

# **Preventing deaths from self-poisoning in the developing world**

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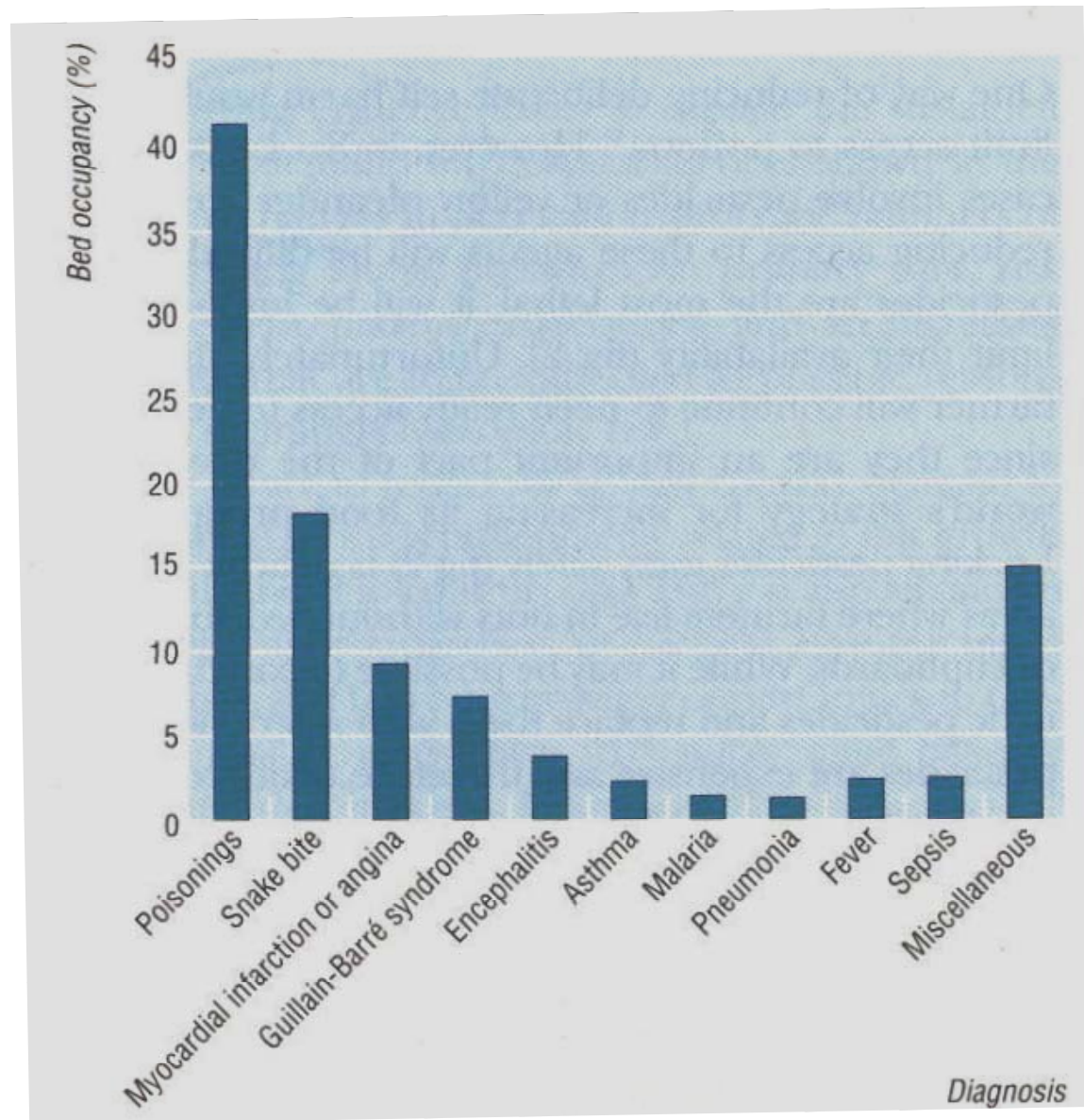


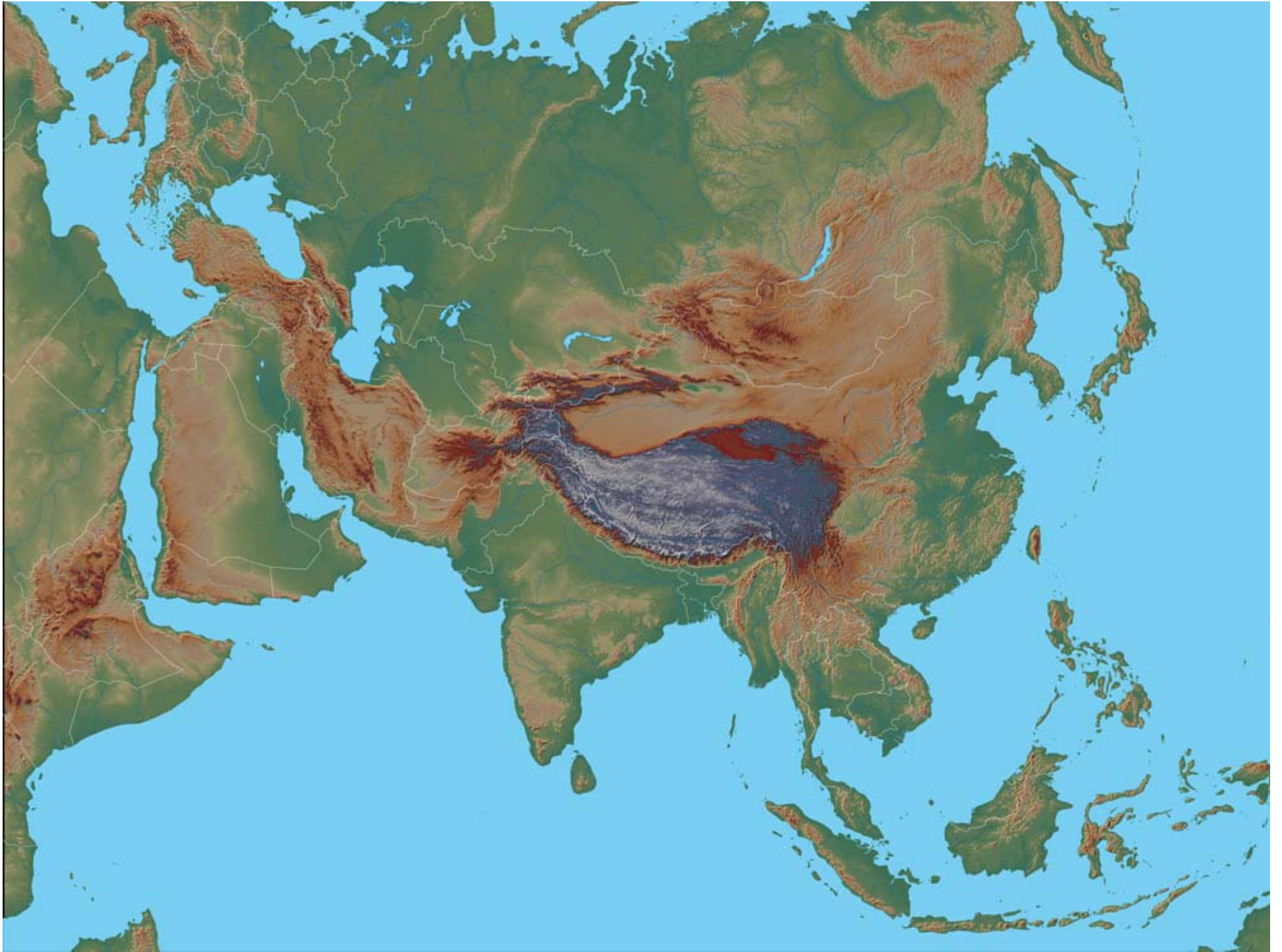






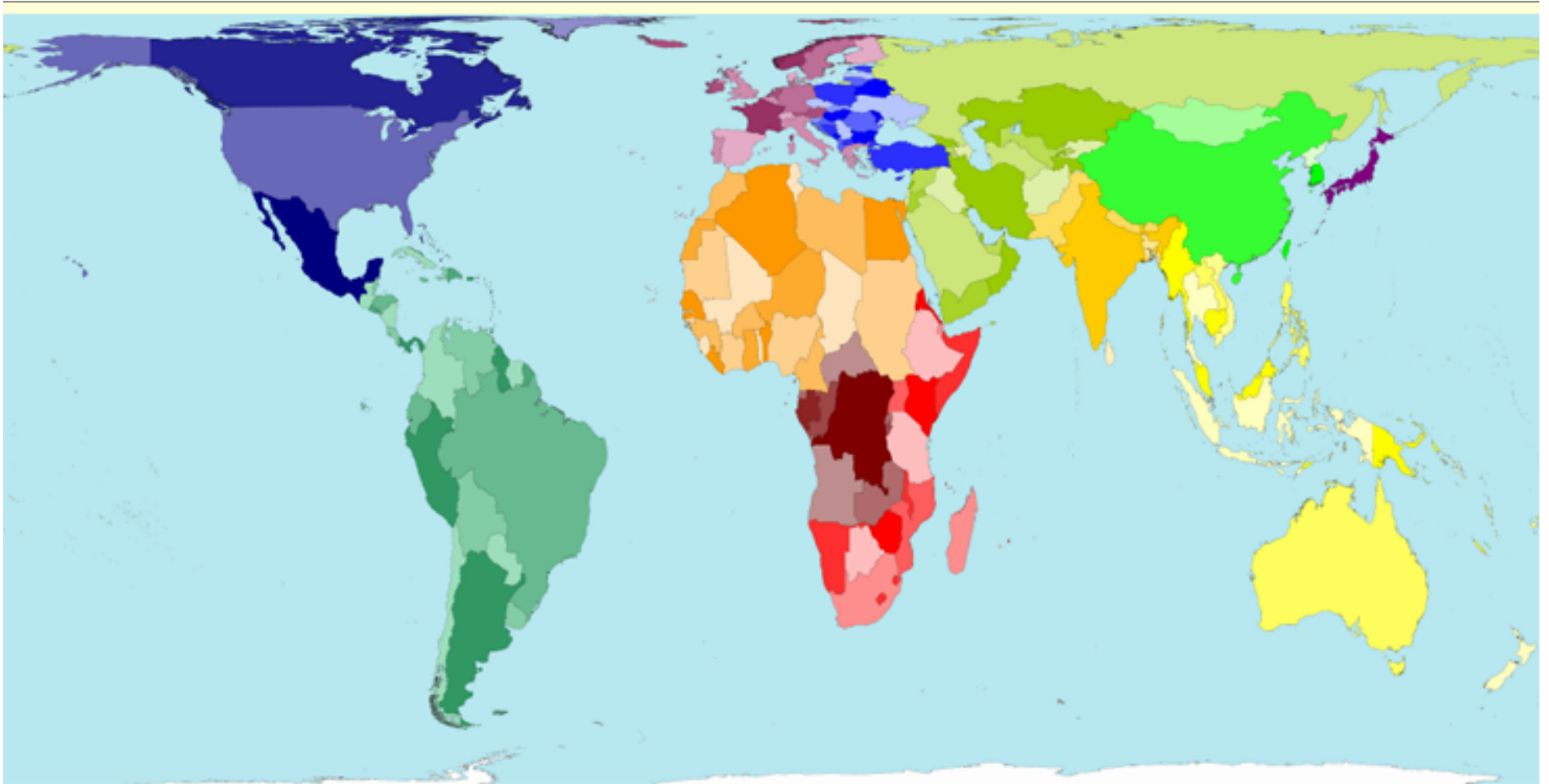
## ICU occupation by diagnosis, Anuradhapura, 1995-6





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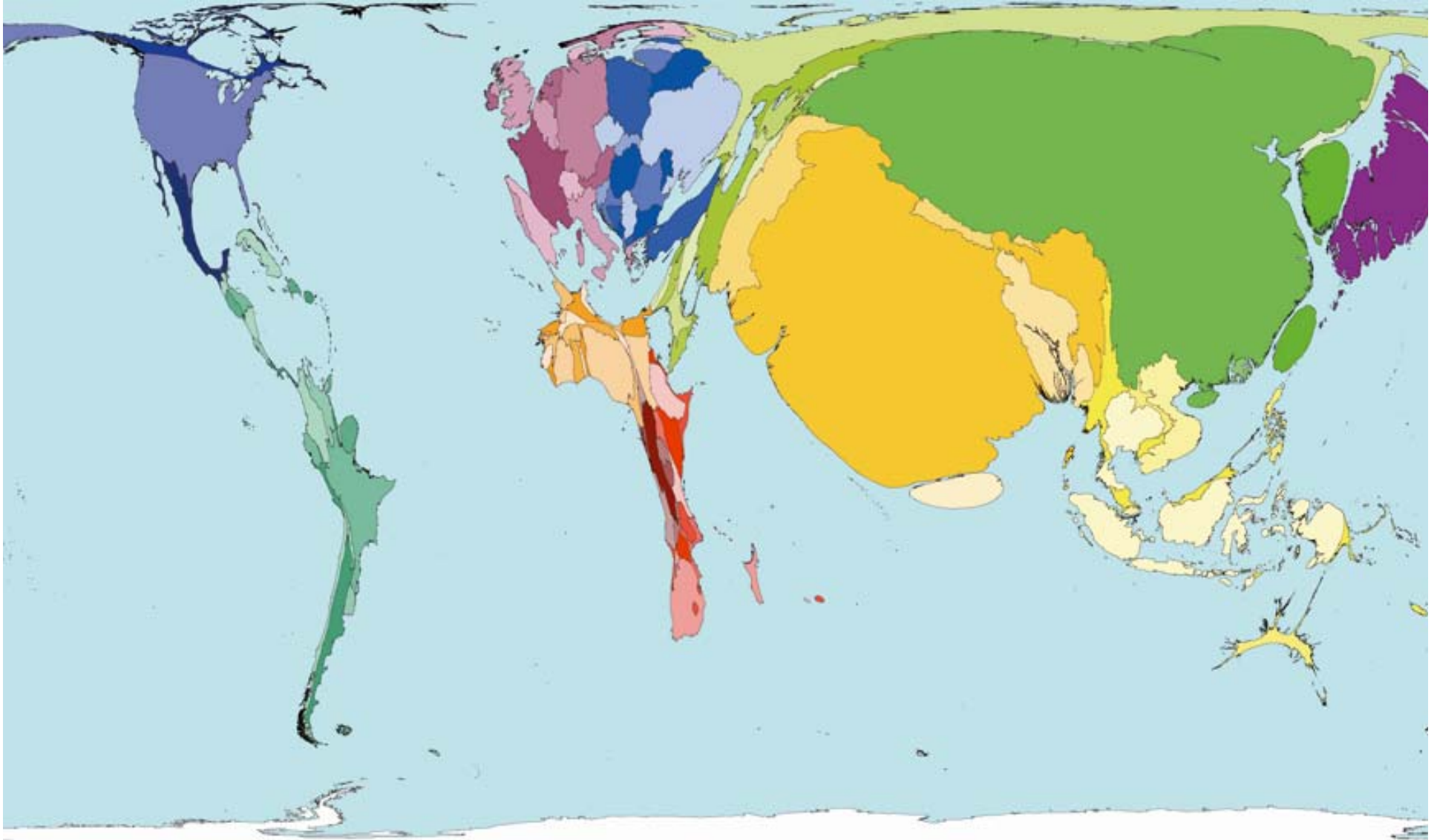
**Why is this important?**



**[www.worldmapper.org](http://www.worldmapper.org)**



## Global burden of fatal intentional self-harm



[www.worldmapper.org](http://www.worldmapper.org)













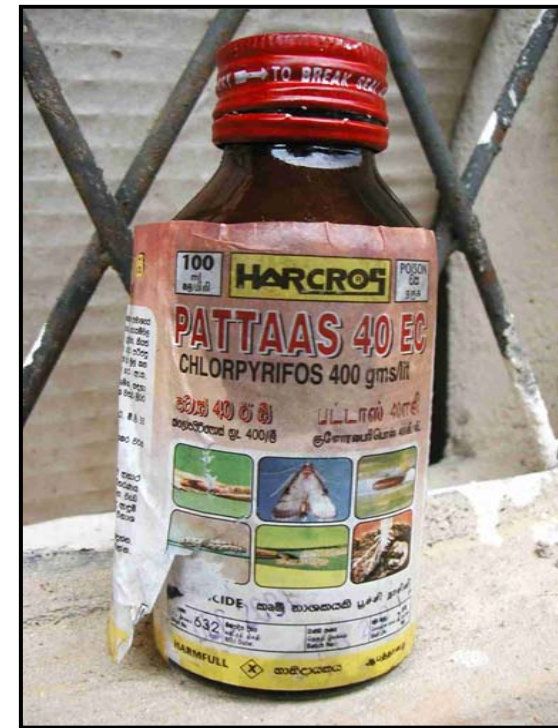
## Pesticide self-poisoning

Major clinical problem in rural Asia

Responsible for about 60% of Asian suicides  
~250-350,000 deaths every year

Incidence  
~350/100,000 per year

Medical management is difficult - 10-20% case fatality if patient survives to reach hospital





## Deaths from pesticide self-poisoning

High number is not due to high rates of self-harm since the rates in rural Asia are similar to rates in Western countries

Due to high case fatality: 10-20% vs <0.5%

### Main risk factors are:

Toxicity of available poisons  
and ease of access





## **Case histories of pesticide poisonings**

A 15 year old girl drank 20% paraquat after an argument and fight with her 11 year old brother... in her distress she had simply grabbed the nearest bottle in the house and drunk it. She died from cardio-respiratory arrest 2 days after admission.

An 18 year old woman committed suicide by swallowing a weedicide following a dispute over a wrist watch with her older sister

Van der Hoek *et al* 1998; Eddleston and Phillips 2004

**Case fatality**  
**(% of deaths amongst those taking an overdose)**

- Paraquat 70%
- Aluminium phosphide 60-70%
- Organophosphate pesticides (variable)
  - Monocrotofos 35%
  - Parathion 25%
  - Dimethoate 23%
  - Chlorpyrifos 8%
- Yellow Oleander 5%
- Paracetamol <0.5%

Sources: Ganeshamoorthy 1985; Siwach 1988; Eddleston 2005; Rao 2005; Gunnell 1997



	Commonest form of self-poisoning	No. hospital admissions per year	No. deaths per year
UK	Paracetamol	40,000	150
Sri Lanka	Pesticides	20,000	2,000

Gunnell *et al* 1996; Roberts *et al* 2003

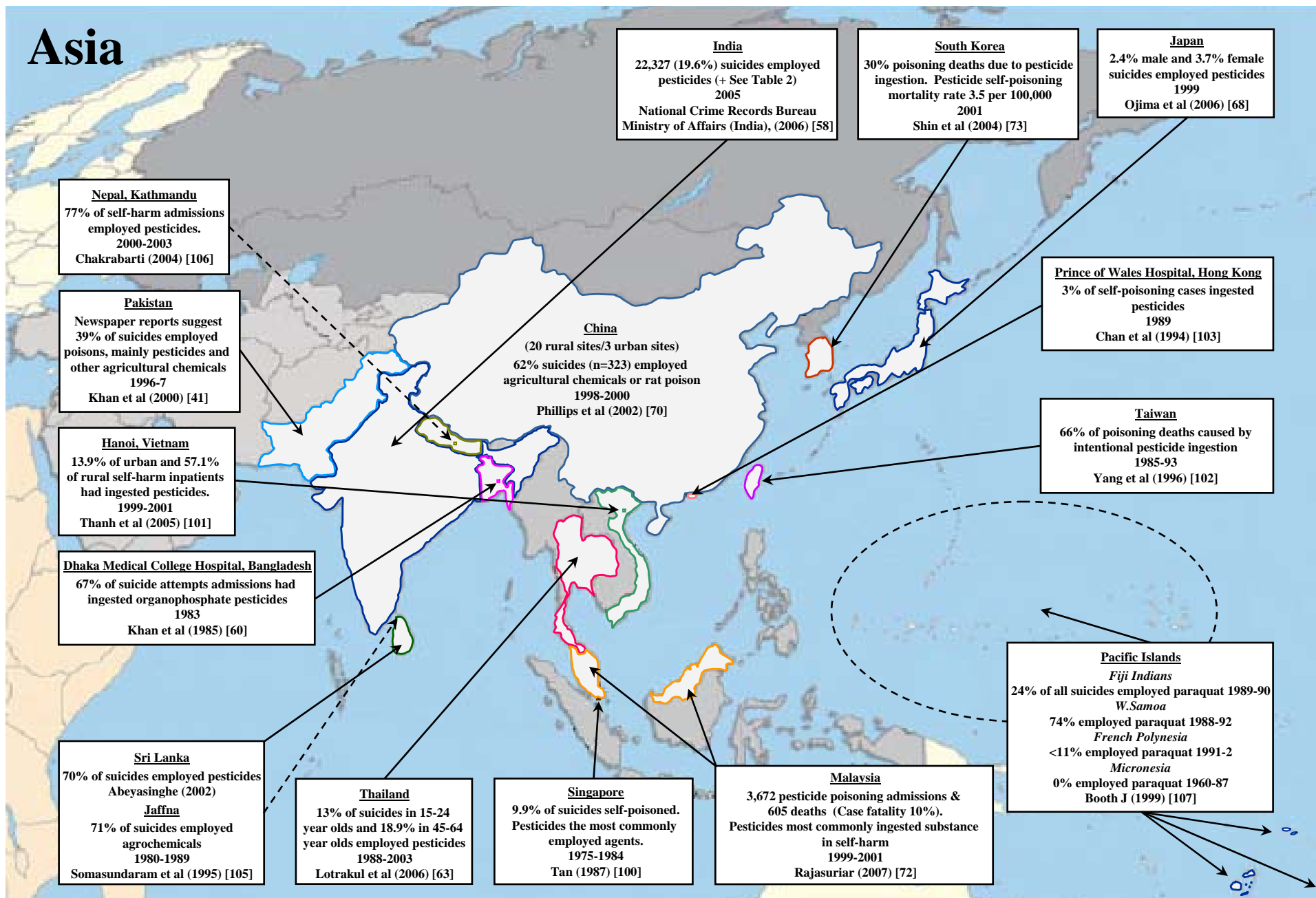
	Commonest form of self-poisoning	No. hospital admissions per year	No. deaths per year
UK (no antidote)	Paracetamol	40,000	? 1,000
Sri Lanka	Pesticides	20,000	2,000

Gunnell *et al* 1996; Roberts *et al* 2003



**What is the incidence of fatal pesticide self-poisoning?**

# Asia





## Global estimate of pesticide suicides

WHO region	Total Suicides (1,000s)
Africa	34
Americas	63
E Mediterranean	34
Europe	163
SE Asia	246
W Pacific	331
WORLD TOTAL	873

## Global estimate of pesticide suicides

WHO region	Total suicides (1,000s)	Pesticide suicides (1,000s) (%)
Africa	34	8 (23%)
Americas	63	3 (5%)
E Mediterranean	34	6 (17%)
Europe	163	6 (4%)
SE Asia	246	51 (21%)
W Pacific	331	185 (56%)
WORLD TOTAL	873	258 (30%) (Plausible range 234 - 326)

## Suicide in India

Author	Setting	Estimated suicide rate
Official rate (2005)		10 per 100,000
Banerjee <i>et al</i> 1990	West Bengal	43 per 100,000
Shukla <i>et al</i> 1990	Jhansi City, Uttar Pradesh	29 per 100,000
Joseph <i>et al</i> 2003	Kaniyambadi, Tamil Nadu	95 per 100,000
Gajalakshmi <i>et al</i> 2007	Villapuram Tamil Nadu	62 per 100,000



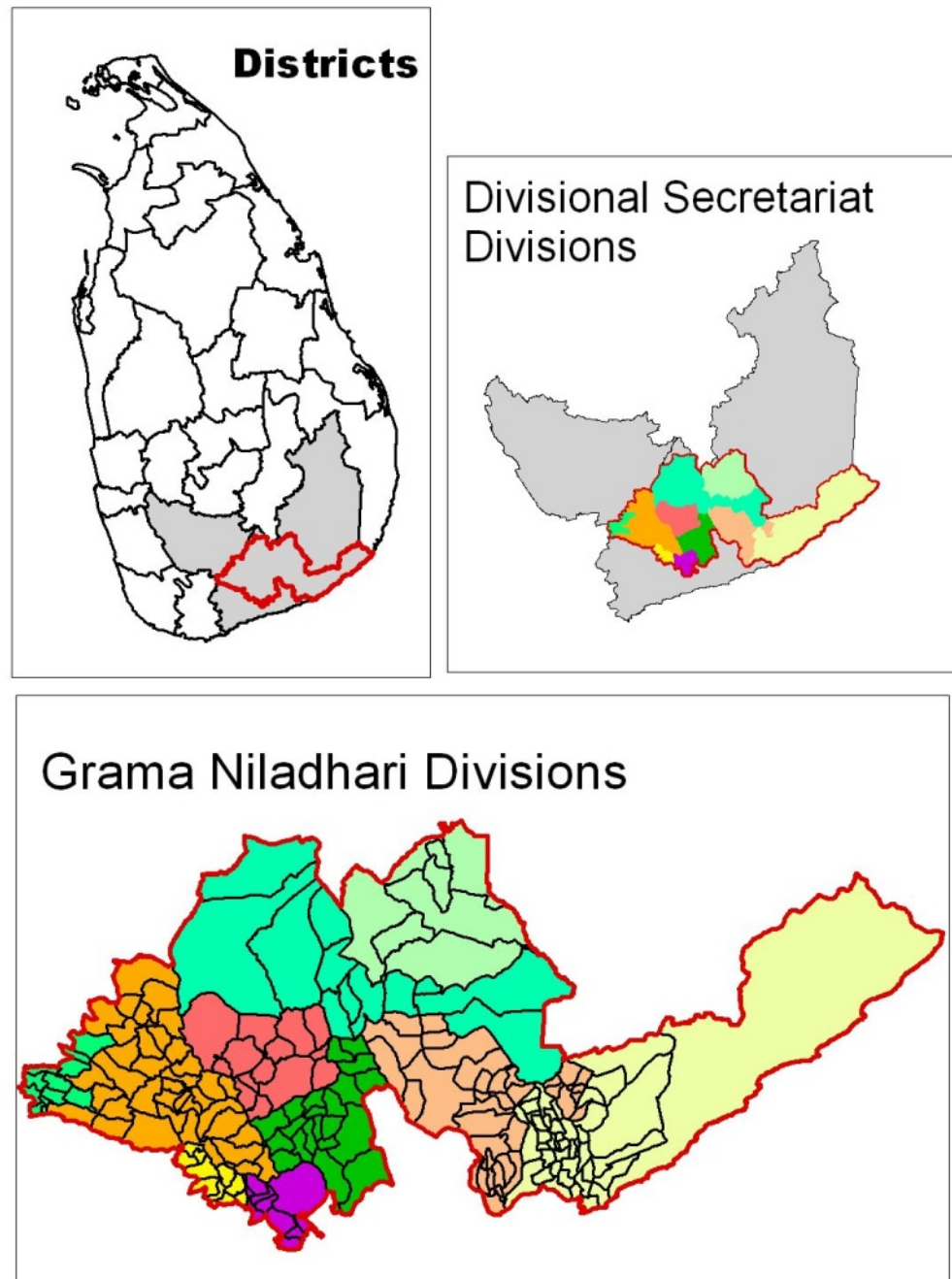
## Global estimate of pesticide suicides: applying correction to India's estimates

WHO region	Total suicides (1,000s)	Pesticide suicides (1,000s) (%)
Africa	34	8 (23%)
Americas	63	3 (5%)
E Mediterranean	34	6 (17%)
Europe	163	6 (4%)
<b><i>SE Asia</i></b>	<b><i>517</i></b>	<b><i>155 (32%)</i></b>
W Pacific	331	185 (56%)
<b>WORLD TOTAL</b>	<b>1,142</b>	<b>372 (30%)</b>

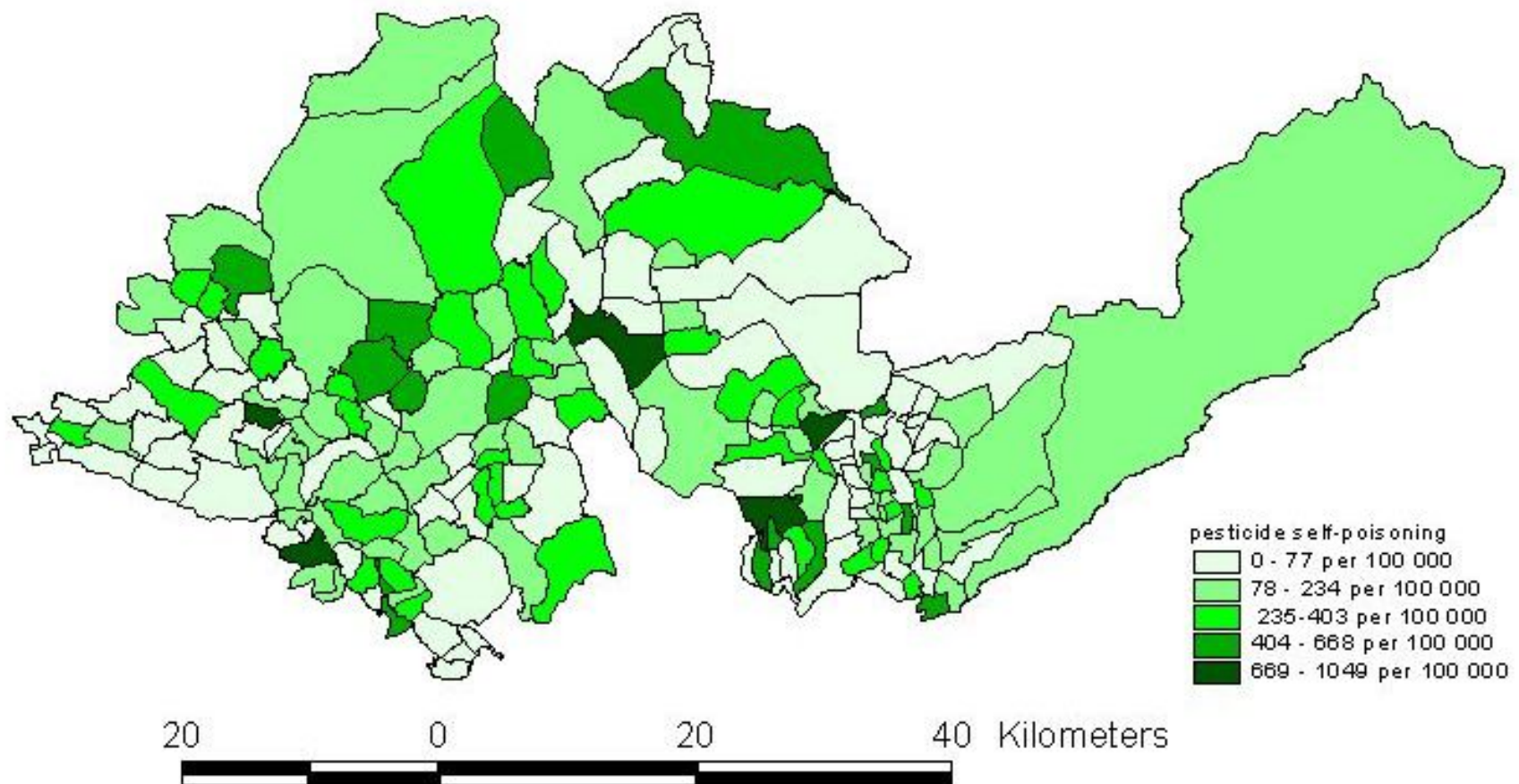
# Clustering of self-poisoning in Sri Lanka

Celie Manuel  
Flemming Konradsen

## LOCATION OF STUDY AREA

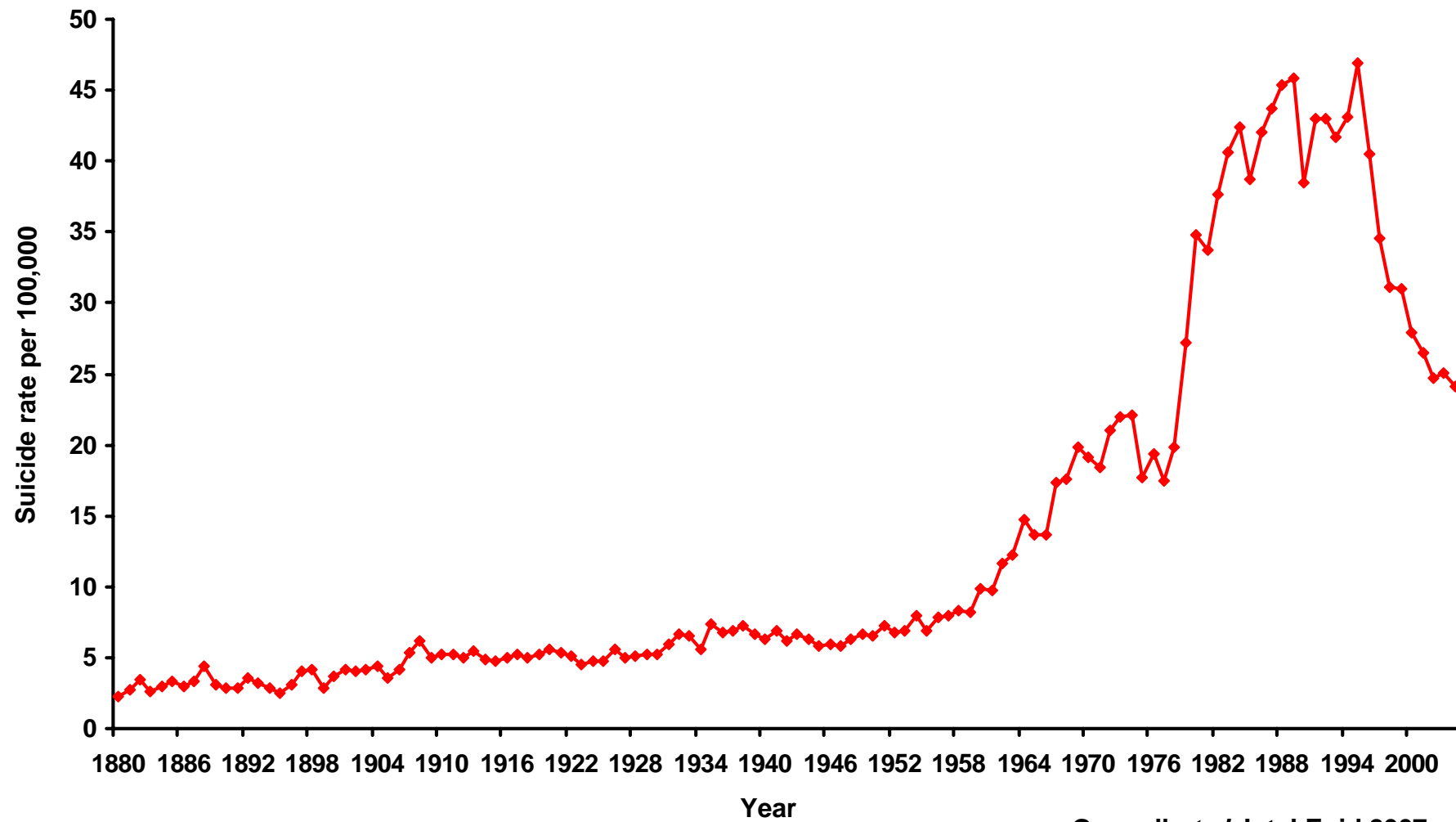


## Self-poisoning in rural Sri Lanka: small area variations in incidence



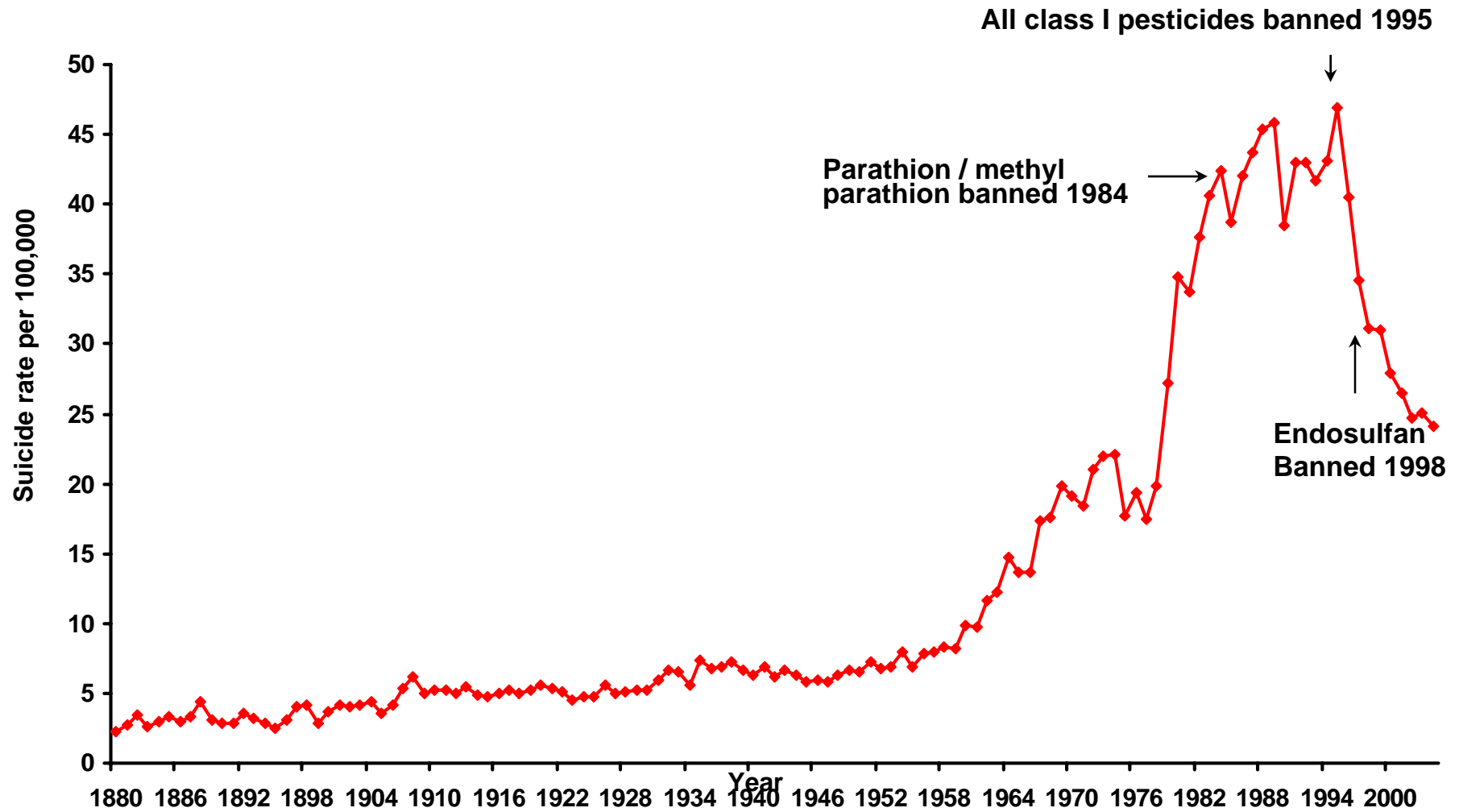


## Suicide rates in Sri Lanka 1880-2005



Gunnell *et al*, Int J Epid 2007

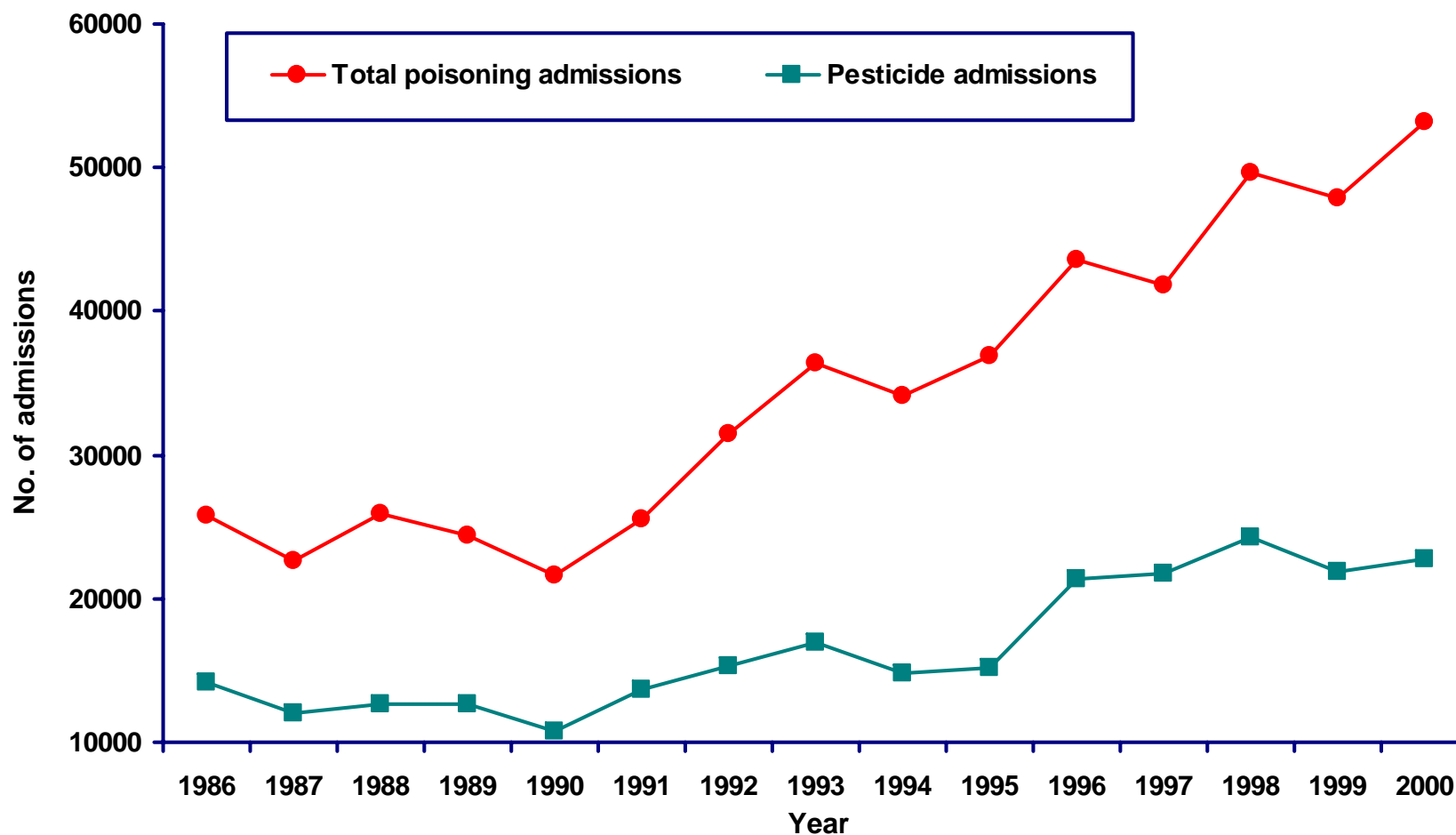
# Suicide rates in Sri Lanka 1880-2005



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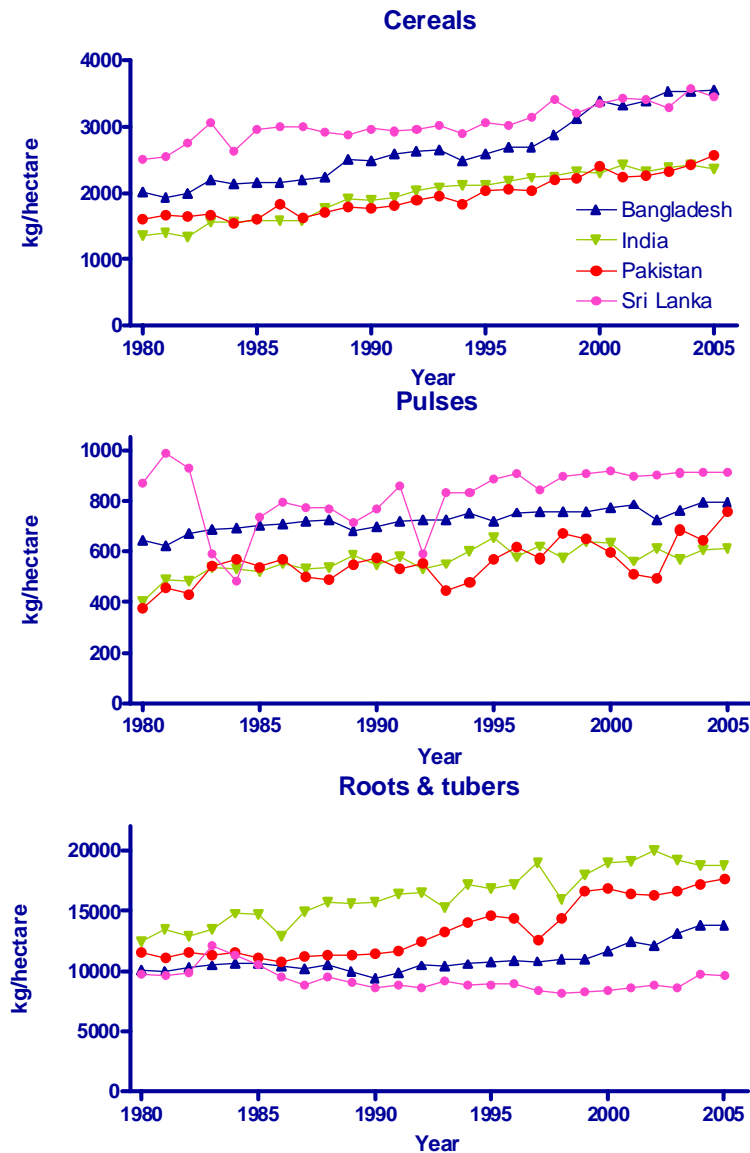


## National number of admissions for total poisoning and pesticide poisoning, Sri Lanka 1986-2000



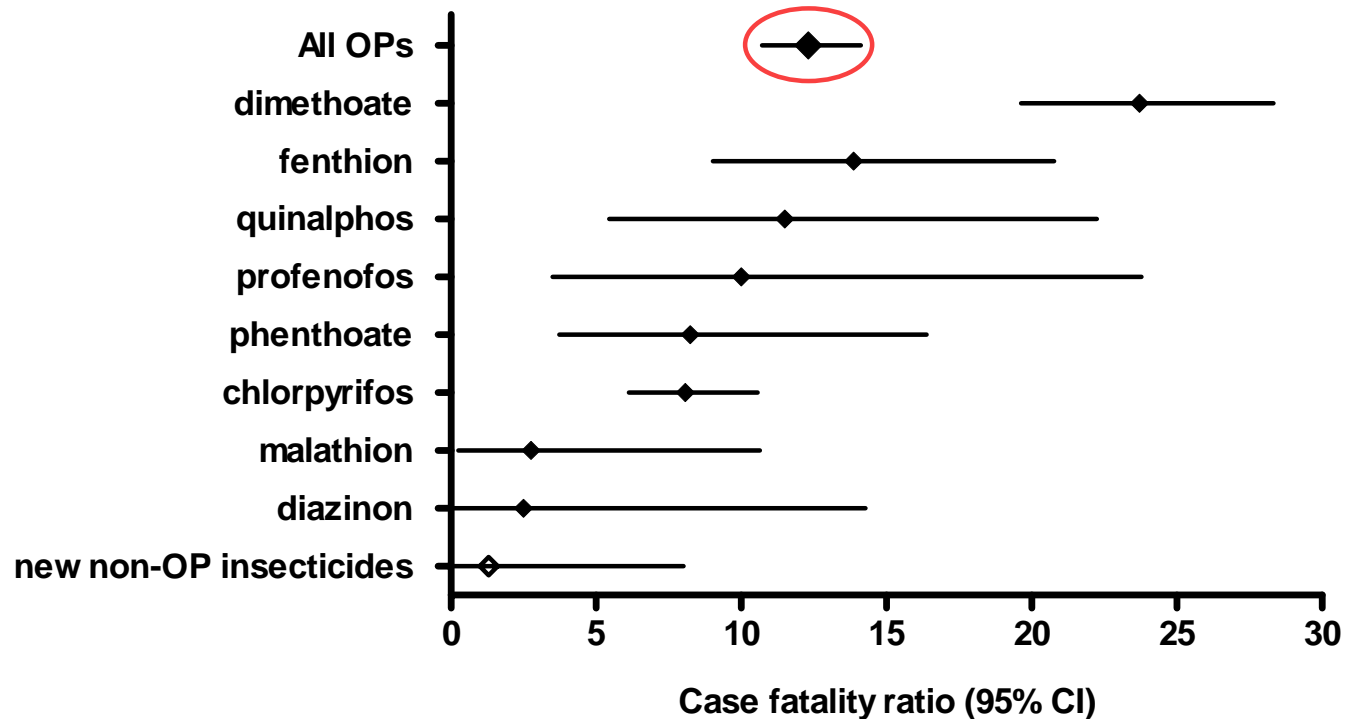
Source: D.M. Roberts *et al.* *Bull WHO* 2003:81

# Agricultural yield in South Asian countries between 1980 - 2005



Manuweera G *et al* 2008

## What should be the next regulatory move?



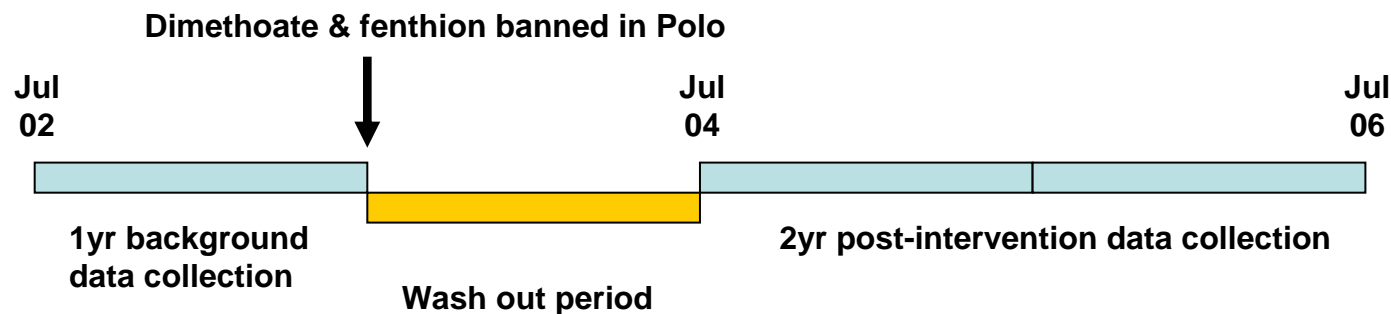
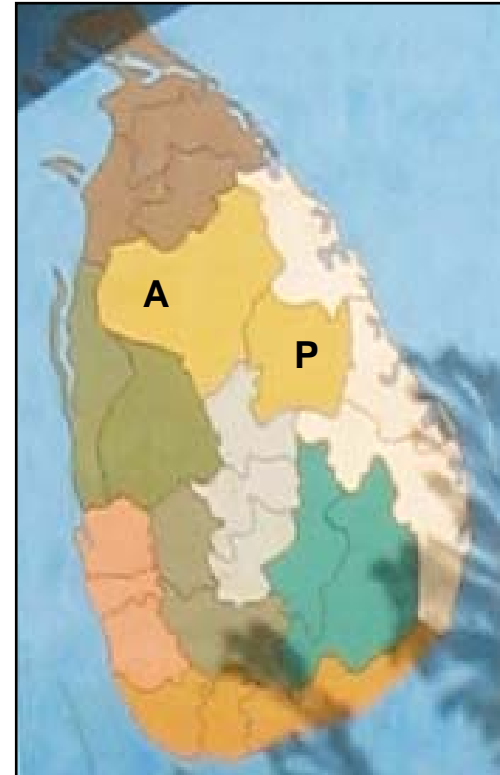
There is marked variation in human toxicity of the different OPs, despite few differences in their agricultural efficacy

**Could we remove the two common highly toxic OPs from use?**



## Study design

- Study initiated by the Sri Lankan Government's Pesticide Registrar
- Dimethoate and fenthion banned in Polonnaruwa district but not in the neighbouring Anuradhapura district in June 2003
- **Outcome** - relative change in case fatality from pesticide poisoning in the 2 district hospitals



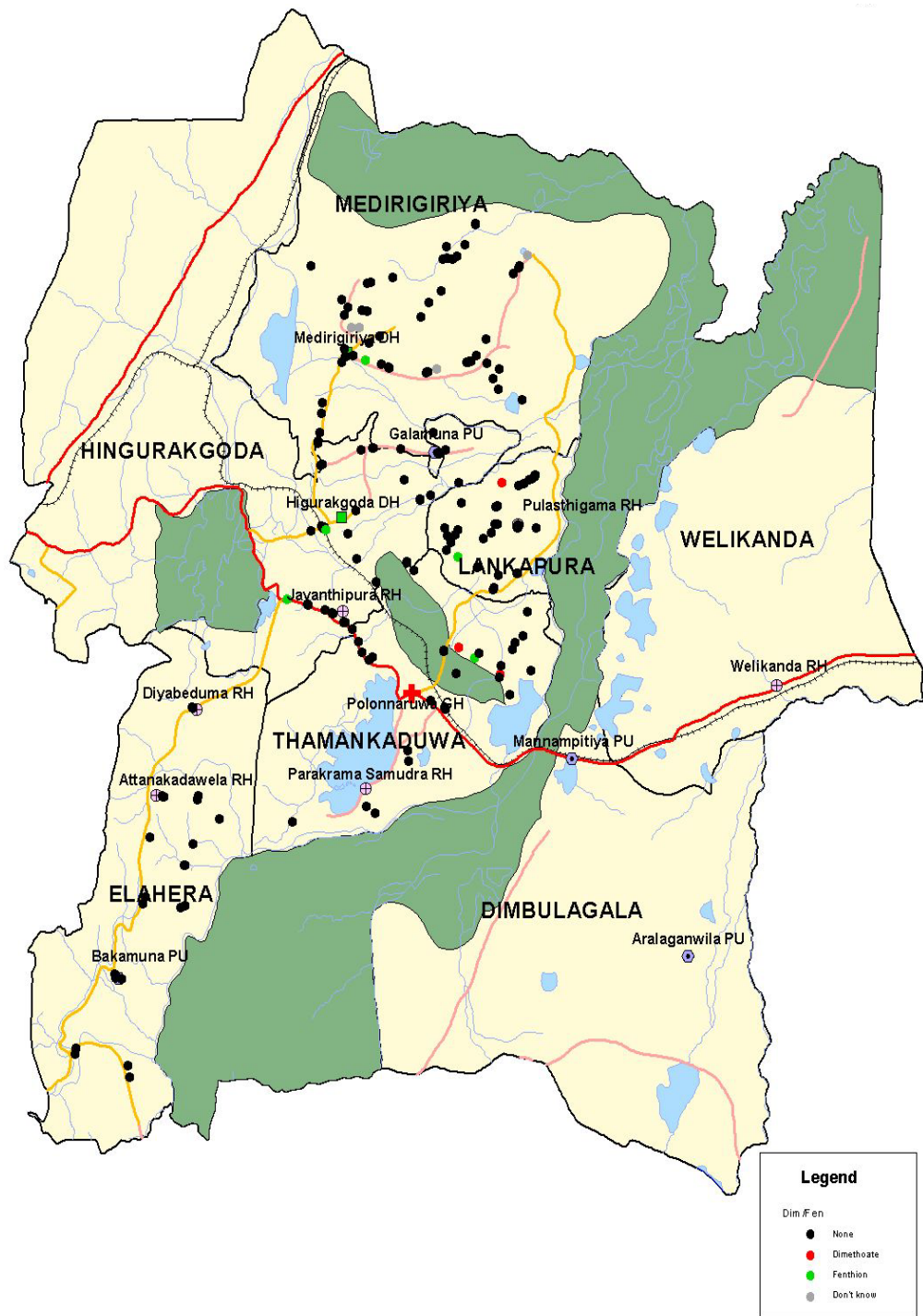
## **Strengths and Limitations of this Study Design**

### **Strengths**

- Study had a control area in which the intervention was not implemented
- Prospective data collection, with identification of the ingested pesticide, from the main referral hospitals covering both districts
- Large populations under study
- Government support with active enforcement by visiting shops

### **Limitations**

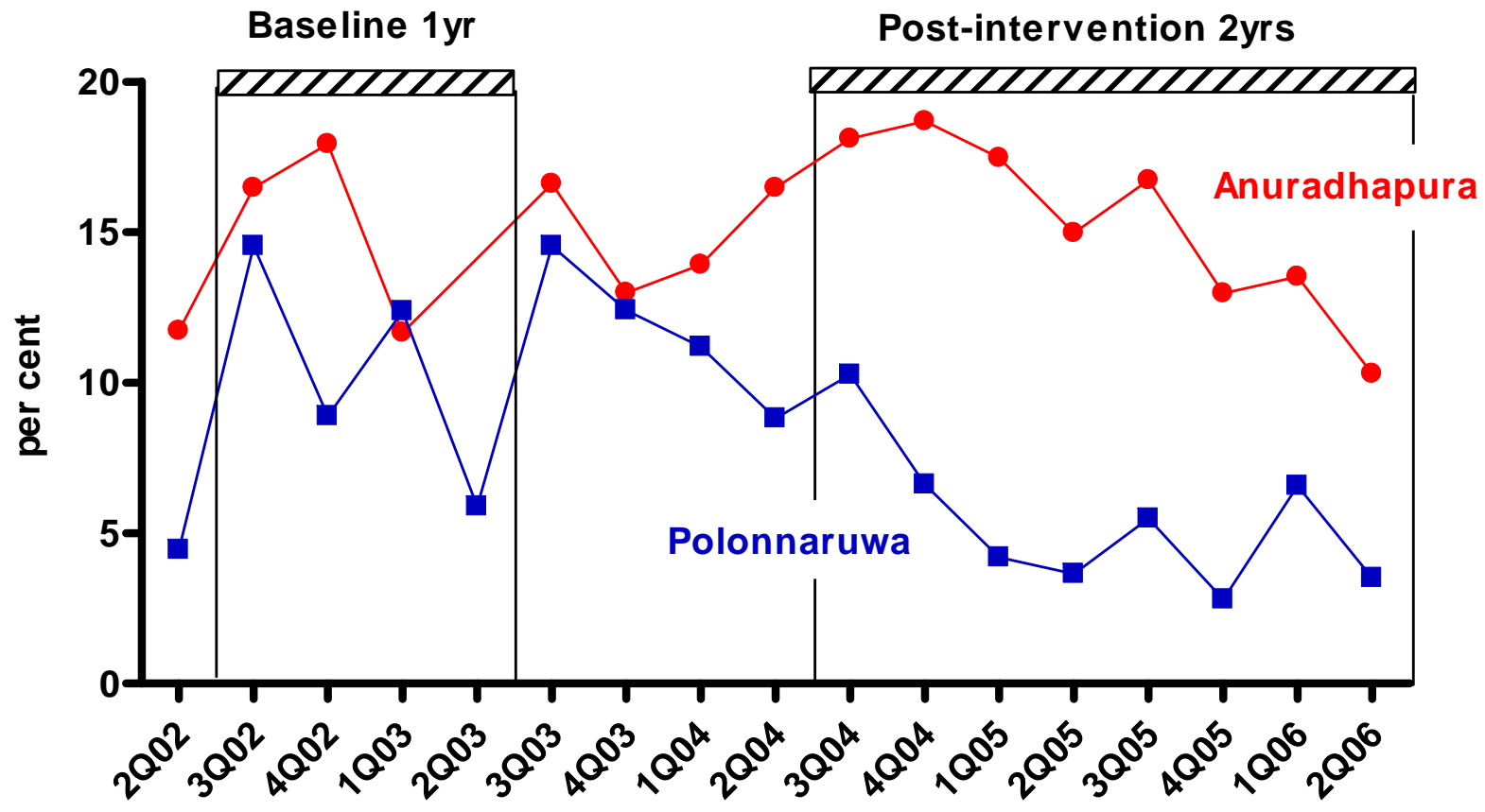
- Only one intervention area and one control area; limited no of events
- Choice of study area for intervention was not random - Polonnaruwa had the better agricultural outreach services to enforce a ban
- Ban was only implemented in 75% of Polonnaruwa district
- Impossible to stop small scale importation of dimethoate and fenthion from surrounding districts where they were still available - study contamination





# Results

## 1. Dimethoate and fenthion patients as a % of all pesticide admissions



## Results

### 2. Primary outcome - *Pesticide Case Fatality*

	Jul02-Jun03	Jul04-Jun06	Odds Ratio
Anuradhapura (control)	66/583 (11.3%)	213/2003 (10.6%)	0.93 (95% CI 0.70-1.25)
Polonnaruwa (intervention)	50/348 (14.4%)	106/1182 (9.0%)	0.59 (95% CI 0.41-0.84)

**Comparison of the two centres: P=0.051**

(Mantel-Haenszel test of heterogeneity. Note the limitations of the study)

## Place of death for poisoned patients

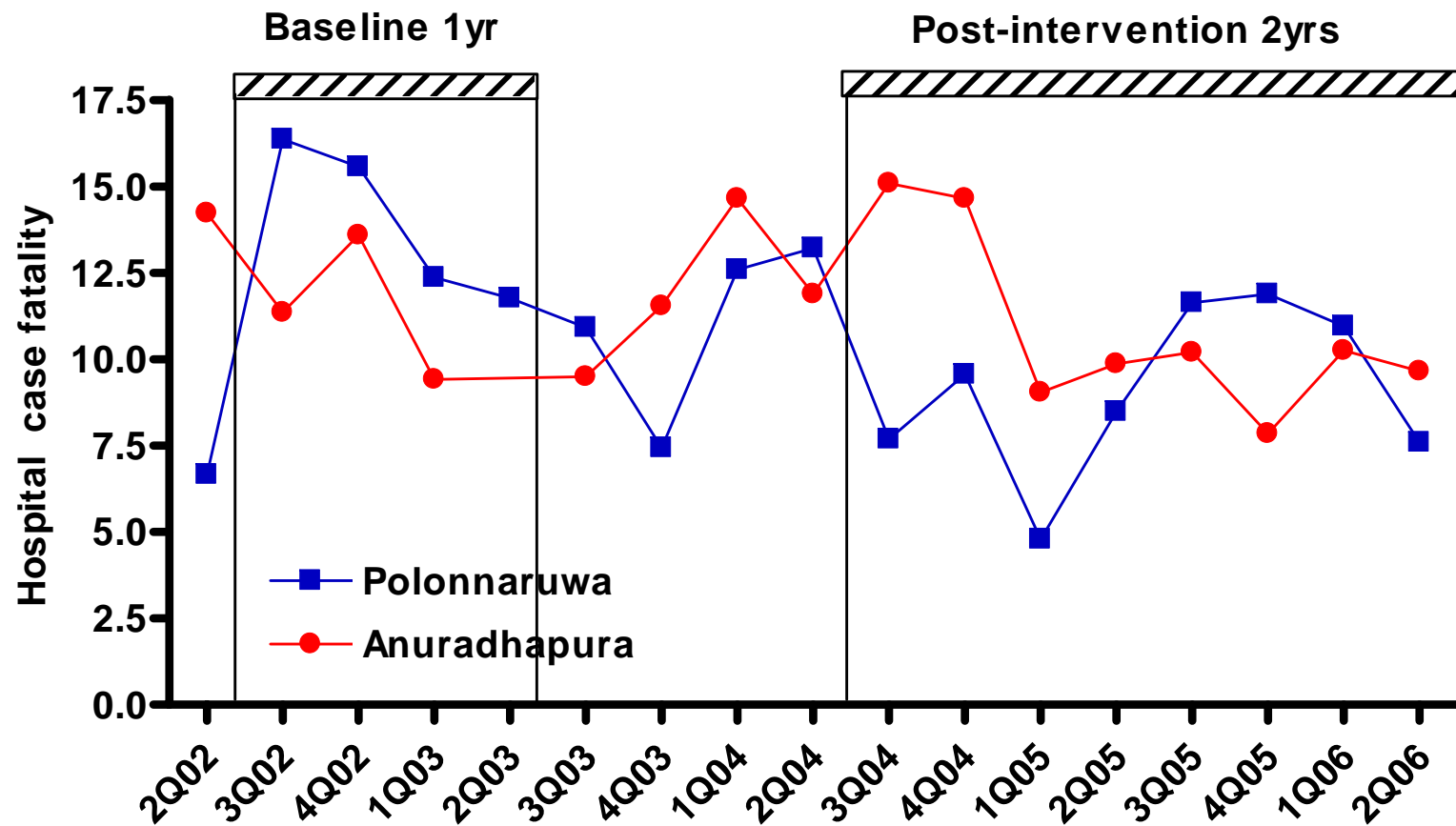
Place of Death	OP	Carbamate
Home	3.5	5.0
Rural Hospital	9.0	42.5
During transfer	5.5	15.0
District Hospital	79.5	32.5
After transfer to specialist hospital	0.0	0.0
Unknown	2.5	5.0

Checked hospitals surrounding Polonnaruwa for an increase in deaths from pesticides after the ban. We found no significant increase that might account for the reduced number of deaths in the district hospital.



# Results

## 3. Case fatality by quarter in the two hospitals



## Results

### 4. Jul 2006 to Jun 2007

Due to the marked difference between 2004-5 and 2005-6, we continued collecting data for another year to determine whether the effect was sustained.

	<b>Pesticide cases</b>	<b>Pesticide deaths</b>	<b>Paraquat deaths</b>	<b>Carbamate deaths</b>
<b>Anuradhapura</b>	<b>1038</b>	<b>78 (7.5%)</b>	<b>19 (24%)</b>	<b>5 (6.4%)</b>
<b>Polonnaruwa</b>	<b>569</b>	<b>69 (12.1%)</b>	<b>19 (28%)</b>	<b>12 (17.4%)</b>

The marked increase in case fatality was mostly due to an increase in the number of carbamate (and paraquat) deaths in Polonnaruwa.

## Conclusions

- It is possible, although difficult, to do large-scale, controlled interventional studies of public health interventions in the rural developing world.
- Banning highly toxic pesticides will reduce the case fatality from pesticide in local hospitals
- However, this effect may be short lasting as agricultural practice shifts to other toxic pesticides (in this case a shift from OP to carbamate)
- An effective public health and regulatory approach to pesticide poisoning might consider replacing all pesticides toxic to humans with newer less toxic pesticides

# THE UTILIZATION OF PESTICIDE SAFE STORAGE DEVICES IN RURAL SRI LANKA: A LONG-TERM ASSESSMENT

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<sup>4</sup> School of Population Health, University of Newcastle, Australia



South Asian Clinical Toxicology Research Collaboration



## Background

- The great majority of deaths follow impulsive acts of self-harm, where the ready availability of pesticides in the homes of rural communities play a key role (Eddleston & Phillips, 2004; Konradsen *et al.*, 2006)
- Safe storage devices are an effective avenue for prevention of self-poisoning episodes (Mishara, 2007)

***Safe storage devices are an effective avenue for prevention of self-poisoning episodes*** (Mishara, 2007)

Safe storage has been promoted by a collaboration of industry, IASP, and WHO 2005-7.

But what is the evidence? 2 x Sri Lankan studies

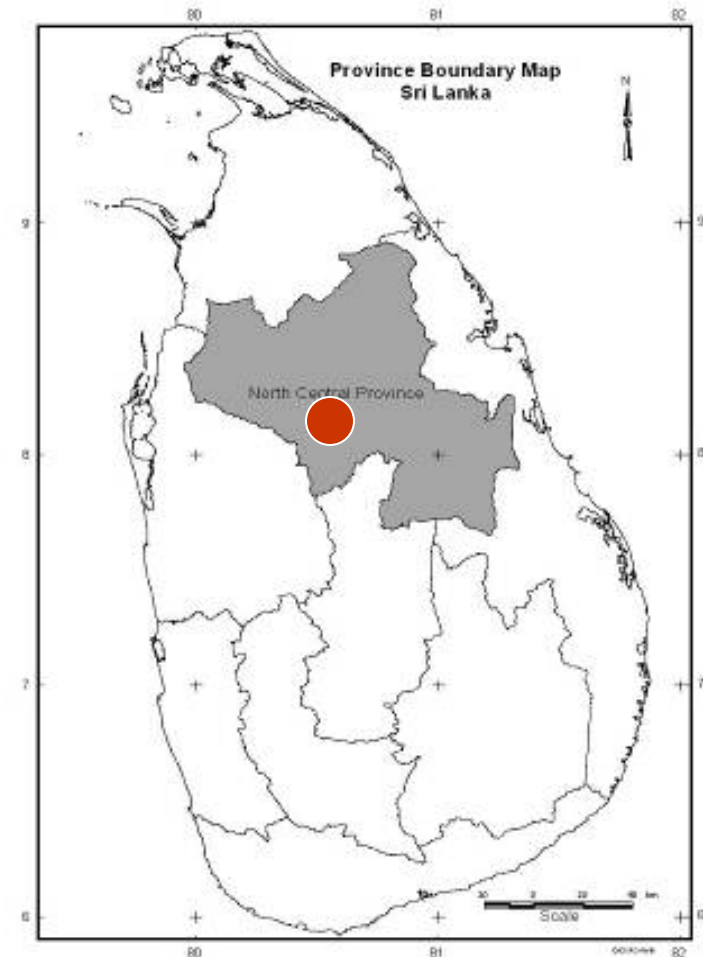
Safe storage interventions should be studied and assessed, since other options such as restrictions, product reformulation or ban of importation are not attractive to the pesticide industry (Konradsen *et al.*, 2007)

# Objectives

**To assess the long-term use of safe storage devices and identify problems faced with safeguarding the key**

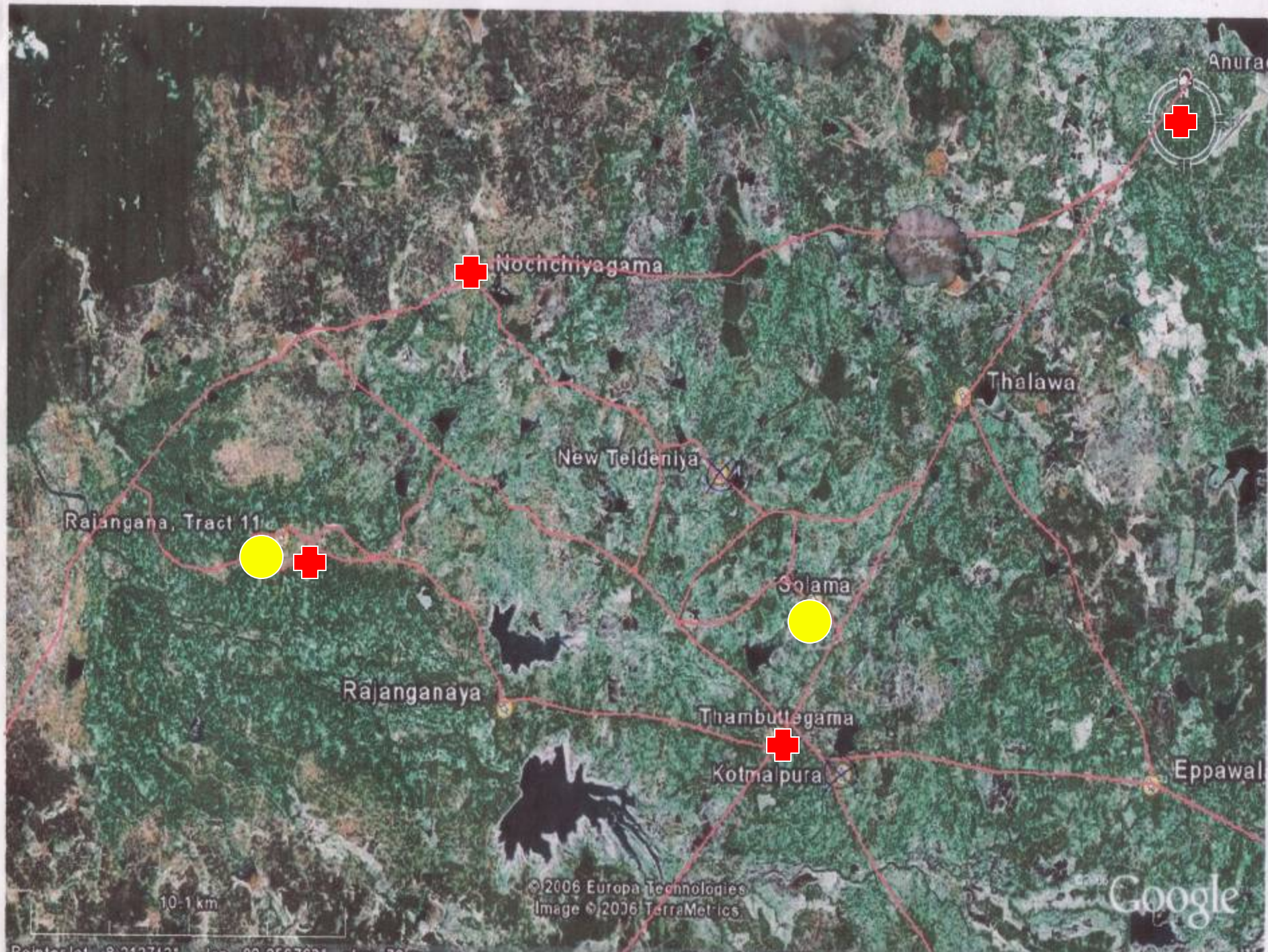
# Methods

Two study villages in  
North Central Sri Lanka



South Asian Clinical Toxicology Research Collaboration









Paddy cultivation



Spraying



Houses



Spraying dates

South Asian Clinical Toxicology Research Collaboration

# Methods

- Selection of households (200 households of 352)
- Baseline survey
  - Families were clearly informed that they could opt out of the project at any time
- Distribution of devices (June 2005)
  - During distribution and one month after, households were encouraged to store all pesticides in the provided device and keep it locked at all times
- First follow-up (January 2006)
- Second follow-up (June 2007)
- Follow-up surveys coincided with the dry season, the period of maximum use of pesticides

# In-house safe storage devices



Large device made of  
mango wood



Device made of metal

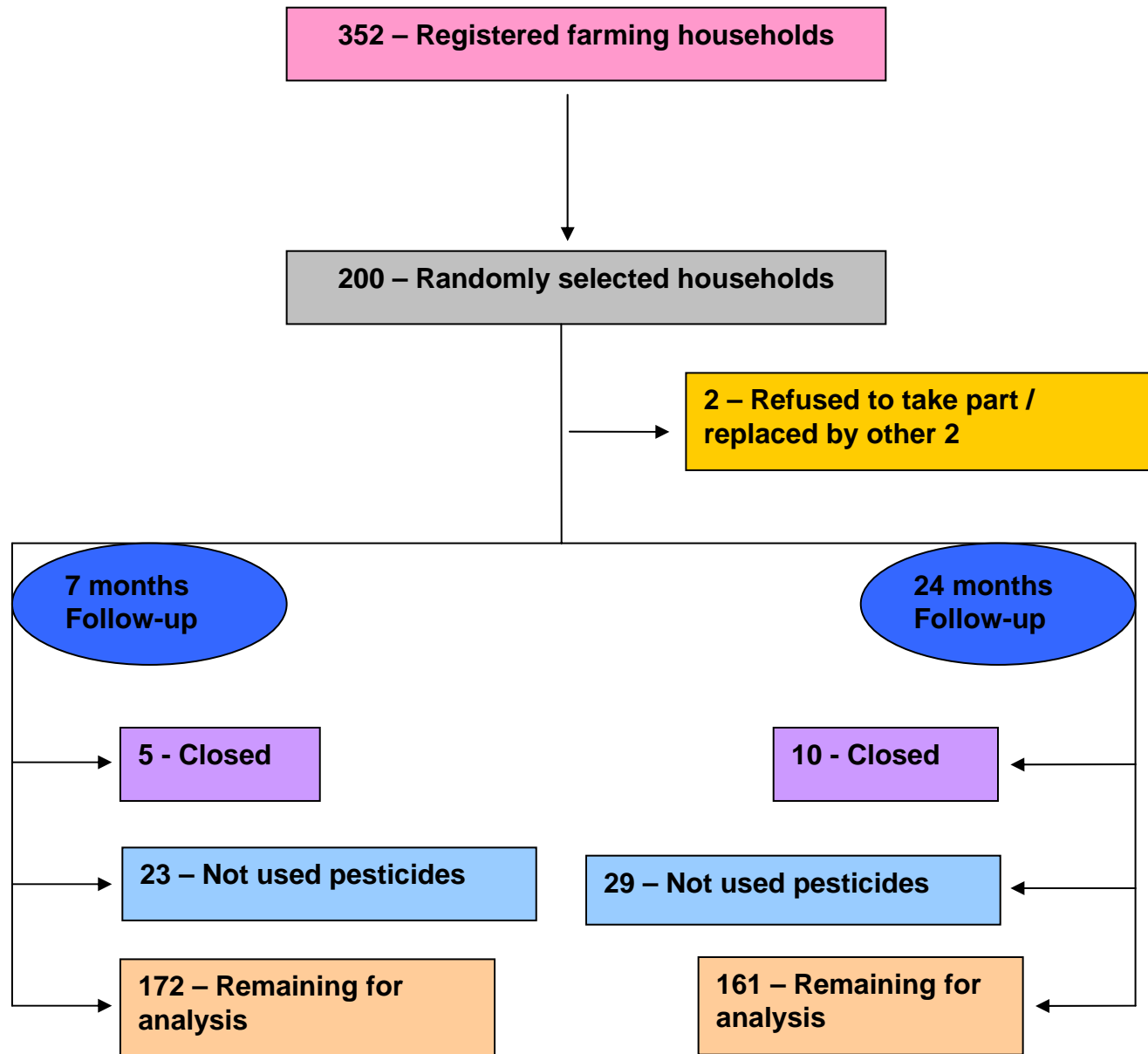


Small device made of  
mango wood



## Baseline – Observations





## Definition of locking pesticides exclusively

- All pesticides stored in the device and device locked
- No pesticides visible in the home and home garden areas
- Household members reporting that no pesticides stored in the field



## Findings

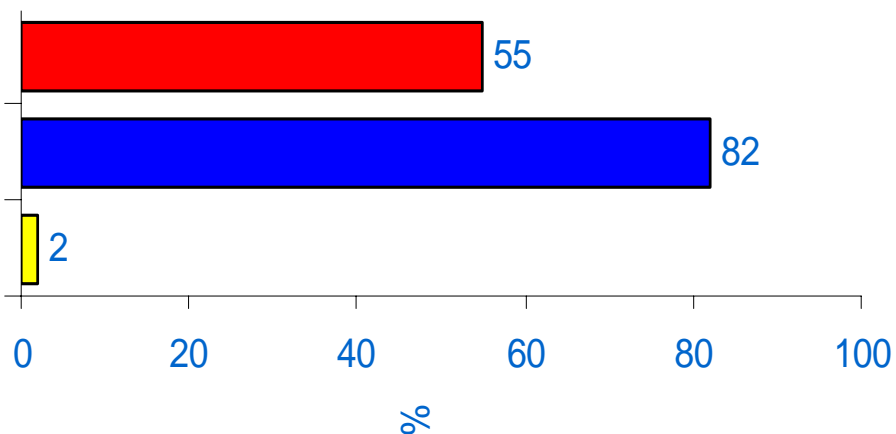
Pesticides exclusively stored and locked away -  
among the in-house devices distributed in the  
villages

24 months  
after

(n = 161)

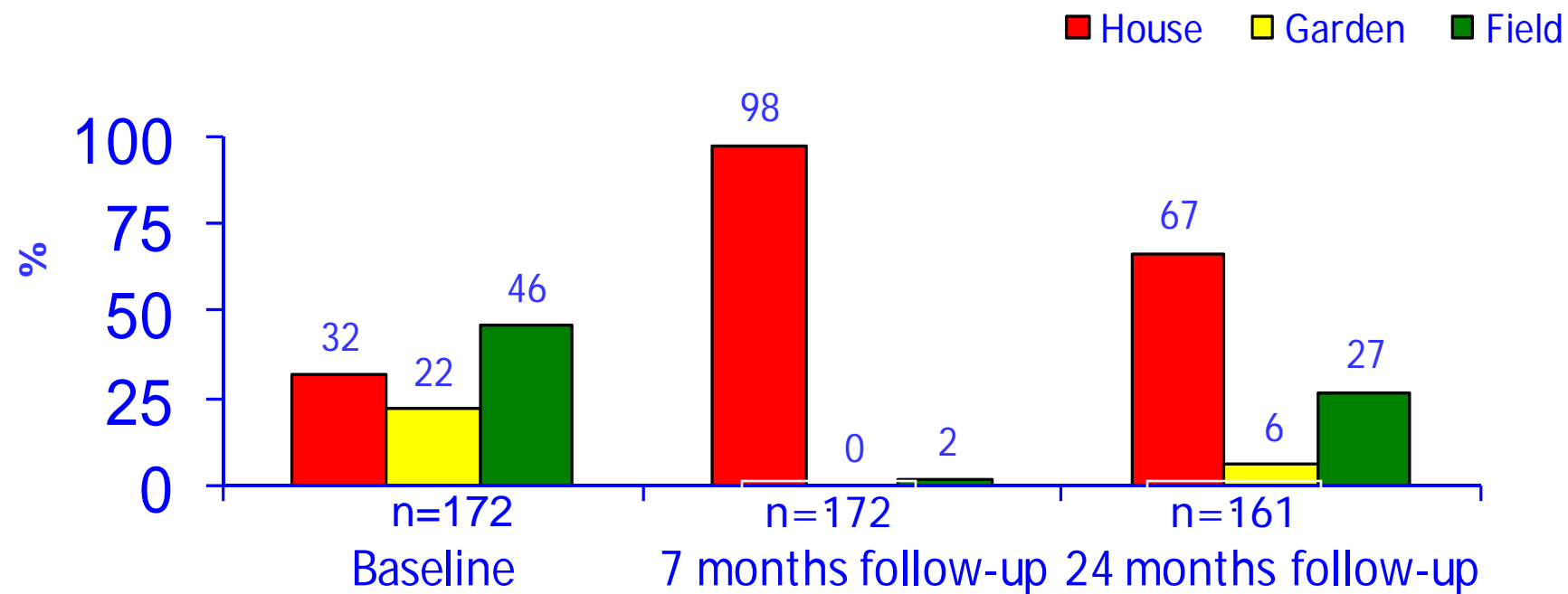
Baseline

(n = 172)





## Shifting of pesticide storage place over time

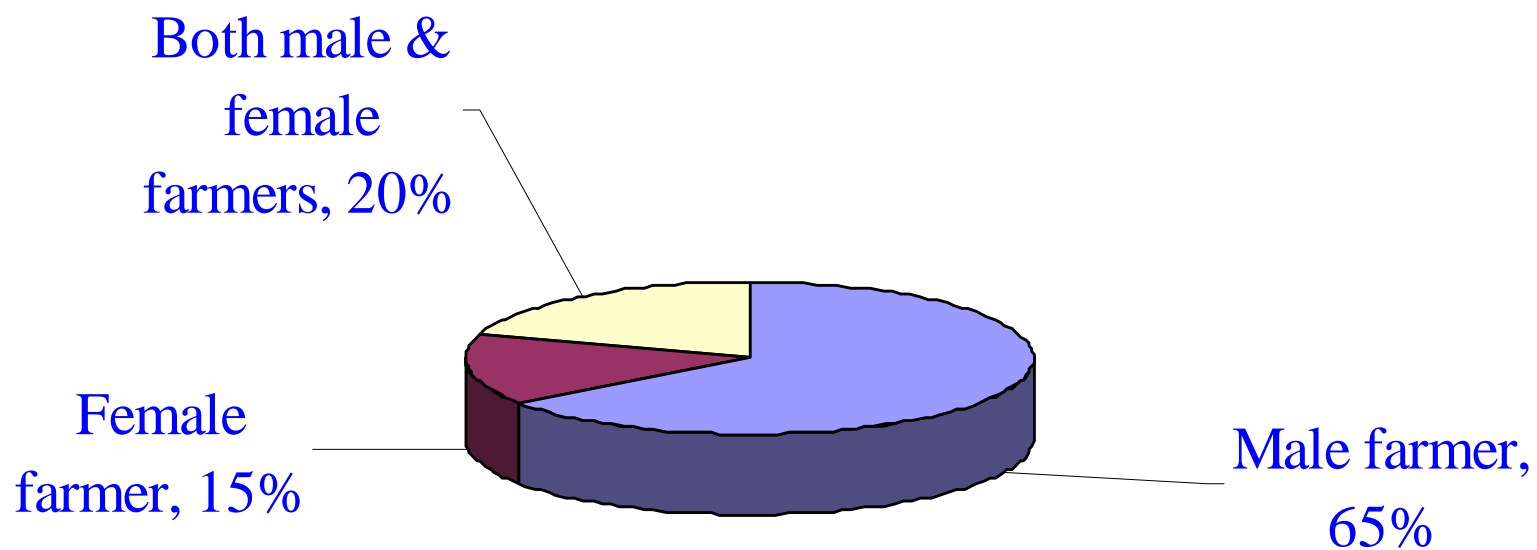


## Reasons for not keeping the device locked

- Padlock is not a user friendly locking mechanism
- Impractical to keep opening the device when pesticides are used frequently
  - ➔ Difficult if several people are involved in pesticide spraying; or
  - ➔ Spraying and key management done by two different persons
- Corrosion and loss of key
- Drawbacks in the design of the devices

- Some farmers do not consider keeping the device locked to be important as they think poisoning would not occur in their household
- Keeping the key away from other family members was a big challenge to farmers: at the 24 month follow-up it was revealed that in 57% (n=42) of the households the children could find key within minutes
- Impractical to hide key away from spouse/cultural aspects
- Although farmers were encouraged to use an additional padlock in critical situations, only seven households had opted to use two padlocks

## Key management by gender (n = 135)



- Regular access to the hidden key increased the chances of the hiding place being spotted by other family members



Key easily accessible to all



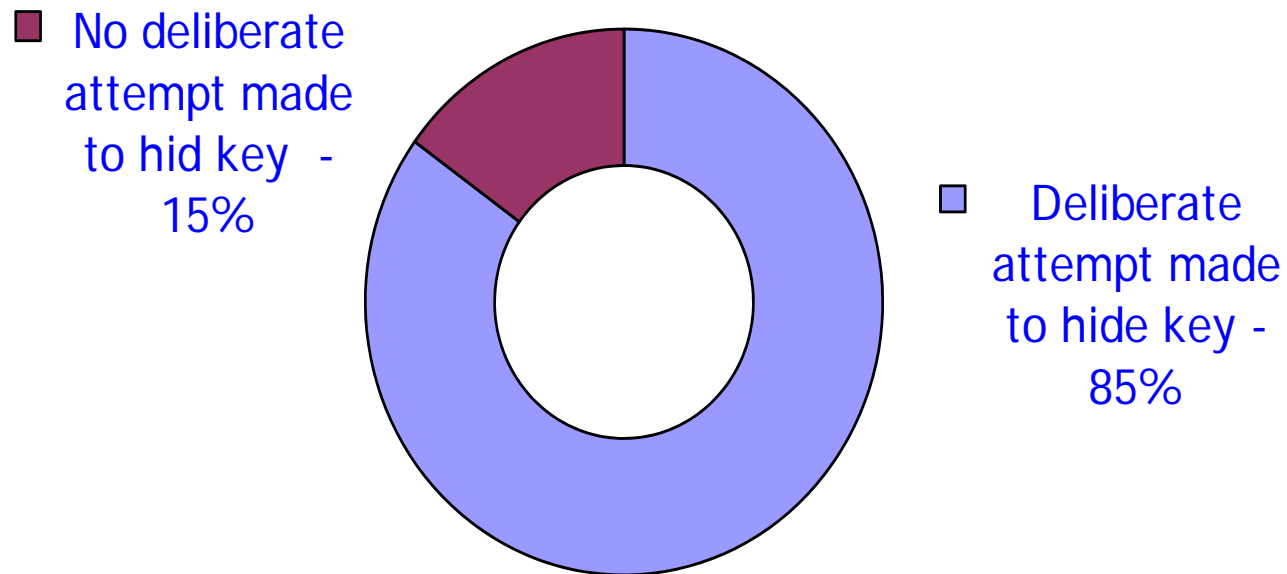
Key in the padlock



Deliberately hiding the key



## Device key hidden from family members (n=124)



## Identified advantages of in-house pesticide storage

- Opportunity to intervene and prevent an attempt of suicide
- Not open to either theft or weather
- Useful to farmers who lease (not own) irrigated lands
- Generally, households with a single occupant (no children) opt for in-house storage

## Identified disadvantages of in-house pesticide storage

- The keeper of the key is vulnerable to easy access to pesticides
- Most conflicts that lead to self-harm attempts occur in the home environment
- Extra pressure to ensure device locked at all times
- If device is kept unlocked owing to an oversight accidental poisoning situations may arise

# Follow-up observations

Device used for purposes other than storing pesticides



Books

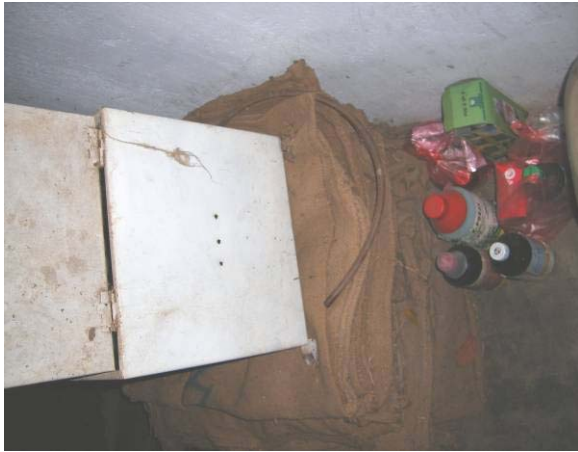


Crockery



Toys

## Unused Devices





## Modification of devices by farmers



Chambered



Long legs



First aid box

## Acute poisoning cases

- 12 cases of acute pesticide reported
  - ➔ Total population in the two villages - around 1900
  - ➔ Four cases at the seven month follow-up and eight cases at 24 month follow-up
- Seven families had received a device
  - ➔ [ 2 deaths – key responsible person] [ 1 – unlocked device]
  - ➔ [ 1 – forced and opened] [ 2 – pesticides obtained from outlets]
  - ➔ [ 1 – No clear information]
- Four failed attempts owing to device

## Observations



## Conclusions

- Provision of in-house safe storage devices had high community acceptance and utilization, especially in the short-term
- Provision of only in-house devices appears to encourage farmers to store pesticides at home, which may increase domestic risk of impulsive self-poisoning episodes
- The ability of other household members, especially children, to find the key easily is worrying

## Conclusions (cont'd)

- The person in charge of the key is vulnerable to easy access of pesticides
- Hiding the key from other family members was still a big challenge to farmers
- Improvement of locking mechanism would be one of the best options to switch non-users to users
- Device had posed some barrier for self-poisoning episodes



Next studies 1....

UV resistant plastic design



Modified concrete designs



Next studies 2....

Safe storage website:

[www.safestorage.toxicology.wikispaces.net](http://www.safestorage.toxicology.wikispaces.net)



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