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Planthoppers Threatening Rice in Asia Again

WHY??

K.L. Heong

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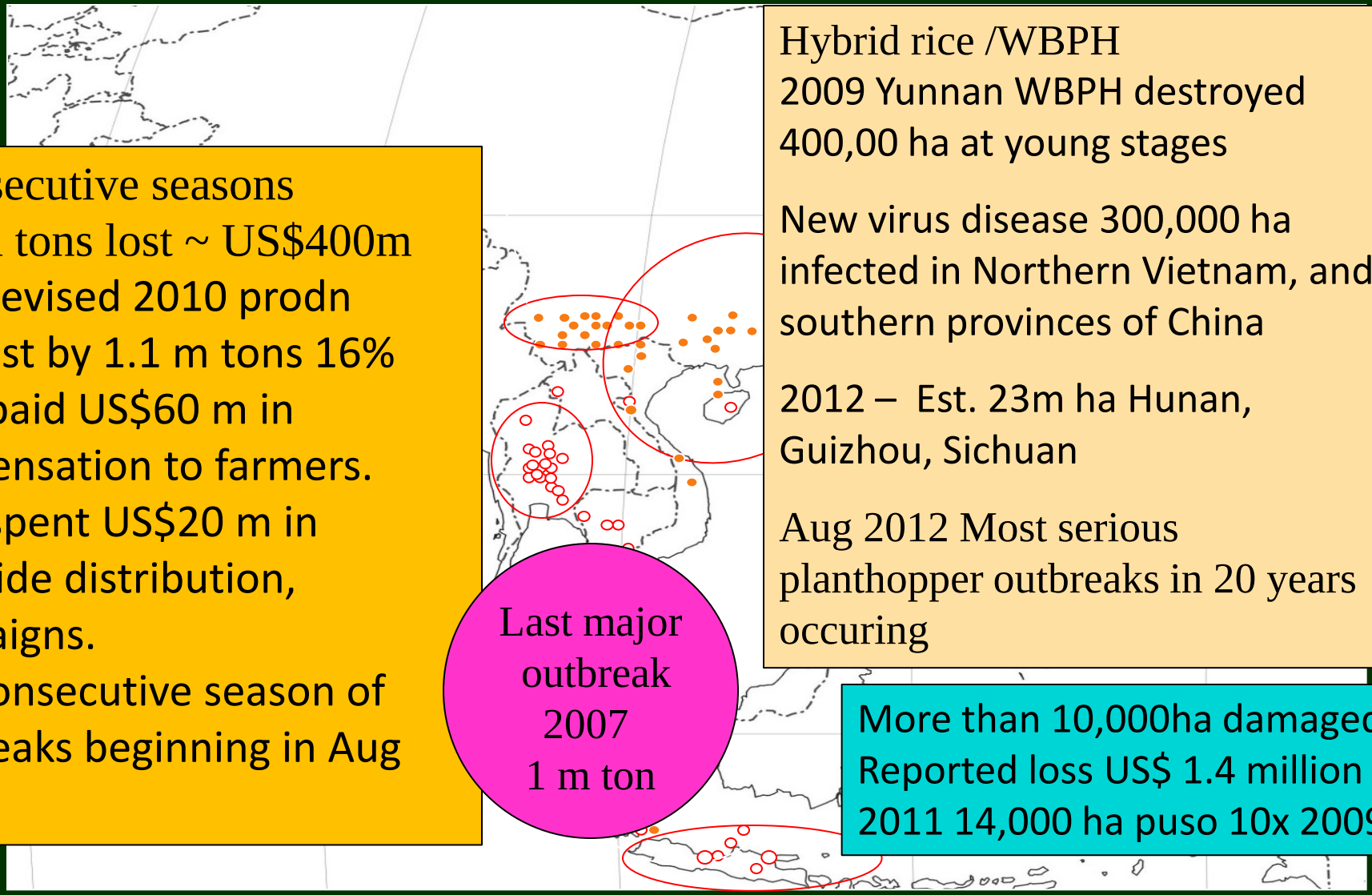
Hopperburn occur in patches with ecosystem services disrupted

Planthopper outbreaks in Asia in 2009/12



9 consecutive seasons
~1.5m tons lost ~ US$400m
Govt revised 2010 prodn forecast by 1.1 m tons 16%
Govt paid US$60 m in compensation to farmers.
Govt spent US$20 m in pesticide distribution, campaigns.
10th consecutive season of outbreaks beginning in Aug 2012

Last major outbreak 2007
1 m ton

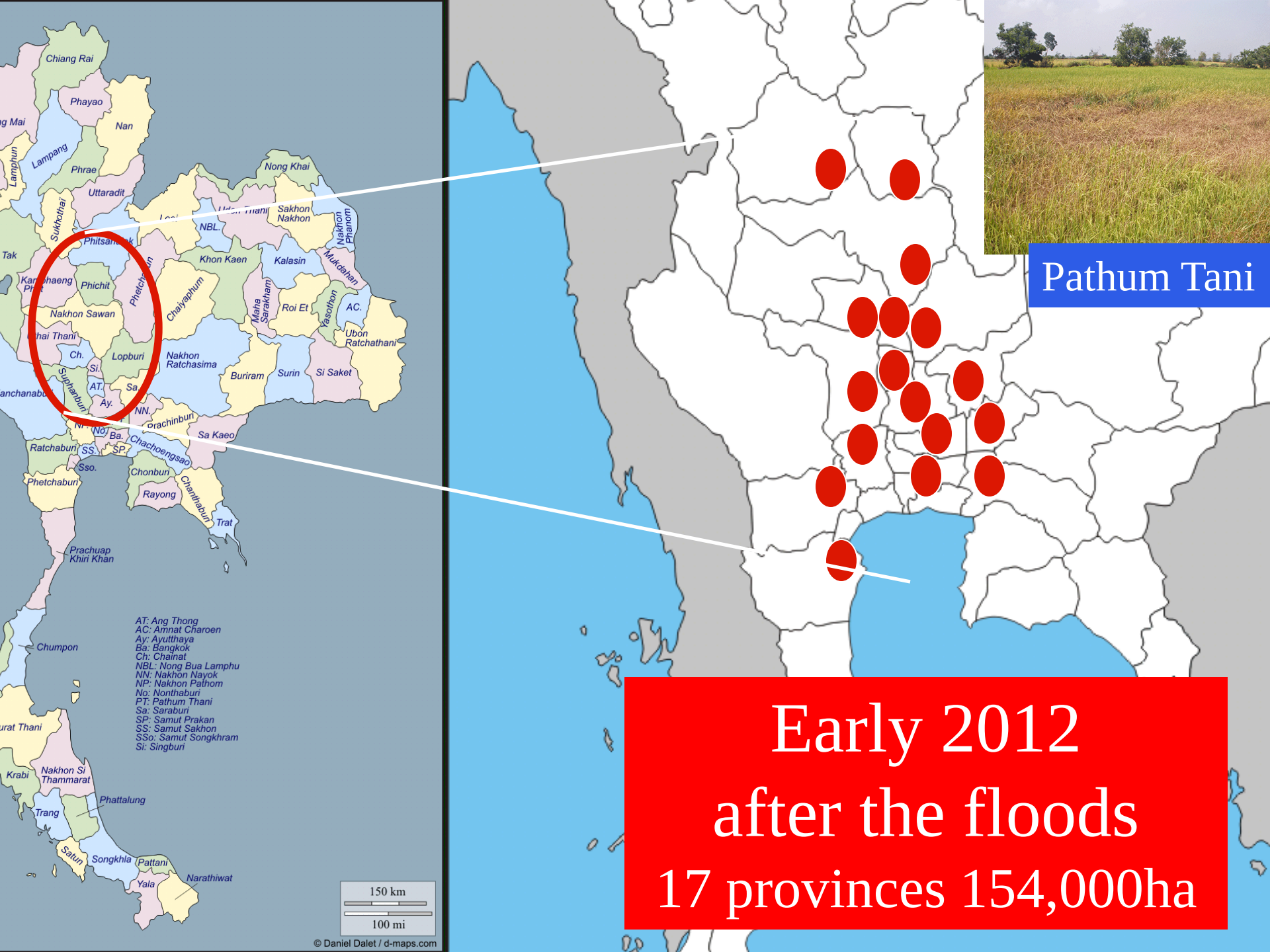
Hybrid rice /WBPH
2009 Yunnan WBPH destroyed 400,00 ha at young stages

New virus disease 300,000 ha infected in Northern Vietnam, and southern provinces of China

2012 – Est. 23m ha Hunan, Guizhou, Sichuan

Aug 2012 Most serious planthopper outbreaks in 20 years occuring

More than 10,000ha damaged
Reported loss US$ 1.4 million
2011 14,000 ha puso 10x 2009


Pathum Tani
Early 2012
after the floods
17 provinces 154,000ha
Chiang Rai
Phayao
Nan
Lampang
Phrae
Uttaradit
Sukhothai
Nong Khai
Sakhon Nakhon
Nakhon Phanom
NBL.
Phitsanulok
Khon Kaen
Kalasin
Mukdahan
Phichit
Phetchabun
Chaiyaphum
Maha Sarakham
Roi Et
Yasothon
AC.
Ubon Ratchathani
Nakhon Sawan
Lopburi
Nakhon Ratchasima
Buriram
Surin
Si Saket
Ch.
Si.
AT.
Sa.
Ay.
NN.
Suphanburi
Prachinburi
Sa Kaeo
Ba.
Chachoengsao
Ratchaburi
SS.
SP.
Sso.
Chonburi
Rayong
Chanthaburi
Trat
Phetchaburi
Prachuap Khiri Khan
Chumpon
Nakhon Si Thammarat
Krabi
Phattalung
Trang
Satun
Songkhla
Pattani
Yala
Narathiwat
AT: Ang Thong
AC: Amnat Charoen
Ay: Ayutthaya
Ba: Bangkok
Ch: Chainat
NBL: Nong Bua Lamphu
NN: Nakhon Nayok
NP: Nakhon Pathom
No: Nonthaburi
PT: Pathum Thani
Sa: Saraburi
SP: Samut Prakan
SS: Samut Sakhon
SSo: Samut Songkhram
Si: Singburi
150 km
100 mi
© Daniel Dalet / d-maps.com

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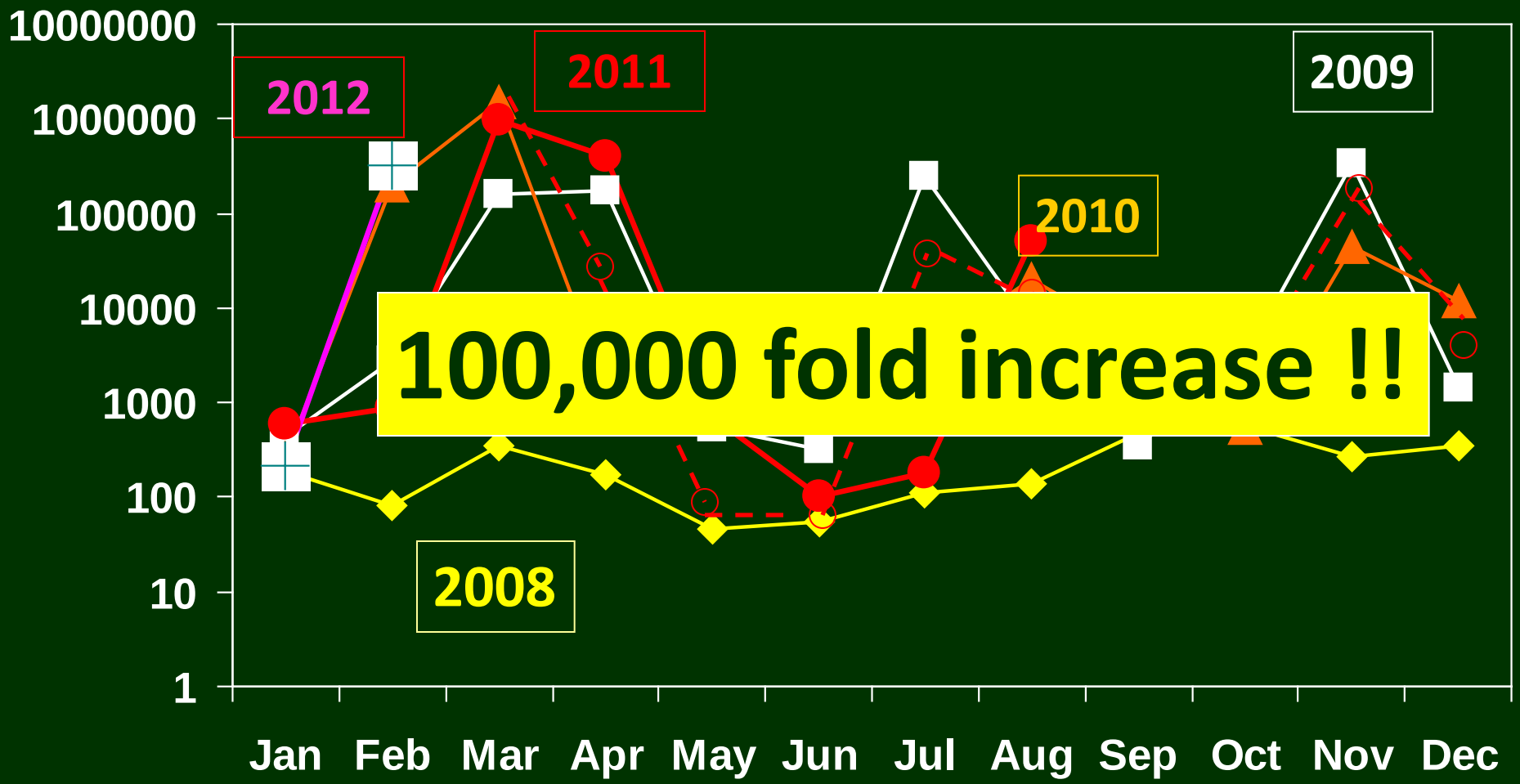
Light trap records in Chai Nat Thailand



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Pest storms in

Thailand

China

Indonesia

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Brown Planthopper (BPH)

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Virus diseases

Grassy stunt

Ragged stunt

Cabauatan et al 2008

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White backed planthopper (WBPH)

New virus carried by WBPH

- Discovered in Guangdong in 2001.
- Transmitted by WBPH
- Southern Rice Black Streak Dwarf virus (SRBSDV) because of its similarity with the RBSDV carried by sBPH in temperate areas.
- Spreading in southern provinces of China, Northern Vietnam areas.

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In Hunan
August 2012

Photos
Juka Kawaai

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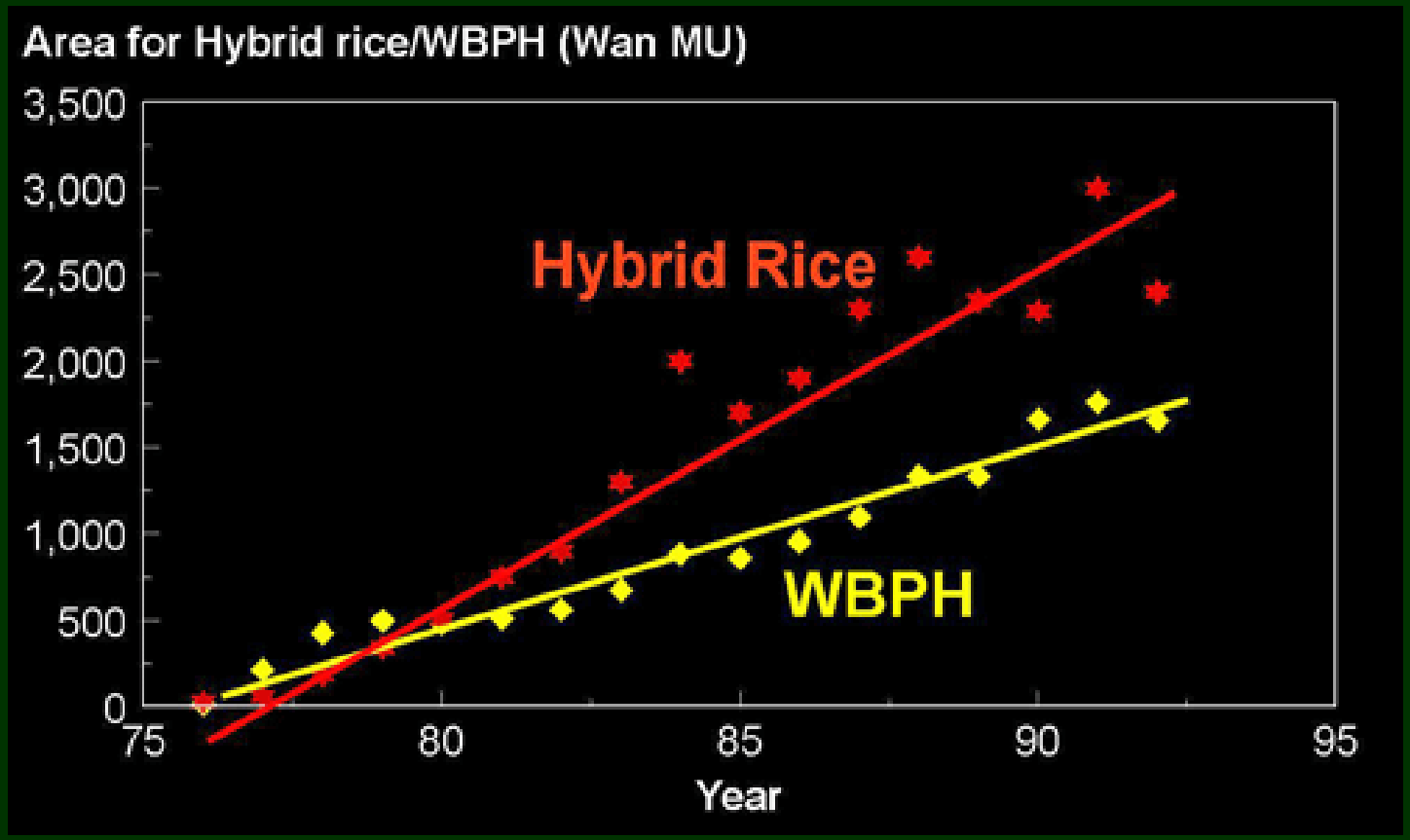
Hybrid rice and WBPH



J A Cheng

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WHY

??

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Three Ecological Principles

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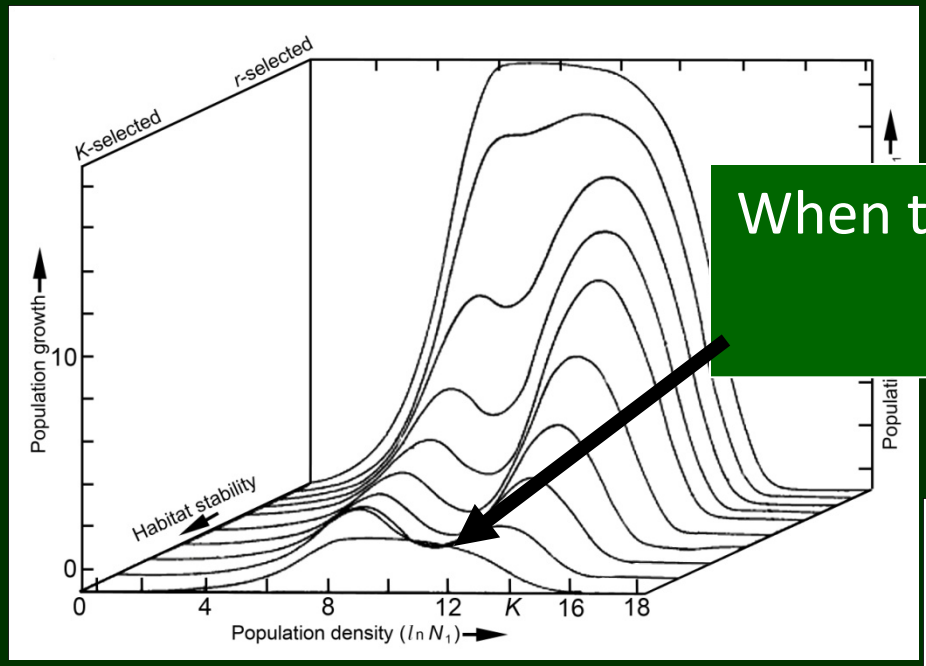
Three Principles

1. Pests' life strategies
2. Biodiversity and ecosystem services
3. Food web structure & food chain length

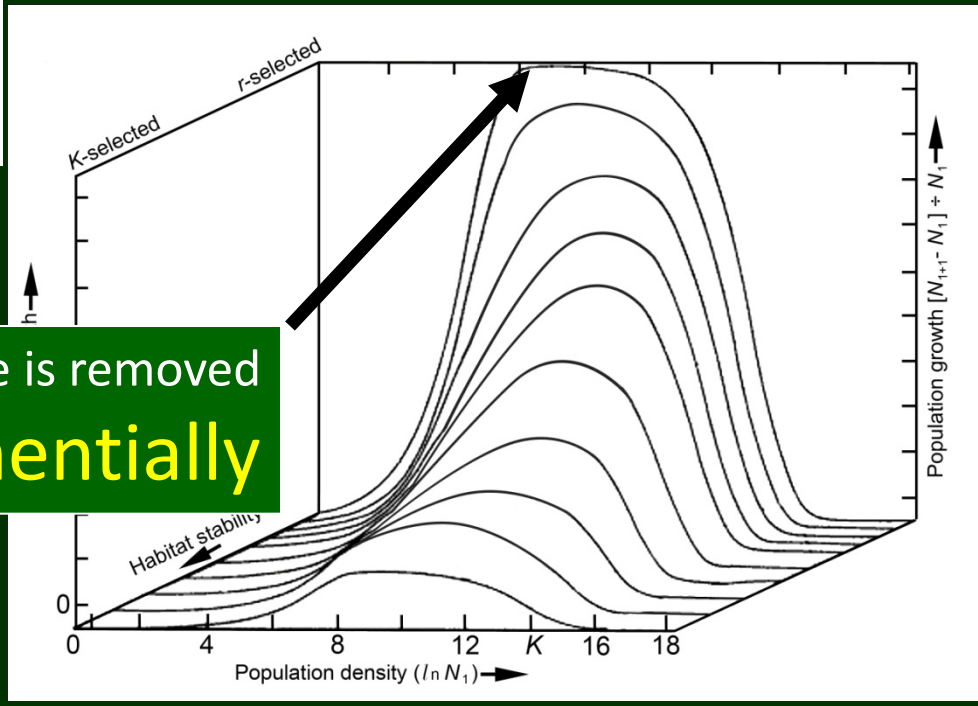
How insecticide sprays affect these principles

r strategists tend to develop exponentially when they "escape" from natural control



When the natural enemy ravine is in place

Populations low



When the natural enemy ravine is removed

Population develop exponentially

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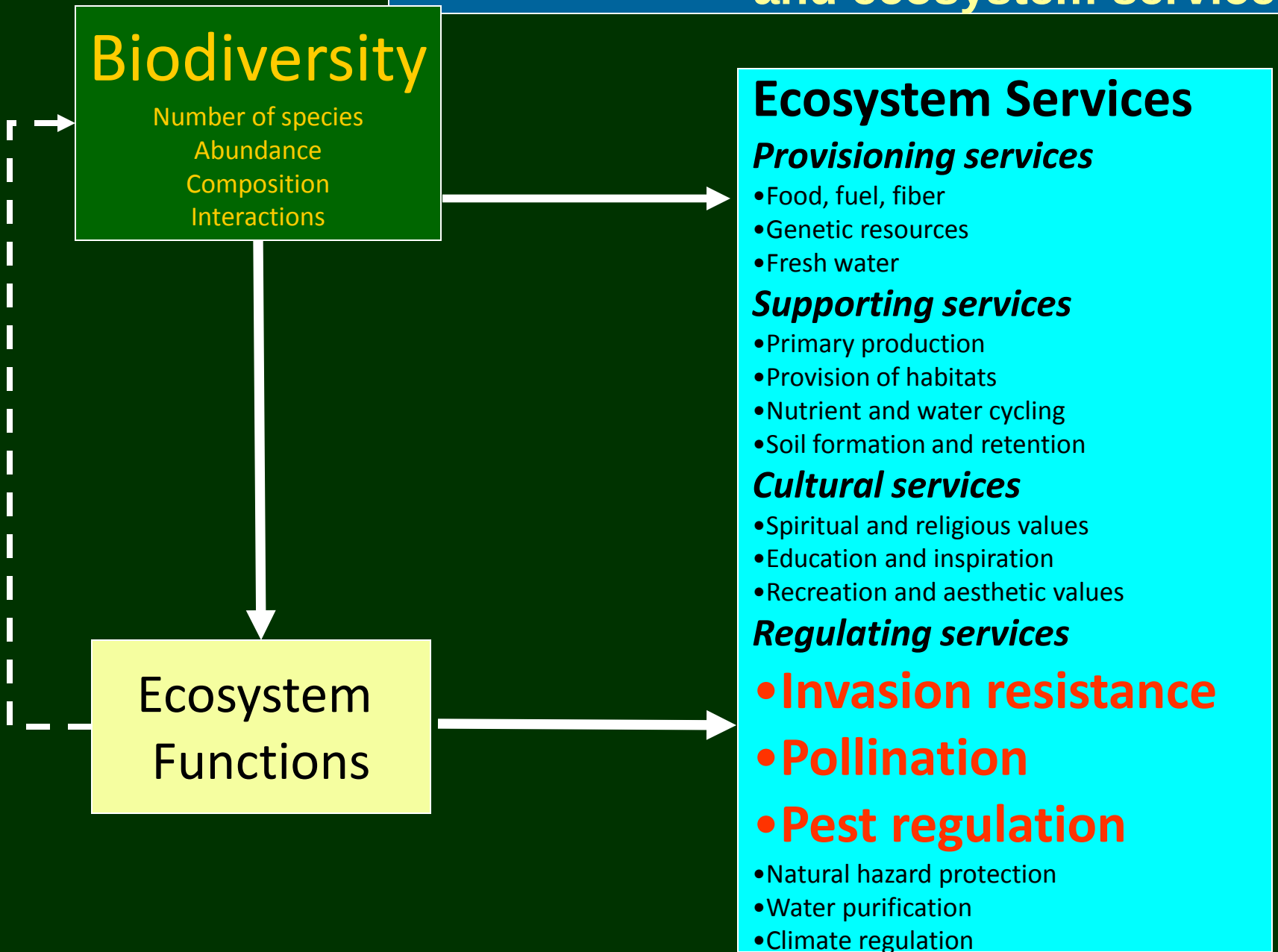
Biodiversity, ecosystem functioning, and ecosystem services



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Biodiversity, ecosystem functioning, and ecosystem services

Biodiversity

Number of species
Abundance
Composition
Interactions

Ecosystem Functions

Ecosystem Services

Provisioning services

- Food, fuel, fiber
- Genetic resources
- Fresh water

Supporting services

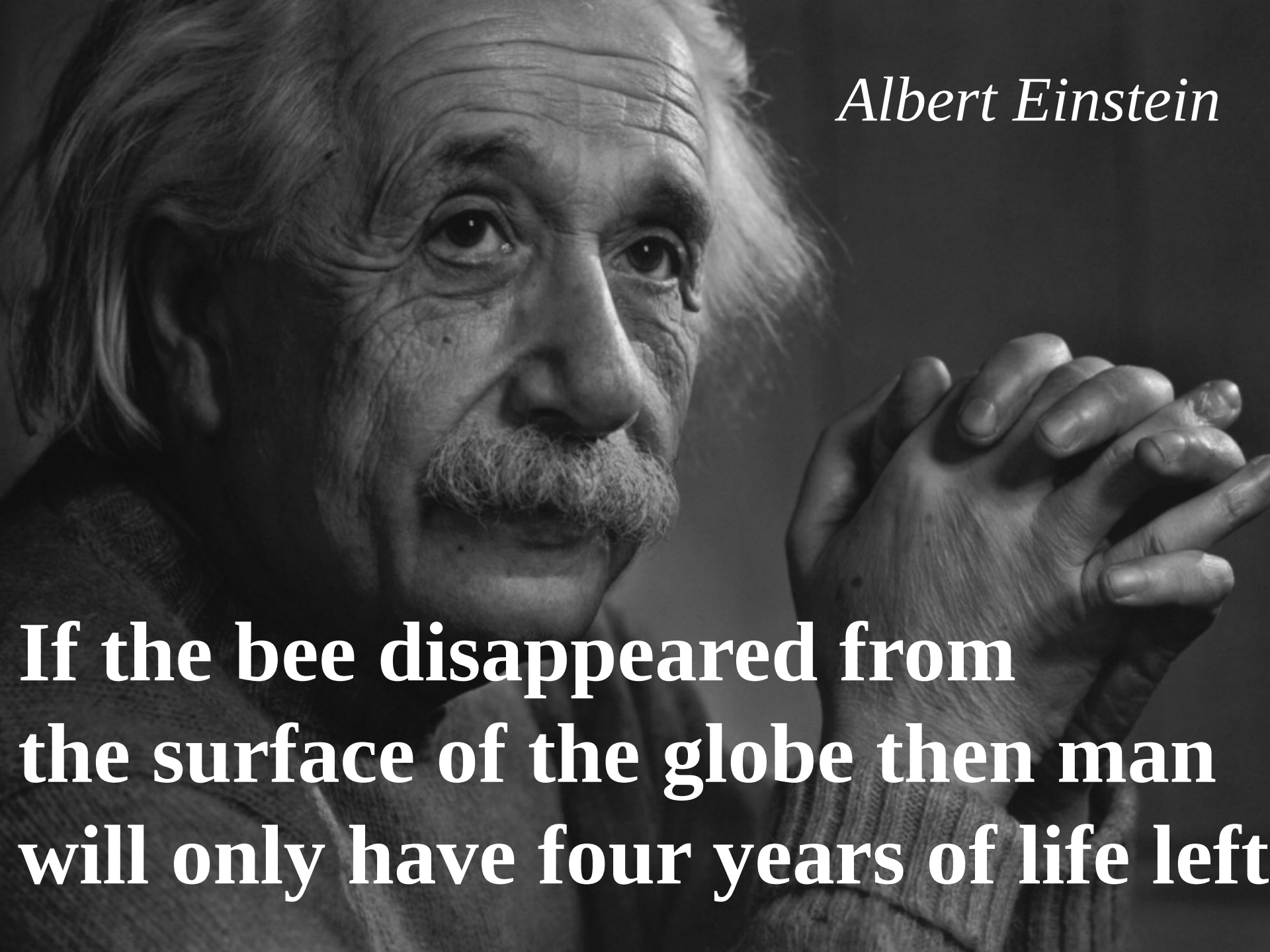
- Primary production
- Provision of habitats
- Nutrient and water cycling
- Soil formation and retention

Cultural services

Regulating services

- **Invasion resistance**
- **Pollination**
- **Pest and disease regulation**

- Natural hazard protection
- Water purification


Albert Einstein
If the bee disappeared from the surface of the globe then man will only have four years of life left

27 March 2013 Last updated at 16:05 GMT

Neonicotinoid pesticides 'damage brains of bees'

By Rebecca Morelle
Science reporter, BBC World Service

Commonly used pesticides are damaging honey bee brains, studies suggest.

Scientists have found that two types of chemicals called neonicotinoids and coumaphos are interfering with the insect's ability to learn and remember.

Experiments revealed that exposure was also lowering brain activity, especially when the two

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No bees = pollination by humans in China

29 April 2013 Last updated at 14:15 GMT

Bee deaths: EU to ban neonicotinoid pesticides

COMMENTS (872)

The European Commission will restrict the use of pesticides linked to bee deaths by researchers, despite a split among EU states on the issue.

Honeybees are vital for pollinating crops - a job that would be very costly without them

There is great concern across Europe about the collapse of bee populations.

Neonicotinoid chemicals in pesticides are believed to harm bees and the European Commission says they should be restricted to

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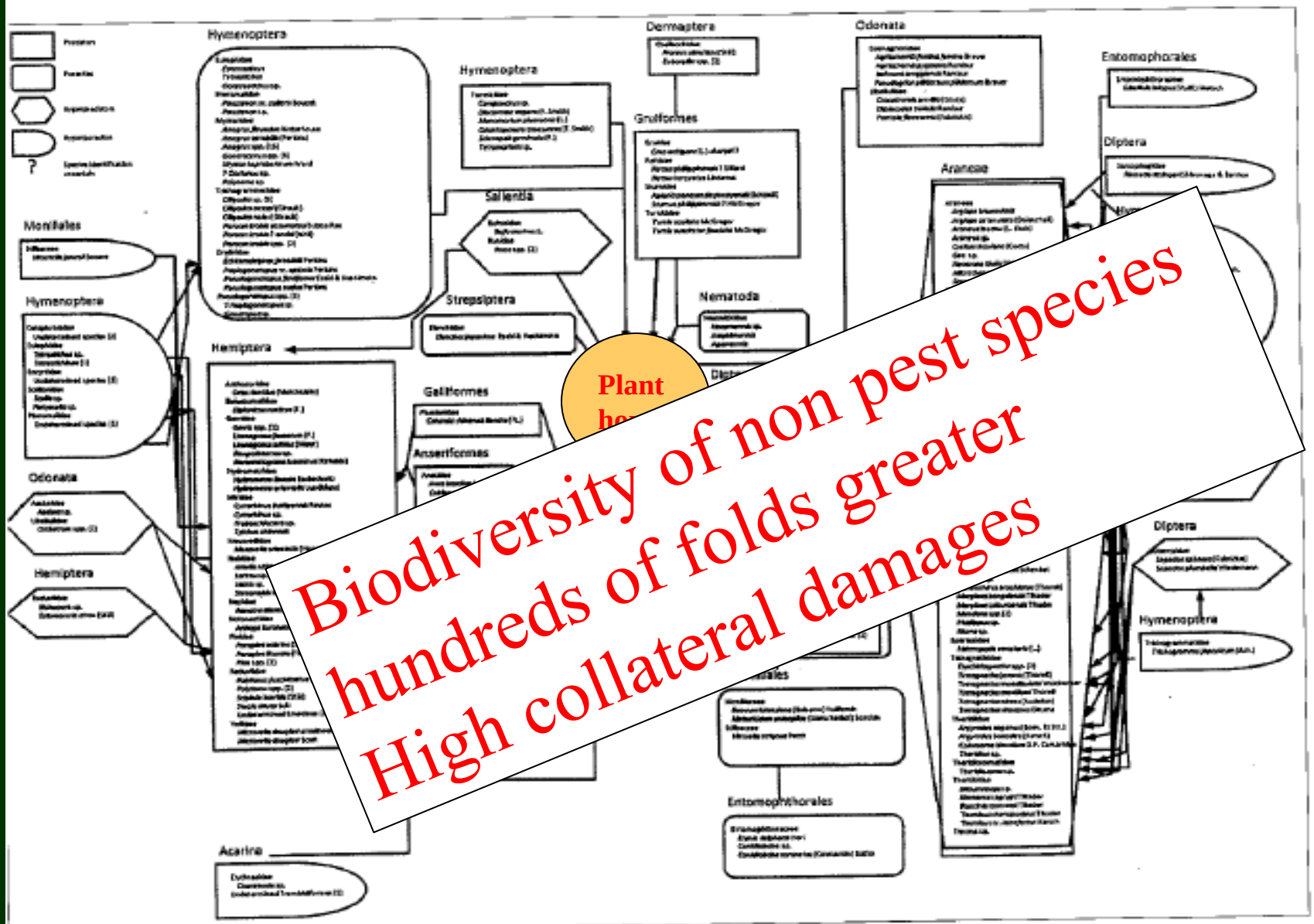
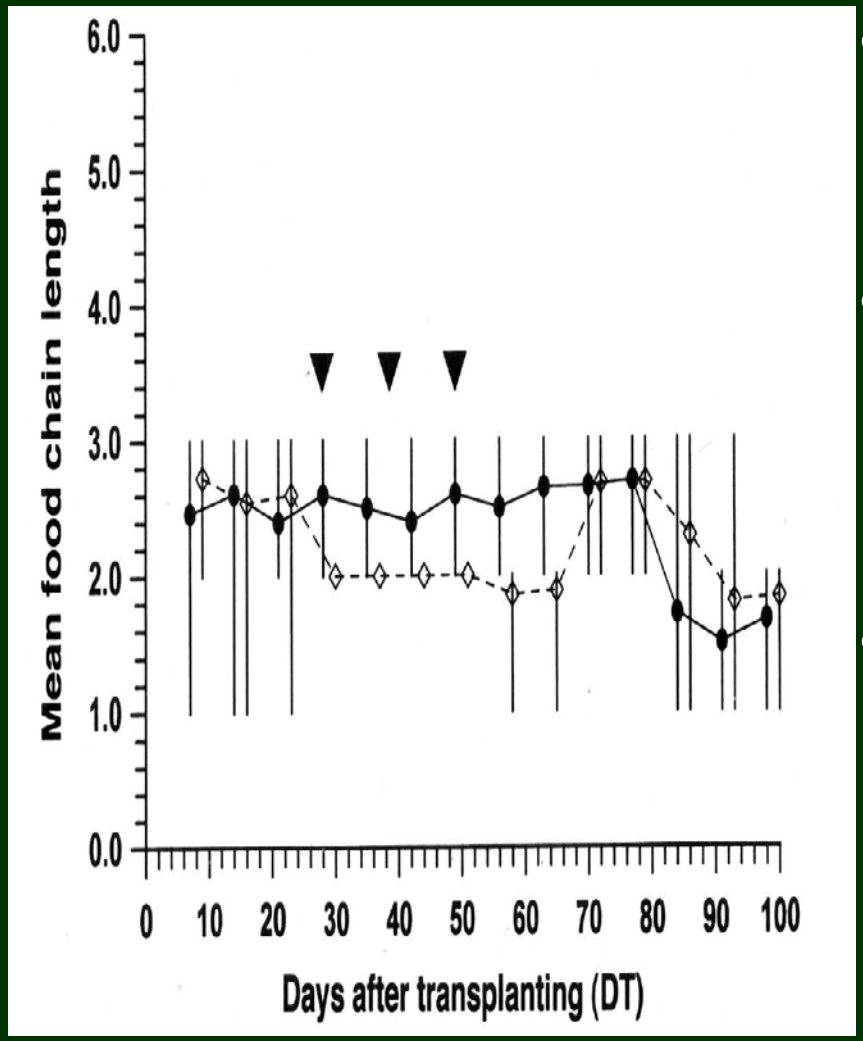
Neonicotinoid Insecticides May be Dumped in Asia if Banned in EU, U.S.

Planthoppers' food web

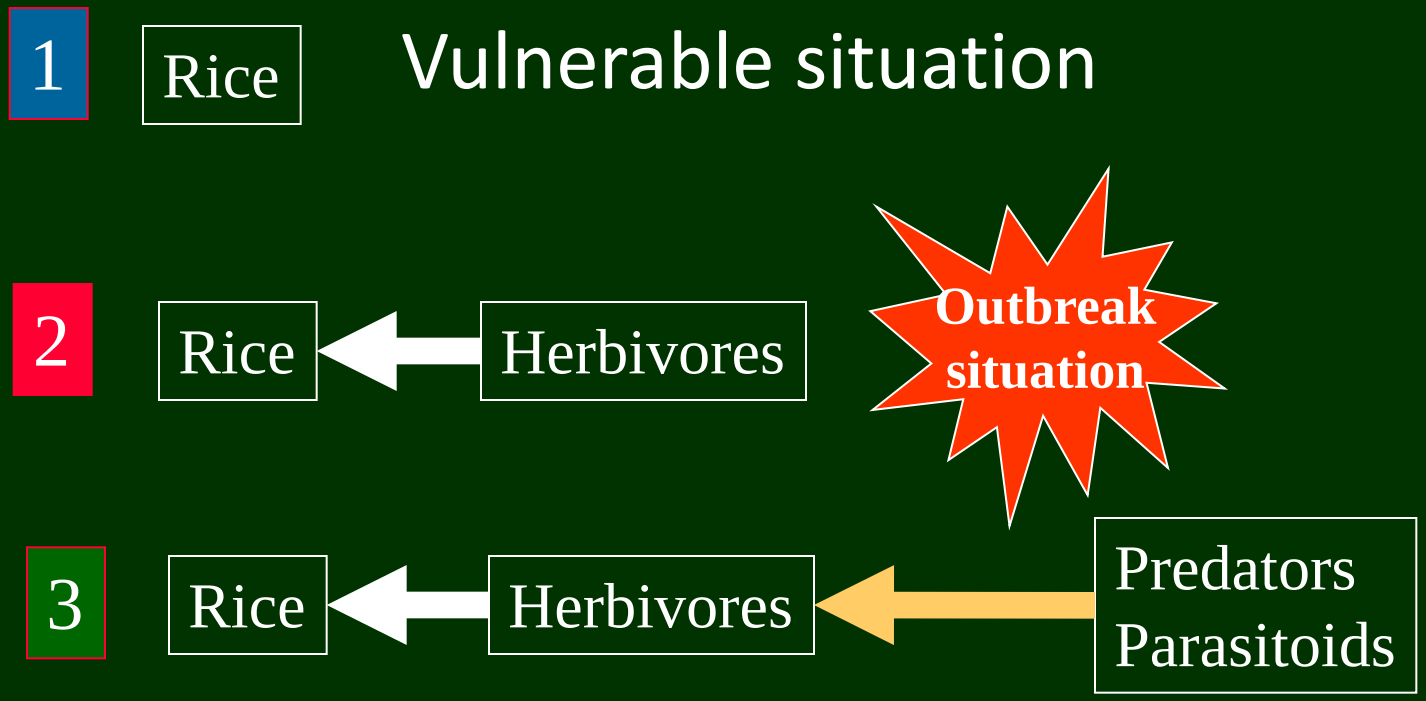


Mean food chain lengths reduced



- Sprays reduced chain lengths significantly from 3 to about 2.
- Estimated time for food web to recover was 22 days after the last spray.
- Sprays bring about asynchrony in predator-prey relationships.

Food chain


1
Rice
Vulnerable situation
2
Rice
Herbivores
Outbreak situation
3
Rice
Herbivores
Predators
Parasitoids
Preferred situation

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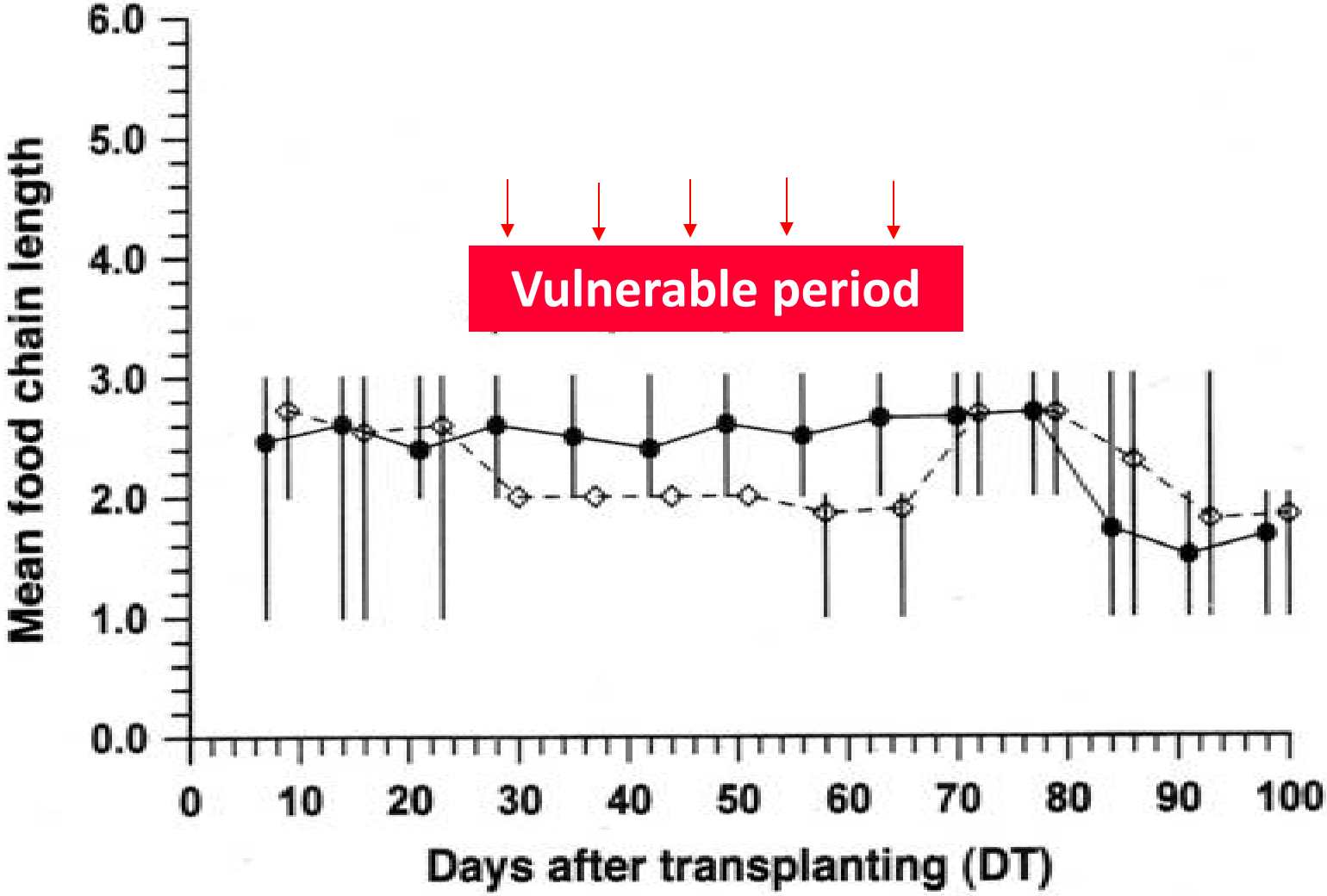
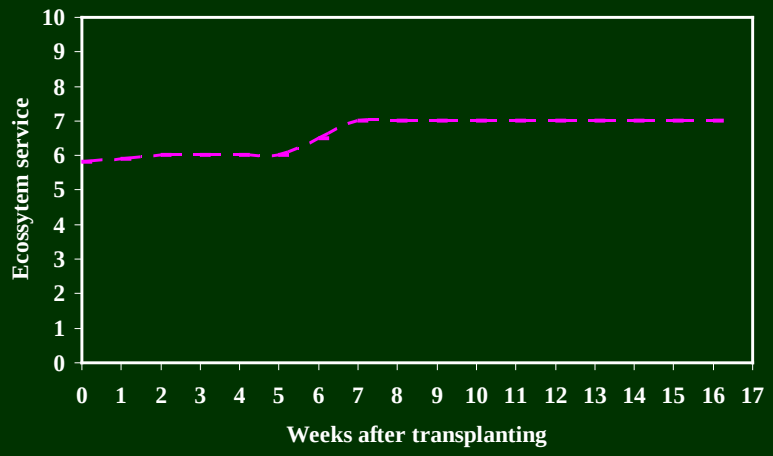
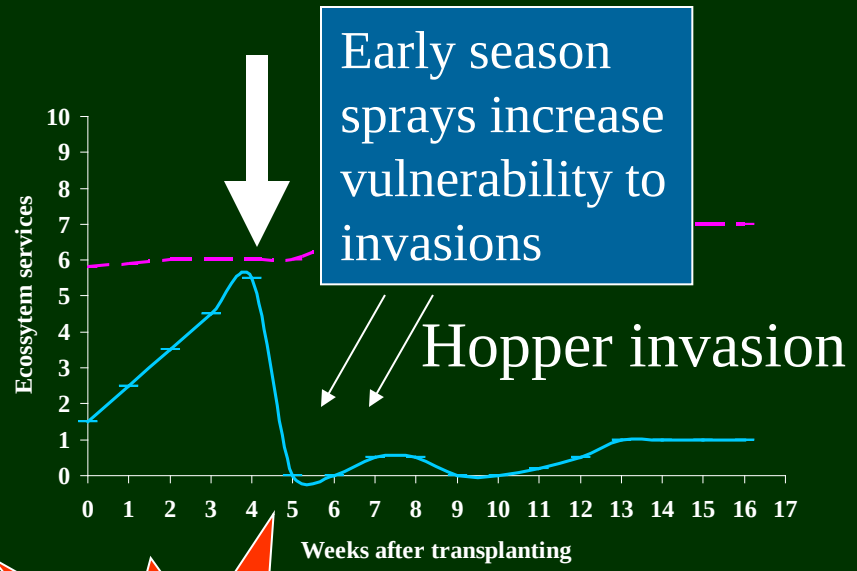
Early insecticide sprays create vulnerability

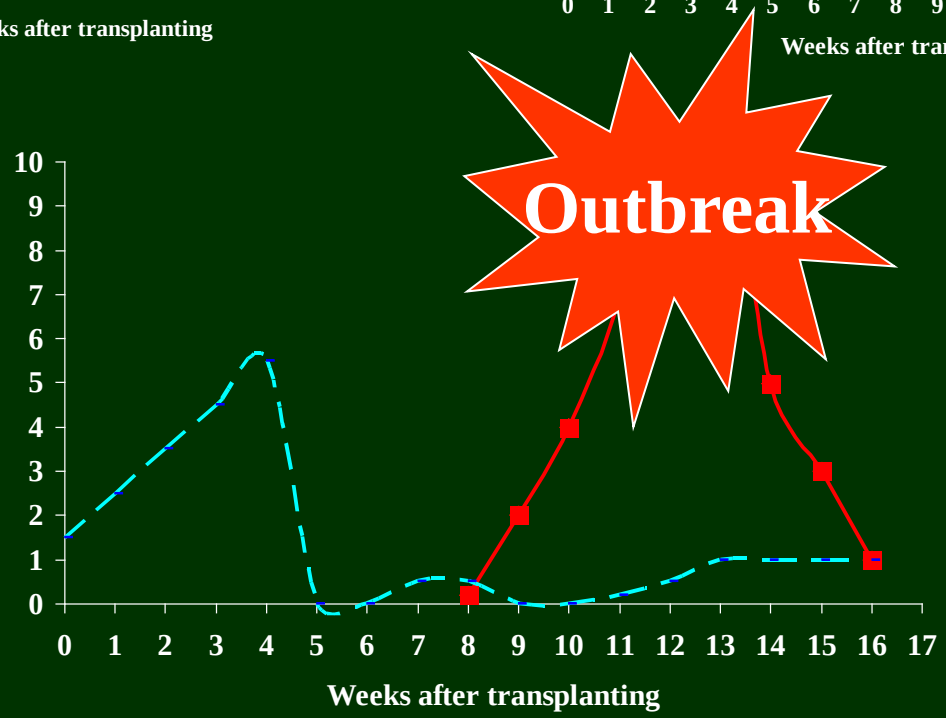


Effect of early season sprays on ecosystem services

Ecosystem services







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Why do planthopper outbreaks continue to threaten rice production in Asia?

Vulnerability factors

- ***Low biodiversity in parasitoids and predators***
  - **Lack habitat and food resources for natural enemies. Bunds sprayed with herbicides.**
  - **High insecticide pressure – farmers often apply 3 to 10 prophylactic sprays.**
  - **High use of insecticides toxic to parasitoids and predators.**
  - **Poor equipment used – low efficacy to pests, high efficacy to non targets esp. aquatic fauna.**
  - **High use of cocktails that broaden the “kill” spectrum.**
  - **Prophylactic spray (pre emptive strikes); mixed with herbicide sprays.**

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Early season blanket spraying

Note
Spraying in early crop stages
Spraying on top of the canopy
Use equipment with poor delivery

Hopperburn along spray paths – Suphan Buri, Thailand

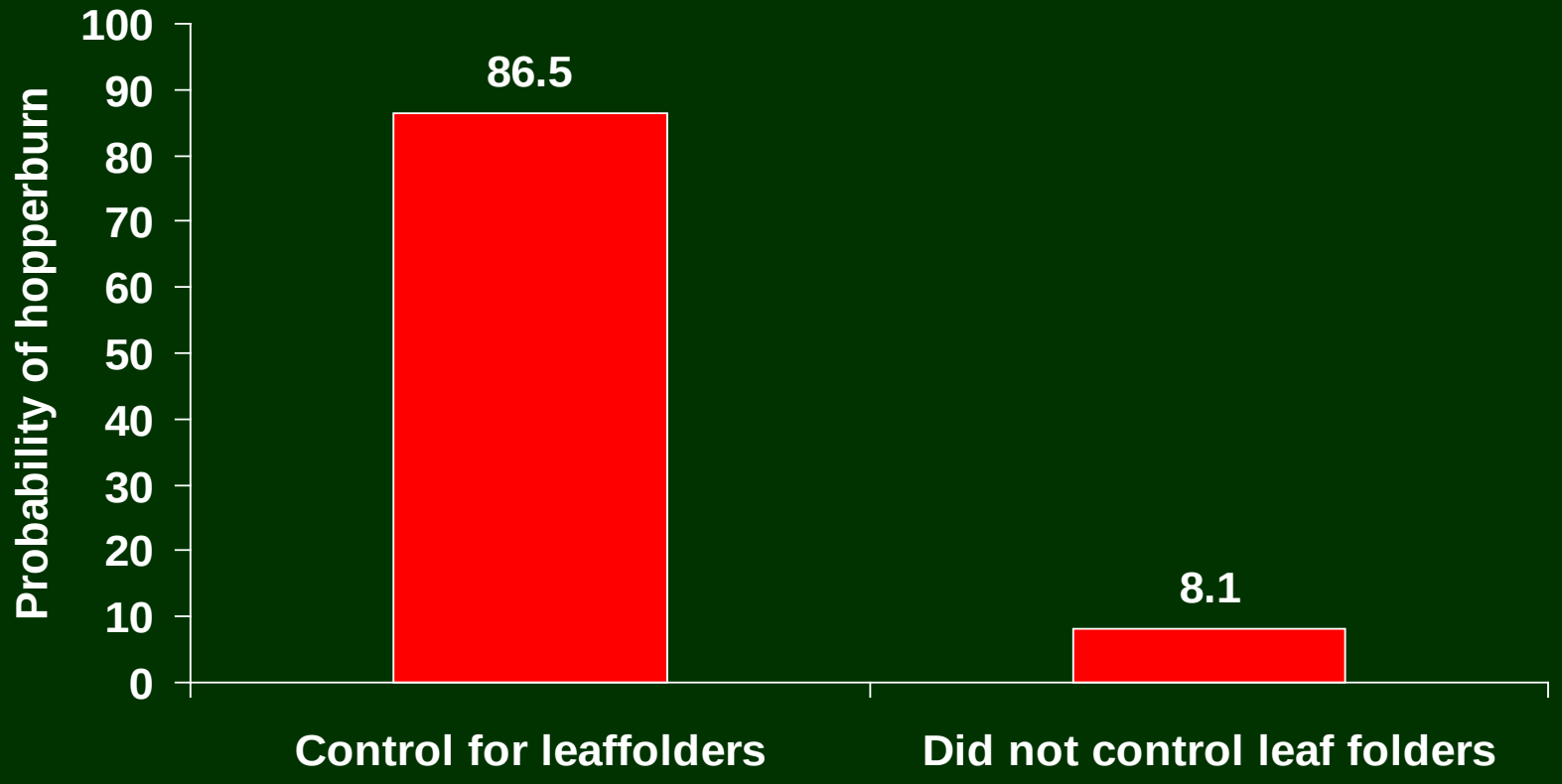
Hopperburn in sprayed spots in Cantho province

Pictures by Pham van Quynh

Hopperburn occur in parallel rows of the sprayer booms

Malaysia

Leaf folder control in early crop stages increases vulnerability to hopperburn by 10 folds



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Insecticide sprays have no effect on hopper – Only few specialist species for egg mortality

Youtube

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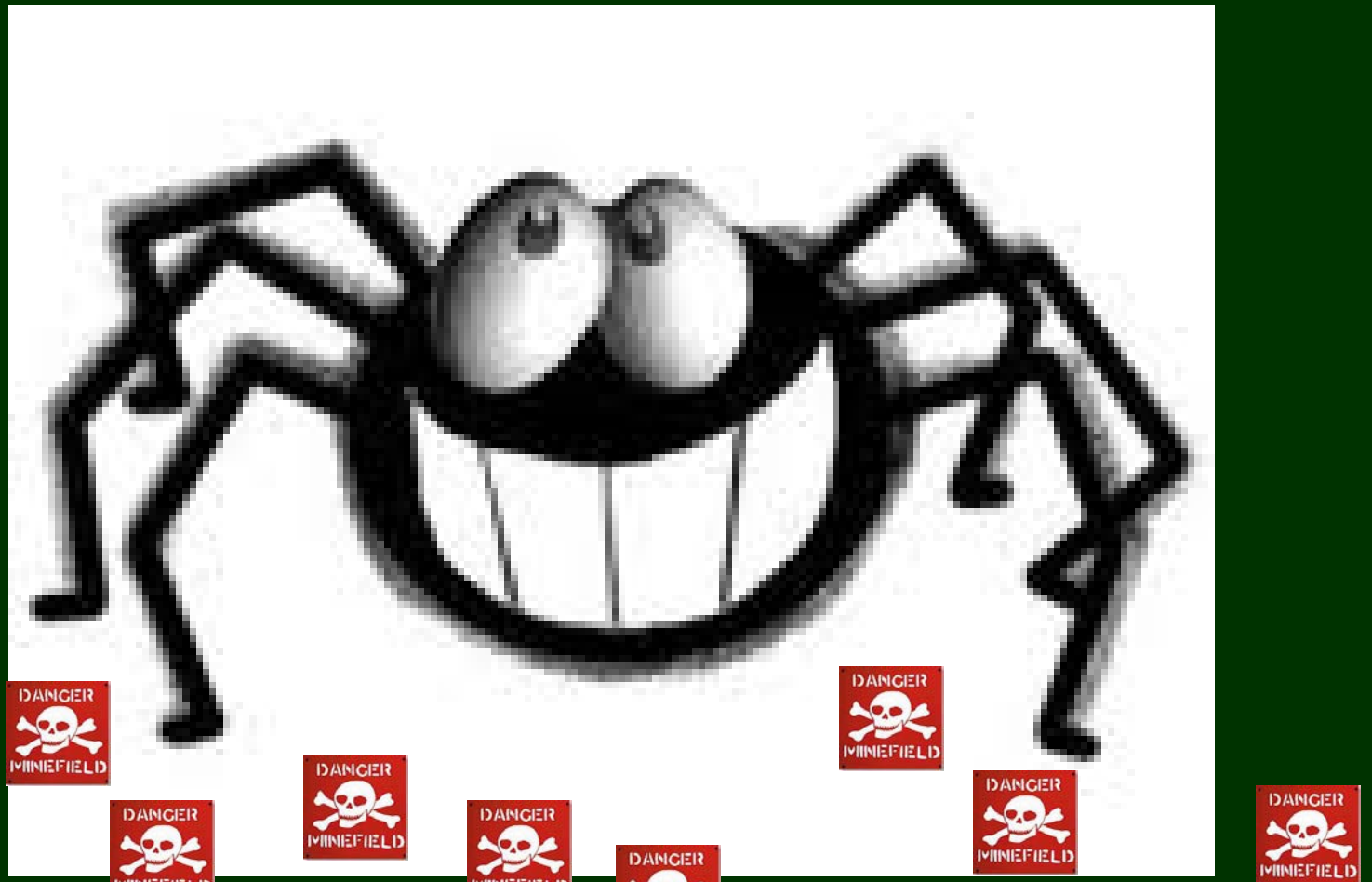
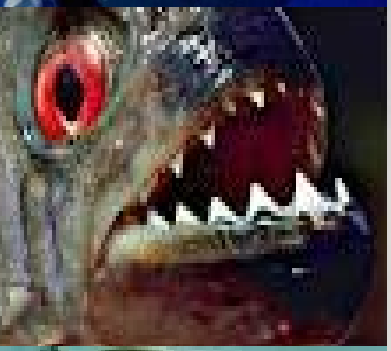
Sprayed rice fields are like mine fields to predators and parasitoids in search of prey





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Planthoppers problems are INDUCED by INSECTICIDES

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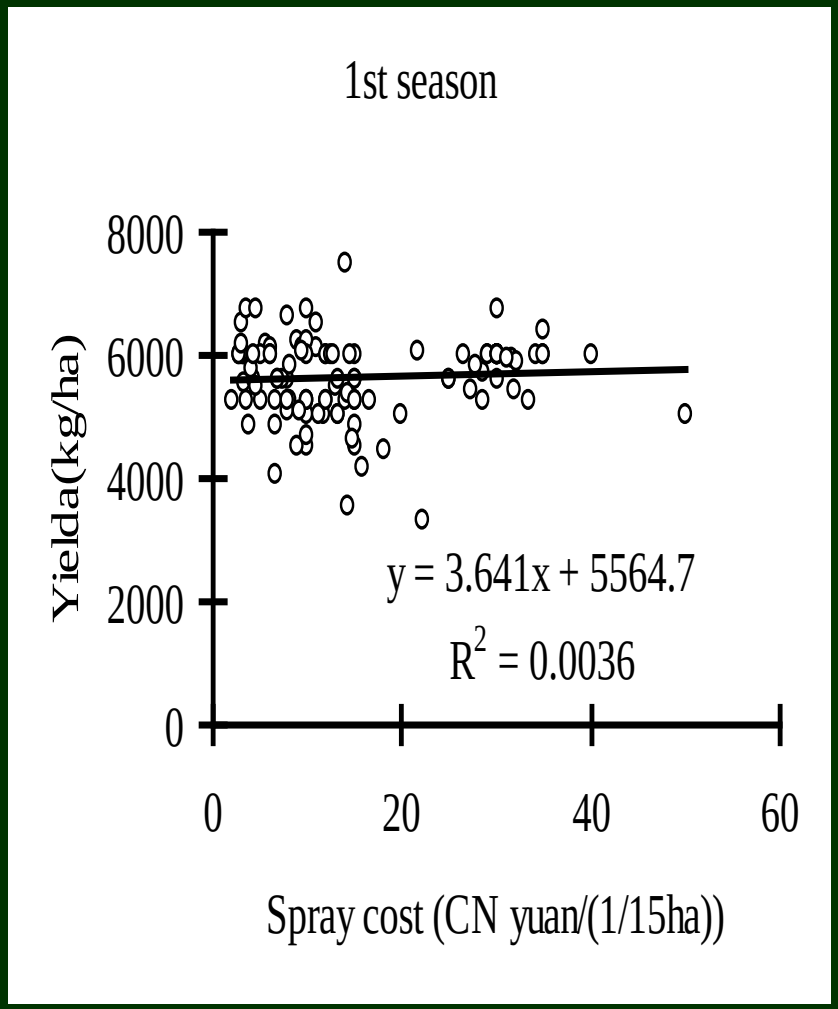
Are there any

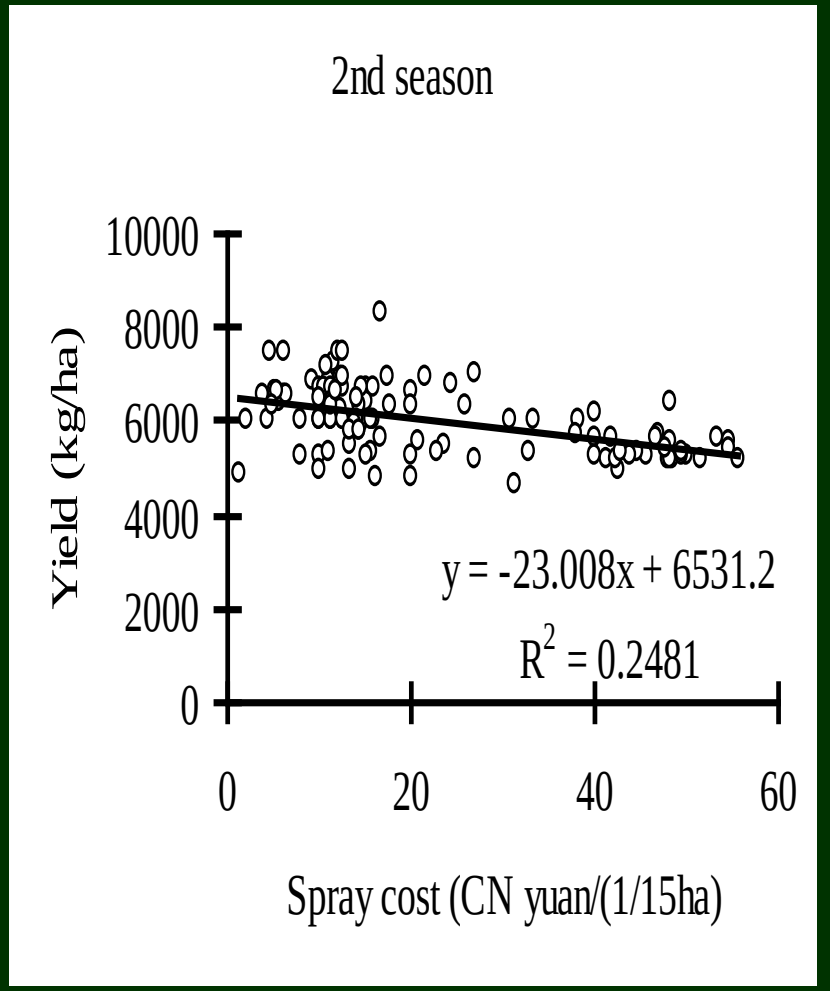
productivity gains

from insecticide applications

by rice farmers in Asia?

Relationships between farmers' yields and pesticide spending in Jiaxing, China.





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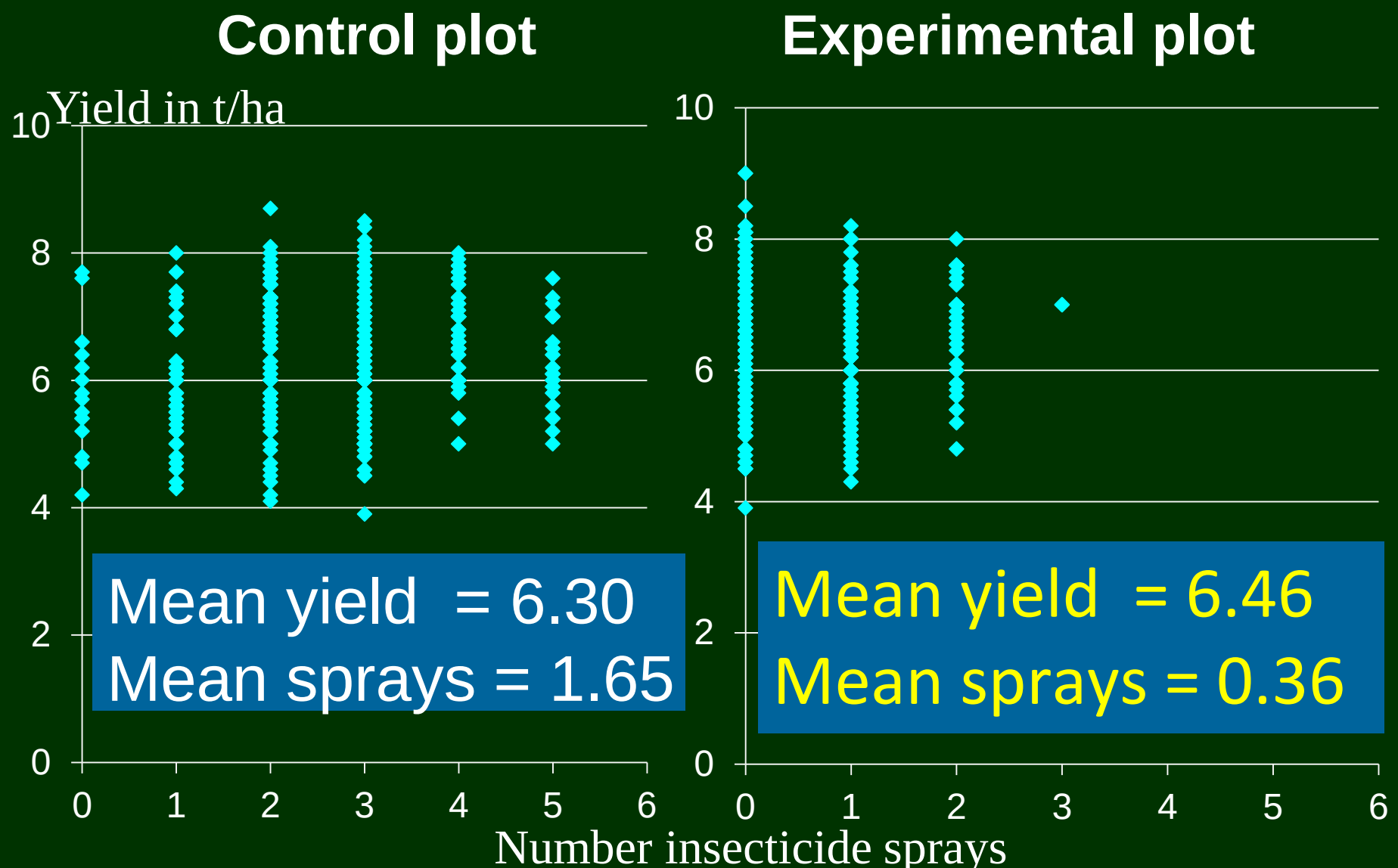
Farmers' participatory paired plot experiments
Mekong Delta W-S season 2001/02



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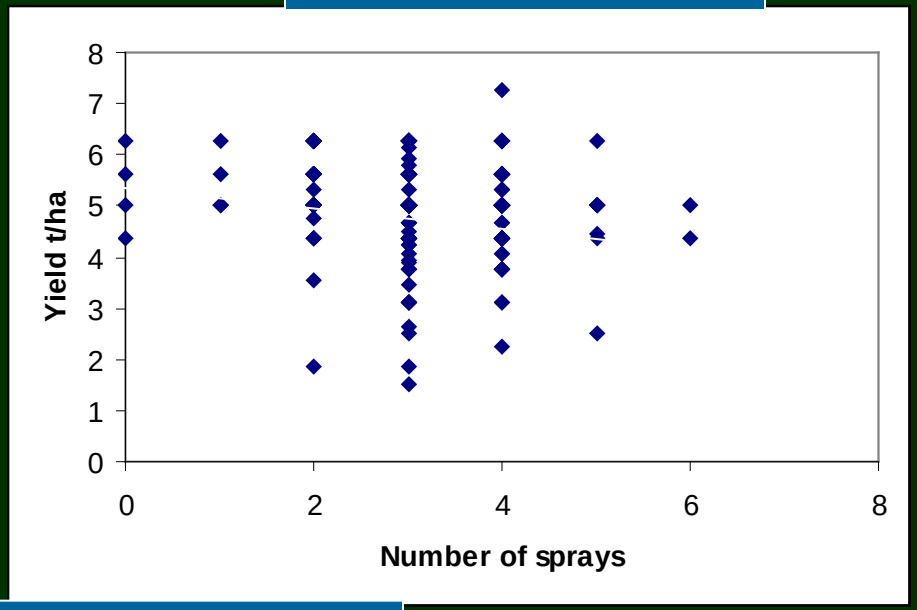
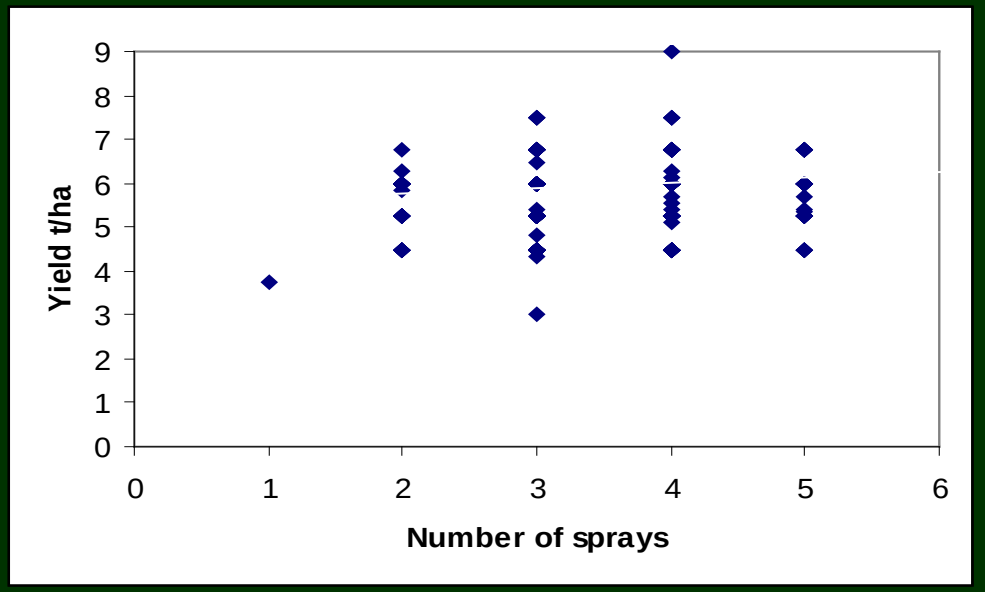
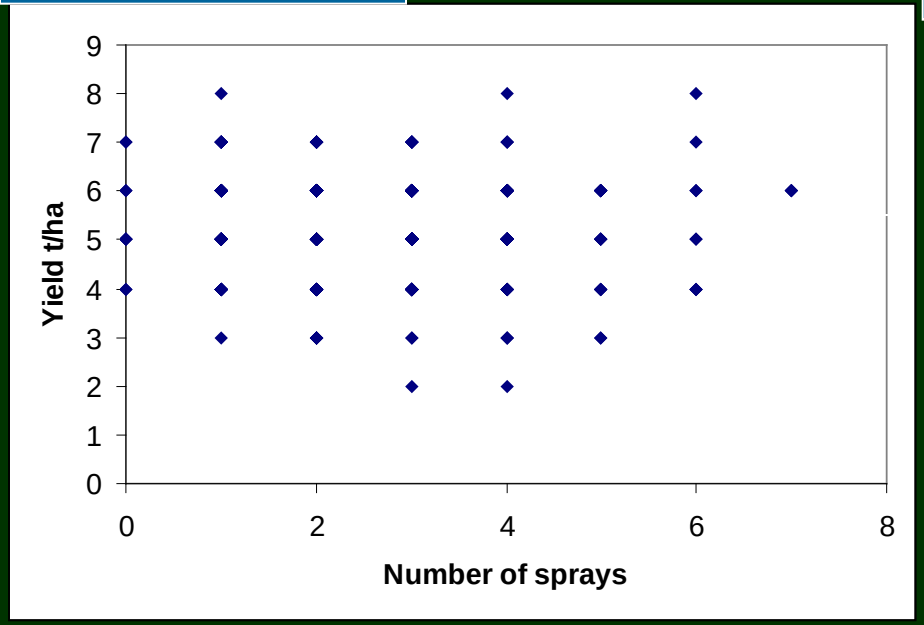
Chainat, Thailand



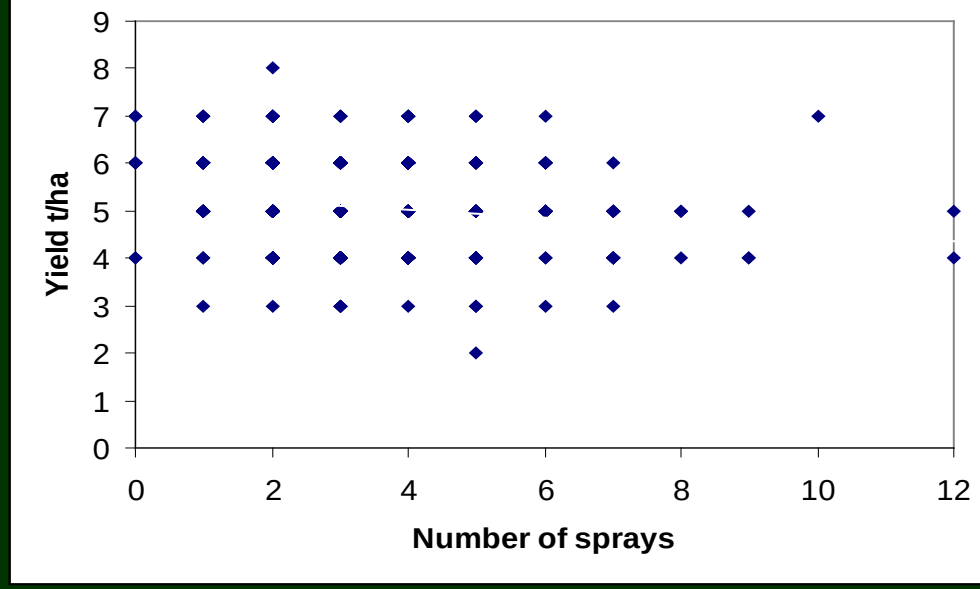
Lingui, China



Cai Lay, Vietnam



Cai Be, Vietnam



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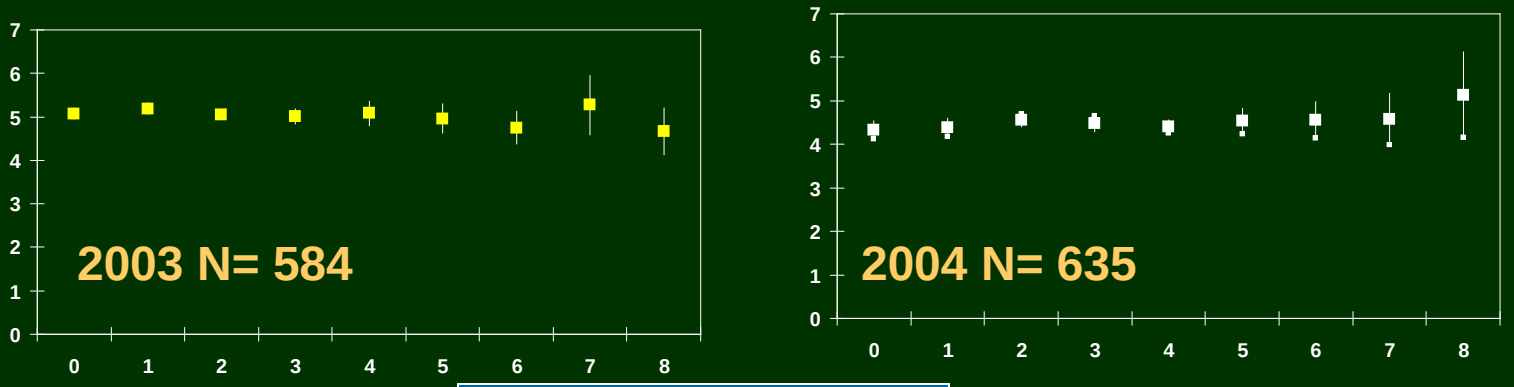
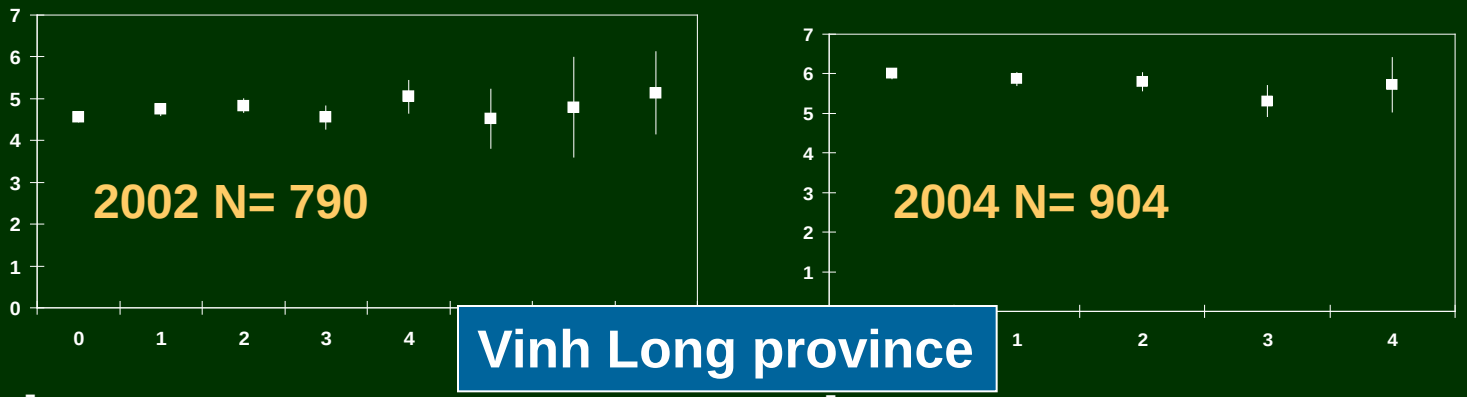
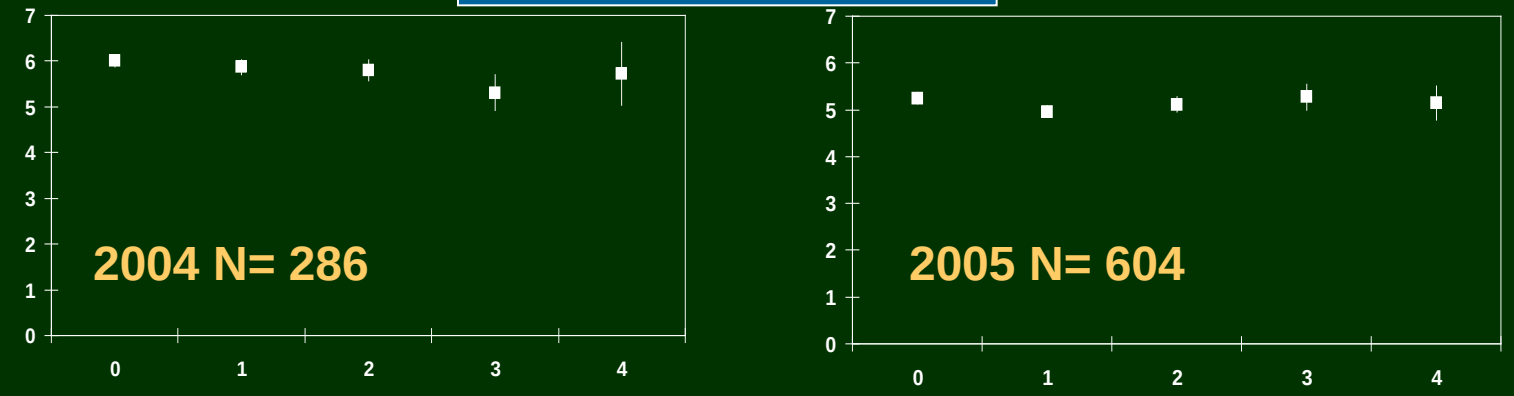
Tiengiang province



Cantho province



Vinh Long province



Yield in tons

Number of insecticide sprays

% benefits of management strategies with health costs Pingali et al 1997

Sites	Management strategies	# sprays	% Net benefits over no spray strategy
Laguna	Complete protection	6	-11.7%
	Farmers' strategy	2	-3.6%
	IPM	1	-5.0%
	No spray	0	--
Nueva Ecija			
	Complete protection	6	-4.65%
	Farmers' strategy	2	-3.11%
	IPM	1	-3.50%
	No spray	0	--

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Positive coefficient of 0.123 - an increase of 123 kg of paddy/spray

Farm gate price of US$0.22/kg paddy and Cost of an insecticide application is US$20

Gain would be US$7/ha.

Labor & health costs wipe away US$7 /spray

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Negative coefficient of - 0.135 –
a loss of 135 kg/spray or
loss of US49/ha (US$29 from paddy loss plus US$20 for each application).

And when labor & health costs are factored in loss will be **> US$ 55/ha**

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Ecological costs

- **Wild life**
  - Bird life, fishes
- **Off site pollution**
  - Fish industry
- **Pest resurgences**
  - Planthoppers, late season leaf-folders

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80% of farmers' insecticide sprays misused

- In 1991 we conducted a survey in the Philippines
- 80% of their sprays can be classified as misuse
- Misuse is defined as the "improper or incorrect use" like an insecticide being used for wrong targets, at the wrong time or both.

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Social impacts on farmers
Collateral damages

Wichian

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Woman in tears

From Juka Kawaai

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WHY is insecticide misuse so rampant?

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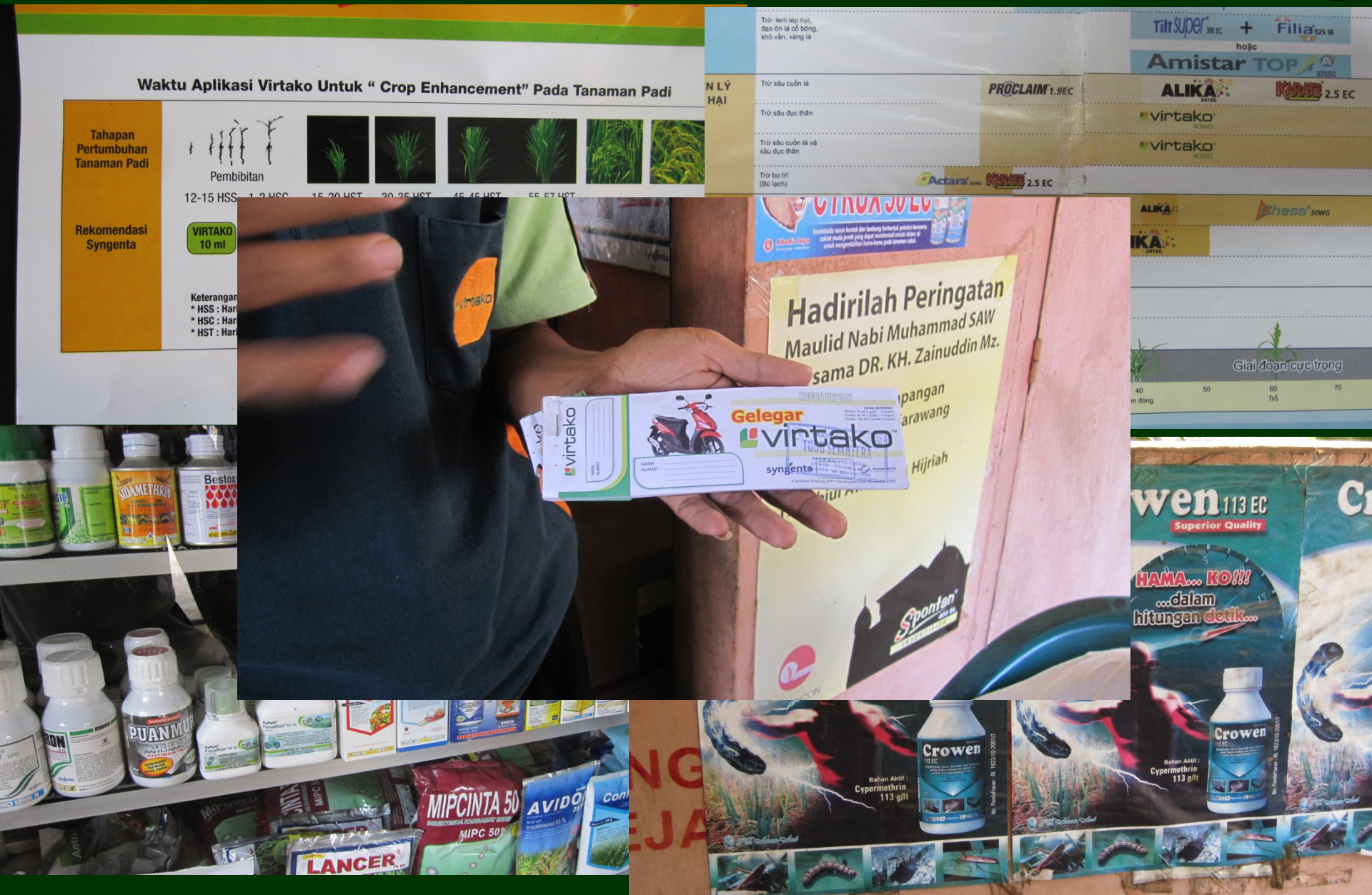
Pest management today and Pesticide Marketing



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Multi tier marketing through downline tertiary sub retailers

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Other sales p mance inc clude:

- Washing machines
- CD players
- TVs
- Cookers
- Free t al tourists' destinations
- Free international destinations
- To Mecca to perform the Haj.

Violations of FAO Code of Conduct on Pesticide distribution

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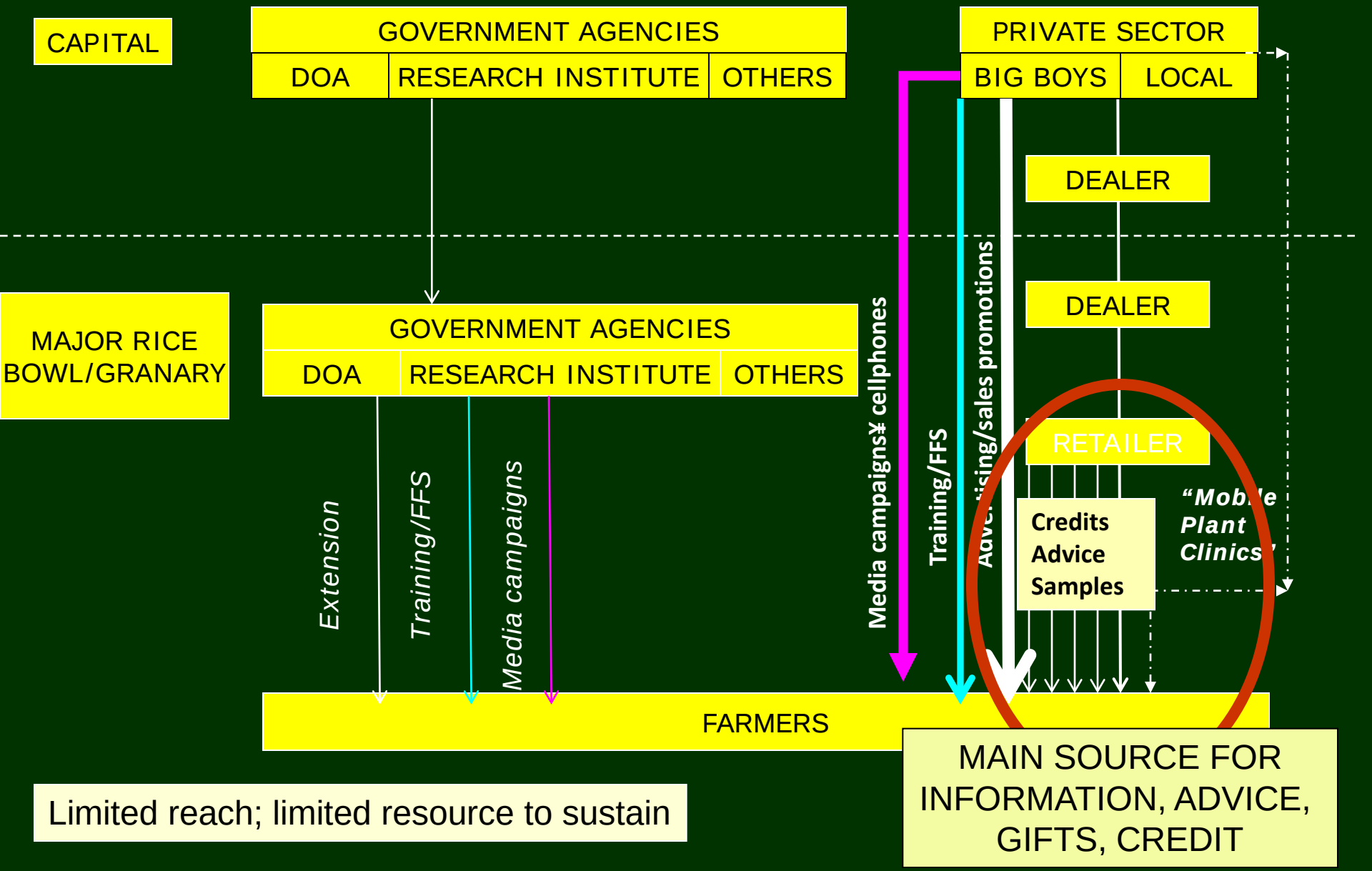
FMCG

Fast Moving Consumer Goods

Insecticide use based on IPM	Insecticide use based on FMCG
Driven by rational decision making skills.	**Driven by product packaging, brand names, attractiveness, recalls.**
Need to use knowledge on pests, natural enemies, predation, insecticide actions. Judicious use.	**No thinking needed. Calendar applications. Mixing several ingredients together to "make sure" of kill.**
Maximize value of knowledge	**Maximize value of sales** **Knowledge unimportant**
Based on economic rationale	**Based on emotions viz status, desire, fear, perceptions, attitudes, sense of power, price.**

Generalized Rice Pesticide Information Supply Chain



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Hands up those who get their pest management advice from the local pesticide retailers

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Wife of secondary pesticide retailer advising farmers to mix cypermethrin with herbicides

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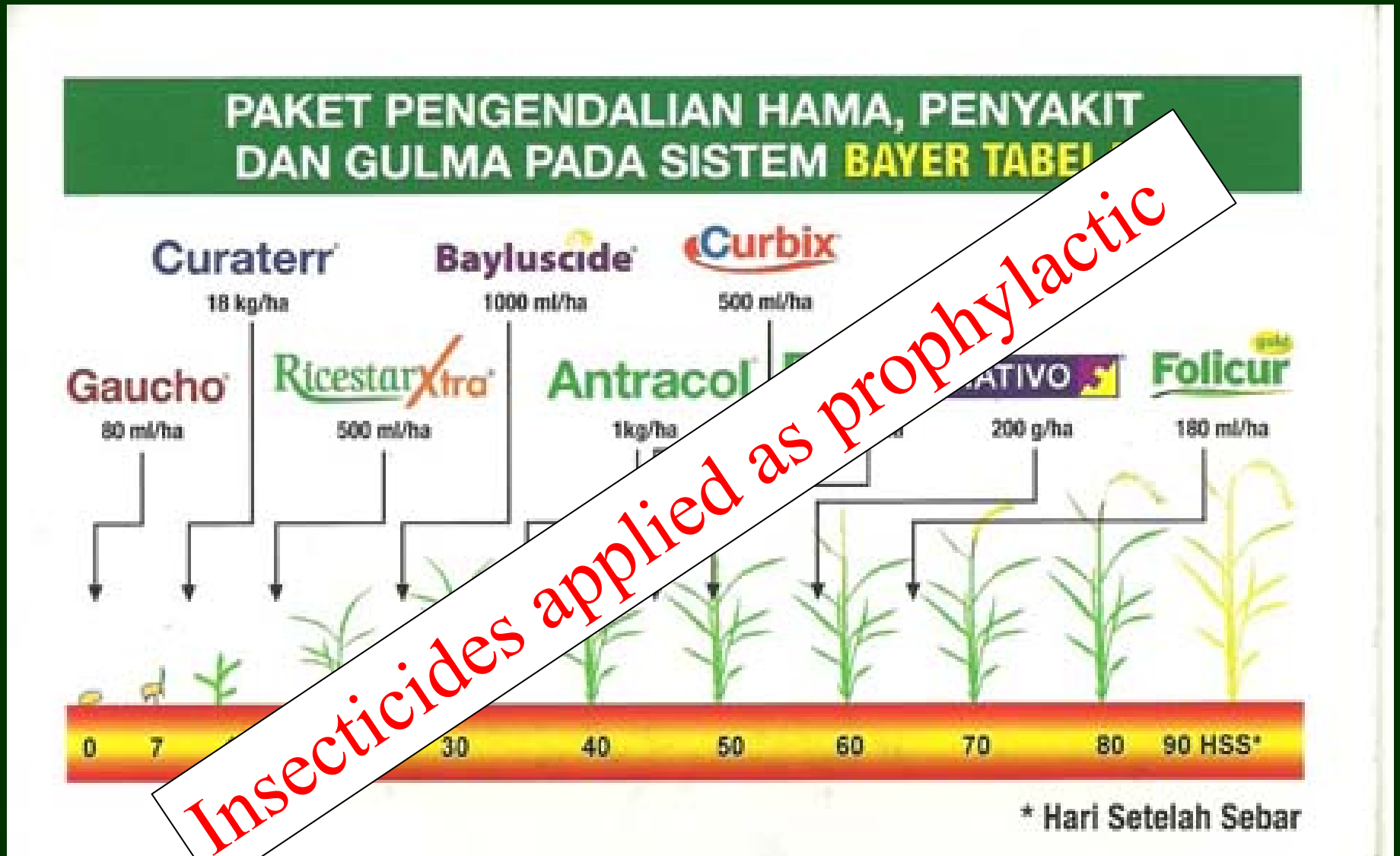
The shop keeper gave wrong advice and sold me the wrong medicine

Today's pest management is prophylactic spraying



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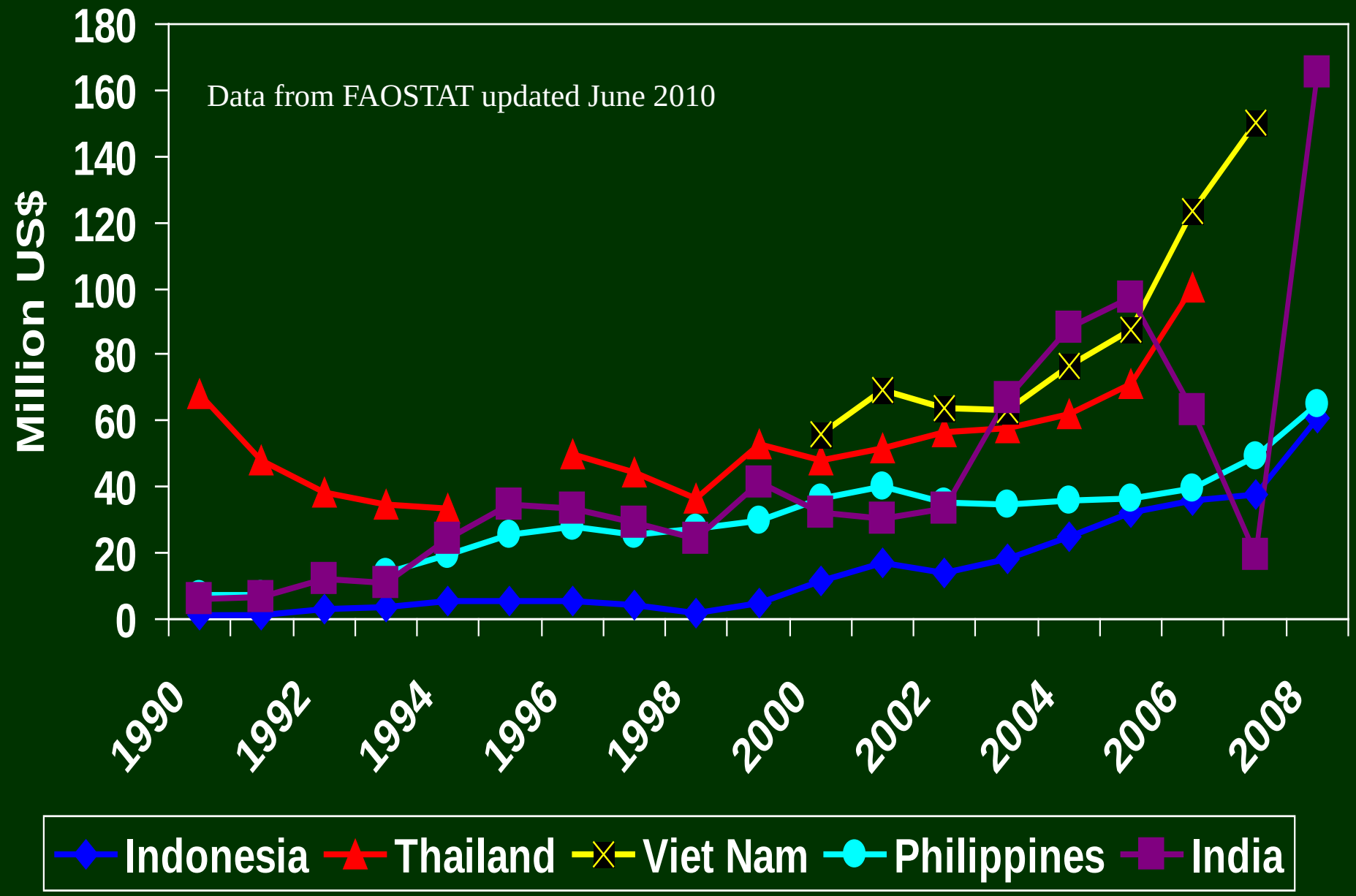
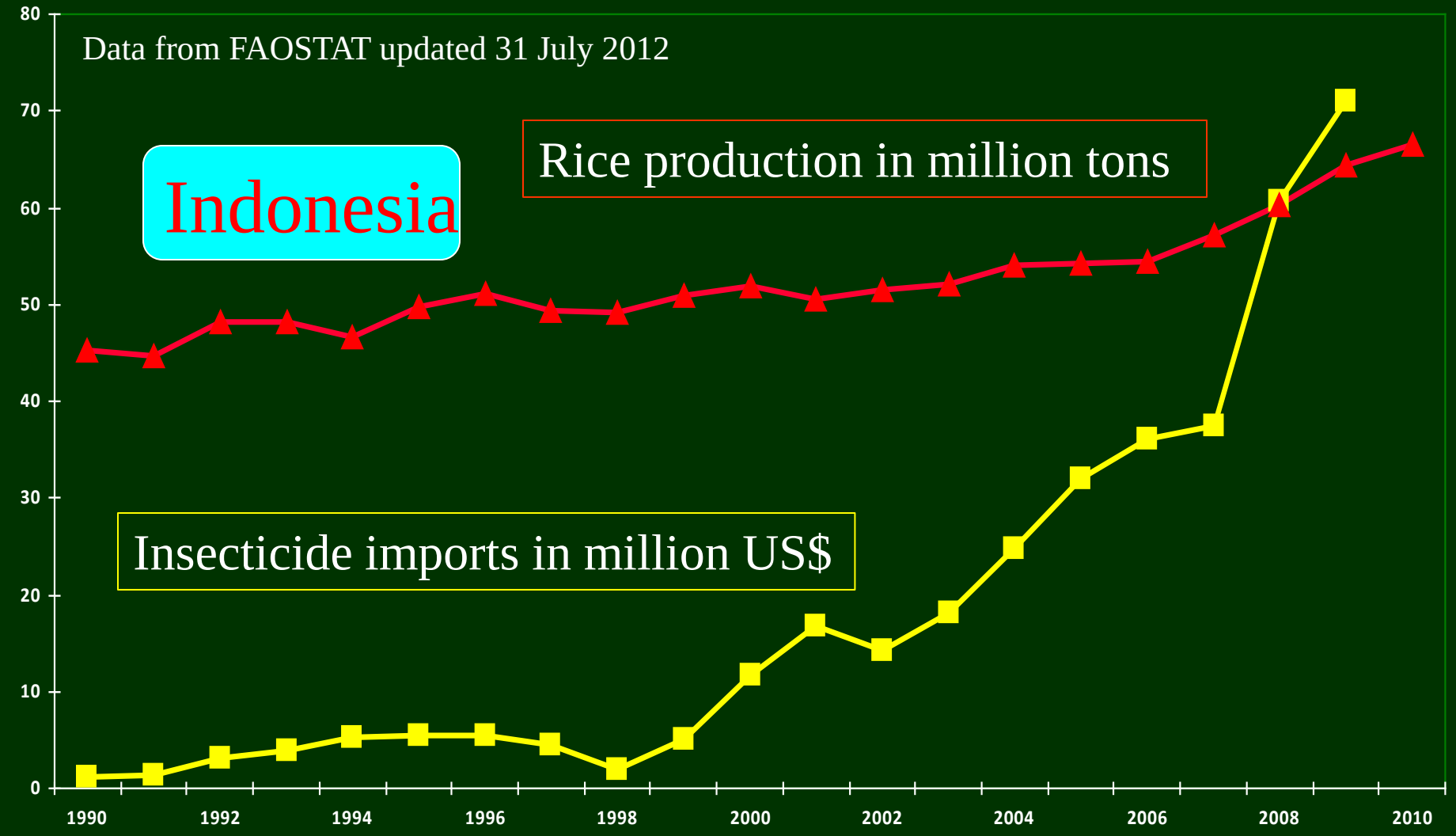
Insecticide imports



Rice production & Insecticide imports



Insecticides are not needed in most cases

- **IRRI ecologists - Way & Heong (1994)**

" We conclude that IPM in tropical rice should be based on the contention that ***insecticides are <u>not needed</u>*** rather than they are and "pests" should be critically reassessed and ***proven guilty before insecticide use is contemplated***"

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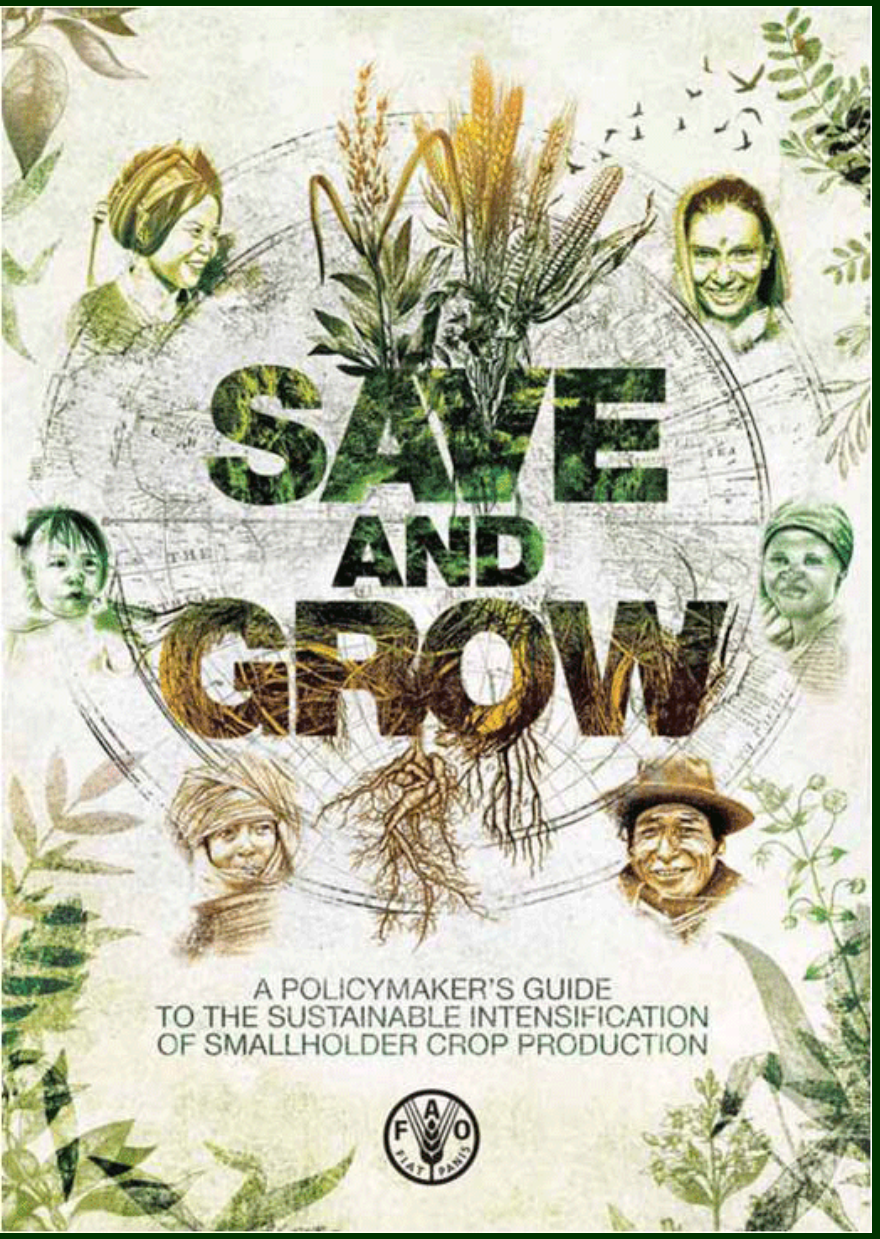

SCPI: Sustainable Crop Production Intensification

FAO 2012:

Most tropical rice crops under intensification require

NO

insecticide use

House with No Roof – weak market regulations

Current system favor YIN

Negatives

Pesticide promotion by private and Public sectors
Govt subsidies, free distributions
ow costs of pesticides
ticide misuses

Positives

Ecological research
Resistant varieties
Ecological engineering
IPM training
Insecticide reduction programs

Structures / Policies favoring Negatives

Inadequate pesticides regulatory system
Ecosystem services not factored into policies
Incentives for short term profit gains
Lack incentives for sustainable practices
Access to emergency pesticide allocations

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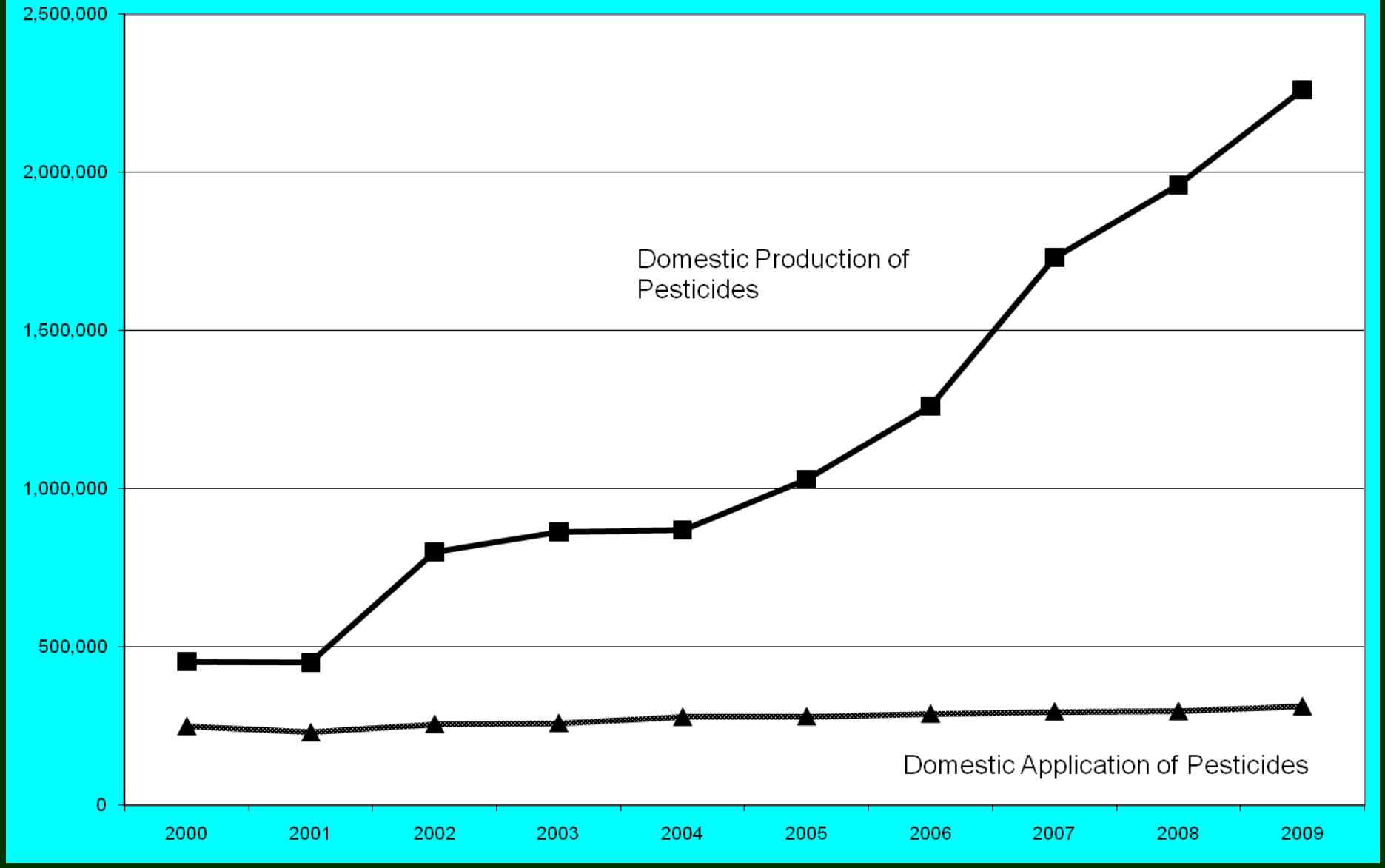
Restore balance – structural transformation

Plant Protection Services need Structural Transformation

China's Pesticide Production (metric tons a.i.) 2000 – 2009. [source: ICAMA]




Pesticide Tsunami
Resistant varieties, IPM Training, Biological control, Biodiversity, Ecological Engineering

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Summary

1. Large proportion of insecticides used **are unnecessary.**
2. There **is little productivity** gain from insecticide applications. Often negative if labor and health costs are factored in
3. Planthopper problems are **insecticide induced**.
4. The mechanisms have been thoroughly researched, simulation models built, well understood and documented.
5. Planthoppers are **r strategists** and management strategies are ecologically based at macro levels in the landscape and across countries.
6. Insecticide misuse is caused by the **FMCG marketing** conditions, misguided policies, research and biases toward favoring pesticide use.
7. **Farmers are the victims** and in information supply chain provide them poor advice.
8. It does NOT have to be like this, especially since we have the knowledge to help solve the problem.

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Can we build safe & sustainable pest management systems ?

Ecological Engineering

生态工程

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ADB

http://ricehoppers.net/

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Ecological Engineering techniques

Restore Biodiversity

Planting nectar flowers on bunds
Crop diversification
Increase diversity of varieties

Conserve Biodiversity

Stop early season (first 40 days) insecticide use
Avoid using insecticides toxic to bees and hymenoptera

Species Biodiversity

Parasitoids, Predators, decomposers

Ecosystem functions

Pollination, parasitism, predation

Ecosystem Services

Pest invasion resistance,
Pest and disease regulation
Pollination

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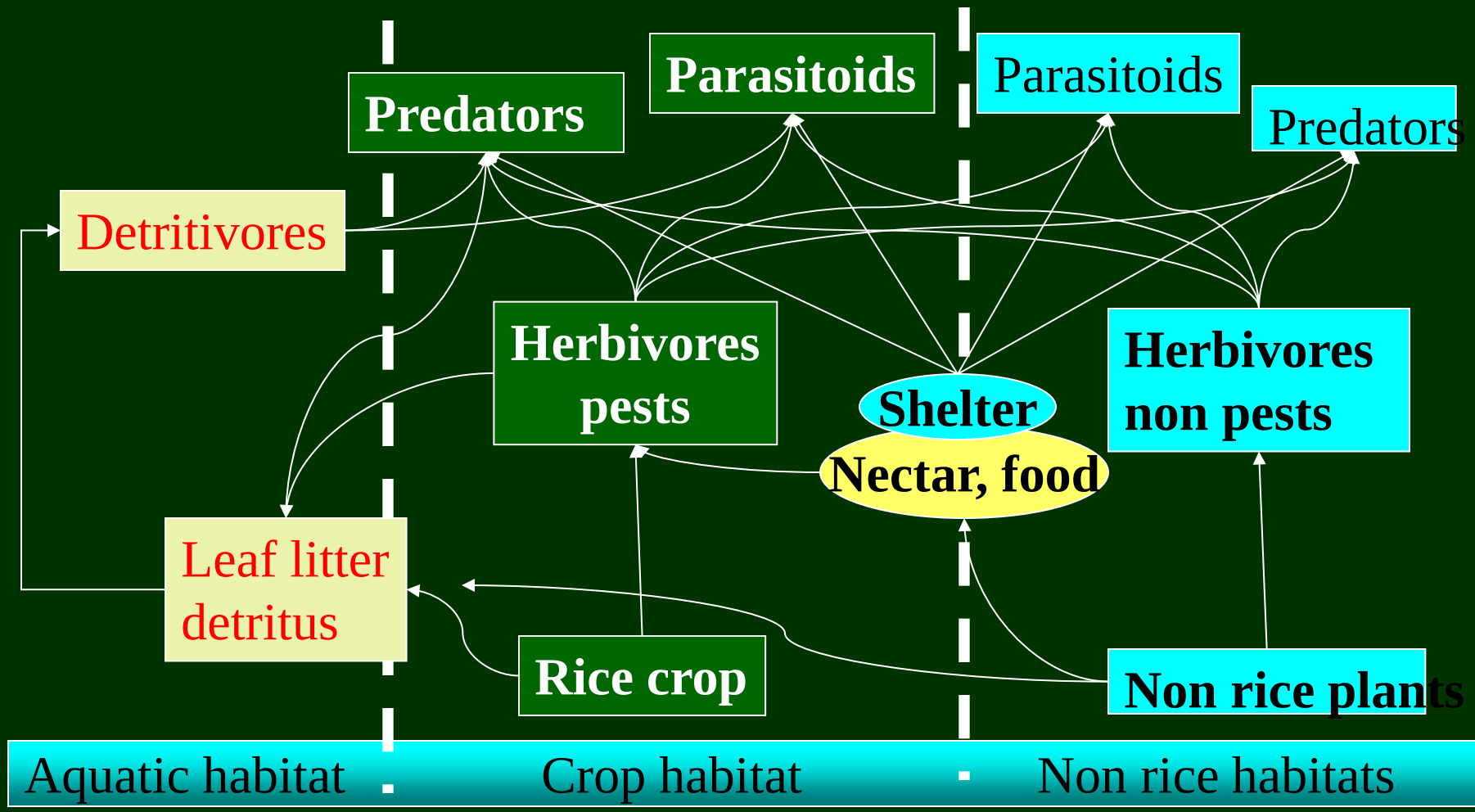
Rice ecosystem food web



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Key Resources Provided by Ecological Engineering

- **SNAP**
  - **S**helter
  - **N**ectar
  - **A**lternative Host/Prey
  - **P**ollen

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Ecological Engineering

Australia

Buckwheat (*Fagopyron esculentum*) used in Australian vineyard to promote biological control of caterpillar pests.

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California

Conservation biological control of the lettuce aphid in organic lettuce

Syrphid larvae (top right) feed on the lettuce aphid and other aphids. Organic growers enhance the activity of these natural enemies by providing nectarresources (nectar and pollen) to adult syrphids (bottom right) in lettuce fields with in-field plantings of alyssum (below) and other insectary plants.

Photo: W.E. Chaney

Photo: W.E. Chaney

Photo: H.A. Smith

Prof Steve Wratten,
Lincoln University,
New Zealand

Ecological engineering in Jin Hua

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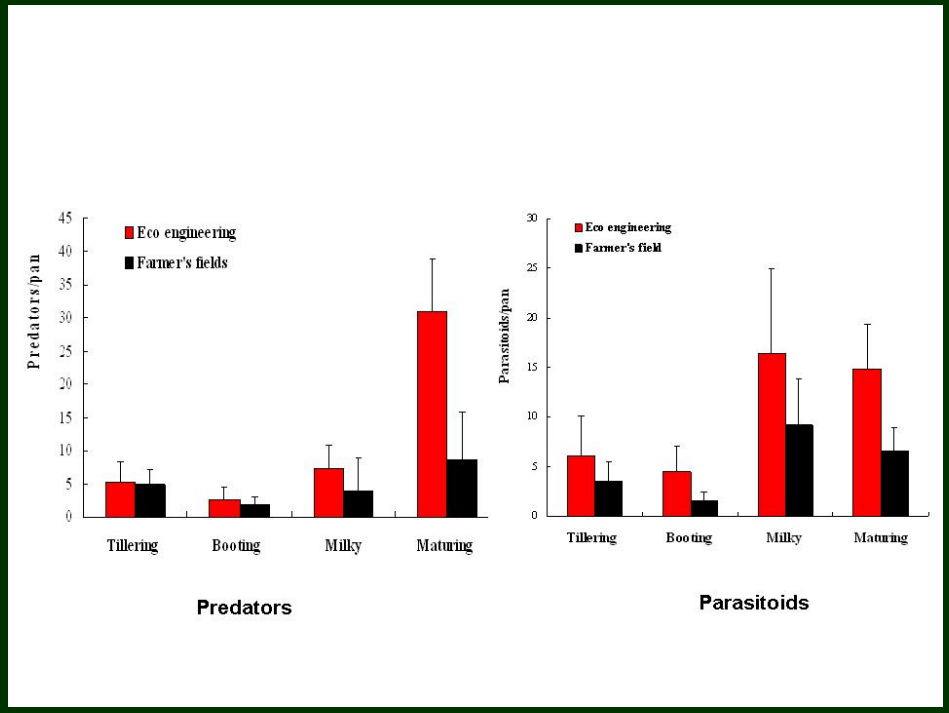
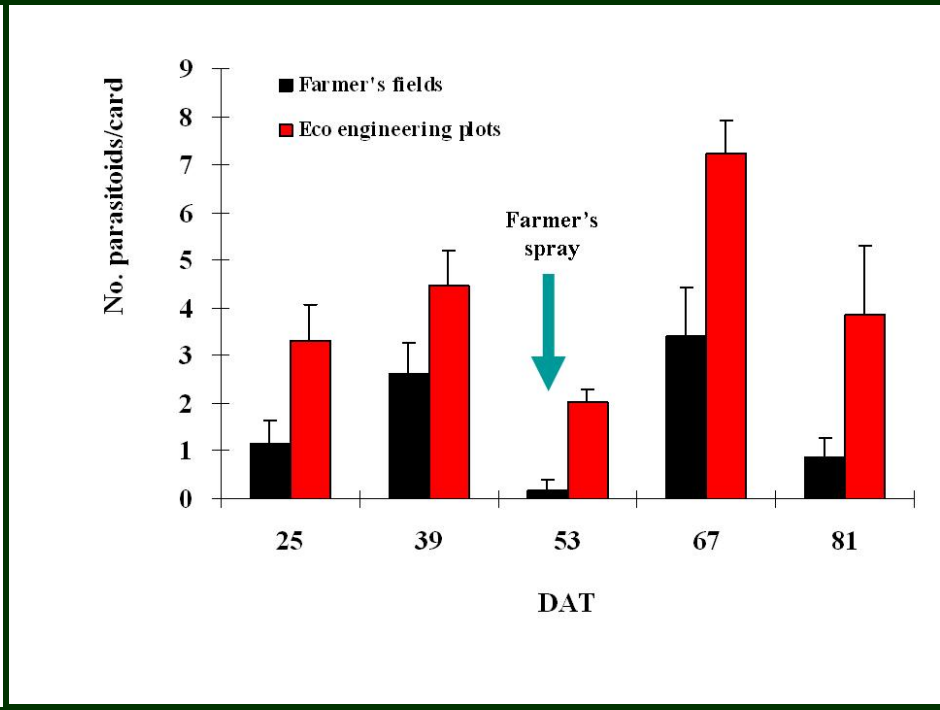
Increase in parasitoids in rice field with sesame and no insecticide use

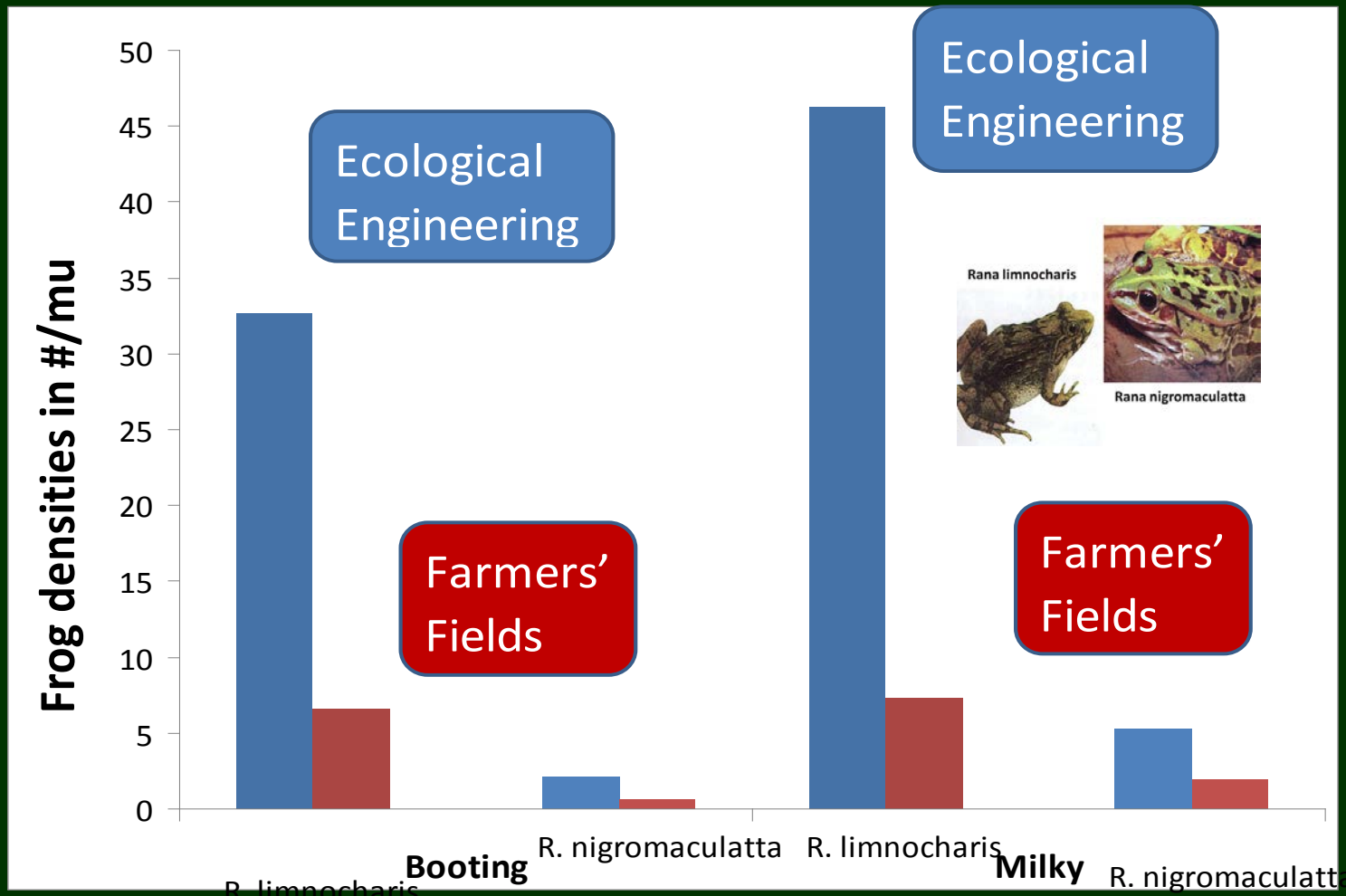
Jin Hua, Zhejiang





Lu et al 2009

Frog densities increase in eco eng fields



Ecological engineering village in Vietnam

Landscape transformation in many Vietnam provinces

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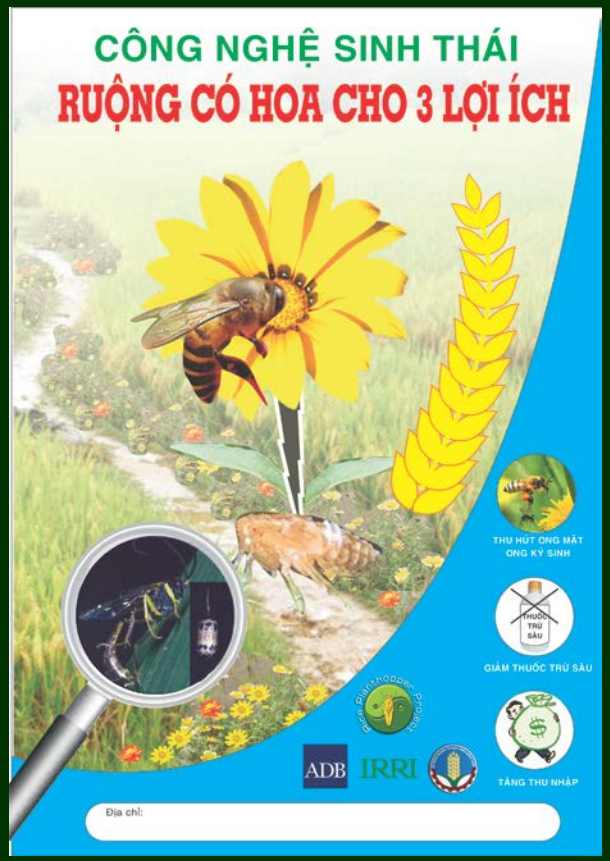
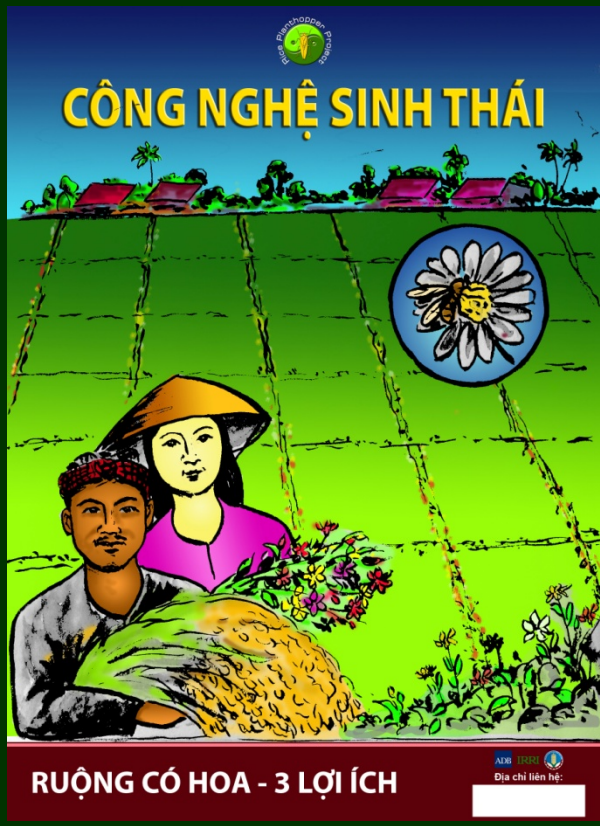
Egg predatory bug increase

Multi media campaign in Vietnam to motivate rural communities to restore biodiversity, increase natural biological control, reduce pesticides and increase their profits





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TV series with popular comedians

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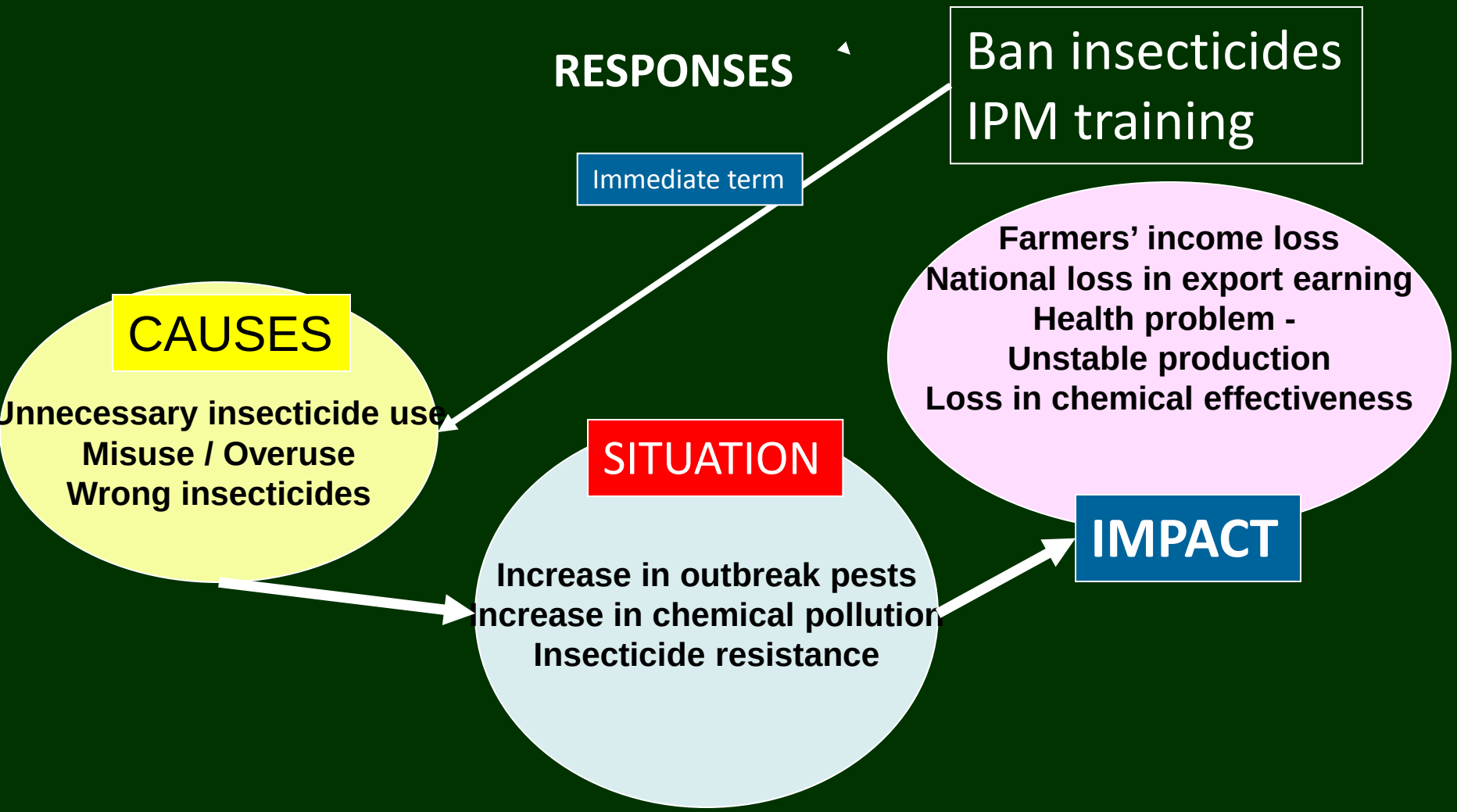
Nakhon Nayuk

Root Causes of Planthopper problems




การประชุมวิชาการข้าวและธัญพืชเมืองหนาว
องในโอกาสวันข้าวและชาวนาแห่งชาติ ครั้งที่ 2 ปี
างวันที่ 3-4 มิถุน 2554
หยุด การระบาด
เพลี้ยกระโดด
สีน้ำตาล
ในนาข้าว
ห้ามใช้
อะบาเม็กติน
ไซเพอร์เมทริน
ทำลายศัตรูธรรมชาติ และทำให้เกิดการระบาด
เพลี้ยกระโดดสีน้ำตาล
ด้วยความปรา
กรมการข้าว

Restore biodiversity, resilience and professionalism

Revise pesticide marketing regulations. License retailers
Structural transformation

ROOT CAUSES

Inadequate regulations
FMCG
Retailers provide advice
Untrained retailers.

Medium/Long term

RESPONSES

Ban insecticides
IPM training

Immediate term

CAUSES

Unnecessary insecticide use
Misuse / Overuse
Wrong insecticides

SITUATION

Increase in outbreak pests
Increase in chemical pollution
Insecticide resistance

Farmers' income loss
National loss in export earning
Health problem -
Unstable production
Loss in chemical effectiveness

IMPACT

IRRI

Governments need to play stronger governance roles to ensure quality information and pesticide prescriptions for farmers

Rather like in the medical profession where doctors and pharmacists are certified.

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Towards Sustainable Agro-ecosystems

Plant Protection Services need to be transformed

FROM

DISTRIBUTING

PRODUCTS & INFORMATION

TO

GOVERNANCE AND CONTROL

OF PRODUCTS AND INFORMATION

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South Korea Environmentally Friendly Agriculture (EFA)

1994:

Environmentally Friendly Agriculture Division Established in the Ministry of Agriculture

1998:

Environmentally Friendly Agriculture Promotion Act (EFA Act)

2001~2005:

First 5 Year EFA Promotion Plan

2006~2010:

Second 5 Year EFA Promotion Plan

2010:

Insect Industry Promotion Act

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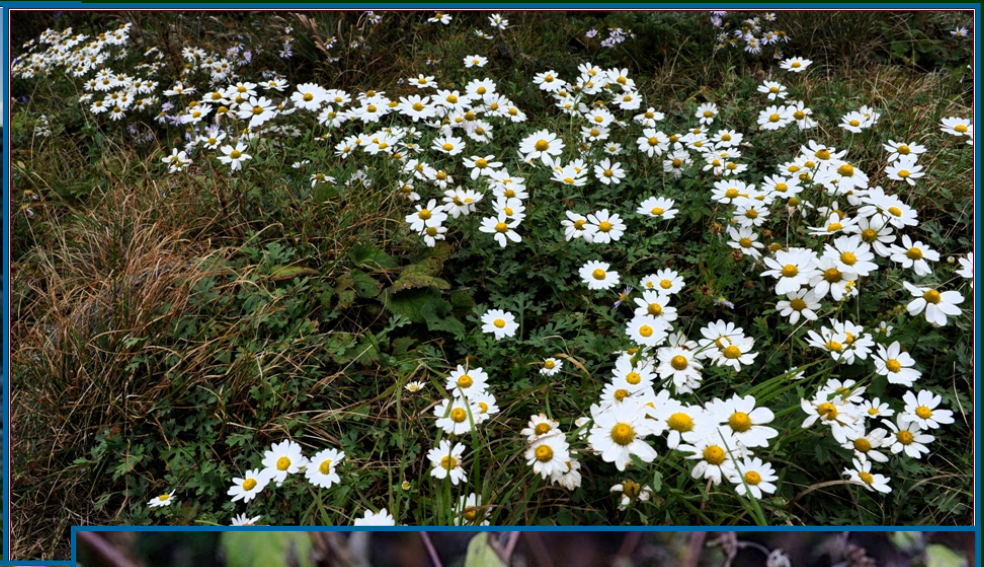
Landscape Crops

IRRI

Landscape Floral Biodiversity



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Pesticide Consumption Trends

IRRI

ADB

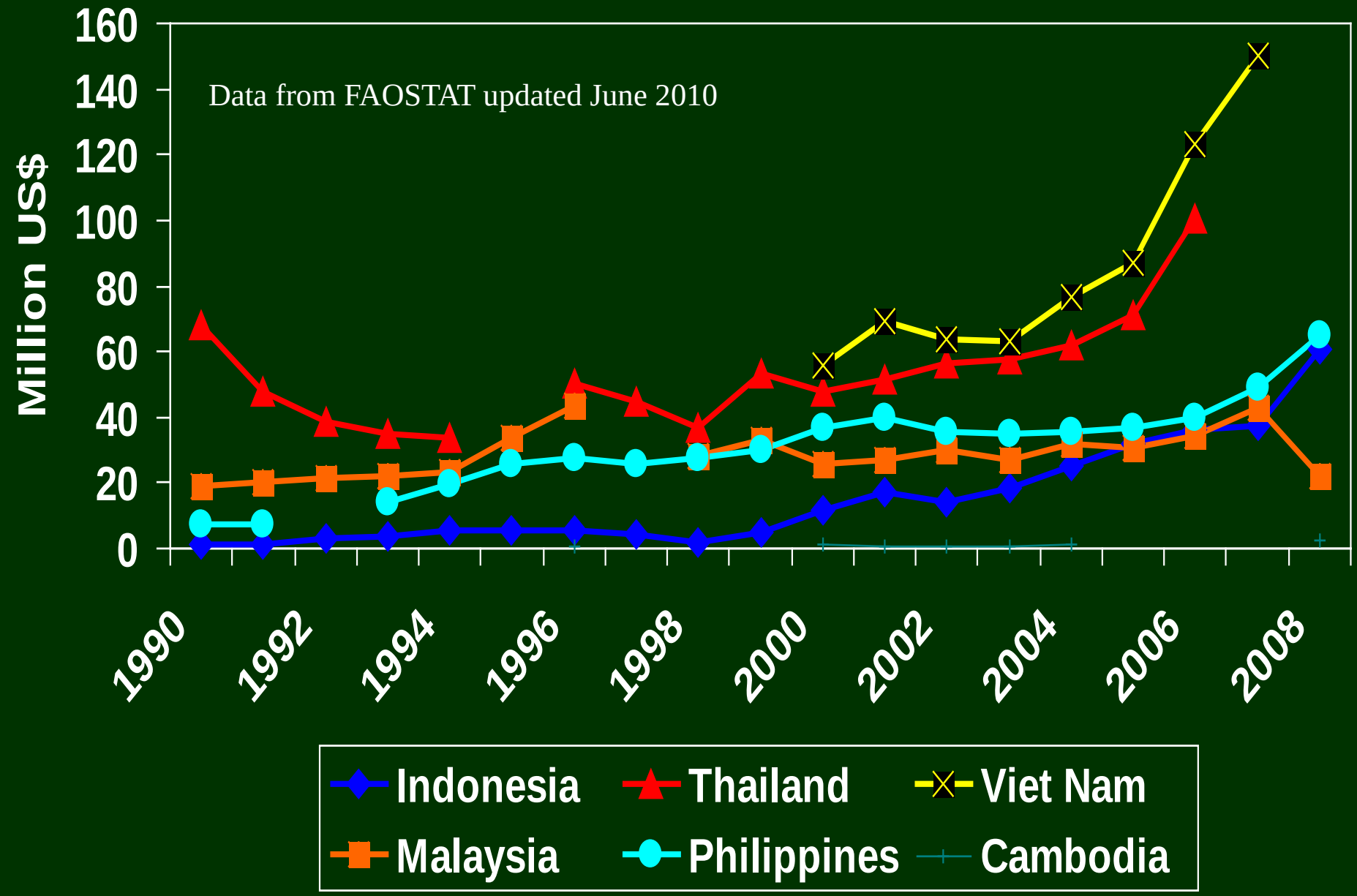
http://ricehoppers.net/

IRRI

INSECTICIDE USE IN SE ASIA

IRRI

Insecticide imports



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Insecticide imports 1980-2010

US$K/Km^2 (Source FAOStats)

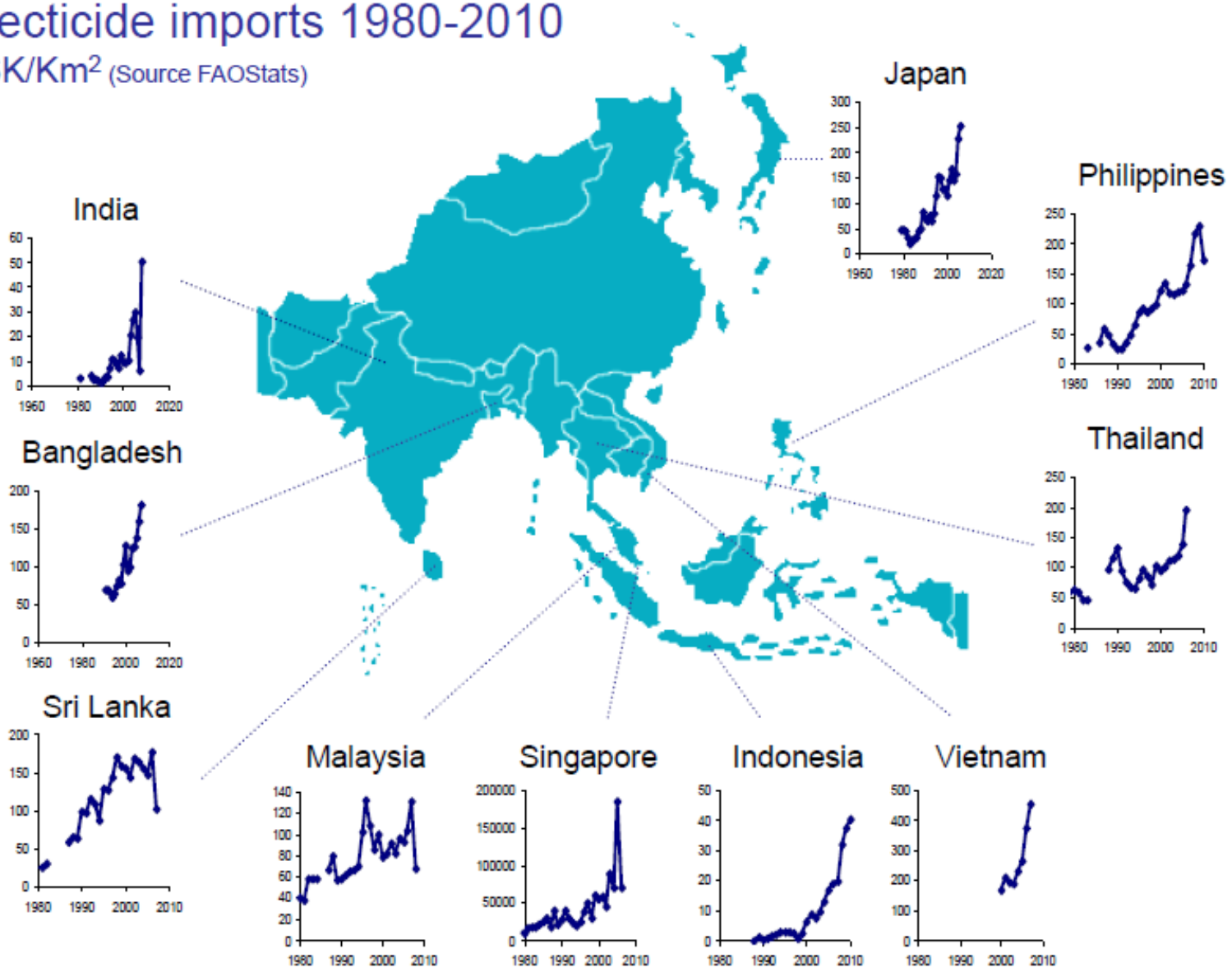

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Table 1. Percent of farmers using each insecticide at different crops stages

	Crop stages (days after sowing)				
Insecticide	0-15	16-40	41-60	61-70	> 70
Abamectin	39.1	31.0	40.0	39.1	37.5
Cypermethrin	26.0	3.3	20.0	2.2	6.3
Chlorpyrifos	15.6	8.7	13.3	10.9	15.0
Dinotefuran	4.2	14.6	6.7	10.9	0
Fenobucarb	0.8	0.3	6.7	2.2	0
Cartap hydrochloride	4.0	5.1	0	8.7	0
Imidacloprid	0.6	3.0	0	4.3	5.0
Fipronil	0.2	3.6	0	0	0
Buprofezin	0.8	3.8	0	2.2	0
Dimethoate	0.2	8.0	0	8.7	25.0
Carbofuran	2.5	2.0	0	2.2	5.0

IRRI

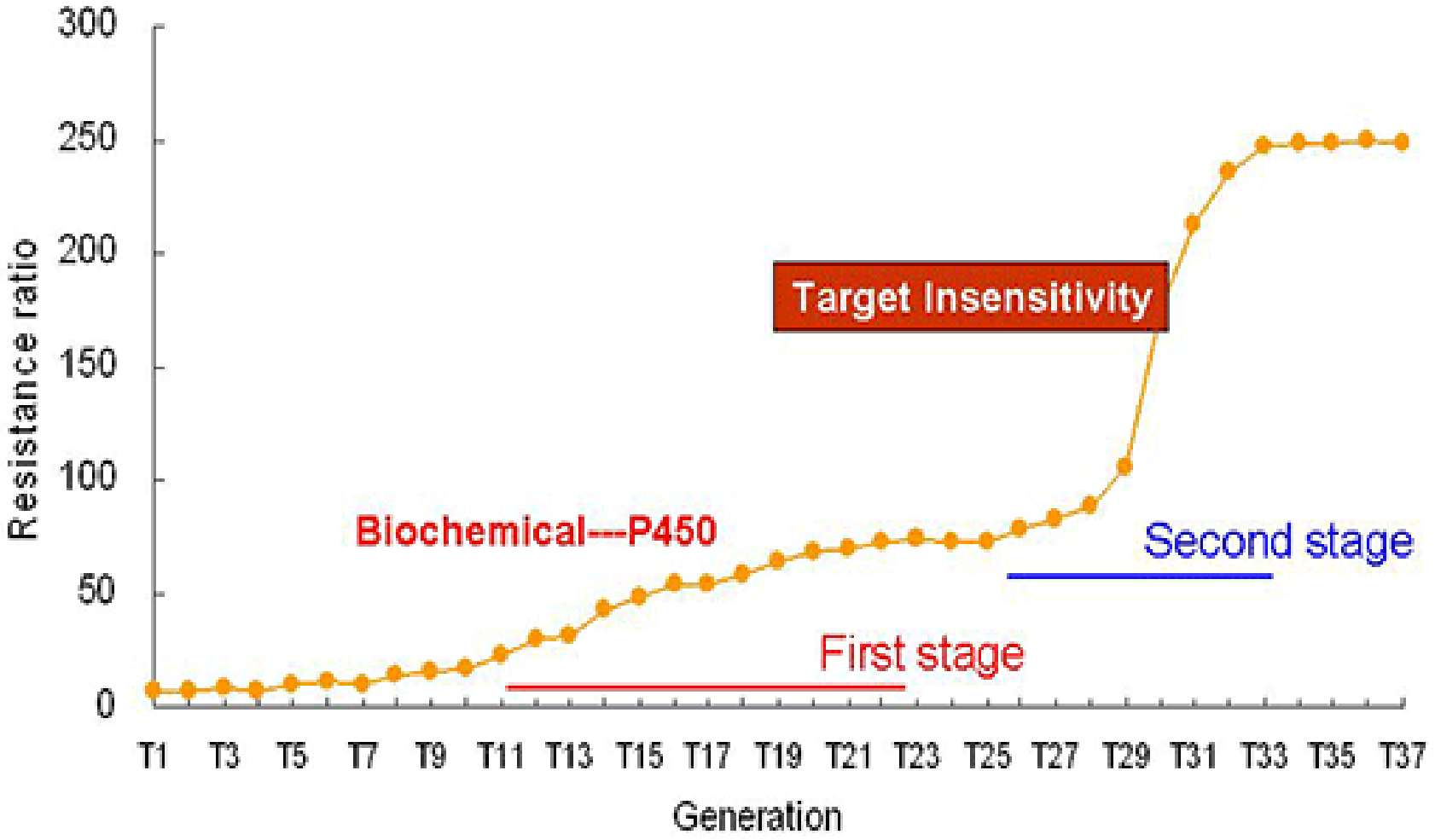

virtako
300SC
Insektisida
Insektisida racun kontak dan sistemik, berbentuk pekatan yang larut dalam air, berwarna putih kecoklatan, untuk mengendalikan hama penggerek batang, wereng dan pelipat daun pada tanaman padi.
No. Pendaftaran: RI.3006/11-2007/T
Bahan aktif: klorantraniliprol 100 g/l
tiametoksam 200 g/l
BACALAH PETUNJUK PENGGUNAAN.
PERINGATAN BAHAYA:
Jauhkan dari jangkauan anak-anak, orang-orang yang tidak berkepentingan dan hewan peliharaan.
Confidor
ADMIRE
ThiamaX
TePro

IRRI

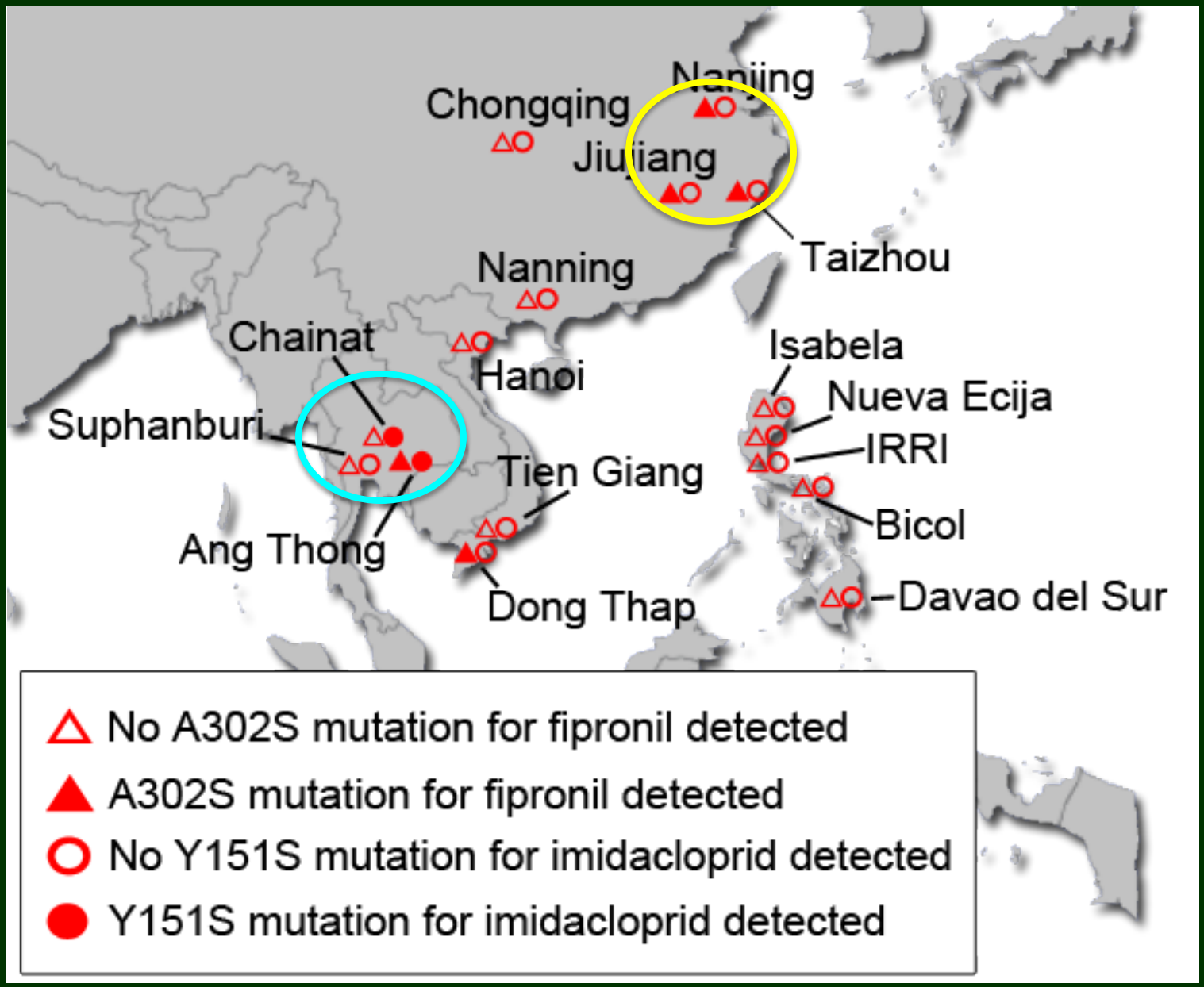
Toxicities and relative potencies of imidacloprid to BPH from 5 different locations in Asia

Location	LD50 in mg/g insect (95% fiducial limits)	Slope (SE)	Hetero geneity	Relative potency
Bicol, Philippines	0.179 (0.144-0.215)	2.70 (0.33)	0.61	1.00
Isabela, Philippines	0.207 (0.167-0.254)	2.11 (0.20)	0.96	1.16
Angthong, Thailand	0.509 (0.266-0.760)	3.27 (0.24)	2.38	2.84
Changsa, China	5.526 (3.573-7.722)	2.45 (0.20)	1.43	30.87
Jinhua, China	11.596 (8.588-14.887)	2.23 (0.20)	1.25	64.78

Insecticide resistance development - biochemical and target site mutation mechanisms.



Target site mutation



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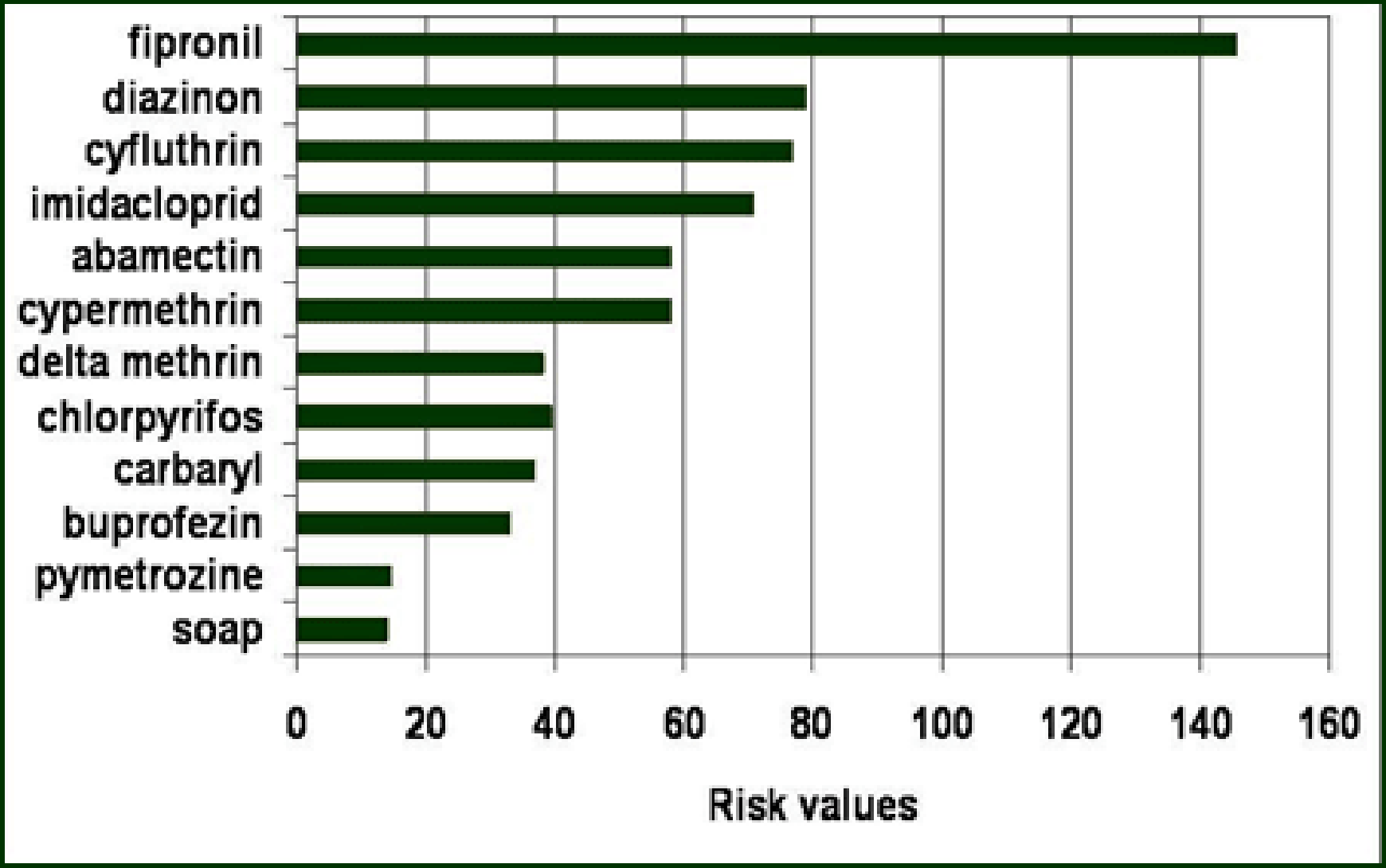
Assessing pest outbreak risks of insecticides



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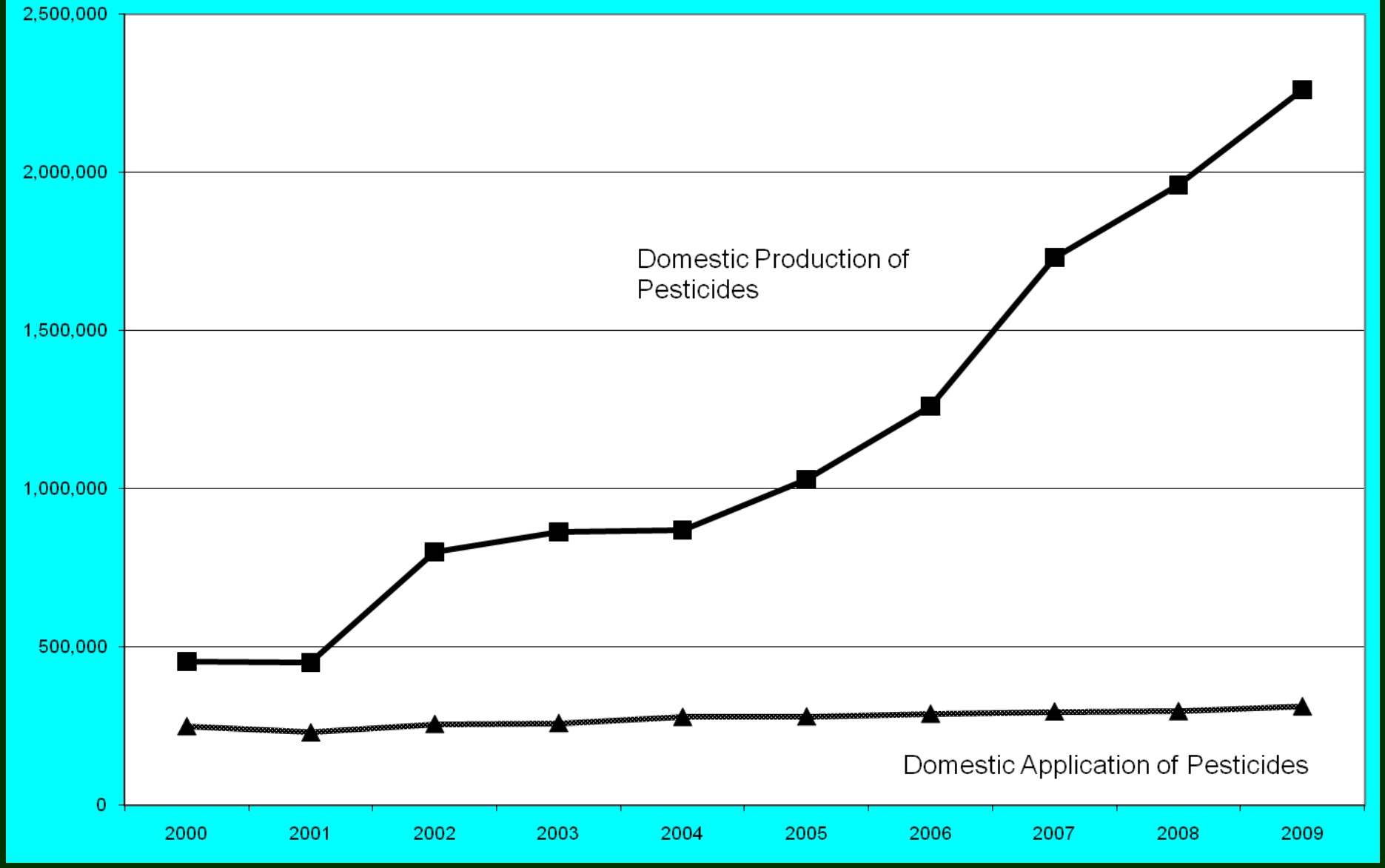
Neonics in China

- Several neonics produced in China – imidacloprid most dominant
- 36 companies manufacturing imidacloprid
- China is the world's largest producer (14,000 t) and exporter (8,000t)
- Domestic market shrinking due to resistance development.
- Applications in rice had been the largest
- Sold as single AI or mixtures in > 500 trade names

China's Pesticide Production (metric tons a.i.) 2000 – 2009. [source: ICAMA]



29 April 2013 Last updated at 14:15 GMT

Bee deaths: EU to ban neonicotinoid pesticides

COMMENTS (872)

The European Commission will restrict the use of pesticides linked to bee deaths by researchers, despite a split among EU states on the issue.

Honeybees are vital for pollinating crops - a job that would be very costly without them

There is great concern across Europe about the collapse of bee populations.

Neonicotinoid chemicals in pesticides are believed to harm bees and the European Commission says they should be restricted to

IRRI

Neonicotinoid Insecticides May be Dumped in Asia if Banned in EU, U.S.