# ONE HEALTH / ECOHEALTH AND ANIMAL HEALTH IN SOUTHEAST ASIA: THEORY AND PRACTICE

*FLAVIE L. GOUTARD*

**Workshop on Applications of One Health / EcoHealth Approach Towards Sustainable Livestock Production in Southeast Asia**

**SEARCA, College, Los Baños, Laguna, Philippines**

GREASE

# HISTORICAL EVENTS LEADING TO DISEASE EMERGENCE

# HISTORICAL EPIDEMIOLOGIC TRANSITIONS – 1ST TRANSITION

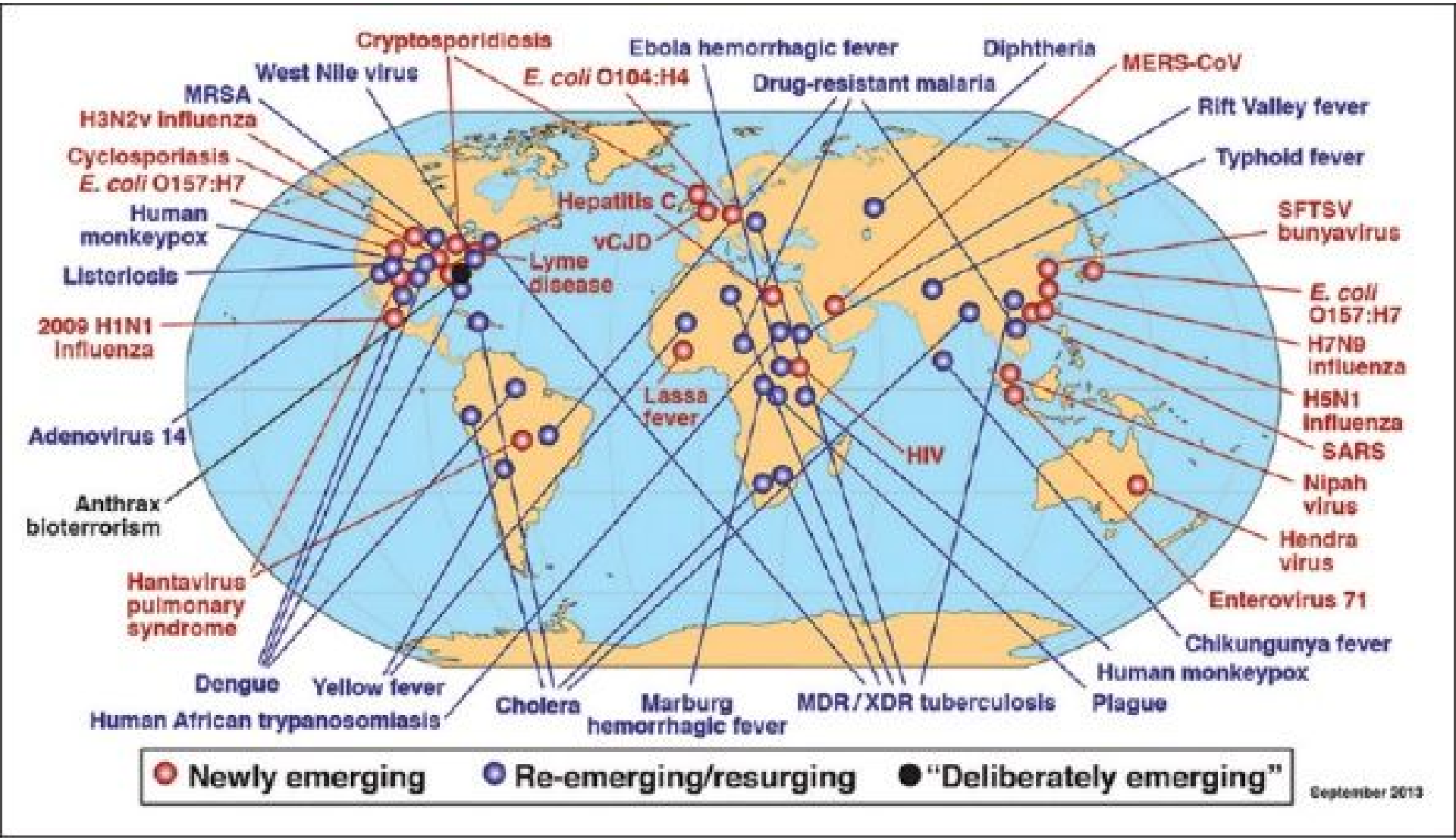
- 10,000 years ago
- New social order due to agriculture
- Zoonoses through animal domestication
- Increases in infectious diseases
- Epidemics in non-immune populations

# HISTORICAL EPIDEMIOLOGIC TRANSITIONS – 2ND TRANSITION

- Coincided with mid-19th century Industrial Revolution
- Decreases in infectious disease mortality
- Increasing life expectancy
- Improved nutrition
- Antibiotics
- "Diseases of Civilization" – cancer, diabetes, cardiovascular diseases
- Environmental problems
- Chronic diseases

# HISTORICAL EPIDEMIOLOGIC TRANSITIONS – 3RD TRANSITION

- Last 25 years
- Emerging infectious diseases globally
- New diseases and increases in mortality; first since 19th century
- Re-emergence
- Antimicrobial resistance
- 75 percent of diseases are zoonotic
- Anthropogenic factors of emergence; the microbial "perfect storm"


Cryptosporidiosis
West Nile virus
MRSA
H3N2v influenza
Cyclosporiasis
E. coli O157:H7
Human monkeypox
Listeriosis
2009 H1N1 influenza
Adenovirus 14
Anthrax bioterrorism
Hantavirus pulmonary syndrome
Dengue
Yellow fever
Human African trypanosomiasis
Cholera
E. coli O104:H4
Ebola hemorrhagic fever
Hepatitis C
vCJD
Lyme disease
Lassa fever
HIV
Marburg hemorrhagic fever
MDR/XDR tuberculosis
Drug-resistant malaria
Diphtheria
MERS-CoV
Rift Valley fever
Typhoid fever
SFTSV bunyavirus
E. coli O157:H7
H7N9 influenza
H5N1 influenza
SARS
Nipah virus
Hendra virus
Enterovirus 71
Chikungunya fever
Human monkeypox
Plague
Newly emerging
Re-emerging/resurging
"Deliberately emerging"
September 2013

# Timeline of new and emerging infections since 1997

Contact with infected livestock is a common mode of transmission for Rift Valley fever

Prairie dog—monkeypox reservoir in 2003 outbreak in USA

Camel—MERS reservoir

West African Ebola outbreak—2014-2016

Ngari virus

Rift Valley fever [Saudi Arabia and Yemen]

Monkeypox [USA]
SARS-CoV
Chapare virus
Plague [Algeria]

*Plasmodium knowlesi*
Lujovirus [southern Africa]
Multi-drug resistant *P falciparum* [SE Asia]
Metallo-β-Lactamase gene in *Klebsiella pneumoniae*

Huaiyangashan virus—SFTS virus
Cholera [Haiti]

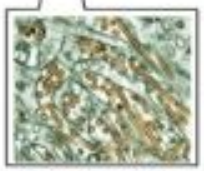
MERS-CoV
Mojiang Paramyxovirus

Avian influenza H5N6
Lassa fever [Benin]
Mobilised colistin resistance gene in E coli
Ebola [West Africa]

CCHF [Spain]
Chikungunya [Pakistan]
Lassa fever [Togo]

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Avian influenza H5N1 virus



Avian influenza A H5N1 virus

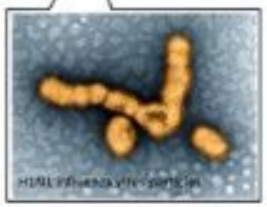
West Nile virus [USA]
Itaya virus
Nipah virus

*Pteropus poliocephalus*—suspected Nipah virus reservoir

EBLV-2 [Scotland]

Human retroviruses, HTLV3, HTLV4

*Candida auris*
Heartland virus
Bas-Congo virus
Plague [Libya]
Lassa fever [Mali]
Pandemic influenza 2009 H1N1 virus

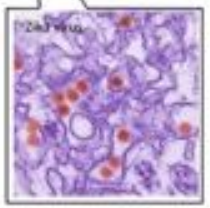


Lassa fever [Ghana]

Avian influenza H7N9 virus
Sosuga virus
Avian influenza H10N8 virus
Chikungunya [Caribbean]

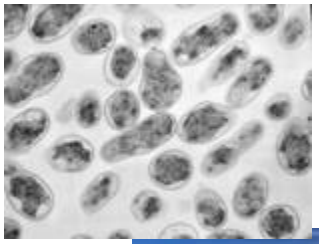
Monkeypox

Bourbon virus
Zika virus [Americas]



All images are from the CDC Public Health Image Library: https://phil.cdc.gov

# FACTORS IN EMERGENCE



- Microbial adaptation and change
- Climate and weather
- Human demographics and behavior
- Economic development and land use
- Changing ecosystems
- Technology and industry
- International travel and commerce
- Poverty and social inequality
- Lack of political will

# MICROBIAL ADAPTATION AND CHANGE

- Increased antibiotic resistance with increased use of antibiotics in humans and food animals (penicillin- and macrolide-resistant Strep pneumonia, multidrug-resistant Salmonella,….)
- *Mycobacterium tuberculosis* and *Neisseria gonorrhoeae* to chemoprophylactic or chemotherapeutic medicines.
- Resistance of the vectors of vector-borne infectious diseases to pesticides.
- Jumping species from animals to humans (avian influenza, HIV?, SARS?)

Cleaveland, S., Laurenson, M.K. &Taylor, L.H (2001). Phil. Trans. R. Soc. Lond. 356, 991-999

# GLOBAL WARMING / ELEVATED RAINFALL

- Global warming - climate changes cause changes in geographical distribution of agents and vectors

- Vector ecology and distribution (flies, ticks, mosquitoes), new breeding habitat for mosquitoes
- Invading pathogen adaptation with new vectors
- Increases of vegetation which increases rodents
- Migratory patterns

# HUMAN DEMOGRAPHICS AND BEHAVIORS

- Economic development and changes in the use of land, including deforestation, reforestation, and urbanization
- Human **demographic change** by which persons begin to live in previously uninhabited remote areas of the world and are exposed to new environmental sources of infectious agents, insects and animals
- Unsustainable **urbanization** causes breakdowns of sanitary and other public health measures in overcrowded cities

2030 - 60% world population living in urban areas

# WILDLIFE FACTOR

- Road construction, Bush meat
  - HIV and chimpanzee
- Forest encroachment, habitat fragmentation
  - Nipah, Hendra and Ebola
- Exotic animal farming (ferret-badger)
  - SARS
- Wet markets, increase of exposition
  - H5N1, H7N9

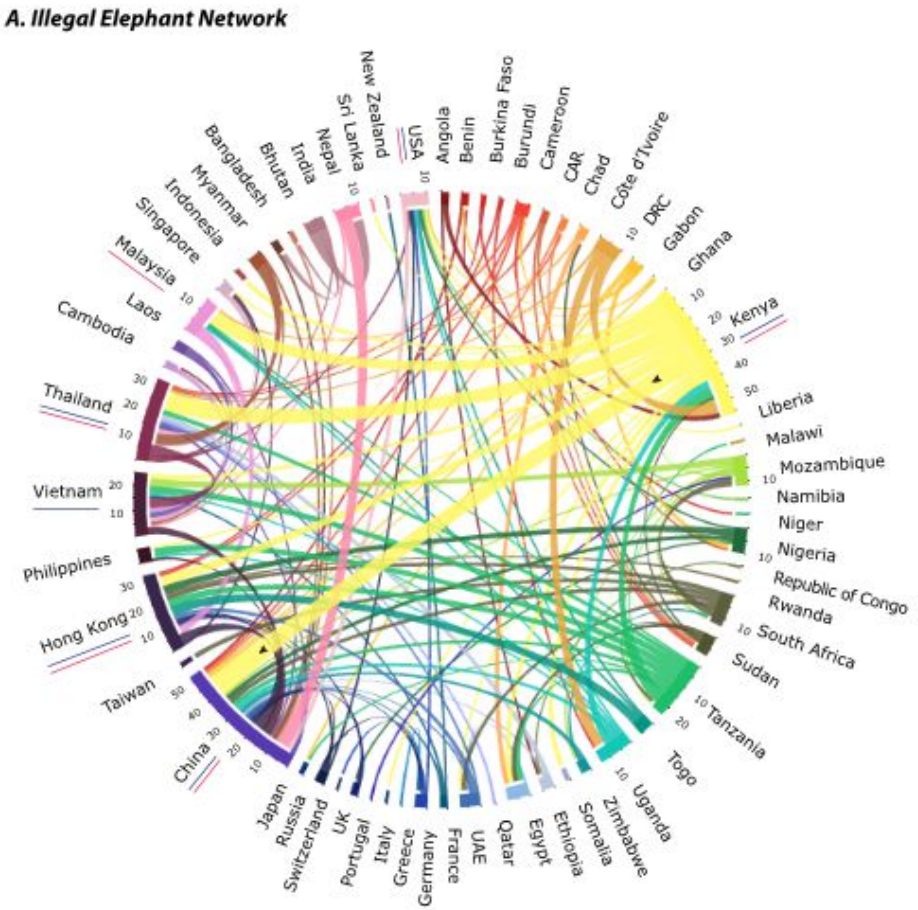
# ANNUAL GLOBAL TRADE IN EXOTIC ANIMALS

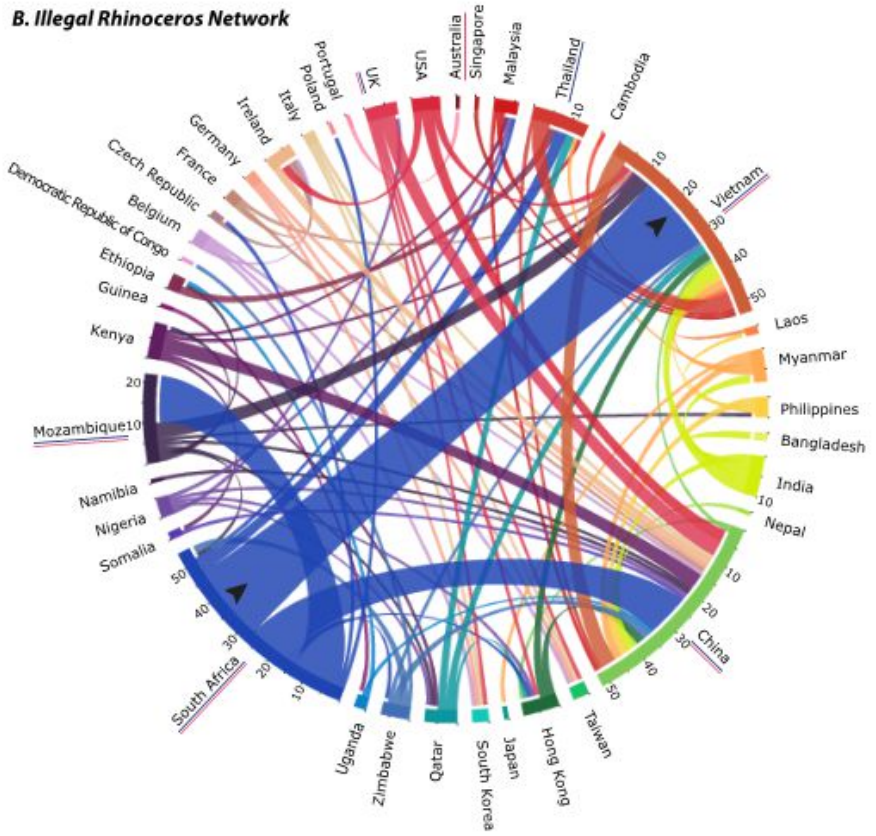
- 4 million birds
- 640,000 reptiles
- 40,000 primates
- Illegal trade unknown – estimate $4-6 billion

- Wildlife Conservation Society



- Illegal wildlife trade flows from august 2010 to December 2013




- Patel, N. G. (2015). *Characterization of illegal wildlife trade networks*. University of Pennsylvania, http://repository.upenn.edu/edissertations/1

# THE NEXT FOOD REVOLUTION

- Global increase and demand for protein and food of animal origin
- Shift from poverty of 1-2 billion people to middle class
- "Westernization" of Asia and Latin America
- Concerns with sustainability
- Increases in emerging zoonoses through the concentration of people and animals

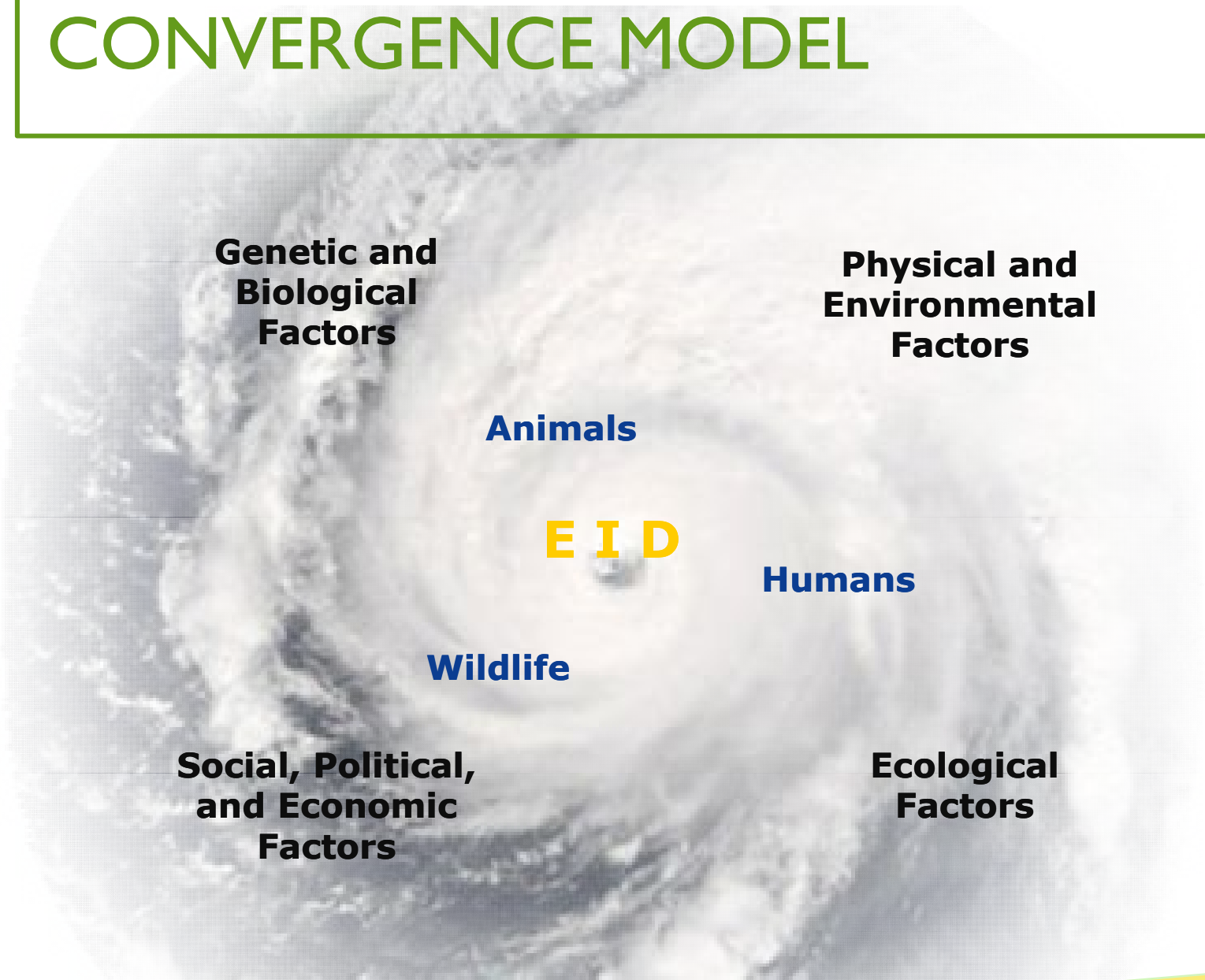
# INTERNATIONAL COMMERCE AND TRAVEL

- International travel and commerce that quickly transport people and goods vast distances
  - 400 million people per year travel internationally

# POLITICAL STABILITY

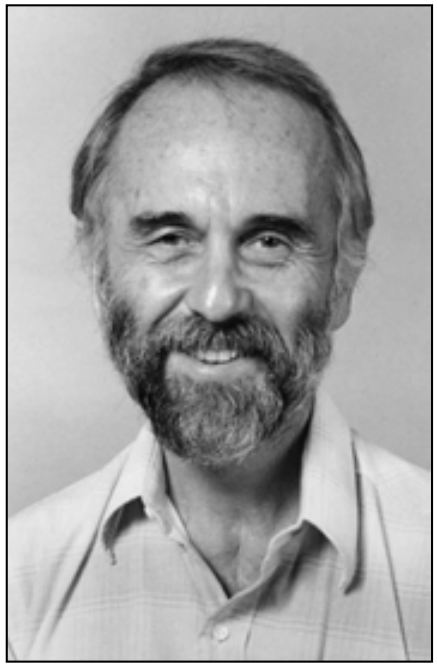
- Lack of political will – corruption, other priorities
- Biowarfare/bioterrorism: An unfortunate potential source of new or emerging disease threats (e.g. anthrax and letters)
- War, civil unrest – creates refugees, food and housing shortages, increased density of living, etc.
- Famine causing reduced immune capacity, etc.
- Manufacturing strategies; e.g., pooling of plasma, etc.

# CONVERGENCE MODEL



# A BRIEF HISTORY OF THE ONE HEALTH APPROACH


www.illinois.edu



Calvin Schwabe
(1927-2006)
Veterinarian

**Calvin Schwabe, veterinary epidemiologist and parasitologist, described and promoted 'One Medicine' and proposed a unified human and veterinary approach to zoonoses in his 1964 book 'Veterinary Medicine and Human Health'**

# INTEGRATING THINKING IN MEDICINE

“ There is no difference of paradigm between human and veterinary medicine. Both sciences share a common body of knowledge in anatomy, physiology, pathology, on the origins of diseases in all species “

(Schwabe 1964).

# ONE HEALTH CONCEPT

- "One Medicine" = crossing over between veterinarians and physicians.
- "One Health" recognizes that humans and animals do not exist in isolation, but are parts of a larger whole, a living ecosystem, and that the activities of each member affect the others.
- One Health = health as a whole (humans, animals, and the environment) *(Kaplan and Scott 2011).*

# ONE HEALTH DEFINITION

**One Health is the collaborative effort of multiple health science professions, together with their related disciplines and institutions – working locally, nationally, and globally – to attain optimal health for people, domestic animals, wildlife, plants, and our environment.**

**One Health Commission**

# THE ECOSYSTEM HEALTH

# WHAT ARE ECOSYSTEMS?

**An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.**

**Wikipedia(http://en.wikipedia.org/wiki/Ecosystem)**

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# ECOHEALTH DEFINITION

- An EcoHealth approach is **transdisciplinary** and recognizes complex biophysical, social, cultural, political and economic relationships between **the ecosystem** and human health.

National Council for Science and the Environment



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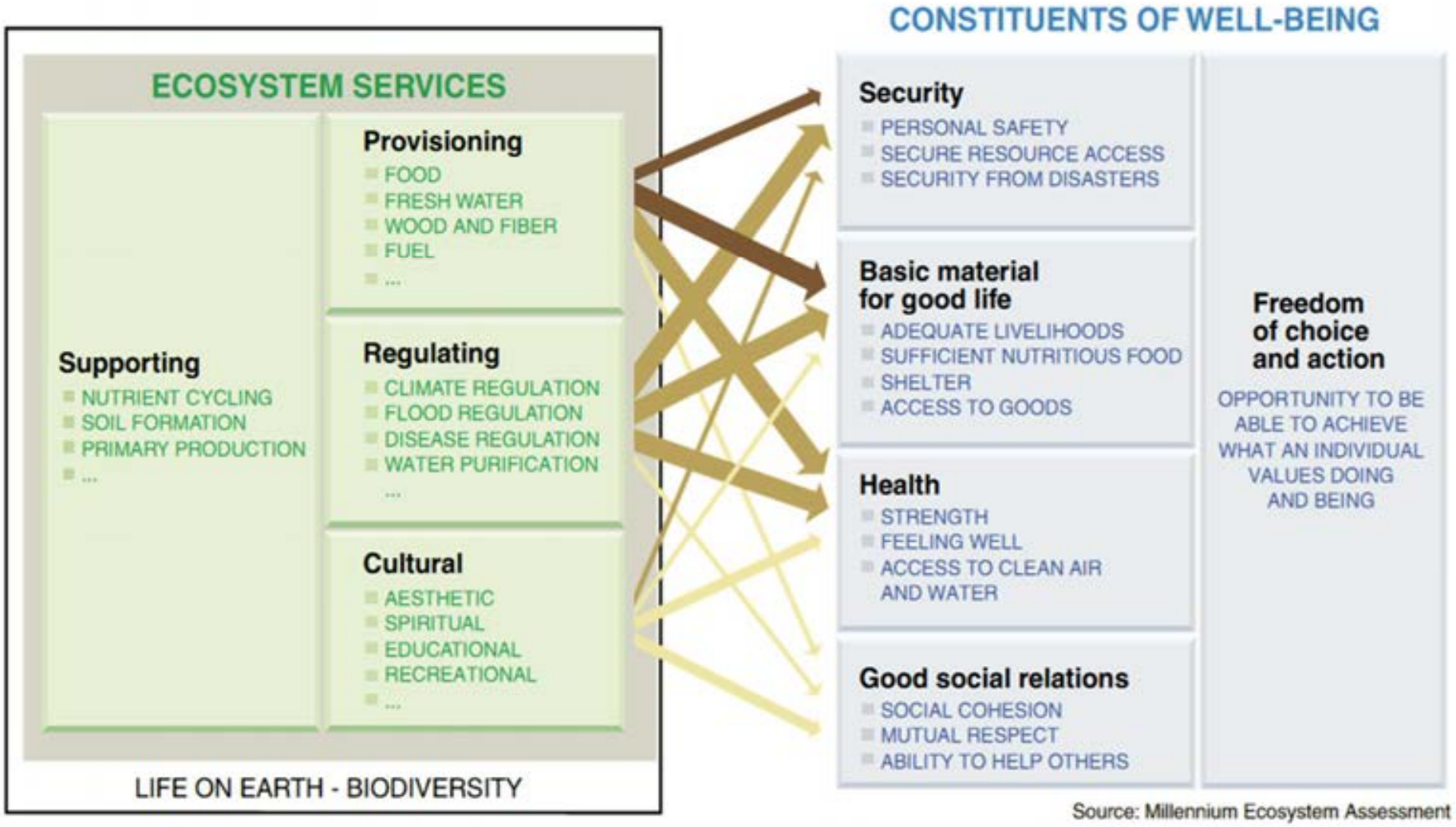


Corvalan, C. et al. 2005. Ecosystems and Human Well-Being: Health Synthesis

# HEALTHY ECOSYSTEM

**A healthy ecosystem is stable and sustainable, maintaining its character in composition, organization and function over time, and its resilience to stress**

# ECOHEALTH: TRANSDISCIPLINARITY

| Normal Science | Transdisciplinary Science |
|---|---|
| Addresses problems conceived by scientists, using controlled experiments, to test hypotheses and advance basic knowledge. | Addresses "real world" problems a perceived by society, using inductive methods in and outside the laboratory and often not in a controlled environment. |
| Fragments of specialization – we call disciplines, sub-disciplines.knowledge into more and more areas. | Re-integrates knowledge in separate disciplines, and sub-disciplines – using interdisciplinary or transdisciplinary approaches. |
| Uses the reductionist approach to investigate nature; breaking it into smaller and smaller parts, each of which is studied in more and more detail. | Uses holistic approach and systems thinking to investigate a problem by combining disciplinary knowledge, concepts and methods, to build a composite "picture" of nature (and social-natural systems). |
| Separates knowledge, teaching and research into academia departments, each focusing on its own discipline, which it advances using the reductionist approach. | Combines knowledge, teaching and research from disciplines through collaborative teaching and research between academia departments. |

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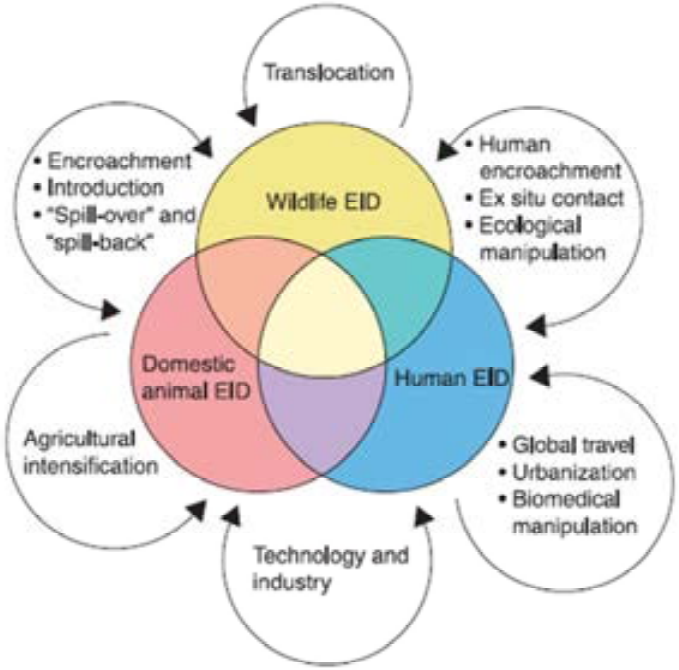
# ONE HEALTH/ECOHEALTH IS ABOUT INTEGRATED APPROACH TO HEALTH

- Addressing health through systems approach, working at **Health/Agriculture/Environment** interface

  → **Shift from disease/pathogens to healthy socio-ecosystems**

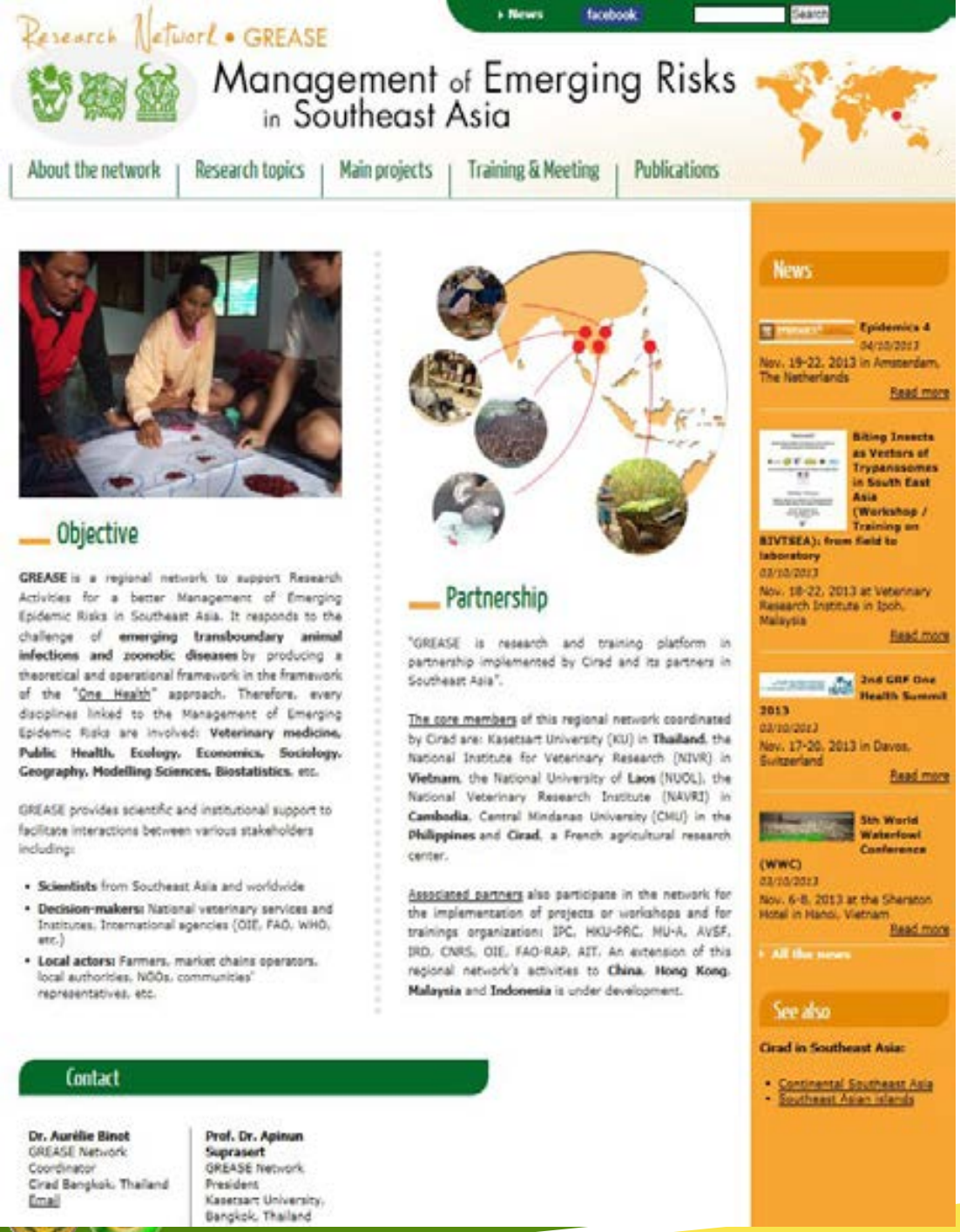
  → **Integration**




Socioecological processes threatening health & Well being

# ONE HEALTH / ECOHEALTH

# GREASE RESEARCH PLATFORM




# Responses to OH challenges in SEA

GREASE enables the development of a multi disciplinary approach through research/training projects and scientific networking

- An interdisciplinary framework for understanding OH / Ecohealth complex issues.
- Strengthening the interactions and dialogue among disciplines, sectors and key actors.
- Contribution to improve risk management strategies
- Development of tailored-made recommendations from scientist to policy makers

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## Partners

**National Veterinary Research Institute >** Cambodia (NAVRI)

**National Institute of Veterinary Research >** Vietnam (NIVR)

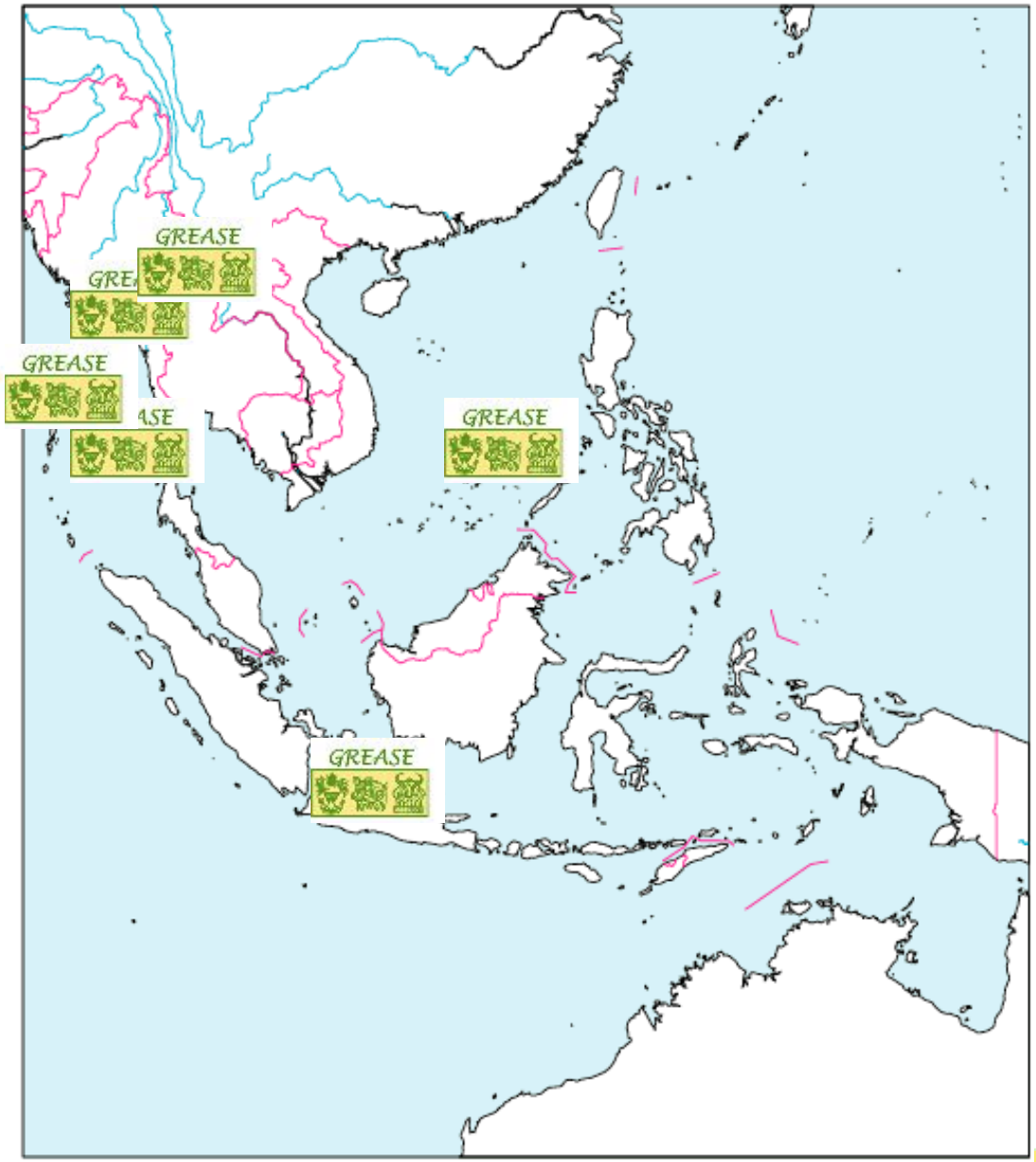
**Central Mindanao University >** Faculty of Veterinary Medicine, Philippines (CMU)

**Kasetsart University >** Faculty of Veterinary Medicine, Thailand (KU)

**National University of Laos >** Faculty of Agriculture (NUOL)

**Gadjah Mada University >** Faculty of Veterinary Medicine (UGM)

**CIRAD >** Internal Research Units: AGIRs, GREEN; Joint Research Units: INTERTRYP, MOISA, QUALISUD



## + 18 regional and international associated partners

Institute Pasteur of Cambodia (IPC), Hong-Kong University-Pasteur Research Center (HKU-PRC), National Institute of Hygiene and Epidemiology in Hanoi (NIHE),Mahidol University (MU), Veterinarians without Borders France (AVSF), Institut de Recherche pour le Développement (IRD), Institut National Polytechnique de Toulouse (INPT), Centre National de la Recherche Scientifique (CNRS), OIE, FAO-RAP, Asian Institute of Technology (AIT), Oxford University Clinical Research Unit in Vietnam (OUCRU), Thammasat University (TU), KhonKaen University(KKU), Veterinary Public Health Centre for Asia Pacific (VPHCAP), Chiang Mai University (CMU), the School of Environmental Science and Management (SESAM-UPLB) of the University of the Philippines at Los Baños, Philippines an the Faculty of Veterinary Medicine of Nong Lam University of Ho Chi Minh City in Vietnam.


## + collaborative centers

Vietnam National University of Agriculture (VNUA), National Institute of Animal Sciences in Vietnam (NIAS), Global Health Asia Institutes (GHA) in Bangkok, Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) in Philippines, Center for Public Health and Ecosystem Research (CENPHER) in Hanoi, South-east Asia One Health University Network (SEAOHUN/ VOHUN), International Livestock Research Institute Asia (ILRI)

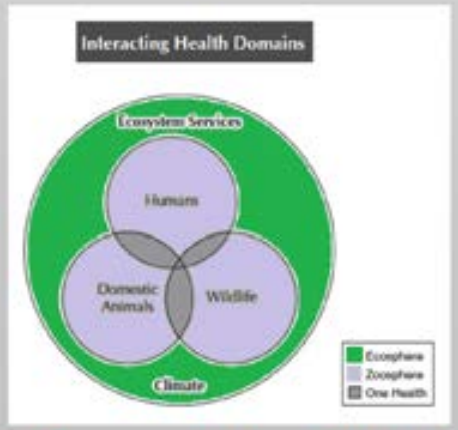
**STRENGHTENING SYNERGIES AMONG RESEARCH INSTITUTIONS**

GREASE

An integrated approach in the framework of veterinarian public health…

A corpus of methods and tools, which combine

Ecology,
Quantitative Epidemiology,
Geography,
Sociology,
Biostatistics,
Mathematical Modeling,
Parasitology etc.




*… Strengthening the interactions between social and biological/medical sciences*

Epidemiology & Modeling

Ecology & Social Sciences

*… Development of a multidisciplinary approach through research/training projects and scientific networking*

***Purpose of GREASE:***
***STRENGHTENING SYNERGIES AMONG RESEARCH INSTITUTIONS***

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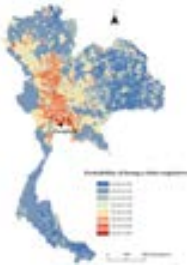
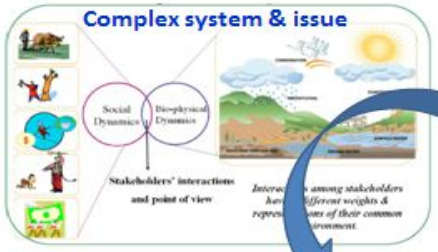
# MERGING TOGETHER SOCIAL & BIOMEDICAL SCIENCES

## Participatory approaches

→Social factors driving behavior (animal health surveillance)
→ Emergence patterns
Social, Cultural, Economical and Political
→ Risks Representations and Perceptions
→ Communities Empowerment & Collective action

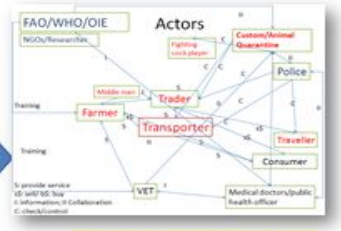





System approach
&
Participatory context analysis

- Problem / issue
- key Actors / stakeholders
- key Resources and related components (land, forest, water, etc.)
- Dynamics/process (and driving factors)
- Interactions

PARDI




Conceptual model

## → Social networks analysis

- Identifying stakeholders and their interactions
- Information spreading (surveillance systems)

## Toward a shared representation of the socio-epidemiological system

→Co-designing a shared representation through Companion Modeling (ComMod)

# NETWORK OF EXPERTISE

- Various skills/competences readily mobilised:
  - Veterinary Sciences / Biology
  - Agriculture / Ecology
  - Public Health
  - Social Sciences / Economics
  - Epidemiology, Biostatistics, Modelling, Health Geography, Laboratory technics, Genetics, Participatory methods…
- Solicitation for:
  - Customized training (on-site) for biomed and soft skills
  - Education
  - Projects development
  - Support in System Thinking application

# CUSTOMIZED TRAINING

- In participatory Epidemiology
- In Companion Modelling
- Qualitative research
- In Surveillance
- In Risk Analysis
- In QGIS
- In Bio-ethics
- Policy transfer
- (…)



policy brief

GREASE

December 2017

Moving towards a One Health surveillance system for antibiotic resistance in Vietnam

Marion BORDIER, NGUYEN Thi Dien

Executive summary

# EDUCATION

**INTERRISK Master Program**

***For the « Assessment and management of health risks at the human, animal and ecosystem interface »***

# KEY PROJECTS

https://www.youtube.com/watch?v=SWO2gsMk708&t=391s

## Revasia

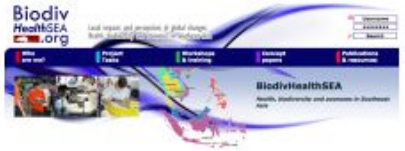

- Research on evaluation/optimisation of animal disease management systems
- Interdisciplinary approaches integrating socio-economy, epidemiology and modeling
- Developing tools to improve public/animal health and private/public partnership in zoonotic disease surveillance


- http://revasia.cirad.fr/

## BiodivHealthSEA


- Niche modelling and epidemiology
  - Does infection in rodents reflect the infection of humans ?
  - Is there "hotspot" of Leptospira incidence in humans?
  - What are the likely socio-environmental associated factors
    - Slopes, watershed, rain-red rice fields…?


www.biodivhealthsea.org




READI

REGIONAL EU–ASEAN DIALOGUE INSTRUMENT

Un réseau d'excellence pilote sur l'utilisation de la modélisation participative appliquée aux questions de sécurité alimentaire dans un cadre One Health

COM ACROSS

Companion Approach for Cross-sectoral collaboration in Health risk management in SEA

EuropeAid INNOVATE One Health in Asia

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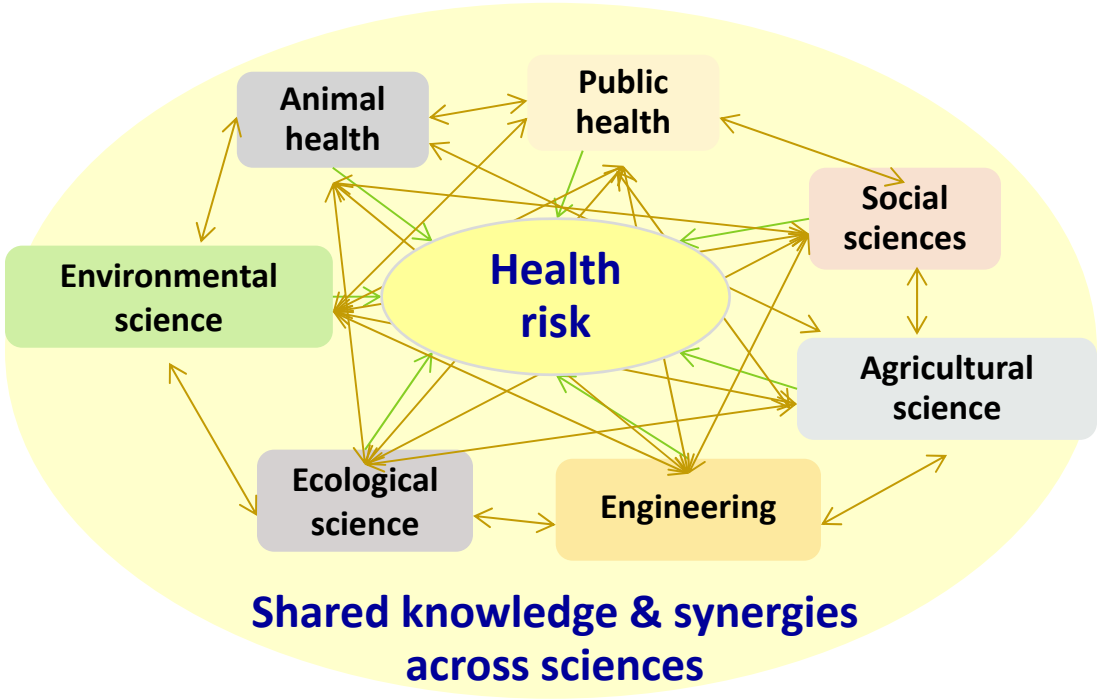
# INTERDISCIPLINARITY / TRANSDISCIPLINARITY

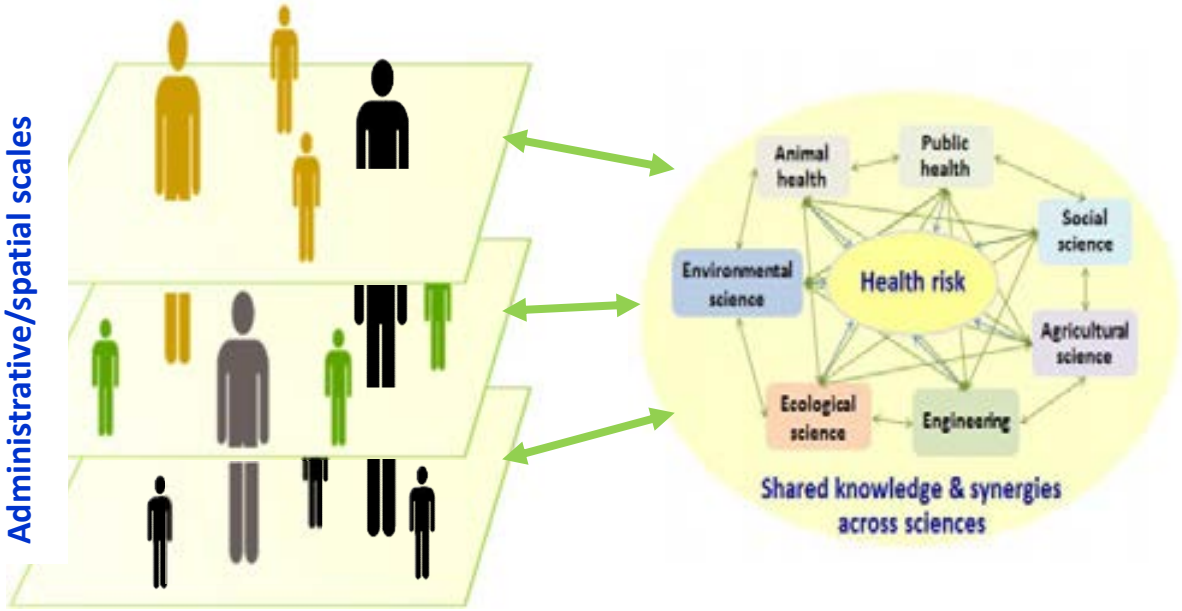



- "*Cannot be understood through conventional disciplinary approaches*" Solutions far beyond technology and scientific knowledge.
- Require **trans-discipline effort** and cross-sectoral collaboration.

# ACROSS MULTI-LEVEL ARENA, CROSS-SECTORAL OH ISSUE:

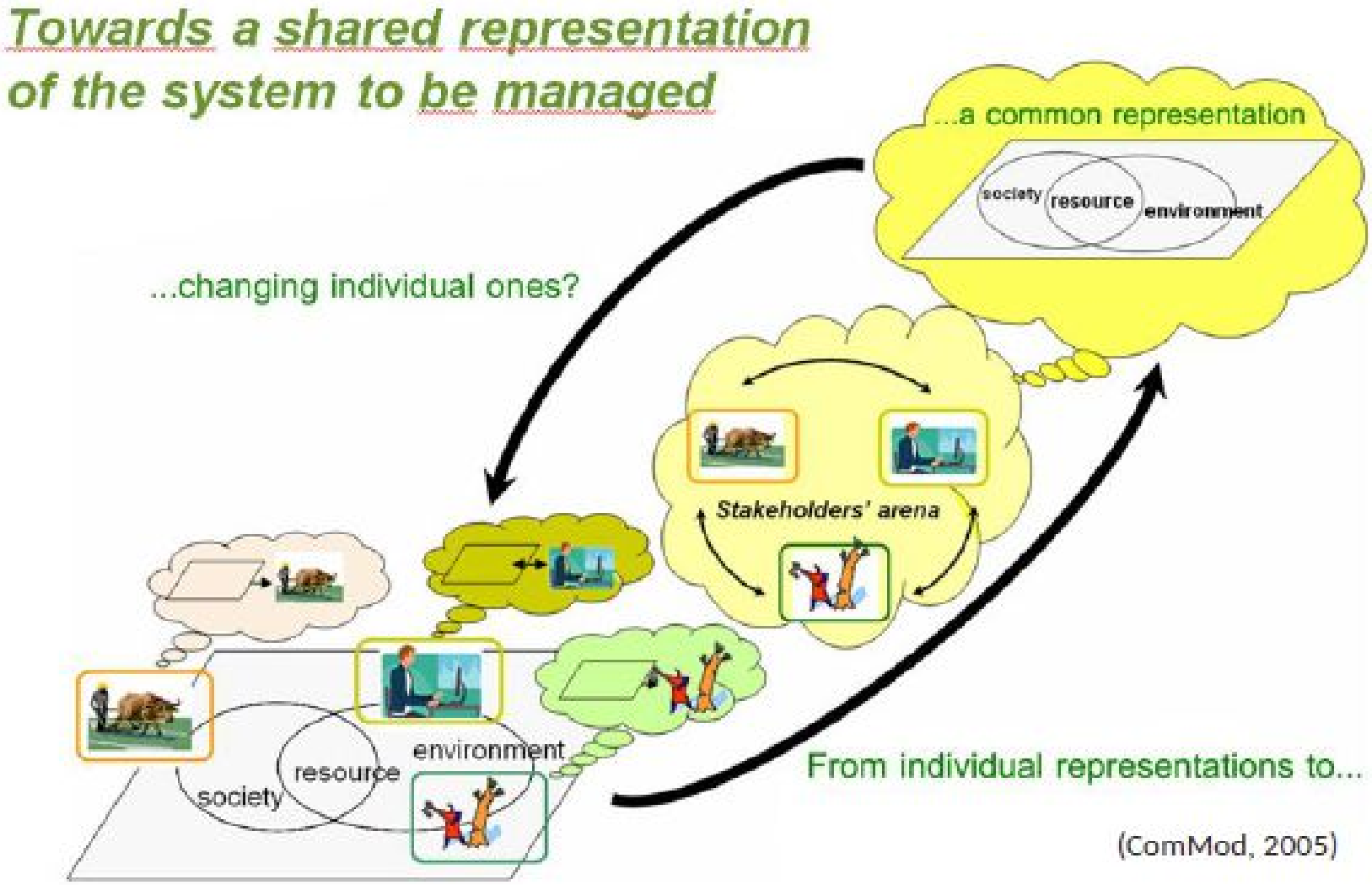
**Articulation between Health/Environment/Agriculture**
**Multi-stakeholders**

So many different stakeholders concerned, from local authorities, communities, policy makers from different levels, researchers, population at risk, private sector,




**How to articulate these stakeholders?**
**How to frame the problem and look for shared and negociated solutions?**

# Relying on participatory and collaborative methods and tools to promote systems thinking



# Developing an integrated One Health Approach operational in SEA (Thailand, Laos, Cambodia) at the Human / Animal / Environment interface

→ **3 Case studies approach to set up One Health community of practice**

Elaborating on "model diseases" as <u>case studies</u> for knowledge sharing and cross-sectoral collaboration:

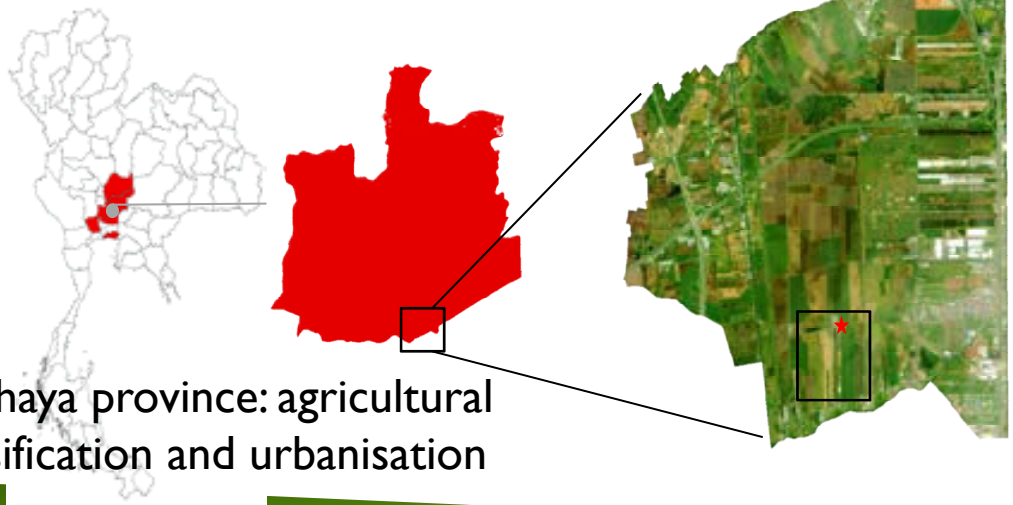
- **Waste management and health (in Thailand)**
- **Encephalites control : JE and Nipah Virus (in Cambodia)**
- **Parasitic zoonoses – neglected diseases in family farming (in Laos)**

**+ Implementation of a capacity building / training program**

# → Thai case: Environmental management (waste, water, rabies)

Accompanying local stakeholders in environmental and health risk management

- Flooding
- Water management
- Waste management



Ayutthaya province: agricultural intensification and urbanisation

# → Implementing collaborative modeling approach

- Stakeholders workshops aimed at **highlighting the gaps in coordination across agriculture, environment and health sectors** at municipality and provincial levels.
- Local **stakeholders' risk perception** was highlighted through participatory process
- The project provided **scientific based evidences** relying on epidemiological studies, participatory appraisal, risk analysis and risk mapping, contributing to empower the local stakeholders for animal and human waste management issues, and for rabies management.
- These inputs have allowed to **modify and implement local policy** (municipality and provincial level) improving **rabies** management: health volunteers training for dogs vaccination, stray dogs surveillance; local **waste management** facilities have been setup

# → Lao case: Parasitic food-borne diseases (PFBD)

## Major sanitary burden faced by farmers' communities

- PFBD can significant impact human health, livelihood and economy
- Neglected disease

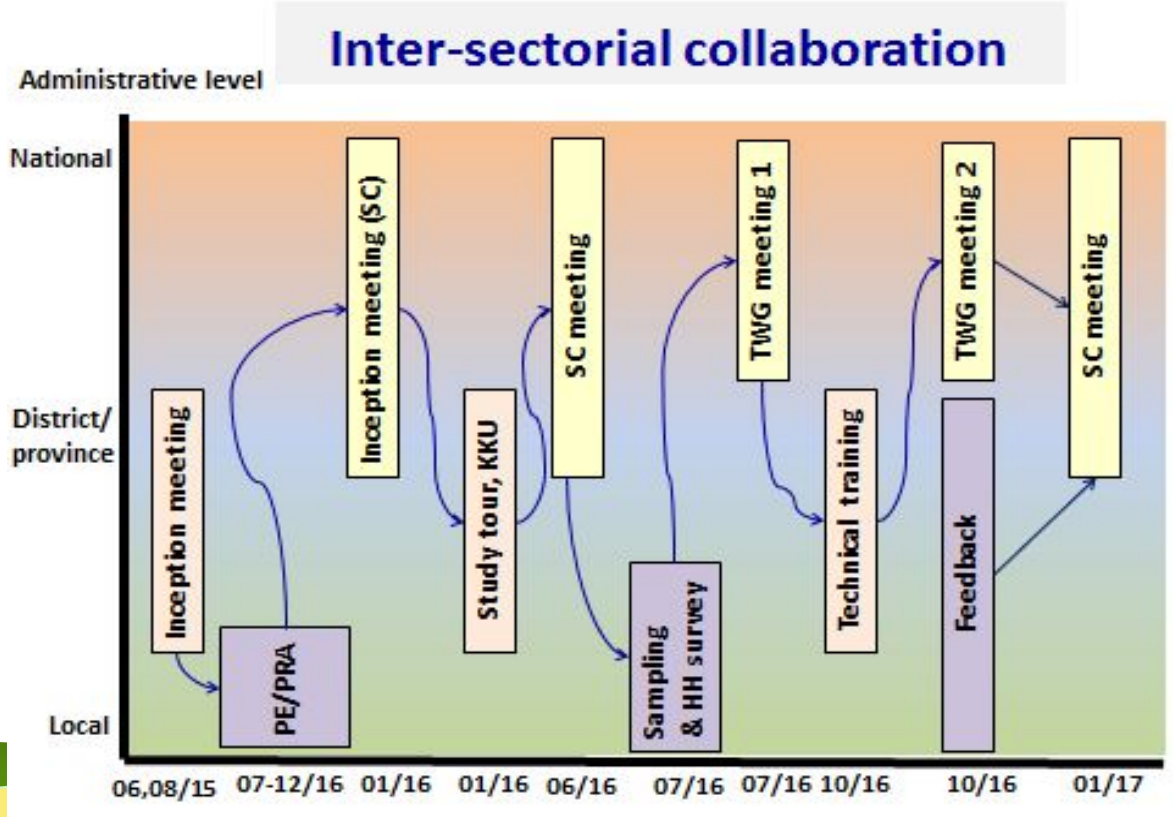
→ Understand risk-related perception & practices

→ Establish a cross-sectorial collaboration platform to promote feasible prevention & control.

# → IMPLEMENTATION OF COLLABORATIVE MODELING APPROACH

- An **inter-ministerial platform** has been set up to address parasitic foodborne diseases as a neglected OH diseases in Southern Laos
- **Building capacities of operators** for integrative approach to participatory/qualitative approaches for the characterisation of Socioecological systems
- Design **interventions at local level** (deworming campaign, awareness rising about risks at school and community level, sampling and diagnosis,…)

**→ Linking levels to understand local risk perception and design intervention accordingly at local level, with national support**



# → Cambodian case: Contribution to encephalites control measures

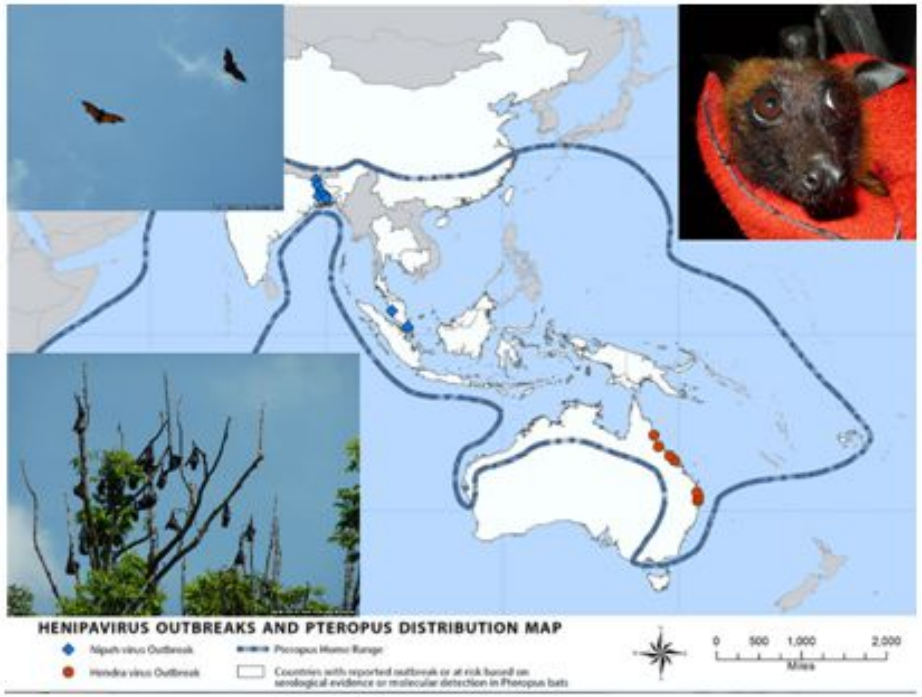
**Japanese encephalites**

- Largest worldwide cause of epidemic viral encephalite, endemic in Southeast Asia
- Vector borne disease: Epidemiology more complex than it seems to be
- Defining areas at risk
- Risk communication/Information/Awareness
- Propose **adapted** and **integrated** control measures combining vaccination, mosquito control, pig and human protection against mosquito bites

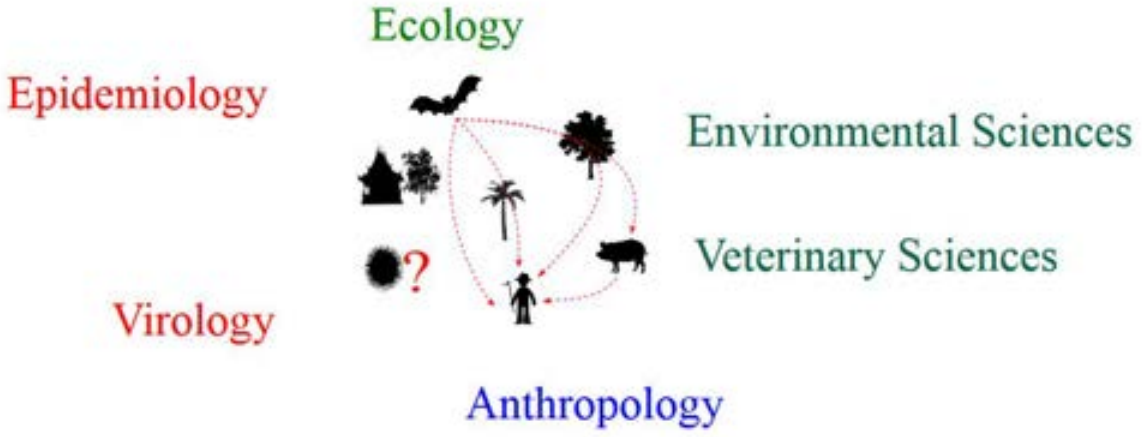
**Nipah Virus**

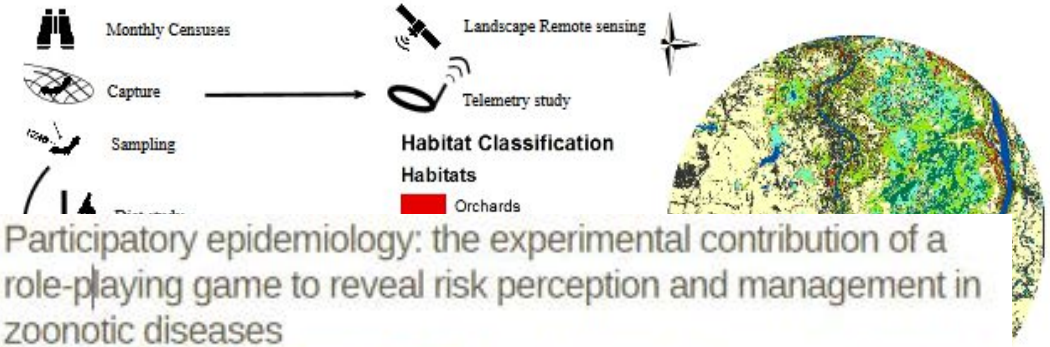
- Bats are considered to be the main reservoir of the virus and transmission of NiV to pigs and to humans
- Environmental factors such as land use change and livestock intensification were pointed out as potential risk factors.
- Understanding the conditions and determinants of bat/human interface

# Complex interactions at Human/Animal/Environment/interface

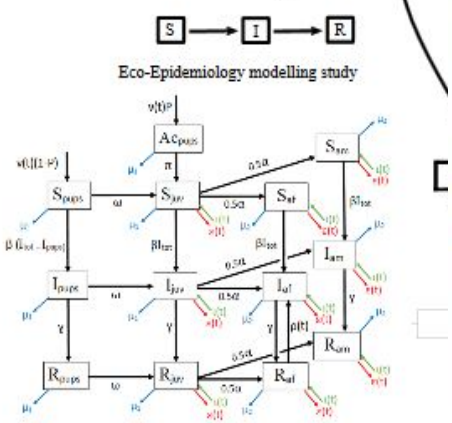



**<u>Example</u>: Nipah virus**






Participatory epidemiology: the experimental contribution of a role-playing game to reveal risk perception and management in zoonotic diseases

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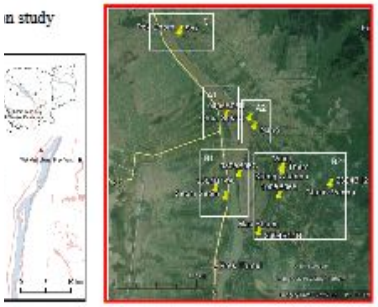

Integration of epidemiological, ecological and socioeconomic data about encephalites in a role playing game

→ Enabling knowledge sharing for risk communication (control measures involving at risk populations)

# CAPACITY BUILDING: ARTICULATION AND INTEGRATION CHALLENGE

- Systems Thinking
- Transdisciplinary Research
- Participation
- Sustainability

**Involving multiple stakeholders**

- ❖ Facilitate mutual learning
- ❖ Reinforcing the environment dimension (socio-ecological system's health)
- ❖ From knowledge to Action

**Applying systems thinking:**

- characterization of the complex system (modeling) and definition of the problem
- Designing solutions through participatory approaches

# Developing an operational framework based on Systems approach

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## A framework to promote collective action within the One Health community of practice: Using participatory modelling to enable interdisciplinary, cross-sectoral and multi-level integration

Aurelie Binot [a,b,*], Raphaël Duboz [a], Panomsak Promburom [c], Waraphon Phimpraphai [b], Julien Cappelle [a,d], Claire Lajaunie [e], Flavie Luce Goutard [a,b], Tanu Pinyopummintr [b], Muriel Figuié [f], François Louis Roger [a,b]

- Improved coordination and systems thinking capacities
- Capacity building
- Involvement of “non traditional” One Health stakeholders at different levels (local authorities), empowerment of One health stakeholders
- Co-management of healthy environments as a common resource

# → Setting up  a One Health community of practice

- Co-designing a common culture, research postures,
- Through practices and regular exchanges, knowledge sharing, participatory activities (ComMod workshops, RPG, PE …)
- Deliverables: methodological participatory tool box (promoting integration) and  systems thinking approaches

- Rather a “process” than a “recipe/formula”
- Science-based / intervention-based activities: integrating environmental management, agricultural & territorial dynamics with our OH global questions
- Learning by doing process conducted with various target groups

https://www.youtube.com/watch?v=SWO2gsMk708&t=391s

# THANK YOU

GREASE