ECOHEALTH IN SOUTHEAST ASIA: THEORY AND PRACTICE

Rico C. Ancog
Ecosystem Services and Environmental Policy (ESEP) Laboratory
School of Environmental Science and Management, UPLB
Southeast Asia is considered as a hotspot for zoonotic diseases due to its tropical condition which is conducive for the spread of such diseases through bacterial multiplication and parasite survival (Gilbert et al., 2014; Nguyen-Viet et al., 2015).
CHALLENGES TOWARDS EMERGING ZOONOTIC DISEASES

- Globalization and international trade
- Forest habitat alteration
- Agriculture intensification
- Urbanization
- Climate change
ECOLOGICAL TIME-SPACE SCALES: LEVELS OF ORGANIZATION RELEVANT TO DISEASE EMERGENCE

Time Scale (yrs) $10^3$

- Climate change
- Urbanization/Habitat loss/
- Agricultural Intensification
- Meta pop’l dynamics
- species diversity/dispersal
- Interspecific interactions
- Herd immunity
- Microevolution
- individuals
- immune response,
- infection, recombination, mutation

Space Scale ($m^2$)

10^6

- The Biosphere
- Biomes & regional ecosystems
- Landscapes
- ecological communities
- populations
- fast & small!

10^0

10^12

Slow & Large!
( Processes that occur on a large spatial scale over long periods of time.)
Development and land use policy

Parasite abundance

Reservoir species diversity and abundance

Disease ecology, tropical medicine, and evolutionary biology of disease

Parasite infectivity and virulence

Pathology, immunology, and molecular genetics

Host-parasite co-adaptation

Innate and innate immune status

Pathogen, infection, disease

Physiological and psychological state

Biomedical and behavioral sciences, medical sociology, and social epidemiology

Social, economic and cultural circumstances

Types, condition and spatial pattern of ecosystems in the landscape

Landscape and ecosystem ecology

Biodiversity studies and community ecology

Habitat availability

Geography and environmental science

Development and policy studies

Land use and land use change

Habitat availability

Vector abundance

Parasite abundance

Parasitology, entomology and medical ecology
Emerging Zoonotic Pathogens as an Ecological Phenomenon

- Ecological factors of infectious disease emergence include land use change, human movement, encroachment and wildlife translocation, and climate change.

- The processes influencing transmission of zoonotic pathogens can be described as a consequence of one or a combination of three possible kinds of change: expansion of the habitat or geographic range of a host, of a pathogen or both; expansion of human's habitat or geographic range; or change in the habitat or ecosystem occupied by both humans and the natural host.

- Examples: Malaria transmission, Lyme disease, Liver flukes, Water-borne diseases
More than 75% of emerging infectious diseases are zoonotic, that is, they spread from animals to humans from natural host-pathogen cycles in nature.

The emergence process involves a multitude of social and ecological factors, forces, and mechanisms operating at the level of microbial genetic adaptation to land use transformation and regional environmental change – not to mention globalization.

**INTEGRATING ECOLOGY AND ENVIRONMENTAL CHANGE**

- Human Ecosystems
- Agroecosystems
- Natural Ecosystems

Host-vector ecological & evolutionary cross-landscape transition
(from Ellis and Wilcox 2009)
REGIONAL ENVIRONMENTAL CHANGE

Population
Technological capacity
Socio-cultural organization

Urbanization
Agricultural intensification*
  * Includes food production
Habitat alteration

ECOSYSTEM LEVEL OF ORGANIZATION

ecosystem continuum

(Human) (Natural)

(Based on Wilcox and Gubler 2005)
REGIONAL ENVIRONMENTAL CHANGE

Population
  Technological capacity
  Socio-cultural organization

Urbanization

Agricultural intensification*
  * Includes food production

Habitat alteration

Species' Ecological-evolutionary Dynamics
  Opportunistic habitat expansion/ecological release
  Vector/Reservoir (domestication)  Feral reservoir species
  Wildlife transport  Human encroachment

LANDSCAPE LEVEL OF ORGANIZATION

ecosystem continuum

(Based on Wilcox and Gubler 2005, Wilcox and Colwell 2005)
REGIONAL ENVIRONMENTAL CHANGE

Population
  Technological capacity
  Socio-cultural organization
  Urbanization
  Agricultural intensification*  
  * Includes food production
  Habitat alteration

Species’ Ecological-evolutionary Dynamics
  Opportunistic habitat expansion/ ecological release
  Vector/Reservoir (domestication)  Feral reservoir species
  Wildlife transport  Human encroachment

Host-Pathogen Dynamics
  Emergence Processes of ‘Host-Parasite Biology’
  Host switching (host novelty)  Breaching of pathogen persistence thresholds
  Transmission amplification and genetic exchange (pathogen novelty)

COMMUNITY LEVEL OF ORGANIZATION

(Based on Wilcox and Gubler 2005)  ecosystem continuum

HUMAN
ECOSYSTEM
NATURAL
ECOSYSTEM
REGIONAL ENVIRONMENTAL CHANGE

Population
- Technological capacity
- Socio-cultural organization

Urbanization

Agricultural intensification*
* Includes food production

Habitat alteration

Species' Ecological-evolutionary Dynamics
* Opportunistic habitat expansion/ecological release
  - Vector/Reservoir (domestication) → Feral reservoir species
  - Wildlife transport → Human encroachment

Host-Pathogen Dynamics
* Emergence Processes of 'Host-Parasite Biology'
  - Host switching (host novelty)
  - Breaching of pathogen persistence thresholds
  - Transmission amplification and genetic exchange (pathogen novelty)

Disease Emergence

(Based on Wilcox and Gubler 2005)

ecosystem continuum
ROLE OF ECOLOGY IN UNDERSTANDING EMERGENCE (RE-EMERGENCE) OF DENGUE (AND OTHER ARBOVIRUSES)

THREE ELEMENTS REQUIRED FOR INTERVENTION TO BE EFFECTIVE (WILCOX & GUBLER, 2005)

Control of Zoonotic Diseases → A multilevel ecosystem approach → Incorporated ecological theory and data → Local scale intervention using a participatory approach → EcoHealth
EcoHealth is a holistic approach to human health that integrates humans, animals, and the environment as one. This approach aims towards understanding risks on animal health through coordination of the human-animal-ecosystem interface applied at the national and regional levels.
Initially designed by disease ecologists

linkages between ecosystems, society and health of animals and humans (Rapport, 1998)

3 key principles (Charron, 2012): transdisciplinarity, participation and equity

More pragmatic level and local scale

Bottom-up (health issues identified by communities)

Transdisciplinary approach to address public health issues attributable to environmental conditions and leaning rather on social conditions than on biomedical variables.
As a theory, EcoHealth recognizes that there are several factors that affect health and well-being, and these factors relate to each other in a complex and multi-dimensional web.

Unger (2015) presented its key principles: systems thinking; knowledge to action; transdisciplinarity; participation; equity; and sustainability.
SYSTEMS THINKING

• Understanding and examining the linkages and interactions between the elements that make up the system.

• Scale is important in a systems perspective
  ▪ E.g. time-scale, seasons, climate change

• Challenges in systems thinking include:
  ▪ Defining the boundaries of the system
  ▪ Choosing between inclusivity and feasibility based on time, skills, and capacity

Adapted from Unger (2015)
Knowledge to action refers to the idea that knowledge generated by research is then used to improve health and well-being through an improved environment.

Knowledge moves both ways
- Researchers pushing new knowledge into policies.
- Policy makers gaining new knowledge from research.
TRANS DISCIPLINARITY

- This refers to a comprehensive vision of health issues by scientists from multiple disciplines together with stakeholders and policy actors.

- Evolves the integration of research methodologies and tools across disciplines including non-academic perspectives and local knowledge.

- Wide range of skills sets are needed which are usually not part of academic training (e.g. consensus building, facilitation, and communication).

Adapted from Unger (2015)
HOW TO OPERATIONALIZE TRANSDISCIPLINARITY?

Scientific bodies of knowledge

Encyclopaedic understanding
- To integrate different disciplines’ bodies of knowledge
- To develop an understanding that accounts for complexity and diversity

Reflection-in-action
- To consider risks and unintended consequences of solutions
- To develop solutions to societal problems that account for complexity and diversity

Non-scientific bodies of knowledge

Holistic understanding
- To integrate scientific and non-scientific bodies of knowledge

Problem solving
- To generate practical solutions that are implemented
Source: Schelling et al (n.d) presentation titled “From One Health research to training and practical implementation”. Human and Animal Health Research Unit. SWISS TPH.  
www.transdisciplinarity.ch  
Brewer 1999, «The challenges of interdisciplinarity», Policy Sciences
• We need a range of methods, if we are to understand the subject of study, by taking an external observational (etic) and internal perceptional (emic) perspective
• Both quantitative and qualitative approaches enrich our knowledge
• Not a question of “either-or” but “when-which”.

Vulnerability and resilience framework - multi-layered social resilience framework, Obrist et al. 2011
PARTICIPATION

- Participation aims to achieve consensus and cooperation among scientific community, stakeholders, and decision-making groups.
  - Define on who should participate and what will be their role
  - Mapping and analysis of potential actors, stakeholders, or groups
  - These will help to:
    - Identify boundaries
    - Recognize existing barriers to change
    - Provide options to move forward

Adapted from Unger (2015)
GENDER AND SOCIAL EQUITY

- Involves analyzing the respective roles of men and women, and various social groups.
  - Gender and age
  - Social, cultural, and economic class
  - Ethnic minorities and marginalized groups

- Why is it important?
  - Inequity in access to health care
  - Women held major responsibilities on health of their families
  - However, women have little power on household income allocation decision-making

Adapted from Unger (2015)
SUSTAINABILITY

- EcoHealth research should aim towards sustainability wherein every action is ethical, efficient, environmentally sound, and socially acceptable.
- Short-term needs might not be consistent with long-term process for health improvement.

Adapted from Unger (2015)
SAME CHALLENGES!!

How to merge together different points of view?
How to demonstrate the benefits?
SOME CASE STUDIES
IN PRACTICE?

RP-PCP
“Production and Conservation in Partnership”
http://www.rp-pcp.org

DP-F&B
“Forests and biodiversity”
http://www.forets-biodiv.org

GREASE
“Research network for the management of emerging risks”
http://www.grease-network.org
Objective

GREASE is a regional network to support Research Activities for a better Management of Emerging Epidemic Risks in Southeast Asia. It responds to the challenge of emerging transboundary animal infections and zoonotic diseases by producing a theoretical and operational framework in the framework of the "One Health" approach. Therefore, every discipline linked to the Management of Emerging Epidemic Risks are involved: Veterinary medicine, Public Health, Ecology, Economics, Sociology, Geography, Modelling Sciences, Biostatistics, etc.

GREASE provides scientific and institutional support to facilitate interactions between various stakeholders including:

- Scientists from Southeast Asia and worldwide
- Ducilators: National veterinary services and Institutes, International agencies (OIE, FAO, WHO, etc.)
- Local actors: Partners, market chain operators, local authorities, NGOs, communities' representatives, etc.

Focus on producing a theoretical and operational framework for analysis and integration of disciplines and stakeholders

http://www.grease-network.org/
COMPANION APPROACH FOR CROSS-SECTORAL COLLABORATION IN HEALTH RISK MANAGEMENT IN SEA

ComACross

2014-2018
Improve awareness on OH/ EcoHealth best practices
- Frameworks and mechanisms for improved “dialogue” and routine collaboration: companion modeling and participatory mapping

Improve vocational competencies
- Eco-epidemiological studies, participatory field work, various training

Raise postgraduate students’ capacities on “Assessment and management of risks at the H/A/E interface
- InterRisk Master degree (Kasetsart Un./ ENVT)
LIVER FLUKE (OPISITHORCHIS VIVERRINI AND CLONORCHIS SINENSIS) INFECTION AND LIVER DISEASE IN SOUTHEAST ASIA

From Spripa et al 2012
TWO VIEWS OF LIVER FLUKE INFECTION AND CCA RISK

Reductionistic View of CCA Risk*

- consumption of raw fish
- *O. viverrini* infection
- CCA

*The biomedical model-based depiction of CCA causation, informing clinical diagnostic and treatment; historically employed by government "health education" campaigns.

(Steele et al, In prep).

---

A Holistic View of CCA Risk*

- Social-Ecological Risk
- Genetic Risk
- Behavioral Risk
- Clinical Risk

* A holistic schema of *Ov*-associated CCA in the diagram to the right represents a synthesis of risk factors from an extensive literature review of published epidemiological, clinical and laboratory research.
“...a conceptual framework for examining the Wilcox-Gubler-Colwell hypothesis in the context of ... risks, and perceptions of risk, associated with highly pathogenic avian influenza (HPAI) caused by the H5N1 virus...

...poultry deaths, can be associated with anthropogenic environmental changes produced by urbanization, agricultural change, and natural habitat alterations

...suggesting these risks are not an accident of time and place, but rather are the product of the modernization and urbanization transitions.

ECOLOGICAL MIXING AT HOST POPULATION, COMMUNITY AND LANDSCAPE LEVELS

<table>
<thead>
<tr>
<th>GLMM</th>
<th>BRT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
</tr>
<tr>
<td>Intercept</td>
<td>-8.511</td>
</tr>
<tr>
<td>Urbanicity: rural</td>
<td>0</td>
</tr>
<tr>
<td>Urbanicity: peri-urban</td>
<td>0.273</td>
</tr>
<tr>
<td>Urbanicity: urban</td>
<td>0.228</td>
</tr>
<tr>
<td>Percentage land under rice*</td>
<td>6.046</td>
</tr>
<tr>
<td>Percentage land under aquaculture*</td>
<td>1.024</td>
</tr>
<tr>
<td>Land-use diversity (Gini-Simpson index)</td>
<td>2.212</td>
</tr>
<tr>
<td>Chicken density*</td>
<td>-0.525</td>
</tr>
<tr>
<td>Duck-rice area density</td>
<td>0.203</td>
</tr>
<tr>
<td>Chicken flock size diversity (Gini-Simpson Index)</td>
<td>1.837</td>
</tr>
<tr>
<td>Duck &amp; goose flock size diversity (Gini-Simpson Index)</td>
<td>1.986</td>
</tr>
<tr>
<td>Annual precipitation*</td>
<td>-4.698</td>
</tr>
<tr>
<td>Compound Topographical Index*</td>
<td>14.627</td>
</tr>
<tr>
<td>Shortest distance to nearest national highway*</td>
<td>-0.040</td>
</tr>
<tr>
<td>Shortest distance to nearest provincial highway*</td>
<td>-0.119</td>
</tr>
<tr>
<td>Shortest distance to nearest town*</td>
<td>-0.127</td>
</tr>
<tr>
<td>Shortest distance to nearest lake*</td>
<td>0.940</td>
</tr>
<tr>
<td>Autoregressive term</td>
<td>60.04</td>
</tr>
</tbody>
</table>

“A surrogate measures, flock size and land use diversity of communes, significantly improve predictive power” – Saksena et al, in preparation
HIGHLY PATHOGENIC AVIAN INFLUENZA (H5N1) AND THE MISSING ECOLOGICAL LINKS
Some Prospects and Challenges

- Appropriate ecosystem scale --- to better understand drivers of diseases, its emergence, transmission, spread, etc
- Testing and developing innovative research approaches, frameworks and tools
- Strengthened support for academic and public services engagements in research, extension work, policy
- Improved coordination and communication system among relevant stakeholders
- More capacity building programs in research activities particularly in linking epidemiology and the social ecology of diseases
- Understanding of the economic costs of the diseases as basis for decisions
- Linking EcoHealth with other food security concerns such as food safety, etc.
Training Workshop on Applications of OneHealth/EcoHealth Approach Towards Sustainable Livestock Production in Southeast Asia

23-25 October 2018

SEARCA, Los Baños, Laguna, Philippines