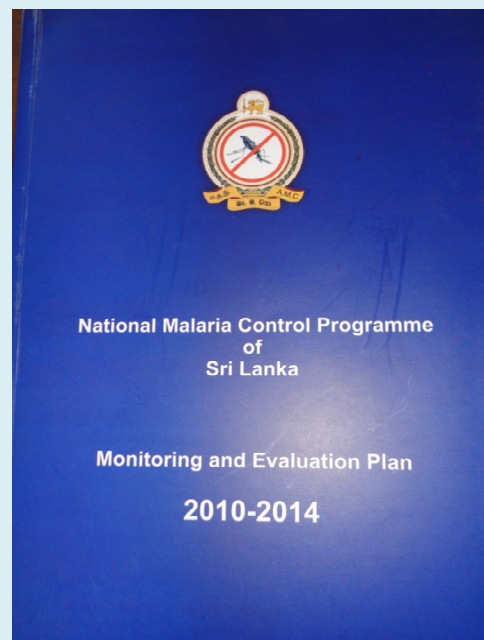
- **Inter-sectoral collaboration**

- Government Departments (Education, Irrigation, Agriculture, Tourism, Defense and Foreign Affairs etc )
- NGOs (Sarvodaya)
- International stake holders (WH), GFATM, UNHCR etc)
- Travel agents

- **Policy Actions, Advocacy and Awareness**

- Development of SOPs and SOWs
- Regular updates of clinicians on malaria diagnosis and treatment
- Chemoprophylaxis to travelers
- Conduct public awareness programmes

# Supported Documents



# Entomological Surveillance

- Evidence based decision making and timely action through Entomological surveillance

Sentinel site surveys  
(Control/Elimination/PoR)

- High risk of transmission over a period of time
- Increase potential risk for vector breeding

Spot checks  
(Control/Elimination/PoR)

- Not covered by SSM
- High receptive areas
- High vulnerable areas

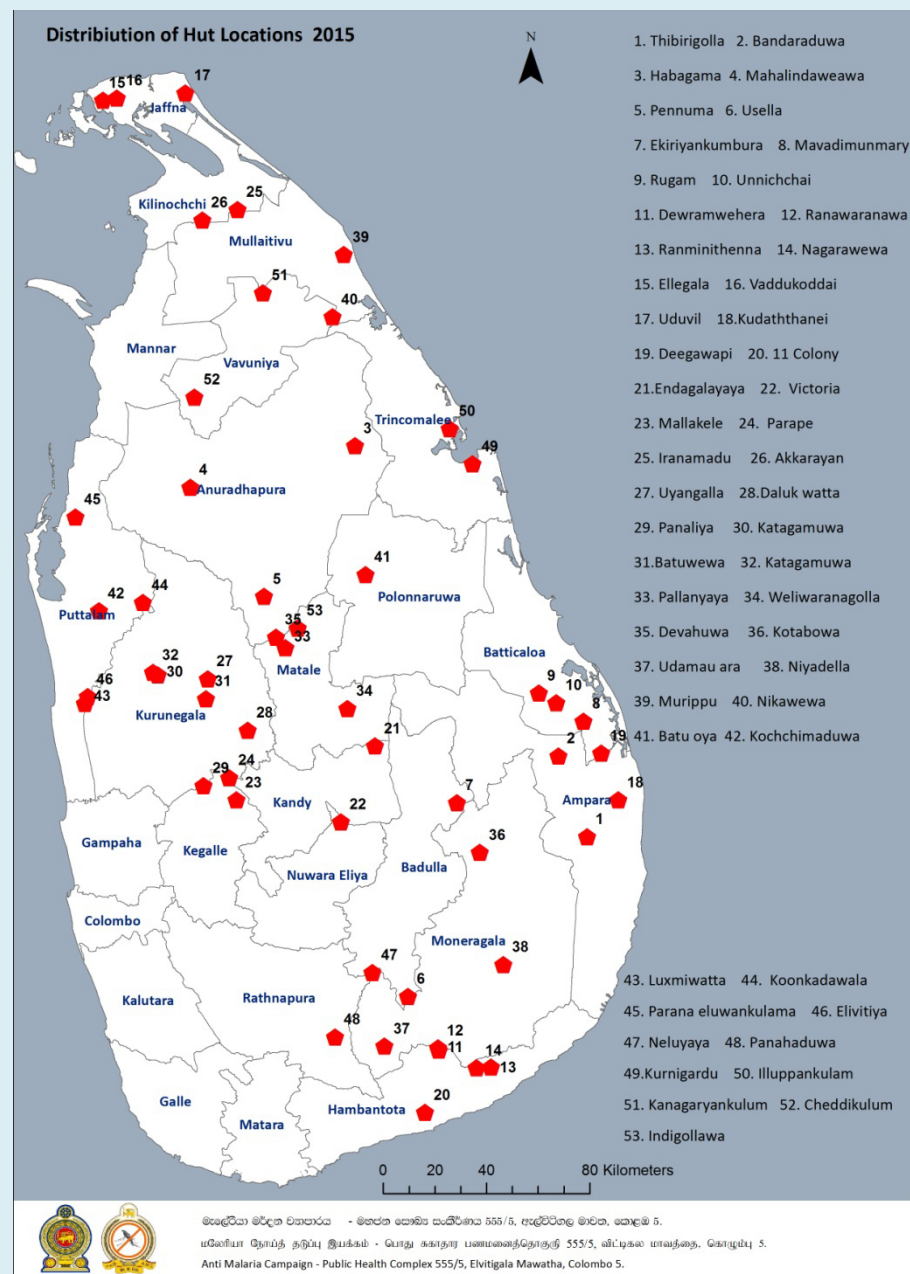
Case based surveys  
(Elimination/PoR)

- Imported case

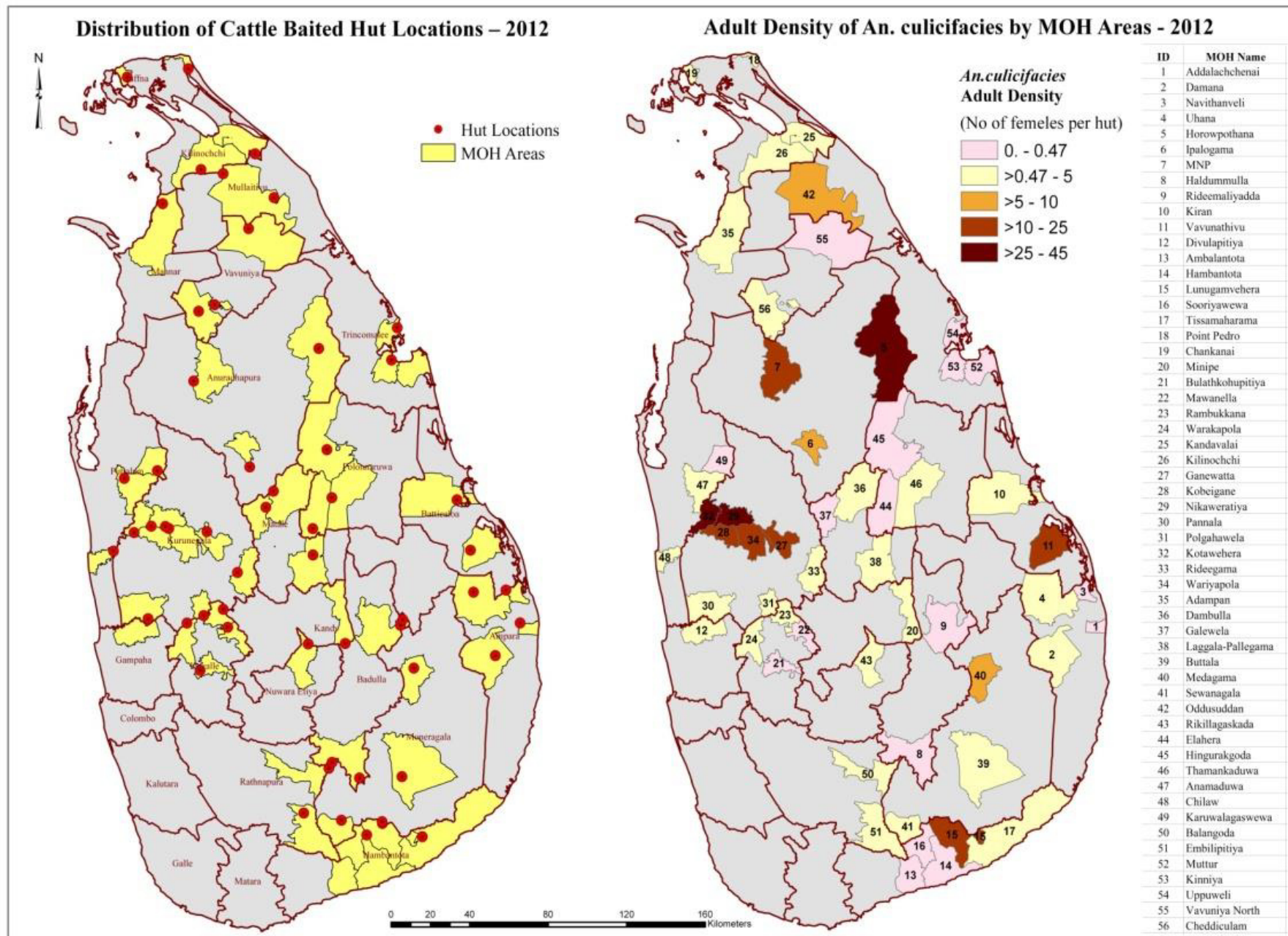


# Vector Surveillance in sentinel sites

- Prevalence and seasonal fluctuation of density (CBHC, CBT, LS)
- Biting behavior (HLC)
- Resting behavior (Indoor/outdoor HC, PSC, WTC)
- Breeding behavior and density (LS)
- Susceptibility to insecticides
- Impact of vector control interventions

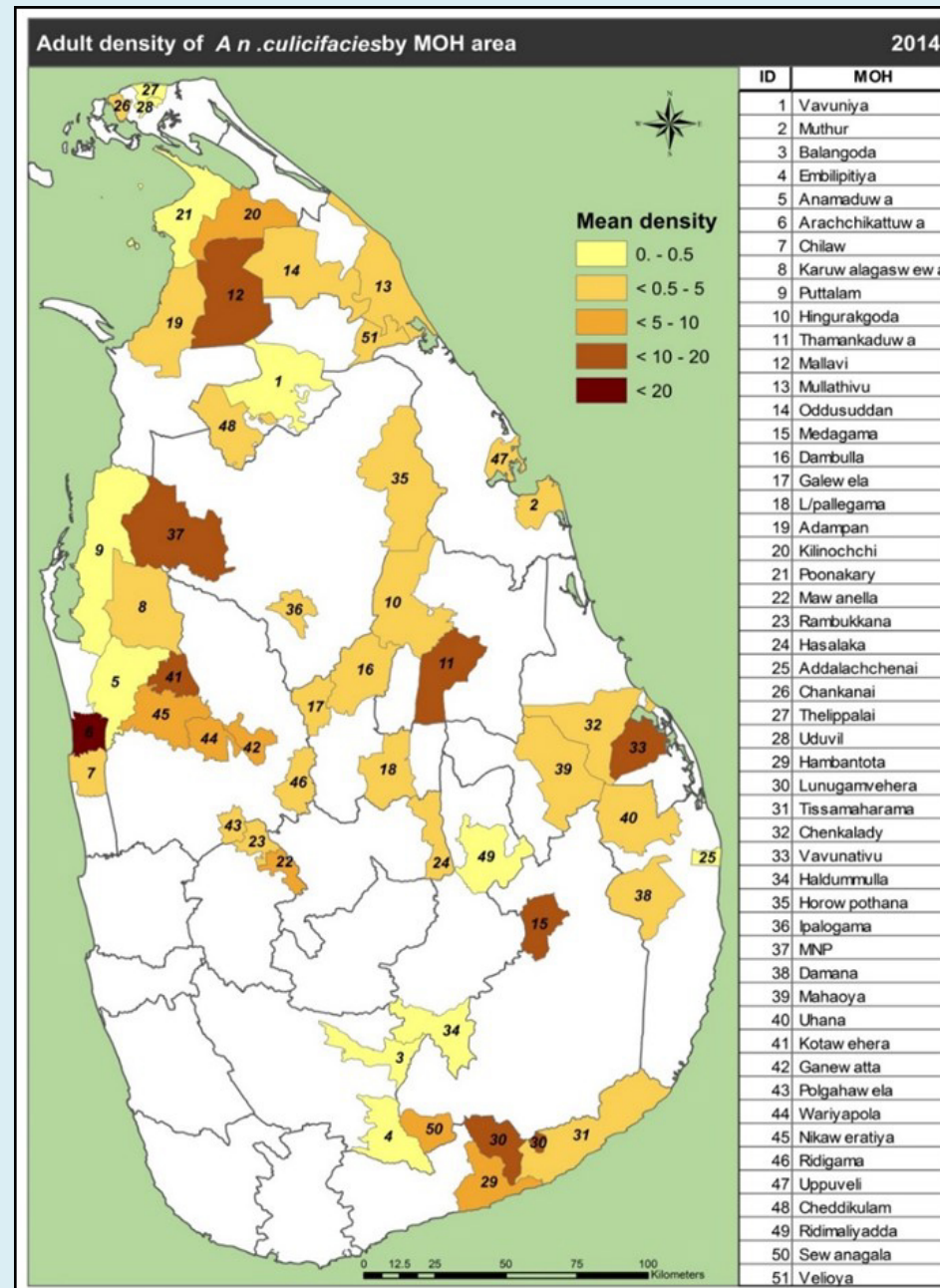


## Adult density of *Anopheles culicifacies* in year 2012 (Data from CBHC)

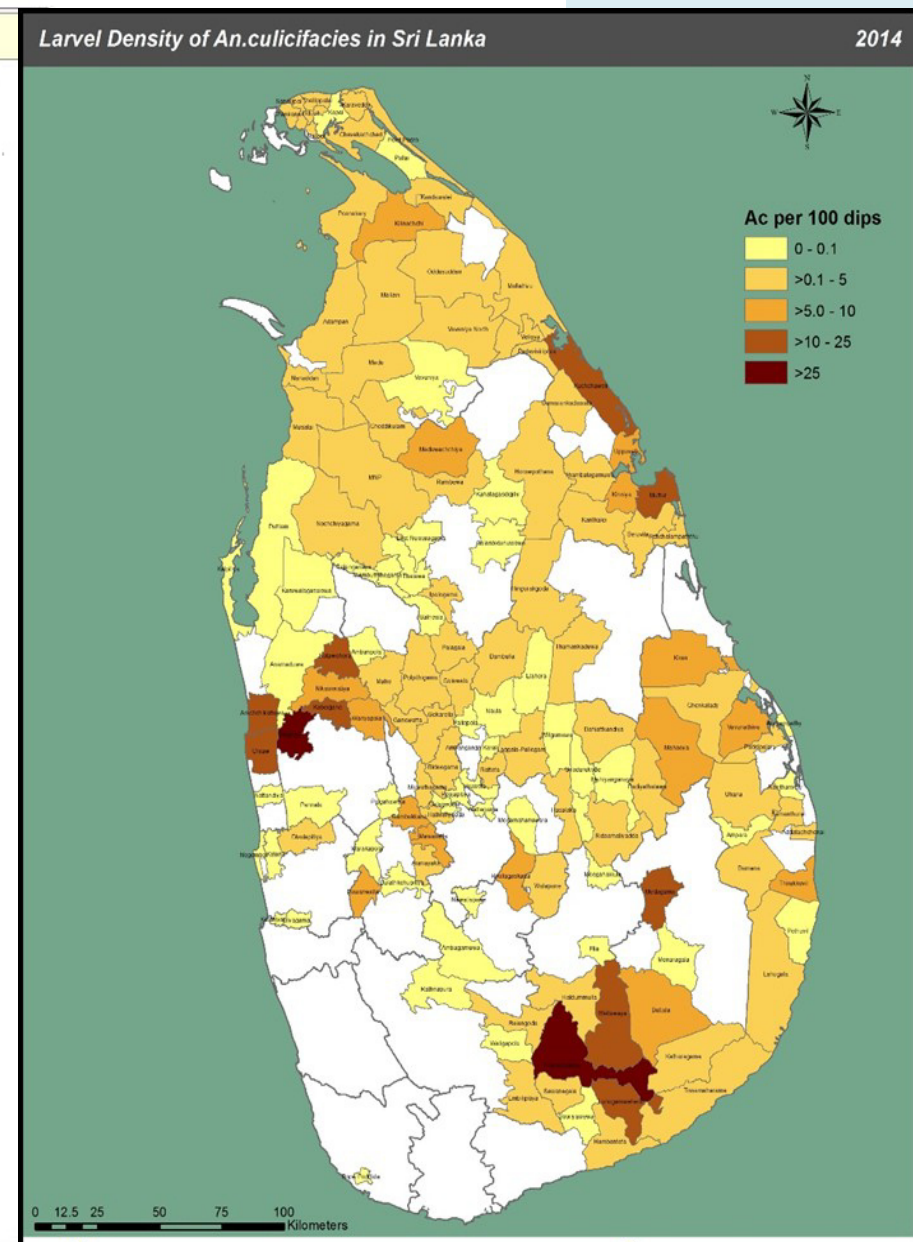
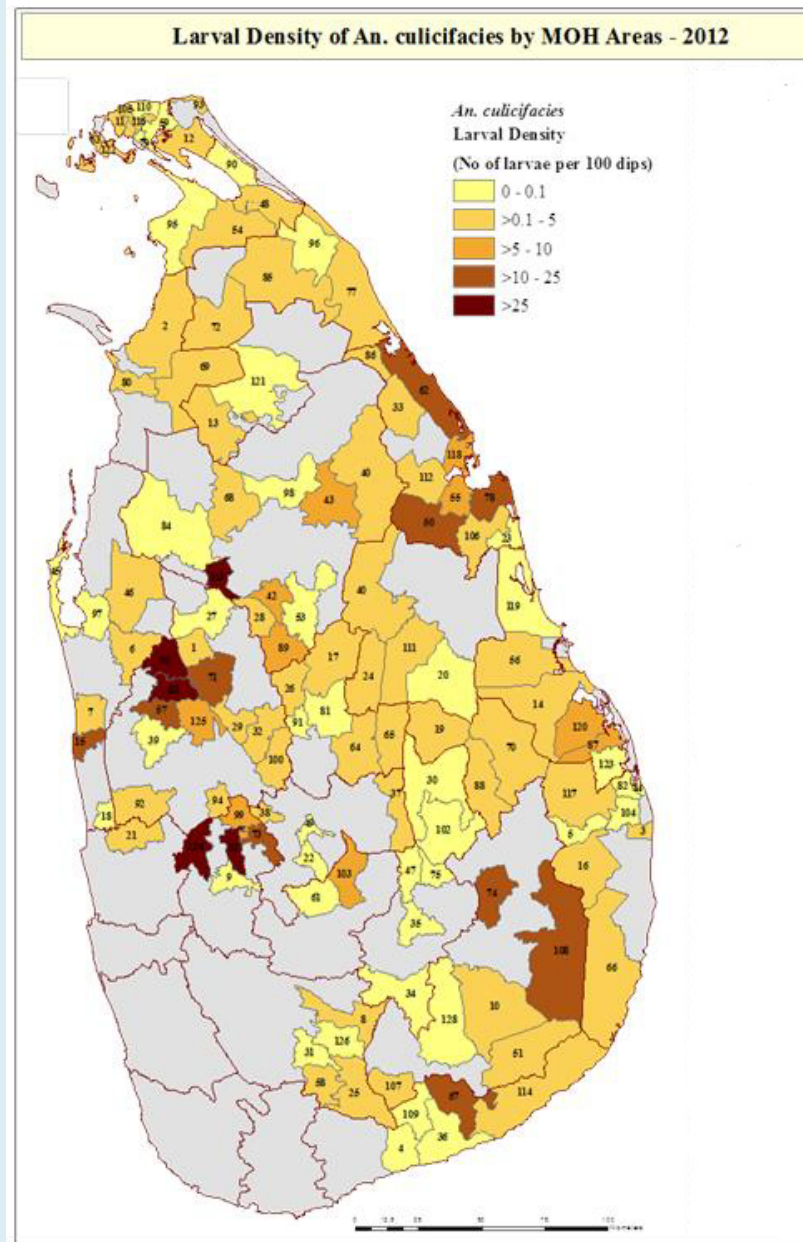




## Adult density of *Anopheles culicifacies* in year 2014 (Data from CBHC)



# Larval density of *Anopheles culicifacies* 2012 and 2014



Ministry of Health



Anti Malaria Campaign

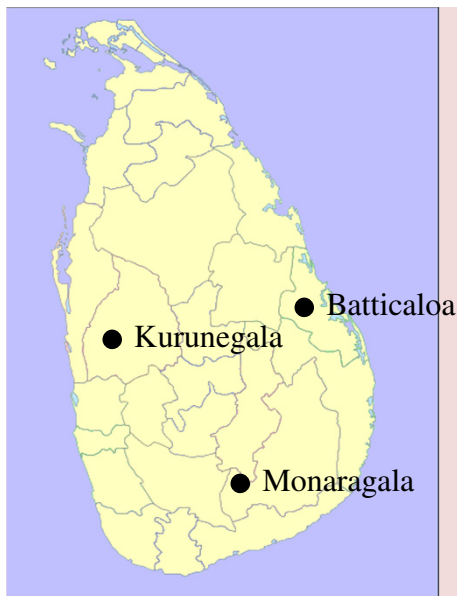
# ENTOMOLOGICAL SURVEILLANCE AND VECTOR CONTROL WHEN A MALARIA PATIENT IS REPORTED

If vectors present

```
graph TD; A[ENTOMOLOGICAL SURVEILLANCE AND VECTOR CONTROL WHEN A MALARIA PATIENT IS REPORTED] --> B[If vectors present]; B --> C[Apply appropriate vector control interventions based on the Vector Bionomics]; C --> D[IRS, Chemical Larviciding, LLIN, Space spraying];
```

Apply appropriate vector control interventions based on  
the Vector Bionomics

IRS, Chemical Larviciding, LLIN, Space spraying



## Research for Timely Response

### Objective

To determine the susceptibility levels of malaria vector mosquitoes to currently available pyrethroids in order to select the most suitable insecticides for malaria vector control in the Elimination Phase in Sri Lanka.

### Methodology

Contact bioassays using WHO standard test kits and procedure *An. culicifacies* and *An. subpictus* mosquitoes (n=100) were tested against discriminative dosage(s) of

- Bifenthrin (2%)

- Cyfluthrin (0.15%)

- Deltamethrin (0.025% and 0.05%)

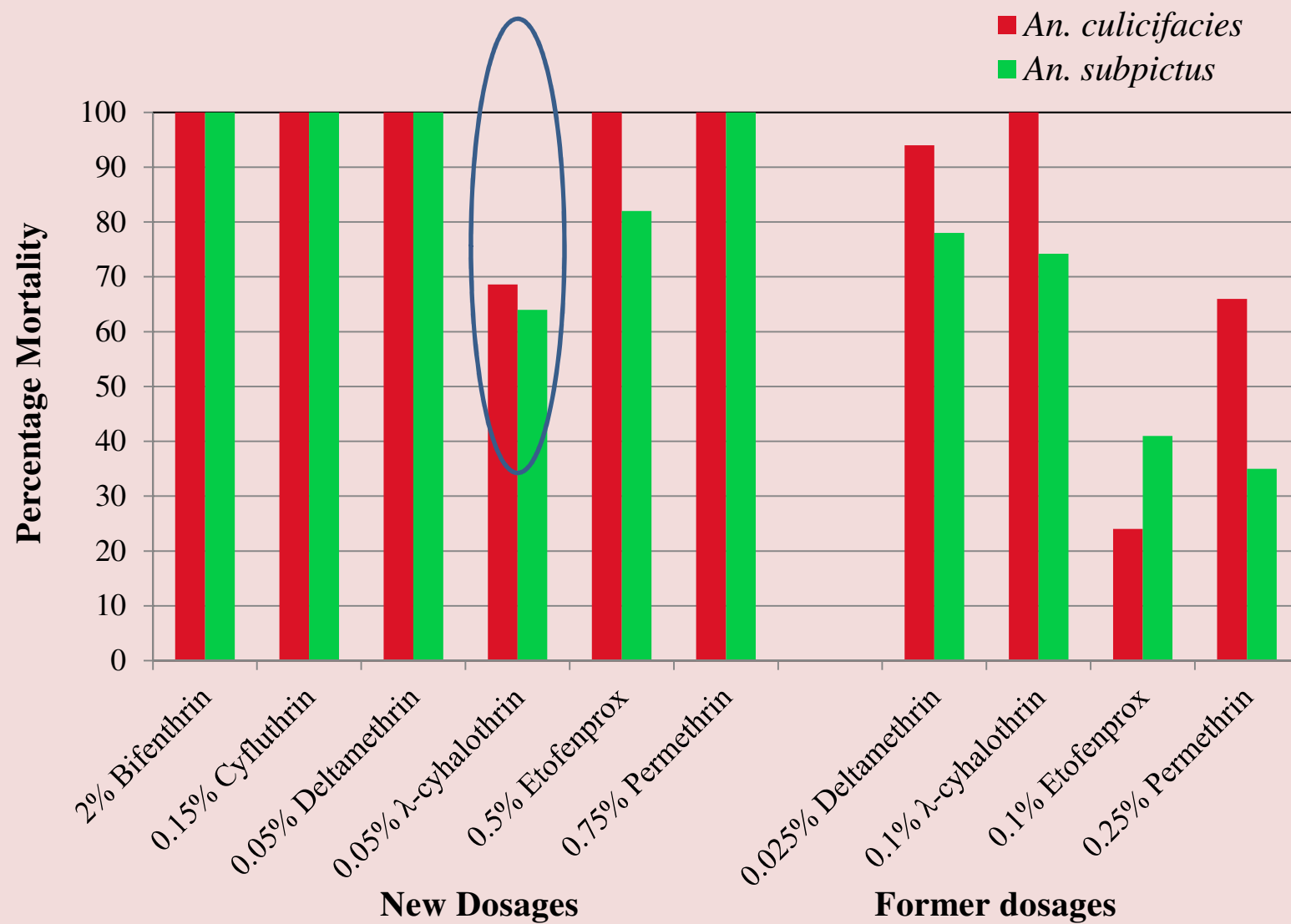
- Etofenprox (0.1% and 0.5%)

- Lambdacyhalothrin (0.1% and 0.05%)

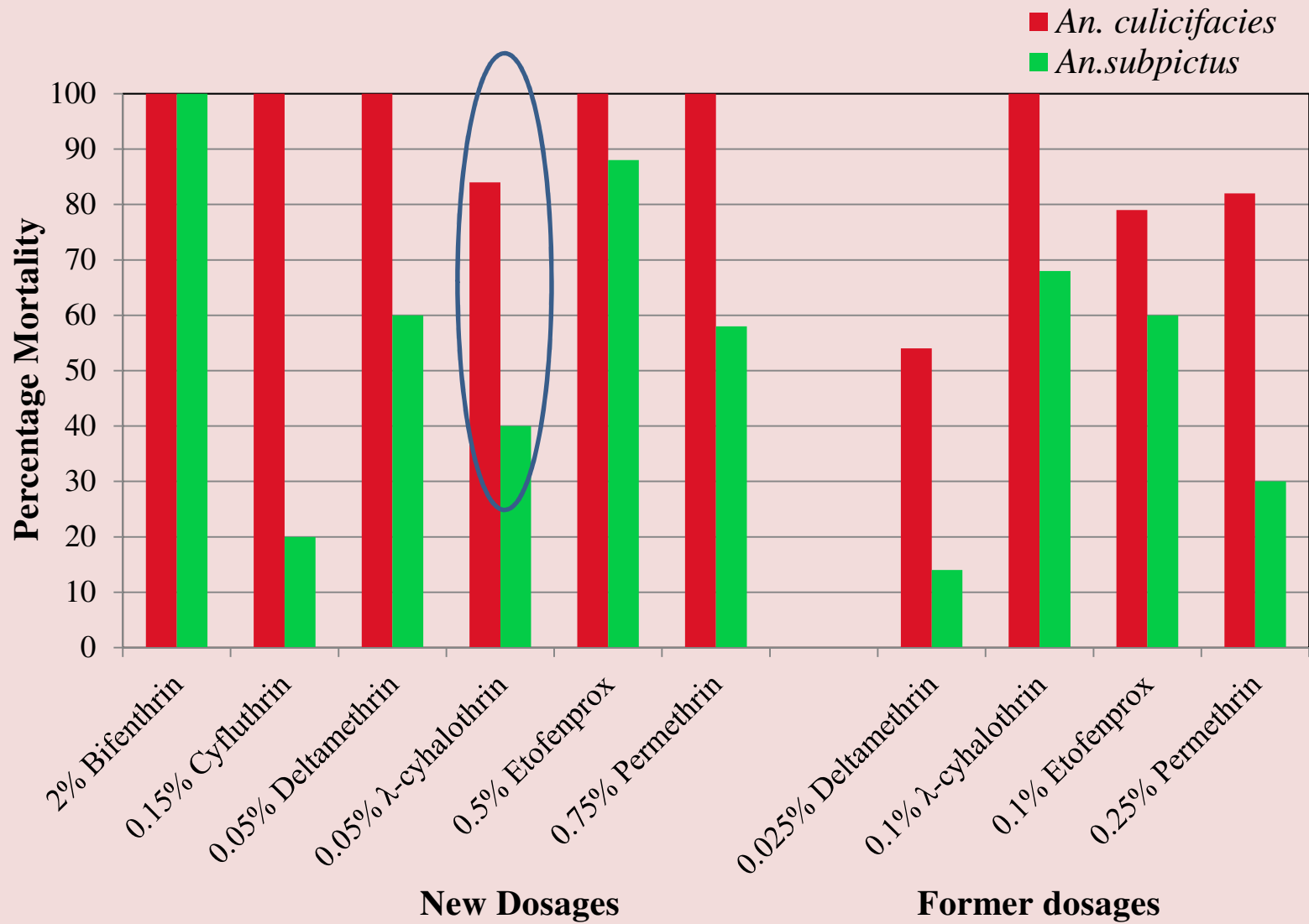
- Permethrin (0.25% and 0.75%)

Involvement of monooxygenase metabolic enzymes in pyrethroid resistance was indirectly tested by exposing mosquitoes to 4% piperonyl butoxide (PB) impregnated paper for one hour prior to bioassay experiments.

## Batticaloa

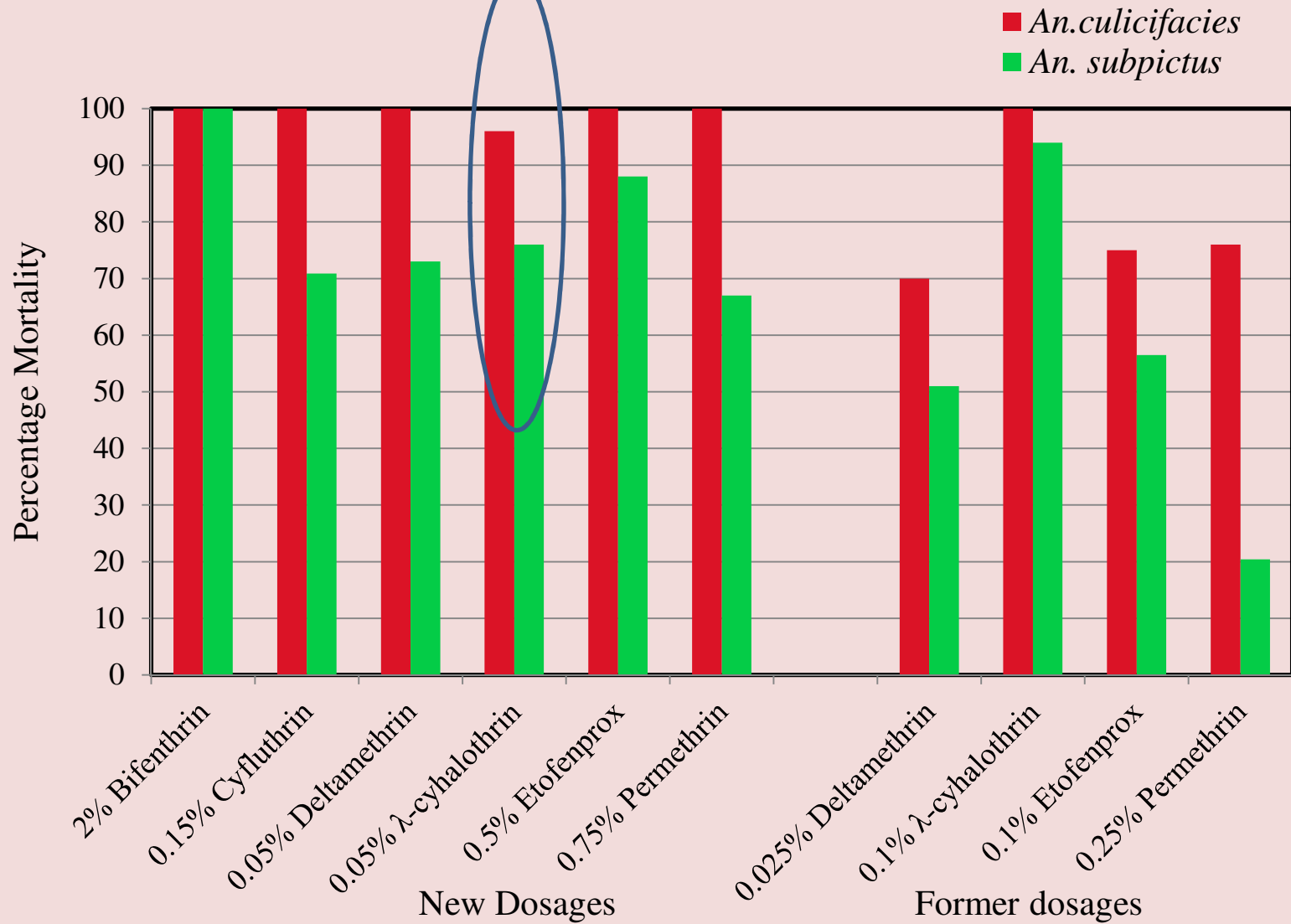


## Kurunegala





## Moneragala



## CONCLUSIONS

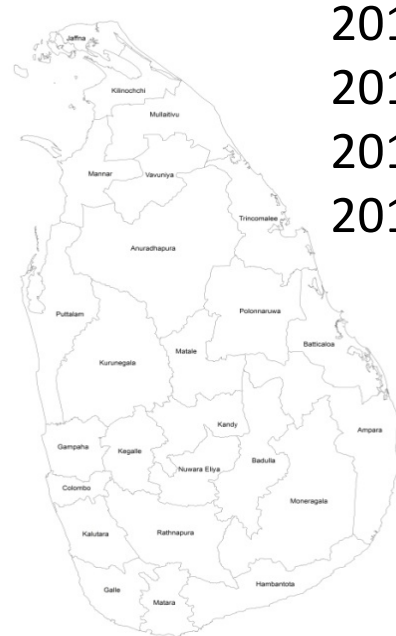
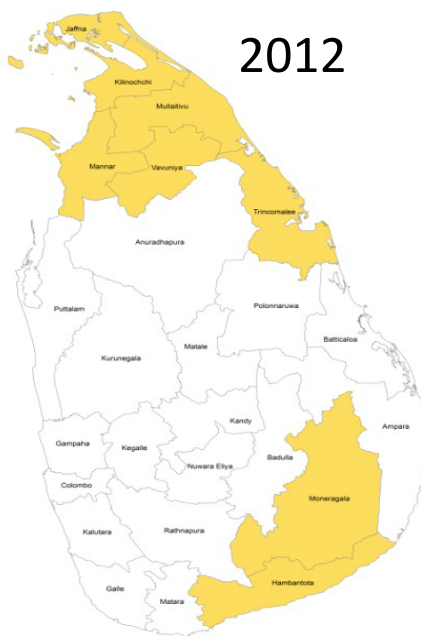
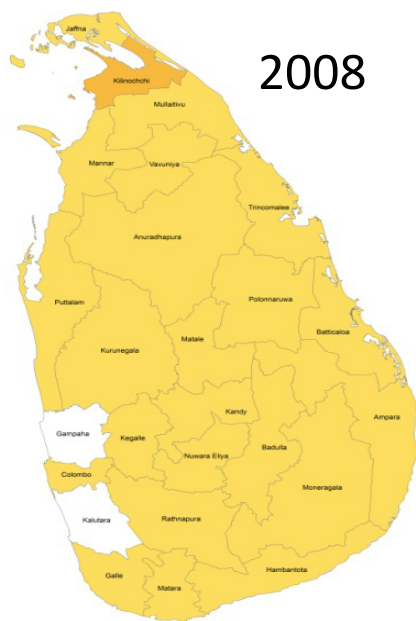
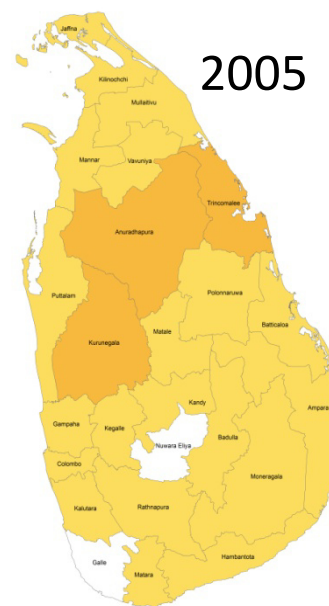
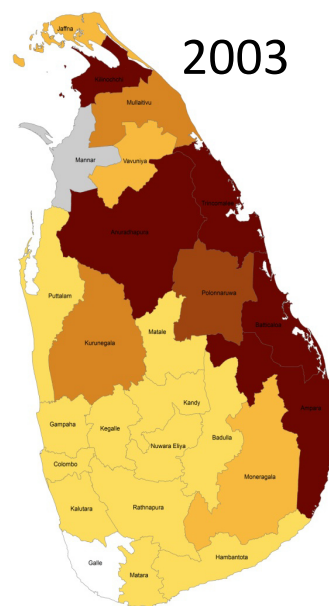
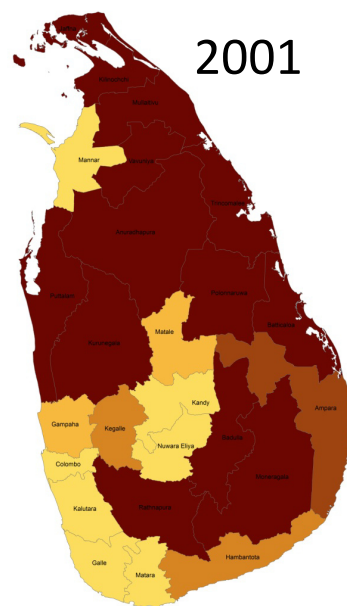
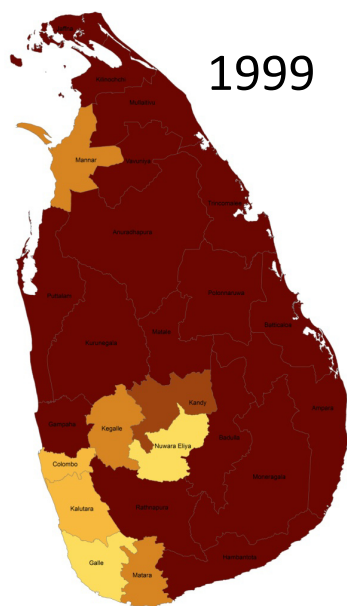
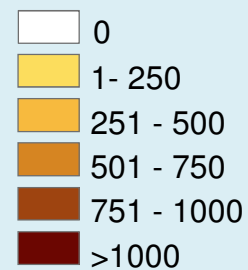
- ❖ *An. culicifacies* and *An. subpictus* populations have developed resistance to pyrethroids
- ❖ Monooxygenase enzyme based mechanism confer pyrethroid resistance in both vectors.

## RECOMMENDATIONS

- ❖ Species specific discriminating dosages for local vectors should be specified.
- ❖ If pyrethroid is continuing for IRS and LLIN, new insecticide products with synergists should be introduced in malaria vector control programmes.

# Shrinking Malaria Map in Sri Lanka

## Malaria Cases



2013

2014

2015

2016



**Dr Margaret Chan**  
Director-General



## **Certification of Malaria Elimination in Sri Lanka**

**“I have the honour to inform you that the Sri Lanka has achieved malaria elimination. This is based on the assessments of the malaria situation in the country by the WHO evaluation teams in Nov 2015 & May 2016, the final assessment by an independent evaluation team on 26 July - 11 Aug 2016, and the review by external experts that included the Chair & two members of the Malaria Policy Advisory Committee, two independent malaria experts, the Director of Global Malaria Program & three other technical experts on malaria within WHO”.**

**- 19 Sep 2016**

# WHO CERTIFIES SRI LANKA MALARIA-FREE

2016

2016







Thank you!