Workshop on

Research Activities on Avian Influenza and Other Transboundary Animal Diseases in South-East Asia

Bangkok, Thailand, 21-22 January 2008

ABSTRACTS
and
List of Participants

Preface

The first highly pathogenic avian influenza (HPAI) H5N1 strain emerged in 1996 when it was identified in geese in Guangdong Province in southern China. It then caused disease in Hong Kong SAR affecting poultry and humans in 1997, poultry only in 2001 and early 2002 and poultry and captive wild birds in 2002-03. From 2003 onwards the disease spread widely, initially through East and Southeast Asia in 2003-04, where it caused unprecedented losses in Thailand, Vietnam and Indonesia, and then into Mongolia, southern Russia, South Asia, the Middle East and to Europe and Africa in 2005-06, with outbreaks recurring in various countries in the three affected continents 2007.

Since its emergence, H5N1 HPAI has attracted considerable public and media attention because the viruses involved have been shown to be capable of producing fatal disease in humans, which gives rise to the fear that the virus might acquire the capacity for sustained human-to-human transmission and thus cause a global influenza pandemic.

Driven by the fear of a possible human pandemic, responses to HPAI outbreaks have generally been top-down, heavy handed government interventions. Control measures have centred on stamping out which may entail large scale culling of infected flocks and non-infected in-contact flocks and the high concentration of poultry in certain areas has led to the culling of millions of domestic birds at great expense. For low income countries in which poultry is raised primarily by smallholders, who are often poor, such measures constitute a serious burden and may lead to socially unjust outcomes, which therefore are likely to be undermined and difficult to sustain.

It appears that the HPAI H5N1 virus has now become endemic in a number of countries in East and Southeast Asia giving rise to a new situation for which the countries in the region may need to reconsider their animal health policy. Due to increased and more rapid movement of people, livestock and livestock products humanity now shares a global commons of disease risk and local animal health practices and national policies have global implications. It is, therefore, imperative that countries adopt a comprehensive, science-based approach to disease risk management, ideally in coordination with their neighbours and major trade partners.

Developing robust animal health policies requires a detailed understanding of both the biological aspects of animal health and the economics of livestock production and marketing. Animal disease control programmes need to look beyond disease ecology and epidemiology and must recognise the motives of people involved in animal food supply chains, and their incentives for managing disease risk. The implementation of animal health programmes is contingent on the capacities of public and private institutions, and the limitations and incentives of the latter also need to be well understood for disease control policies to be effective.

This meeting, organized by CIRAD, the Royal Veterinary College of the University of London and FAO, brings together more than 50 scientists of a number of disciplines from the region and abroad to share their research on various aspects of HPAI and other transboundary diseases, with the ultimate aim to contribute to the goal of science-based disease risk management in Southeast Asia. The immediate aim of the meeting is to review what is

known about the main transboundary animal diseases present in the region and to identify the most important knowledge gaps research needs to fill.

In the case of HPAI, despite significant scientific advances made in the recent past, important knowledge gaps remain, pertaining to:

- disease ecology and epidemiology,
- the economic impact of HPAI and its control, and
- the institutional arrangements most suited for disease control in different production systems and socio-economic settings.

For example, the role played by wild migratory birds in medium to long distance disease spread as well as the importance of wild waterfowl as reservoir of HPAI H5N1 remain debated. Likewise, the relative risks of HPAI genesis and spread in small scale backyard operations vis-à-vis larger more intensive units are contested. The main pathways for human infection are still unknown. How useful is vaccination for disease risk reduction in the different species of poultry and in the various production systems practiced in the region? How reliant are smallholders on their poultry and which subgroup of the rural poor is particularly reliant on poultry? How, in the light of these unknowns, can the relevant authorities devise an effective disease risk management strategy which is efficient and socially just? How can the fiscal burden of disease risk management be reduced by providing incentives for private investment in improved animal health? These and related issues will be addressed in the meeting.

In order to improve local and global and capacity for making evidence-based decisions on the control of HPAI and other diseases with epidemic potential, which inevitably have major social and economic impacts – particularly on the poor – the UK Department for International Development (DFID) has funded a multi-disciplinary and collaborative HPAI research project covering the countries in the Mekong region, Indonesia and selected countries in Africa. With similar intentions, the Government of France is funding both a research project on HPAI epidemiology inVietnam and in 5 selected countries in Africa and a collaborative research project on transboundary animal diseases (RESTAD) for Southeast Asia.

We hope that this meeting, which is jointly organized and co-funded by the two abovementioned projects, and for which you have made yourselves available at relatively short notice, can act as catalyst for a regional, multi-disciplinary, and above all collaborative research agenda that will provide decision support to animal health policymakers tasked with reducing the risk and impact of animal diseases and particularly of those animal diseases which may affect human health.

Joachim Otte
Coordinator
Pro-Poor Livestock Policy Initiative
FAO of the United Nations
Rome, Italy

Dirk Pfeiffer
Professor of Veterinary Epidemiology
Royal Veterinary College
University of London

Francois Roger
Head
Epidemiology and Ecology of Animal Diseases Research Unit
CIRAD

Table of Contents

HPAI Viruses in Live Bird Markets in Thailand

Alongkorn Amonsin[*], Chuensakon Choatrakol[*], Jiradej Lapkuntod[*], Rachod Tantilertcharoen[*], Roongroje Thanawongnuwech[*], Sanipa Suradhat[*], Kamol Suwannakarn[**], Sunchai Payungporn [**], Apiradee Theamboonlers[**], and Yong Poovorawan[**]

[*] *Faculty of Veterinary Science, Chulalongkorn University, Pathumwan, Bangkok, Thailand*

[**] *Faculty of Medicine, Chulalongkorn University, Pathumwan, Bangkok, Thailand*

A surveillance program for Highly Pathogenic Avian Influenza viruses (HPAI) subtype H5N1 was conducted in live bird markets and food markets in central region of Thailand during July 2006 - August 2007. Twelve (1.29%) HPAI viruses were isolated from 930 samples of both live birds and bird meats from the markets. All 12 isolates were recovered during the recent AI outbreaks in Thailand (November 2006-January 2007). Phylogenetic analysis showed that H5N1 viruses circulating in live birds and bird meats are genetically related to H5N1 viruses in 2004-5 in Thailand.

HPAI, Poverty and Livelihoods: A Review of Recent FAO Experiences in the Socio-economic Analysis of HPAI Impacts

John Curry[1], Anni McLeod[1] and Pari Baumann[2]

[1] Food and Agriculture Organization of the UN
[2] Independent Consultant

Highly Pathogenic Avian Influenza (HPAI) not only constitutes a major risk to poultry health and production worldwide but also poses a complex development and livelihoods challenge. Although there has been some estimation of the consequences of the disease to economies and human lives, comparatively much less attention has been paid to the losses that HPAI causes to people dependent on poultry for a livelihood. These losses are incurred both as a direct consequence of an outbreak and indirectly as a result of drastic and widespread control measures that have led to wide-scale culling, consumer panic and related market shocks. Such losses often lead to both short-term adjustments in coping strategies and long term adjustments to a changing poultry sector driven by the objective of HPAI containment.

The poverty context in which these direct and indirect effects occur and the short-term and longer-term adjustments made by different types of poultry producers, particularly those belonging to poor and vulnerable groups, is still poorly understood. The livelihoods approach is a very effective analytical tool that facilitates an understanding of the factors that enable people to cope with the impact of HPAI and that help generate practical policy implications on how to negotiate the trade-off between risk reduction requirements *vis-à-vis* sustaining local livelihoods of those dependent on poultry production, including the poor.

Drawing upon insights gained from recent FAO studies of the socio-economic impact of Avian Influenza in Vietnam, Cambodia, Turkey and Egypt, this paper discusses the poverty implications of a range of likely household-level HPAI impacts on livelihoods, vulnerability, social relations and household coping mechanisms of smallholder poultry producers. The poverty implications of these impacts differ depending on the socio-economic status, gender and location of the poultry producer as well as the characteristics of the poultry production system in which they are involved. The paper concludes with a discussion of future research areas related to the nexus of HPAI, poverty and livelihoods that need to be addressed and offers a tentative framework for such research in future.

Direct and Indirect Impact of *Trypanosoma evansi* on Transboundary Animal Diseases; Interferences in Vaccination Campaigns (FMD, HS & CSF)

Marc Desquesnes

CIRAD, UR Trypanosomes, Montpellier, F-34000 France / Kasetsart University, Faculty of Veterinary Medicine, Department of Parasitology, Chatuchak, Bangkok, Thailand; marc.desquesnes@cirad.fr

Transboundary movements of living animals are responsible for circulation of *Trypanosoma evansi* parasite strains, especially when they are uncontrolled, for example from China to Thailand via Myanmar and Laos. Numerous Chinese isolates of *T. evansi* exhibit chemoresistance to a number of trypanocide drugs; the importation of such isolates by itself constitutes a serious transboundary animal disease problem for Thailand which actually handles only diminazen aceturate as trypanocidal drug.

Like others livestock trypanosomoses, *T. evansi* induces classical clinical signs: fever, anaemia, oedema etc. However, even if less apparent, its immunosuppressive effects can interfere with other diseases (e.g. anaplasma, babesia) and with establishment of an immune response during vaccination campaigns.

Field observations have suggested that *T. evansi* infections could be responsible for vaccination failures, notably in foot and mouth disease (FMD) and hemorrhagic septicaemia (HS) in cattle and buffaloes, and FMD and Classical Swine Fever (CSF) in pigs (Touratier 1999).

For CSF, experimental studies have clearly demonstrated a reduced protection against CSF in *T. evansi* infected pigs (Holland *et al.* 2003). In buffaloes experimentally infected with *Trypanosoma evansi*, decrease in antibody response and local inflammation against *Pasteurella multocida* vaccine have been demonstrated. The impact of *T. evansi* infection in FMD and HS vaccination campaigns in cattle was raised; however, experimental work is required to confirm and complete this information.

For these reasons, it appears urgent and determinant to (1) study and control the presence of *T. evansi* in livestock movements, especially when originating from China, (2) conduct field experiments with trypanocidal treatments in enzootic areas, to demonstrate *in situ* the role of *T. evansi* infections in FMD, HS and/or CSF vaccination campaigns (and livestock health and production), and (3) carry out experimental studies in cattle (buffaloes and pigs) to confirm the impact of the infection on vaccination efficiency against FMD and HS (and CSF).

Based on the present knowledge, it is already confirmed that the control of *T. evansi* infection by trypanocidal drugs will improve the efficiency of vaccination campaigns in infected animals; however, antibody detection screenings by ELISA could easily be realized to determine where and when such measures would have the highest cost/benefit ratios.

Research Collaborations Underpin Regional FMD Program

Edwards JR, Robertson ID and Abila, R.

Murdoch University, Murdoch, Australia

The Southeast Asia Foot and Mouth Disease Campaign (SEAFMDC) is based on a progressive zoning strategy for the control of FMD, known as SEAFMD 2020. This is a roadmap for foot and mouth disease freedom with vaccination by 2020 in Southeast Asia. Free zones established to OIE standards are already present in Indonesia, the Philippines and Sabah and Sarawak in Malaysia. Potential zones for FMD control have been identified in mainland Southeast Asia in the Malaysia-Thailand-Myanmar (MTM) region, Region 2 of Thailand, the Lower Mekong, the Upper Mekong, the Red River Delta and the Sagaing Division of Thailand.

To ensure the success of the SEAFMD 2020 strategy it is necessary to carry out the research, and the epidemiological and economic studies to determine the feasibility of zoning and to guide future work. Since 2005, researchers and postgraduate students at Murdoch University have been collaborating with a range of organisations to assist in this process. Collaborators include: Australian Centres for International Agricultural Research, the Asian Development Bank, ASEAN countries (Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines and Thailand), AusAID, AusVet, the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Diseases, Department of Agriculture and Food Western Australia, Department of Agriculture, Fisheries and Forestry, Australian Animal Health Laboratories, FAO, OIE and the World Reference Laboratory, Pirbright.

The projects involve laboratory, epidemiological, and sociological studies and these are: the epidemiology of FMD in Malaysia (Siti Zubaidah Ramanoon); development of a risk based system for FMD in Indonesia (Pebi Purwo Suseno); epidemiological and economic studies in the Tanintharyi and Sagaing Divisions of Myanmar (Kyaw Naing Oo); the application of geographical information systems and modelling to zoning for FMD and CSF in the Lower Mekong region (Tum Sothyra); and studies on the pig-adapted strain of FMD in Taiwan (Shih-Ping Chen); the establishment of the MTM epinet and risk based studies to progress zoning in the MTM zones (Polly Cocks), an ACIAR project to study the drivers and the risks associated with animal movements in Cambodia and Lao PDR (Ben Madin), a study of the role of the Asian swamp buffalo in the transmission of FMD in Southeast Asia (Blesilda Verin), the epidemiology of FMD in Bhutan (Kinzang Dukpa), and studies on crisis communication in animal health (Elaine Llarena) and to develop a model for animal health communication (Jim Caro).

Early achievements from this work include progress with conduct of surveillance programs in Cambodia, Myanmar and Indonesia, the use of participative approaches to surveillance, the progression of zone status in the MTM zones of Myanmar and publication of work on the transmission of FMD and the evaluation of diagnostic tests and vaccines. A significant step has been the establishment of an Epidemiological Network (Epinet) for the MTM zones and the conduct of training programs.

The Role of Mathematical Modelling in Helping to Understand the Transmission and Control of Highly Pathogenic Avian Influenza

Azra Ghani

MRC Centre for Outbreak Analysis & Modelling
Department of Infectious Disease Epidemiology
Imperial College London, UK

Mathematical models are increasingly being developed both to understand the factors determining transmission of infectious diseases and to guide and monitor the effectiveness of interventions. Increasingly these models are being developed and applied to "real-time" outbreaks with prominent examples including the use of models to aid control of the FMD epidemic in the UK in 2001 and their use in the SARS outbreak in 2003. Models cannot however be built without good epidemiological data and must also incorporate appropriate husbandry and movement patterns. In this talk I will first explain some of the basic ways in which mathematical models are constructed and applied, using examples from FMD and HPAI modelling work undertaken for the UK. I will then outline the role that they could play in understanding the transmission and control of HPAI in South-East Asia and highlight the types of data that are required to construct and validate the different types of models.

Key References:

Ferguson NM, Donnelly CA, Anderson RM (2001). The foot-and-mouth epidemic in Great Britain: pattern of spread and impact of interventions. *Science* **292** 1155-1160.

Ferguson NM, Donnelly CA, Anderson RM (2001). Transmission intensity and impact of control policies on the foot and mouth epidemic in Great Britain. *Nature* **413** 542-548.

Resistance of Influenza Viruses in Environmental Reservoirs and Systems: An Ecological Approach in Cambodia

F. Goutard[1], S. Vong[2], A. Tran[1], F. Rankowski[3], P. Buchy[2], J. Radomski[3]

[1] CIRAD, UR 22, Campus international de Baillarguet, Montpellier, France
[2] Institut Pasteur, Phnom Penh, Cambodia
[3] Interdisciplinary Centre for Modelling, Warsaw, Poland

The emergence and the re-emergence of the avian influenza (AI) epizootic caused by the highly pathogenic avian influenza virus H5N1 in South-east Asia, and its evolution poses numerous questions, particularly concerning the role of the environment as a reservoir of the virus. There are strong arguments for considering that the ecology of the AI viruses is closely linked to the environment, particularly water, which allows virus persistence outside the host, and can be a source of virus transmission. However, the literature on the global ecology of influenza viruses in nature is limited, or outdated, and thus may not be extrapolated to the current A (H5N1) virus.

The RIVERS project (Resistance of Influenza Viruses in Environmental Reservoirs and Systems), funded by the EU and coordinated by the Institut Pasteur - Paris, aims at improving the prevention and the control of the disease through a better understanding of the role of the environment (water, manure, feces, air, soils, housing etc) in the survival of the virus and in the re-emergence of outbreaks. In Cambodia, Institut Pasteur – Cambodia is (1) to collect data on the survival of the virus in its natural environments (isolation of the virus from lakes, ponds and rivers throughout the year), and (2) to contribute to developing models for virus survival in its natural environments. The final objective is to identify and characterize the conditions favourable to the perpetuation of the virus in biological and environmental reservoirs.

Several activities will be implemented in Cambodia in 2008, including field, epidemiological, spatial and modelling studies. These activities will be guided by experimental studies carried out by the other teams within the framework of the RIVERS project on favourable conditions for the survival of virus (temperature of water, pH, etc). The physical parameters of water tested within the framework of the experimental studies will be measured in the field in various villages, to evaluate whether the environmental conditions in at risk areas could be adequate for the survival of the virus in water. We shall consider a series of measurements, during the rainy and dry seasons and in-between. In addition, in response to notification of confirmed H5N1 in humans or poultry, we will collect environmental specimens in the outbreak settings. Bundled with each specimen, we will collect physico-chemical parameters following a standardised protocol. Finally, surveillance data in place in six provinces of Cambodia will identify areas affected or not by H5N1 virus. The comparison of the areas will help determine spatial and environmental risk factors associated with circulation of H5N1 viruses. Environmental parameters such as land cover or the temporal variations of flooding will be taken into account by the analysis of time series of MODIS images. These risk factors will be connected for their analysis with the results of the experimental setting and the results of the field measurements of waterbodies.

Although a general model of transmission seems difficult to develop at the moment, data generated by the several studies implemented in Cambodia will allow a descriptive low-level simulation models and multi-scale agent-based, heterogeneous simulation model for AIVs perpetuation, viability and inactivation in various natural water environments.

Sero-surveillance of Avian Influenza H5NI Virus among Ducks (Free Range and Transient) and Village Chickens in Identified High-Risk Areas in the Provinces of South and North Cotabato, Philippines

Gundran RS, Tecson LL and Delima MCM

Central Luzon University

The study was conducted with the objectives of 1) detecting the presence of highly pathogenic avian influenza H5N1 among free range and transient ducks and village chickens in identified high-risk areas in the province of South Cotabato and the high risk areas along Liguasan Marsh in North Cotabato; b) identifying possible risk factors for the occurrence of highly pathogenic avian influenza infection among ducks and chickens; and, c) describing the knowledge, attitudes and practices of poultry raisers in the province regarding HPAI and their possible association with its occurrence.

A total of 720 serum samples (300 samples from resident ducks, 300 samples from transient ducks, and 120 samples from village chickens) were collected from November 2006 to April 2007 from 10 randomly selected barangays of the provinces of South and North Cotabato. The samples were tested at the Philippine Animal Health Center Diagnostic Laboratory using haemagglutination inhibition (HI) test for ducks and ELISA test for chickens. A total of 115 duck and village chicken raisers were interviewed to determine their knowledge, attitudes and practices (KAP) regarding Avian Influenza.

All serum samples yielded negative results for the presence of Avian Influenza antibodies. The KAP Survey revealed that there is a great need for the conduct of an intensified information and education campaign by the national and local governments to increase the level of awareness of farmers in the two provinces. The campaign may focus primarily on KAP-related risk factors that may contribute to the occurrence of Avian Influenza. As an example, most of the respondents do not practice basic bio-security measures nor do they control human and animal traffic in their farms.

The study clearly indicates that there is a need to sustain and step up the surveillance activities in the two provinces where domestic and wild birds congregate. This is particularly the case in Liguasan marsh of North Cotabato because the area serves as refuge for the migratory birds coming from neighbouring countries and is also the common destination of transient ducks coming from the various areas in the island of Mindanao. Sustained testing at these sites will provide an early detection mechanism for the event of a possible incursion of HPAI in the country.

The Epidemiology of Highly Pathogenic Avian Influenza (HPAI) in Ducks in Indonesia and Vietnam – Investigations into the Maintenance and Transmission of HPAI in Backyard and Small-Scale Commercial Duck Farms

J.Henning[1], H.Wibawa[2], P.D.Purnomo[2], K.Henning[1], Truc Ha[3], N.T.Long[3], J.Meers[1]*

[1]School of Veterinary Science, University of Queensland, St. Lucia, Queensland, Australia
[2]Disease Investigation Centre, Directorate General Livestock Services, Wates, Yogyakarta, Indonesia
[3]Regional Animal Health Centre VI, Department of Animal Health, Ho Chi Minh City, Vietnam
**author for correspondence: j.meers@uq.edu.au*

South-East Asia has been affected by devastating H5N1 Highly Pathogenic Avian Influenza (HPAI) outbreaks since 2004. Vaccination programs and improved biosecurity have been implemented in backyard farms and in small-scale commercial duck enterprises in this region with varying results. The role of ducks in the maintenance and transmission of HPAI to chickens and to people has been proposed, but solid field data are still not available. Therefore a three-year project was funded by the Australian Centre for International Agricultural Research (ACIAR) with the aim to describe the epidemiology, pathogenesis and control of HPAI in ducks in Indonesia and Vietnam. A field survey is the major component of this project. The temporal patterns of HPAI infection among farmed duck populations and in-contact chickens will be examined over a period of 12 months from early 2007 in the Mekong Delta of Vietnam and in Central Java in Indonesia. A total of 96 household flocks in Indonesia and 80 household flocks in Vietnam are being monitored at bi-monthly intervals, and prevalence and incidence rates of infections are assessed and possible risk factors of infection are investigated. Detailed outbreak investigations have been conducted on every HPAI case occurring in the study flocks. In addition a case-control study was carried out to identify risk factors associated with the HPAI outbreaks that occurred from December 2006 to January 2007 in duck and chicken farms in the Mekong Delta. Using participatory rural appraisal methods the husbandry of nomadic ducks and the risk this production system might pose to the spread of HPAI in the Mekong Delta of Vietnam was also investigated.

The second part of the project consists of experimental activities. The genome of H5N1 viruses derived from samples collected in the survey will be sequenced. Challenge experiments of vaccinated and unvaccinated ducks will be performed using H5N1 viruses isolated in Indonesia and Vietnam. These trials will determine the tissue tropism, duration of viral excretion and pathogenicity of the virus for ducks. Collation and analysis of data generated from these field and laboratory studies will provide recommendations for ongoing monitoring systems, taking into account the latest findings on the behaviour of virus in the field.

Demand-Oriented Approaches to HPAI Risk Management

J. Ifft[1], J. Otte[2], D. Roland-Holst[1], and D. Zilberman[1]

[1] University of California, Berkeley

[2] Food and Agriculture Organization of the United Nations

Because HPAI represents a critical public health concern, responses to disease outbreaks have generally been led by swift and determined government interventions. Moreover, most intervention and control strategies have been targeted to the supply side of the market, including culling, banning live bird and even meat sales, and mandating changes in husbandry practices. These measures have had varying success, in part because of uneven application and because such command and control approaches do not take full account of the roles of incentives and other private agencies in the food supply system. Beyond this, such approaches rely on public resources and institutional capacity, and thus may be difficult to sustain for extended periods, particularly in cases where HPAI becomes endemic.

With these considerations in mind, it is reasonable to examine what kind of market-oriented approaches to HPAI risk management could be developed. From that perspective, this study of the Pro-Poor Livestock Policy Initiative examines how the demand side of the poultry market can play a constructive role in reducing disease risk. To the extent that consumers care about and are willing to pay for certified HPAI-free poultry, there options may exist for private finance of more bio-secure and safe poultry supply chains.

In a pilot effort to ascertain the feasibility of such systems, we are conducting focused market surveys in countries of the Mekong sub-region. Early evidence from Vietnam indicates that demand side approaches to reducing disease risk should be more actively investigated.

Livelihoods Impact of Bio-Security Policy Implementation for Highly Pathogenic Avian Influenza in Jakarta, Indonesia

Muhammad Iqbal and Adang Agustian

Indonesian Center for Agro-Socioeconomic and Policy Studies (ICASEPS)

HPAI (Highly Pathogenic Avian Influenza) was first recorded in Indonesia in 2003 and is currently endemic in 31 of its 33 provinces including Jakarta, the capital city of Indonesia. On 17 January 2007, the Provincial Government of Jakarta issued two decrees on bio-security measures: (i) a ban on poultry rising within Jakarta City limits, and (ii) that birds would be culled without compensation. Entry of birds into the Jakarta markets would also be controlled to avoid spread of HPAI.

Within days of the announcement of the decree, the poultry markets in Jakarta experienced a shock as demand and prices for poultry fell by as much as 50 percent. This paper analyses the results of a livelihoods study that assessed the impact of the control measures on the incomes of people engaged in poultry production and marketing.

The study shows that the income of smallholder poultry growers on average decreased by about 44 percent. Incomprehensive socialization and lack of community socio-economic considerations were among the issues perceived as detrimental about the adopted policy by poultry business actors. It therefore seems necessary to carry out a concept rearrangement through stakeholder participation to arrive at a comprehensive and holistic bio-security measure policy feedback.

Epidemiology of and Progress in Research on Highly Pathogenic Avian Influenza Infections in Malaysia

Kamarudin Md Isa

Director of Research Division, Department of Veterinary Services, Putrajaya, Malaysia

In Malaysia, an outbreak of Highly Pathogenic Avian Influenza (HPAI) is defined as any detection of HPAI H5N1 virus with (actual outbreak) or without clinical manifestation. A total of 18 outbreaks (66.7% actual outbreaks and 33.3% virus isolation) have occurred since the first confirmed case on 17 August 2004. Of these, 12 occurred in 2004, none in 2005, 5 in 2006 and 1 in 2007. All outbreaks were successfully eradicated by stamping out with full compensation. The effectiveness of the eradication program complying with OIE standards is reflected by the reduction in days from confirmation till declaration of freedom (DCDF): The DCDF was 276 days in 2004, 124 days in 2006 and further improved to 95 days in 2007. The total number of cases from actual outbreaks was 223 (mean: 18.6, range: 1 - 67), of which 93.7% involved village chickens, 4.5% quails and 1.8% ducks. Of the 6 HPAI H5N1 isolated without clinical signs, 3 (50%) were from village chickens and 1 each from quail, smallholder broiler and a pet bird in an aviary. Thus village chickens are the bird species at highest risk of HPAI H5N1 infection.

Phylogenetic analysis of the virus isolates showed that 15 (83.3%) of the outbreaks were caused by HPAI H5N1 Thailand/Vietnam strain, 2 (11.1%) by the Fujian strain and 1 (5.6%) by the Hunan strain. All 12 outbreaks in 2004, which occurred in the border districts of the northern state Kelantan, were due to movement of affected chickens from an affected neighboring country. The mode of virus introduction of the outbreaks in 2005 (3 Thailand/Vietnam, 1 Fujian and 1 Hunan strains) and 2007 (Fujian strain) remains unknown.

Malaysia lies on the East-Asian Australian pathway of the migratory birds. Birds migrate from the north to the south from October till January and some of them stop at a number of bird sanctuaries along the coastal area. The 2004 outbreaks were clearly due to movement of infected chicken. The 2006 (February-March) and 2007 (June) outbreaks occurred outside the migration months. All cloacal swab samples collected from migratory birds (240 in 2006, 498 in 2007) from birds in bird sanctuaries showed no evidence of HPAI virus. Thus, to date migratory birds have no apparent role in HPAI outbreaks in Malaysia.

Since the first outbreak occurred, a top down research on HPAI has been initiated. A collaborative research project by two local universities and the Veterinary Research Institute (VRI), funded by the Ministry of Science and Innovations, on the development of diagnostic methods for the rapid differentiation of influenza virus subtypes was completed and now is in the stage of exploring countries for collaborative international trials. In addition, VRI has also successfully developed an inactivated vaccine using a low pathogenic local AI H5N2 isolate. A challenge study using field H5N1 is on-going and to date has indicated good results.

In view of the HPAI epidemiology in Malaysia, research proposals to address HPAI in village chickens and the role of imported chicken products have been proposed. Collaborative work with international and regional research institutions will further enhance results and impacts of this research and in turn improve effectiveness of controlling and eradicating HPAI regionally and globally.

Risk Assessment of Introduction of HPAI into Commercial Farms in Thailand

S. Kasemsuwan, S. Wongnarkpet, C. Lekcharoensuk, T. Rukkuamsuk, P. Arunpipas, T. Songserm, P. Chaithaweesap, T Parakamawong, R. Magalhaes and D. Pfeiffer

In Thailand, H5N1 HPAI caused a disaster to chicken farms from 2004 and had hit Thailand periodically, lately in backyard poultry. At present, broiler farms are successfully preventing infection by bio-security measures without vaccinating against Avian Influenza. Government and private sectors have agreed to commence compartmentalization in commercial broiler farms. This paper presents a risk assessment of introducing H5N1 HPAI into compartmentalization implemented broiler farms.

A biological pathway starting from parent stock farms to hatcheries and to broiler farms was considered along with the other factors including animated and in-animated risk factors following the compartmentalization manual issued by the Department of Livestock. Binomial and Poisson processes were used in the release assessment model. Risk mitigation measures, such as location, layout, housing system, farm management, feed management, worker management, poultry health management, pest control, water source management, bio-security practices in emergency situation were addressed in the model (figure 1). Input data was derived from literature, statistics and mostly from expert opinion, therefore high uncertainty is inevitable.

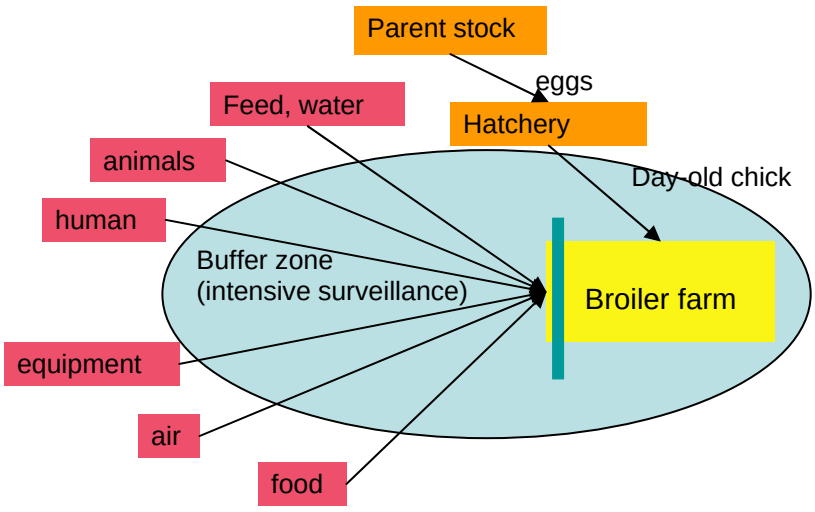

Figure 1: Release assessment model pathway of risk of introduction H5N1 HPAI to a commercial broiler farm

Under the current situation, the probability of introducing the virus into a farm is estimated as being negligible (10^{-3} in a farm a year) and rice husk is considered the most influential factor to the model.

Epidemiology and Ecology of Classical Swine Fever in the Lao People's Democratic Republic

Syseng Khounsy[1] and James Conlan[2]

[1] National Animal Health Centre, Department of Livestock and Fisheries, Vientiane, Lao PDR
[2] School of Veterinary and Biomedical Sciences, Murdoch University, Murdoch WA, Australia

Classical swine fever (CSF) is one of the most important transboundary viral diseases affecting livestock in the Southeast Asian Region. In the Lao People's Democratic Republic (Lao PDR) CSF is endemic and has a severe impact on the smallholder-farming sector, which accounts for approximately 80% of the national pig herd. Research has been conducted over the past 10 years with the financial support of the Australian Centre for International Agricultural Research (ACIAR) and technical support of the Australian Commonwealth Scientific and Investigative Research Organisation (CSIRO) to determine the epidemiology and ecology of CSF and develop and test control strategies.

Only genotypes 2.1 and 2.2 of CSF virus are present in Lao PDR and there is a clear geographical distribution of CSF isolates in the Northern (genotype 2.1) and Southern Region (genotype 2.2). The majority of Lao isolates that have undergone molecular analysis belong to genotype 2.2. Structured and passive serological investigations were conducted in the period 1997 – 2001. Active surveillance estimated sero-prevalence in four provinces ranging from 1.2% in Bolikhamxay Province to 21.1% in Vientiane Capital. Overall, the mean estimated sero-prevalence from passive surveillance in all provinces was 17.6%.

From May 2002 to August 2006, a longitudinal survey was conducted in 16 villages in two districts in the central province of Bolikhamxay. The observed village-level-incidence was 21 CSF-outbreaks per 100 village-years (41 per 100 village-years in Bolikhan District and 4 per 100 village-years in Pakading District). A vaccination program was undertaken in December 2004 and January 2005, resulting in a marked reduction in CSF incidence (pre- and post-vaccination crude incidence ratio = 0.52). By univariate risk analysis, two factors were found to be significantly associated with the introduction of CSF into a village: (i) the presence of a mobile live pig and/or pork trader in a village was strongly associated with outbreaks of CSF (OR=8.33, 95% CI: 1.25-55.36, Fisher Exact Test P=0.008), as well as (ii) having a mean village pig population greater than 200 head (OR=4.33, 95% CI: 1.61-11.69, Fisher Exact Test, P=0.04). Other non-significant risk factors included being in Bolikhan District (OR=5.00, 95% CI: 0.74-33.78, Fisher Exact Test P=0.11) and a history of CSF in a nearby village (OR=3.00, 95% CI: 0.97-9.30, Fisher Exact Test P=0.11).

In the Lao PDR and the wider Southeast Asian Region, CSF is one of the most important transboundary diseases of livestock and the most important disease affecting pigs. Impacts on farmer incomes can be severe and farmers at the village level are likely to sell sick pigs to minimize financial losses. This serves to perpetuate the transmission cycle. Detailed research is required to further understand the epidemiology of this important disease and build on the research conducted over the past 10 years.

New AusAID-IDRC Applied Research Program for Emerging Infectious Diseases

Julia Landford

Regional Emerging Infectious Diseases Coordinator, AusAID, Australian Embassy,
37 South Sathorn Road, Bangkok 10120
Phone (66-2) 344 6470
Fax (66-2) 344 6305
email: julia.landford@dfat.gov.au

The Australian government's Agency for International Development, AusAID, has committed over $152 million for initiatives to combat the threat of pandemics and emerging infectious diseases in the Asia Pacific region since 2003. The Emerging Infectious Diseases program aims to improve the recognition, control and prevention of EIDs.

AusAID recognises that research is a key contributor to better development in a rapidly changing and increasingly complex global environment. Research funds are provided to reduce poverty and achieve sustainable development with the aim of providing decision-makers with practical, policy-relevant solutions to priority problems.

A new Emerging Infectious Diseases research program is under development in partnership with the International Development Research Centre (IDRC), Canada. This research program will be managed by an institution in the Asia region, and will provide opportunities for multiple country research bids. The approach will focus on partnerships, capacity building and policy coherence to undertake interdisciplinary applied research using existing regional structures.

The research program will provide an opportunity for regional researchers, health professionals and other stakeholders to undertake several long-term research projects linked to policy for emerging infectious diseases in a development context.

Complementary research streams focusing on priorities to be identified by regional stakeholders could include: global change and disease emergence in the region; social, economic and environmental transformations and implications for health systems strengthening for prevention and response to EIDs; or migration and demographic impacts on EIDs. The geographic focus for the research program will be the Asia-Pacific region. It is anticipated that regional consultations will begin during February and bids will be called during mid 2008.

The Present Situation of Avian Influenza in China

Yanbing Li

Harbin Veterinary Research Institute, Beijing

Following the emergence and spread of the H5N1 strain of highly pathogenic avian influenza (HPAI) virus in Southeast Asia in late 2003-early 2004, the virus also spread and caused catastrophic losses to the poultry industry in China since 2004. Phylogenic and antigen analysis of the virus isolates showed that mutant viruses emerged in chicken in Shanxi and Ningxia Provinces. The unprecedented H5N1 outbreak in migratory birds in Qinghai Lake in May 2005 in China lead to major and energetic debates on the role of the migratory birds in the current HPAI epidemics across the world. In 2006, the HPAI reemerging in the migratory birds struck the Qinghai region again.

Culling and vaccination were implemented in China in the effort to prevent and control the disease. This strategy is regularly revised and updated to reflect the changing disease situation.

The biological characteristics of H5N1 HPAIVs in China, including the phylogenic and antigen analysis, molecular basis of the virus across the host range, as well as the vaccines generated and used in China recent years will be presented and discussed.

Risk Assessment on Foot-and-Mouth Disease (FMD) in Pork from Vaccinated Animals

Emelinda L. Lopez

Animal Health Division, Bureau of Animal Industry, Visayas Avenue, Diliman, Quezon City 1100 Philippines

A quantitative risk assessment was done on the risks of FMD virus introduction in pork from vaccinated animals in FMD-affected areas already declared free from the disease. The probability of having FMD virus contaminated meat from vaccinated animals was found to be 14×10^{-10} per epidemic. This is a very negligible risk. When converting this into affected export volumes, this would translate only to a few grams to less than a kilo in several metric tons of exports. A qualitative risk assessment was also made on the further risk of FMD virus survivability in fresh and frozen meat as well as in meat and meat products. Depending on pH changes prior to freezing as well as the risk material involved, there is a very low to a very high risk of introducing FMD virus through meat. The risk is very low when the meat undergoes sufficient post-mortem pH changes to a level which can inactivate the virus prior to freezing. The risk is very high when the meat contains lymph nodes, bone, skin and residual blood since the virus persists longer in these risk materials when frozen. Thorough heat treatment of pork and its products offers a very low risk for FMD virus introduction. On the other hand, pork which underwent some degree of meat processing presents a moderate risk since not all processing methods could adequately inactivate the virus.

Development of Risk-Based Strategies for the Successful Management of Animal Movement and the Subsequent Spread of Transboundary Animal Diseases in Cambodia and Lao PDR

Ben Madin [1,2], Ian Robertson [2], Angus Cameron [1], Chris Hawkins [3] and John Edwards [2]

[1] AusVet Animal Health Services, Australia
[2] School of Veterinary & Biomedical Sciences, Murdoch University
[3] Department of Agriculture & Food Western Australia

In Southeast Asia and many other parts of the world the most significant factor in the spread of trans-boundary animal diseases (TADs) is lack of effective animal movement management. This project will result in clarification of the risks and development and evaluation of innovative strategies for effective animal movement management. This project is working on three main areas to improve this understanding.

What are the movement patterns of livestock?

Although there is some agreement in general terms about the flow of animals in the region, there is very little definitive work. Retrospective (analysis of existing movement records) and prospective information (animal movement tracking) will be examined and analysed using general, temporal and spatial techniques to record all animal flows.

What drives these patterns?

In simple terms, the most powerful driver is likely to be market value. However, even with a well-designed network to capture this information, there would still be other drivers that wouldn't be incorporated, including cultural, historical, seasonal and legislative factors. This analysis will be pursued by a mix of techniques - development of a network to capture market prices where possible, interviews with livestock traders, evaluation of legislative restrictions on trade and discussions with livestock owners on their reasons for selling.

Can these patterns be modelled to allow enhanced warning about disease spread?

If it were possible, it would allow the implementation of targeted interventions (such as pre-warning potential purchasers about the risk of specific disease in imported animals), and thus significantly reduce the impact of disease.

The development of the ASEAN Regional Animal Health Information System means countries in the region now have almost real-time notification of disease outbreaks. If this could be coupled with a low cost regional model of animal movements the potential for reducing the spread of disease would be enhanced.

Parallel work will also be undertaken in Australia using cattle movement data from the National Livestock Identification System and National Livestock Reporting Service to validate the model.

Policy Making and Decision Support for Pro-poor HPAI Prevention and Control: The Communication Challenges

Anni McLeod

Food and Agriculture Organization of the United Nations

The design of policies, strategies and plans for HPAI prevention and control programmes is a process of negotiation between government and other stakeholders backed up by the best information available at the time.

To support decisions towards pro-poor HPAI control, information is needed on technical issues (the level of risk and the tools and methods available) and socio-economic issues (how people and institutions need to contribute to control, and how they will be differently affected by it). For an equitable and effective negotiation to take place, all of the involved stakeholders require access to the same information, and there must be opportunities for them to communicate their concerns as they weigh up the options for creating policies and plans that are both effective and pro-poor. This poses considerable challenges in building a bridge between those who are gathering together information and those who will need to use it.

This paper discusses the tasks that will be faced by the project “Pro-Poor Policy Options for Control of Highly Pathogenic Avian Influenza (HPAI) in Africa and Southeast Asia” to ensure that the results of different kinds of research done by different organisations are available in an appropriate form and on time when planning is taking place.

Avian Influenza Outbreak Prevention Strategy in Thailand

Siripun Morathop

Department of Livestock Development, Thailand

Thailand is predominantly an agricultural country and most agricultural revenues come from exports. Livestock makes up a huge portion of Thailand's agricultural exports valued at more than US $ 1.5 million. Among the livestock industries, poultry forms the biggest component. Poultry meat and eggs are widely accepted by Thai people, regardless of religious, race or cultural background.

In 2006, about 100.4 million broiler chicken and 9.7 million meat type ducks were produced, which was less than in the year 2002, attributed to Avian Influenza (HPAI) outbreak in 2002, 2003 and 2004. Avian Influenza, and more specifically the H5N1 type is one of the worst hazards that could happen to any poultry producer: big or small and even for backyard and hobby poultry farmers.

A thoroughly planned and prepared set of measures offers the best chance for controlling HPAI in the shortest time and in a safe way for animals, people and the environment. This applies not only to HPAI, but also to other contagious diseases in animals. In Thailand, monitoring and housing of backyard and free - ranging (grazing) poultry are accorded key roles. In addition, a nationwide active surveillance programme, termed X-ray survey, is conducted twice a year, to detect HPAI infections in poultry, based on laboratory testing of cloacal swabs. Bio-security measures have also been implemented in poultry production. Poultry movement restrictions are another measure to limit the spread of infection to a region, in which it has not yet occurred.

Tackling Avian Influenza – Role of the FAO's Wildlife Disease Programme

Scott Newman, Taej Mundkur, and Boripat Siriaroonrat

Food and Agriculture Organization of the United Nations

The Wildlife Disease Programme (WDP) within the Emergency Centre for Transboundary Animal Disease facilitates partnerships, coordinates activities, enhances training opportunities, and supports science that leads to greater understanding about multiple aspects of HPAI H5N1 viral ecology, and in the future, other transboundary diseases that involve both wildlife and agricultural elements. The WDP has focused on understanding the role of wild birds in maintenance and spread of HPAI and has established many collaborative partnerships to accomplish this work at a global, regional and national level. As an internal programme consisting of only 2 staff members at HQ and one in the Asia-Pacific office in Bangkok, collaborations are vital to the success of the WDP. The WDP coordinates with global and regional partners through the Scientific Task Force on Avian Influenza and the Asia-Pacific Working Group on Migratory Waterbirds and Avian Influenza.

Over the past 24 months, the WPD has coordinated, facilitated, or implemented training of more than 300 in-country nationals from over 100 countries on disease and avian ecology with assistance from a range of international organizations and NGO's. The WPD is also actively supporting flyway activities in the Africa-Eurasian region which have participants and country participation spanning from western North America to Australia, and Russia to South Africa receptively. Through the telemetry-based migration, ecology and farm : wildlife interphase studies FAO is also partnering with over 20 organizations to undertake these studies based from Mongolia, China, Kazakhstan, Mali, Malawi, and Nigeria. Migratory movements of birds breeding in Qinghai Lake have revealed that the birds migrate down towards NE India, Bangladesh and Myanmar. Disease surveillance in healthy wild birds has been conducted in 19 countries, with collection of almost 20K samples through partnerships with national and international experts. Our disease surveillance is also being closely coordinated with a partner program, Wildlife Conservation Society, consisting of more than 20 global partner organizations under the Global Avian Influenza Network for Surveillance (GAINS), with whom we have a data sharing agreement. The presentation will provide an overview of the work and plans for the future.

HPAI Risk in Backyard vs Commercial Flocks: Evidence from South East Asia, Canada and Europe

Joachim Otte [1], Dirk U Pfeiffer [2] and David Roland-Holst [3]

[1] Food and Agriculture Organization of the United Nations
[2] The Royal Veterinary College, University of London
[3] University of Berkeley, California

Several epidemic waves of HPAI have occurred in Indonesia, Thailand, Vietnam and elsewhere. Because the majority of HPAI outbreaks have been reported in smallholder backyard flocks, there is an assumption that these operations are inherently more risky than other types of poultry operations and the widespread practice of smallholder backyard poultry keeping is frequently cited as one of the primary risk factors for HPAI outbreaks and disease spread.

We tested this assumption using data on HPAI outbreaks reported in Thailand, Vietnam, Canada, Holland and Italy. The results of our qualitative and quantitative analysis suggest that although backyard poultry keepers will often have no or only limited bio-security measures in place, their HPAI risk seems to be relatively small, with the counter-intuitive finding that backyard poultry production may be less risky, in terms of HPAI infection, than production in larger and more intensive commercial poultry operations.

External Shocks, Producer Risk, and Adjustment in Smallholder Livestock Production: The Case of HPAI in Vietnam

J. Otte[1], M. Epprecht[2], and D. Roland-Holst[3]

[1] Food and Agriculture Organization of the United Nations
[2] Independent Consultant
[3] University of California, Berkeley

Smallholder production remains the majority enterprise model in global agriculture, largely because of the predominance of household farms in low income countries. Two salient challenges for the world's poor smallholders are risk and vulnerability. Because of their poverty, these farmers are more likely to experience adverse external shocks than higher income counterparts. In response to this, smallholders have developed strategies for (*ex ante*) risk management and (*ex post*) risk coping. Public policies that seek to alleviate rural poverty can be more effective if they recognize the farmers' own capacity for adjustment and facilitate this constructively, helping smallholders secure the basis for more sustainable improvements in their livelihoods.

To achieve this requires deeper insight into smallholder behaviour, including a better understanding of how household enterprises respond to adverse shocks. This paper examines the case of smallholder poultry production and adjustments arising from the risk of HPAI infection in Vietnam. We consider how farmers can mix three risk reduction strategies: product diversification, investment in product quality (bio-safety), and development of off-farm income opportunities, to mitigate the adverse effects of significant animal disease risk. With our findings we aim to provide a basis for complementary policies that promote smallholder viability while achieving risk reduction, an approach that increases both individual and economy-wide welfare.

Societal Aspects of the Spread of Avian Influenza H5N1 between Poultry Farms in Thailand

Mathilde Paul[1], Christian Ducrot[2], Gérard Salem[3] and François Roger[4]

[1] CIRAD (French Agricultural Research Centre for International Development) – INRA (French National Institute for Agronomical Research) – mathilde.paul@cirad.fr

[2] INRA Clermont-Ferrand/ Theix, Unité 'Epidémiologie Animale'

[3] Laboratoire Espace Santé Territoire, Université Paris X

[4] CIRAD, TA A-16 / E. Campus international de Baillarguet

Objective:

The objective of our work is to identify and understand societal aspects of the spread of avian influenza H5N1 between poultry farms, based on the data of previous outbreaks in Thailand. The research is part of the French-funded projects and will be carried out in close collaboration with the University of Kasetsart, Bangkok. This paper outlines the research questions we aim at answering in the next three years and the methodological framework of our study.

Research Questions and Methodology:

Human practices and poultry trade are assumed to play a crucial role for the spread of H5N1 virus between farms. Based on this hypothesis, we aim at giving quantitative and qualitative information on the importance of human factors in the spread of influenza in Thailand.

Our research will be led in two steps, and requires methods and tools from epidemiology, spatial analysis, and geography. The approach is based on the analysis of data from previous outbreaks, and on retrospectives interviews about societal practices during the previous outbreaks.

The first step is to study the spatio-temporal distribution of HPAI in Thailand**.** By computing and mapping the percentage of infected farms, we aim at identifying high and low-incidence ratio areas in Thailand and link relative risk with socio-economic factors. Moreover, we will study the diffusion of HPAI in Thailand through spatial analysis methods, to identify the different patterns of HPAI spread, both in time and space.

The second step of our work will be to study the social aspects of HPAI diffusion between poultry farms, on the basis of a field work in Suphanburi province, where H5N1 first emerged and spread. We will study the organization of avian product chains and poultry farming systems during the epidemics, and their evolution since 2004. Then with a quantitative approach on poultry holders, we will identify high-risk farming practices for the spread of the infection, during these past outbreaks. Finally, searching to identify some social practices linked with the disease diffusion process, we'll interview different stakeholders or social groups to understand the societal mechanisms underlying the collective management of the infection.

Research on Socio-Economic Issues of Avian Influenza in Vietnam within the GRIPAVI Project

Renard J.F.[1], Peyre M.[1], Desvaux S.[1], Figuié M.[2]

[1] CIRAD, Research Unit 22, [2] CIRAD, UMR MOISA

GRIPAVI is a research project aiming at a better understanding of avian influenza and Newcastle disease epidemiology. In terms of socio-economic research the project should improve knowledge on i) impacts of the disease and control strategies at smallholder level and ii) the role of commodity chains in disease epidemiology.

In Vietnam a preliminary study on the cost-benefit evaluation of HPAI vaccination in small scale production systems was implemented to address part of the first socio-economic objective of the project. 128 farmers were interviewed within two selected provinces (Long An in the South and Ha Tay in the North). As expected, vaccination appeared to be more cost effective for the farmer than culling and other strategies developed by farmers such as emergency sales at low price. Vaccination is economically preferable for smallholders and this preference for vaccination breaks even as soon as the prevalence is between 1.2 and 3.3%. The results were the most interesting when comparing BCRs and financial parameters according to farmers' attitudes when facing an outbreak.

Prototype models for the financial evaluation of various vaccination strategies are currently being set up based on this preliminary data. More investigations are planned to clarify production and transactions costs at smallholder level in targeted species and production systems to get a better understanding of farmers' attitudes.

Regarding the second objective, in Vietnam the research coming on line soon within the project will allow:

- to compare virus circulation in the field and at critical points of the commodity chains (studies performed in parallel) using an approach mixing both classical value chain analysis methodologies and HACCP methods;
- to model virus spread risk along the commodity chains using data collected by classical value chain analysis, risk factor identification and risk analysis;
- to study the re-organisation of the poultry commodity chains under a sanitary crisis: to assess structural changes within the supply chains, their determinants, the winners/losers, and their impacts on risks;

These results would be further combined at a later stage with a disease diffusion model in order to provide recommendations and tools to improve disease surveillance and control.

Overview of Avian Influenza Research in Indonesia: Needs, Ongoing Activities and Gaps

Elly Sawitri Siregar[1] and Darminto[2]

[1] HPAI-Campaign Management Unit/CMU, Ministry of Agriculture/MoA
[2] Research Institute for Veterinary Science, Bogor, MoA

Based on the Government of Indonesia's National Strategic Work Plan for the Progressive Control of Highly Pathogenic Avian Influenza in Animals, the need for research is given a high priority. Rapid, appropriately-targeted research is needed to help review and refine the approaches taken in HPAI prevention and control measures.

This paper identifies gaps in research in Indonesia, specific research conducted to date and ongoing studies by Indonesia institutes as well as those supported by international organizations and donor countries.

International organizations and institutes are paying increasing attention to research in Indonesia and therefore there is a need for the Government of Indonesia to define its research strategy which clearly articulates the needs, priorities and gaps.

The Impact of Highly Pathogenic Avian Influenza (HPAI) on Rural Livelihoods in Cambodia

Suon Seng

Executive Director of CENTDOR Consulting

Cambodia has an agriculture-based economy, in which 75% of the population depends on agriculture for their living. Rice is the main food crop, often combined with home gardening and small livestock keeping. Poultry production is usually integrated in rural livelihoods as the second, third or fourth most important household activity, contributing to food consumption and cash income. Chicken and ducks are the most common poultry species kept. Chicken raising is mostly very small scale (4-6 hens / household) and very extensive, while duck production can be medium-scale (500 ducks / household) or large-scale (2,000 ducks / household) and can be done in a semi-intensive mode. In duck raising areas, the latter can be the first or the second most important economic activity of rural households, depending on household investment capacity and availability of family labour.

Given limitations in the animal health system in Cambodia, livestock production has remained very extensive and of low productivity. Chicken and ducks suffer high mortalities, especially in the hot season. Thus, in Cambodia, farmers have been confusing HPAI outbreaks with 'normal' poultry mortality in the hot season and with other fatal poultry diseases. Nevertheless, since its occurrence in the last few years, livelihoods of small-scale poultry producers, but especially of medium and large-scale duck producers, have strongly been affected by HPAI. The impact of HPAI on medium and large scale duck producers mainly stems from 1) loss of birds due to the disease and 2) loss of birds from culling without compensation. Many duck producers have lost their investment and economic basis due to HPAI outbreaks.

Since law enforcement as well as implementation of policies and regulations in Cambodia is weak due to poverty and corruption, live bird movements are taking place both within the country and cross borders with limited control. Sick birds are slaughtered and sold in market stores. Live birds, particularly layer ducks, are unofficially imported from neighbouring countries and raised by Cambodian farmers. Because of their poverty, poultry producers, middlemen and retailers ignore the regulations for HPAI and its public health dimension and do not seem to care much about bio-security practices as they will try anything to earn money for a living.

HPAI also has negative impacts for the urban poor. Poultry products are becoming more and more expensive and urban poor have difficulties to afford poultry meat. In the last few years, the price of food items has increased compared to the price of non-food items. Since the demand for local poultry meat is growing, Cambodian poultry producers are interested to re-invest in poultry production, but this entails advantages and disadvantages: it is risky to invest in poultry due to the limited knowledge of HPAI and the deficiencies of the animal health services, while on the other hand, investment in poultry production will contribute to maintain the important role of poultry production to rural livelihoods as well as to keep prices of food items affordable for the urban poor.

The Use of Poultry Market Chains in Developing an HPAI Control Programme in North Sumatra

Albiner Siagian

Humanitarian Activities Unit, University of North Sumatra, Medan, Indonesia

The continuing outbreaks of highly pathogenic avian influenza (HPAI) in several Southeast Asian countries that begun in late 2003 and early 2004 have been disastrous to the poultry industry in the region and have raised serious global public health concerns. Risk for animal and human health exists along the whole poultry market chain. The University of North Sumatra and the Food and Agricultural Organisation of the United Nations completed a market chain study in Medan during 2007 as a means to develop a better understanding of the trade flows, disease transmission mechanisms and possible entry points for intervention in various the poultry market chain. This paper outlines the methodology used to undertake this market chain study and its use in developing policy and HPAI control measures that decrease animal and human health risks.

Our findings indicated that the poultry market chain in North Sumatra is complicated. Many actors are involved in the poultry market. Collectors have an important role in the market chain by linking directly either to consumers or to producers. The market chain study indicated that It is necessary to promote self-breeding of kampong (village) chicken, duck and quail; to form collector associations; to build slaughterhouses for poultry to replace the slaughter points used in traditional markets; to have manure management at the level of livestock keepers; and to more effectively control the distribution of poultry among provinces. Also, there is a need to intensify public awareness campaigns particularly for non-commercial farms, slaughter point staff, and collectors, and to have an integrated effort by government offices, the poultry industry, and non-governmental organizations to prevent and control the spread of HPAI in Indonesia.

A Framework to Assess the Direction of HPAI H5N1 Virus Evolution

Jan Slingenbergh

Food and Agriculture Organization of the United Nations

Host radiation, as triggered by changes in host niche availability, may be depicted in the form of three main, subsequent invasion steps (initial establishment, colonisation, and occupancy) operating simultaneously in three distinct host environment components (host community, population and body), yielding, through iterative interplay and feedback, (i) a new host range, (ii) a new disease reproduction number (R_o), and, importantly, (iii) a new, typical course of infection and transmission mode. The collective process is directed by an (agro-)ecology based switch from an initially strongly *r* oriented to a more *K* based strategy.

The above framework is applied to Avian Influenza Viruses (AIV), H5N1 in particular. Following an unprecedented upsurge in domestic duck production in China starting in the mid-1980s, HPAI H5N1 emerged in the mid-1990s in Guandong province, the first ever HPAI virus showing a strong affinity to domestic waterfowl, developing into at least 21 different duck-based genotypes by the late 1990s. H5N1 virus prevalence was at a far higher level in ducks than in chicken, until the evolution of the aggressive genotype Z, triggering a sub-continental spread starting mid-2003, with high mortality in all terrestrial poultry species in eastern and south-eastern Asia, rapidly seeding H5N1 infection across a larger territory.

With the gradual retraction of the genotype Z virus into wetland based rice-duck agriculture areas, geographically different clades evolved, suggesting a progressive fit to local host niches. With the progressive adjustment to the domestic duck host niche, H5N1 viruses spilled back to wild ducks / waterfowl, kick-starting an intercontinental spread starting in spring 2005, with the Qinghai virus evolving into the Europe-Middle East-Africa (EMA) group of virus strains. The affinity to domestic ducks prevails today and the H5N1 incursions in wild waterfowl did not yield any distinct novel virus lines, although mallard ducks may (seasonally) form an integral part of the H5N1 host reservoir. The wild mallard duck is genetically almost identical to the Peking duck, the foremost host of H5N1 and a hundredfold more abundant. China is arguably the main source of H5N1 spillback from domestic to wild waterfowl.

Current H5N1 viruses usually infect - in order of importance - domestic ducks, domestic waterfowl, terrestrial poultry, wild ducks, other wild waterbirds, other avifauna, and, finally, bird-eating mammals, including humans. Today there are ten or so remaining H5N1 patches distributed across three continents. In some patches virus circulation has been shrinking with fragmentation and progressive fade out. In others, there is evidence of a progressive build-up of genetic diversity, enriched by interpatch virus exchange. Here, colonisation has turned into a state of occupancy.

Further work is in progress to depict, frame and predict the three main subsequent H5N1 invasion steps against the three principal processes taking place in the host environment (acquisition of a novel host range, disease reproduction number and course of infection in the host body). A three by three matrix is established for the events at the global level as well as for the individually persisting patches. A preliminary, schematic plot of geographic spread and virus genetic evolution suggest an initially punctuated, epochal virus evolution process matching the bumpy progression in the invasion process, to an eventual precipitation in the form of a newly defined pathogenic agent, best fitting the novel domestic waterfowl niches.

Transmissibility of Avian Influenza (H5N1) in Incident Poultry Farms in Vietnam

Ricardo J Soares Magalhaes[*1], *Dirk U Pfeiffer*[2], *Joachim Otte*[3]

[1] *School of Veterinary Sciences, University of Queensland*
[2] *The Royal Veterinary College, University of London.*
[3] *Food and Agriculture Organization of the United Nations*

Since late 2001, countries in the Mekong region continue reporting outbreaks of highly pathogenic avian influenza virus of the H5N1 subtype (HPAI H5N1) in their poultry populations with potential serious implications to public health. Poultry outbreak incidence in Vietnam has been observed in yearly waves from late 2003, with the highest incidence being reached in January and February.

We have used surveillance data recorded by the Department of Animal of Vietnam to estimate and evaluate the within-farm transmissibility of avian influenza viruses. Our results suggest that current disease control actions have significantly reduced the within-farm infection transmission when compared to previous outbreak periods. However, the mean within-farm reproductive ratio of infection is still above the threshold for transmission (R_0>1).

The results of this study suggest that current disease containment strategies are not sufficient to reduce the likelihood of recurrence of HPAI H5N1 poultry outbreaks in Vietnam. We anticipate that this would be achievable by applying risk-based poultry vaccination coupled with synchronized bio-security measures tailored to local epidemiological conditions.

A Simulation Model of Avian Influenza (HPAI H5N1) Transmission between Smallholder Poultry Farms in Vietnam

*Ricardo J Soares Magalhaes[*1], Lorenzo Pellis, Barbara Wieland[3], Lisa Collins[3], Dirk U Pfeiffer[3], and Joachim Otte[4]*

[1] School of Veterinary Sciences, University of Queensland
[2] Division of Epidemiology, Imperial College London
[3] The Royal Veterinary College, University of London
[4] Food and Agriculture Organization of the United Nations

This work aims at contributing to risk-based and equitable disease control strategies that might be beneficial in the reduction of the transmission of virus at the local and sub-national in Vietnam. Here we describe the results of computer simulations using a farm-based disease transmission model that approximates the dynamics of HPAI H5N1 outbreaks in smallholder poultry farms at commune level in Vietnam.

During model experimentation the impact of varying different sets of epidemiological parameters on the probability of early extinction, on the mean conditional outbreak size and on the reproductive ratio (number of secondary infected farms arising from a typical infected farm in a commune, R_0) within a commune is simulated. Our results suggest that recent disease control measures do not completely eliminate the possibility for circulation of residual infection in a commune. Complete elimination of HPAI H5N1 from domestic poultry in Vietnam requires coupling rapid response times with high levels of vaccine coverage in small holder poultry.

We anticipate that under the current situation more attention must be paid to early detection of infection and reduced response time in the face of an outbreak.

Participatory Management of Avian Influenza in Village Poultry

Lertrak Srikitjakarn, et al.

Chiang Mai University, Chiang Mai, Thailand

This qualitative study aimed to develop a participatory surveillance and risk communication model for avian influenza control suited for backyard poultry systems. The iterative formulation of the model was based on information and perceptions of strengths and weaknesses existing surveillance and risk communication systems and incorporated suggested improvements from the perspectives of all stakeholders.

The principle of the proposed model is based on to 2 key community organs namely Moobaan and Tambon, which should have the responsibility to conduct clinical surveillance, report disease, engage in risk communication and implement emergency responses with the full support of the regional governmental authority. The village headman and the LAO president are key persons at Moobaan and Tambon level respectively. They should be assisted by an AI committee at each level, which has the authority to deploy the emergency response according to a pre-established plan.

To increase sensitivity of this surveillance system the definition of reportable clinical cases is any form of poultry plague, which is familiar to villagers. To accelerate and counter check disease reporting, the communication chain comprises of 2 parallel channels, a formal and an informal report up to 2 superiors in the chain. At Moobaan level, the village headman formally reports to LOA and informally to the District Livestock Officer and calls an emergency meeting to decide whether to implement the Moobaan Contingency Plan. At Tambon-level the Tambon AI committee has full authority to decide to use the Tambon Poultry Plague Contingency Plan.

This model moves the key actors from the district to the LOA. The regional governmental office shall have duty to technically support LOAs, laboratory diagnosis, risk communication at district level, report to province, monitoring effectiveness of epizootic surveillance schemes practiced by LAOs and transferring central government policy to LOAs.

The participatory approach allows villagers to manage their own interest, reducing loss of their poultry from contagious diseases. Acceptance and cooperation with their own emergency response including culling and temporally raising poultry in close system can be expected to be high. Self-reliance strengthens community responsibility and development. AI surveillance, risk communication and risk management are systemically implemented with clear duties, responsibilities, timely action and complete area coverage. The model ensures sensitive surveillance with rapid response supported from LOA, who can decide to implement emergency action within 3 hours after an outbreak has been detected. This can prevent high economic loss at very low cost. The model can be modified to monitor other zoonoses as well as agricultural hazards in rural area.

Economic Impact Assessment of Foot and Mouth Disease on Smallholder Farms in Northern Vietnam

Dinh Xuan Tung[1], Nguyen Thu Thuy[2]

[1] Department of Livestock Economics and Farming Systems,
National Institute of Animal Husbandry, Hanoi, Vietnam, dxtung@hotmail.com
[2] Department of Animal Health, Ministry of Agriculture and Rural Development, Vietnam

This case study was designed to measure the economic losses caused by the current Foot and Mouth Disease (FMD) epidemic in smallholder farms in Northern provinces of Vietnam, to compare the economic losses of FMD between different farm types and ecological zones, and to estimate economic losses of FMD at commune level. The investigation was carried out on 36 smallholder farms in the Northern provinces of Vietnam, located in six districts representing three ecological regions: lowland, midland and highland. The study was conducted between November and December 2006. Farmers involved in the case study were interviewed and focus group discussions (FGDs) were conducted separately with animal health workers and local authorities. The FGDs assisted in further understanding the perception of the impact of FMD on smallholder farms.

Economic loss of FMD on livestock keeping households was analysed and measured at household level. The results revealed that the economic impact of the FMD epidemic on affected smallholder farms across the range of ecological regions and production systems in Northern provinces of Vietnam were substantial. Among the ecological regions, the highest economic losses were incurred in farms in low lying areas with high livestock density. This was followed by areas of low livestock density in the same ecological region. Farms located in midland areas with low livestock density tended to have minimal losses due to FMD.

Other impacts such as loss in investment and employment opportunities, lack of draught power leading to delayed harvest, and delayed opportunity for breeding animals were also investigated.

At commune level the study revealed that the most adverse effect of FMD occurred in lowland areas where all infected animals were destroyed by local veterinary authorities. A sensitivity analysis was carried out to further investigate the possible impacts of FMD at the commune level by changing the proportion of household farms affected by FMD in a commune.

Frequency and Types of Contact with Poultry and Potential Risk of H5N1 Transmission to Humans in Rural Cambodia

Maria D. Van Kerkhove[1,2], Sowath Ly[1], Davun Holl[3], Javier Guitian[4], Punam Mangtani[2], Azra Ghani[5], Sirenda Vong[1]

[1] Epidemiology Unit, Pasteur Institute of Cambodia, Phnom Penh, Cambodia
[2] Infectious Disease Epidemiology Unit, London School of Hygiene and Tropical Medicine
[3] National Veterinary Research Institute, Phnom Penh, Cambodia
[4] Epidemiology Division, The Royal Veterinary Collage, London, UK
[5] MRC Centre for Outbreak Analysis & Modelling, Imperial College London, UK

Since 2004, H5N1 outbreaks have been recurrent in domestic poultry and humans in Cambodia. To date, seven human cases (100% CFR) and 22 outbreaks in poultry have been confirmed. Because household ownership of backyard poultry (FAO Sector 4) in rural Cambodia is high and epidemiologic data on human exposure risk at the animal-human interface is largely incomplete, an understanding of the extent and frequency of poultry handling behaviours in these settings is necessary to assess the risk associated with different practices and to formulate sensible recommendations to mitigate this risk. Using data collected from four geographic regions, we explore patterns of human contact with poultry among rural farmers in Cambodia to identify populations with the highest potential exposure to H5N1.

A cross-sectional survey interviewed 2,400 backyard poultry owners from 77 randomly selected villages in four geographic regions throughout Cambodia. Using risk assessment methods, patterns of contact as surrogate measures of exposure risk were used to generate risk indices of potential H5N1 transmission among different populations in contact with poultry. Groupings were generated by combining poultry handling practice with a transmission risk weighting factor for each individual and examined stratified by age and gender.

Our results demonstrate that most of the population in rural Cambodia is in frequent contact with domestic poultry, with an estimated 58% of the population carrying out on a regular basis at least one of the practices that we considered of high risk of effective transmission if the bird is infected. Subjects reported high contact with domestic poultry (chickens and ducks) through the daily care and food preparation practices, however contact patterns varied by gender and age ($p<0.001$). Males between the ages of 26-40 reported practices of contact with poultry that give rise to the highest H5N1 transmission risk potential, followed closely by males between the ages of 16-25. This risk assessment lacks the power of a formal quantitative risk assessment because epidemiologic data gaps and uncertainties of H5N1 pathogenesis in the host species currently exist. Data is urgently needed on the prevalence of H5N1 in poultry species in regions where H5N1 is recurrent or endemic in domestic poultry flocks; he potential routes of transmission of H5N1 from poultry to humans and prevalence of such practices in human populations; the contribution of genetic or immunological factors on transmission; virus survival in poultry during food preparation practices, in poultry waste, soil and water under different environmental conditions; and the persistence of H5N1 in poultry tissues.

Research Activities of the Cambodia Pasteur Institute on Avian Influenza in Cambodia

Vong S and Buchy P.

Institut Pasteur in Cambodia, PO Box 983 - 5 Bld Monivong, Phnom Penh, Cambodia

The recent spread of avian influenza A (H5N1) has affected Cambodia causing high poultry mortality and seven human H5N1 cases to date. The Institut Pasteur – Cambodia (IPC), as a member of the Cambodia avian influenza task force which includes the ministries of Health and Agriculture, FAO and WHO, is responsible for laboratory diagnosis in human (WHO National Influenza Center, H5 National Reference Laboratory) and for confirmation of H5N1 infections in animals and has initiated research activities based upon H5N1 outbreak investigations and surveillance in animals and humans.

This report summarizes IPC's research activities in AI in collaboration with national and international partners. We have expanded the scope of the outbreak investigations to include retro mortality surveys in poultry, environmental surveys and sero-epidemiological surveys in humans: (1) Poultry mortality surveys will help understand the dynamics of infection in poultry and define epidemiological characteristics that are associated with H5N1 infection; (2) The environmental surveys will explore the conditions of virus survival in the environment and scaffold hypotheses; and (3) Sero-epidemiological investigations aim to determine the frequency of human infection by avian influenza A (H5N1) viruses among persons of different ages in southern Cambodia that are in close contact with poultry populations and determine the risk factors associated with testing positive for antibodies to H5N1 compared to seronegative individuals.

The circulation of the virus and its dynamics are also studied through (1) analyzing the MAFF national surveillance data of poultry mortality; (2) understanding the interaction between humans and birds in markets and at the village level; (3) modeling the poultry trading network for its influence in the spread of H5N1 in the poultry population; (4) virus characterization and phylogenetical analysis of H5N1 viruses identified in Cambodia and (5) identifying spatial, environmental and physico-chemical conditions that play a role in the survival of the virus in the environment via laboratory experiments and modeling.

Our various partners include CIRAD, IP Paris and IP International Network, LSH&TM, WHO, US CDC Atlanta, RIVERS European project partners and the 2 Cambodian ministries of Agriculture and Health.

Poultry Production and Health Investigation in China 2007

Xinjie Wei

China Animal Health Epidemiological Centre, Qingdao

In recent years, China's poultry industry has developed rapidly with distinct regional differences and increased scale of production. In order to assess the structure of poultry raising, health status, live bird trading and slaughter patterns in different areas, in 2007, CAHEC carried out an epidemiological investigation in 26 counties of 13 provinces. The findings are as follows.

1. The structure of the poultry industry in China has not yet effectively changed with scattered family poultry raising still accounting for the majority of poultry producers. However, the average scale of poultry production has changed: while the farm / household numbers falling into FAO's classification of Sectors I, II, III account for only 1%, their poultry inventory exceeds 58%.
2. Through on-the-spot visits of 60 poultry farms / households, it was found that poultry mortality, which ranged from 0 to 35.3%, decreased with increasing investment in disease prevention measures.
3. HPAI was not reported in any of the 26 counties. Sampling of 54 farms / households showed that the proportion of samples with protective H5 titres increased with improved disease prevention measures. In Sector I this proportion reached 92%, which is similar to results obtained in live bird markets.
4. Seven of the 26 counties (27%) have banned live bird markets. In rural areas the proportion of birds traded in live bird markets as opposed to slaughtered poultry was 58%, which is more than double the proportion in urban areas (26%). Bio-security of live bird markets can be categorized into four classes, of which the 'standardized' market (Class I) accounts for 4%, while the proportion traded in Classes II, III, IV are 29%, 57%, and 11% respectively.
5. As for live bird movements in the 26 counties, intra-province import volume accounted for 80%, while the intra-province export volume only accounted for 16%. With respect to live bird transportation across provinces, most movements occurred between neighbouring provinces, while some counties had long distance transportation across provinces.
6. None of the 26 counties has a large poultry slaughterhouse with an annual bird slaughter volume over 30 million. Nine of the 26 counties have small or medium scale poultry slaughterhouses, the average annual bird slaughter volume being 1.54 million per slaughterhouse.

Report of Surveillance and Applied Research on Foot and Mouth Disease in Indonesia

Augus Wiyono, Musny Suatmodjo, Darminto and Harry Besar Sosiawan

Indonesian Ministry of Agriculture

In Indonesia foot and mouth disease (FMD) was first reported in Malang, East Java, in 1887. An eradication program was carried out by conducting vaccination, restriction of transportation, and quarantine regulations. The last outbreak occurred in 1983. Since 1986 Indonesia has been declared an FMD free country based on a Decree of the ministry of Agriculture, which was then formally recognized by the OIE in 1990.

In order to maintain FMD-free country status, several programs have been implemented in Indonesia, namely: (1) Policy and legislation to implement strict import procedures on animals, animal products and by-products; (2) Implementation of an FMD Indovet Plan (emergency preparedness for FMD); (3) Diagnosis and surveillance; (4) Disease reporting system; (5) Private sector integration, and (6) Public awareness and communication system.

The surveillance program has been routinely ongoing ever since Indonesia declared FMD-freedom. Samples are collected by Provincial / District Livestock Services in collaboration with animal health posts, especially from border districts and districts which have previously has outbreaks. Each year approximately 1,000 serum samples are collected from susceptible animals (cattle, sheep, goats and buffalo) and tested by the National Center for Veterinary Biology (Pusvetma) using an Indirect Double Sandwich ELISA to detect antibody subtypes O, A, C, and Asia 1. All samples have so far tested negative. The same results were also obtained by applied research studies conducted by the Indonesian Center for Veterinary Science. A proficiency test with other international laboratories will be conducted in the near future.

Based on these results, it is concluded that Indonesia remains FMD-free.

List of Participants

Family Name	First Name(s)	Country	City	Organization	e-mail
Abila	Ronello	Thailand	Bangkok	OIE	r.abila@oie.int
Agustian	Adang	Indonesia	Weat Java	ICASEPS - Ministry of Agriculture	iqbalrafani@yahoo.com
Benigno	Carolyn	Thailand	Bangkok	FAO	Carolyn.Benigno@fao.or
Brady	Molly	Thailand	Bangkok	USAID	Mobrady@usaid.gov
Buchy	Philippe	Cambodia	Phnom Penh	Pasteur Institute	pbuchy@pasteur-kh.org
Burgos	Sigfrido	Italy	Rome	FAO	sigfrido.burgos@fao.org
Chormai	Theerachai	Thailand	Bangkok	Department of Livestock Development	t_chormai@yahoo.com
Damrongwatanapokin	Sudarat	Thailand	Bangkok	USAID	sdamrongwatanapokin@usaid.gov
Desquesnes	Marc	Thailand	Bangkok	CIRAD	marc.desquesnes@cirad.fr
Desvaux	Stephanie	Vietnam	Hanoi	CIRAD	stephanie.desvaux@cirad,fr
Dinh Xuan	Tung	Vietnam	Hanoi	Asian Partnership on AI Research	xuantung168@yahoo.com
Do	Dung	Vietnam	Hanoi	Department of Animal Health	dung.dah@gmail.com
Edwards	John	Australia	Murdoch	Murdoch University	John.Edwards@murdoch.edu.au
Franco-Dixon	Mary Ann	Thailand	Bangkok	FAO	MaryAnn.FrancoDixon@fao.org
Gaidet	Nicolas	France	Montpeiller	CIRAD	nicolas.gaidet@cirad.fr
Ghani	Azra	UK	London	Imperial College	a.ghani@imperial.ac.uk
Gilbert	Jeffrey	Vietnam	Hanoi	FAO	Jeffrey.Gilbert@fao.org
Gleeson	Laurie	Thailand	Bangkok	FAO	Laurence.Gleeson@fao.org
Goutard	Flavie	France	Montpeiller	CIRAD	flavie.goutard@cirad.fr
Gundran	Romeo	Philippines	Nueva Ecija	Central Luzon University	romygundran@yahoo.com
Hoang Van	Nam	Vietnam	Hanoi	Department of Animal Health	hvnamdah@yahoo.com
Hogerwerf	Lenny	Belgium		Universite Libre de Bruxelles	lennyhw@gmail.com
Isa	Kamaruddin Md.	Malaysia	Kuala Lumpur	Department of Veterinary Service	kamar@iph.gov.my
Kalpravich	Wantanee	Thailand	Bangkok	FAO	Wantanee.Kalpravich
Kasemsuwan	Suwicha	Thailand	Nakorn-pathom	Kasetsart University	fvetswk@ku.ac.th
Khetkan	Phloenphan	Thailand	Bangkok	Department of Livestock Development	ppkk_phan@yahoo.co.th
Khounsy	Syseng	Lao PDR	Vientianne	Ministry of Agriculture and Forestry	ahr0301@laopdr.com

Family Name	First Name(s)	Country	City	Organization	e-mail
Landford	Julia	Thailand	Bangkok	AusAID, Australian Embassy	julia.landford@dfat.gov.au
Le Thi Mong	Phuong	Vietnam	Hanoi	Institute of Sociology	lephuongxhh@gmail.com
Li	Yanbing	China	Beijing	Harbin Veterinary Research Institute	lyb@hyn.ac.cn
Lopez	Emelinda	Philippines	Quezon	Bureau of Animal Industry	doc_minnie12@yahoo.com
Madin	Ben	Australia	Broome	Murdoch University	ben@ausvet.com.au
McLeod	Anni	Italy	Rome	FAO	anni.mcleod@fao.org
Meers	Joanne	Australia	Bisbane	School of Veterinary Science	jmeers@uq,edu,au
Miranda	Noel Lee	Indonesia	Jakarta	ASEAN	noel@aseansec.org
Monicat	Francois	France	Montpeiller	CIRAD	francois.monicat@cirad.fr
Morathop	Siripun	Thailand	Bangkok	Department of Livestock Development	siripunm@hotmail.com
Morissey	Chris	Australia	Canberra	CSIRO-AAHL	chris.morissey@csiro.au
Morzaria	Subhash	Thailand	Bangkok	FAO	subhash.morzaria@fao.org
Mundkur	Taej	Italy	Rome	FAO	taej.mundkur@fao.org
Murray	Gardner	Australia	Canberra	OIE	gardner.murray@acreewagi.net.au
Myat	Kyaw	Myanmar	Yangoon	Ministry of Livestock and Fisheries	wahwatin@cccirgn.net.mm
Nguyen Thi	Thuong	Vietnam	Hanoi	National Institute of Hygiene and Epidemiology (NIHE)	Kitthuong24@yahoo.com
Otte	Joachim	Italy	Rome	FAO	joachim.otte@fao.org
Pandey	Harsaran	Italy	Rome	FAO	
Paul	Mathilde	France	Champanelle	CIRAD-INRA	mathilde.paul@cirad.fr
Pfeiffer	Dirk	UK	London	RVC	pfeiffer@rvc.ac.uk
Pham	Thinh Thanh Hoa	Vietnam	Hanoi	CIRAD	hoaven@yahoo.com
Rafani	Mohammed Iqbal	Indonesia	West Java	ICASEPS - Ministry of Agriculture	iqbalrafani@yahoo.com
Renard	Jean-Francois	France	Montpeiller	CIRAD	jean-francois.renard@cirad.fr
Rich	Karl	Kenya	Nairobi	ILRI	k.rich@cgiar.org
Roger	Francois	France	Montpeiller	CIRAD	francois.roger@cirad.fr
Roland-Holst	David	USA	California	University of California Berkeley	dwrh@are.berkeley.edu
Roy	Devesh	USA	Washington	IFPRI	d.roy@cgiar.org
Sawasdee	Prapawan	Thailand	Bangkok	Department of Livestock Development	ppwan23@hotmail.com

Family Name	First Name(s)	Country	City	Organization	e-mail
Siagian	Ir, Albiner	Indonesia	North Sumatra	University of North Sumatra	albiner_sgn@yahoo.com
Siregar	Elly Sawitri	Indonesia	Jakarta	HPAI-CMU	upp_ai@yahoo.com
Siriaroonrat	Boripat	Thailand	Bangkok	FAO	Boripat.Siriaroonrat
Slingenbergh	Jan	Italy	Rome	FAO	jan.slingenbergh@fao.org
Sommanustrueechai	Angkana	Thailand	Bangkok	Zoological Park Organization	ungangkana@yahoo.com
Souris	Marc	Thailand	Bangkok	IRD	souris@ird.fr
Suon	Seng	Cambodia	Phnom Penh	Centre for Development Oriented Research	suonseng@centdor.com
Tipkantha	Wanlaya	Thailand	Bangkok	Zoological Park Organization	wanraya_v62@yahoo.com
Unger	Fred	Kenya		ILRI	F.Unger@cgiar.org
Van Kerkhove	Maria	England	London	London School of Hygiene and Tropical Medicine	Maria.Vankerkhove@lshtm.ac.uk
Vong	Sirenda	Cambodia	Phnom Penh	Pasteur Institute	svong@pasteur-kh.org
Vu Chi	Cuong	Vietnam	Hanoi	National Institute of Animal Husbandry	vccuong@netnam.vn
Wei	Xin Jie	China	Qingdao	China Animal Health Epidemiological Centre	weixinjie@epizoo.org
Wiyono	Agus	Indonesia	Jakarta	Directorate General of Livestock Services	agusrini@indo.net.id
Wongsathapornchai	Kachen	Thailand	Bangkok	Department of Livestock Development	wkachen@gmail.com