CIRAD's Platform in Partnership (GREASE) Activities on Zoonoses in South East Asia

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Introduction

Globally, the majority (ca. 60%) of emerging infectious diseases are zoonoses (Jones et al. 2008). Such diseases have major economic and sanitary consequences. They affect farmers' incomes and may have serious repercussions on human health (Bordier and Roger 2013). In a recent report, a disease reference group worked on zoonoses and marginalised infectious diseases. It identified the followings key concerns: (a) the general lack of reliable quantitative data on their public health burden; (b) the need to evaluate livestock production losses and their additional impacts on health and poverty; (c) the relevance of cross-sectoral issues essential to designing and implementing public health interventions for zoonotic diseases; and (d) identifying priority areas for research and interventions to harness resources most effectively (Molyneux et al. 2011).

South East Asia (SEA) is a hotspot for emerging zoonoses, especially those originating from wildlife. The most recent emerging zoonoses of importance have been geographically limited to SEA – Nipah virus (NiV), highly pathogenic avian influenza (HPAI) virus and severe respiratory acute syndrome (SARS) virus (Caceres and Otte 2009). The increasing global trade, climate change, urbanization, the weakness of many public health systems, and increasingly intensified animal production are all factors in the emergence of animal and zoonotic diseases in SEA (Bordier and Roger 2013). Neglected by the international community, zoonotic diseases take root in the area, and local public and animal health infrastructures struggle to tackle the diseases. They put a serious threat to socioeconomic, health and wellbeing stakes in SEA. Their management calls for a better integration between animal health science, public health, social science, agriculture and livestock, engineering, ecological and environmental sciences.

The agricultural research centre for development (**CIRAD -** http://www.cirad.fr/en) is a targeted research organization, and bases its operations on development needs, from

field to laboratory and from a local to a global scale. CIRAD works with the whole range of developing countries to generate and pass on new knowledge, support agricultural development and fuel the debate on the main global issues concerning agriculture. CIRAD's operations centre on six priority lines of research including animal health and emerging diseases.

Among the different CIRAD's teams working on this topic, the Animal and Integrated Risk Management research unit (**AGIRs -** http://ur-agirs.cirad.fr/en) is focusing on the health risks threatening local communities, societies and socio-ecosystems in the South. The unit is organized around two primary, interdependent domains: disease ecology, and socio-ecosystems and public health. Geographically, the unit focuses on two areas: Southern Africa and SEA. The head of the unit and six executive researchers are based in Thailand, Cambodia, Laos and Vietnam and cover different and complementary research areas (veterinary epidemiology, ecology, anthropology, modelling), for the implementation of multi and interdisciplinary research activities for development.

In order to tackle the scientific and development challenges posed by zoonoses in SEA, AGIRs is involved in **research** programs, participates to **development** activities such as education, training and capacity building, and is an active member of different regional and international research networks. AGIRs is conducting its activities **in partnership** with local universities and research institutes where are permanently based its researchers. These activities fall under the One Health and EcoHealth concepts, taking into account all the components of the diseases at the human–animal–ecosystems interface.

Partnership policy

Following CIRAD's geographical partnership strategy, AGIRs is implementing research and training platforms in partnership in collaboration with other research units (CMAEE, INTERTRYP, GREEN, MOISA,..) . In South East-Asia, AGIRs has initiated the **GREASE network**, which is a regional network with the aim to support research activities for a better management of transboundary and emerging diseases in SEA. The GREASE MoU integers six "core members": Kasetsart University (Thailand), National Institute for Veterinary Research (Vietnam), National University of Laos, National Veterinary Research Institute (Cambodia), Central Nindanao University (Philippines) and CIRAD. Different regional partners are also associated to the network through collaborations like Hong-Kong University, Institut Pasteur du Cambodge (Cambodia), University of Gadjah Mada (Indonesia), Mahidol and Thammasat Universities (Thailand). International partners are also associated to the network like French IRD and CNRS or international organization like FAO and OIE. The network is expanding geographically and the MoU may evolve to integrate new core members from South East Asia like Malaysian, Burmese, and possibly Chinese institutions in the following years.

Long-term partnerships have been built with local partners where AGIRs researched are based. This allows better communication and collaboration with our partners in SEA. In a One Health perspective, the partnership with the International Pasteur network is a

good example of cross sectoral collaboration involving physicians, veterinarians, virologists, epidemiologists and ecologists. Similarly, in links with InterTryp Joint research unit (CIRAD-IRD), and with the support of OMS, FAO and WAHO, a network on Atypical Human Infections by animal Trypanosomes (**NAHIAT**) was recently set up to gather information on these rare and neglected diseases which include human infections by rodent trypanosomes (*Trypanosoma lewisi*) or livestock trypanosomes (*Trypanosoma evansi*), observed especially in SEA (Desquesnes et al. 2001; Milocco et al. 2012).

Through these partnerships, CIRAD aims at promoting a cross sectoral research for development in SEA. New partnerships with regional initiatives like the Mekong Basin Disease Surveillance or collaborations over other emerging threats like antibiotic resistance are among the potential future activities. Overall, AGIRs researchers are developing tools, methods, knowledge that can be applied to different health problematics in the region with a large set of potential partners.

Research activities

Socio-ecosystems and public health

The One Health and the Eco-Health concepts require the definition and the effective use of a holistic approach regarding health issues. AGIRs contributes to this paradigm shift by addressing different research and development questions within the domain of socio-ecosystems, including veterinary public health. Therefore, AGIRs develops and promotes an interdisciplinary approach within two main thematic.

The first thematic is the understanding of the interdependence between social structures and the epidemiology of infectious diseases. Indeed, understanding how public health measures are implemented and perceived from local communities to central governments is a main objective for AGIRs. Bringing together researchers from different fields is possible when they share a common research object. The flu (avian, swine and human) has been an interesting model to collaborate with human health actors but also with "non-traditional" health actors like sociologists, economists or environmentalists, with shared question about the perception of risks and other health related issues by local communities or about the type of models that could best describe these socio-ecosystems (Figuie and Fournier 2008; Duboz 2012; Goutard et al. 2012a; Collineau et al. 2013; Binot and Morand In Press). In South East Asia, a strong partnership has been established within GREASE network with the Human Health sector through the Pasteur International Network and led to collaboration on zoonoses like avian influenza H5N1 (Conan 2012), on the spill-back transmission of H1N1p virus from humans to animals (Trevennec et al. 2012; Rith et al. 2013) or on rabies (Ponsich 2012). Other institutions like the Kasetsart University in Thailand, the NaVRI in Cambodia or the NIVR in Vietnam are also long-term partners sharing concerns about zoonoses management in SEA.

The second thematic concerns the evaluation and improvement of surveillance systems in SEA. Indeed, a central issue in disease management is how to construct permanent

surveillance networks that are capable of promptly detecting the emergence of a disease to enable a rapid reaction. This issue is even more important in developing countries where human and financial resources are limited and where the physical access and the communications are sometimes very restricted. To achieve this, the **REVASIA (**http://revasia.cirad.fr/en/**)** research program is developing innovative quantitative methods based on an evaluation of the health situation and the existing surveillance systems in SEA. In REVASIA, the research is based on methods coming from veterinary medicine and public health, as well as modelling and simulation of surveillance systems. The goal is to design generic tools for the evaluation of influenza virus surveillance systems that would be applicable to both developing and industrialized countries. This research program has led to the adaptation of tools for the evaluation of surveillance systems in animal health to the contexts of developing countries (Peyre et al. 2011) like capture-recapture methods (Vergne et al. 2012), probabilistic approaches to optimize the detection of a disease (Goutard et al. 2012b), systemic analysis of surveillance and control (Collineau et al. 2013) and the introduction of costing methods within simulation (Duboz 2012).

Future works: preliminary study has been carried out regarding the risk of introduction and spreading of exotic vector-borne diseases in SE Asia. Thereby, risk assessment methods and MCDA techniques will be applied to Rift Valley fever .

Disease ecology in the One Health and EcoHealth frameworks

Understanding the impact of biodiversity and wildlife ecology on disease transmission is another important and complementary challenge for AGIRs. With most zoonoses originating from wildlife, studying the patterns of circulation and transmission of pathogens between wild species and at the interface with livestock and human population is key to the prevention and control of zoonoses.

The **BiodivHealthSEA (**http://www.biodivhealthsea.org/**)** project aims at investigating the local impacts of global changes on zoonotic diseases in SEA, with the support of GREASE network. It follows the CeroPath project (http://www.ceropath.org/), which focused on the community ecology of rodents and their pathogens in SEA (Bordes et al. 2013; Jiyipong et al. 2013). Southeast Asia is a hotspot of infectious emerging diseases of potential global pandemics and, also, a hotspot of biodiversity particularly at threat due to land use and climate changes. SEA attracts the attention of international organizations, developmental agencies and non-governmental conservationist organizations for its global concerns in terms of biodiversity and health. The project uses SEA as a model to investigate locally the perception and effects of global changes and global governance on the interaction between biodiversity and health and is focusing on rodent-borne diseases, in relation to biodiversity changes. The local perception of biodiversity changes and their links to health is analysed through the global governance, the national public policies and the actions of NGOs in the sectoral domains of health, environment, conservation and development (i.e. the "One Health" approach).

The Southeast Asia encephalitis (**SEAe**) project is a multidisciplinary research program aiming to reduce the morbidity and mortality associated with infectious encephalitis in

SEA by improving diagnosis and medical care for patients and by investigating risk factors driving encephalitis. One specific objective of the project is to document and analyze factors related to clusters of encephalitis cases integrating human health, animal health and environment through the One Health and EcoHealth approaches. This is including ecological and virological monitoring of wildlife reservoir like flying foxes (bats). The SEAe research consortium is associating international research institutes, national authorities in Cambodia, Lao PDR and Vietnam and local major universities and clinical sites (national hospitals and provincial health centers).

Development activities

GREASE network is involved in different activities such as education, capacity building and training aiming at improving the surveillance and control of zoonoses in SEA. These activities are coordinated with local partners based on their needs and supported by regional and international funders. The **ComAcross project**, under the One Health in Asia call by Europeaid is aiming at reinforcing the development of the holistic approach to health, based on case studies implementation coordinated through a participatory approach to reveal and strengthen the synergies between the various stakeholders involved. The project will be articulated around 3 specific results: (1) Improved awareness and exchange of One Health and EcoHealth best practices within a Community of Practice, (2) Improved vocational competencies: target groups will have better technical skills to address zoonotic diseases' complexity and (3) Raised competencies on "Assessment and management of health risks at the human, animal and ecosystem interface".

This project is based on long-standing collaboration and networking experience in SEA. Notably, since 2009, **training** for academic and technical staff from SEA countries on the use of risk management tools and field work with communities. Different training sessions will be implemented during this project, including training in innovative participatory approaches to improve risks assessment and management at the AHE interface, social and environmental diagnosis, participatory epidemiology, participatory rural appraisal, wildlife and natural resources monitoring provided by experienced teams. **Capacity building** activities focus on technical skills that can be improved within cross-sectoral and interdisciplinary perspective. It deals first with the ability to take into account dynamics at the animal-human-environment interface in the elaboration of diagnostic and control methods, leaning on a better understanding of the interactions between pathogens, hosts, social and natural environment (including vectors).It includes the development of innovative diagnostic tools for zoonotic diseases and the training of laboratories' staff for routine analysis and diagnosis of human, animal and environmental samples and data. The project will also help developing a "Health Geographic Information System" and cross-sectoral data management procedures allowing interdisciplinary data sharing analysis between all partners. The **BioZoonoSEA** platform for Research, Higher Education and Training is a concerted action implemented by Kasetsart University, Mahidol University, CIRAD and IRD under the umbrella of the Franco-Thai DORAS, working for temporary gathering of human resources and

experiences to fill gaps in the knowledge of neglected zoonotic parasitoses, or to respond to specific needs in emerging diseases identified at the regional level in SEA. Its main actions will be the organisation of workshops and trainings, supervising of individual or collective trainings and implementation of data banking.

The ComAcross project will also support the implementation of a new master program opening in September 2014 at Kasetsart University, Thailand: **The InterRisk Master.** This master program aims at delivering postgraduate-level education for individuals with academic degrees from medicine, veterinary medicine or life sciences, currently employed or anticipating a career in the field of public health. This programme will provide advanced academic training in the evaluation and management of health risks related to animals, considering the One Health (human and veterinary health) and ecosystem (animal-human-ecosystem interface) dimensions of these risks. This master's curriculum has been designed to fit the key competencies identified during different regional meetings organised by International organisations (FAO, OIE). Efforts to educate students in a "One Health" perspective will be made, by making veterinary, medical and biosciences students work together. Zoonotic diseases and antimicrobial resistances will specifically be targeted. A focus will be made on cross-country health issues in order to push students to think and work at a regional scale when appropriate. Special attention will be given during the courses to community-based participatory actions. Innovative pedagogical tools (active learning, real case problem-solving, field visits, and computer-based modules) will be promoted.

AGIRs is involved in other **education** activities with researchers teaching and supervising master and PhD students from different universities or institutes in SEA like Kasetsart University and the Asian Institute of Technology in Thailand or the Royal University of Phnom Penh in Cambodia as well as French students working in animal health and doing their field works in SEA.

Salient findings

Influenza (avian, swine and human), a major zoonosis, has been an interesting model to implement interdisciplinary studies involving veterinarians, physicians, virologists, sociologists, economists or environmentalists. Recent studies showed evidences of spillback transmission of H1N1p virus from humans to animals (Trevennec et al. 2012; Rith et al. 2013). Integrated studies allowed us to better understand perception of risks and other health related issues by local communities (Figuie and Fournier 2008; Goutard et al. 2012a).

The **wildlife-livestock-human interface** is key to the emergence of zoonoses in Asia. Rodents, the most diverse group of Mammals, are considered a major reservoir for zoonotic pathogens. Recent studies focusing on the communities of rodents and of their pathogens identified areas with possibly a higher risk of rodent-borne disease for human inhabitants in South East Asia (Bordes et al. 2013) as well as new zoonotic pathogens (Jiyipong et al. 2013).

Management of Health and in particular the capacity of surveillance systems to detect zoonotic epidemics has been an important field of research. Research efforts have led to the adaptation of tools for the evaluation of surveillance systems in animal health to the contexts of developing countries (Peyre et al. 2011) like capture-recapture methods (Vergne et al. 2012), probabilistic approaches to optimize the detection of a disease (Goutard et al. 2012b), systemic analysis of surveillance and control (Collineau et al. 2013), participatory approaches and socio-economic issues (Delabouglise et al. 2012) and the introduction of costing methods within simulation (Duboz 2012).

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