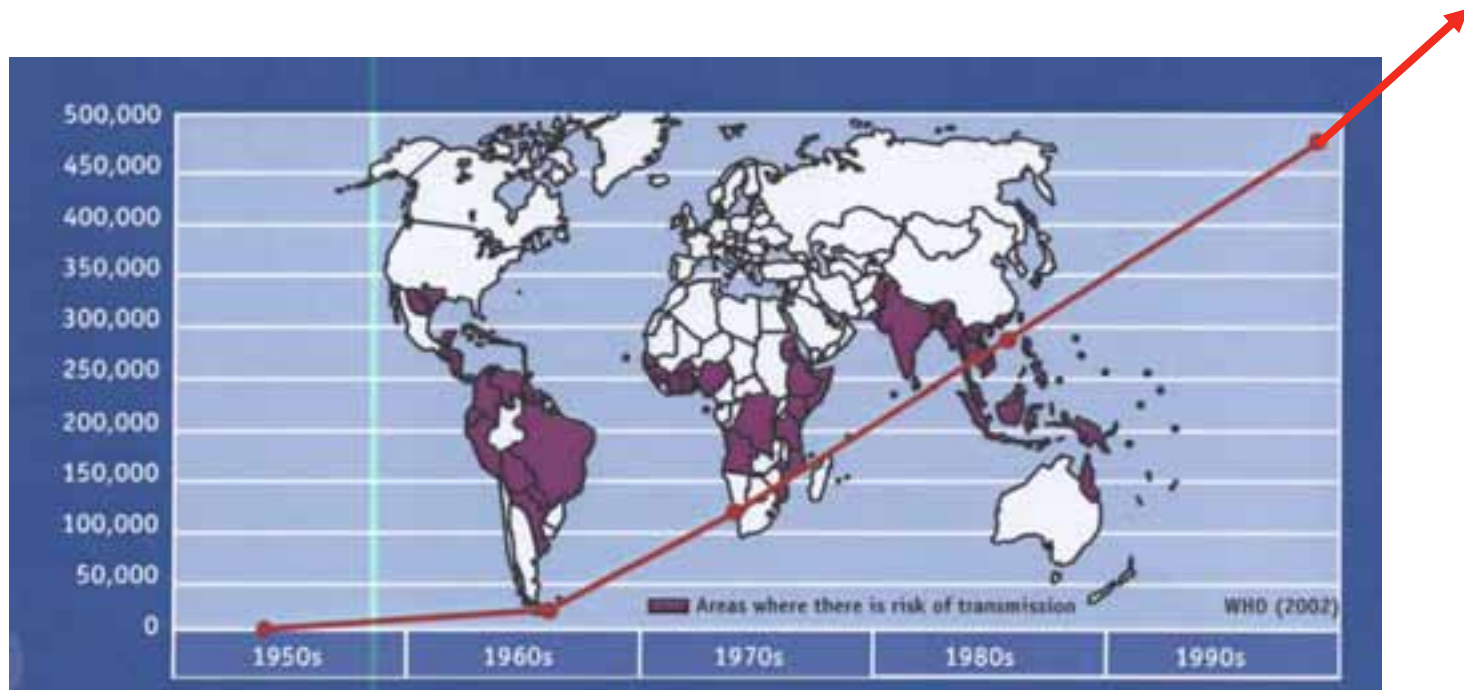


# MANAGING DISEASE VECTORS: LESSONS LEARNED-LESSONS IGNORED

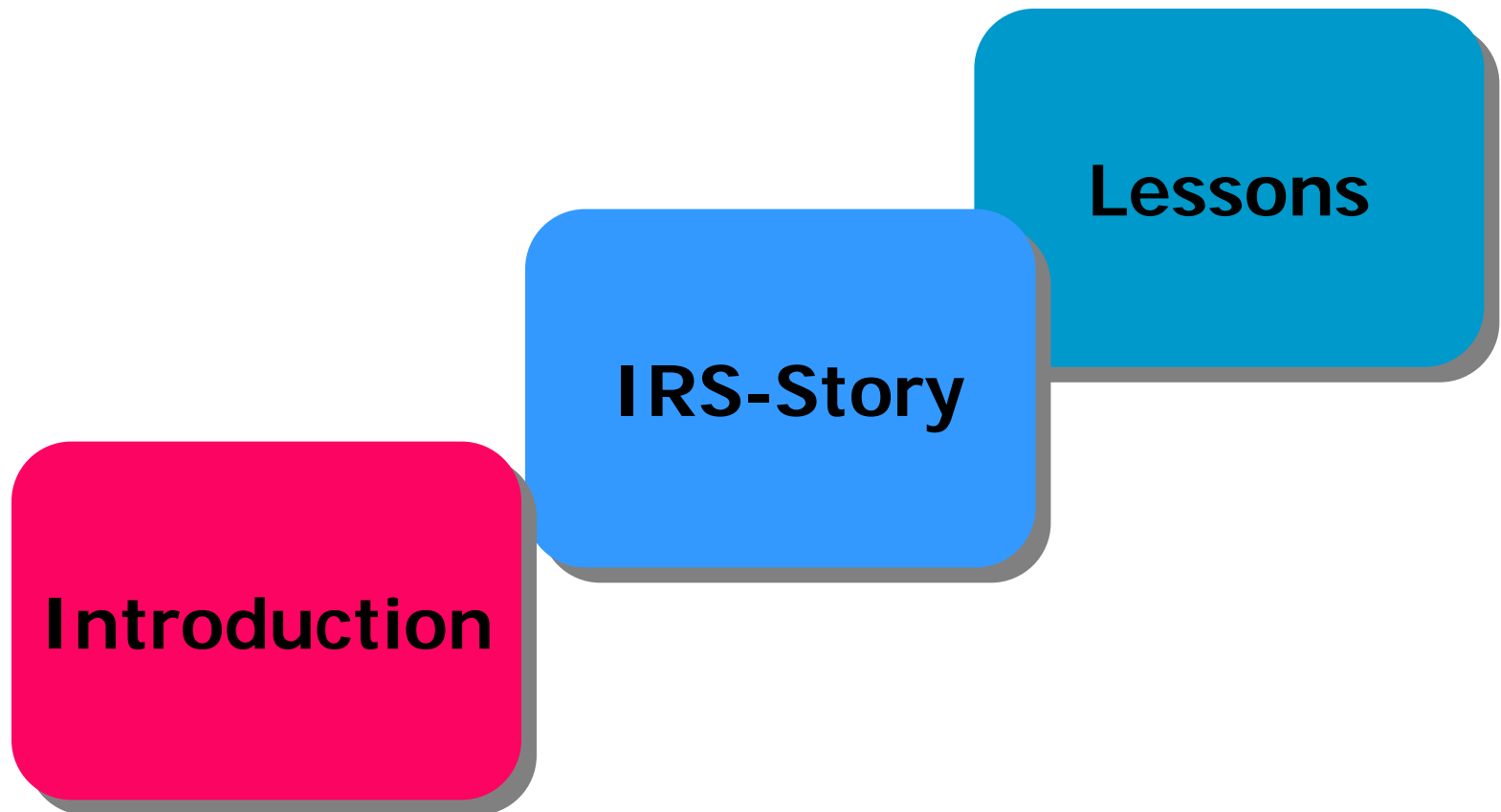
Global Health Histories Seminar

Axel Kroeger



Annual DHF cases

# LESSONS LEARNED- LESSONS IGNORED



# **(A) INTRODUCTION**

## **Insect vectors and "their diseases"**

- WHO are they
- WHERE do they occur
  - HOW do we know?
- WHAT are the control options?

# Examples of insect vector borne diseases

DENGUE



Visceral Leishmaniasis

Others...



Lymphatic Filariasis

MALARIA



Chagas

# Examples of insect vectors

Triatomine: Chagas



*Aedes aegypti*: Dengue



Anopheles: Malaria



Sand fly: Leishmaniasis



# WHERE?

## The vector belt around the world (example dengue)



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

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Data Source: WHO  
Map Production: Public Health Mapping and GIS  
Communicable Diseases (CDS) World Health Organization

# HOW DO WE KNOW?

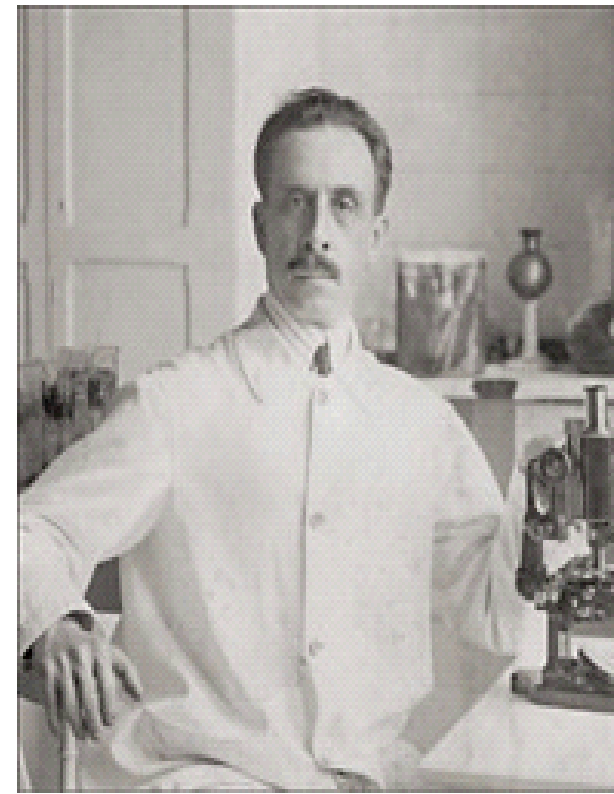
Pioneers and victims



**Patrick Manson**  
*Lymph. Filariasis*  
**1878**



**Ronald Ross**  
*Malaria*  
**1897**



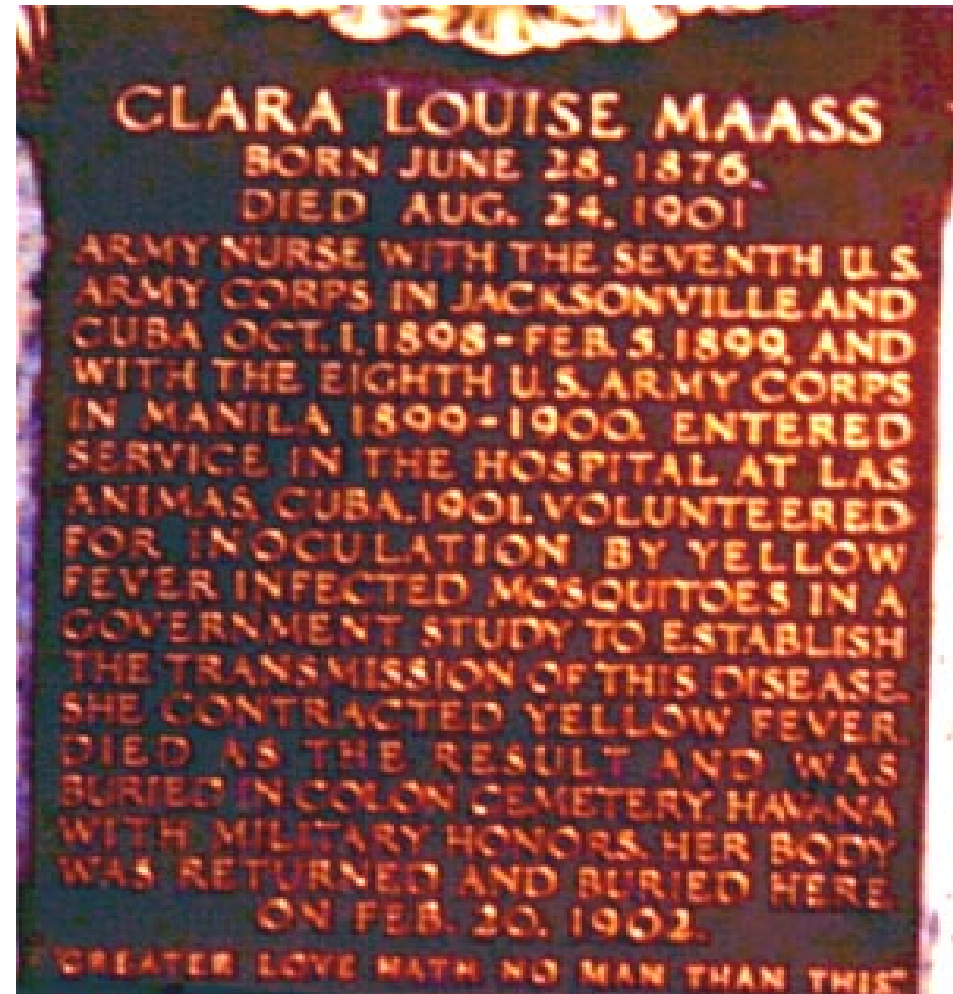
**Carlos Chagas**  
*Chagas Disease*  
**2009**

**PIONEERS IN VECTOR BORNE DISEASE RESEARCH**

# VICTIMS OF VECTOR BORNE DISEASE RESEARCH

## Clara Maass

Clara was buried in Havana, Cuba and later reburied in New Jersey at Fairmount Cemetery

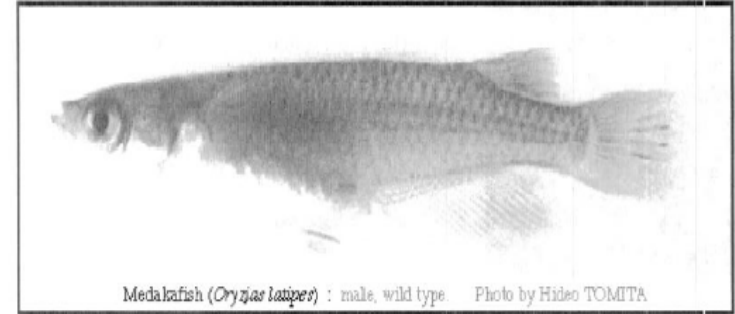


# **Vector Control: What are the options?**

- **In the early days**
- **Today**

# Larviciding & biological control in the old days

- Screening of houses
- Mosquito nets
- Drainage & filling of swamps
- Oil or Paris Green in breeding sites



Early 1940`s



FIGURE 2.—Larvae control. Spraying larvae in water barrels. Espiritu Santo, New Hebrides, October 1942.



FIGURE 3.—Larvae control. Introducing larva-eating guppies into water tank. Espiritu Santo, New Hebrides, October 1942.



# Current control options



## Biological



- Personal protection
- Containers:

- Larvivorous fish
- Copepods (mesocyclops)
- Dragon flies



- Clean-up campaigns (dengue)
- Lime plastering (sand flies)
- Other ecosystem management



## Chemical



- IRS** (Indoor Residual Spraying)
- ITNs** (Insecticide treated nets)

Anti-larval: Pyroproxifen, Temephos, Bti

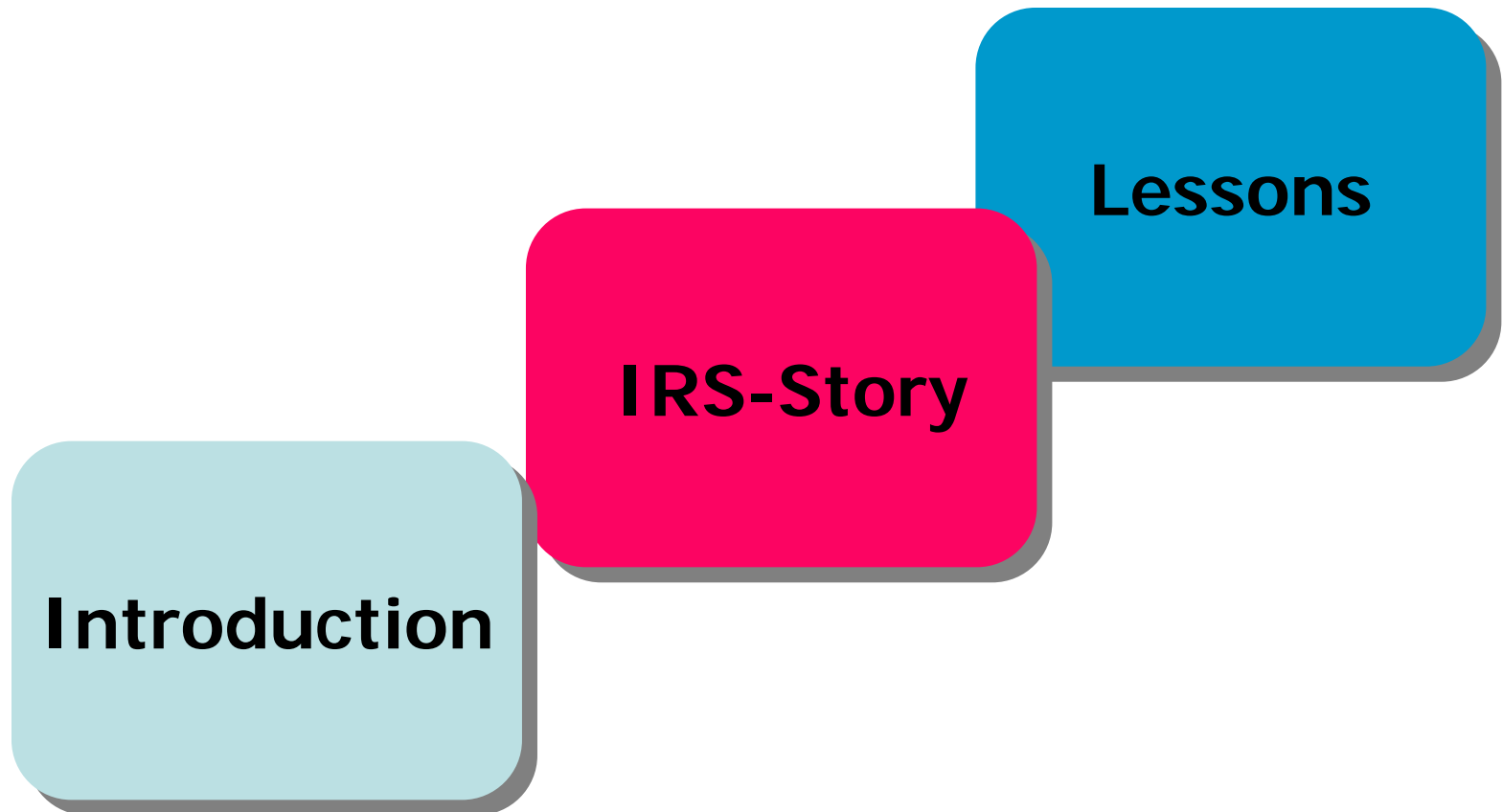
- Insecticidal lid covers
- Fogging



## Others

Genetically modified vectors

# LESSONS LEARNED- LESSONS IGNORED

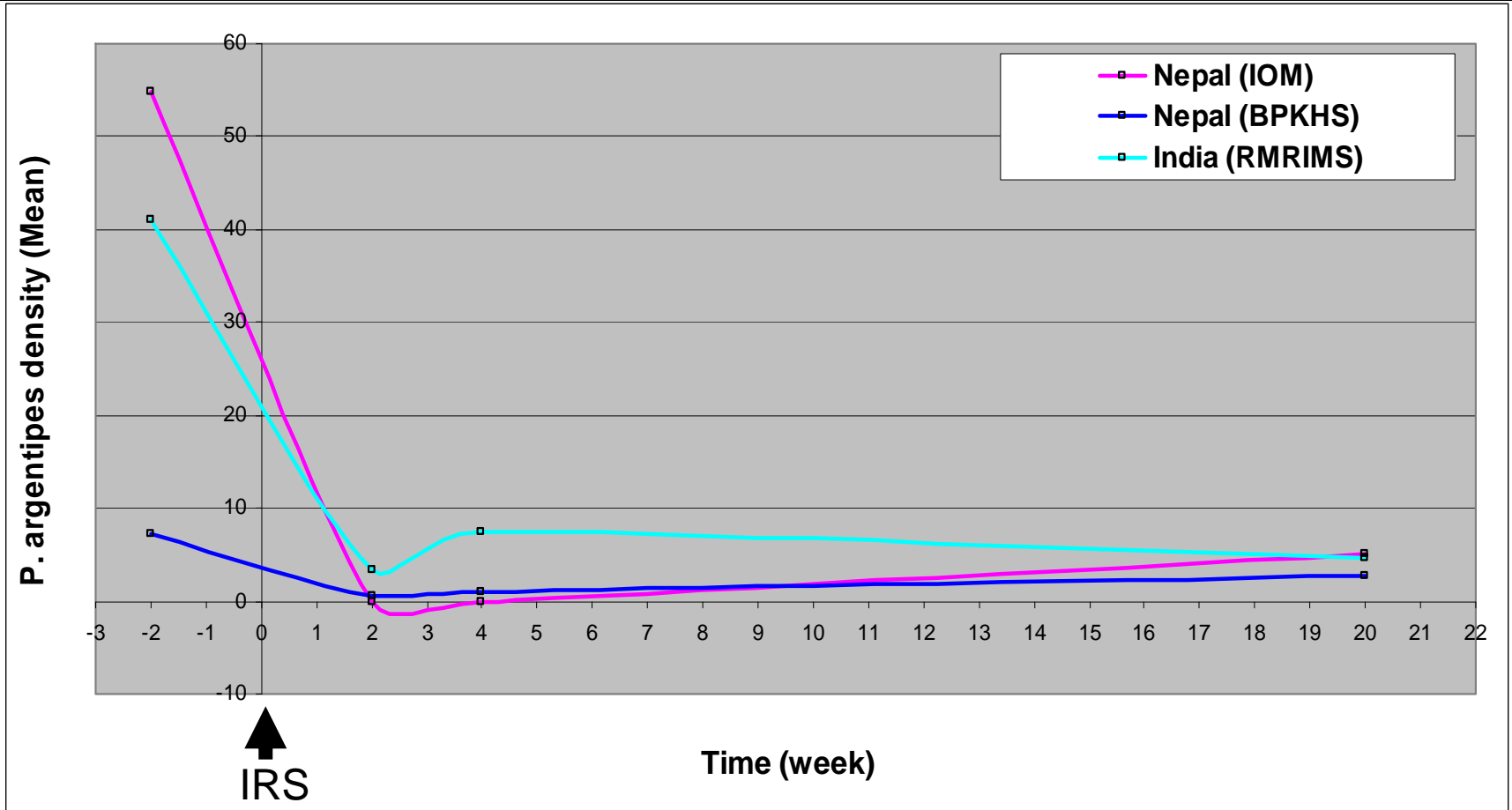


# (B) THE IRS STORY & HISTORY

- Aim
- Effort
- Cost
- Achievements
- The managerial & political face

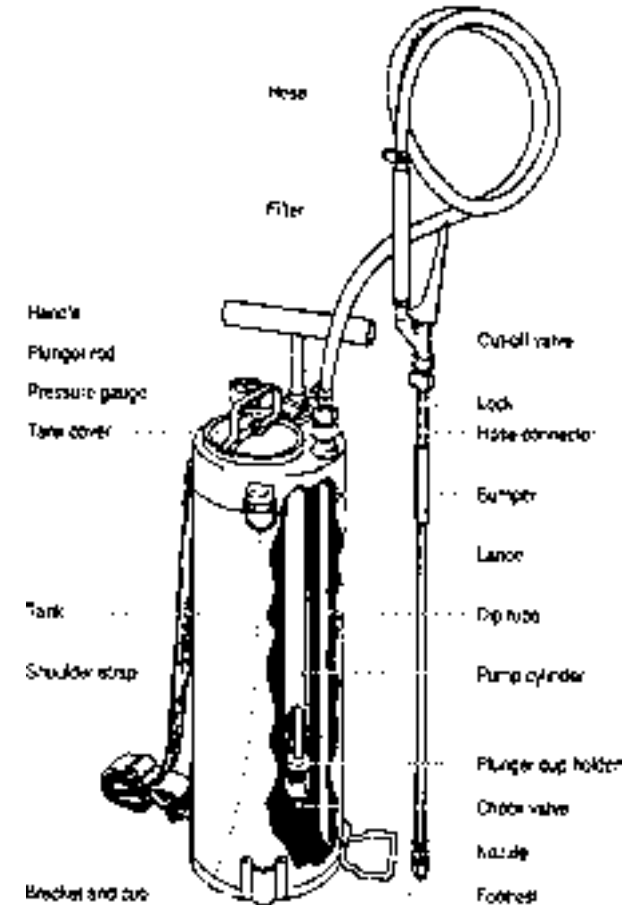
IRS= Indoor Residual Spraying

**AIM: Reduction of vector density/longevity through IRS that no further transmission occurs**  
**("Break point"; Threshold level)**



# THE EFFORT:

## Pyrethroid spraying with Hudson pump



# THE EFFORT

## DDT spraying in India with Stirrup Pump



# IRS: The managerial & political face (1)

## "Classical" IRS programmes:

- Practiced at a massive scale during and after WWII
- Enabled by DDT
- Strengthened by the Malaria Eradication programme
- Organized as independent vertical programme
- Planned usually in an "eradication mood" for a limited time period due to its high costs
- Not applied in high endemic areas of Sub Saharan Africa

# DEPARTMENT OF STATE

To all to whom these presents shall come, Greeting:

I the undersigned, Secretary of State of the United States of America, hereby request all whom it may concern to permit

Fred L. Soper,  
a citizen of the United States, safely and freely to pass and in case of need to give him all lawful Aid and Protection.

This passport is valid for use only in the following countries and for objects specified unless amended.

Brazil  
NAME OF COUNTRY

Professional work  
OBJECT OF VISIT

The bearer is accompanied by his wife Juliet S.



Given under my hand and the seal of the Department of State at the City of Washington, the 3rd day of January in the year of our Lord of the Independence of the United States the one hundred and forty-fourth.

Robert Lansing

### PERSONAL DESCRIPTION

Age 26 years Mouth Medium  
Height 5 ft 11 in Chin Full  
Forehead high Hair Brown  
Eyes green Complexion ruddy  
Nose broad Face young

Distinguishing marks  
Place of birth Ketchikan, Alaska  
Date of birth 13 Dec. 1893  
Occupation Physician

Fred L. Soper MD  
SIGNATURE OF BEARER



PHOTOGRAPH OF BEARER

No. 153995

# Fred Soper`s obsession with IRS (1)

*After having achieved the eradication of *A. gambiae* from Brazil, Soper was one of the first to use the new weapon against malaria, called **DDT**, at a large scale.*

His principles:

- apply motivation, discipline, organization

His approach:

- uniforms for malaria inspectors
- rigorous protocol for inspecting houses
- mapping, number houses and sectors, assign inspectors to each sector
- bonus for supervisors who found larvae that the inspector had missed, fee reduction for inspectors who deviated by > 10 minutes from their spraying schedule

## ACHIEVEMENTS OF IRS:

- "ELIMINATION" OF **DENGUE** VECTORS FROM THE AMERICAS...AND RE-INFESTATION (map)
- ELIMINATION OF **CHAGAS** VECTOR FROM CONO SUR" ... AND PARTIAL RE-INFESTATION
- ELIMINATION OF **MALARIA** FROM SUB-TROPICAL AREAS
- OTHERS...

1930s



1970



2002



## Fred Soper`s obsession with IRS (2)

*However, even in the heydays of Malaria Eradication, serious problems arose:*

- Insecticide resistance
- Environmental disequilibrium: bedbugs and carterpillars in Malaysia
- "Silent spring" by Rachel Carlson (1962)
- Corruption with insecticides (diluted sprays)
- Massive re-infestation in previously "free" areas
- People`s "resistance" to IRS (particularly the better-off)

# IRS: The managerial & political face (2)

*"Modified" IRS programmes in the 1990`s (LA, Asia) because of:*

- Decline in programme efficiency due to
  - Loss of national & international funding
  - More expensive new insecticides
  - Establishment of powerful malaria Unions
  - Loss of managerial skills and flexibility
- Decentralized health sector with threats and opportunities:
  - Integration into general health services
  - Massive reduction of workforce (spray teams often hired instead of being employed)
  - Loss of authority
  - Lack of programme expertise at district/sub-district level

## IRS: The managerial & political face (3)

*"Modified" IRS programmes in the 1990`s(LA, Asia) because of:*

- Decline in public attention due to
  - Decrease in malaria mortality
  - Urbanization of large population groups
- New challenges for vector control services
  - Advent of other neglected diseases such as dengue, LF, Leishmaniasis
- Advent of new tools, particularly ITNs
  - Emphasis shift towards ITNs in Africa



*It took 10 years to get research findings on ITNs into national programmes in Africa supported by massive international funding.*

*Mainly "vertical" distribution pattern as during the "classical" IRS period.*

*Will the IRS story be repeated when international donors disappear?*

# 1<sup>st</sup> lessons on IRS & vector control

- One intervention (IRS) is not sufficient to "eradicate" malaria or any other vector borne disease (*lesson learned?*)
- The weakness of managerial and political systems as well as "human nature" have to be taken into account (*lesson learned?*)
- Massive investment does not guarantee sustainable success in terms of reducing vector densities to threshold levels if the performance at all levels is not ensured (*lesson learned?*)

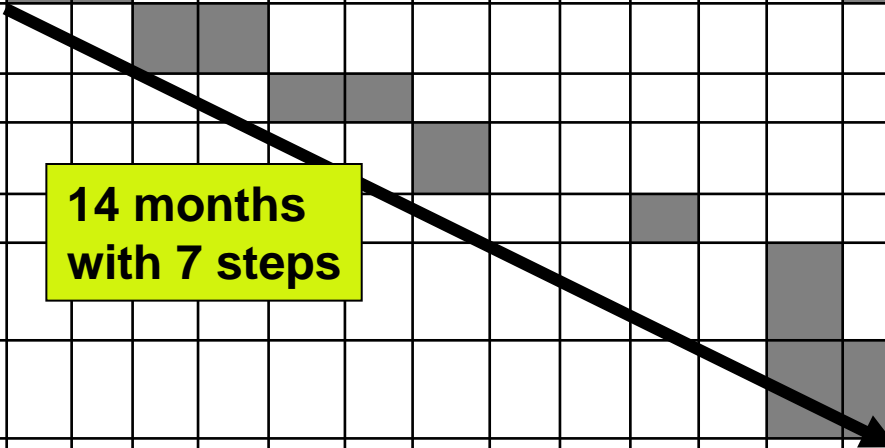
# IRS today

- Complexity of IRS programmes
- Efforts needed
- Major threats: performance problems
- Political and other interferences

# COMPLEXITY: Procurement of insecticides and funds release (National Level, India)

	First Year												Second Year											
Activity	Ja	F n	M e b	A P a r	Ma R	Ju y	Jul n	Au y	Se g .	Oc p t	No t .	De v .	J c	Fe a n	Ma b	A r	M P R	Jun a y	Jul	Au y	Se g .	O p t	N c t .	Dec o v
National level																								
PROCUREMENT OF INSECTICIDE																								
Project Insecticide requirements	█	█											█	█										
Budget allocations			█	█											█	█								
Approval of MOH					█	█											█	█						
Placing order to HIL							█												█					
Start of supply										█												█		
Completion of supply to state												█												█
Distribution to districts and PHCs												█	█											█
Spray 1st Cycle														█	█									
Spray 2nd Cycle																		█	█					
RELEASE OF FUNDS																								
Project requirements																								█
examination through PIP	█	█																						
Approval of BE					█	█																		
Release of 1st								█	█															

**14 months with 7 steps**



# THE EFFORT: Annual costs of IRS

## INDIA:

- 20.4 Million Dollar for IRS (80% of this for insecticide)

DDT per household = 1.6\$

## Dengue vector control, example:

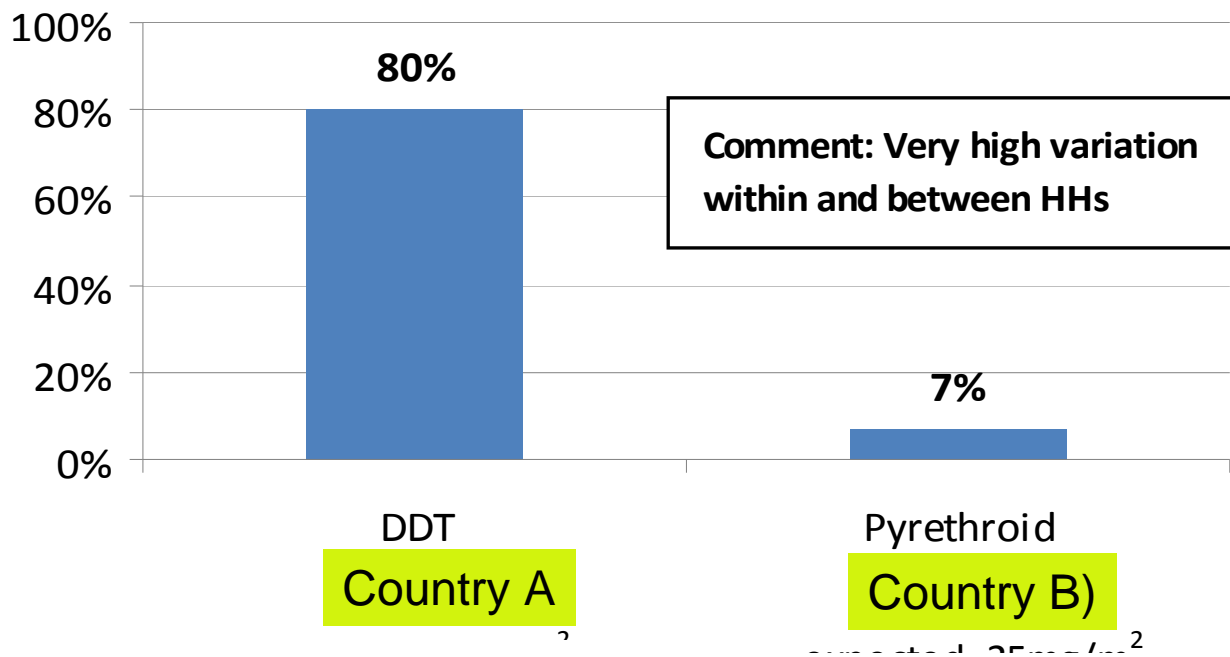
- Malaysia 240.000\$ per 1 Mio. Population
- Thailand 188.000\$ per 1 Mio population
- Singapore 2.400.000\$ per 1 Mio. Population

# RESULTS

Filter paper method to determine insecticide concentration achieved on the wall



INSECTICIDE CONCENTRATION ON THE WALL AS % OF THE EXPECTED VALUE



IRS PERFORMANCE



Regular spray



Irregular spray



Spraying over food



Spraying objects

# PERSONAL PROTECTION

## RESULTS



HAT/FACE SHIELD

MASK

GLOVES

LONG SLEEVED OVERALLS

BOOTS



...more comfortable, but more dangerous

# Observation of IRS at community level

Items	Observation		
	Country A	Country B	Country C
<b>General condition of the pump:</b> i. Leakage ii. Nozzle iii. Pressure gauze	No leakage Good Good	<b>leakage</b> <b>Working</b> Good	<b>Leakage</b> <b>2/19 not working</b> <b>None worked</b>
Method of mixing insecticide	<b>Improper</b>	Proper	<b>Improper in some HH</b>
Shaking of the pump	<b>Not enough</b>	<b>Not enough</b>	<b>Not enough</b>
Distance of nozzle from the surface (45cm from the surface)	<b>Not maintained</b>	Yes	<b>Not maintained</b>
Spray swath	<b>Not uniform</b>	<b>Not uniform</b>	<b>70cm (38-90 cm)</b>
Marking of sprayed house	<b>Incomplete</b>	Yes	<b>No</b>
Use of safety procedures (gloves, coat, eye glasses, boots, caps, masks etc.)	<b>No</b>	<b>No</b>	<b>No</b>

# POLITICAL & MANAGERIAL & CLIMATIC INTERFERENCE IN IRS

Sorry...

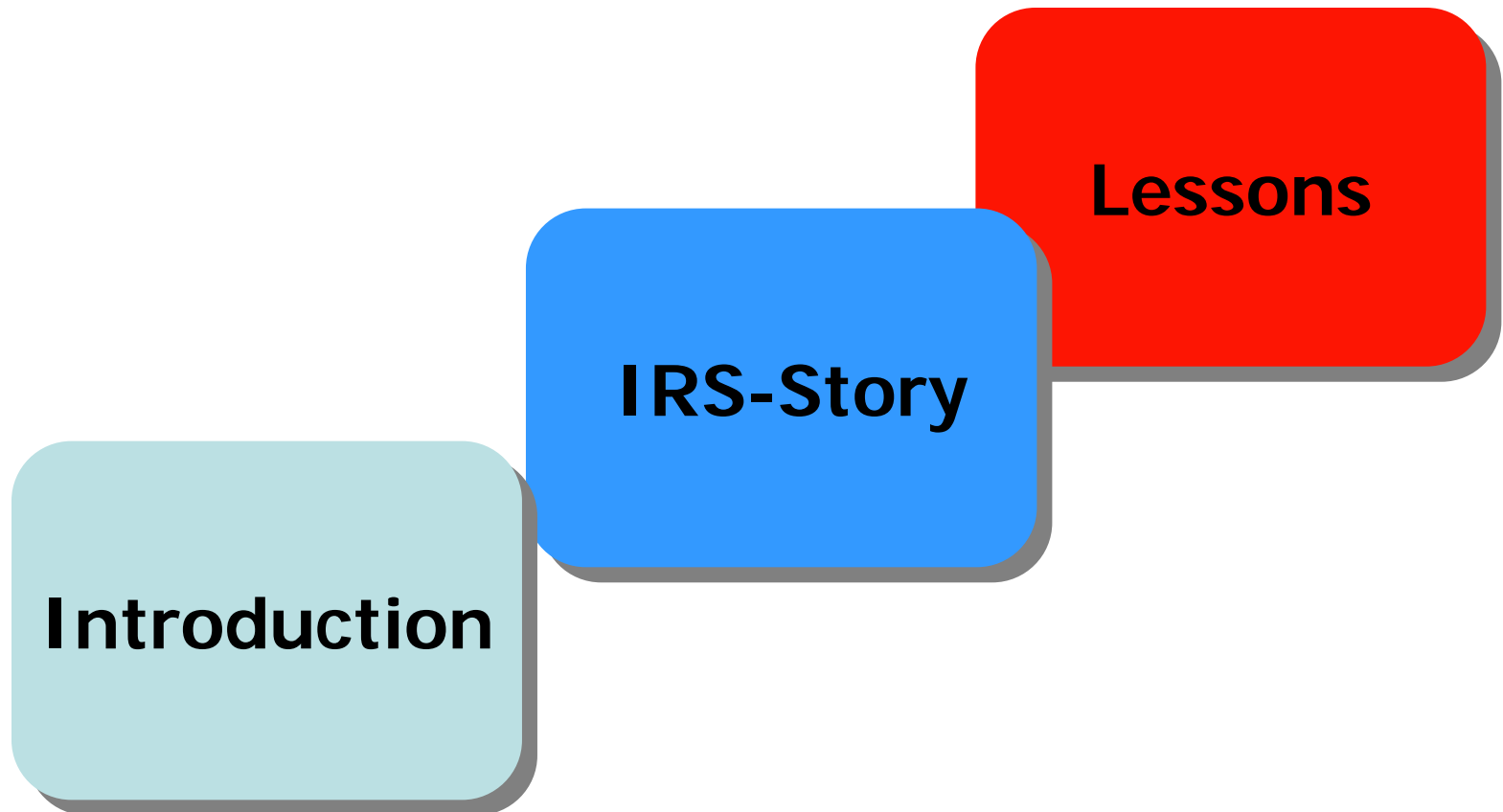
- ...we could not start because of the elections
- ... we could not start because of late approval of budget
- ...we could not finish because the monsoon came early
- ...we could not complete because we ran out of insecticide
- ...we could not continue because of industrial action
- ...we could not train sprayers because of the large number

Etc.....

# Lessons learned for IRS

- Staff training and performance monitoring are crucial for the success *(lessons from Fred Soper)*
- Political and managerial bottle necks are a "natural" part of IRS programmes and have to be dealt with *(not accepted by Fred Soper)*
- Combination with other vector control methods are unavoidable *(not yet understood by Fred Soper)*

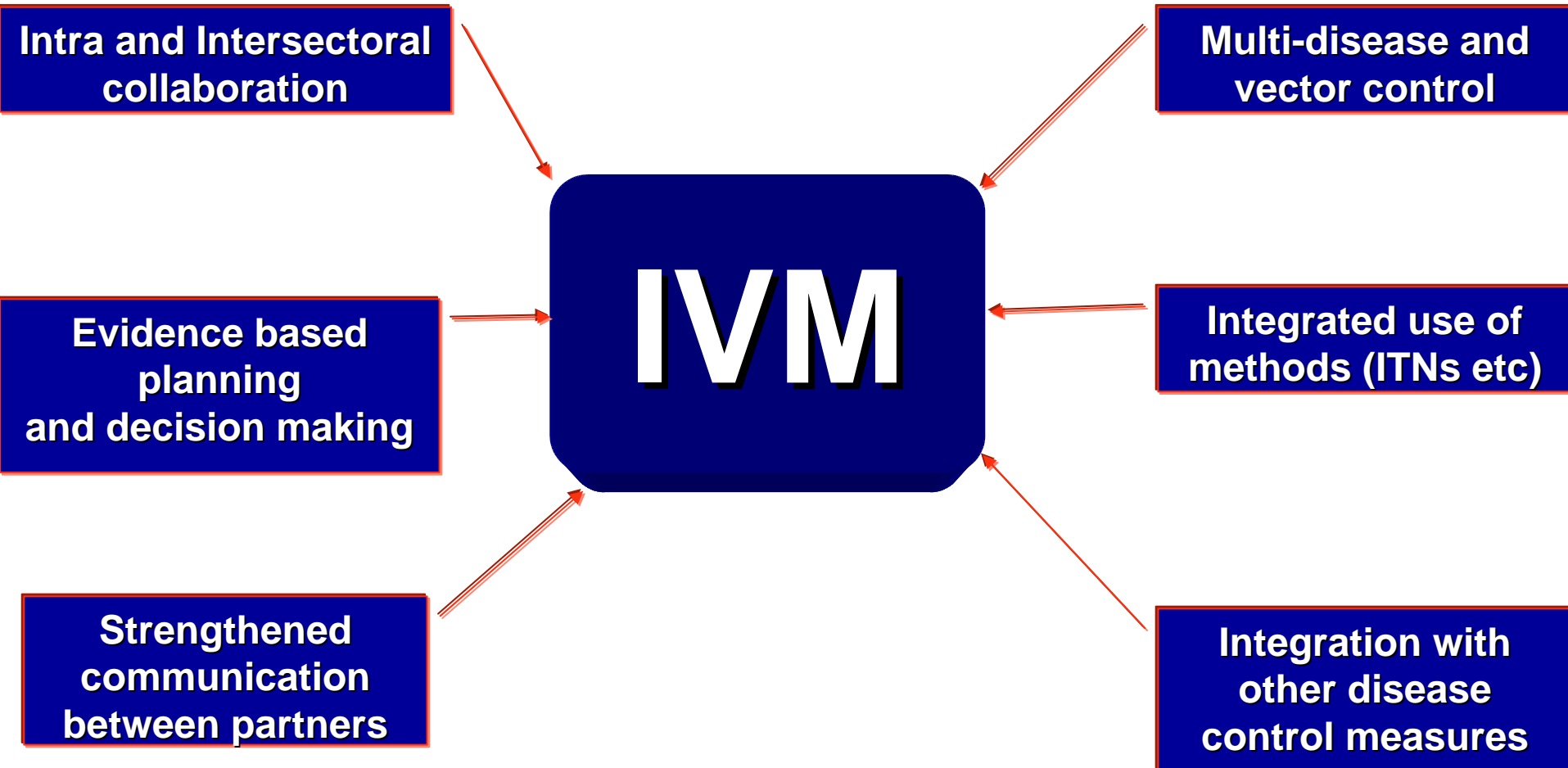
# LESSONS LEARNED- LESSONS IGNORED



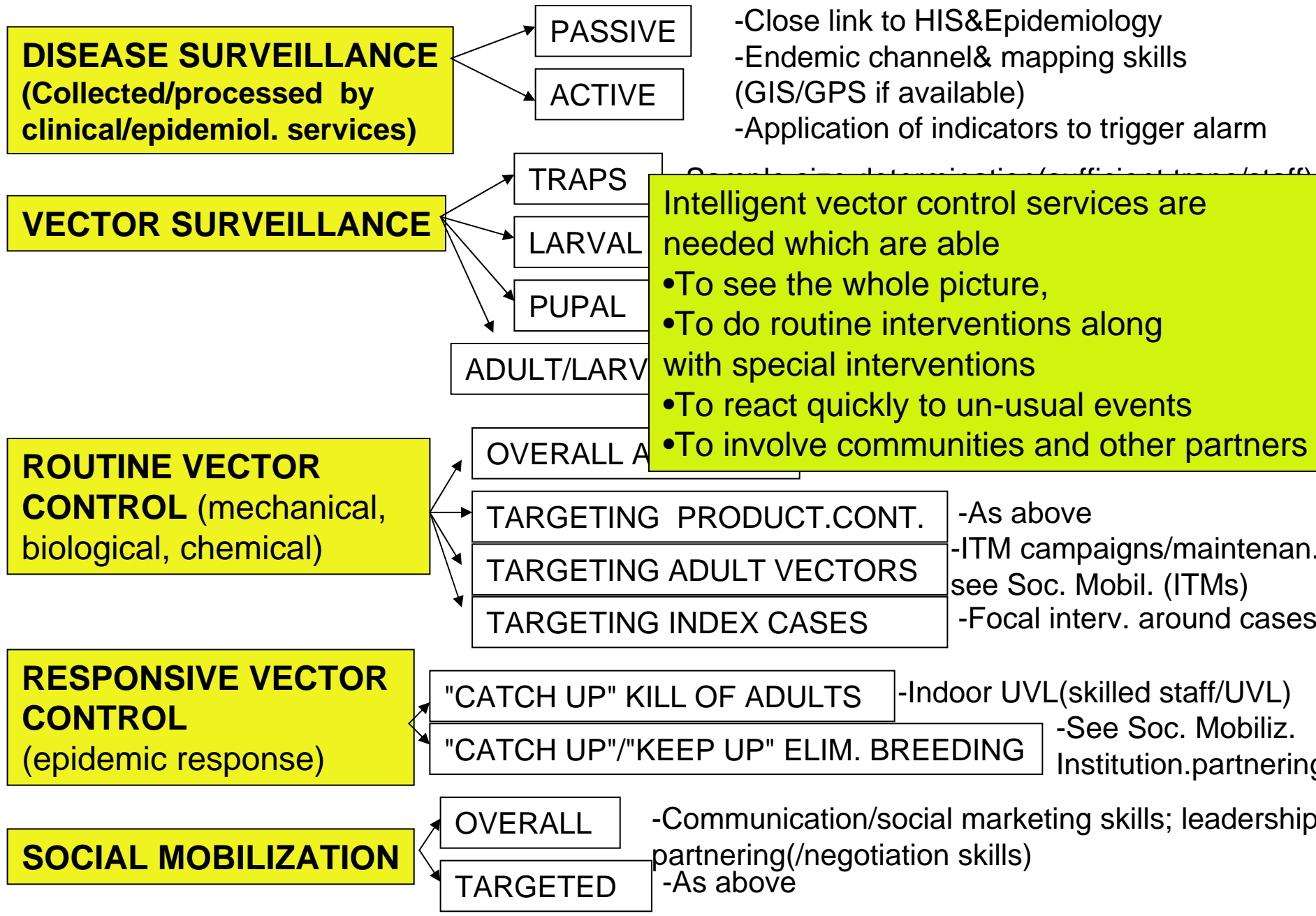
# (C) LESSONS OF WHAT IS NEEDED

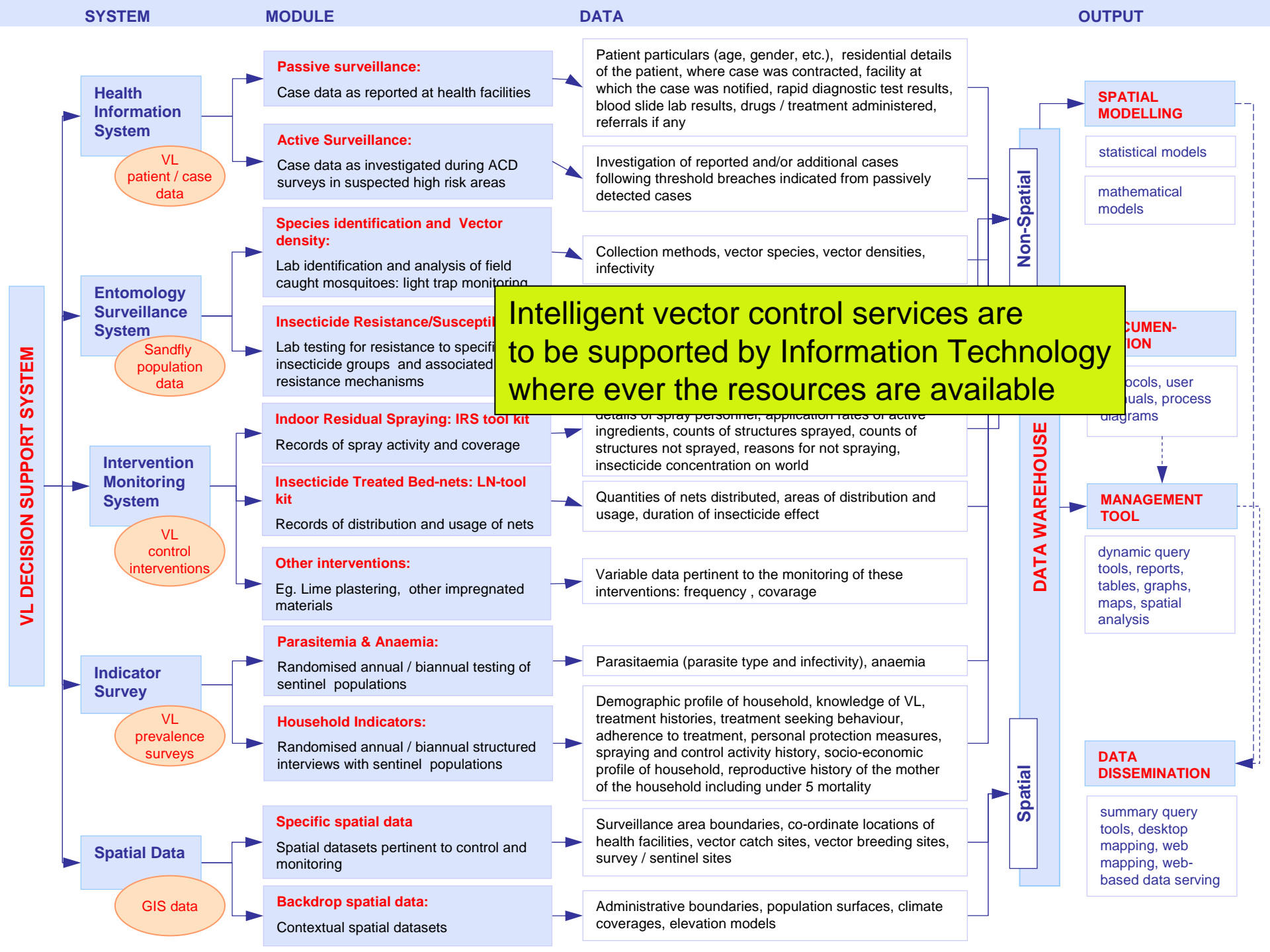
- IVM strategy
- "Intelligent" control services
- Comprehensive view of vector ecology
- Environmental Management (EVM)
- Involvement of communities and other partners

# INTEGRATED VECTOR MANAGEMENT

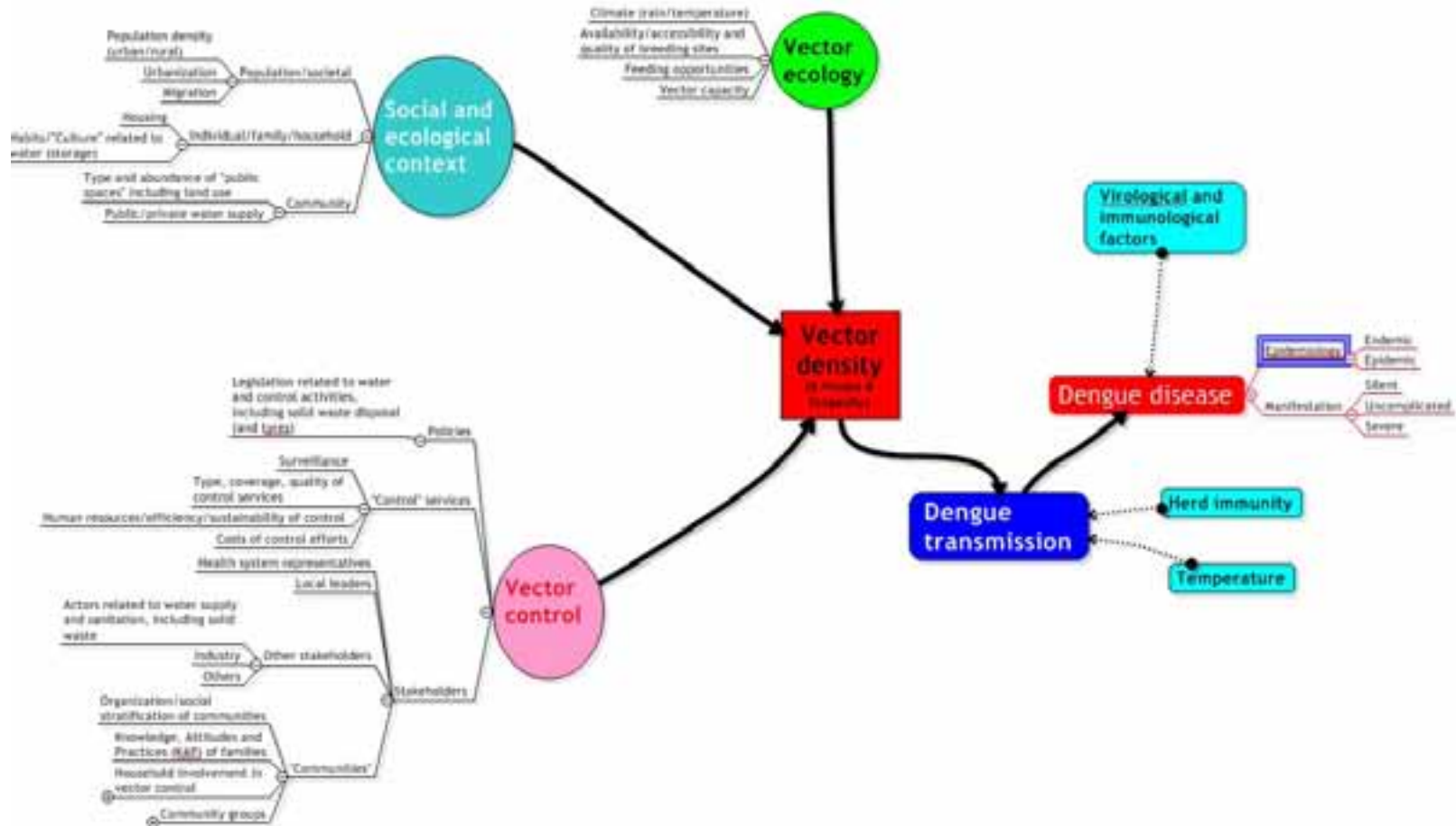


# VECTOR CONTROL SERVICES: SKILLS/ KNOWLEDGE/ TOOLS NEEDED





# Understanding & responding to the complexity of vector dynamics: The dengue example



# Understanding vector ecology : Landscape mapping and eco-tope characterisation





KENYA



PERU



MEXICO



MYANMAR

**SELECTIVE VECTOR CONTROL targeting productive containers**



THAILAND



VENEZUELA



PHILIPPINES



VIETNAM

**Mechanical control of dengue vectors: labour intensive; potential for community involvement**



**Environmental management:  
Cotton Net Sweeper in Myanmar**

Vector Breeding Site



Lime Plastering of Walls: Difficult logistics



**Environmental management of VL Vectors (sand flies): lime plastering**



Lime Plastering of Walls: Difficult to maintain



# Understanding attitudes towards vector management

Focus group discussion with female members:



- **What are peoples` perceptions of the problem?**
- **What would they be willing and able to contribute?**
- **Who else should be involved?**

# COMMUNITY INVOLVEMENT



Cooperative for malaria control



Putting containers upside down (dengue)



Support of Control staff



Environmental management

# COMBINING ITN WITH IRS

## Example Bangladesh:

- Management: Central community dipping point
- Dipping carried out by community volunteers and HH members
- 98% Coverage achieved

Dipping in slow release insecticides



# Summary of forgotten lessons

- Combine control tools & develop sustainable strategies
- Amalgamate Fred Soper`s discipline with a flexible community directed approach
- Recognize potentials and limitations of community involvement
- Realize the programmatic difference between "attack phase" and "maintenance phase"
- Accept programme failures as lessons which have to be learned

# Working together- achieving together

