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EAHMI Conference 2013

Use of environmental animal health management strategies for decision-making

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EAHMI Conference 2013

Use of environmental animal health management strategies for decision-making

Conference proceedings

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Foreword

At a macro level, growing populations, income gains and urbanization have made livestock one of the fastest growing subsectors of agriculture. Past sector expansion in developed countries and more recently in emerging nations, has been impressive and has been associated with a widespread transformation of the livestock sector.

However, as a result of globalisation and climate change the world is currently facing an unprecedented increase of emerging and re-emerging animal diseases and zoonoses (animal diseases transmissible to humans). Environmental conditions have profound influences on animal productivity and production, and the distribution of many endemic animal diseases, especially those transmitted by biological vectors (e.g. insects and snails), and up surge of emerging diseases. As you all are aware, livestock are important in supporting the livelihoods of poor livestock keepers, traders and labourers throughout the developing world. Hence, diseases affecting livestock can have a devastating impact on animal productivity and production, on trade in live animals, meat and other animal products, on human health and, consequently, on the overall process of economic development.

Better understanding and wider appreciation of the diverse interactions between livestock and the environment is, therefore, essential for effective disease control and sustainable development.

It was based from these developments that FAO advocated the use and application of the Environmental Animal Health Management Initiative, first as a country project initiative and for which the expansion to other countries was anchored on.

The FAO project "Environmental Animal Health Management Initiative for Enhanced Smallholder Production in Southeast Asia" (GCP/RAS/244/ITA) is an institutional strengthening and capacity building project of the Food and Agriculture Organization of the United Nations (FAO) and the Governments of Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam with funding from the Government of Italy.

Environmental animal health management (EAHM) is a holistic approach to disease control and environmental protection where many interactions between farm animals and the environment are studied and analyzed, mapped, and addressed with unprecedented coordination and collective action. It refers to the theory and practice of assessing, correcting, controlling and preventing those factors that may have adverse effects on the health of animal and human populations, and the wider environment. And this is what the EAHMI project have endeavored to do.

After 8 years of doing EAHM interventions, first in the Philippines in 2006, then expanded to include Cambodia and Lao PDR in 2009-2010 and expanded again in Myanmar and Viet Nam in 2011-2013, we have compiled all the works under this project to showcase what the countries have done in the areas of capacity building, data management and analysis, application of EAHM strategies to animal production and health and networking.

I encourage all stakeholders to share the EAHM best practices on animal production and health, the lessons learned, and discuss what more is needed to fully integrate EAHM into the veterinary services planning and implementation. FAO will continue to advocate the use of environmental animal health management as well as assist countries in applying this tool to enhance smallholder livestock production in the region.

May I at this point recognize the cooperation of the participating countries under this project and urge you to continue the EAHM work.

I also greatly acknowledge the contribution of the Government of Italy for supporting an initiative that combines integrated animal disease management, improved animal husbandry and farm management practices, and better use of natural resources, all based on coordinated geographic information. The support of the Italian government has truly helped in defining the emerging field of environmental animal health management.

May we all continue to network and dialogue so we may gain a clearer understanding of issues concerning the animal-human-environment interface.

Hiroyuki Konuma
Assistant Director-General and Regional Representative

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Acknowledgements

The Food and Agriculture and Organization of the United Nations is grateful to the contributions made to this conference proceedings, the submissions of which were coordinated by the respective National Focal Points of the participating countries, namely: Sar Chetra of Cambodia, Settha Sinthasak of Lao PDR, Okkar Soe of Myanmar, Rubina Cresencio of the Philippines and Phan Quang Minh of Viet Nam.

Special thanks to Raffaele Mattioli for guiding the direction of environmental animal health management in the region and to the FAO project team in the Philippines for monitoring the work in the five countries.

The roles of Carolyn Benigno, Imelda Santos, Rafael Umbrero, Janice Sabagay, Grace Balingit , Chanrit Uawongkun and Terry Clayton for bringing all the inputs together, are much appreciated.

Executive summary

The EAHMI Conference 2013 was a dissemination workshop of the Environmental Animal Health Management Initiative (EAHMI) for Enhanced Smallholder Production in Southeast Asia (GCP/RAS/244/ITA), an institutional strengthening and capacity building project implemented by the Food and Agriculture Organization of the United Nations and the Governments of Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam with funding from the Government of Italy. The workshop aimed to gather EAHMI stakeholders on animal production and health to present the work done by the project as well as share experiences and lessons learned during implementation.

The two-day conference was held from 18 to 19 September 2013 at the Fairmont Hotel, Makati City, Philippines, with the theme Use of Environmental Animal Health Management Strategies for Decision-Making.

The opening ceremony was graced by the presence of Dr Alfonso Tagliaferri, Chárge d'Affaires, Embassy of Italy in Manila, and Mr Daniele Salvini, Senior Programme Officer, FAO Regional Office for Asia and the Pacific. The delegates were also welcomed by Dr Davinio Catbagan, Assistant Secretary for Livestock, Department of Agriculture, Philippines.

A total of 55 delegates participated in the conference comprised of representatives from the Embassy of Italy in Manila, Royal Embassy of Cambodia in Manila, Embassy of Lao PDR in Manila, FAO Rome, FAO RAP and FAO Philippines, World Organization for Animal Health (OIE), EAHMI member countries, Indonesia, Thailand, project implementers and counterparts in the government, academe, and local government units in the Philippines.

The conference consisted of a plenary session, five technical sessions and a poster gallery exhibit. The 20-poster exhibit showcased the work and outputs of the project in Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam conducted in partnership with stakeholders in universities, government agencies, and local government units.

Dr Raffaele Mattioli, Senior Officer at Agriculture and Consumer Protection Department in FAO Rome, presented *Environmental Animal Health Management in Animal Production and Health*, *a Global Perspective* during the plenary session.

A total of 13 presentations for the technical sessions were grouped into five categories namely: capacity building, information management systems, commissioned studies as examples of GIS applications on animal production and health, integration of environmental animal health management (EAHM) in veterinary services planning and implementation, and networking.

In conclusion, the conference acknowledged:

- That capacity building on data gathering, management and analysis is core to implementing environmental animal health management.

- That developing information management systems requires an appreciation and prioritization of what data should be collected, how they should be collected, collated and analyzed in a harmonized and periodic way that would lead to the development of an information system truly owned by the country.
- That there are several GIS applications on animal production and health that can assist in providing evidence-based decisions.
- A favorable synergy has been achieved with universities and development partners.
- The Philippines experience in investing its own resources to develop and apply the principles and lessons learned through the implementation of the project has been very useful to other countries.
- That EAHM is a useful tool to veterinary services planning and implementation.

With respect to the closing of the EAHMI project, existing EAHMI member countries were concerned that the gains from the project would not be consolidated and followed through, thus, the conference made recommendations in three areas:

Next Steps: develop and submit by December 2013 a regional project proposal on the consolidation and expansion of EAHM in consultation with concerned countries; initial contacts be made by countries and the regional office with donor representative/s concerning the needed financial support at different levels; studies be compiled and edited for possible publication by FAO; countries involved in the current EAHMI network consider the injection/support of internal resources to consolidate what has been achieved in their countries;

Strengthening EAHM networking: Existing EAHMI networks should be maintained and sustained and expanded to include other countries in the Southeast Asian region; the EAHMI website should be maintained and regularly updated by the lead country (Philippines) through the Bureau of Animal Industry; conduct of an annual EAHMI conference with funding should be explored to share results of studies and activities conducted.

EAHM strategies: Countries meet with their stakeholders and partners to discuss priority areas on animal production and health for EAHM technical intervention and support; capacity building programme to be designed where countries can monitor their levels in a stepwise manner (e.g. basic computer skills, GIS, remote sensing); and EAHM to be advocated as a tool for veterinary services planning and implementation.

The conference registered its note of thanks to the Government of Italy for supporting an initiative that combines integrated animal disease management, improved animal husbandry and farm management practices, and better use of natural resources, all based on coordinated geographic information; to FAO for leading the implementation of project activities in the region and for networking with the countries; the cooperation of the participating countries under this project; and the lead country, Philippines for steadfastly advocating the use of EAHM in the region and for hosting the conference.

Introduction

The EAHMI Conference 2013 is a dissemination workshop of the Environmental Animal Health Management Initiative (EAHMI) for Enhanced Smallholder Production in Southeast Asia (GCP/RAS/244/ITA), an institutional strengthening and capacity building project implemented by the Food and Agriculture Organization of the United Nations and the Governments of Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam with funding from the Government of Italy.

The conference aimed to gather EAHMI stakeholders on animal production and health to present the work done by the project as well as share experiences and lessons learned during implementation. The conference encouraged the participation of interested individuals from governments, universities, and the private sector who are interested in the improvement of animal production and disease control, or who simply want to learn about environmental animal health management.

The two-day conference was held from 18 to 19 September, 2013, at the Fairmont Hotel, Makati City, Philippines. During the opening ceremony, Dr Alfonso Tagliaferri, Chárge d'Affaires, Embassy of Italy in Manila, stressed that the achievements of the project were very positive and productive. He stated that Italy was indeed pleased and proud to be part of the EAHMI and looks forward to working with FAO in the future.

Mr Daniele Salvini, Senior Programme Officer, FAO RAP, encouraged all stakeholders to share EAHM best practices on animal production and health, lessons learned, and discuss what more is needed to fully integrate EAHM into veterinary services planning and implementation. He also recognized the cooperation of the participating countries under the EAHMI project.

The delegates were also welcomed by Dr Davinio Catbagan, Assistant Secretary for Livestock, Department of Agriculture, Philippines.

The Philippine Department of Agriculture and the Bureau of Animal Industry turned over the National Atlas of Philippine Farm Animal Resources, one of the major outputs spearheaded by EAHMI Philippines, to the Government of Italy. The atlas was received by Dr Tagliaferri.

Participants

A total of 55 participants attended the two-day conference, comprised of representatives from the Embassy of Italy in Manila, Royal Embassy of Cambodia in Manila, Embassy of Lao PDR in Manila, Food and Agriculture Organization of the United Nations (FAO) in Rome and Regional Office for Asia and the Pacific (FAO RAP), FAO Philippines, World Organization for Animal Health (OIE, country delegates from country project implementers and counterparts, members of academe, and local government units.

Technical sessions

A total of 14 technical presentations were made during the conference grouped in a plenary and five technical sessions namely: capacity building, information management systems, commissioned studies as examples of GIS applications on animal production and health integration of EAHM in veterinary services planning and implementation, and networking.

Plenary session

Dr Raffaele Mattioli, Senior Officer at Agriculture and Consumer Protection Department in FAO Rome, presented *Environmental Animal Health Management in Animal Production and Health: a Global Perspective,* during the plenary session. He discussed the biological and abiotic factors contributing to disease emergence and re-emergence. Biotic factors include environmental, climate and climate changes, ecosystem and biological changes, animal density and biomass, host-pathogen interaction changes, microbial adaptation, changes in land use and natural resource management, and increased contacts between pathogens and host populations. Abiotic factors include globalization, international trade and level of economic development, lack of or inadequate policies for setting up control and confinement measures, political instability, breakdown of public services in charge of disease control, changes in production systems, and the introduction of inadequate or inappropriate technology.

Dr Mattioli highlighted that developing countries have increasing human population that will translate into greater milk and meat demands and this has contributed to higher rates of shifting to different production systems, especially in Asia. He further explained that these high intensity production systems pose a great risk in the creation of new pathogens. He cited examples of predicting the presence of diseases using predictive parameters used for mapping analysis such as ecological parameters (normalized difference vegetation index (NDVI), annual pluviometry and average temperature), epidemiological parameters (biomass density, percent species at disease risk on total biomass), and socio-economic parameters (population density, density of agricultural activity). He also suggested a modular policy approach for environmental animal health management intervention to improve livestock-agriculture production systems which encompasses different areas such as socio-economics, institutional support, agricultural production, training and information and land use, land tenure and natural resource management that will lead to a successful disease control scheme. This approach allows a spread of investments for EAHM interventions that would also translate into a spread of benefits to land use, agricultural production and socio-economic and market development. (*The full paper appears as Annex 1.)*

Session 1: Capacity building[1]

The technical session on capacity building was led by Dr Sar Chetra, EAHMI Cambodia National Focal Point. The session focused on capacity training activities of the EAHMI Project in the five countries on data management, GPS and GIS and their applications to animal health and production through various training workshops and secondment programmes.

Dr Imelda J. Santos, EAHMI Regional Focal Point, presented an *Overview of Capacity Building under the EAHMI project*, in which various basic and intermediate training on data management using MS Excel and GIS/GPS were conducted, and where a total of 789 personnel were trained from the period 2012 to 2013. The EAHMI Secondment Programme further strengthened skills in GIS/GPS through knowledge sharing and mentoring. Four trainees from Lao PDR, Cambodia and Philippines completed the secondment programme.

Dr Khin Ohnmar Lwin, Assistant Director of Myanmar Livestock Breeding and Veterinary Department, presented . *Use of Environmental Animal Health Management Strategies in the National Veterinary Services: Myanmar Experience*, which focused on . MS Excel and GIS/GPS training for veterinary officers of the LBVD, partner agencies and Township Veterinary Officers to support the smallholder dairy profiling survey in Mandalay, Yangon and Shan states.

Dr Rubina Cresencio, EAHMI Philippines National Focal Point and Director of the Bureau of Animal Industry, shared how EAHM strategies were used in the Philippine National Veterinary Services.

Her presentation highlighted the successful deployment of the Philippine Animal Health Information System (PhilAHIS) as the national reporting system for animal health in the country, in parallel with training on standard reporting forms for municipal livestock technicians and training workshops for GIS/GPS applications. Various commissioned studies were also carried out by EAHMI Philippines in collaboration with universities that were translated into a national strategy for disease control and management specifically for surra.

Session 2: Information management systems[2]

The technical session on information management systems was chaired by Dr Reildrin Morales, Animal Health Officer, Regional Support Unit of FAO RAP. The session focused on the lessons learned from the pilot program on standardized reporting forms on animal production and health in Cambodia and Lao PDR, and the application of PhilAHIS to national veterinary services planning and implementation in the Philippines.

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[1] *Full papers under Session 1 appear as Annex 2.*

[2] *Full papers under session 2 appear as Annex 3.*

Dr Sar Chetra, EAHMI Cambodia National Focal Point and Deputy Director of the Cambodia Department of Animal Health and Production (DAHP), presented Lessons Learned from the Pilot Programme on *Standardized Reporting Forms on Animal Production and Health in Cambodia*, which highlighted the standardization of reporting forms on animal diseases and disease outbreak investigation, animal movement, number of animals vaccinated, number of slaughtered animals, and animal farm profile. The standard forms were piloted in seven provinces of Banteay Meanchey, Battambang, Kampong Cham, Preah Sihanouk, Pursat, Svay Rieng and Takeo. The piloting of standard reporting forms built institutional and human resource capacity at the provinces and districts as well as within the DAHP, though training workshops including GIS/GPS applications. Dr Chetra emphasized that the pilot programme contributed to improving animal production and health information and in establishing a national georeference database of animal diseases and livestock resources. The geodatabase will be a useful tool for the formulation of policy, strategy, and work plans for national animal disease control and management and livestock development.

Dr Settha Sinthasak, EAHMI Lao PDR National Focal Point, and Head, Livestock and Legislation Section of the Lao PDR Department of Livestock and Fisheries (DLF), discussed *Lessons Learned from the Pilot Programme on Standardized Reporting Forms on Animal Production and Health in Lao PDR*. He briefly mentioned the various training programmes on GIS/GPS applications in animal health management. EAHMI Lao PDR initiated the standardization of four reporting forms: animal movement, meat consumption, farm profile (pigs), and animal health monitoring, that were piloted in the three partner provinces of Vientiane Capital, Xayabouly and Salavan. Piloting strengthened capabilities of veterinary staff at the provincial level in the use of standard reporting forms. The initial data collection demonstrated its importance to provide data analysis for immediate response to and from DLF, easier collation, storage and retrieval of data and data update for dissemination. Through the pilot programme, DLF realized it is critical to enforce the use of standard reporting forms as they serve as important inputs for effective GIS mapping which is an important decision support tool for planning strategies by the epidemiological unit for disease outbreak investigation and animal movement control.

Ms. Marites Gealone, Agriculturist, from the Philippine Bureau of Animal Industry, presented *PhilAHIS and its Applications to the National Veterinary Services Planning and Implementation.* The Philippine Animal Health Information System aims to standardize reporting formats and establish a core reporting system for animal health and production, that facilitates efficient and timely reporting of accurate information from local to national level veterinary services. PhilAHIS has three components: Surveillance and Vaccination Usage System, Livestock Movement Monitoring System, and Laboratory Information System. To date, only the Surveillance and Vaccination Usage System has been deployed and is operational nationwide. The two remaining components are still under development and testing. Ms. Gealone highlighted that in terms of data management, PhilAHIS has improved the communication flow of reporting. This has contributed to the prompt availability of animal health information, allowed for quick response and tracing back of disease outbreaks, and increased efficiency of animal health programmes. The continuous

engagement and strong linkage and coordination between PhilAHIS counterparts in the regions and provinces and the national government as well as the appreciation and system ownerships at the provincial and regional level ensures the sustainability of PhilAHIS.

Session 3: Commissioned studies as examples of GIS applications for animal production and health[3]

Four commissioned studies on animal genetic resources, main crop and fodder resources, culled animal disposal methods and regulations, and market supply chain were conducted in Cambodia and Viet Nam respectively. University and partner organizations showcased in the third technical session on commissioned studies was chaired by Dr Emelinda Lopez, Officer-in-Charge of Animal Health Division of the Bureau of Animal Industry, Philippines.

Dr Mom Seng, Vice Rector and Acting Dean for Faculty of Veterinary Medicine, Royal University of Agriculture in Cambodia, presented a *Strategy and Action Plan for the Management of Cambodia's Farm Animal Genetic Resources".* Her study compiled and reviewed available information related to animal genetic resources in Cambodia through consultations and discussions with key informants, published and grey literature, Domestic Animal Diversity Information System (DAD-IS), and international guidelines for animal genetic resources. There is a little information about livestock genotype characteristics available and knowledge of livestock breed characteristics varies among technical officers in different areas of Cambodia, especially for pure native breeds. The study revealed that most Cambodian entries in the DAD-IS lack descriptions of important breed characteristics and some are not included. There is limited capacity for implementing livestock breeding research and improvement programmes and there is no official livestock breed classification with well defined, easily recognizable breed characteristics. Dr Seng recommended the conduct of consultation workshops to establish consensus on local and common names of domestic animals in Cambodia and their international equivalents and to update information in the DAD-IS. Likewise, there is a need to develop a national strategic plan for animal genetic resource management consistent with national priorities and international guidelines.

A *National Assessment of Cambodia's Main Crop and Fodder Resources* was presented by Aum Sitha, Monitoring, Evaluation and GIS Specialist of the Centre for Livestock and Agricultural Development (CelAgrid). The study conducted a national assessment of fodder resources by district and province using GIS and GPS technology with ground truthing in representative field sites across the country. It further included the use of latest available spatial data relating to human, livestock and poultry population densities, land cover, topography, water resources, administrative boundaries and major towns. The study presented the estimated available rice-straw, corn, sugarcane, cassava and natural grass and recommended that animal production should be in areas with high densities of crop and fodder production.

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[3] *Full papers under Session 3 appear as Annex 4.*

The third presentation was delivered by Dr Phan Quang Minh, EAHMI Viet Nam National Focal Point and Deputy Head of the Epidemiology Division, Department of Animal Health in Viet Nam. The paper on the *Review of Culled Animal Disposal Methods and Regulations in Viet Nam* discussed the international regulations and Viet Nam's regulations and practices on disposing culled animals amidst and increasing number of various animal diseases reported including PRRS, H5N1 and foot and mouth disease. Burial, incineration and aerobic composting are currently being practiced in Viet Nam as methods of disposal. The most appropriate method of disposal depends on geographic location, climate conditions, economic circumstances, and the technology and human resources available. The study also used GIS applications to identify suitable disposal sites in Hai Duong Province.

Dr Nguyen Quang Linh, Dean and Professor at the Faculty of Fisheries, Hue University in Viet Nam presented *Pig and Poultry Market Supply Chain Study in Quang Nam Province, Viet Nam.* The study highlighted that movement of live animals that markets and transport of livestock could lead to re-emerging diseases and should be taken into account in planning risk management strategies for disease prevention and control. Pig and poultry markets are also high risk areas for disease transmission due to inadequate slaughterhouse facilities, poor sanitation, movement and transportation of live animals by motors or bicycles, and lack of disease control efforts at the farm level.

Session 4: Integration of EAHM in veterinary services planning and implementation[4]

This session was led by Dr Phan Quang Minh, EAHMI Viet Nam National Focal Point and Deputy Head of the Epidemiology Division of the Viet Nam Department of Animal Health. The session focused on the integration of EAHM in veterinary services planning and implementation.

Dr Emelinda Lopez, Officer-in-Charge of Animal Health Division of the Bureau of Animal Industry Philippines presented the *Use of EAHM for development of a national animal health strategy in the Philippines*, in which the National Strategy for the Control and Management of surra was highlighted. The strategy envisioned the Philippines to control and manage surra by year 2025 with disease incidence nearly zero. This will be implemented in two five-year phases with expected outputs including greater understanding on the epidemiology of surra, establishment of a national reference laboratory to assist and advise satellite laboratories on sensitive and specific diagnostic tools, and train laboratory staff, a research agenda for providing evidence-based actions and decisions to control and manage surra, and all stakeholders more aware of the impact of surra.

Dr Clarissa Yvonne Domingo, Associate Professor of the College of Veterinary Science and Medicine at Central Luzon State University, Philippines, presented on the *Epidemiology of Fasciolosis, Assessment of Ecological Factors and Recommended Snail*

[4] Full papers under Session 4 appear as Annex 5.

Control in Nueva Ecija Province, Philippines. The study conducted profiling of risk areas and created a database guide for disease monitoring as a basis for appropriate control measures, determined the effectiveness of phytochemical control on the intermediate host *Lymnea spp*., and GIS-aided mapping of risk determinants. Dr Domingo pointed out that ecological factors with significant association to snail distribution are location snails (rice fields), water sources to irrigate rice fields, and chemical inputs. It was also demonstrated that neem tree seed extract can be a safer and effective molluscicide alternative to the synthetic chemical niclosamide. She further stressed that with the study findings, knowledge transfer of the recommendations for the control of fasciolosis in smallholder production should be carried out to all stakeholders such as farmers, local government unit veterinarians, para-veterinarians and policy makers.

Session 5. Networking platforms

Dr Carolyn Benigno, Animal Health Officer at FAORAP, Bangkok, Thailand, and EAHMI Lead Technical Officer, discussed networking platforms for EAHM. She highlighted that collaboration with partners should be continuously tapped among FAO projects, partner institutions like OIE, universities, NGOs, veterinary services, and ASEAN on the mapping of outbreaks, livestock populations and livestock-related infrastructure, capacity building assistance and reporting indicators and parameters. She also noted that data resources on livestock populations, environmental parameters, and livestock-related infrastructure compiled by the EAHMI projects are available to partners. Dr Benigno facilitated a short activity among participants to share their insights and recommendations on how EAHM networking can be enhanced and strengthened and what are the next steps for the EAHMI project.

Poster presentations[5]

Twenty poster exhibits submitted by the project counterparts, collaborators from universities, local government units, and stakeholders from Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam were displayed during the duration of the conference. The exhibit was officially opened for viewing by Daniele Salvini of FAO RAP, together with the Philippine Department of Agriculture Assistant Secretary, Davinio Catbagan and the Bureau of Animal Industry Director, and EAHMI Philippines National Focal Point Rubina Cresencio.

The poster entries followed the themes of the technical sessions on capacity building, information management systems, and commissioned studies as examples of GIS applications for animal production and health, and integration of EAHM in veterinary services planning and implementation.

A special award for the best poster, voted by the conference participants, was awarded to Dr Mary Rose Vincoy, Provincial Veterinarian of Cebu, Philippine, for her entry entitled *Application of GIS for Improving Veterinary Services in the Province of*

[5] *Poster abstracts appear as Annex 6.*

Cebu, Philippines. The poster showcased rabies control and eradication programmes as guided by the Philippine Animal Health Information System and GIS applications.

Conclusion and recommendations

The EAHMI Conference 2013 participants welcome:

- The conduct of the conference with the theme *Use of Environmental Animal Health Management Strategies for Decision-Making*; and
- The gathering of various collaborators to share information on the different work done under the EAHMI project.

The EAHMI Conference 2013 acknowledges:

- That capacity building on data gathering, management and analysis is core to implementing environmental animal health management;
- That developing information management systems requires an appreciation of what data should be collected, how they should be collected, collated and analyzed in a harmonized and periodic way that would lead to the development of an information system truly owned by the country;
- That there are several GIS applications on animal production and health that can assist in providing evidence-based decisions;
- The favorable synergy was achieved with the universities and development partners;
- The Philippines experience in investing its own resources to develop and apply the principles and lessons learned through the implementation of the project is of great value; and
- That EAHM is a useful tool to veterinary services planning and implementation.

With respect to the closing of the project GCP/RAS/244/ITA EAHMI for enhanced smallholder production in Southeast Asia, the existing EAHMI member countries are concerned that the gains from the project would not be consolidated and followed through and the EAHMI Conference 2013 therefore recommends the following steps below.

Next steps:

- A regional project proposal on the consolidation and expansion of EAHM be developed in consultation with concerned countries, to be submitted by December 2013;
- Following country requests, initial contacts be made by countries and the regional office with donor representatives concerning the needed financial support at different levels (country level, through FAO country offices, government priorities and local embassies);
- Studies be compiled and edited for publication by FAO; and

- That countries involved in the current EAHMI network consider the injection and support of internal resources to consolidate what has been achieved in their countries.

Strengthening EAHM networking:

- The existing EAHMI network be maintained and sustained and expanded to include other countries in the Southeast Asian region;
- The EAHMI website be maintained and regularly updated by the lead country, Philippines, through the Bureau of Animal Industry; and
- The conduct of an annual EAHMI conference and its funding be explored to share results of studies and activities conducted.

EAHM strategies:

- Countries meet with their stakeholders and partners to discuss priority areas on animal production and health for EAHM technical intervention and support. An action plan to include commissioned studies may be conducted from these priority areas;
- A capacity building programme be designed where countries can monitor their levels in a stepwise manner (e.g. basic computer skills, GIS, remote sensing); and
- EAHM be advocated as a tool for veterinary services planning and implementation.

The EAHMI Conference registers its note of thanks to:

- The Government of Italy for supporting an initiative that combines integrated animal disease management, improved animal husbandry and farm management practices, and better use of natural resources, all based on coordinated geographic information;
- FAO for leading the implementation of project activities in the region and for networking with the countries;
- The cooperation of the participating countries under this project; and
- The lead country, Philippines, for steadfastly advocating the use of EAHM in the region and for hosting this conference.

Annex 1

Environmental animal health management in animal production and health

Raffaele Mattioli
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Background

Integrated Pest Management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks. According to FAO, IPM is the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations, and keeps pesticides, drugs and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment.

Environmental animal health management (EAHM) is based on IPM principles with greater emphasis placed on integration of cross-sectoral and multi-disciplinary modes of addressing disease threats at the animal-human-agroecosystem interface. Disease emergence has a range of causes. Factors involved in or contributing to disease emergence and re-emergence and spread include both biological and abiotic factors.

Biological factors

Environmental, climate, weather changes (temperature and humidity). The environment, specifically climate, greatly affects agricultural and livestock production. Climate influences the availability of pasture and forage crops as well as the distribution of diseases and pests. The health resistance of animals is also dependent on temperature and humidity. A climate-normal condition is the average climate conditions during a period of 30 years in a given region. Evident effects of climate change are flooding and drought, loss of habitats and ecological niches, and change in livestock-agricultural production systems. Losses due to climate change in the year 2 000 were estimated to be USD 40 billion.

Climate change also has the following effect s on disease occurrences:

- Increased parasitic zoonoses (helminthoses, tick-borne diseases).
- Increased spread of vectors and vector-borne diseases (e.g. Rift Valley fever, West Nile virus).
- Increased incidence of tropical diseases in areas previously considered as having temperate climate conditions (e.g. Old and New World screwworm).
- Alteration of disease eco-epidemiology. new disease patterns, and change in vector capacity.
- Change in geographic range, host range and pathogen virulence.

Ecological and ecosystem changes. Changes in the current conditions of the ecosystem affect many animals and cause higher risk for emergence of diseases and the occurrence of pathogens and parasites.

Animal density and biomass. The optimal density of animals in a specific location is vital to animal health. Overcrowding or high densities pose high risks and allow faster transfer of parasites and pests.

Changes in host-pathogen interactions. The emergence and re-emergence of diseases can be attributed to host-pathogen interactions. When these interactions are interrupted or altered, the resistance of animals can be weakened and places them in vulnerable states.

Microbial adaptation (genetic drift and shift) to new environmental conditions. The emergence of some diseases is due to the natural evolution of micro-organisms. Resistance to the effects of anti-microbial drugs also contributes to the re-emergence of diseases.

Changes in land use and use of natural resources. Human economic activities cause major changes in land use. Forest clearings and land conversions for various uses such as industry, pasture, residential space and agriculture bring about changes in animal and human density and distribution. It also alters local biodiversity through the introduction of exotic and invasive species that could cause extinction of one or more species.

Increased contacts between pathogens and host population (urbanization, rural-periurban-urban continuum). With continuous human population growth, land available for livestock and agriculture decreases as a result of urbanization and industrial conversion. Animals are kept in densely populated areas. This increases the contacts between pathogens and hosts that lead to increased exposure and risk.

Abiotic factors

Globalization, international trade, and level of economic development. Globalization is driven and constrained by economic forces, technological developments, political, cultural, social and environmental factors that impact directly and indirectly on health at a number of levels. As globalization spreads, animals and products that could be infected or contaminated are transported and pose a wide range of risks that affect the emergence of diseases.

Lack or inadequate policies for control and confinement measures. Policies are important in managing and implementing movement restrictions of animals and products from one place to another, especially across borders. Collective efforts in crafting policies should be considered that would include important stakeholders, specifically farmers. Policies and strategies should be improved to safeguard animal health, public health, livelihoods and food systems.

Political and civil strife and instability.
Breakdown of public services in charge of disease control.
Introduction of inappropriate or inadequate technology.

Changes in production systems. Production systems are shaped by prevailing biophysical and socio-cultural environments. In many of these systems, the livestock element is interwoven with crop production, as in rice-buffalo or cereal-cattle systems in Asia. Many of these systems are the result of a long evolution and are currently under pressure to adjust to rapidly evolving socio-economic conditions and large intensive livestock production units. In particular, pig and poultry production have emerged over the last decades in many developing regions in response to the rapidly growing demand for livestock products .

With the world human population constantly increasing since 1960, especially in developing countries, it is expected that food demands will likewise increase. Projections from 1961 to 2020 showed that demand will increase dramatically to around 400 million tons of milk in developing countries. Likewise, meat demands from both monogastric and ruminants from these areas will also increase by 2020 to more than 160 million tons, with greater emphasis on monogastric meat (Figures 1, 2 and 3).

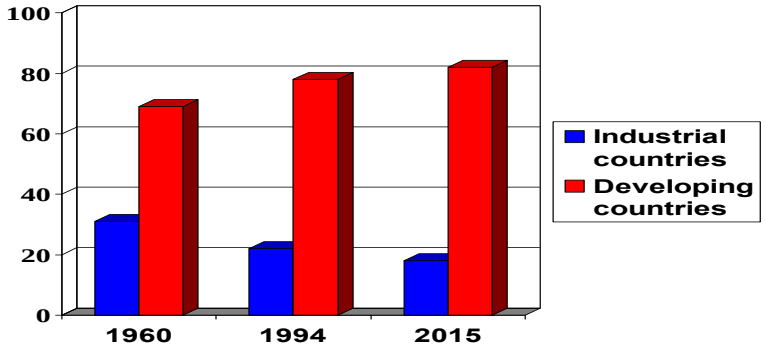

Figure 1. World population growth and distribution (percent).

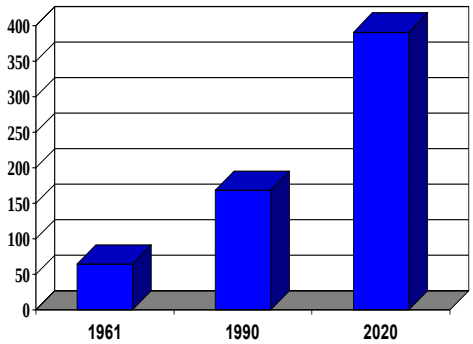

Figure 2. Milk demand in developing countries (million tons).

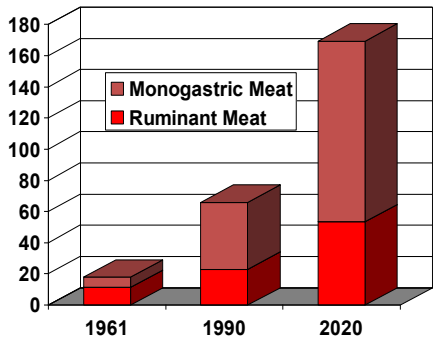

Figure 3. Meat demand in developing countries.

A large shift in annual growth rates of production systems to industrial systems is also seen in Asia at more than 15 percent as compared to Sub-saharan, West Asia, North Africa, and Central and South America. Asia still leads, with mixed systems at less than 5 percent. However, a decrease of 5 percent in grazing systems in Asia is evident. West Asia and North Africa take the lead for grazing systems (Figure 4).

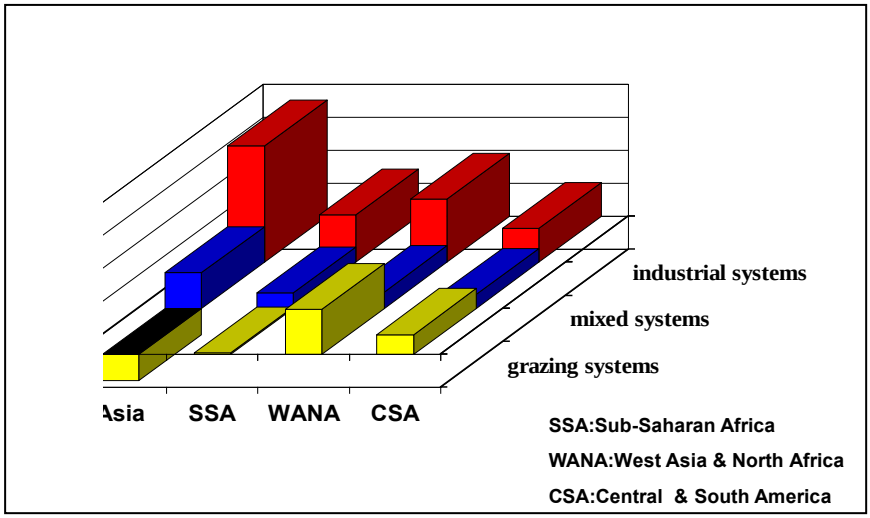

Figure 4. Annual growth rates of different production systems in developing countries.

The intensity of production poses risks to the emergence of zoonoses. As the intensity of production increases, there is greater complexity and severity of diseases.

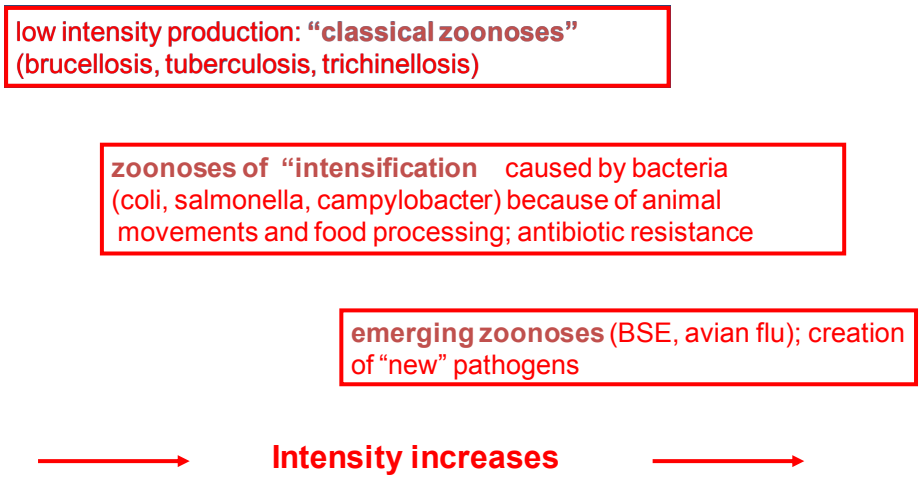

Figure 5. Intensity of production systems and diseases.

One example of emerging zoonoses is bovine spongiform encephalopathy (BSE), which rapidly evolved into an issue of major public concern in 1996. This disease crossed the species barrier and infected humans in the UK. The European Geographical BSE Risk Analysis (GBRA) basic assumption is that the BSE agent is initially introduced into a country's domestic cattle production system through the importation of contaminated feedstuffs or live cattle. The GBRA showed that a majority of countries in Europe had a high risk of BSE, followed by North America (Figure 5).

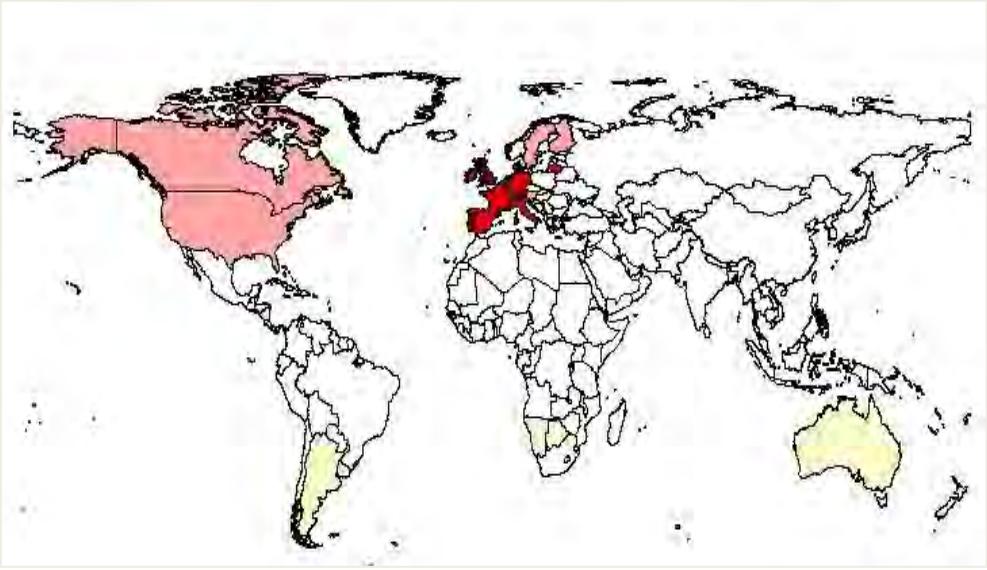

Figure 6. Geographical BSE Risk Analysis.

In the case of BSE, and looking at the trend of using cereals as feed in different countries and regions, China is projected to dramatically increase its use of cereals by 2020, reaching 178 million MT, which is more than double its usage in 1993. Latin America is also seen to have increasing use of cereal feeds. These increases could pose high risk of emergence of BSE that should be closely monitored (Table 1, and Figure 7).

Table 1. Projected increase in use of cereal feeds.

Total cereal use as feed			
Region	1983	1993	2020
		(million MT)	
China	40	84	178
India	2	3	14
Latin America	40	55	92
Sub-Saharan Africa	2	3	5
World	592	636	928

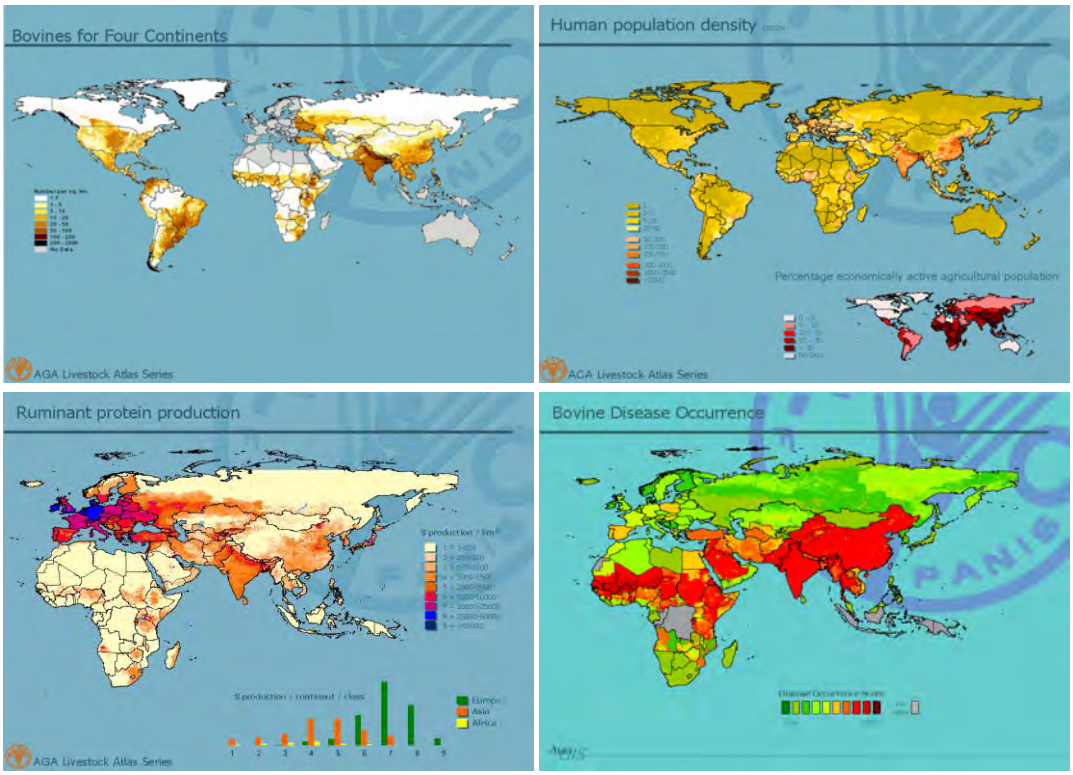

Figure 7. Human and animal densities: a) bovine densities for four continents; b) human population densities; c) ruminant protein production; and d) bovine disease occurrence.
Halting disease spread: Caribbean Amblyomma Programme

The *Amblyomma variegatum*, a tropical bont tick, primarily infests domestic animals. Its preferred host is cattle, but it also parasitizes sheep, goats, horses, dogs and some larger wild mammals. The bites of the tropical bont tick are severe and can result in septic wounds and abscesses, inflammation of the teats of cows, and considerable damage to hides and skins. The tick is the main vector of the rickettsia, *cowdria ruminantium,* which causes heartwater disease. It is also associated with an increase in the prevalence of acute dermatophylosis, a skin disease of cattle caused by the bacteria *Dermatophilus congolensis*.

The genus *Amblyomma* is distributed worldwide, but the tropical bont tick is of African origin. It was first introduced into the Caribbean in 1828 when infested cattle were imported into Guadeloupe from Senegal. It spread to the island of Marie Galante in 1830 and to Antigua in 1895. During the twentieth century, the tick spread to many other Caribbean islands and up to 1990 was still spreading.

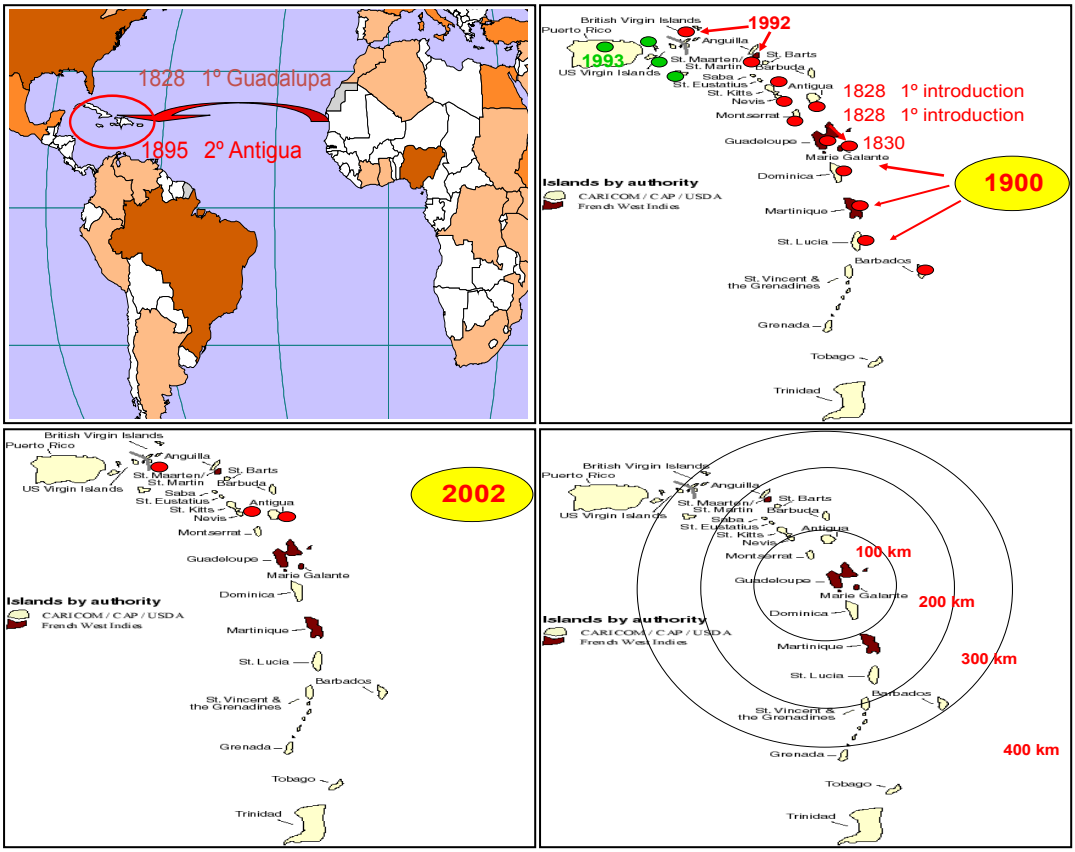

Figure 8. Spread of Amblyomma from Africa to Caribbean region.

An increase in the movement of livestock between Caribbean islands has played an important part in the spread of the tick. However, there is considerable evidence that migratory birds, especially cattle egrets (*Bubulcus ibis)*, which carry larvae and nymphs of the tropical bont tick, also spread the parasite, thus threatening mainland countries in North, Central and South America and other islands in the Caribbean. In the Caribbean, livestock mortality was estimated at 90 percent in St Kitts and Nevis. Also in the region, losses are estimated at USD 1 billion per year, should the disease spread to the mainland (Figure 8).

Figure 9. Current and potential area of Amblyomma infestation [based on climatic suitability].

Macro-environment and diseases

The macro-environment can influence the pattern of disease events. Extreme conditions of the physical environment such as climate, topography, vegetation and soil can directly cause illness or disease to animals. Factors affecting pathogen vectors, endemicity, and pathogen vector diffusion include temperature, relative humidity, vegetation cover and plant species and chemical composition of soils.

These macro-environment factors could be significant in determining distribution of gastrointestinal parasites, as external temperature affects the transformation of eggs of parasites in L1, L2 and L3. At temperatures of less than 10°C, the process is prolonged, while at greater than 25°C, process is rapid but with high L3 mortality. Acid or base soils can affect the survival of eggs and larvae of gastrointestinal parasites. Retrospective analysis of meteorological data, including wind direction, explained the spatial distribution of bluetongue transmitted by Culicoides in sheep in Turkey.
The distribution of tsetse flies in Africa is governed by macro-environment factors. Temperature, humidity and vegetation cover were used to map the distribution of tsetse fly vectors. The presence of the tsetse fly in each vegetation cover could be determined and later combined for final mapping (Figure 10).

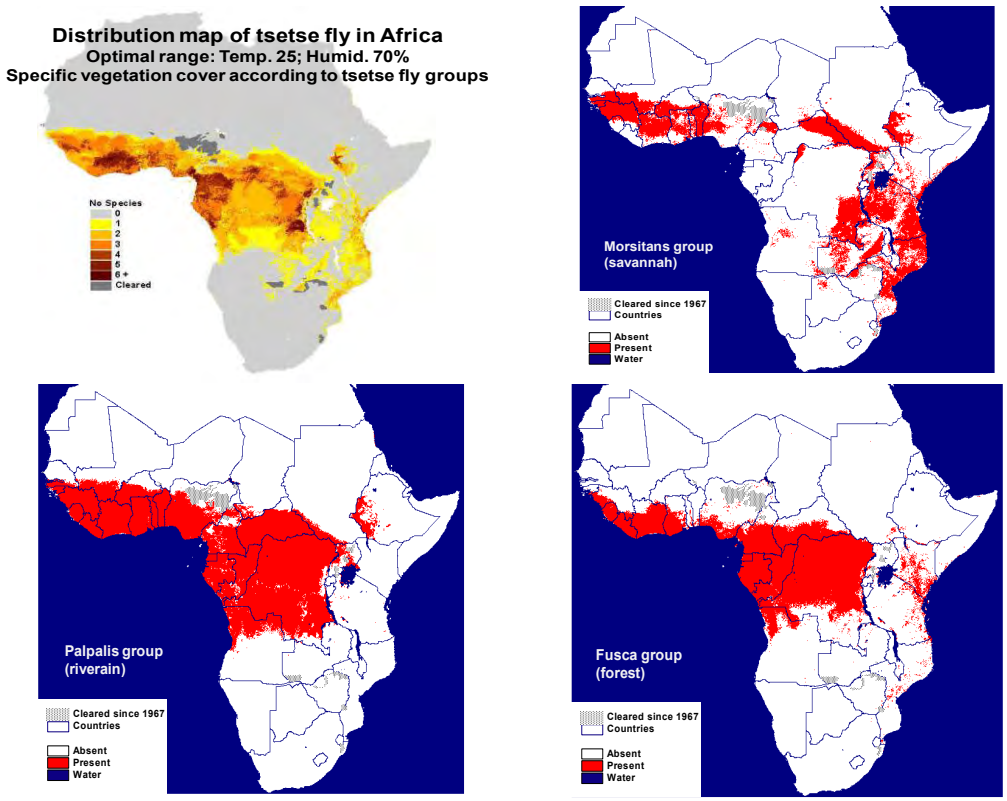

Figure 10. Distribution of tsetse fly in Africa:
a) temperature, humidity and vegetation cover; b) Morsitanis group; c) Palpalis group; and d) Fusca group.

More detailed predictive parameters can be used in the analysis to determine areas under disease risk. Aside from the macro-environment factors, epidemiological and socio-economic factors could be integrated for a more refined mapping output of disease risk areas (Table 2).

Table 2. Predictive parameters used in analysis to determine areas of disease risk.

Ecological parameters	NDVI Rain Temperature	Normalized Difference Vegetation Index Annual pluviometry Average Temperature
Epidemological parameters	Biomass Biomass density Proportion of livestock on total biomass	 Biomass/km^2 % species at disease risk on total biomass
Socio-economic parameters	Density agric. Popn. Density total popn. Popn agri/popn total	Popn/km^2 active in agriculture Popn/km^2 % of popn. Active in agriculture activity

Predicting the presence of disease using a set of parameters could accurately model the observed disease situation in a certain area. Predictive mapping could be useful for the management control planning in a large area (Figure 11).

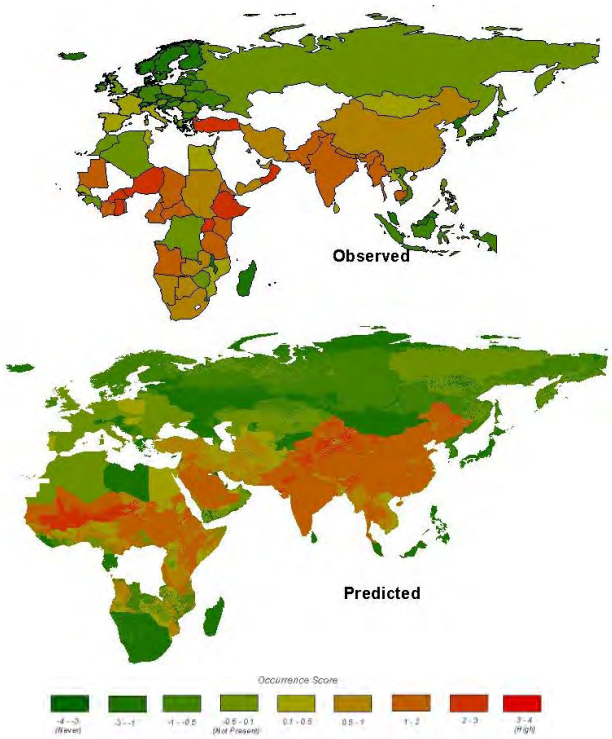

Figure 11. Prediction of presence of diseases.

Micro-environment and diseases

Micro-environment also plays an important role in the emergence of diseases. Micro-environment involves the interaction between biological supports (host animal, vector, and pathogen), which determine the establishment, multiplication, spread or reduction, and even elimination of infections.

Capacity of a host to respond to infectious attack:

- **Susceptibility.** The ability to acquire a pathogen and to show a pathological status.
- **Tolerance.** The relative capacity to control the development of a pathogen and to limit its pathological effects.
- **Resistance.** The ability to reduce the growth rate , fecundity, and persistence of a population of pathogens.
- **Resilience.** The ability to grow and be productive despite the presence of a normal pathogen charge**.**
- **Refractoriness.** The impossibility to acquire an infection because the biological support inhibits the multiplication of the pathogen.

Micro-environmental interactions and competitions:

- Coccidia and helminths: There is equilibrium at the level of the gastrointestinal track. Treatments against coccidia positively affect the multiplication of gastrointestinal helminths and vice versa.
- Tsetse flies, intestinal symbionts and trypanosome infections: There are symbiotic micro-organisms (*Wigglesworthia glossinidia*) that confer a degree of immunity to the tsetse fly to acquire and transmit trypanosome infections.

Economic impact of main parasitic diseases

Many parasitic diseases worldwide have caused great economic losses. Ticks and tick-borne diseases (*Amblyomma, Hyalomma, Rhipicephalus, Boophilus, Anaplasmosis, Babesiosis, Theileriosis*, heartwater) in cattle cost an estimated USD 15-20 billion.

Gastrointestinal parasites (*Paramphistomum, Haemonchus, Ostertagia, Trychstrongylus, Cooperia, Strongyloides, Oesophagostomum*) put at risk 300 million bovines and 250 million sheep; mortalities and decreased productivity amounted to an estimated USD 3 billion.

Tsetse transmitted trypanosomosis (*T. congolense, T. vivax, T. brucei*) in Africa put at risk 60 million cattle with a mortality rate of 3 million cattle each year; 40 million doses of trypanocides are used annually while livestock; agricultural production losses are estimated at USD 4.5 billion. Non-tsetse transmitted trypanosomosis (*T. evansi* and *T. vivax*) in Asia and Latin America caused losses in the range of hundreds millions of US dollars.

Coordinated response to disease threats

The FAO Animal Production and Health Division (AGAH) has established coordinated response teams to disease threats in collaboration with other programs and international organizations, centers and countries (Figure 12).

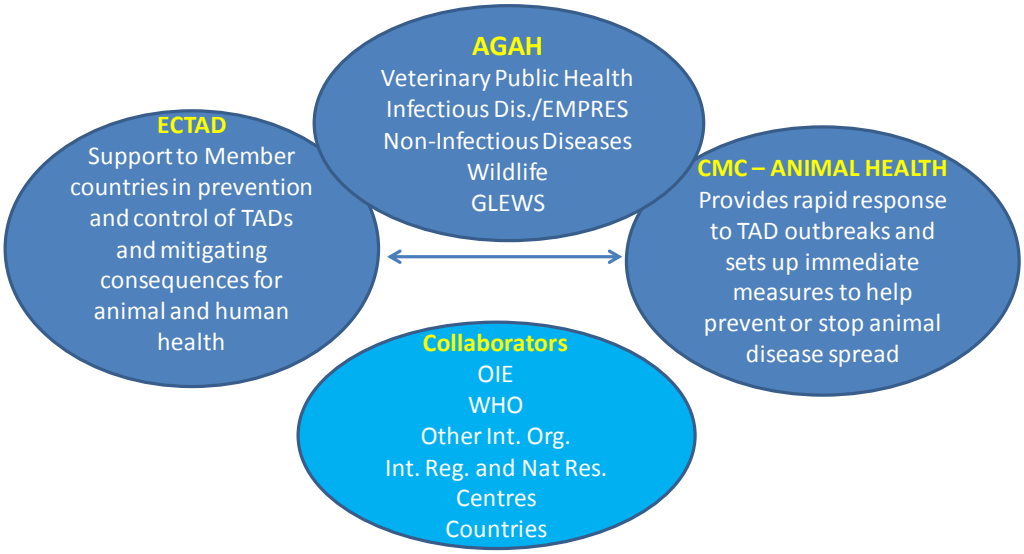

Figure 12. Animal Production and Health Division coordinated response to disease threats.

Modular policy for environmental animal health management interventions to improve livestock and agriculture production systems

EAHMI interventions to improve livestock and agriculture production systems require policies that address many aspects. Successful control and management of a specific disease includes interventions in socio-economic dimensions, institutional support, training and information, land use, land tenure, and natural resource management, and increasing agricultural production (Figure 13).

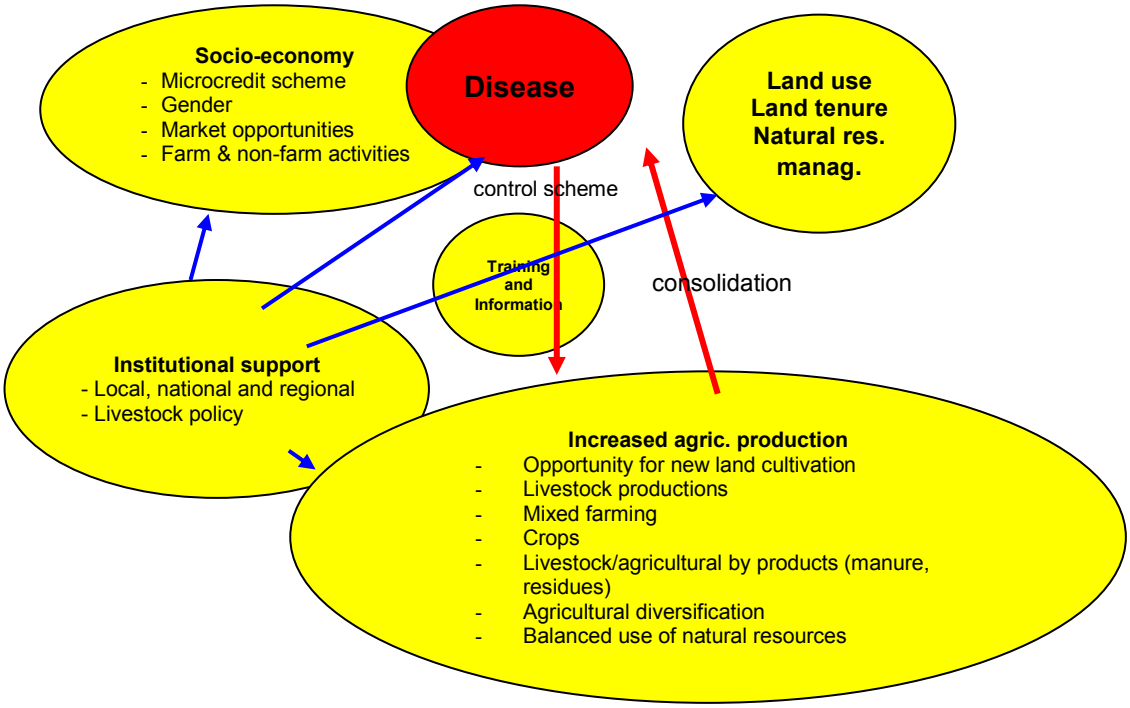

Figure 13. Modular policy for environmental animal health management interventions to improve livestock and agriculture production systems.

Spreading investments in EAHM interventions

Total investments in EAHM interventions, when dispersed into different components such as disease removal and other animal health problems, land use, agricultural infrastructure support, training and information, socio-economic measures, development of market agriculture, and improved technology would require a minimal average investment per person for a number of years. For example, a total program investment of USD 20 million would amount to USD 13 per person when implemented in a 10 000 km^2 project area for five years and assuming an estimated rural population density in the target area of 20-30 people/km^2.

Spreading of benefits of EAHM interventions

EAHM is multi-disciplinary and provides direct and indirect benefits. An EAHM approach would benefit farmers economically, ecologically, and socially. The use of EAHM interventions will contribute to better animal health and better animal production which then result to better income of farmers and eventually lead to better human health.

Annex 2

Overview of capacity building under EAHMI

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Introduction

The Subregional Environmental Animal Health Management Initiative (EAHMI) for Enhanced Smallholder Production in South East Asia (GCP/RAS/244/ITA) is an institutional strengthening and capacity building project of the Food and Agriculture Organization of the United Nations (FAO) and the Governments of Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam, funded by Government of Italy. The project's anticipated outputs are:

1. Improved capacity to analyze animal disease risk and develop environmental animal health management strategies which are fully integrated as core elements in animal production and health services in the Philippines.
2. Capacity to analyze animal disease risk and develop and apply strategies on environmental animal health management are further strengthened and applied in selected priority areas in Cambodia and Lao PDR.
3. Capacity for database management, analysis and application of GIS to implement environmental animal health management strategies in Myanmar and Viet Nam are developed and strengthened.
4. Technical, scientific and policy dialogue and networks for information exchange and dissemination with the participating countries are established, with the Philippines having a coordinating role and the further use of environmental animal health management strategies in animal production and health are thereby promoted.
5. National institutions and stakeholders networked and poor livestock keepers empowered and enabled to participate in the policy decision making process of their respective countries.

These outputs depend mainly on the availability of good data on animal production and health such that valuable information can be derived that can assist in animal production and health management. Prior to implementation of any capacity building efforts for GIS and information technology, it is necessary to identify the lead proponents and stakeholders and to establish a task force or steering committee or advisory group for oversight and guidance. The advisory group provides critical inputs and views from different perspectives that will contribute to the successful implementation of the capacity building activities. The agency needs and requirements for capacity building should be clearly identified and reviewed as well as the organization's current procedures and skills. It also important that the capacity building initiatives are in line with the long term development strategy and objectives of the agency or organization as well as its

priority information requirements. Collaborative links must be established with organizations with existing and strong information technology skills (e.g. database management, use of GPS devices and GIS software).

Trainings on Excel, GIS and GPS

Various training workshops have been conducted on data management using MS Excel spreadsheets, GIS) and GPS, both at basic and intermediate levels in each country. These training programmes were conducted in collaboration with universities, livestock departments and other institutions and regional, province and town personnel. A total of 789 personnel have been trained in Cambodia, Lao PDR, Myanmar, Philippines and Viet Nam on data management, analysis and GIS mapping, with basic training (288) and intermediate training (501) for the years 2012 to 2013 (Table 1).

Table 1. Country training programmes implemented in 2012-2013.

Country	Basic Training	Intermediate Training
Cambodia	Refresher Training on Fundamental GIS using ArcGIS Desktop 9.3 and QuantumGIS	
Lao PDR	Basic, Entry Level Training in Use of GIS Software	Intermediate Training in Use of GIS Software
Myanmar	Basic Training on Microsoft Office Excel, GPS and GIS for Township Veterinary Officers	Training of Trainers in Use of GIS Software
Philippines	Basic QGIS for Spatial Epidemiology (academe)/ PhilAHIS deployment and QGIS in two remaining regions*	Re-engagement with regional and provincial report officers on PhilAHIS and GIS*
Vietnam	Basic Training Course on Data Analysis and GIS mapping (Northern, Central and Southern)	Intermediate Training on QuantumGIS

**Funded and implemented by Bureau of Animal Industry*

The Philippines has trained the most personnel with a total of 585. These GPS and GIS training programmes were refresher courses administered to provincial and regional level staff in conjunction with the national implementation of the Philippine Animal Health Information System (PhilHIS). As support, all these training programmes during the period 2012 to 2013 were funded and implemented by the Philippine government. The Philippines has also provided separate training programmes for 820 municipal technicians to accurately complete PhilAHIS forms (Figure 1).

Annex 2

GIS Training	Number Trained
Basic	288
Intermediate	501
Total	**789**

Philippines (Training on PhilAHIS forms for Municipal Technicians **820**

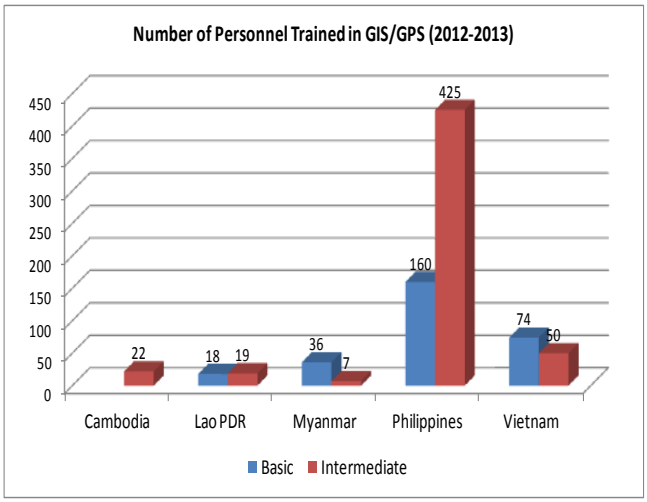

Figure 1. Number of personnel trained on basic and intermediate training courses in each country.

Viet Nam has the second highest number of trained personnel with a total of 124 (basic, 74 and intermediate 50). Viet Nam implemented a nationwide basic training course on data analysis and GIS mapping and intermediate training on Quantum GIS.

Myanmar trained a total of 43 personnel: 36 participants for the basic training on MS Excel, GPS and GIS for Township Veterinary Officers, and seven participants for training-of-trainers in the use of GIS software.

Lao PDR provided training for 37 personnel: 18 participants for basic entry level training in the use of GIS software, and 19 participants for intermediate training in the use of GIS software.

A total of 22 personnel from Cambodia were given refresher training on GIS using ArcGIS 9.3 and Quantum GIS.

Looking at the gender balance of these training programmes in general, only the Philippines has a high number of female participants, which surpassed the number of male trainees. Figure 2 summarizes these results.

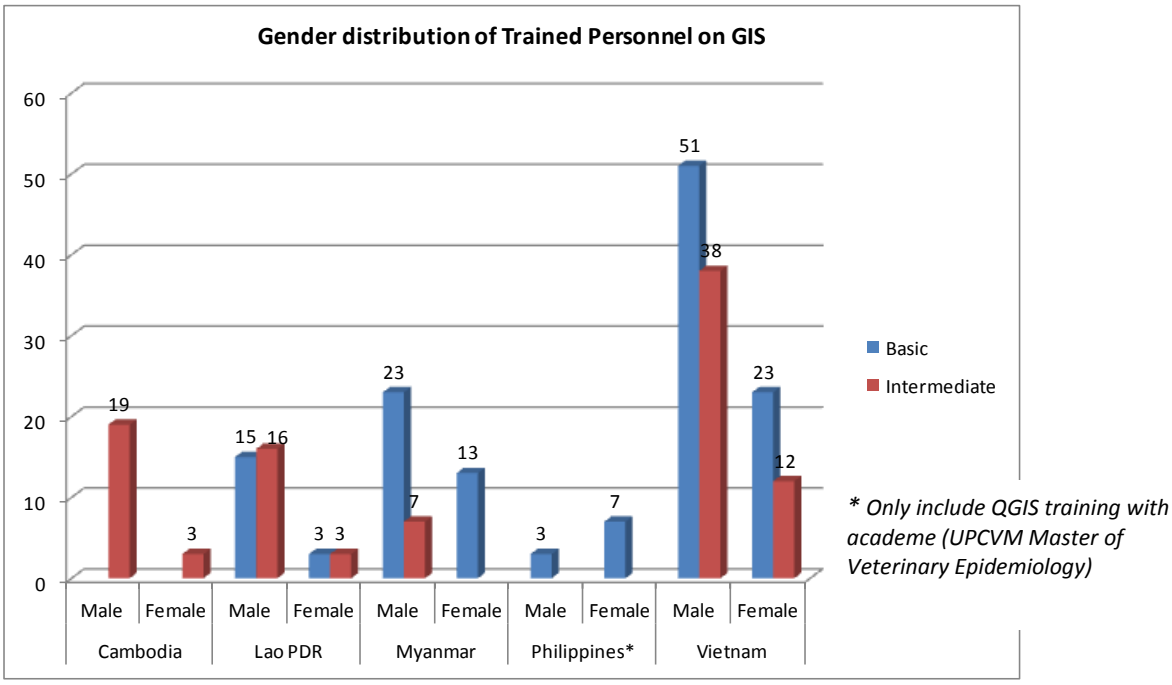

Figure 2. Gender distribution of personnel trained on data management and GIS/GPS in each country.

Secondment programme

The EAHMI secondment programme provides an opportunity for government counterparts of a member country to be appointed on a special assignment to EAHMI Philippines for a specific period of time for further skills enhancement, knowledge sharing, and strengthening collaboration in the application of GPS and GIS as tools for environmental animal health management. The secondment involves two weeks of close mentoring by the regional staff based in the Philippines, during which time the secondee works on his/her country datasets that address a particular animal production or health issue.

A total of four secondees have completed the secondment programme since its introduction in October 2012 (two from Lao PDR, one from Cambodia, and one from the Philippines). Mr Vireak Chun of the Department of Animal Health and Production, Cambodia, was the first trainee to join the programme and worked on managing data reports from his department using spreadsheet applications and mapped data using GIS. He was also trained in the use of GPS devices and entering collected field data into Excel spreadsheets.

Dr Emerson Tapdasan, a veterinarian with the Bohol Province Veterinary Office, Philippines, and a Field Epidemiology Training Programme for Veterinarians (FETPV) trainee in Thailand, examined the influence of environmental factors related to reported cases of hemorrhagic septicemia in Bohol Province, Philippines.

The third secondee was Dr Moua Yang, a project officer with the Northern Region Sustainable Livelihoods through Livestock Development Project in Lao PDR. He was trained in data management using MS Excel to clean datasets. He organized datasets and geographically visualized them in GIS using his project data on livestock production groups, animal vaccinations and other activities. He also performed data analyses for disease control strategies.

Dr Settha Sinthasak of the Department of Livestock and Fisheries, Lao PDR and the EAHMI Lao PDR national focal point completed the secondment programme in August 2013. He was mentored on how to use MS Excel to manage monthly reports on the piloting of key standard reporting forms being implemented in three partner provinces in Lao PDR. These data were also linked with GIS for mapping.

Integration and sustainability plan

The EAHMI project achieved significant outputs in each member country, especially in terms of enhancing capacities for data management, the use of GPS and GIS, and the establishment of standard reporting forms for animal production and health. With the closure of the project in October 2013, integration of environmental animal health management strategies in the national veterinary services, planning and implementation is critical to ensure sustainability. Each EAHMI member country has committed to the following:

Institutionalization of GIS/GPS as a decision support tool in animal health and production management. GPS and GIS technology is now widely used in many fields of study and has proven to be an effective and efficient tool for decision making. EAHMI has successfully used these technologies for animal health and production management, especially in disease control efforts and distribution of livestock and related resources that can be used in planning and implementation of strategies.

Establishment of a national georeferenced database of animal resources and diseases linked with GIS. The EAHMI project has established a subregional geodatabase on animal resources which includes animal population, keeper density, related infrastructure and environmental parameters. Each country should continue populating its national georeferenced database so it can be linked with those of other countries.

Institutionalization of standardized reporting forms in animal production and health in Cambodia and Lao PDR. The piloting of standardized reporting forms in seven provinces of Cambodia and three partner provinces in Lao PDR has demonstrated the importance of a standard set of information that captures the data needs of the national livestock department. The pilot programme had demonstrated several advantages including easier data report generation, storage and retrieval, geographic and temporal analysis, and visualization through spreadsheets and GIS. The pilot programme will be continued and expanded to other provinces of Cambodia and Lao PDR.

Expansion of a Myanmar pool of trainers for GPS, GIS and Excel. EAHMI Myanmar successfully trained seven staff from the Livestock Breeding and Veterinary Department, partner organizations and universities on the applications of GPS and GIS technology for animal production and health data visualization, GIS analysis for disease control strategies, and risk mapping. This pool of trainers can actively assist in the conduct of various training programmes for Township Veterinary Officers. This experience of Myanmar could be expanded and replicated by other countries.

Harmonization of training on GPS and GIS. The EAHMI Project developed a harmonized training manual that will serve as a reference for EAHMI member countries in implementing various training programmes.

The way forward

The EAHMI project has successfully established a secondment programme which has been recognized by member countries and stakeholders as a crucial element in capacity building initiatives. The secondment programme provides an avenue for continuously sharing knowledge and experiences among member countries and at the same time enhances and updates the skills of staff in the use of GPS and GIS for animal production and health management. To reiterate its lead country role, the Philippines Bureau of Animal Industry has to committed ongoing support to the secondment programme.

The EAHMI countries have committed to periodically updating their national geodatabases on animal resources which is linked to the EAHMI subregional geodatabase. This commitment is important to have readily available information on animal populations and disease situations that could benefit not only the EAHMI member countries but the ASEAN region with regard to animal production and health management.

Annex 2

Use of environmental animal health management initiative strategies in the national veterinary services: Myanmar experience

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Introduction

The Subregional Environmental Animal Health Management Initiative (EAHMI) for Enhanced Smallholder Production in Southeast Asia (GCP/RAS/244/ITA) is an institutional strengthening capacity building project of the Food and Agriculture Organization of the United Nations (FAO) with funding from the Government of Italy. Myanmar joined the EAHMI regional network during the Phase 3 of the project in 2012.

The EAHMI Myanmar inception workshop was held on 29 August, 2012 at the University of Veterinary Science (UVS), Nay Pyi Taw, and was attended by stakeholders from the Livestock Breeding and Veterinary Department, Ministry of Livestock and Fisheries, University of Veterinary Science, Geography and Meteorology Department, Forestry, Myanmar Information Management Unit, FAO, and the private sector.

The Livestock Breeding and Veterinary Department (LBVD) has been using GPS and GIS software in disease surveillance and outbreak investigation activities. However, data gathered during those activities were not used to create a database. LBVD decided to start data collection from regions and states intended for dairy cattle profiling in 15 townships and for the purpose of training Township Veterinary Officers (TVOs) in the use of GPS and GIS software.

An agricultural census mapping of the smallholder dairy sector was conducted in May 2013. Data were collected and showed that a high density of cattle in Myanmar can be found in the following regions and states: Magwe Region, Bago Region, Mandalay Region, Sagaing Region, Ayeyarwaddy Region, and Shan State.

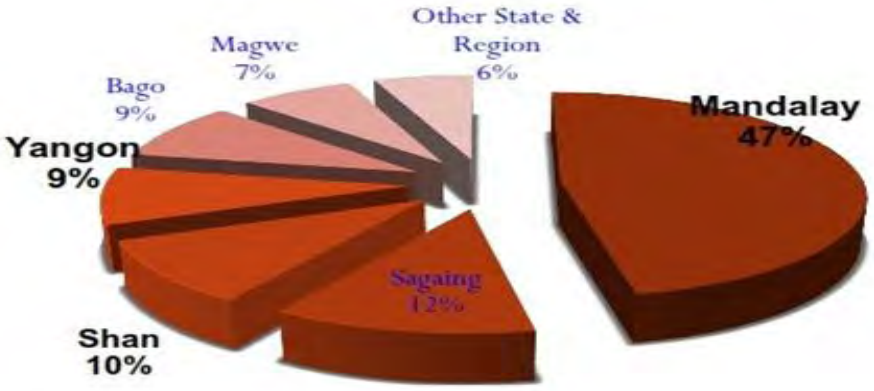

Figure 1. Distribution Pattern of Diary Population in Regions & States.

Annex 2

Results and discussion

Assessment of data needs and sources: The project launch and inception workshop aimed to introduce EAHMI in Myanmar, explain the concept of environmental animal health management, review ongoing LBVD animal production and health information collection, review the regional institutional landscape (identification and links with partners), identify capacity building needs, identify potential subjects and geographical areas of interest for collaborative study, and discuss formation of a technical advisory group. A total of 20 participants attended the inception workshop, composed of TVOs from 15 townships which are the focus of dairy cattle farming in Myanmar (Mandalay, Yangon Region and Shan State), and staff from LBVD and UVS. Resource persons from the different departments and organizations were invited to participate, including the Myanmar Livestock Federation, Settlement and Land Record Department (SLRD) and the Myanmar Information Management Unit (MIMU)t.

After the training needs assessment of the TVOs, EAHMI Myanmar conducted a training-of-trainers workshop in the use of GPS and GIS and training in basic MS Office Excel and use of GPS and GIS for TVOs. Staff from the EAHMI project and MIMU trained facilitators.

EAHMI Myanmar also assisted LBDV in reviewing geospatial data availability, including administrative structures, land use, environmental conditions and livestock and poultry resources, as part of the census activity. EAHMI Myanmar also established collaborative links with the SLRD to develop resource maps on livestock with a focus on the dairy sector.

Training in GPS and GIS

Capacity training focused on basic Excel, GPS and GIS mapping for the first level (train the trainers) and second level training for TVOs.

The training-of-trainers workshop, in collaboration with the Myanmar Livestock Federation, was conducted on 5-9 November 2012 with seven participants. The training aimed to enhance the knowledge and skills of the participants on MS Excel, GPS and GIS in preparation for the second phase of training in which the trained trainers will support and facilitate the basic training on MS Excel, GPS and GIS for TVOs from the project areas. The training was also intended to enhance data analysis and mapping capacity for the better understanding and wider dissemination of the results of from the 2010 and 2011 Agricultural Census.

Training on basic MS Office Excel and use of GPS and GIS software for TVOs was conducted on 7-11 January 2013 at UVS with 21 participants. The training aimed to provide participants with a better understanding of MS Excel data entry and the use of GPS devices as well as GIS software for data collection and mapping of dairy cattle in the project areas. A second training workshop on use of GIS Software for TVOs in UVS was conducted on 5-7 August 2013 with 17 participants.

Annex 2

Data analysis to address issues raised

EAHMI Myanmar addressed issues regarding the analysis of the results from the survey on dairy cattle profiling through data validation and checking for errors during data entry.

The survey for dairy cattle profiling was conducted in 15 townships namely, Amarapura, Hlegu, Kalaw, Kyaukse, Meiktila, Mingalardon, Parhtingyi, Pyawbwe, Pyin Oo Lwin, Sintgaing, Tada-U, Tatkone, Taunggyi, Tharzi and Yamethin Townships. Information in the survey questionnaire included the following:

- Location
- Owner(s) name
- Respondent
- Cattle farm
- Feeding management
- Feeding regime
- Animal health management
- Disease occurrence and symptoms
- Milk production
- Reproductive management

Collated results of the survey after checking and validation by EAHMI Myanmar indicated that:

- Most dairy cattle owners are male.
- 595 of 961 surveyed persons owned their land.
- Most have pastures fields.
- Ownership by farmers varies greatly (average: 12 head/farm).
- 16 percent of respondents (133/835) use their own bull for breeding and the rest (702/835) use artificial insemination or a bull from another farm.
- 64 percent of the respondents (657/1017) reported the calving interval minimum of 300 days to a maximum of 750 days after removing the outliers in less than 250 days.
- 61.4 percent (567/924) said that their cows have had a yearly calving interval.
- A minimum of 2 viss;[1] a maximum of 700 viss of milk can be produced in the study townships.
- Major problems in surveyed areas were reproductive and management problems.
- TVOs and their staff need training on data collection and data entry to MS Excel.
- Farmers need training in dairy cattle management, feeding and reproductive management.

[1] A 'viss' is a traditional unit of measure equivalent to 1.63293 kg.

Annex 2

Integration and sustainability plan

Training needs assessment and capacity building activities at the central veterinary services, district and township level are essential to fully integrate EAHMI strategies in the planning and implementation of the Myanmar's animal health management program.
EAHMI strategies have been adopted by LBVD through collaborative efforts with stakeholders, academic institutions and other government partner organizations such as UVS, MIMU and SLRD:

- Collaboration with the Epidemiology Unit in the conduct of training on the use of GPS devices as well as data entry.
- Collaboration with MIMU in the conduct of training in the use of GPS and GIS for TVOs.
- Collaboration with UVS to jointly organize the training on GPS and GIS use.
- Collaboration with SLRD for the animal census data needed in the development of resource maps on livestock with focus on the dairy sector.

LBVD has committed to continue the training on the use of GPS and GIS software for TVOs from every district down to the community level. Refresher courses for TVOs in the previously surveyed areas will be organized. Data collection and data management of the animal census data will also be implemented in collaboration with the UVS.

The way forward

The training-of-trainers implemented in Myanmar can be duplicated in the other EAHMI member countries to develop a pool of local trainers who can provide capacity training to provincial and district level staff. This will ensure efficiency and accuracy during collection of data for dairy cattle profiling in the entire project area and in every township where the data collected and the results of the survey will serve as baseline data for the country.

Annex 2

Use of environmental animal health management initiative strategies in the national veterinary services: Philippines experience

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Introduction

The Subregional Environmental Animal Health Management Initiative for Enhanced Smallholder Production in Southeast Asia (GCP/RAS/244/ITA) is an institutional strengthening and capacity building project of the Food and Agriculture Organization of the United Nations with funding from the Government of Italy.

The EAHMI project was first implemented in the Philippines in 2006 and has since expanded to include Cambodia, Lao PDR, Myanmar and Viet Nam. EAHMI Philippines is the lead country and EAHMI is hosted by the Philippine Department of Agriculture, Bureau of Animal Industry, which coordinates activities in other member countries.

Initially, the application of environmental animal health management (EAHM) strategies focused on the control of vector borne diseases such as surra, but as a result of improved capacity on GPS and GIS, EAHM was applied to the development of control strategies for other diseases such as rabies and hemorrhagic septicemia.

Results and discussion

Enhanced information systems: In the Philippines, EAHMI paved the way for the development of the Philippine Animal Health Information System (PhilAHIS) to serve as the national reporting system. PhilAHIS is an integrated system designed to enhance the animal health and management capability of the country by providing standard, timely and improved quality information through the use of automatic data generation. The PhilAHIS system has been deployed in 16 regions and 139 cities and municipalities have installed PhilAHIS in their offices.

Training on GPS and GIS: EAHMI Philippines provided full support for the deployment of PhilAHIS on surveillance and vaccination usage for regional and local veterinary services nationwide. Basic and advanced training on GPS and GIS were conducted wherein staff and personnel from national and local veterinary services, Department of Agriculture Regional Field Units, other Department of Agriculture agencies, the private sector, and ASEAN member countries participated. In collaboration with universities and government agencies including public health and wildlife health, GPS and GIS training programmes were provided to post-graduate veterinary epidemiology students, wildlife and human health officers, and veterinary epidemiology trainees.

Secondment programme: The EAHMI secondment programme was launched in October, 2012, to provide opportunity for staff of the EAHMI member countries to enhance skills,

share knowledge and strengthen collaborations in the application of GPS and GIS data analysis. The programme involves two-weeks of close mentoring by the Regional GIS Manager, in which the secondee works on their own country data sets. A total of four secondees from Cambodia, Lao PDR and Philippines have completed the programme to date.

Publication of a national atlas of Philippine farm animal resources: The National Atlas of Philippine Farm Animal Resources, Philippines is based on the 2006 Avian Population Survey and 2010 Livestock Population Survey. The atlas is the first of its kind to be published in the Philippines and is an authoritative and reliable source of information about the distribution of farm animal resources and animal production facilities, and a basis for the development of the livestock, poultry and feed crop industry road map. The digital version of the atlas has been uploaded to the EAHMI website for distribution and to serve as reference material for stakeholders and project partners.

Commissioned studies: A total of four commissioned studies were funded by EAHMI Philippines through letters of agreement, in collaboration with academic institutions, local government units and Department of Agriculture Regional Field Units. Results of the commissioned studies have helped the Bureau of Animal Industry of the Department of Agriculture in the formulation and development of its disease control and management policies and decisions.

A training programme on the control and management of surra was conducted in 2011 to 2012 by the Department of Agriculture, Regional Field Office XI, in collaboration with the University of Southern Mindanao and Central Mindanao State University in Kabacan City, North Cotabato and Musuan City, Bukidnon.

A training programme on the control and management of fasciolosis for smallholder farmers was conducted by the Central Luzon State University in Nueva Ecija Province in 2011 to 2012. Ecological factors related to seroprevalence of Ebola Reston was also conducted by the Central Luzon State University in 2011.

A training programme on agricultural land use mapping was conducted by the Nueva Ecija University of Science and Technology, Nueva Ecija Province from 2011 to 2012.

Lead role in coordinating EAHM strategies: As agreed during the EAHMI national focal points meeting in Bangkok in March 2013, EAHMI Philippines is committed maintaining its lead country role by continuing to host the EAHMI website, promoting the use of EAHM strategies, networking among ASEAN members for implementation of EAHM strategies, and supporting the secondment programme.

Integration and sustainability plan

Information generated from the EAHM work on surra prompted the project team and the director of the Bureau of Agricultural Industry to implement the National Strategy for the Control and Management of Surra based on the results of the commissioned studies

conducted. The strategy document was developed after consultation with representatives from national and regional veterinarians, animal diagnostic laboratories, universities, and the Philippine Carabao Center.

Communications campaign materials for dissemination to farmers on disease control and management on fasciolosis based on the results of the commissioned study was developed by the Bureau of Agricultural Industry in collaboration with Central Mindanao State University.

Other EAHM strategies being streamlined in Bureau of Agricultural Industry planning and implementation include:

- Use of PhilAHIS and GPS and GIS in disease monitoring and surveillance activities of the Animal Health Division, Regional and Local Veterinary Offices.
- Use of GIS/GPS applications for mapping vaccination programmes, rabies incidence reports, and establishment of rabies free zones in connection with the Rabies Free Philippines 2020 eradication programme, production of the Animal Health Yearbook, and mapping of native animal genetic resources for conservation of native animal species.
- Integration of EAHM in the Philippines as part of its core animal production and health services planning and implementation has been demonstrated, and uptake of the tool should be encouraged.
- The EAHMI Philippines project office will be maintained under the Animal Health Division of the Bureau of Animal Industry. The Bureau has also committed funds to sustain EAHMI in the 2014 budget.
- The Bureau of Animal Industry will continue to support the secondment programme for government counterpart staff to further enhance knowledge sharing and strengthen collaboration in the application of GIS as a tool for EAHM.
- To further enhance the National Reporting System, PhilAHIS will be linked with the Philippine Information Management System, and Animal Health Information Communication for uniformity of disease and surveillance reporting.
- The Bureau of Animal Industry will collaborate with the University of Philippines College of Veterinary Medicine on the masters' programme in Veterinary Epidemiology by offering GIS and PhilAHIS facilities for student research and data analysis.

The way forward

EAHMI Philippines has successfully integrated EAHM strategies in some of its animal health programmes and is committed to continue its support in the development of animal disease emergency plans for emerging diseases and other transboundary animal diseases such as HPAI and foot and mouth disease. EAHM strategies will continue to be implemented to maximize their use in the planning, monitoring and evaluation of existing animal health programmes of the Bureau of Animal Industry, such as those for eradication of rabies and control of classical swine fever.

Annex 2

EAHM strategies will be used in the development of a road map on native animal genetic resources that can serve as a model for regional conservation and production of native livestock species, not only in the Philippines but also in Southeast Asia.

Annex 3

Lessons learned from the pilot programme on standardized reporting forms on animal production and health in Cambodia

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Introduction

The Department of Animal Health and Production (DAHP) of Cambodia expressed interest in a centralized management information system in which the Environmental Animal Health Management Initiative project could provide support. A pilot feasibility study was initiated through EAHMI Cambodia's network of provincial partners, in collaboration with EAHMI Philippines. An initial review of the reporting flow, reporting forms and the information needs of DAHP was carried out in 2011 with the assistance of EAHMI Philippines.

It was recommended that capacity building in information communication and technology (ICT) within DAHP, and a training programme for the technical working group or *ad hoc* group of DAPH information officers be conducted to enhance ICT skills and the capacity of the department staff. It was recommended to use a progressive, strategic approach to piloting standardized data collection in selected provinces, and linked to a central database and information system. Following these recommendations, three workshops were conducted:

A workshop to identify key indicators of animal production and health in Cambodia was held on 18 November 2011, to review the current reporting flow from the provinces to the DAHP, existing report forms used, and information needs of DAHP that would capture all important data from the field. This was a critical initial step in the standardization of reporting forms. The workshop identified five main types of information: animal diseases, animal movement, vaccination, number of slaughtered animals, and farm profile.

A technical working group strategic planning workshop on standardizing animal health and production reporting forms held on 23-27 April 2012. The planning workshop was intended to review, revise and agree on the following draft standard reporting forms generated during the November 2011 identification of key indicators workshop: disease outbreak investigation, animal quarantine movement, vaccination, number slaughtered animals and vaccination.

It was agreed that the standardized reporting forms would be piloted in seven provinces: Pursat, Battambang, Preah Sihanouk, Svay Rieng, Bantay Meanchey, Takeo and Kampong Cham for an initial three months (June to August 2012), after which an assessment would be conducted for the evaluation of piloting implementation and revisions to the standard report forms. The workshop also provided introductory training on MS Access for DAHP staff and provincial office staff from the seven provinces.

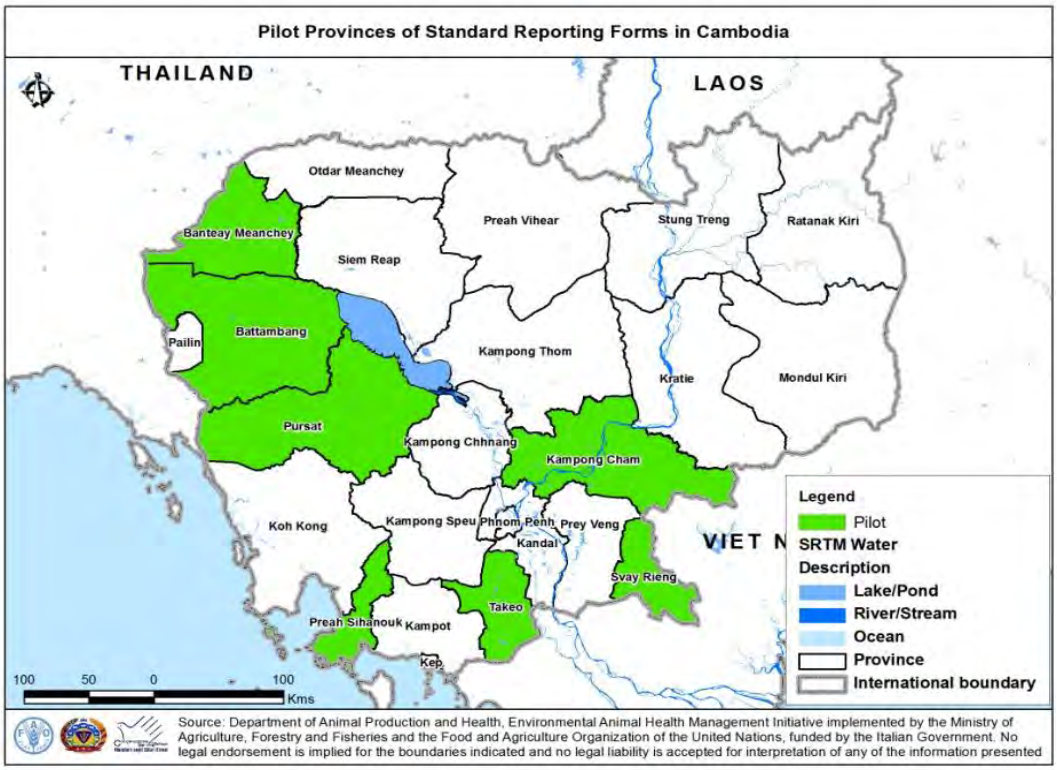


Figure 1. Pilot provinces for the standard reporting forms.

An assessment workshop of pilot programmes on standardizing animal health and production reporting forms held on 19 September 2012. The workshop assessed the implementation of the pilot programme on standardizing reporting forms. The main issues encountered during the pilot included late report submissions due to the different submission dates of the government prescribed forms and the use of the pilot forms, most reports were submitted as hard copy and were filled in by hand, some reports were completed using MS Word instead of MS Excel making them difficult to consolidate, incomplete information on the standard reporting forms as some data fields were not relevant for Cambodia, lack of capacity of district officials to use the GPS device, and insufficient data collection in the field due to several tasks assigned to provincial staff or because the areas were too remote to be reached and there was no . budget for travel.

It was agreed during the workshop that the five forms on animal quarantine movement and transport permits, disease outbreak investigation, farm profile, slaughtered animals, and vaccination, be further revised according to comments and suggestions of the pilot programme implementers.

Training in GPS and GIS applications

Various training programmes on computer applications such as spreadsheets, database and GPS and GIS were conducted by EAHMI Cambodia in collaboration with other partners to enhance the skills and capability of staff necessary for support to the development and piloting of the standardized reporting forms and the centralized information management system for animal health and production of the DAHP. The training courses included:

- Training course on basic and advanced MS Excel
- Training course on basic MS Access
- Training course on fundamental and advanced GPS and GIS
- Refresher training course on GPS and GIS
- GPS and GIS applications were implemented in the seven target provinces and some offices of DAHP
- Training on applications of the DAHP website

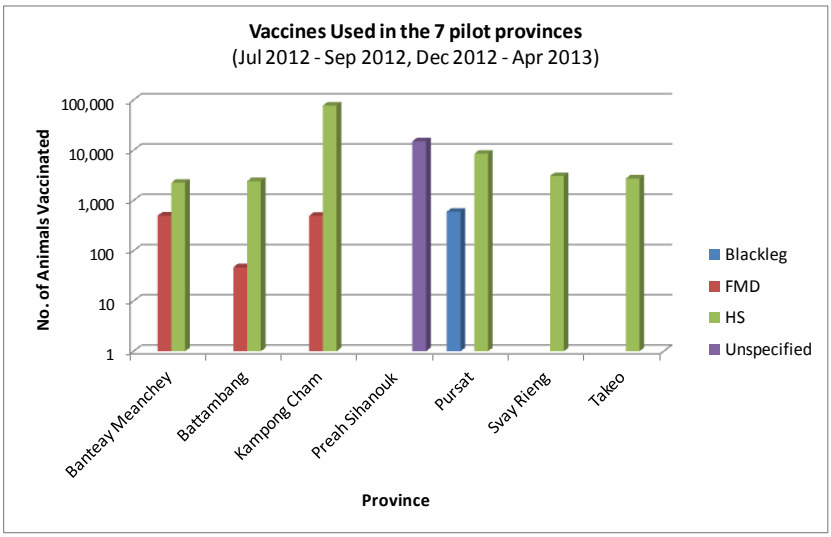
Analysis and mapping of the pilot programme for standardized reporting forms

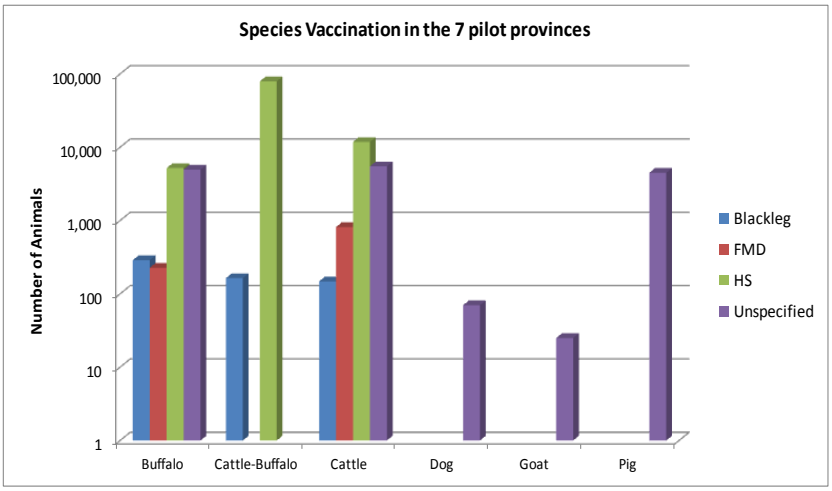
The monthly reports for the reporting period July 2012 to September 2012 and December 2012 to April 2013 submitted by the seven provinces to DAHP were collated by the EAHMI Cambodia GIS and Database Manager. Initial analysis and mapping of the data on animal vaccination, slaughtered animals and animal movement was conducted to demonstrate the advantages and importance of the standardized reporting forms in terms of data that is easier to manage and retrieve for analysis that could provide information that to facilitate faster response from and to DAHP.

Vaccination

Based on the vaccination reports during the reporting period, hemorrhagic septicemia (vaccines were used in all pilot provinces except Preah Sihanouk, which did not specify the types of vaccines used in their vaccination activities. With regard to the species vaccinated, buffalo and cattle received the bulk of vaccinations and again, unspecified vaccine types given to each species were seen. These findings prompted calling to the attention of the concerned provincial officials that they should correctly complete the report forms. The monthly trend for vaccination for hemorrhagic septicemia also showed that the peak was observed in August 2012 and February 2013, although there is a two-month data gap (October-November 2012).

Annex 3





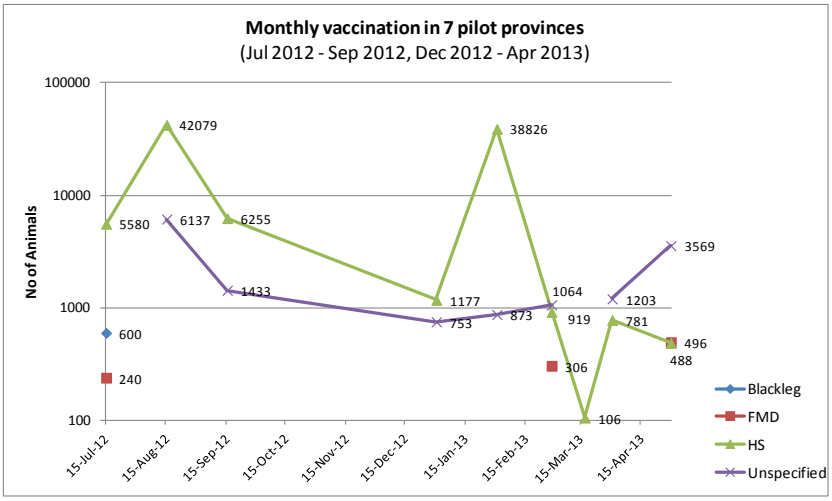
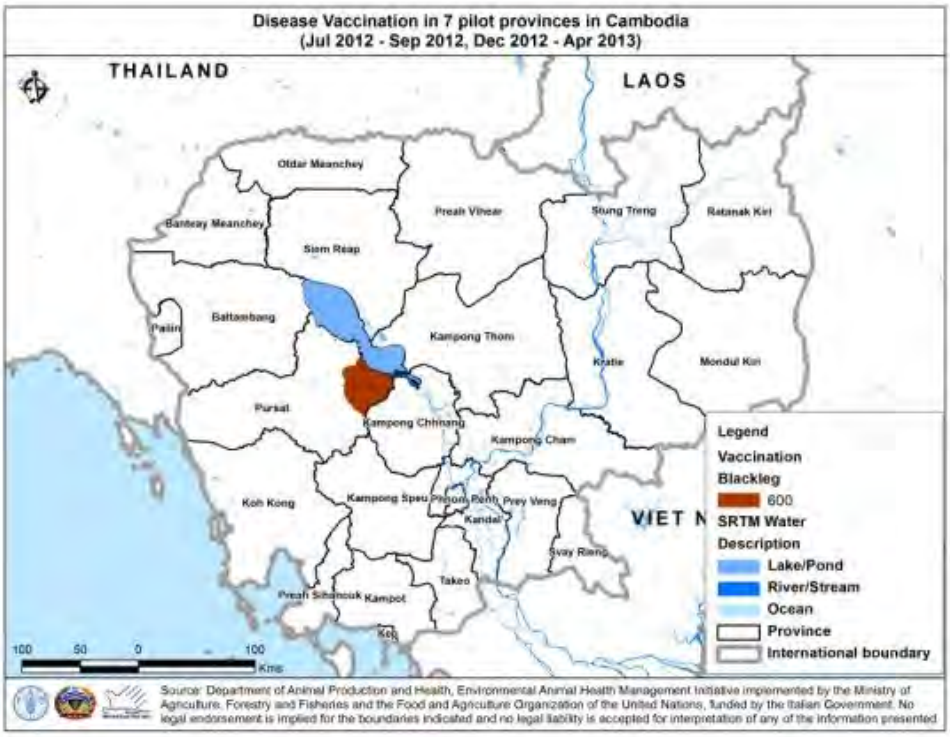


Figure 2. Charts of vaccines used, species vaccinated, and monthly vaccination distribution in the seven pilot provinces.

Mapping the vaccination reports showed that black leg vaccination was only observed in one district of Pursat Province. Foot and mouth disease vaccination was seen to be greatest in one district of Kampong Cham, with 496 animals vaccinated and vaccination also observed in Banteay Meanchey and Battambang. The highest number of hemorrhagic septicemia vaccinations were observed in Kampong Cham and Pursat. Preah Sihanouk did not specify the vaccines used (Figure 3).



Blackleg

Figure 3. Mapping vaccination reports for a) black leg

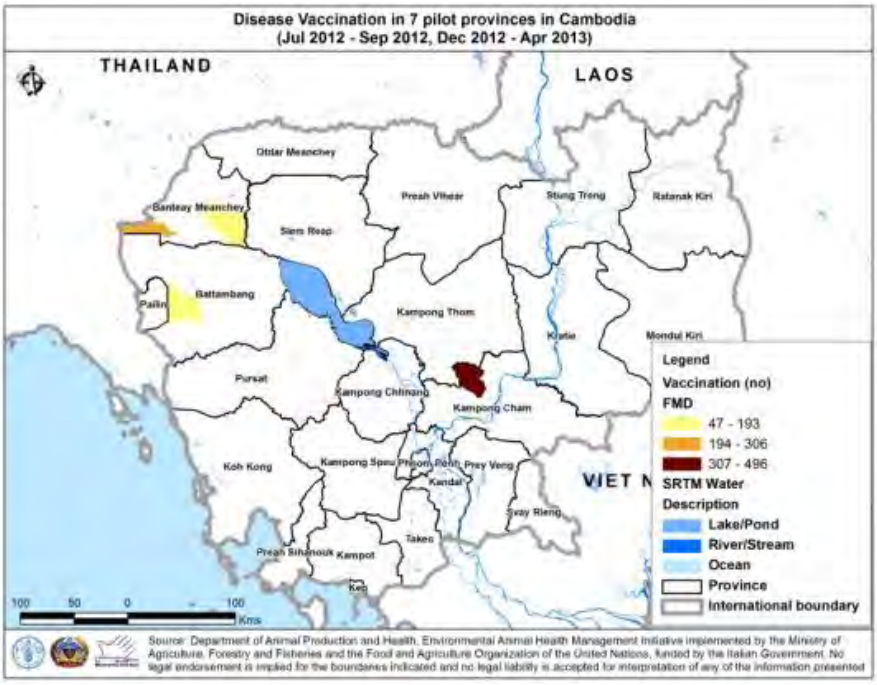


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Figure 3. Mapping vaccination reports for b) foot and mouth disease,

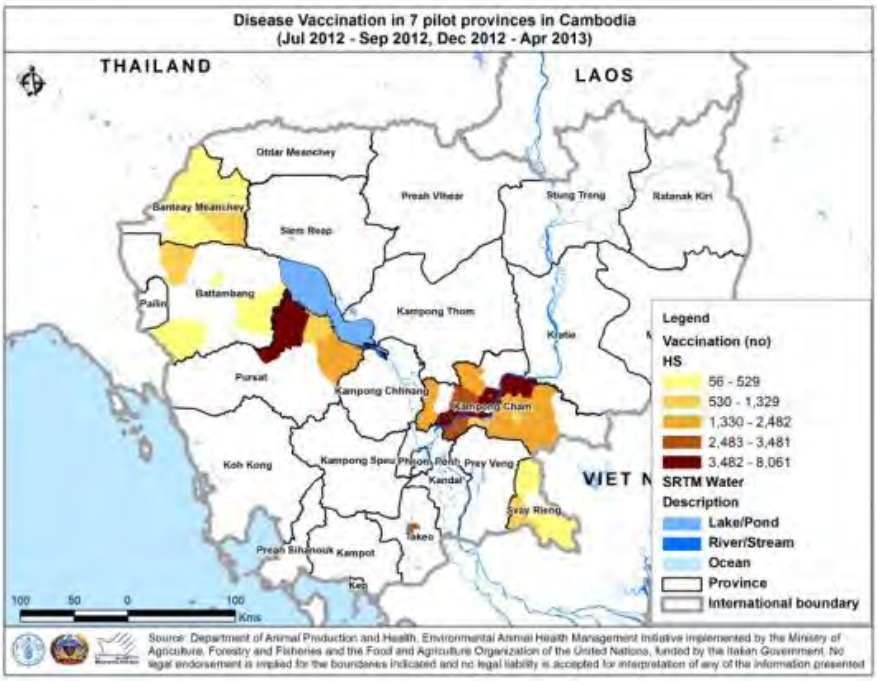

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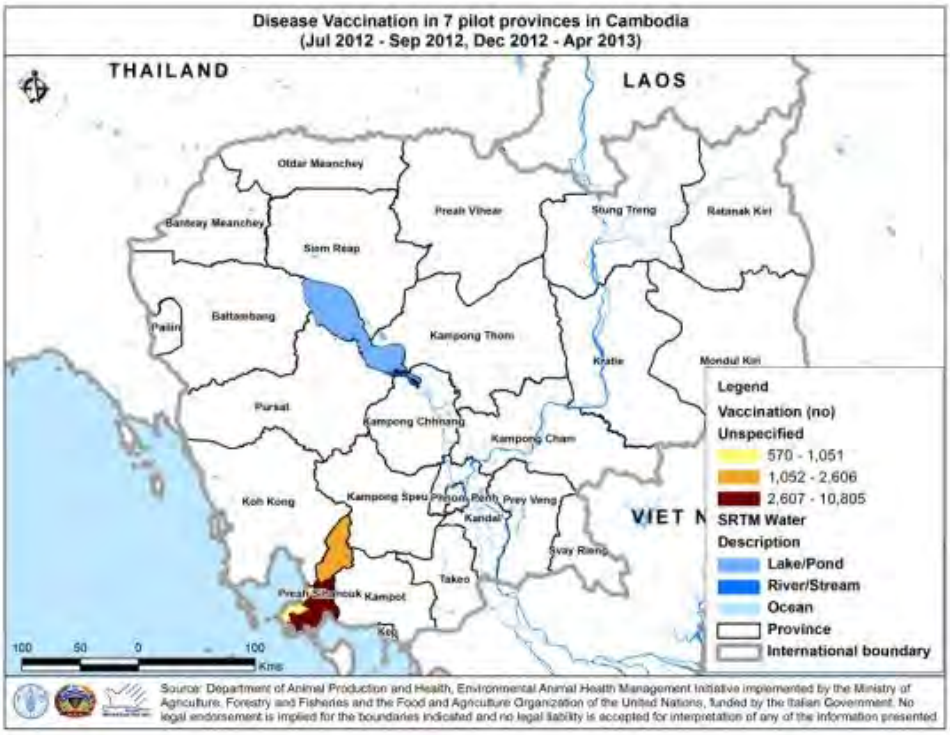
Figure 3. Mapping vaccination reports for c) hemorrhagic septicemia,

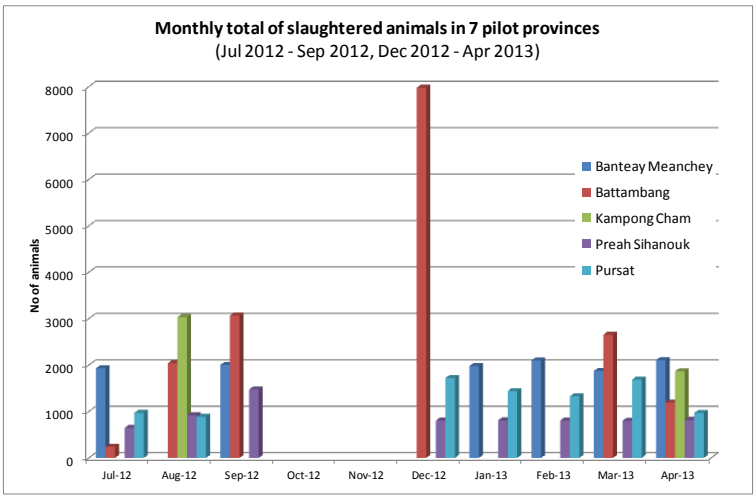


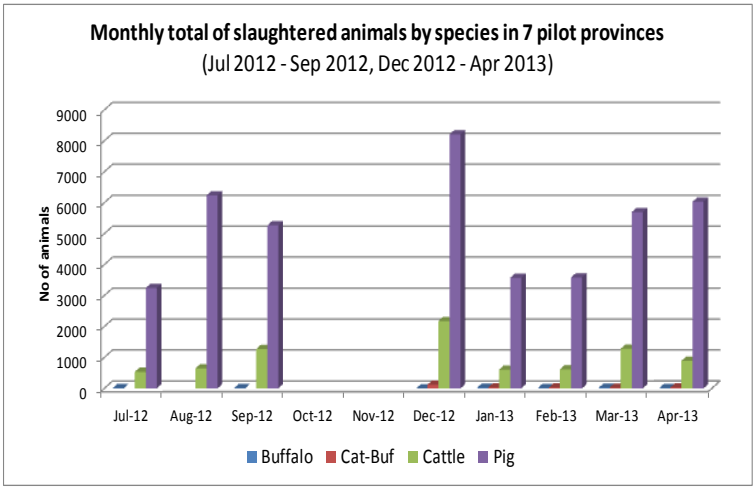
Unspecified

Figure 3. Mapping vaccination reports for d) unspecified vaccinations.

Slaughtered animals

Looking at the monthly reports for slaughtered animals for the same reporting period, it was noted the high number of slaughtered animals reached nearly 8 000 head in December 2012, while in other months did not reach 3 000 head. It was also evident that in the seven provinces, the majority of animals brought for slaughter were pigs. The geographical distribution of slaughtered animals showed that districts with the highest numbers were Banteay Meanchey, Battambang, and Pursat (Figure 4).





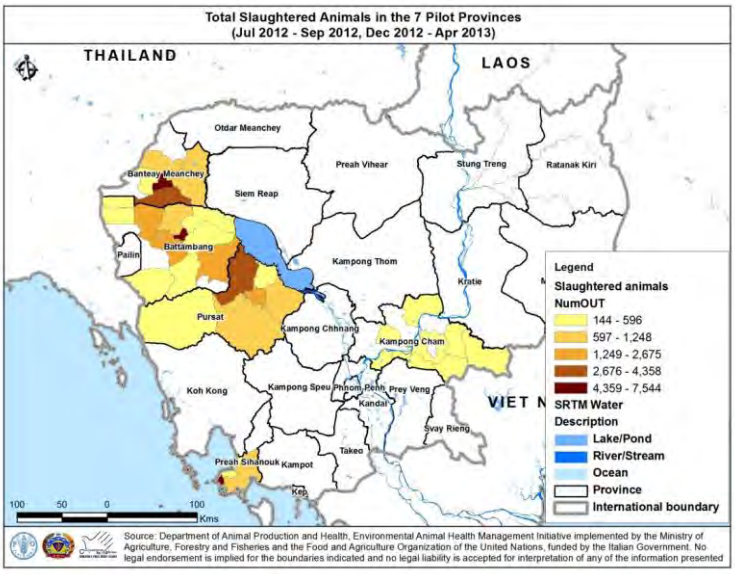


Figure 4. Number of slaughtered animals.

Animal movement

Animals transported were live buffalo, cattle, chickens, ducks and pigs. while animal products were mainly cattle skins and eggs. The provinces of Banteay Meanchey, Battambang, Preah Sihanouk, Pursat inspected cattle skins, while Kampong Cham and Svay Rieng inspected mainly eggs. Some of the provinces did not specifically identify the species with entries of cattle, buffalo and poultry, when in fact individual species have been separately identified (Figure 5).

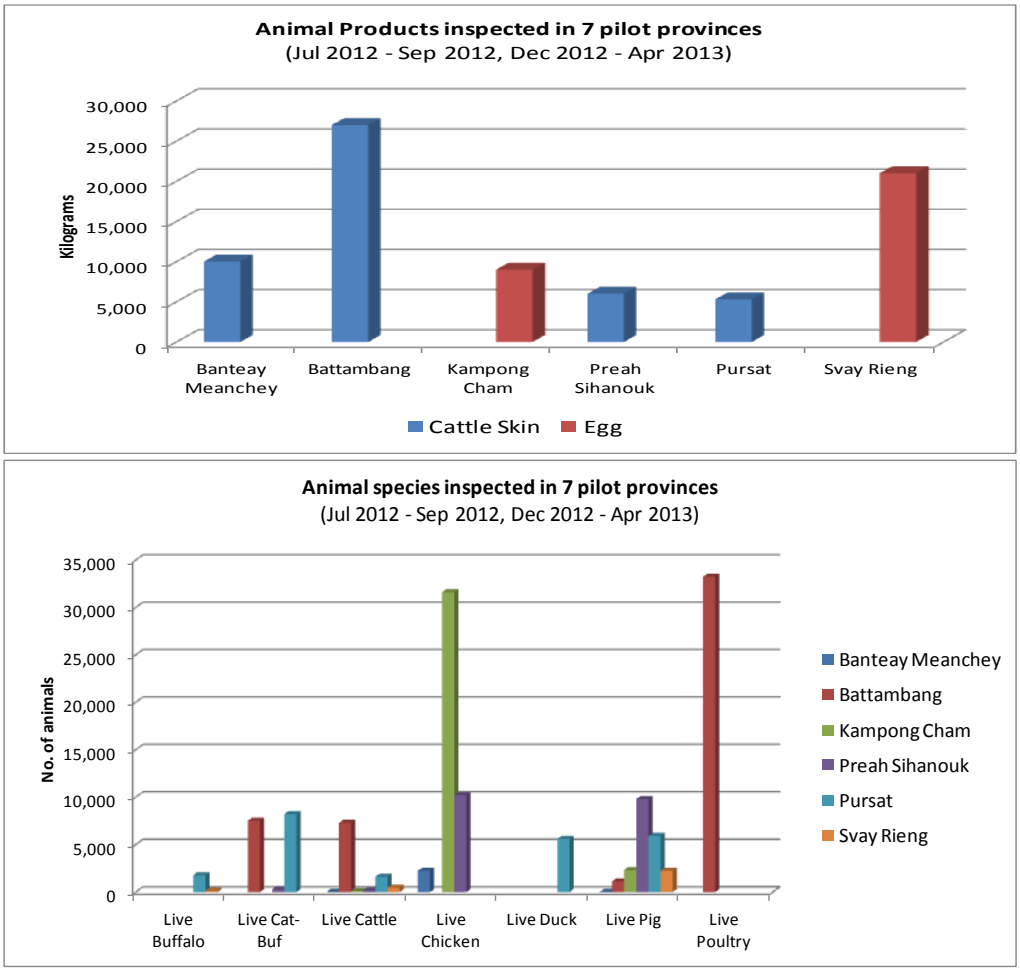


Figure 5. Distribution of animal products and live animals inspected in the pilot provinces.

Impact of interventions: major changes in data management

The piloting of the five standardized reporting forms in the seven pilot provinces showed how standard reporting forms provide for the department's data needs and can be expanded to other provinces. Routine animal disease monitoring and surveillance activities were made using GPS and GIS applications. Mapping of animal distribution, vaccination, disease incidence, biodigesters, and animal farm, forage plots, and check points were also undertaken so that datasets on animal health and production could be visualized and linked with the reporting forms for better planning.

Annex 3

Conclusions

Standardized reporting forms provided more comprehensive information that meets the needs of DAHP and its partner agencies. It was also noted the capacity of provincial staff were improved in terms of reporting, report submission, data entry, GIS mapping and GPS applications. Likewise, the piloting experience provided many advantages to DAHP such as easiness to electronically collect data, more comprehensive data available, and data could be easily computerized with coding.

The way forward

With the lessons gained, it is logical for DAHP to enhance and expand capacity building of EAHMI activities to provincial offices of animal production and health in all 24 provinces of Cambodia. Training programmes should be provided to improve capacity of staff in terms of data collection, data entry, reporting, and GIS and GPS applications, which will help in the enforcement of implementation. It is envisioned that DAHP will develop a Cambodian animal production and health information system that can store large amounts of data centrally located at DAHP for easy retrieval and analysis. It is further recommended that EAHMI Philippines should maintain its support for the secondment programme so that information sharing and skills development will continue amongst the EAHMI regional network of countries.

Lessons learned from the pilot program on standardized reporting forms on animal production and health in Lao PDR

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Introduction

EAHMI Laos Phase II was officially launched in September 2009 with the Department of Livestock and Fisheries (DLF) as the implementing government agency in Lao PDR, following a favorable Independent external review of the first phase of the project in the Philippines from September 2005 to August 2008. The EAHMI project is implemented in three selected provinces in Laos: Xayabouly, Vientiane Capital, and Salavan.

EAHMI Laos provided institutional strengthening and capacity building support in terms of computer equipment and software, and GPS devices and basic software training to enhance information collection and reporting. It has also supported data analysis and GIS training to provincial and departmental staff, including the Northern Region Sustainable Livelihoods through Livestock Development Project (NRSLLDP).

Based on a review of reports submitted by EAHMI provincial partners, it was evident that the information reported was not standardized and was in various formats, including hard copy reports, faxes and email attachments, which also came in different forms (e.g. JPEG, Word, Excel). Frequency of reporting can be weekly, monthly, quarterly, annually, or on request. Reports generally contain both descriptive text in Lao and tabulated data.

Results and discussion

Training on GPS and GIS applications

Various training programs at basic and intermediate levels on and GPS and GIS were conducted from 2010 to 2012 in collaboration with the Science and Environment Faculty of the National University of Laos. A total of 90 personnel were trained within the time period: 35 participants in 2010, 25 participants in 2011, and 30 participants in 2012. Staff from DLF, National Animal Health Center, Provincial Agriculture and Forestry Offices (PAFOs), and project personnel participated in these training programs.

Both basic and intermediate training programs were conducted using a combination of formal lectures, hands-on exercises, and field demonstrations. Knowledge about GPS and GIS were used by staff on animal farm location marking, disease outbreak investigations, and animal movement for reporting to their own organization.

Annex 3

Standard reporting indicators

Various animal health information systems have been developed and partially implemented by DLF over the past 15-20 years, including: LAOBASE, European Union Lao PDR Livestock Support Project Database (LFSP), and the Food and Agriculture Organization of the United Nations Transboundary Animal Disease Information System (TADINFO). None of these previously developed information systems had been sustained beyond the life-time of their respective projects. It is important to acknowledge this historical reality, and recognize that standardized data collection and database development is not a trivial activity that can be solved with the introduction of the latest software and a short-term consultancy. The development of an information system requires a careful assessment and identification of priority needs in terms of data needs and availability, human resource capacity, institutional will, hardware, software, and funding sustainability.

The DLF recognized the need to identify its priority information needs, and committed itself to the development of a computerized animal production and health information system for long-term use so that information is systemically reported, recorded and readily accessible, not only for internal reporting within DLF and the Ministry of Agriculture and Forestry, but also to meet Lao PDR's international commitments to the ASEAN Secretariat and member states, international organizations and other regulatory bodies.

A strategic planning workshop was conducted on 2-3 October 2012 in Vientiane, Lao PDR, to identify key indicators and parameters for animal production and health. The workshop was intended to review the current information reporting practices by EAHMI partner provinces, present experience and lessons learned from EAHMI Cambodia, discuss and identify reporting indicators for environmental animal health management, and prepare a plan for information collection and reporting (Figure 1).

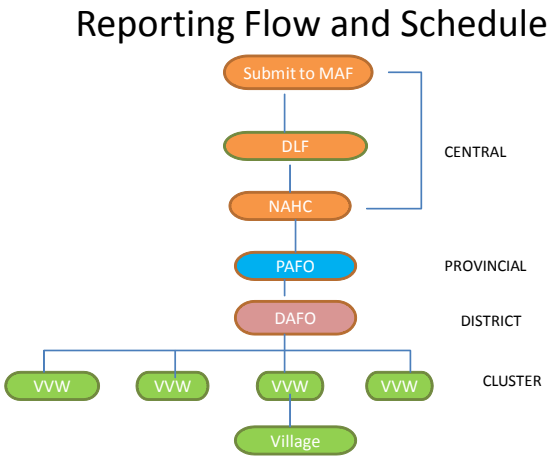


Figure 1. Reporting flow and schedule in DLF.

Workshop participants identified the key reporting indicators and four standardized reporting forms on meat consumption, animal movement, farm profile (pig) and animal health monitoring. During the workshop, it was agreed that these forms should be piloted in the three partner provinces for three months (December 2012 to February 2013). This was further extended to June 2013. The provincial staff completed the forms and submitted monthly reports to the EAHMI Laos national focal point for checking and consolidation. Report submission was encouraged in electronic format, particularly in Excel, to minimize errors from encoding and for easier compilation. However, some provinces still submitted the reports in hardcopy or not editable forms. There were also some instances where some form fields were modified. Several orientation sessions were held and a guide for completing the forms was prepared for the provincial staff so that they were able to complete the forms correctly.

Mapping and analysis of reports

Monthly reports from the pilot program in the three provinces were encoded, collated and translated into English for mapping and analysis. With the cleaned report data, manipulations were done in MS Excel for summary and later linked to geographic data using GIS software for visualization.

The meat consumption reporting forms using reports from slaughterhouses revealed that 82 percent of the total animals slaughtered in the three provinces were pigs. However, when individual provinces were examined, it showed that in Salavan Province, cattle were the major species being slaughtered at 50 percent of total animals.

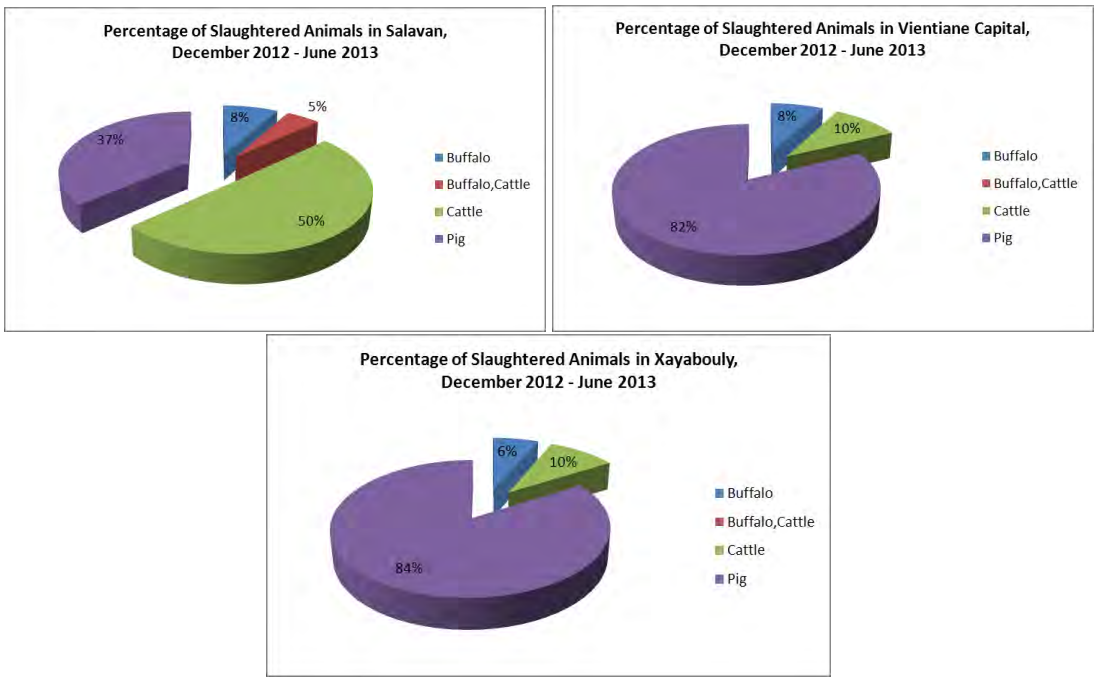


Figure 2. Percentage distribution of slaughtered animals by species in three pilot provinces.

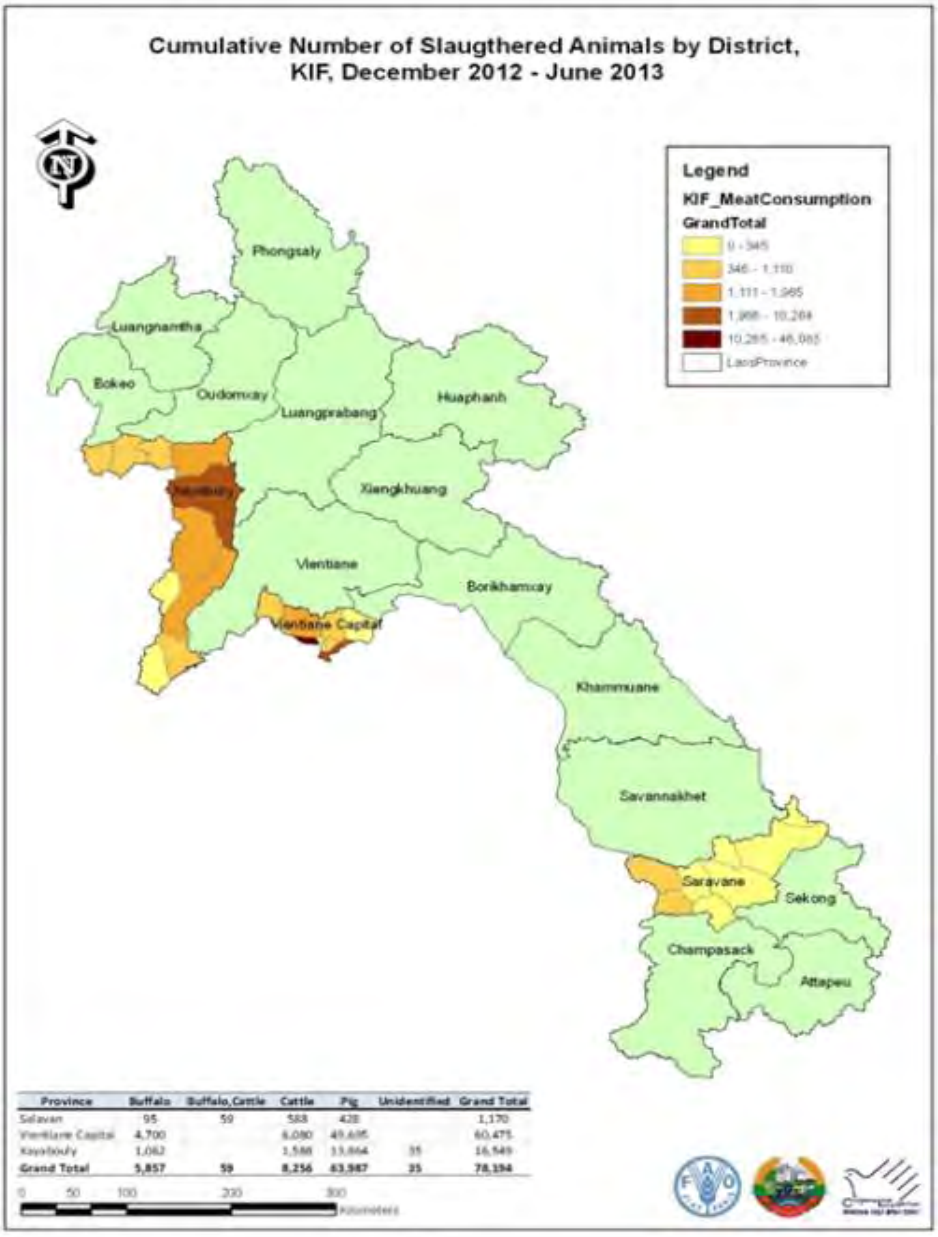
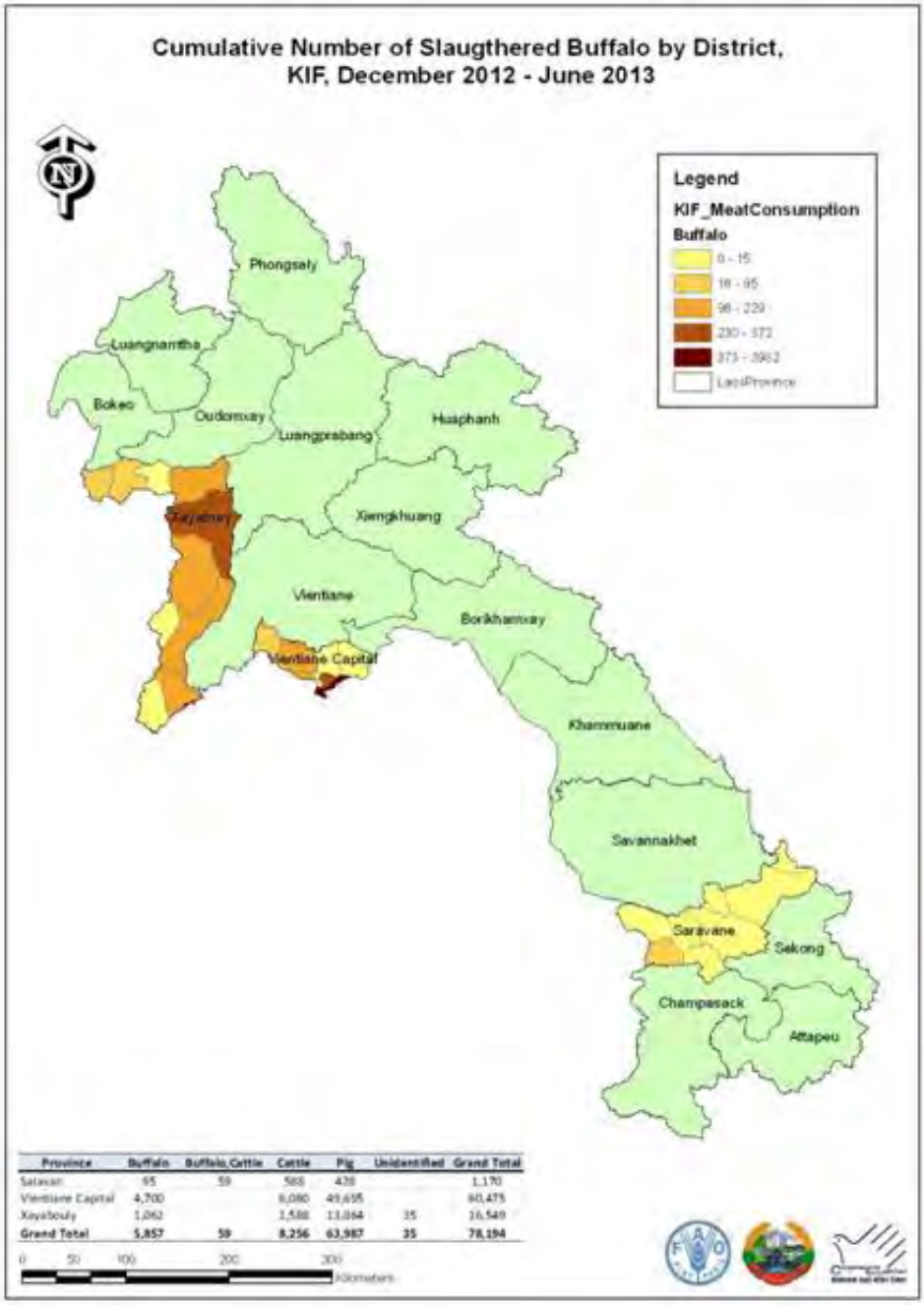


Figure 3. Geographic distribution of slaughtered animals during the pilot period. Impact of interventions: major changes in data management



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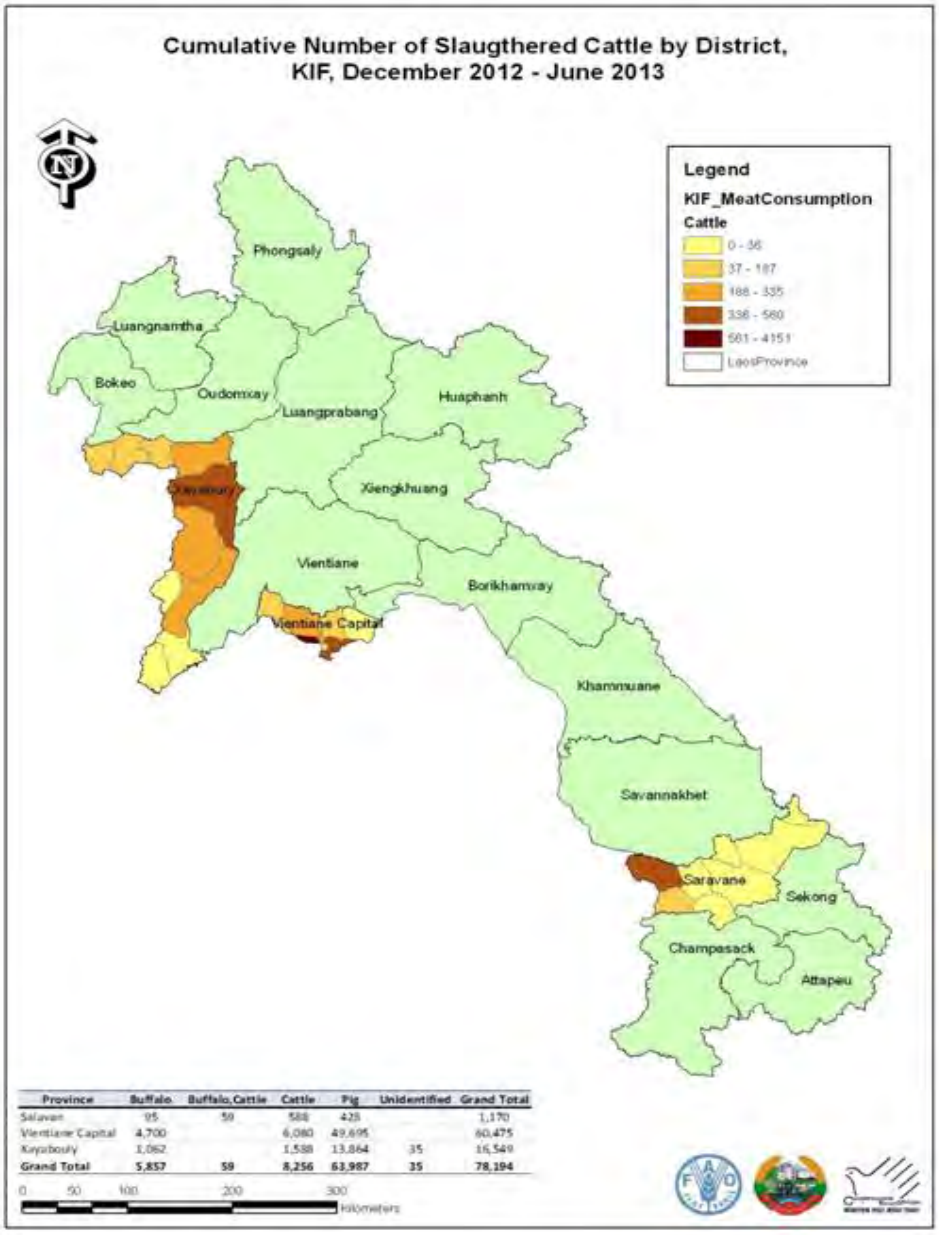

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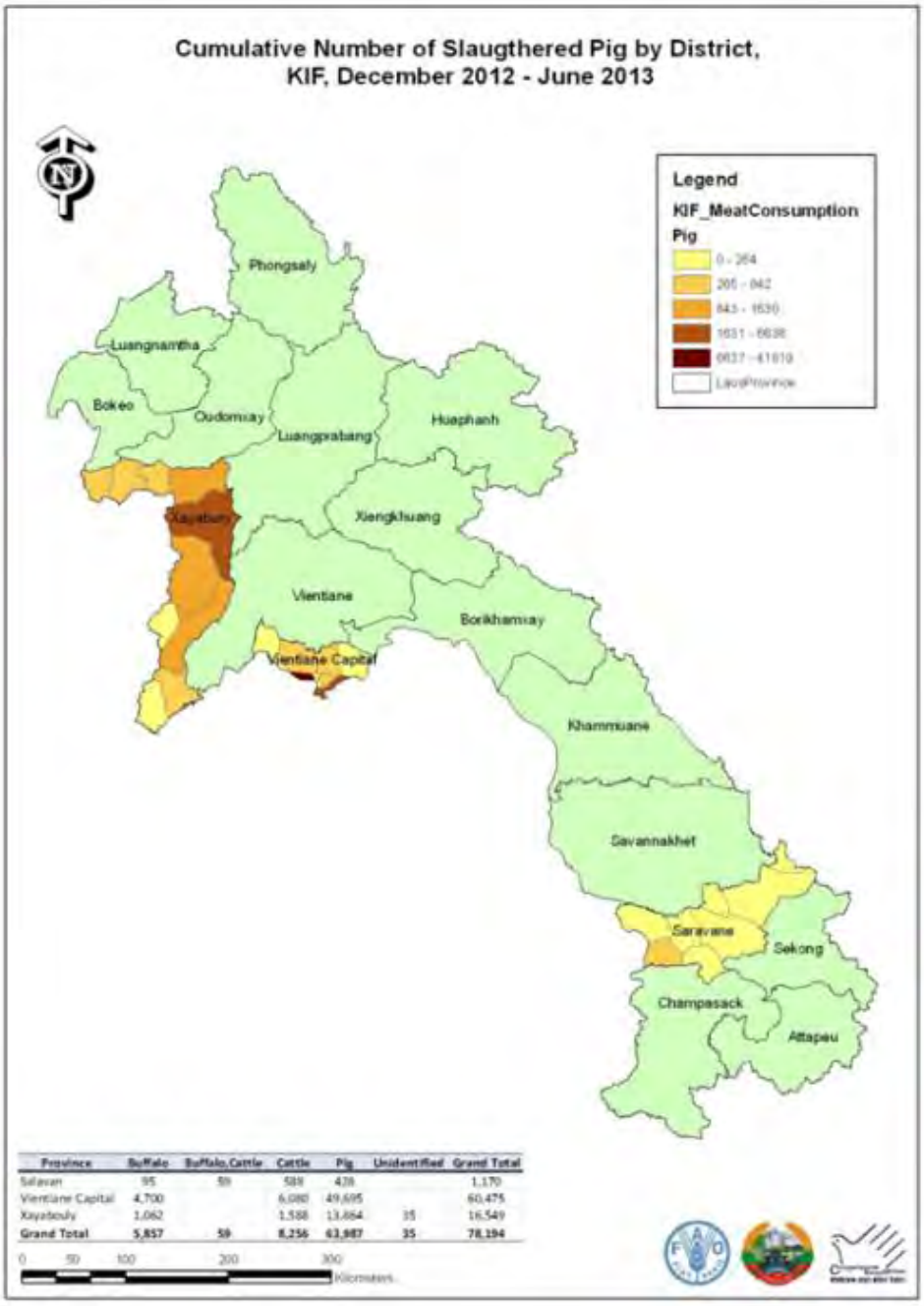

Figure 3. Geographic distribution of slaughtered animals during the pilot period. Impact of interventions: major changes in data management

The DLF, through initial mapping and analysis of the consolidated reports from the pilot provinces, recognized the advantages of standardized reporting forms that could provide relevant information for immediate response to and from DLF, and the reports were easier to update and can be consolidated for faster dissemination. With electronically stored reports, a wide range of data manipulation and analyses can be explored for possible identification of trends and patterns on animal production and health that could greatly help the department in its veterinary services planning and implementation. The conduct of training and exposure through development and piloting of the standardized reporting forms strengthened PAFO staff capacity for data reporting, especially on disease outbreak investigations and animal movements.

Lessons learned

The EAHMI Laos experience and expertise on mapping played a key role in the response to the first case of a porcine reproductive and respiratory syndrome virus outbreak on a pig farm in the Vientiane Capital in 2010. This helped promote the use of GPS and GIS technology as a decision support tool within the department and partner agencies and institutions.

EAHMI Laos assisted in development and piloting the standardized reporting forms in the three provinces. Close monitoring and coordination for the submission of monthly reports ensured timely submission as well as enforcing the use of standard forms. The DLF also realized that submission of reports in spreadsheet format can minimize data handling errors and makes for easier collation. Hard copy reports with an official stamp can then be sent to DLF.

The experience of EAHMI Philippines with the national deployment of the Philippine Animal Health Information System (PhilAHIS) provided further knowledge and ideas on how the pilot information system in Laos can be developed. Collaboration with NUOL for the conduct of capacity training and networking with other organizations on the use of GPS and GIS applications during the GIS User Forum provided further avenues for information sharing.

Conclusions

With the pilot program on standardized reporting forms, the DLF and its partners realized that standard reporting is critical and serves as an important input for effective GIS mapping. GIS and GPS are important decision support tools and are useful for planning strategies within the epidemiological unit for disease outbreak investigation and animal movement control that will benefit smallholder production. The various training programs on MS Excel, GPS and GIS strengthened the capacity of the DLF staff and its partners on data analysis, data management and mapping and have assisted the government in its disease control efforts such as those for HPAI and porcine reproductive and respiratory syndrome.

The way forward

As a way forward and to sustain the gains and outputs of the EAHMI project in Lao PDR, specifically the standardized reporting forms and GIS analysis, DLF committed to transfer the use of GPS and GIS technology to DLF staff and project partners, who in turn will assist the DLF's epidemiological unit in implementing its animal health program on disease outbreak investigations.

EAHMI Laos recommends the development of a formal database using the standardized reporting forms for easy storage and retrieval, analysis and mapping, that will be hosted at DLF and will later link data and information to ASEAN, FAO and OIE.

DLF committed also to providing periodic updates to the EAHMI geodatabase, specifically animal population, holdings and infrastructure, and to develop data and information for planning division staff.

Annex 3

PhilAHIS and its application to national veterinary services planning and implementation

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Introduction

The need for a centralized information management system started the concept of the foot and mouth disease (FMD) Information Management System (FMD-IMS), a DOS-based program developed in 1997, which became operational in 1998 to handle all the FMD data as part of the country's FMD Control and Eradication Programme.

In 2009, a letter of agreement for funding of USD 50 000was signed by FAO and the Bureau of Animal Industry for the enhancement of FMD-IMS. The FMD-IMS was migrated to MS Windows and developed into a functional national reporting system database now called Philippine Animal Health Information System (PhilAHIS).

The implementation of PhilAHIS has four main objectives:

- To standardize the reporting format and establish a core reporting system for animal health and production.
- To facilitate efficient and timely reporting of accurate information from local to national level veterinary offices.
- To establish PhilAHIS as the data warehousing facility for the livestock sector, accessible to all stakeholders.
- To combine and integrate PhilAHIS datasets with the existing information to support program implementers and decision and policy making bodies.

PhilAHIS was piloted in the four regions (Regions 1, 3, 8 and 11). Personnel were trained in the use and maintenance of the system and at same time were provided the necessary equipment. Additional funding of about PHP 15 million from the Philippine government through the Livestock Population Survey Project (LPS) was then allocated for the national rollout of PhilAHIS in the remaining regions of the country. These funds provided equipment such as computer servers, desktop computers, and GPS devices. Extensive training for third level municipal livestock technicians was conducted for filling out report forms and disease investigations.

The Environmental Animal Health Management Initiative (EAHMI) Project in the Philippines supported the PhilAHIS implementation. EAHMI provided technical support for PhilAHIS system enhancement and capacity building in GIS for regional and local government unit (LGU) counterparts. EAHMI also funded first level (regional) and second level (provincial) training for the national rollout.

Three components of PhilAHIS

- **Surveillance and vaccination usage system** provides basic information on surveillance such as animal health monitoring, routine services, outbreak reports, serosurveillance and rabies information and information on vaccination such as vaccination reports, sources, and distribution usage.
- **Livestock movement monitoring system** provides pertinent data on the movement and flow of trade in animals, animal products and animal by-products.
- **Laboratory information system** provides laboratory data for the surveillance and vaccination usage system core support for mounting surveillance-based data collection for management and analysis. It includes laboratory results for necropsy, blood chemistry, clinical pathology, bacteriology, ELISA, rabies, titers and other data.

Currently, the surveillance and vaccination usage system is deployed and operational nationwide. The other two components are still being developed, tested and piloted.

Activities conducted

The national deployment and implementation of PhilAHIS involved several activities.

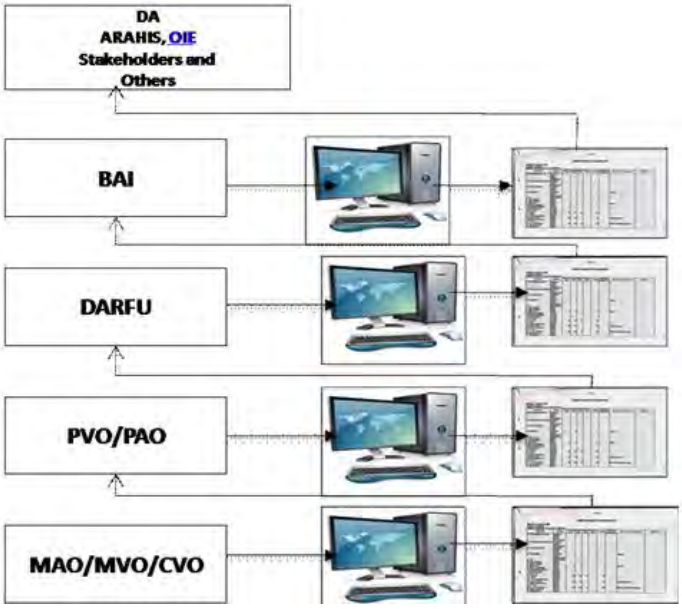
1. **Standardization of reporting forms**. Stakeholders from the municipal to national level were consulted on the standardization of reporting forms. Several consultations and revisions were conducted until all parties were satisfied and all information needs were captured by the report forms. There are two forms in the surveillance and vaccination usage system: the animal health monitoring and routine services form and the vaccination form.

2. **Organization of reporting process flow**. Reporting is done on a monthly basis. Livestock inspectors in each municipality complete the two forms for the surveillance and vaccination system and submit them to the Provincial Veterinary Office or Provincial Agricultural Office. Each province was given a computer desktop with PhilAHIS installed for encoding the municipal reports. The provinces send the encoded data in Extensible Mark-up Language (XML) format to the Department of Agriculture, Regional Field Unit (DAFRU) where a PhilAHIS regional server is setup for consolidating regional data. The region sends the consolidated regional data to the PhilAHIS central server located at the Bureau of Agricultural Industry (Figure 1).

3. **Training personnel for PhilAHIS.** Three levels of training were conducted for the implementation of PhilAHIS nationwide.

   First level training. This level of training is an intensive hands-on workshop intended for IT personnel designated by the PhilAHIS Regional Coordinator as the focal point IT technician and one veterinary staff to handle technical matters pertaining to animal health. Training covers topics pertaining to the introduction and setting up PhilAHIS and includes basic hardware and software troubleshooting, setting up local area networks, an overview of PhilAHIS, server configuration setup, and encoding and

database management. This training is designed to enable users to assist their counterparts in the provinces.



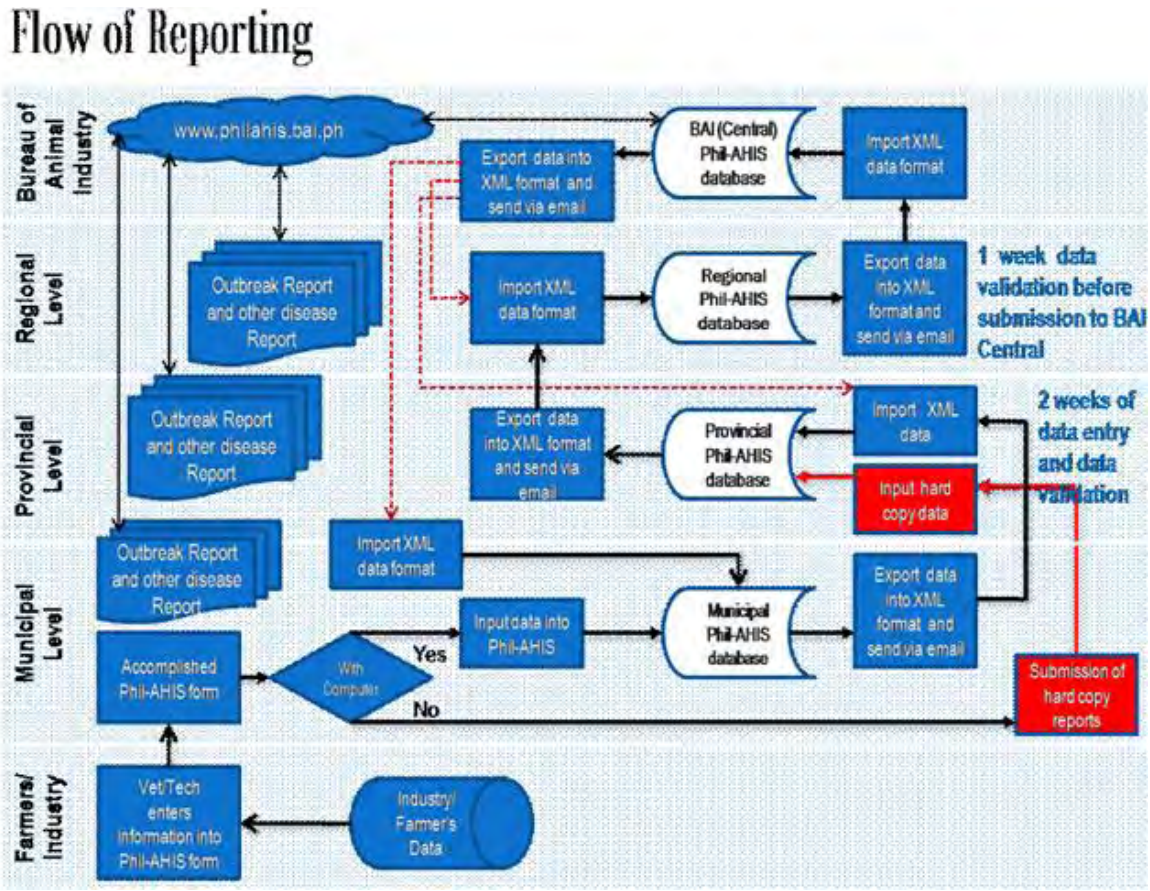


Figure 3. PhilAHIS reporting flow.

Second level training. This is a hands-on workshop conducted among the designated provincial IT report officers for introduction to and familiarization with PhilAHIS and includes an orientation to database management, PhilAHIS structure, hands-on training for database usage, encoding, data extraction and system troubleshooting.

Third level PhilAHIS Training. This is capacity building for grassroots level personnel (designated livestock inspectors from each municipality). This is the most important aspect of the program as the primary source of data will come from this level. The objective of this training is to introduce and orient field officers to the use of PhilAHIS, focusing on the correct use of the forms and prompt submission of reports. It also offers continuing education for field officers on animal disease recognition, basic animal disease control and prevention, and risk communication.

GPA and GIS applications. Both the first (region) and second (province) levels were trained to use GPS and GIS applications for animal health management. An advanced GIS training course was provided to the first level since they handle large volumes of data from several provinces. It was also noted that at the regional level staff plan, manage and implement various agricultural programs of the government, including livestock production management. The provincial or second level were trained on basic GPS and GIS applications such as mapping animal statistics, animal health reports, disease response, and control management.

PhilAHIS as a management tool

With PhilAHIS now deployed and operational nationwide, its importance as a tool in managing data from the grassroots level has been realized and recognized especially at the regional and national level.

Data collection. Data collection from the field to the national office has been improved through the use of standard forms and systematic reporting flow.

Data accuracy. Repeated encoding, which increases errors, has been greatly reduced. With the comprehensive details that PhilAHIS provides, it allows for validation of data.
Data storage and retrieval . The storage and retrieval of animal health data has been automated. Bulk reports have been reduced and paperless submission to the national level has been achieved.

Data analysis and visualization. PhilAHIS data are GIS ready and can be transformed into useful, standard, timely, and quality information. Data can also be easily mapped for analysis and visualization.

Impacts of PhilAHIS

The PhilAHIS deployment started in 2009 and was completed nationwide in 2012. Within that duration, huge volumes of data have already been stored in the central server.

Numerous enhancements to the system and reporting arrangements have been integrated to ensure that accurate information for animal health management in the country is available. This information can be used for planning and addressing various issues on animal production and health as well as in formulating government programs.

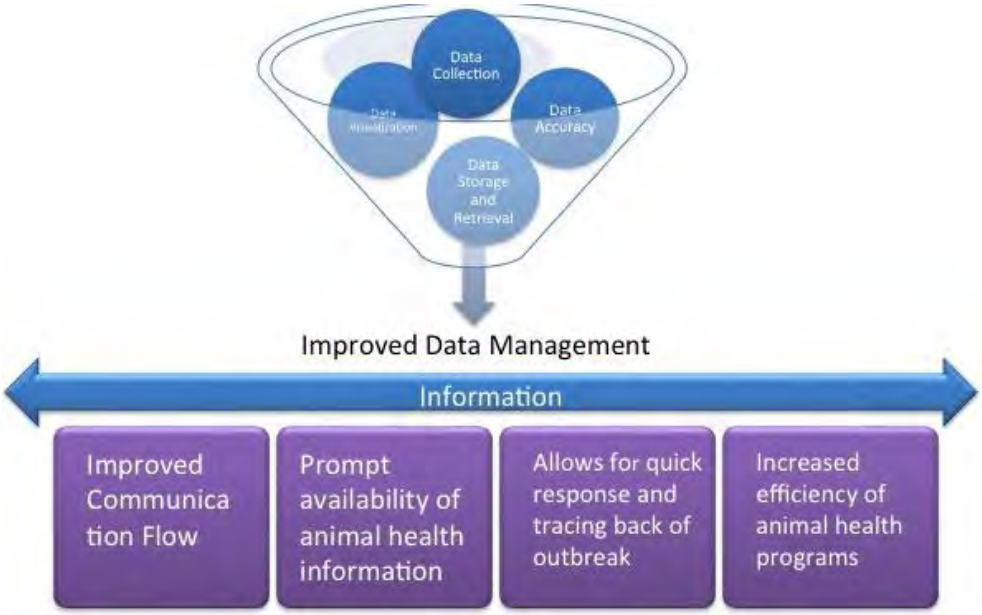


Figure 4. Impacts of PhilAHIS.

Improved reporting flow

PhilAHIS structure has provided a strict reporting flow that ensures valid and accurate information are entered into the system. PhilAHIS has identified and broken down into steps the process of report submission with allowed sufficient time frames to reach the central server as indicated on Figure 1.

Prompt availability of animal health information

PhilAHIS provides an overview of the animal health situation that can be mapped to pinpoint geographic locations and distribution of disease occurrences. It also ensures prompt availability of data for managers and policy makers with minimal personnel requirements to manage the data from local government and regional offices.

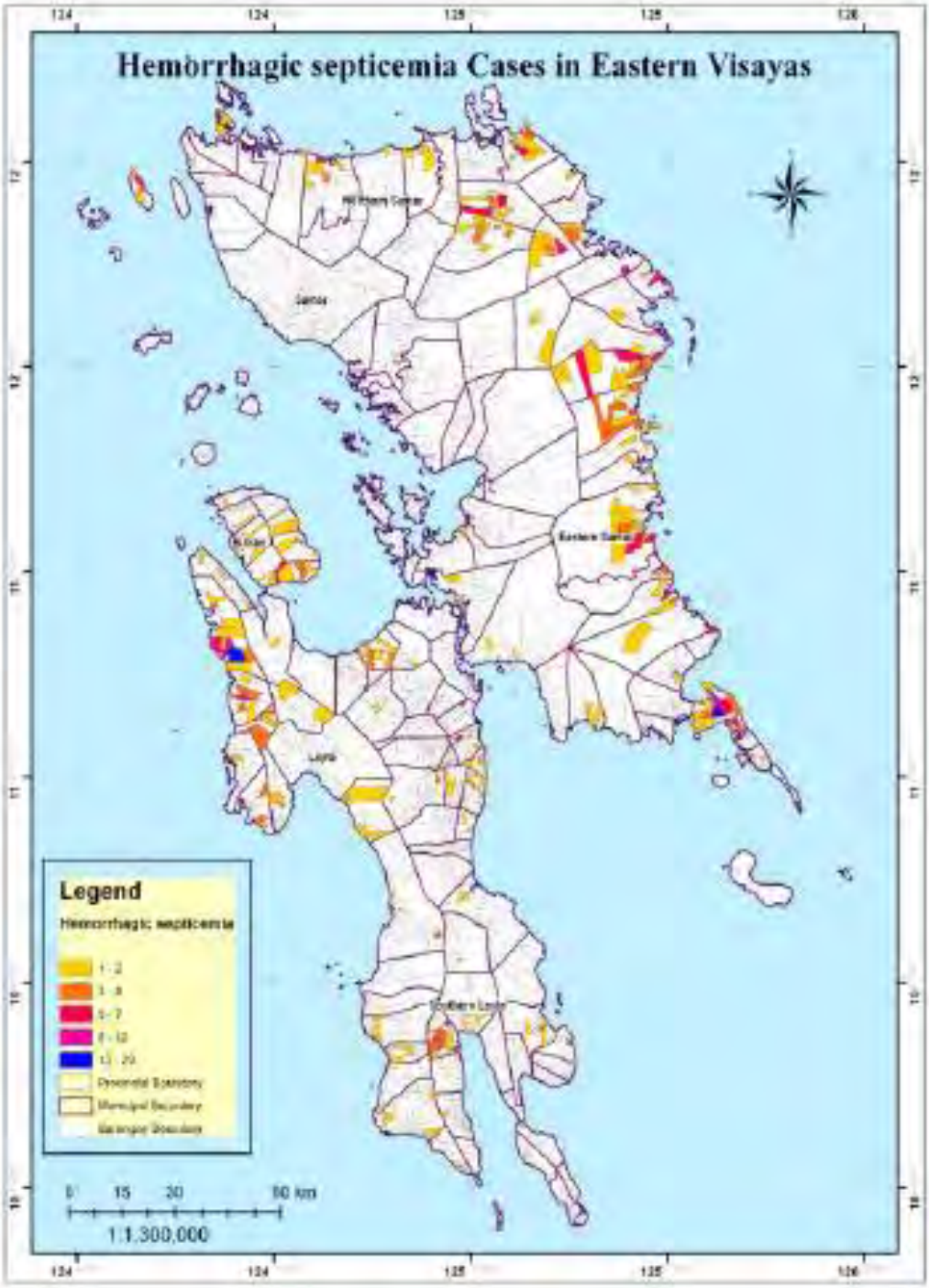


Figure 5. Sample mapping of PhilAHIS reports in one region.

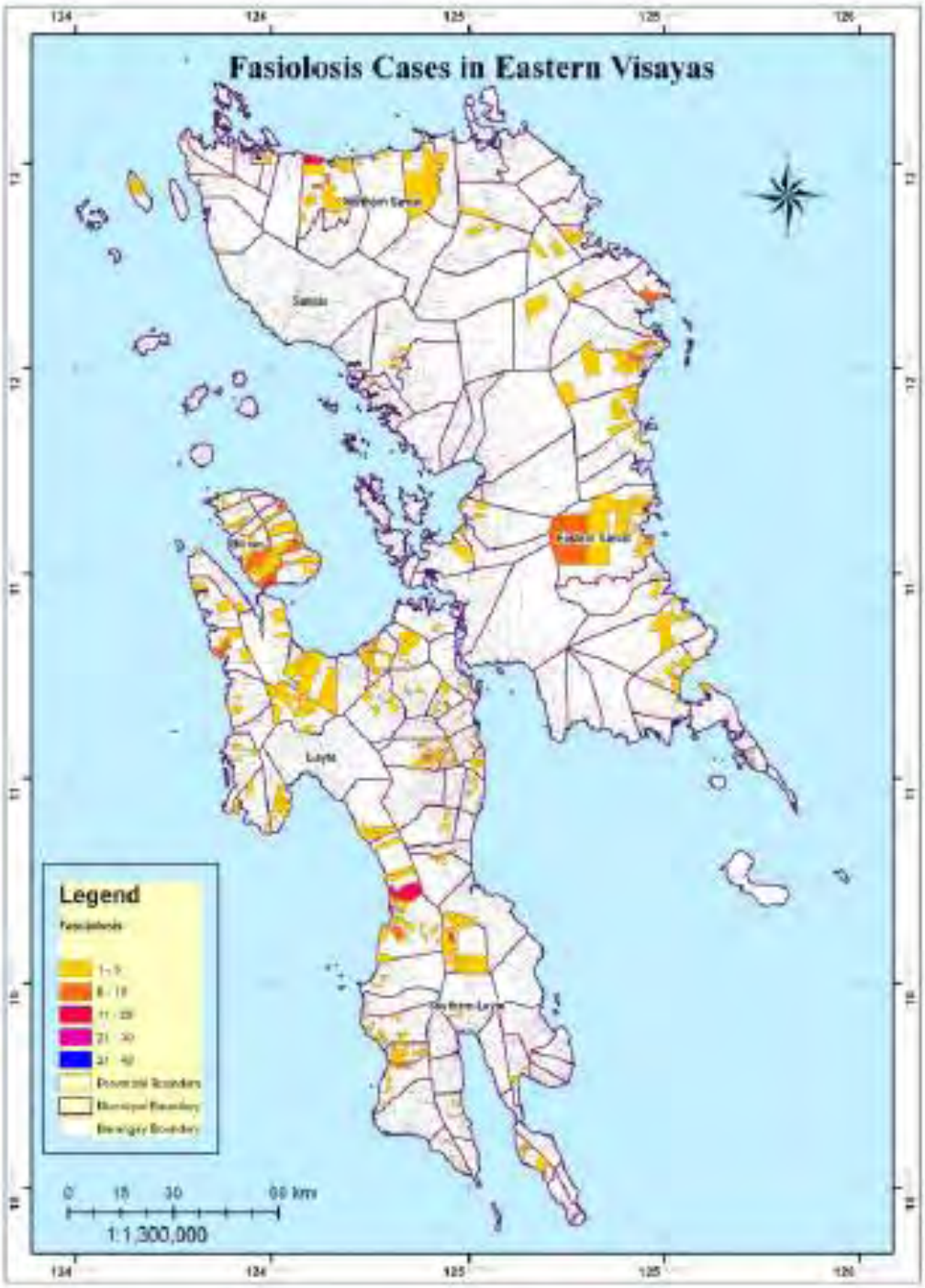


Figure 6. Sample mapping of PhilAHIS reports in one region.

Allows for quick response

PhilAHIS allows for quick response in case of a disease outbreak. Since the data generated from PhilAHIS are GIS ready, maps can be easily prepared in case of an outbreak. The map can pinpoint the outbreak location, perform buffering, and can estimate animal populations at risk in a given area and identify needed resources that could be appropriated with realistic estimates such as the purchase of vaccines or required human resources.

Increases efficiency of animal health programmes. PhilAHIS generates simplified and easy to interpret animal health data with the use of maps and charts. It can also assist in setting priorities and action plans for the programme implementation.

Lessons learned

Continuous engagement with DARFUs and local government units should be done to maintain their enthusiasm and commitment to the use of PhilAHIS, thereby securing ownership in the regions and provinces. To ensure the sustainability of PhilAHIS, users must fully appreciate the system and incorporate PhilAHIS reporting into their routine activities, and they must be able to use the data generated according to their needs.

Conclusions

PhilAHIS is a functional tool used to improve animal health data management and veterinary services. The efficiency with which animal health information is reported from the field to the national office is continuously being enhanced through development and innovations such as the creation of a PhilAHIS website.

The strong links to and coordination between PhilAHIS counterparts and the national office ensures sustainability of the system. The deployment of the system by the DARFU and provincial local government units also helps sustain the system. To date, a total of 269 cities and municipalities have adopted the system.

The yearly budget of PHP 4 million allocated by the National Livestock Programme of the Livestock Development Council from 2011 up to the present for the implementation of PhilAHIS activities proves that the system is in progress and is being sustained.

The way forward

It is envisioned that PhilAHIS can be deployed down to the city and municipal level as there are already 269 cities and municipalities that have adopted the system. This would help to minimize the encoding workload of the provinces and could also increase accurate encoding.

The completion of the laboratory information system and livestock movement monitoring system will eventually be deployed and integrated with PhilAHIS. PhilAHIS datasets will be integrated with other Bureau of Animal Industry information systems. PhilAHIS has been

designated as the core reporting system for livestock agencies of the Department of Agriculture.

Annex 4

A review of Cambodian livestock and poultry breeds and types

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Introduction

Cambodia's farm animal genetic resources (AnGR) are poorly documented and existing information is widely scattered and difficult to access. According to *The State of the World's Animal Genetic Resources for Food and Agriculture* (FAO, 2007b) Cambodia has zero scores in all aspects of institutional capacity for animal genetic resource management: research, knowledge, awareness of topic, infrastructure capacities, participation of local/regional level, laws, political programmes, and degree of implementation. This assessment is out of date and needs to be revised and updated. The purpose of this study is to conduct a comprehensive review of all available documents and related information about Cambodian livestock and poultry breeds, as well as international guidelines on the management of animal genetic resources, with a view to establishing a consensus for the identification of precursors and priority requirements for the formulation of realistic national strategies and action plans for the management of Cambodia's animal genetic resources.

Methods

1. In consultation and discussion with key informants, compile a comprehensive body of formally published and grey literature relating to Cambodia's farm animal genetic diversity, including both mammalian and avian species.
2. Review Cambodian entries in the Domestic Animal Diversity Information System (DAD-IS), with a view to identifying and recommending appropriate amendments and revisions.
3. Review international guidelines for AnGR management and identify gaps in knowledge and constraints on implementing those guidelines.

Available information related to animal genetic resource in Cambodia

Buffalo

Buffalo belong to the Bovidae family. There are two main species of buffalo: the Asiatic buffalo (*Bubalus bubalus*); and the African Buffalo (*Syncerus caffer*). The water buffalo, or domestic Asian water buffalo (*Bubalus bubalis*), is a large bovine, extensively raised in East, South and Southeast Asia, and also widely in South America (especially Brazil), southern Europe, north Africa (especially Egypt), and elsewhere. Asian water buffalo are divided into two subspecies: the river buffalo and the swamp buffalo. The exact phylogenetic relationship between swamp and river buffalo is still in question. It seems likely, however, that there have been separate domestication events for river buffalo in India, and for swamp buffalo in China (Sali & Majeed, 2012). Maclean (1998) reported that all Cambodian buffalo are of the swamp type, which has been confirmed by recent

genetic study (Takahashi *et al.*, 2007). In animals more than four years old, withers height ranges from 116.8 to 152.2 cm in females, and 113.3 to 137.6 cm in males (Namikawa *et al.*, 2006b), although the authors indicated that the height of males, in particular, might have been underestimated because of difficulties in tethering large animals.

Two basic colour types of domestic water buffalo are recognized in Cambodia: black and white, with black being by far the most common, accounting for 99 percent of a recent survey of some 671 722 animals (Seng *et al.*, 2012). The white or albino form (with a dominant white allele) appears to be more frequent in the eastern mountains (Nozawa *et al.*, 2006), an observation confirmed by Seng *et al.* (2012), who found a higher proportion of white buffalo in Ratanak Kiri, Mondul Kiri and Preah Vihear Provinces in eastern Cambodia.

In his review of Cambodian domestic animal genetic resources, Soun (2003) classified Cambodian swamp buffalo into two sub-types: mountain and lowland buffalo (Figure 1).

Mountain buffalo (krobey phnom in Khmer) are found in Ratanak Kiri, Preah Vihear, Kampot, Kampong Som, Koh Kong, Kratie and Stung Treng Provinces, and are characterized by their larger size, with a withers height of 140-150 cm and a mature weight of 350-450 kg for females, and 500-600 kg for males.

Lowland buffalo (krobey sre, krobey kdam in Khmer) are found in Prey Veng, Svay Rieng, Takeo, Kampong Thom, Siem Reap, Battambang, Pursat and Kampong Chhnang are smaller than mountain buffalo, with a withers height of 120-137 cm, and an adult weight of 300-400 kg for females, and 400-500 kg for males.

Cattle

Cattle raising in Cambodia is for dual or multi-purpose (draft, calves and meat). Cows are generally not milked. Dairy production is limited to a few small specialized farms catering to niche urban markets. The most common cattle in Cambodia are of the local indigenous type (kor srok in Khmer) (Maclean, 1998). Hariana and Brahman were introduced to Cambodia in the 1950s and the 1980s and have been widely cross bred (Maclean, 1998; Soun, 2003). Kor srok are relatively small in size, mature early at about 250-350 kg, and have a low maintenance requirement. They are found in both upland and lowland areas, including rice growing and riverine areas, and predominate in the northeastern provinces (Maclean, 1998).

Soun (2003) subdivided kor srok (kor kmer) into two sub-types (Figure 2):

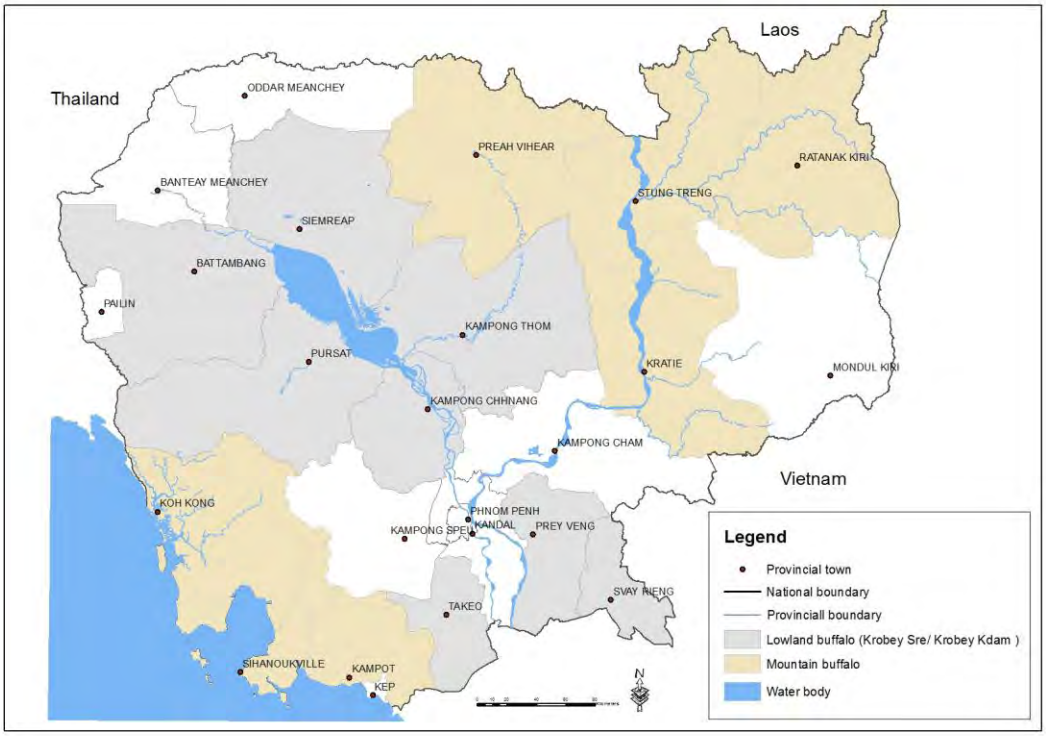

Figure 1. Distribution of main buffalo sub-types.
Source: Soun (2003). Map layout and design: Mr Voeun Vinichai, Royal University of Agriculture.

Subsequent, extensive discussions with provincial animal health and production officers (Seng et al., 2012) have confirmed the existence of two recognizable types of buffalo in Cambodia: 1) krong, the larger type; and 2) bay or sre, the smaller type.

Lowland cattle (kor tum neap kandal in Khmer), with little drooping dewlaps, small humps, and brown, yellow or black coat colour, have a live weight of 250-350 kg. They are found mainly in Prey Veng, Svay Riang, Takeo, Kampot, Kampong Speu, Kampong Cham, Kampong Thom, Pursat, Battambang and some parts of Kandal Province.

Upland and mountain cattle (kor kpong reap and kor phnom in Khmer), without dropping dewlaps, yellow-brown coat colour, and live weight of 150-200 kg. They are found mainly in Kratie, Stung Treng, Ratanak Kiri, Mondol Kiri, Preah Vihear, Oddar Meanchey, and parts of Siem Reap Province.

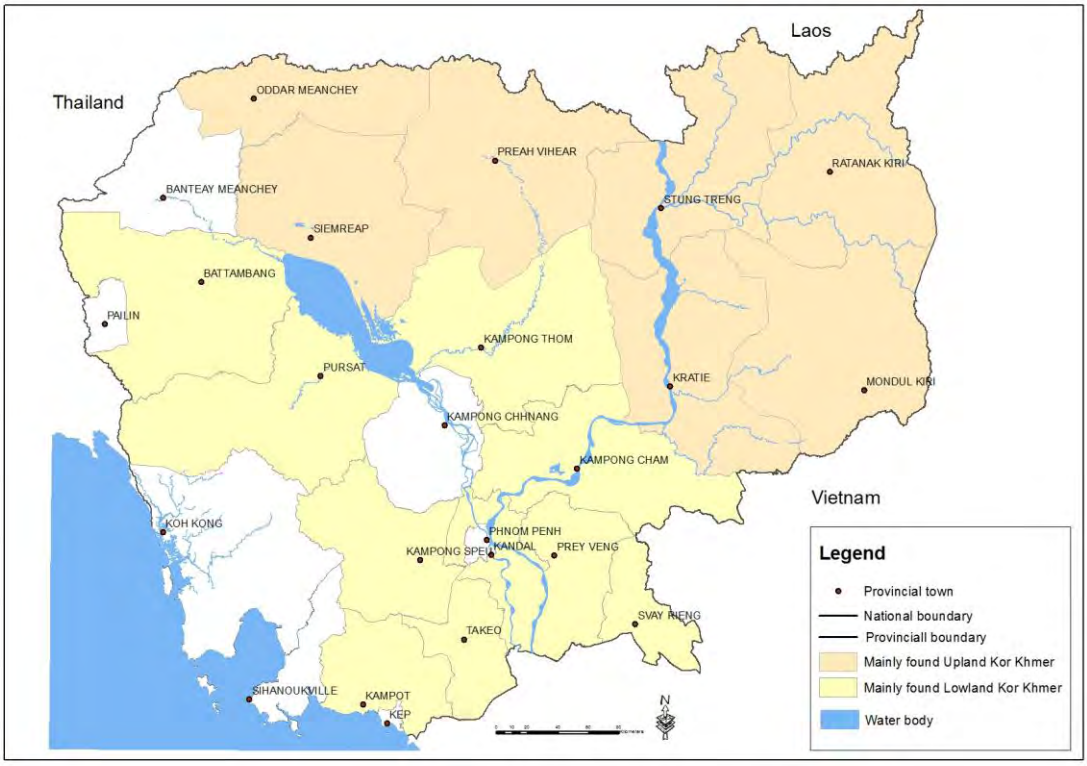

Figure 2. Distribution of main cattle sub-types.
Source: Soun (2003), Map layout and design:
Mr Voeun Vinichai, Royal University of Agriculture.

A series of studies on indigenous Cambodian cattle was carried out in the early 2000s by Japanese researchers and the Royal University of Agriculture (Namikawa *et al.*, 2006a; and Nomura *et al.*, 2007). The original coat colour of indigenous Cambodian cattle is believed to have been yellow-brown to black, but appears to have changed over time. From an overall sample of 28 140 animals in 18 provinces in 2002 and 2004, almost half (49.9 percent) were yellow-brown; 43.1 percent were white-grey; 5.5 percent were dark brown; and 1.6 percent were black. A few spotted individuals were also found. Prevailing colour varied according to region, with yellow-brown, dark brown and black prevailing in eastern regions (100 percent) and western areas (60 percent), compared with only 8.4 percent in the south-central plains. The high proportion of white-grey animals in south-central Cambodia is likely e related to the relatively recent introduction of Haryana and Brahman stock (Namikawa *et al.,* 2006a).

The mean wither height of adult, native cattle ranged from 101-117 cm in males and 96-113 cm in females (Namikawa *et al.*, 2006b). Gene frequency (enzyme polymorphism) analysis of 25 blood proteins from 208 blood samples taken across 14 provinces indicates that indigenous Cambodian cattle are of basic zebu–type, with an admixture of genes from taurine, Banetng and Gayal sources (Nomura *et al.* 2007).

Seven cattle types (Figure 3) were identified in a recent study by the Royal University of Agriculture (Seng, *et al.*, 2012):

1) **Local cattle:** Indigenous cattle with low a mature weight of 150-250 kg, low hump, well adapted to limited feed availability. These animals are commonly yellow-brown, brown, black, and grey-white, and are locally called in Khmer: *kor bay, kor kdam, kor srok*.

2) **Coloured cross bred cattle:** Crosses between local and exotic breeds. They have higher live weight and bigger humps than local cattle. The mature weight varies from 300-450 kg. They are comparatively poorly adapted to limited feed availability. Common colours are grey-white/yellow and pale yellow/black, and are locally known in Khmer as *koa lagn, thlork*.

3) **White cross bred cattle:** Referred to cross bred between local and exotic, but they are white. They have a high hump and mature weigh is comparable to coloured cross bred cattle types. These animals are commonly called *kor tunle*, which means river cattle. They are not well adapted to poor feeding management.

4) **Mountain cattle**: Commonly raised in mountainous areas. Typical characteristics are a high hump and bigger dewlap. They have relatively high mature body weight, ranging from 300-500 kg. They are usually yellow/brown in colour and are locally known in Khmer as *kor phnom*.

5) **Brahman cattle:** Imported or locally raised with predominantly Brahman characteristics.

6) **Haryana cattle:** Imported or locally raised with predominantly Haryana characteristics.

7) **Others:** Recently introduced or offspring of the cross breeding between exotic and local cattle and raised for either meat or milk. Relatively few in number and constitute only a small proportion of Cambodia's total cattle population.

With regard to cattle types, white cross bred and local cattle types predominate in most provinces, except in mountainous areas in northeastern Cambodia, where local and mountain types are most common. Minor cattle types, such as dairy and Brahman crosses, Santa and Simbrah crosses, and Kampengsen, are present only in very small numbers in Kandal, Pursat and Tekeo Province, respectively (Seng *et al.*, 2012).

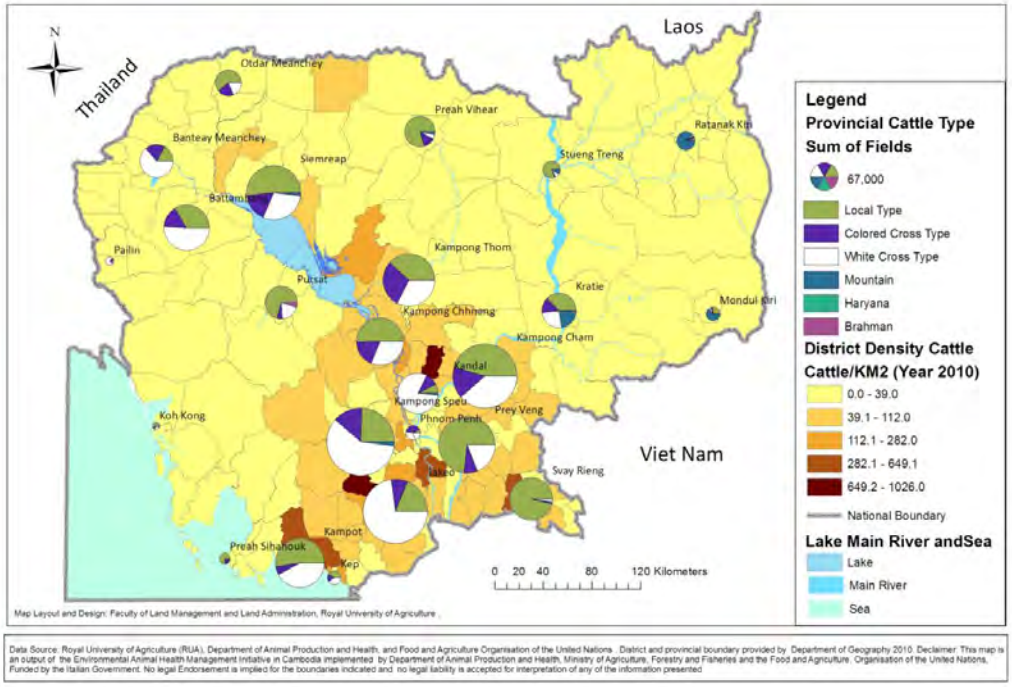

Figure 3. Cattle distribution by district and phenotype proportions by province.
Adapted from Seng *et al.* (2012).

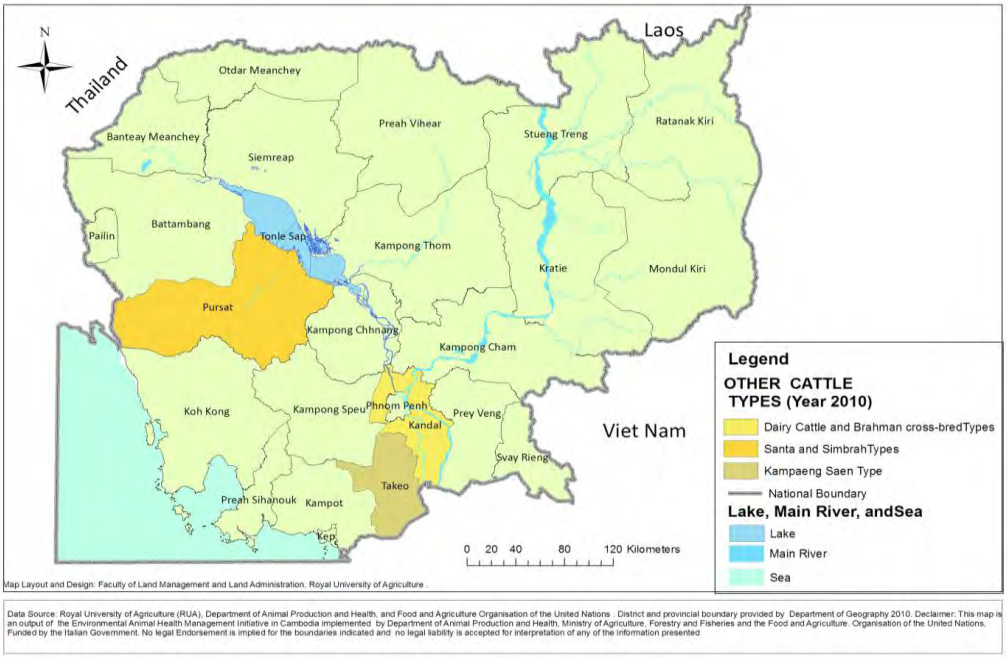

Figure 4. Sources of cattle semen and breeding stock.
Adapted from Seng *et al.,* (2012).

These observations are consistent with the findings of Maclean (1998) and Soun (2003), especially with regard to indigenous cattle (kor srok), Brahman and Hariana. However, it is not clear if the mountain cattle referred to in Seng et al., (2012) are the same as highland (kor srok) referred to by Soun (2003). Seng et al., (2012) provide more detailed descriptions of cattle types. White and coloured cross bred animals generally have a greater body weight than indigenous cattle (kor srok).

Chickens

Maclean (1998) states that there are four major breed types of chicken in Cambodia: 1) *moarn cher* (jai chickens); 2) sampov (moarn sampov, sampov chickens); 3) *skuoy* (*skuoy* chickens); and 4) *moarn chul*.

Subsequently, researchers from the Royal University of Agriculture (Sann and Chhum Phit, 2004) conducted a field survey to assess the characteristics of indigenous chickens, which included 150 householders from Kandal, Kampong Speu, Kampong Thom, Siem Reap and Ratanak Kiri Provinces (according the circle on the map) (Sann, undated). Eight chicken breed types were identified, including: *moarn prey* (red jungle fowl) and *sampov*, as shown in Table 1, with the latter accounting for more than half (55 percent) of the birds sampled.

Table 1: Summary of local chicken characteristics.

	Local name In Khmer	English name	Mature weight (kg)	Dominant colour
1	*Moarn prey*	Wild chicken	1,5 – 2,5	Very colourful
2	*Sampov*	Local fowl	3 – 3,5	Colourful
3	*Dandong*	Slow feathering	3,5 – 4	Few feathers, black
4	*Skuoy*	Bicolour	3 – 3,5	White, black and yellow neck
5	*Kringos*	Fizzle	1,5 – 2,5	Black and curve
6	*Ashley*	White dwarf	0,5 – 0,8	White
7	*Moarn cher*	Barred dwarf	0,5 – 0,8	Very colourful
8	*Moarn chul*	Fighting chicken	3 – 3,5	Colourful

Source: Sann and Chhum Phit (2004); and Sann (undated).

Comparative gene frequency analysis of native chickens in various Asian countries has confirmed some similarity between Cambodia and Thai birds (Nishibori *et al.*, 2006).

Annex 4

Ducks

Maclean (1998) identified four duck breeds in Cambodia:

1. **Tea angkam** (in Khmer), slightly smaller than the tea sampov; a dual purpose egg and meat producer. Produces smaller eggs (about 80 gm) than the tea sampov, but more of them. Pure flocks rarely found, usually cross bred with tea samov.

2. **Tea sampov** (in Khmer), similar to the tea angkam, but slightly larger. Eggs larger (100-120 gm) than the tea angkam, but few or them. Pure flocks rarely found. usually cross bred with tea angkam.

3. **Peking duck** (tea pekang in Khmer) is a tall white bird, reared for meat production and commonly found in peri-urban areas.

4. **Muskovy duck** (tea kapa in Khmer) is found only in small numbers, kept around the house by smallholders not specialized in duck raising. Very good at incubating eggs, with 10-15 eggs per clutch. Sometimes used to incubate the eggs of other ducks or chickens.

In addition, there is the introduced Kakikambel duck, which is raised primarily for egg production without dependence on water sources.

Goats

According to Nozawa *et al.* (2006), goats can be classified into three basic morpho-genetic types: 1) the bezoar-type; 2) the savannah-type; and 3) the Jamnapari-type. The latter began spreading into Southeast Asia in relatively recent times (Nozawa *et al.*, 2006). Goats have been raised in Cambodia for at least a thousand years, as depicted in the gallery reliefs of the Bayon temple in the ancient city of Angkor Thom (Nozawa *et al.*, 2006).

Very few documentary records of goat keeping in Cambodia could be found. However, there has been increasing interest in goat keeping in recent years, and several breeds have been imported from neighbouring countries, Europe and America (Seng *et al.*, 2012). The DAPH has been recording goat numbers in its annual statistics since 2009. Unlike cattle or pigs, different goat breeds are not generally recognized by Cambodian farmers, who are more likely to refer to their country of origin. The following goat breeds are known to occur in Cambodia: Kakang; Etawa, cross bred Etawa, Alpine and Anglo Nubian (Seng *et al.*, 2012).

Horses

With a total estimated population of 11 638 horses in Cambodia in 2011, they are relatively uncommon but widespread and kept by households in various areas for transportation (Seng *et al.*, 2012). Recently, however, increasing numbers of horses are being kept for renting and riding for pleasure, especially around Siem Reap and Phnom Penh (Seng *et al.*, 2012). The indigenous *angkam* breed, which predominates (94.4 percent) in Cambodia, is of relatively small stature and usually brown, white or black in colouration. According to coat colour allele frequencies, the Cambodian horse appears to be closely related to those found in the plains of central Myanmar and other Southeast Asian countries (Nozawa *et al.*, 2006).

Pigs

Pig keeping is widespread in Cambodia and plays an important role in generating household income in rural areas. Commercial, semi-commercial, and smallholder modes of production exist, but the latter is by far the most common and widespread (Seng *et al.*, 2012). With the extensive importation of Euro-American breeds, the proportion of pure native pigs has diminished, and they are now most commonly reared by hill tribes (Kurosawa *et al.*, 2006). Following Seng *et al.*, (2012), Cambodian pigs are classified as follows:

Local type: All local breeds are known in Khmer including:

a. *Kandol:* small size and short-eared, *kandol* in Khmer means "mouse'. This pig is early maturing to 50-60 kg and black in colour. It has a relatively low growth rate but is well adapted to low input systems (Maclean, 1998).
b. *Hainam:* imported from China in the nineteenth century. Larger body side (mature weight 130-150 kg) and good for reproduction (Maclean, 1998).
c. *Damrey: (*elephant pig*)*: uncommon. Larger body size; curve-shaped body; face resembles that of an elephant.

Cross bred type: Various crosses between local and imported breeds. These animals have higher reproduction and growth rates but are not well adapted to low input systems.

Imported breeds: Pure bred or selected lines imported as sows or semen, usually by commercial operators for their own piglet and fattening production, or selling piglets to semi-commercial operators for fattening or reproduction.

Crossbreeds predominate (58.9 percent), with pure local breeds accounting for 37.2 percent and pure imported breeds 3.9 percent of the total (Seng *et al.,* 2012). Local types predominate in remote provinces (Maclean, 1998, Kurosawa *et al.* 2006, Seng *et al.*, 2012) and those kept by hill tribes using their traditional raising system (Kurosawa *et al.*, 2006). Crossed bred and pure exotic breeds are present in higher proportions in the plains region (Kurosawa *et al.*, 2006, Seng *et al.*, 2012).

Annex 4

Cambodian entries in the Domestic Animal Diversity Information System

Cambodian entries in the DAS-IS are summarised in Table 2, which includes comments and suggestions for updating and revising in the remarks column.

Table 2. Cambodian entries in the Domestic Animal Diversity Information System

1. Most common breed name
2. Breed local name
3. Origin
4. Purses of uses
5. Breed qualities
6. Breed colour
7. Breed morphology (weight, height of breed)
8. Breed horn (except of horse)
9. Breed performance
10. Population data
11. Organization monitoring breed
12. In vivo programs
13. Cryo programs
14. Publications related to breed
15. Breed reproduction
16. Breed milk

Breed	Note	Remarks
Buffalo: two breeds recorded		
Mountain breed is locally *called moi* or *kraybe beng*. • Predominantly in the plateau areas (provinces of Ratanak Kiri, Preah Vihear, Kampot, Krong Preah Sihanouk, Koh Kong, Kratie, Stung Treng) • Brown-coloured • Male wither height 150 cm, female 140 cm • Male weight 550 kg, female 400 kg. • They are • Swamp type, big body • Two long horns • Females have 600-day parturition interval, and 48-60 months to first parturition	No documented related to: 4, 5, 10, 11, 12, 13, 14, 15, 16 Insufficient documented related to: 9	Other name should be discussed and agreed in general Other descriptors should be updated Image should be included
Plain breed buffalo is locally called Cambodgienne, Cambodian, *krabai sre, krabey leu* • Predominantly in the plain areas (provinces of Prey Veaeng, Svay Rieng,	No documented related to: 6, 11, 12, 13, 14, 15 Insufficient documented	

Breed	Note	Remarks
Takaev, Kampong Cham, Kampong Thu, Siem Reap, Battambang, Poursat and Kampong Chhnang) • Raised for draught power • Have good ability to digest plants such as rice straw • Male wither height 139 cm, female 129 cm • Male weight 450 kg, female 350 kg • Also swamp type, but small size and short tail • Two short, round, curving horns • 14-year productive life • Were 800 000 in 1991 • 14 lactations on average	related to: 9, 10, 16	
Cattle: 10 breeds recorded		
1. Brahman: most common name and breed name; originally imported from the Philippines in 1985	No documents related to: 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	Picture should be added
2. Burmese Gaur: both most common name and breed name Originally from wild species: Bos (*Bibos*) *gaurus readai (Lydekker)*, variety of Gaur; the Gaur is the largest of the Asiatic bovids; two subspecies are recognized, *B. g. gaurus* (India, Nepal) and *B. g. laosiensis* (Myanmar, Thailand, Laos, Viet Nam, Cambodia and West Malaysia) • Locally called *pyaung, pyoung, pyun*, or Burmese bison • Breed quality information: animals produce good, tasty meat and leather of good quality • Male weight 950 kg, female weight 750 kg • Two horns for both males and females	No document related to: 4, 6, 9, 10, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 7	Local name: *kting* Picture and additional information should be added
3. Haryana: (most common and breed name; raised for milk • Originated in East Punjab State, North India; imported to Cambodia In 1956 • Animal is white or grey; males also have a black patch on the back • Breed morphology information: male average withers height 145 cm, female	No documents related to: 2, 5, 9, 10, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 4	Picture and additional information should be added

Breed	Note	Remarks
135 cm; male weight 450 kg, female 350 kg • Long horn, short thin hair, soft thin skin, long narrow face, and skull bulged at forehead, long ears, compact shoulders, and thin short tail		
4. Kouprey: the most common name and brand name; local names are grey Cambodian ox, Indo-Chinese ox, and Cambodian wild ox • Wild species: *Bos bibos novibos sauveli* • Possibly resistant to rinderpest • Population was less than 200 in 1994	No documents related to: 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 5, 10	There is a black and white diagram of Kouprey body by a Japanese researcher; can it be used or not?
5. *Tsine*: both the most common name and brand name; locally called Burmese banteng • Originated from Bos (Bibos) javanicus *birmanicus*, a variety of banteng • Used for general purposes • Two horns for both males and females	No documents related to: 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16	Local name: *tun sorng* Picture and additional information should be added
6. *Moi*: most common name; originally a breed of Zebu; population was less than 100 in 1988	No documents related to: 2, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 10	No supporting information found for this name
7. Cambodian: most common name; local name Cambodgienne • Two horns for both male and female 8. Highland Khmer: most common name • Indigenous breed; probably originated from wild cattle (Bos Sauvelis); ecotype or variety of the Khmer cattle • Found in Kratie, Stung Treng, Ratanak Kiri, Preah Vihear, Oddar Meanchey and some areas in Siem Reap • Found mostly in upland areas • Male weight . 200 kg, female 150 kg. • Short neck, no dewlap, raised hump, slightly bulging eyes, and short horn;	No documents related to: 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16 No documents related to: 2, 5, 9, 10, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 7	These four breeds should be discussed and grouped: • Cambodian • Highland Khmer • Khmer • Lowland Khmer Proposed: Local cattle (*ko srok* in Khmer) highland or upland (Khmer)

Breed	Note	Remarks
brown-red colour • Used for draught power		White cross bred (*kor tonle*),
9. Khmer: most common name; local name *kor khmer*	This breed has the same information as highland Khmer	Haryana line, mostly for drought
10. Lowland Khmer: most common name	They are the same as highland Khmer, but are mainly in lowland areas	Coloured cross bred (bigger than local, in some areas called *kalang* or *thlork*) Other recent cross breeds for milk and beef in Kandal and Pursat Province, should be added
Chickens: Two breeds recorded		
1. Cambodian broiler: most common name • Imported from Thailand and raised for meat Well known for its rapid growth rate and high economic value • Male weight 4 kg, female 2.5 kg • Males 5 months to maturity, 4 months for females • There were 50 000 Cambodian broilers in 1994; 5 000 breeding males, and 40 000 breeding females • Produce 300 eggs per year	- No document related to: 2, 6, 8, 10, 11, 12, 13 - Insufficient document related to: 7, 9, 14	Image and detail an update information should be added
2. *Monn Khmer*: most common name • Indigenous breed • Raised for meat purpose • Well adapted to the local environment • Male weight 3 kg, female 2 kg • Feathered legs • Males mature at 6 months, females 5 months • There were 5 139 100 *monn* khmer: 1 808 963 breeding males, 2 107 031 breeding females, and 9 pure bred females • Produce 48 eggs per year	No documents related to: 2, 6, 10, 11, 12, 13, Insufficient documents related to: 7, 8, 9, 14	According to the literature, there are eight indigenous breeds: *moarn prey* *sampov* *kandong* (slow featuring) *skouy* (guinea fowl) *Kragnas* (fizzle) *Samley* (white dwarf) *moarn che* (bare dwarf) *moarn chul* (fighting cock) These should be recorded

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Breed	Note	Remarks
		Recent breeds of commercial broilers, layers and three blood mixed should be included
Ducks: two breeds recorded		
1. *Tea kapa* (Muskovy duck): most common name. • The raised for meat • Black to bluish-black • Male weight is 4 kg, female 3 kg • Males mature at 6 months females at 5 • There were 1 000 to 10 000 tea kapa in 1993: 2 000 breeding males, 8000 breeding females, and 50 pure bred females • Produce 80 eggs per year	No documents related to: 2,3,5, 10, 11, 12, 13 Insufficient documents related to: 7, 8, 9, 14	Image and characteristics should be added
2. *Tea angkam*: most common name. • Indigenous breed • Raised for meat • Male weight 2.5 kg, female 2 kg • Males mature at 6 months, females at 5 months • There were 1 261 768 *tea ankam*: 504 700 breeding males, 757 000 breeding females, and 1 purebred female • Produce 250 eggs per year	No documents related to: 2, 5, 6, 10, 11, 12, 13 Insufficient documents related to: 7, 8, 9, 14	Image and additional information should be added Proposed to add: • tea sampov • tea *peking* (Peking duck) • *kakikambel* (egg production)

Goats: one breed recorded Goat: Indo-Chinese • Raised for meat • Usually fawn, and occasionally with white or black extremities and back • Short hair, erect ears, 2 short horns	No documents related to: 2, 3, 5, 9, 10, 11, 12, 13, 14, 15, 16 Insufficient documents related to: 7	Could not find reference and image of this breed Present as transboundary breed with Viet Nam There are other breeds similar to Kakang, cross bred Etawa, Etawa, Alpine and Anglo Nubian
Horses: one breed recorded There is only one breed of horse: Cambodia Originally part of Southeast Asia pony group	No documents related to: 4,5,6,7,9,10,11,12,13,14, 15,16	Common name and characteristics should be added Recent imported breeds should be entered
Pigs: four breeds recorded *Chrouk kandol*: common name. • Indigenous • Raised for asset savings or security	No documents related to: 2, 5, 6, 7, 8,9,10,11,12,13,14	Image and other information should be added
Duroc Imported breed	No documents related to: 2,4, 5, 6, 7, 8,9,10,11,12,13,14	Image and other information should be added
Landrace Imported breed	No documents related to: 2,4, 5, 6, 7, 8,9,10,11,12,13,14	Image and other information should be added
Yorkshire (large white) Imported breed	No documents related to: 2,4, 5, 6, 7, 8,9,10,11,12,13,14	Image and other information should be added Suggest to add three more local: Kampot, Hainam, and Damrey (Elephant)

Annex 4

Recent Animal Genetic Resources for Food and Agriculture Guideline

Knowledge of animal genetic resources for food and agriculture (AnGR) is important for sustainable use, development and conservation. The *Global Plan of Action for Animal Genetic Resources*, adopted as the first internationally agreed framework for the management of AnGR by 109 countries at Interlaken, Switzerland, in 2007, and subsequently endorsed by all FAO members (191 countries and the European Community) notes that:

> Understanding the diversity, distribution, basic characteristics, comparative performance and the current status of each country's animal genetic resources is essential for their efficient and sustainable use, development and conservation. Complete national inventories, supported by periodic monitoring of trends and associated risks, are a basic requirement for the effective management of animal genetic resources. Without such information, some breed populations and unique characteristics they contain may decline significantly, or be lost, before their value is recognized and measures taken to conserve them (FAO, 2007a).

The global action plan for Animal Genetic Resources and the Interlaken Declaration identifies the following four strategic priority areas:

> **Strategic priority area 1: Characterization, inventory and monitoring of trends and associated risks**. These actions provide a consistent, efficient and effective approach to the classification of animal genetic resources and to assessing trends in and risks to animal genetic resources.
>
> **Strategic priority area 2: sustainable use and development.** These actions ensure sustainability in animal production systems, with a focus on food security and rural development.
>
> **Strategic priority area 3: Conservation.** This actions focuses on steps needed to preserve genetic diversity and integrity for the benefit of current and future generations.
>
> **Strategic priority area 4: Policies, institutions and capacity building.** These actions directly address the key questions of practical implementation through development of necessary institutions and capacities.

Subsequently, various other related reports have been published, including:

- State of the World's Animal Genetic Resources for Food and Agriculture (FAO, 2007b).
- Report of the Fifth Session of the Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture (FAO, 2009a).

- Development of country-based early warning and response systems for animal genetic resources (FAO, 2009b).
- Preparation of national strategies and action plans for animal genetic resources (FAO, 2009c).
- Report of the Twelfth Regular Session of the Commission on Genetic Resources for Food and Agriculture (FAO, 2009d).
- Threats to animal genetic resources, their relevance, importance and opportunities to decrease their impact (FAO, 2009d).
- Breeding strategies for sustainable management of animal genetic resources.

In many developing countries, however, only limited information is available on local breed characteristics. For example, no data are available on the size and structure of populations for more than a third of the breeds recorded in the Global Databank for Animal Genetic Resources (FAO, 2011b). Several other guidelines have been released recently to address these and other related issues:

The primary guidelines to help countries initiate the development and implementation of management programmes for their animal genetic resources (AnGR) for food and agriculture: *Developing the institutional framework for the management of animal genetic resources* (FAO 2011a) includes the following:

> **Section 1** provides an overview of the development of FAO's AnGR programme. This section is meant for those who have become involved in the programme recently and would like a better understanding of the process that led to the adoption of the *Global Plan of Action*.
>
> **Section 2** introduces the guidelines.
>
> **Section 3** contains a general description of the global institutional framework for AnGR.
>
> **Section 4** describes the roles and responsibilities of FAO as the global focal point for AnGR and in providing services to FAO member countries in the implementation of the *Global Plan of Action*.
>
> **Section 5** describes national institutional frameworks and the tasks and activities of a national focal point.
>
> **Section 6** describes the status of development and operation of regional focal points and provides advice on the process for their establishment.

The continuing and increasingly rapid evolution of animal production systems needs to be monitored carefully, so that effective management strategies can be developed. Guidelines on surveying and monitoring animal genetic resources (FAO, 2011b) include the assessment of population size, structure and trends, geographical distribution, breed characteristics, cross-border genetic linkages, breed production environments, cultural

aspects, indigenous knowledge, and the identification of potential threats. This knowledge is essential for strategic planning, improving livelihoods, raise awareness, and to fulfil national and international obligations. These guidelines provide a useful tool for the establishment of well-organized national programmes for the collection and disseminate of AnGR information.

Another set of guidelines on the *Molecular characterization of animal genetic resources* (FAO, 2011c) is designed to help countries plan and implement effective analyses of their animal genetic diversity, so that the resulting information can contribute to the development of effective plans for the sustainable use and conservation of national AnGR. The guidelines include advice on how to:

- Plan molecular characterization studies
- Collect and evaluate DNA
- Organize and analyse molecular characterization data
- Interpret the results
- Collaborate internationally to obtain the maximum utility from the information

Characterization of animal genetic resources involves three types of information: phenotypic, genetic, and historical. Phenotypic characterization is the process of identifying distinct breed populations, external and production characteristics, including social and economic factors in certain environments. Recording the animal breed and other characteristics involves many problems, since the existing animal populations do not belong to any recognized breed. The FAO (2012a) guideline presents the whole process of organizing a phenotypic characteristic study from the initial identification trough to reporting and promoting outputs. The guideline presents both primary and advanced phenotypic characterization activities:

- Primary characterization activities can be done in a single visit to the field. Measurement are morphological features, interviews with livestock keepers, observations and measurement production environment and mapping.
- Advanced characterization activities which require repeated visits. Measurements are productive capacities and adaptive capacities in specific environments.

In addition to the traits indicated above, social, cultural and economic traits should also be reported on as part of breed profile (FAO, 2012b).

Conclusion and recommendations

Following an extensive review of available reports and scientific papers, it is concluded that very few documents have been published on Cambodian animal genetic resources, either in the scientific, or grey literature. The majority of entries in the DAD-IS lack important characteristics. No information could be found to support the inclusion of some recorded breed types, and some breed types known to exist are not included. The following actions are proposed:

- Hold consultation workshop to establish consensus on local/common names of domestic animals in Cambodia and their international equivalents.
- Update Cambodian entries in DAD-IS with currently available information.
- Identify potential studies to support additional characterization and advance characterization of selected breeds/types of cattle, pigs and chickens.
- Develop a national strategic plan for animal genetic resource management and development consistent with national priorities and international guidelines.

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Annex 4

Appendix 1: Key people with expertise in indigenous farm animal resources and animal breeding.

No.	Name	Position	Institution
1	Dr Soun Sothoeun	Deputy Director	DAPH
2	Dr Sar Chetra	Deputy Director	DAPH
3	Mr Mam Somony	Chief	DAPH
4	Mr Keo Cheany	Deputy Director, former chief of Phnom Tamao cattle breeding station	NAVRI, DAPH
5	Dr Chhum Phit Loan	Dean	ASVM, RUA
6	Mr Te Kuyhor	Vice Dean	ASVM, RUA
7	Mr Dam Sambo	Director	Academic Affair, RUA
8	Mr Duk Chheng	Chief (buffalo expert)	Social Office, RUA
9	Mr Ith Manoy	Lecturer(pig and chicken expert)	ASVM, RUA
10	Mr Theng Kouch	Lecturer (former team of Heifer)	ASVM, RUA
11	Mr Ung Putheany	Researcher	RUA
12	Mr Kong Reatry	Deputy Director	Pursat PDA
13	Mr Thai Ly	Chief, Animal Production and Health Office	Takeo PDA

Informal discussions were held with only some of the above. Others have yet to be informed, but will be briefed prior to a workshop proposed in the EAHMI Cambodia work plan.

Appendix 2: Summary of reviewed literature related to Cambodian livestock breeds.

Title	Author	Abstract/key points (breed classification/ characteristic/ intervention)
Coat colour variation of cattle observed in the fields of Cambodia, and withers height and other traits in native cattle subjected to further experimental analyses	Namikawa *et al.*, 2006	• 28 140 head of cattle were observed for the field survey in 18 provinces from August 2002 to January 2004 • Coat colour variations of Cambodia native cattle were 43.1 percent white-grey, 49.9 percent yellow-brown, 5.5 percent dark brown, and 1.6 percent black • Mean withers height of adult male native cattle ranged about from 101 to 117 cm, and 96 to 113 cm in females • The study could suggest geographical differences or degree of isolation between subdivided populations, or genetic introgression of another breeds or species in a country
Withers height measurement in native water buffalo subjected to further experimental analyses	Takeo Namikawa *et al.*, 2006	• Withers height was measured for 113 native water buffalo and blood samples taken for further genetic analyses • The data of withers height integrated with some other traits were shown as the primary information obtained in the field • Over 4-years of age animals have 120.9 cm withers height in males, 119.9 cm in females • The mean value for the males in those populations might be generally underestimated because of difficulties in controlling a large male for measurements and blood collection in the field
Field survey on local pigs in Cambodia, focusing on external characteristics and raising conditions of the short-eared pig	Yaetsu Kurosawa *et al.*, 2006	• The external characteristics of Cambodian domesticated local pigs including those of a wild female pigs (*Suis scrofa*) were examined • Most local pigs were short-eared type But pigs with medium-sized lop ears over the eyes or horizontal ears, and some typical of the Hainan breed (with a concave back and black with white belly) were observed in the plain regions • Euro-American breeds and crossbreeds of local pigs with those modern breeds were found with relatively high frequencies in those regions • The local pigs in the plains have seven teat pairs at the highest frequency • Short-eared pigs with five teat pairs in mountainous regions (Cambodia wild pig) were found at a high frequency

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Domesticated animal genetic resources in Cambodia	Suon Sothoeun, 2003	• Conditions of Cambodian geography, weather, and population • Conditions of local Cambodian animal genetic resources • Constraints, demands, policies, and strategies of livestock sector • National activities on animal genetic resource management Development priorities of national programs of conservation and use of efficient and sustainable animal genetic resources • Recommendations on international cooperation
Livestock in Cambodian rice farming systems	Murray Maclean, 1998	• Demand and supply of livestock and livestock products • Cattle and buffalo production systems • Pig production systems • Chicken production systems • Duck production systems • Livestock in rice-based farming systems: problems and prospects
Survey on feed utilization for cattle production in Takeo Province	Keo Sat, 2008	• Three common *Bos Indicus*, local cattle type, crossbred Haryana and crossbred Brahman were found in Keo et al, 2008 study; crossbreeds of Haryana with local cattle highly dominated and their phenotype characteristics are similar to Maclean (1998); cows are naturally mating in the field or cows were brought to breeding bull in their community
The effects of inbreeding in cattle on performance in the following generation in Kandal Stueng District , Kandal Province	Venn Vutey, 2008	• Inbreeding resulted in a number of combination problems such as disease susceptibility, growing constraints and high rates of mortality at birth; according to Venn (2008) the majority of farmers did not know the consequences of inbreeding animals and mostly they did not exchange the breeding stock. All farmers are free ranking their animals. As a result, free natural mating occurs and the offspring are born to unknown bulls; two third of respondents emphasized that they lack a bull service in their community; within their female ancestor F1, F2 and F3 generation, the animal body weight significantly dropped from 213.16, 207.3, and 181.13 and 161.72 kg • Further study and breeding improvement among local farmers level, breeding program and management should be taken into account in terms of stock exchange, artificial insemination and research facilities for genetic background

Characterize the promising economic indigenous chicken in Cambodia	Sann and Chhum Phith, 2004	To identify the characteristic of indigenous chicken breeds, 150 householders were sampled from various areas. Seven candidates were recorded. *Moan prey* (red jungle fowl), represented 2 percent of total indigenous chickens and can be distinguished from *sampov* (local bantam), which accounted for 55 percent of the sample, by the largish white rump patch of the male and slate-grey legs of both sexes and relatively small mature size. *Kandong* (slow feather), *skoeuy* (bicolour), *kragnas* (frizzle), *samley* (dwarf) represented 10 percent, 7 percent, 5 percent, and 5 percent respectively of the total sample and are candidates for further investigation in heat stress tolerance, disease resistance and meat quality. *Moan chol* (fighting cock), about 16 percent, have a very high statue in the hobbies of society. Mature body size ranges from 3 to 3.5 kg for *sampov*, similarly for *moan prey, kandong, skoeuy, kragnas and moan chol* to 0.5 to 0.8 kg of *samley*. Egg laying: 5 to 15 eggs with mounting period of 1 to 3 weeks. The share of specialized broilers and layers has increased from 1 percent to 15 percent of total chicken population in the last two decade

Annex 4

National assessment of Cambodia's main crop and fodder resources

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Commissioned by the Department of Animal Production and Health and Food and Agriculture Organization of the United Nations Environmental Animal Health Management Initiative in Cambodia, funded by the Government of Italy

Abstract

Information about crop and fodder resources in Cambodia is equally important with livestock productions, which are majority owned and managed by smallholder farmers. This study was conducted to map and determine the availability of crop and fodder along with livestock distributions in Cambodia. Data were collected using satellite images and statistics of livestock and crop production were gathered from various agencies and EAHMI partners in Cambodia. Ground truthing was also conducted for validation of fodder availability and a random sampling was implemented for the crop cutting survey for the estimation of crop/fodder production both for wet and dry season of rice, corn, sugarcane, cassava and grass. The results of this study will be used both as strategic input to the Environmental and Animal Health Management Initiative, and as an objective basis for priority setting and targeting of research areas as well as in the promotion of livestock production in parallel with fodder availability.

Introduction

The great majority (around 90 percent) of livestock in Cambodia are owned and managed by smallholder farmers. Livestock are raised for various purposes, including: draft power for ploughing, carting and riding, sale and income generation, and milking, although the later is not widely practiced. Manure is also widely used as an organic fertilizer, and increasingly for the generation of biogas in bio-digesters as an energy source for cooking and lighting (www.nbp.org.kh). Ruminant livestock, including buffalo, cattle, sheep and goats, depend on crop and fodder resources for their survival, maintenance and reproduction. Nevertheless, surprisingly little is known about crop and fodder resource distribution in Cambodia. A recent review of animal production in Cambodia concluded that *"more detailed disaggregated information is needed on the distribution and abundance of livestock and poultry resources and the temporal and spatial patterns of disease risk"*. Reliable, up-to-date information about the distribution and abundance of fodder resources, upon which ruminant species depend, is equally important.

The Centre for Livestock and Agriculture Development (CelAgrid) was commissioned to conduct a national assessment of crop and fodder resources in Cambodia through a Letter of Agreement (LOA/RAP/2010/75) with the Food and Agriculture Organization of the United Nations (FAO), signed on 6 December 2010 on behalf of the Cambodian component of the "Sub-regional environmental animal health management initiative (EAHMI) for enhanced smallholder production in South East Asia" (GCP/RAS/244/ITA). This study aimed to establish a national, spatial database on fodder resources and

provide meaningful estimates of fodder resources by district and province across Cambodia, for further research, both as a strategic input to the Environmental and Animal Health Management Initiative, and as an objective basis for priority setting and targeting further investigations.

Methodology

Satellite data which include Landsat 7 ETM+ (30 m) of dry season (07 March 2003) and rainy season (08 Sep 2004), Terra MODIS (250 m) both seasons in 2010, and Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) were downloaded from the internet. Recent land use, land cover, soil fertility, ecological zones, water resources, human, livestock and poultry population, crop statistics and were collected at various sources in the government and other partner agencies.

Ground truthing activities were also implemented to verify the crop cover, fodder resources (dry and wet seasons), and other land covers using handheld GPS devices. Sample sites were selected using simple random sampling and sample households were interviewed to determine the number of harvesting seasons, crop types and location. Collection of samples using a crop cut survey was also employed in selected sites to measure yield samples of crop and fodder resources such as rice (rice straw), cassava, corn, sugarcane, and natural grass per hectare for estimating and preparing spatial data on crops and fodder resources by district and province in Cambodia. The Field Crop Cutting Survey was conducted from February 2011 and continued until the end of November 2011. Crop cut surveys were conducted depending on crop type, season and cultivation period. Twenty four samples each for dry season rice, cassava, corn, sugarcane and grasses were collected from four selected provinces: Prey Veng, Kratie, Pursat and Kampot.

Results and discussion

Landforms: elevation, slope and digital terrain model (DTM)

Landforms are natural physical features of the Earth's surface and local landscapes, such as mountains, valleys, plateaus, and plains. Data on Cambodia’s landforms for the Digital Elevation Model (DEM) and the digital terrain model (DTM are important factors to consider in livestock production, for instance, whether or not the land is low-lying and prone to flooding, or the terrain is mountainous and well drained and prone to dry season water and fodder shortages, and whether or not crop and fodder yields and overall production are sufficient to feed the number of animals being kept.

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Land use and land cover

Land covers of Cambodia in 2010 included: 56.9 percent forest land; 23 percent agricultural land; 13.4 percent grass and shrub land; 3.1 percent flooded forest; 2.8 percent water bodies; 1.2 percent settlement and infrastructures; 0.4 percent mangrove forest; 0.20 percent rock and soils; and 0.03 percent shrimp farming and salt ponds.

Figure 1. Simplified land use/land cover of Cambodia.

Crop and fodder resources

Rice

In Cambodia, rice is cultivated in both in wet and dry seasons. Rice re-growth after harvesting can be used as pasture and may be grown thickly until semi-solid kernels are formed and then cut and cured into hay. In this study, only rice and rice straw harvested from the field during dry and wet season were measured. Milled rice, rice bran, rice hull (husks, chaff), rice polishing, or rice pollards were not measured. The estimated total cultivated area of 2 777 323 ha in 2010/11, included 2 372 519 ha of wet season rice (85.4 percent) and 404 804 ha of dry season rice (14.6 percent) with an estimated 8 249 449 tons of total rice grain produced in 2010/11. At the provincial level, the highest total production density of both wet and dry season production in 2010/11 was 277.2 tonnes/km^2 in Takeo.

Rice straw has a fair palatability, and field sampling showed that more than half (54.4 percent) of the rice straw produced was removed by farmers, with the remaining 45.6

percent left in the field. Nationally, this is equivalent to 15 472 364 tonnes of fresh rice straw being removed and 12 951 916 left in field. The dry matter content of rice straw is 80.8 percent. The highest density of rice-straw production in 2010/11 was 745.5 tonnes /km^2 in Takeo with the lowest density of 2.2 tonnes/km^2 in Koh Kong Province.

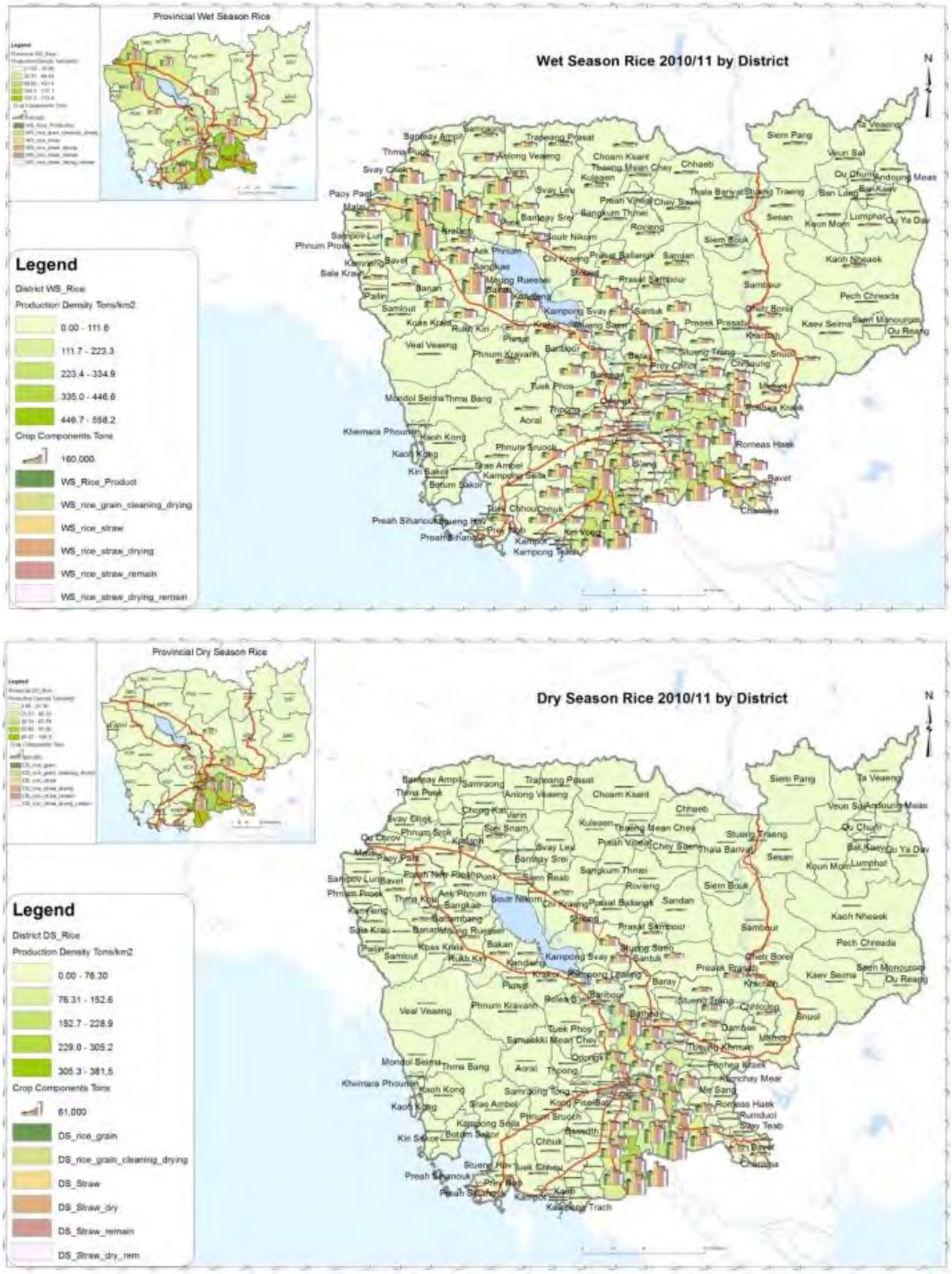

Figure 6. Wet (top) and dry (bottom) rice production density in Cambodia.

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Corn (maize)

Two types of corn are grown in Cambodia: white and red corn. The total estimated quantity of corn (maize) produced in 2010/11 was 780 774 tonnes, including 655 091 tonnes of red corn (83.9 percent) and 125 684 tonnes of white corn (16.1 percent). At provincial level, the highest production density of total corn in 2010/11 was 107.1 tonnes/km^2 in Pailin Province, while the lowest production density of 0.03 tonnes/km^2 was in Kandal and Svay Rieng provinces. The estimated total fresh corn residue (leaves, stems, bushes and cobs) in 2010/11 was 4 028 404 tonnes while corn product (grain) in the same year was only 780 774 tonnes. The dry matter (DM) content of fresh residue was 23.6 percent. The province of Pailin was observed to have highest production density of total fresh corn residue in year 2010/11 at 552.8 tonnes /km^2 while Svay Rieng showed the lowest production density of 0.03 tonnes /km^2.

Figure 7. Corn production density in Cambodia.

Sugarcane

Sugarcane can be used in a variety of ways: a) for animal feeding it can be grown for forage; b) the juice can be use in the form of invert molasses, c) the leaves for fodder, and d) the bagasse or the fine portion of the bagasse as roughage or as a carrier for molasses.

Figure 8. Sugarcane production density in Cambodia.

The total sugarcane production in Cambodia in 2010/11 was 368 549 tonnes. The highest production density of sugarcane was 14.8 tonnes/km^2 in Kandal Province and Svay Rieng Province with 10.7 tonnes/km^2. Pursat and Koh Kong had the lowest density of 1.0 tonnes/km^2 and 0.08 tonnes/km^2 respectively.

The estimated total fresh residue from sugarcane was 300 982 tonnes equivalent to 81.7 percent of total sugarcane production. Fresh residue has 44.7 percent dry matter content. At provincial level, the highest production density of fresh residue was 12.05 tonnes/km^2 in Kandal Province, and 8.8 tonnes/km^2 in Svay Rieng Province, while lowest production density of 0.07 tonnes/km^2 was in Koh Kong Province.

Cassava

Cassava root, cooked or raw, is widely used for pigs, cattle, sheep and goats in many countries. Cassava root meal can also be included up to 10 percent in rations for growing chicks and up to 20 percent in ration for layers with good results. The leaves are also richer than any other part of plant in protein and minerals that are relished by all classes of livestock. However, cassava must be processed very carefully as they contain a glucosides and linimarin, which is acted upon by an enzyme to liberate prussic acid.

Figure 9. Cassava production density in Cambodia.

The total estimated production of cassava in Cambodia was 4 248 942 tonnes in 2010/11; 3 980 963 tonnes (93.7 percent) in the wet season and 267 978 tonnes (6.3 percent) in the dry season. At provincial level, the highest production density of cassava was 371.6 tonnes/km^2 in Pailin and Phnom Penh Provinces has the lowest production density of 0.03 tonnes/km^2. An estimated total of 7 088 879 tonnes of cassava residue, which include cassava leaves, cassava peel and stem, were produced in 2010/11, with a dry matter equivalence of 1 848 361 tonnes (26.1 percent). Fresh cassava residue is 1.67 times heavier (167 percent) than the cassava tubers produced. Also, the highest production density of dry cassava residue was 161.7 tonnes /km^2 in Pailin Province, while lowest production density of 0.01 tons/km^2 in Phnom Penh Province.

Grass

Grass was collected from natural grassland areas in the selected districts of the four selected provinces: Kratie, Pursat, Prey Veng and Kampot. The weighted average of fresh natural grass was 5.8 tonnes/ha and its production density was 77.2 tonnes/km^2. The weighted average of dry natural grass was 2.3 tonnes/ha and its production density was 31.4 tonnes/km^2. The dry matter percentage was 40.7 percent. The estimated total fresh grass production for the whole country in 2010/11 was 13 979 845 tonnes.

Figure 10. Grassland production density in Cambodia.

The province of Kampong showed the highest density of fresh natural grass with 201.07 tonnes/km^2 with the lowest production density in Pailin Province with 9.5 tonnes/km^2. Meanwhile, the largest grassland area was observed in Kampong Thom Province with 302 385 ha. Pailin Province has the smallest grassland area of 1 783 ha.

Comparison of animal biomass and crop/fodder production

The relationship between overall animal biomass in terms of the standard 250 kg animal units and an index of overall crop and fodder resource abundance, was calculated as the sum of rice, maize, sugar cane and cassava production densities, so as to have an objective, comparative measure of the relative abundance of animal and crop/fodder resources in each province. In a scatter plot, there is a clear trend for animal unit density to be higher in provinces with greater crop/fodder production density. Those provinces that lie above the trend line have comparatively high animal unit densities for their level of crop/fodder production, whilst those below the line have comparatively low animal unit densities compared with their level of crop/fodder production.

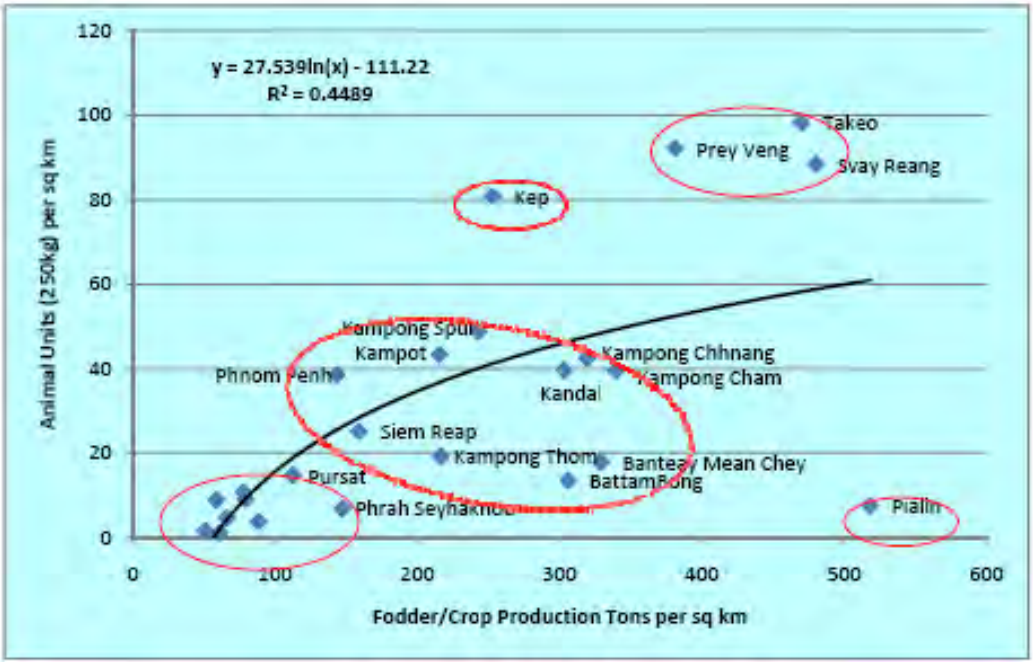

Figure 11. Scatter plot of animal biomass and crop/fodder resources by province.

Recommendations

Animal production should be promoted in areas where crop and fodder production densities are high and animal biomass is low. Conversely, crop and fodder production and crop residue consumption should be promoted in areas where animal densities are high, such as: Takeo, Prey Veng, Kandal, Svay Rieng, Kampong Cham, Battambang, Pursat, Kampot and Bantey Meanchey Provinces.

Ruminant production should also be promoted in provinces where there are extensive grasslands and natural grass production is high, such as: Kampong Chhnang, Kampong Thom, Banteay Mean Cheay, Kampong Speu, Phreah Sihanouk, Battambang, and Kandal Provinces. Conversely, special attention should be given to validate the exceptionally low densities of animal biomass in Koh Kong, Kratie, Mondulkiri, Udor Meanchey, Phreah Sihanouk, Preah Vihear, Pursat, Ratanakiri, and Steung Treng, which are characterized by low animal unit and crop/fodder densities.

During the forthcoming animal production and health data collection exercise, special attention should be given to validating exceptionally high and low densities and stocking rates. Subject to the findings of that review and validation of farm animal resources in EAHMI partner provinces, it may be deemed appropriate to consider conducting a national farm animal survey to obtain standard updated statistics for the whole country, as conducted in Lao PDR and the Philippines.

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Annex 4

Review of culled animal disposal methods and regulations in Viet Nam and demonstration of using GIS to identify potential disposal sites

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Introduction

Livestock and poultry production generates significant quantities of waste, not only dung and urine, but also the remains of farm animals dying from natural causes, disease outbreaks, and culling. In 2007, global farm animal populations were estimated to be in the order of 1.9 x 10^{10} birds and 2.31 x 10^{8} mammals (FAO, 2007). In Ontario, Canada, farm animal mortalities have been estimated at 3 percent for beef cow-calves; 3 percent for milking cows; 4 percent for goats; and 4 percent, for broiler chickens (Hawkins, 2009). Global poultry mortalities, thus, amount to an estimated 760 x 10^{6} dead birds a year.

In Viet Nam, official statistics indicated a total poultry population of 322.6 million birds in 2011 (General Directorate of Statistics, 2012). Conservatively assuming 4 percent farm mortality, there are estimated to be at least 12.9 million bird deaths a year, excluding pandemic deaths.

An increasing number of outbreaks of various animal diseases have been reported in Viet Nam in recent years, including PRRS, H5N1 and FMD. During outbreaks of avian influenza (H5N1) from 2003 to 2007, more than 65 million poultry carcasses were disposed of by burial in Viet Nam. Animal carcasses are also disposed of by incineration. A thorough understanding of the advantages and disadvantages of the various disposal methods available is required to prevent or control the spread of disease (Tran Ngoc Thang, 2007). Local knowledge and expertise are also essential in assessing options and identifying the most appropriate and effective method of animal disposal.

The choice of suitable locations for the disposal of animal carcasses is a complex problem for planners and implementers, because it requires an integrated assessment of economic, social and environmental factors. The use of multi-criteria analysis (MCA) and geographical information system (GIS) tools can be very useful in evaluating such complex problems. Gilbert, M. *et al*. (2008) have successfully modeled and mapped HPAI H5N1 disease risk in Indonesia, using just five environmental variables: elevation, human population, chicken numbers, duck numbers, and rice cropping intensity. In Viet Nam, MCA and GIS tools have been used to identify the most appropriate locations for landfill sites in Thu Duc District, Ho Chi Minh City (Thao, N.D.P, 2011).

The aim of this study is to integrate GIS tools with statistical analysis of existing data to determine suitable locations for disposal sites, taking various environmental, social, and economic factors into consideration. The study supports the action plan of the Department of Animal Health for better planning and implementation of disposal methods. Various factors, including: slope, land use type, soil type, distance from disposal

sites to residential areas, main roads and major river systems, were considered and outputs are presented in map layouts. These factors were then assessed to determine environmental/land suitability for carcass disposal.

Materials and methods

This report reviewed the methods of animal disposal applied around the world and in Viet Nam focusing on international guidelines, Viet Nam's current regulations and practices, previous studies on aerobic composting, and constraints on implementation of disposal methods.

In order to identify and map potential sites for carcass disposal using GIS, this study focuses on Hai Duong Province, North Viet Nam, where the first recognized outbreak of PRRS occurred and subsequently spread to other provinces. Problems were encountered in finding suitable locations for the disposal of animal carcasses during that first outbreak.

Hai Duong Province lies in the Red River Delta, from 20° 36' to 21° 33' latitude and from 106° 30' to 106° 36' longitude, and has six neighboring provinces: Bac Ninh, Bac Giang and Quang Ninh to the North; Hung Yen to the West; Thai Binh to the South; and Hai Phong in the East (Figure 1).

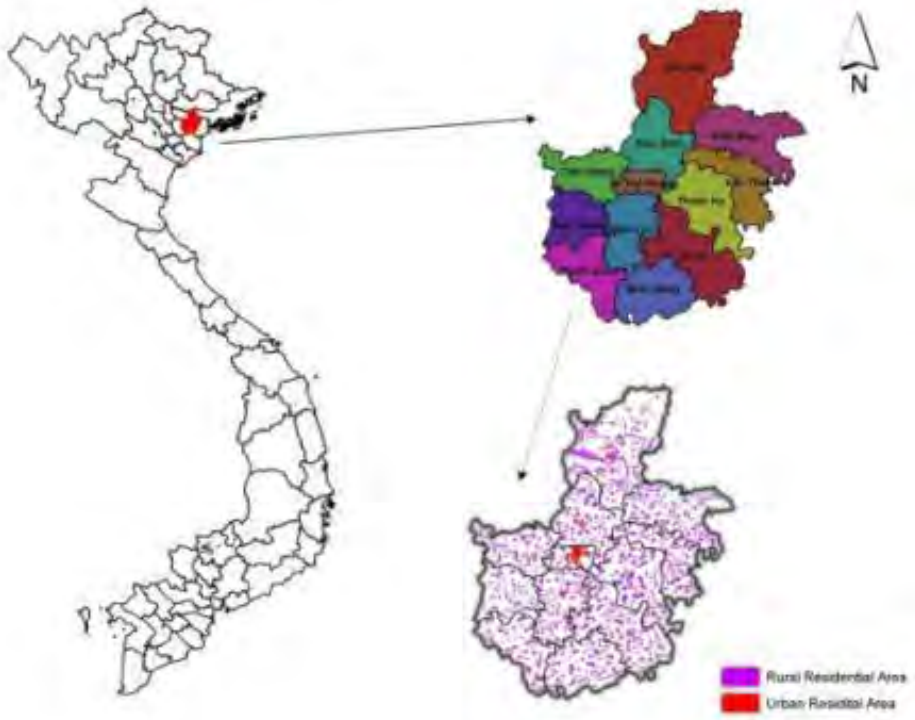

Figure 1. Location of Hai Duong Province in North Viet Nam.

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Secondary data collection was carried out at EAHMI, DAH, HUA, and IAPD to obtain all available spatial data for Hai Duong Province (Figure 2). Administrative data, with political boundaries, roads, rivers and water bodies, was obtained from the Institute of Agricultural Planning and Design. Digital Elevation Model (DEM) data were obtained from a previous DAH study. Land use data for 2010, derived from SPOT satellite imagery, was obtained from IAPD.

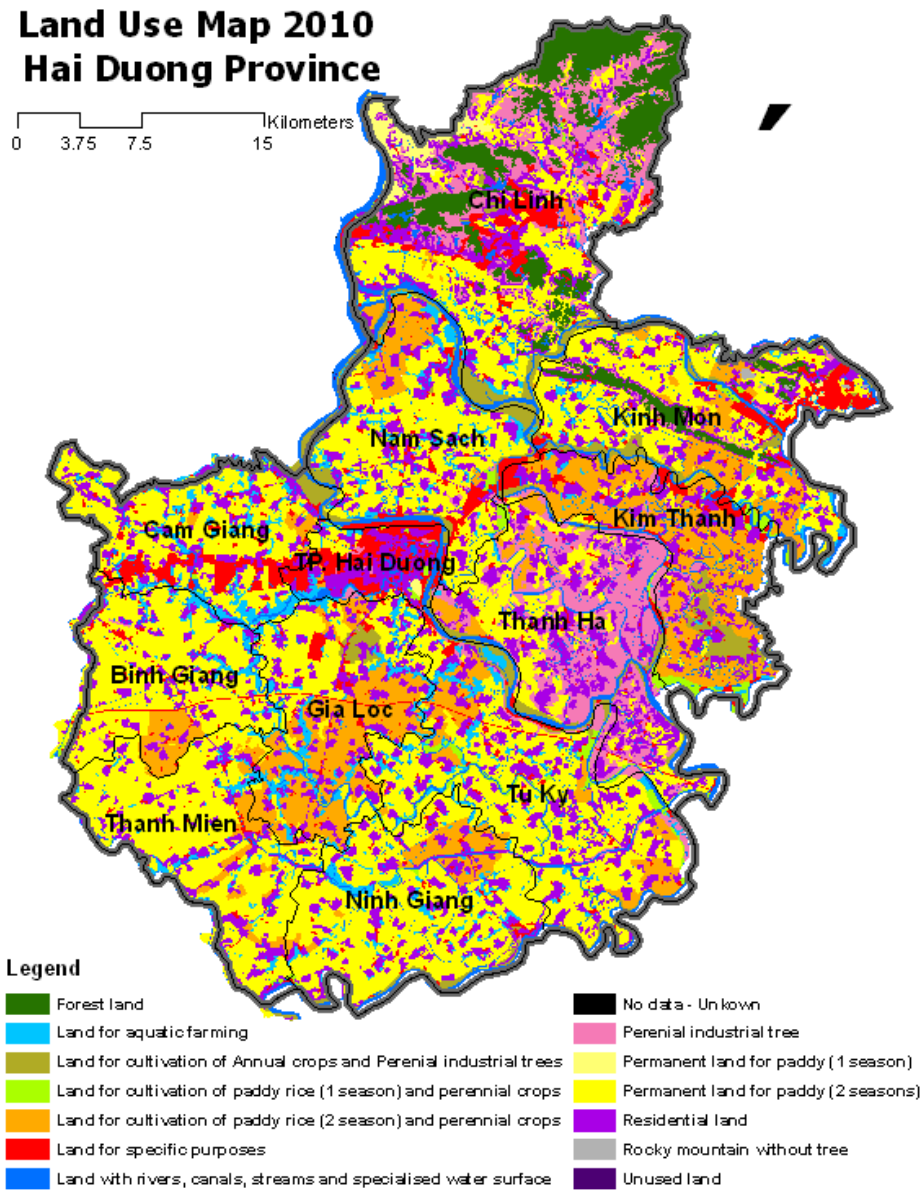

Figure 2. Hai Duong Province land use map 2010. Source: IAPD, 2011

PRRS outbreak data collected by DAH over the past five years includes names of infected communes, total population of animals, and total number of dead animals that were stamped out.

Results and discussion

Animal mortalities constitute a major source of waste in agriculture that requires appropriate means of disposal and mitigation. Various methods of disposal have been adopted around the world, and in Viet Nam. Each method has its own advantages and disadvantages. The most appropriate method depends on geographic location, climate conditions, economic circumstances and the technology and human resources available. GIS applications can assist in identifying suitable disposal sites. Further studies are required to monitor potential risks of pollution and disease spread, and assess the benefits and costs of alternative disposal methods.

Below are factors to be considered for effective disposal of animal carcasses:

- Modern equipment for disposing of large quantities of animal carcasses, such as incinerators, spades and backhoes should be stockpiled for immediate access during emergencies. Financial support from government and international organizations is required to buy that equipment.
- Well trained technicians, with a good understanding of carcass disposal methods are required for effective implementation. Short courses should be organized to train professional teams for the disposal of animal carcasses during disease outbreaks. Each district should have one team.
- Selection of the most appropriate disposal method depends on the following considerations:
    - Environmental protection laws in each country, for example, some countries prohibit carcass burial and incineration. Authorities should consider environmental protection laws before choosing carcass disposal method and carcass disposal areas.
    - Available facilities and human resources: machinery, equipment, materials and premises.
    - Cost of alternative of methods.
    - Biosafety: disposal methods with biosecurity benefits, such as aerobic composting should be recommended.
- Establish a system for early warning and quick response to disease outbreaks. Improve coordination between veterinary agencies and local organizations and communities.
- Support from other government agencies and organizations is essential. There should be specific legislation on animal disposal. Governments should provide financial support to animal producers.
- Raise community awareness of the benefits of safe animal disposal. Hold several short-term courses for farm communities.
- The role and responsibility of the Veterinary Agency is very important.
    - Evaluate and select the most appropriate disposal method for specific circumstances.
    - Apply appropriate techniques and methodologies to dispose of carcasses.
    - Develop alternative methods of animal disposal for future use.

- Promote better understanding of regulations and guidelines, and seek advice from local authorities regarding their preferred method of disposal.
- Cooperate with other national government and local agencies in carcass disposal during disease outbreaks.

There are various animal disposal methods. Burial, incineration and aerobic composting are among those recommended for animal carcasses disposal in Viet Nam.

Burial

Burial is commonly used in Viet Nam as a traditional method of animal disposal. The Ministry of Agriculture and Rural Development has provided guidelines on animal carcass disposal. The disadvantages of this method include pollution of water and soil, potential spread of pathogens in surrounding areas, need for earth moving equipment and large areas of land. MARD guidelines should be followed to minimize and mitigate adverse impacts. The following should be considered in burial location selection:

- Burial locations must be approved by competent authorities.
- Burial location must not pollute the surrounding environment.
- Do not bury animal carcasses in wetlands or shallow groundwater levels.
- Landfills should be located away from urban centers, cities, densely populated areas, cultural projects, resorts, temples, hospitals, health stations.
- Carcasses should be buried in an area which has many trees in order to speed up inorganic chemical processes occurring in the burial pit and limiting environmental pollution**.**

Below are the specifications for a burial pit (Figure 3):

- In sandy areas, the bottom of the pit and immediately surrounding area should be lined with waterproof materials to protect the groundwater.
- General size of hole: for ease of operation, width should not exceed 3 m; length: 9-12 m; depth: 1.2-1.5 m.
- Where more than 10 tonnes of animal carcasses/pits and burial areas are located close to water sources, or lakes, or is likely to contaminate groundwater, burial pits and immediately surrounding areas should be lined/covered with waterproof material.
- Where less than 10 tonnes of animal carcasses/pits and burial areas are near residential areas or groundwater, carcasses can be buried without waterproof material.
- After burial, the burial pit surface and the area around burial pits must be sprayed with lime and disinfectant to kill germs.
- Signs should be placed to indicate location of burial areas.
- Burial areas should be checked weekly in the first month after burial. If any abnormalities, such as collapse, subsidence or rupture are detected, mitigation measures such as coating with soil, backfilling and spraying with disinfectant

should be implemented (Ministry of Agriculture and Rural Development, Viet Nam, 2008).

- Water samples should be taken for testing from households and farms within 100 m radius of burial areas 3-4 weeks after burial and re-checked after six months.

Animal disposal through burial should be done in the following steps:

Step 1. When the pit is complete, the bottom will be covered by a plastic sheet. Manure and litter should be then placed at the bottom of the pit. Burial pits should be 3-4 times the volume of carcasses to be buried. There is no need to spray lime on the bottom of the burial pit.

Photo 1: Burial pit lined with impermeable plastic sheet.

Step 2. Put carcasses into pit.

Photo 2: Putting animal carcasses into burial pit.

Step 3. Sprinkle a layer of manure and litter on top of the carcasses pile. Then sprinkle a layer of lime powder (0.8-1 kg/m^2) on top of the pile. Do not use oil or gasoline to burn before land filling.

Step 4. Fill with excavated material and compact surface to fill pits.

Step 5. Continue the process. Add more soil above the surface. Form the upper layer into a pyramid 0.6-1 m high and 0.3-0.4 m wide to minimize rainwater flowing into the pit.

Use water to moisten the top soil layer for easy operation.

The weight of the soil above the burial pit has a blocking effect to prevent predators from digging, and it deodorizes and absorbs foul water generated by decomposition.

Step 6. In the surrounding area, about 1 m from burial pit, create a gutter of 10-30 cm wide and 10-25 cm deep to facilitate drainage of rainwater and avoid stagnant water around the burial pit.

Step 7. Sprinkle lime on the burial pit surface (0.8 kg/m^2), or spray with 2 percent liquid chlorine at 0.2-0.25 liter/m^2) to kill germs.

Step 8. After completing the burial, place warning signs and appoint authorities to manage the burial pit for the first one to two days to avoid digging by unauthorized people and limit the entry of people and animals into areas around the burial bits.

The cross section of burial pit

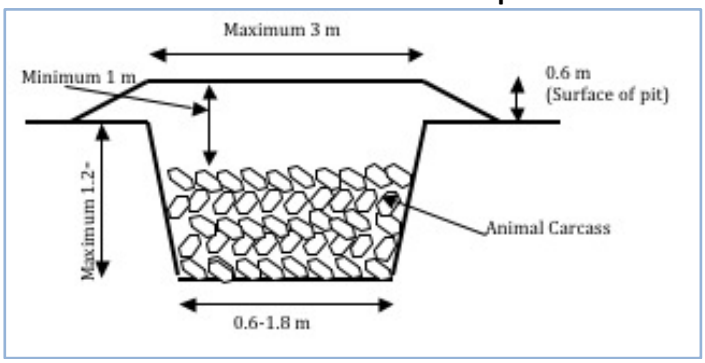

Figure 3: Specifications for a burial pit

Incineration

Incineration is considered the best way to destroy pathogenic agents and should be used for the disposal of livestock that have died from dangerous diseases such as anthrax. Factors to be considered when applying incineration include: gaseous emissions, smoke and odors that may occur during incineration and the risk of spreading pathogenic agents during transportation of carcasses from farms to incineration sites. Specialized equipment, such as incinerators and safe vehicles for transport of carcasses is required and should be made available.

Aerobic Composting

Aerobic composting has been applied in some countries to dispose of animal remains, such as poultry mortalities from avian influenza and associated culling. This method has been studied in Viet Nam, where the temperature in composting piles exceeded 70^0 C. Mesophilic bacteria and viruses are killed at such temperatures, but some thermophilic organisms can survive. Aerobic composting should not be used for the disposal of dead animals that have died from spore-forming bacteria, such as *Bacillus anthracis*.

Using MCA) and GIS tools, spatial analysis was done to identify suitable locations for carcass disposal in Hai Duong Province.

Table 1. Criteria for identifying suitable locations for carcass disposal.

Factor considered	Criteria name	Technical requirements
Environmental factor	Distance to major rivers and streams	Greater than 500 m
	Distance to main roads	Less than 200 m
	Topographical condition	Slope from 5 to 25 degrees
	Soil condition	No disposal pit implementation in or close to wet soil areas
Economic factor	Current land use	Unused land or agricultural land with low economic value
Social factor	Distance to residential areas	Greater than 500 m

Based on the criteria in Table 1, environmental or land suitability was identified. Figure 4 shows land suitability in Hai Duong Province ranked from 1 (marginally suitable) to 5 (very suitable).

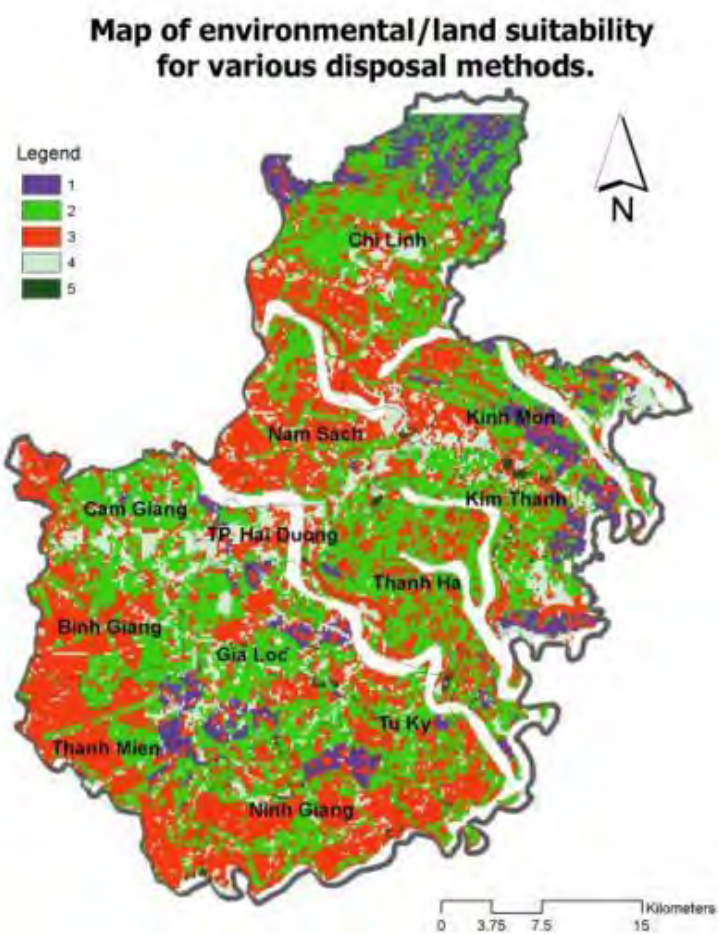

Figure 4. Land suitability in Hai Duong Province.

Using GIS, potential land areas for carcass disposal by district and suitability in the province were identified. As shown in Table 2, the most suitable land for carcass disposal (Level 5) is the least extensive, occupying a total area of 1 082 ha, with much larger areas of Levels 4, 3 and 2.

Table 2. Potential Land Areas for Carcass Disposal by District and Suitability in Hai Duong Province

	Suitability					Total area
District	**1**	**2**	**3**	**4**	**5**	**(ha)**
Binh Giang	1.96	4 152.58	4 961.21	901.35	22.70	10 039.80
Cam Giang	194.65	4 532.37	3 029.31	2 202.99	24.98	9 984.29
Chi Linh	3 813.07	11 241.82	8 008.52	2 103.40	37.69	25 204.50
Gia Loc	14 94.63	5 354.52	2 630.85	1 869.98	50.72	11 400.71
Kim Thanh	1 230.07	4 525.37	2 619.54	2 292.05	271.72	10 938.74
Kinh Mon	2 060.02	4 870.43	4 549.90	1 900.89	138.87	13 520.11
Nam Sach	5.42	2 613.21	5 643.59	1 339.32	29.54	9 631.09
Ninh Giang	754.88	4 279.39	7 040.59	11 54.44	127.22	13 356.52
Thanh Ha	247.63	7 759.11	4 901.51	393.48	41.11	13 342.85
TP Hai Duong	285.04	1 823.34	2 173.81	1 867.57	77.06	6226.82
Tu Ky	488.80	6 157.31	6 303.36	1 416.95	213.23	14 579.64
Total by level of suitability (ha)	**11 163.91**	**60 852.64**	**58 674.98**	**18 202.37**	**1 081.61**	**149 975.51**

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Annex 4

Pig and poultry market supply chain study in Quang Nam Province, Viet Nam

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Introduction

There is growing interest and demand for meat and eggs produced in livestock systems that allow animals to express their natural behaviour. Different feeding systems have been used for livestock production. Pigs and poultry have evolved within extensive and semi-intensive systems on different ecosystems (coastal, low and upland areas) and are an obvious choice for reproduction in native land in a sensitive and environmentally-friendly way. Through domestication, both pigs and poultry have been bred to live indoors under artificial conditions. In recent years, this intensification has been scrutinized for its negative effects on animal welfare and the animals' inability to show natural behaviour in such restricted conditions.

Pigs and poultry able to express their natural behaviour (such as foraging in the case of pigs and poultry) tend to be healthier animals and consequently the quality of the final product is much higher and can demand a higher market price. Chickens reared by householders are fed a higher dietary composition than free-range animals, both in uplands and lowlands (Nguyen Quang Linh, *et al*., 2007).

The market for products such as pork and chicken reared in lowlands and highlands is not currently well-researched. There are more pigs in Dien Ban, Thang Binh, and Duy Xuyen than in other districts. According to the Provincial Veterinary Office in Tam Ky (2012), there are more pig and chicken householder farms, with 746 838 pigs and 4 600 000 poultry. There is a demand for more information from producers in Quang Nam on coastal and upland production of pigs and poultry, both in terms of management and markets. Livestock systems have been developed in recent years that allow poultry and pigs to live partly indoors and partly outdoors in minority groups in a free-range environment. Local markets have also developed for producers who have been able to sell their breeding stock as weaners and fatteners. The integration of pigs and poultry back into coastal and upland areas will encourage exotic and local breeds to be used. Poultry in particularly prefer enclosed areas and integrated farms.

In the early part of 2013, disease outbreaks among swine and chickens occurred in Quang Nam. According to Mr Le Muon (Vice Director of Department of Agriculture and Rural Development, Quang Nam) *"Currently a count of the total number of pigs and chickens that died from the disease are underway. We will have specific recommendations for PPC to propose to the central government to support farmers. As a rule, farmers who own vaccinated pigs that die of PRRS receive 70 percent of the market price, about VND 27 000/kg, while poultry is VND 35 000/kg".* Quang Nam Provincial People's

Committee proposed to add support from MARD for 100 000 doses of attenuated vaccine for PRRS prevention (strain *JXA1-R*) and 20 000 l of chemical disinfectent for the province.

The transfer and movement of live animals through markets, the transport of livestock on vehicles without covers, the introduction of new animals without isolation or quarantine, and disease outbreaks can bring new and changing disease risks for livestock. The market supply chains that link production systems, markets and consumers constitute a contact network for contagious diseases and provide opportunities for transmission of disease within and between sectors. These networks must be taken into account in planning risk management strategies for disease prevention and control. This should result in successful disease control strategies that are sustainable in the medium and long term. Strategic planning must be based on knowledge in order to identify: the disease agent and the disease it causes; the risk factors of the diseases and the livestock populations in which it is active; possible interventions; and the people who manage and own these animals. These steps in strategic planning apply epidemiology in its widest sense. Sustained control of contagious disease can be achieved by reducing the risks of disease transmission in the livestock population, in addition to quick disease detection, containment and response. In order to reduce risks, an understanding of the risks and the factors that determine them is required.

Materials and methods

Nine communes in three districts (Duy Xuyen, Dien Ban and Que Son) of Quang Nam Province were selected for study of their pig and poultry market supply chains based on the following criteria: (1) live animal population size greater than in other districts; (2) diversity of animal production systems: intensive and semi-intensive systems in Dien Ban; and semi-intensive and smallholder pig and chicken farms in Duy Xuyen and Que Son; (3) occurrence of disease outbreaks and diseases in 2009-2012.

The study was conducted in three districts (Que Son, Duy Xuyen, Dien Ban) of Quang Nam Province, located in the middle agro-ecological zone of Quang Nam (Figure 1). The location was chosen for several reasons. First, the region is known for its high pig production in Quang Nam. Out of the total of 575 971 fatteners, 3 571 500 chickens, and 677 000 ducks identified in Quang Nam, the three districts represent 86 percent of total pig population, 92 percent of total chicken population and 85 percent of total duck population. Second, the marketing system for pigs is well-developed in the area. Within the area there are several markets which may fall into any of these market categories: primary/collection markets, secondary/regrouping markets, and terminal markets. Within these markets, there are many actors (farmers, traders, assemblers and brokers) who are involved in performing different types of marketing functions or roles along the marketing chain. As participants in the market chain, they contribute to variations in prices and movement/transportation of live pigs and poultry and their products.

Figure 1. Map of market and farm points in Quang Nam Province.

The survey included both qualitative and quantitative assessments of live animals and products traded, and the geographical extent of market chains supplying nine relatively small, district level slaughter houses. Information collected included: number of animals slaughtered, source of supply, and prices paid route from source to final markets. All live animal markets and transfer points between Quang Nam and Da Nang, and Quang Nam and Laos, were also geo-referenced for mapping. Questionnaires were employed for investigating the sources/origins and outlets of pigs and poultry owned by respondents. The respondents consisted of 144 pig and 88 poultry producers, 9 village dealers (assemblers), 14 slaughter houses, 36 retailers (butchers) of pigs and 27 of chickens and ducks. There were also two companies and two quarantine stations, Doc Soi Quarantine Station and Hoa Phuoc Quarantine Station, between Quang Nam and Da Nang, where staff were interviewed for data and information on market supply chain.

To test the number of unit roots in each time data series, we used questionnaires and semi-structured interviews. Since monthly data were used, seasonal unit root can occur. According to Hoang Nghia Duyet *et al*., 2008 the CARD test is valid only for non-seasonal data and the shorter the time series, the more difficult it is to reject the hypothesis of non-stationary time series.

Long-run vertical price relationships and reactions to deviations to the long-run equilibrium in the Quang Nam poultry and pork markets were investigated using a multivariate, co-integration approach (Nguyen Quang Linh *et al*., 2008), which allows testing for the presence of multiple co-integrating participants and the vectors of adjustment parameters. In the long-run, it was expected that the equilibrium price relationships in the form of a co-integrating equilibrium relationships and a co-integrating vector would describe the changes of adjustment toward equilibrium. Co-integration

refers to a linear combination of two or more integrated variables, which implies that traditional trends of variables are linked over time, where there is also a link with the current deviation from the equilibrium relationship. The vector autoregressive error correction model was used.

$$Y = \mu + \alpha_i + \beta_j + \sum^n a_n X_n \pm e_{ijk;}$$

Where Y represents different prices between farm-gate and consumers (pork, piglets, chickens and ducks; i = 1 to n; α, different ecosystems; β, different breeds (F1/F2 or local breed, exotic

The estimation and testing procedure included estimating the number of co-integration vectors using trace and maximal eigen-value tests. Tests on residuals are used to determine the lag length of the models (according to the procedure described by Boswijk and Franses, 1992). Weak erogeneity is tested to find out whether farm-gate or retail prices adjust to the long-run equilibrium after a price shock. The condition for a variable to be weakly exogenous for the long-run parameters is the alpha (α) vector of the exogenous variables (ecological zones) and beta (β) vector of ingenious variables (breeds) can be measured and recognized by the interviewer. If a price variable is found to be weakly exogenous, then a partial model is re-estimated.

Results and discussion

Slaughterhouses and selling points of pigs and poultry were identified and investigated. There are markets and slaughter houses allocated in three districts selected for investigation and mapping choices for recording data and information. A total of 141 pig and 88 poultry farms were surveyed in the three districts (Table 1).

Table 1. Pig and poultry farms.

No.	Commune and district	Pig farms	Poultry farms
1	Dien Thang Nam-Dien Ban	18	9
2	Dien Hoa-Dien Ban	16	11
3	Dien Ngoc-Dien Ban	18	9
4	Duy Phuoc-Duy Xuyen	16	13
5	Duy Thanh-Duy Xuyen	15	9
6	Duy Son-Duy Xuyen	15	11
7	Que Long-Que Son	14	13
8	Que Phu-Que Son	17	9
9	Que Xuan-Que Son	12	4
	Total	**141**	**88**

Annex 4

The market supply chain does not contain any information on the factor loadings α and β of the monthly exogenous and ingenious variables. The re-estimation of the equation as a partial model is shown in the equation, i.e. conditioning on weakly exogenous variables, is very likely due to improved statistical properties of the model. To test whether piglet and pork markets are competitive, we carried out structural tests, i.e. imposing restrictions on the β vector (Tables 2-4).

There were different prices between areas and regions in the same province, influenced by the different ecosystems and breeds on the basic price under control by slaughter houses/middle men and other stakeholders. There was a higher price in Que Son district because there are more piglets available in the market supply chain, whereas piglets can be sold easily in Laos and China than in other districts. However, based on farm-gate prices, farmers can sell to wholesalers or commissioned agencies and they can transfer to border markets.

Table 2. Market piglet supply chain in the three districts.

District (ecosystems) 1					**2**				**3**				
Breeds		1	2	3	b1	b2	b3	b1	b2	b3	b1	b2	b3
Variables	μ	*α1*	*α2*	*α3*	*Si g.*	*[β11/α1*	*β12/α1*	*β12/α1]*	*[β21/α2*	*β22/α2*	*β23/α2]*	*[β31/α1*	*β32/α3*
β33/α3]													
Sig.													
F	**42.15**	-1.58	-1.58	3.17**	-1.27	1.27	1.01	-1.34	-2.27	3.61	-2.11	1.73	2.37
M	**45.17**	-1.01	-1.69	5.68**	-1.86	1.09	1.77	-1.42	-2.66	3.08	-1.99	1.34	2.64
M_c	**48.21**	-1.48	2.18	3.30**	1.53	1.12	-1.65	1.15	-1.46	1.31	1.19	1.90	-2.09
M_d	**49.55**	3.06	-1.62	-2.44***	1.77	8.16	-9.93	2.66	3.23	-3.89	1.20	2.28	-2.48
M_p	**50.13**	-1.08	-1.07	2.15 **	-1.04	0.18	-1.14	2.07	-1.08	1.01	-1.13	-1.21	1.34

There were different prices between farm-gate and final market prices: 18.93 percent

α1, Dien Ban; α2, Duy Xuyen, α3, Que Son; β1, Exotic; β2, F1; β3, Local
** with P <0.05; ** with P < 0.01; and ***with P < 0.001*

Table 3. Market pork supply chain in the three districts.

District (ecosystems)	1					2					3				
Breeds	1	2	3			b1	b2	b3			b1	b2	b3		
Variables	μ	α1	α2	α3	Si g.	[β11/α1	β12/α1	β12/α1]			[β21/α2	β22/α2	β23/α2]		[β31/α1 β32/α3 β33/α3] Sig.
F	**80.72**[1]	-5.58	-4.58	-3.17	**	-2.27	-2.17	-2.15	-4.11	-4.32	3.15	-2.11	1.73	2.37	**
M/S	**76.15**	5.01	6.69	5.68	**	3.86	2.15	2.23	4.42	2.33	3.34	-1.99	1.34	2.64	*
R_c	**87.56**	-1.48	2.18	3.30	**	5.33	4.75	2.21	2.15	-2.46	2.31	1.19	1.90	-2.09	*
R_d	**87.17**	3.06	-1.62	-2.44		3.77	4.55	-5.12	2.66	3.23	-3.89	1.20	2.28	-2.48	*
C_p	**95.01**	-1.08	-1.07	2.15	**	-2.14	3.21	-2.44	2.07	-1.08	1.01	-1.13	-1.21	1.34	*

There were different prices between slaughters/middlemen and consumer market prices: 24.77 percent, even farmers must buy a higher price in their local market 6 percent.

α1, Dien Ban; α2, Duy Xuyen, α3, Que Son; β1, Exotic; β2, F1; β3, Local
** with P <0.05; ** with P < 0.01; and ***with P < 0.001*

Table 4. Market chicken supply chain in the three districts.

District (ecosystems)	1					2					3				
Breeds	1	2	3			b1	b2				b1	b2			
Variables	μ	α1	α2	α3	Sig.	[β11/α1	β12/α1]				[β21/α2	β22/α2]			[β31/α1 β32/α3] Sig.
F	**90.15**	-5.58	-4.58	-3.17	**	1.27	-37.26		4.38	-44.21		5.11	-41.73		**
M/S	**95.14**	5.01	6.69	5.68	**	5.86	- 40.21		4.65	- 42.45		6.17	-45.34		*
R_c	**95.27**	-1.48	2.18	3.30	**	5.31	- 48.72		5.52	- 52.16		5.24	- 51.19		*
R_d	**96.13**	3.06	-1.62	-2.44	*	6.77	- 46.51		5.67	- 53.67		7.18	- 52.28		*
C_p	**110.15**	-1.08	-1.07	2.15	**	12.14	- 50.11		10.72	-56.18		9.82	- 56.21		*
Con.	**120.15**	2.16	4.21	5.72	**	22.21	- 60.12		20.32	-61.15		19.17	- 59.55		**

There were different prices between slaughters/middlemen and consumers market prices: 33.28 percent.

α1, Dien Ban; α2, Duy Xuyen, α3, Que Son; β1, Exotic; β2, Local
** with P <0.05; ** with P < 0.01; and ***with P < 0.001*

The major actors in the pig market chain include assemblers, wholesalers, retailers and producers. Field data collected delved into the most prominent of these market channel actors. To this end, producers were requested to indicate the major buyer of their animals. A large proportion of the producers said they prefer selling their animals to assemblers because of quick and guaranteed payment for their animals, the reduction of risks associated with transportation, and the reduction of costs associated with the performance of marketing functions that could well be efficiently undertaken by

[1] Farmers have to buy meat at a higher price than they sell it in rural areas.

assemblers. The assemblers sell to rural wholesalers and commission agents. These two set of intermediaries sell either to rural retailers or urban wholesalers.

The price average of different variables was affected by two major aspects of breeds and areas, from farm-gate price via middle men/vendors to slaughter houses up to the markets. The retail price for pork is constructed as the weighted average of retail prices of pork bone, pork without bones, ham, no fat, no skin. Note that poultry and pork are sold in a wide variety of products at the retail level.

Most of the traded pigs brought to market are from pig farmers living in rural areas and the surrounding villages. At village level, itinerant traders visit the homes of pig farmers to buy pigs in small numbers. They are then sold at local village markets and district markets to intermediate traders who are assemblers with more funds and capacity for trading in larger numbers. These intermediate traders visit similar smaller markets, such as Dong Phu and Ba Ren markets, and gradually build up a herd for sale in the Dan market. Ownership of pigs may in some cases change hands two or three times before reaching local markets (with each new owner taking a small mark up in price), while in other cases it may be direct supply from buyers at the village to the local markets.

In conclusion, prices in the pig market supply chain vary depending on the participants, at the level where the animal or meat products are sold, age of animals, and type of meat products. These factors contribute to the prices of pigs and chickens: area where pigs and poultry are sourced; breeds of pigs and poultry; presence of slaughterhouses in the area; role of middlemen and retailers; and distance between farms and consumers. There is high risk of disease transmission for both pig and poultry markets due to inadequate slaughterhouse facilities (freezers for storage of carcasses, clean floors for slaughtering); and movement and transportation of live animals by motorcycle or bicycle. There is a 30-50 percent risk for transmission of pathogens due to lack of disease control efforts at the farm level and for piglets and breeding farms. Farmers and slaughterhouse keepers should be made aware of the importance of certification and traceability for disease control, for consumer-safe meat and meat products, and for increase in market prices of their animals and meat products.

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Annex 5

Use of environmental animal health management for development of a national animal health strategy

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Introduction

Livestock is a very important and rapidly expanding component of the Philippine agricultural economy. Animal husbandry is a major activity in rural areas and a primary source of income for many smallholders, who own and manage the great majority of the country`s livestock resources. In the first half of 2013, livestock production increased by 2.12 percent. The subsector contributed 15.53 percent to total agricultural production, while a production increase was noted for cattle at 2.28 percent (Figure 1).

Livestock and Poultry:
Inventory by Year and Animal Type
(thousand head)

	Carabao	Cattle	Goat	Swine	Chicken	Duck
2013	**2,912.84**	**2,497.91**	**3,694.02**	**11,807.05**	**166,379.18**	**10,136.24**
2012	2,963.98	2,493.16	3,715.23	11,863.02	164,192.25	10,011.48
2011	3,074.26	2,518.41	3,881.50	12,303.10	162,812.90	10,126.36
2010	3,270.41	2,570.88	4,177.72	13,397.79	158,984.32	10,268.01
2009	3,320.97	2,586.39	4,222.23	13,596.40	158,663.08	10,577.40

Source: Bureau of Agricultural Statistics - CountryStat Philippines

Figure 1. Livestock and poultry: inventory per year and animal type.
Source: Bureau of Agricultural Statistics.

Surra is one of the most economically important diseases of livestock and is caused by a hemoflaggelate known as *Trypanosoma evansi.* Surra, or trypanosomosi occurs in all regions of the country, but most cases are recorded in Regions 3, 4 and 5 (Luzon), 6 and 8 (Visayas), 11 and 13 (Mindanao). Regions 11 and 13 are the most affected because of the intensive use of horses as draft animals in fruit, rice and timber production, in festivities (e.g. horse fights), and the regions have a favorable environment for insect vectors. Surra infection can also exist with other diseases such as hemorrhagic and liver fluke infection (fasciolosis).

The overall prevalence of surra is 2.54 percent based on blood parasite examination. Horses, cattle and buffalos are commonly affected. Closely adjacent populations favor the spread of the disease from animal to animal. Surra is considered a chronic disease of

ruminants and pigs. The archipelagic geography of the Philippines limits the spread of the disease to specific islands.

Methodology

Cases of surra recorded in the Philippines are based on the following:

- Field reports submitted to the Animal Health Division of the Department of Agriculture-Bureau of Animal Industry (Figure 2).
- Laboratory reports from the Philippine Animal Health Center (PAHC) and Regional Animal Diagnostic Laboratories (RADDLs) (Figure 3).
- Disease prevalence card agglutination test for trypanosomosis (CATT) which is percent positive by municipality (Figures 4 and 5).

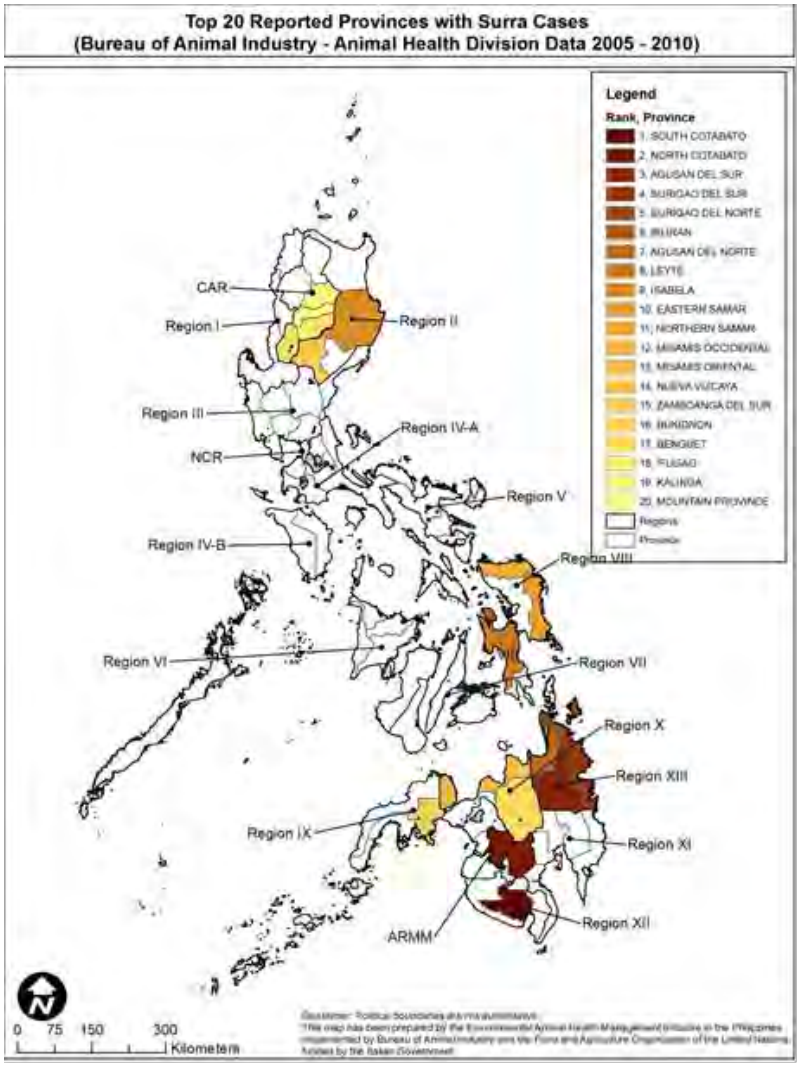

Figure 2. Top 20 reported provinces with surra cases, 2005-2010.
(Source: BAI-AHD.)

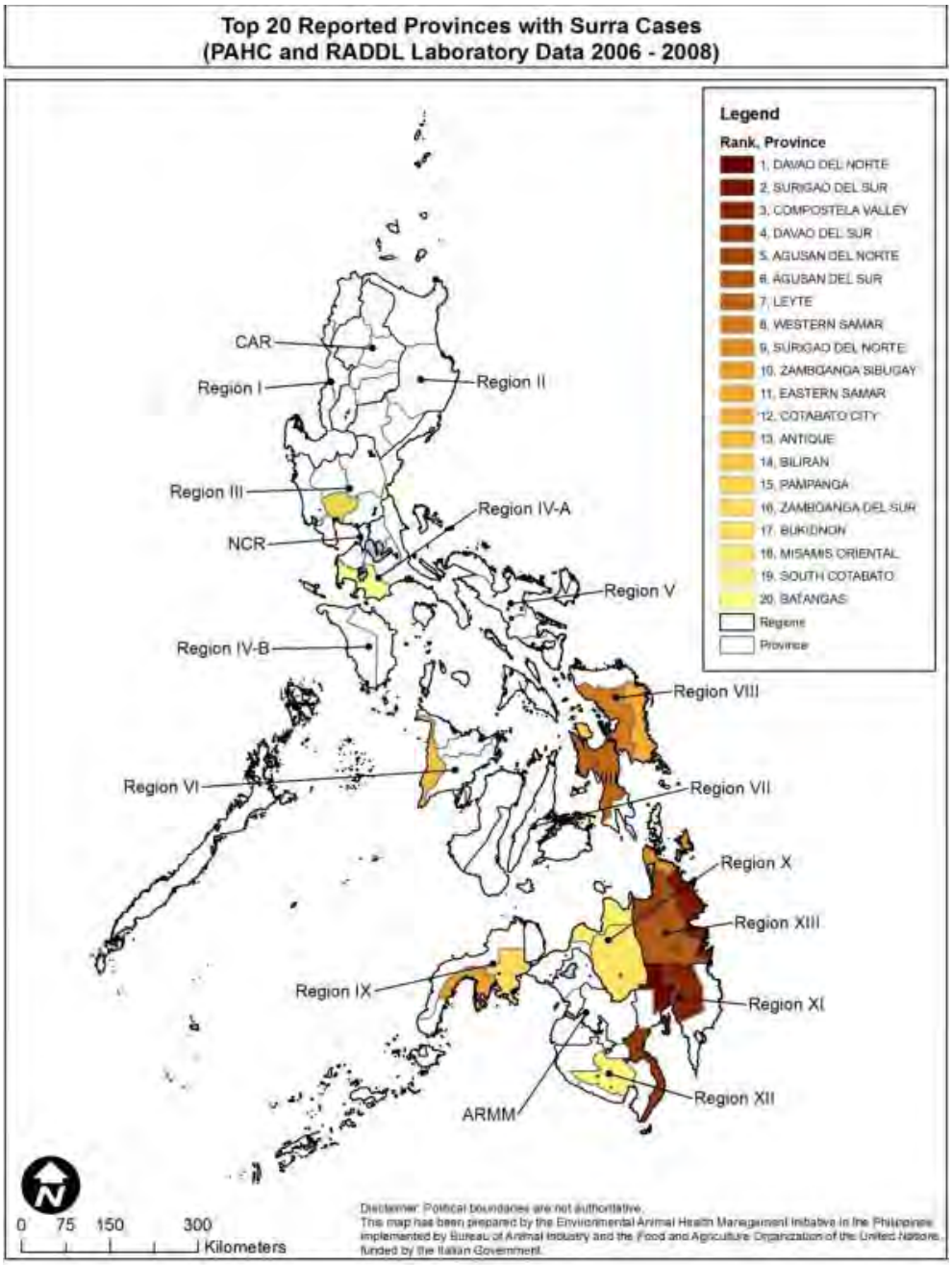

Figure 3. Top 20 reported provinces with surra cases, 2006-2008.
Source: PAHC and RADDL

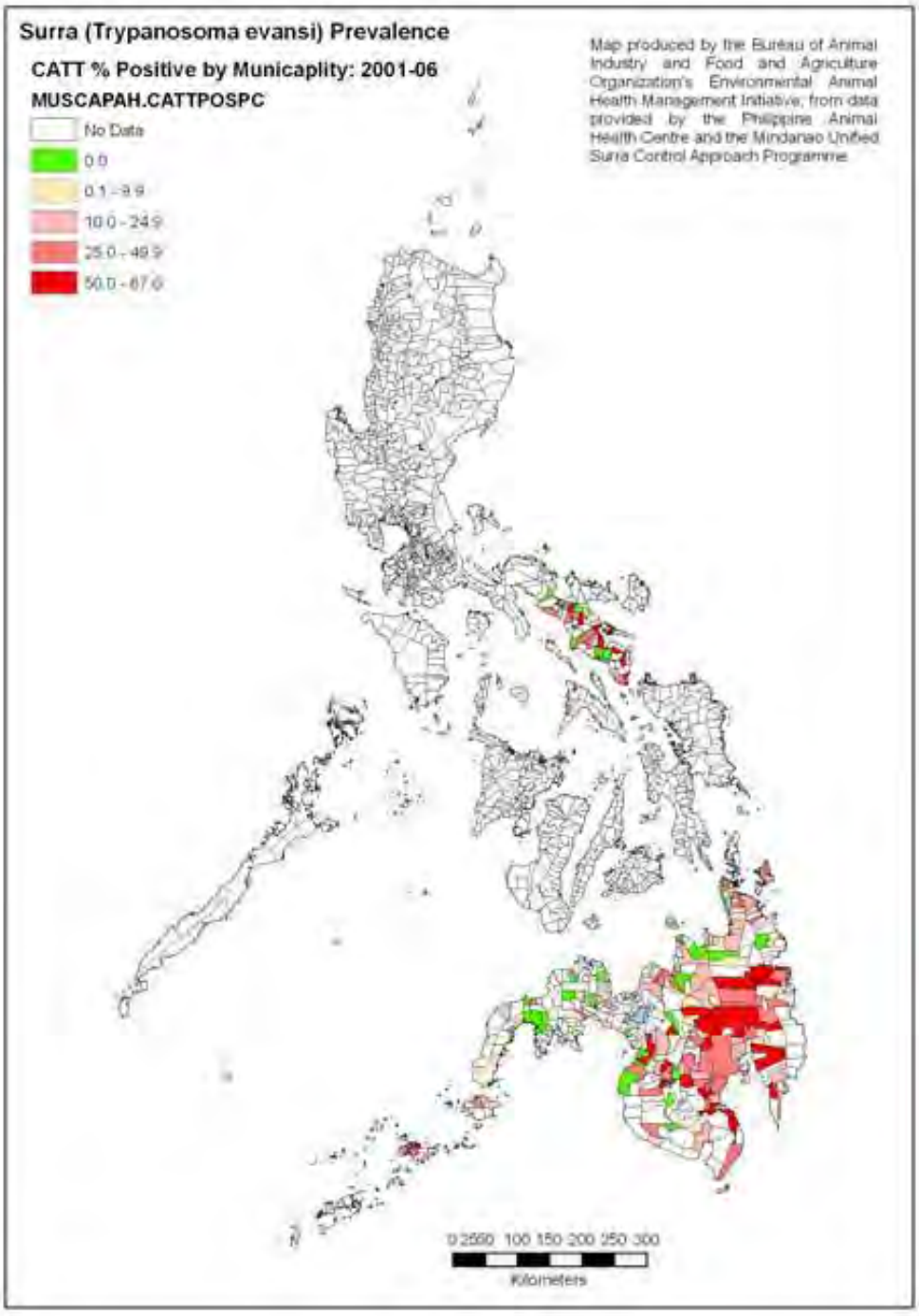

Figure 4. Surra prevalence CATT percent positive by municipality, 2001-2006.
Source: MUSCAPAH CATTPOSPC.

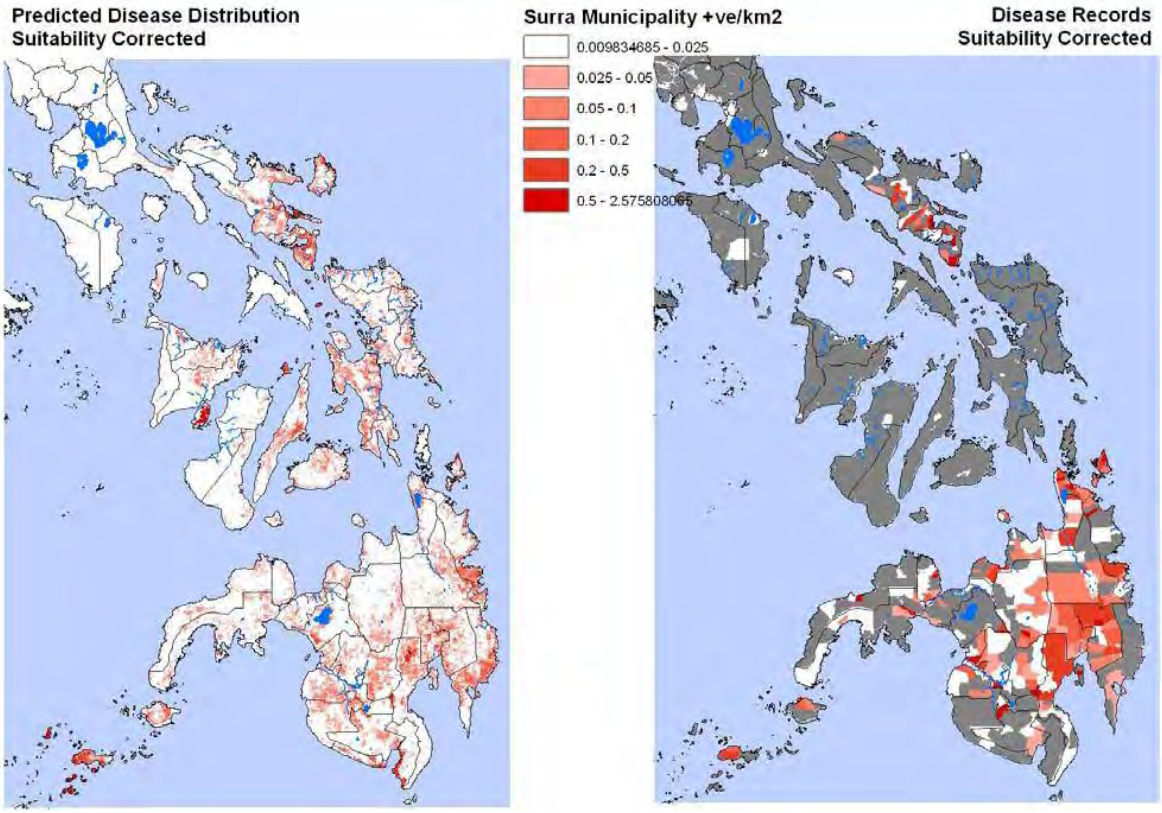

Figure 5. Baseline and predicted trypanosomosis distribution in the Philippines: laboratory confirmed CATT positives/square kilometer.

Results and discussion

Prolonged rainfall, high humidity and warm ambient temperatures predispose susceptible animals to the disease. The blood parasite examination (BPE) prevalence rate is 5.69 percent in areas where there is even distribution of rainfall throughout the year (Climate Zone IV) and 4.25 percent in areas with no obvious dry season and very pronounced rain from November to January (Climate Zone II). Based on the prevalence odds ratio:

- Climate Zone IV has 14.5 times greater risk of surra than animals in Climate Zone I (two pronounced season: dry from November to April, wet during the rest of the year).
- Climate Zone II has 11.14 times greater risk.
- Climate Zone III has 3.6 times greater risk (seasons are not very pronounced, relatively dry from November to April and wet for the rest of the year).

Surra causes high economic losses due to increased morbidity and mortality rates, shorter life expectancies of animals, decreased milk and meat yield, lower value of affected animals, higher costs of therapeutic interventions, and poor reproductive performance due to decreased fertility of animals and decline in calf production.

Annex 5

National strategy for the control and management of surra

Using the studies conducted on surra, stakeholders composed of faculty researchers and representatives from Department of Agriculture Regional Field Units and the Bureau of Animal Industry were brought together to discuss the work done on surra and determine a way forward for surra control and management. The following outputs were identified from that discussion:

Impact: The long term control and management of surra in the Philippines will contribute to increasing agricultural productivity and incomes, thus improving livelihoods and ensuring food safety.

Outcome: The outcome of the strategy program envisions control and management of surra such that incidence will be nearly zero by 2025.

Implementation: The program will be implemented through two five-year phases, after which a review of the situation will be conducted before the next five-year phase begins.

Phase 1 of the programme includes:

- Year 1: strategy is approved with funding
- Year 2: prevalence of surra is established
- Year 3: control and response measures are implemented
- Year 4: good production practices and animal health management implemented
- Year 5: decrease in surra incidence by 50 percent

Summary and conclusions

At the end of the workshop, the participants agreed that:

1. Greater understanding on the epidemiology of surra allows a more directed approach to surra control and management.

2. A national reference laboratory on surra is able to assist and advise satellite laboratories on sensitive and specific diagnostic tools and train laboratory staff to perform laboratory diagnosis in its area of jurisdiction.

3. A research agenda is defined to assist in providing evidence-based actions and decisions to control and manage surra:

4. All stakeholders are aware of the impact of surra and actively participate in the control and management of surra:

5. A surra control and management mechanism is in place with the Bureau of Animal Industry having a coordinating and monitoring role with existing

management mechanisms (e.g. Mindanao Surra Control Approach [MUSCA], Mindanao Animal Health Plan) and new mechanisms to be put in place.

6. An international and national network of field and laboratory staff is established and fully functioning in providing and sharing information on surra control and management.

Annex 5

Epidemiology of fasciolosis in Nueva Ecija Province, northern Philippines, including an assessment of ecological factors and recommended control measures

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Introduction

Fasciolosis is an infection due to *Fasciola spp.* and is contracted by ruminants by ingesting contaminated water or vegetation containing encysted metacercaria of fasciola. In the Philippines, it is considered the leading cause of morbidity and mortality in ruminants. *Fasciola gigantica and Fasciola hepatics* are the two major causative agents of this disease, with aquatic lymnaeid as their intermediate hosts (Molina *et al.*, 2005). It is the most widespread and most destructive parasitic disease of farm animals across the country, especially in endemic areas with incidence rates between 35-100 percent (Tongson, 1978). Also, it is the most frequently recorded animal disease in the country by far, with over 6 000 records of more than 267 000 cases during the period 1997 to 2004 (EAHMI, 2008).

Due to its prevalence, it has been reported to cause economic losses of between USD 20-107 million in countries such as Cambodia, Indonesia and the Philippines (Spithill *et al.*, 1999). In the Philippines, a joint study in 2007 by the Environmental Animal Health Management Initiative (EAHMI) and Environmental Research Group, Oxford, showed that the predicted risk of fasciolosis is highest in the lowland areas such as Nueva Ecija in Central Luzon.

Nueva Ecija is included in the top 20 provinces with the highest predicted risk of fasciolosis. Based on the data provided by the Provincial Veterinary Office (PVO), Muñoz, Cabanatuan City, Palayan City, Guimba, Sto. Domingo, Laur, Sta. Rosa, Carrangalan, San Leonardo and Quezon are among those having the most reported of cases of fasciolosis.

This study was a survey and epidemiological profile of fasciola prevalence and its risks among cattle, carabaos and goats in two municipalities of Nueva Ecija. The first is , where no fasciola reports have been recorded for the past five years, and the other one is Muñoz, where fasciolosis has been constantly reported for the past five years among large and small ruminants.

In the first phase, a list of *barangays* with the highest number of ruminants in the municipality of Gabaldon were chosen as a sampling frame. A total of 80 carabao, 80 cattle and 80 goat fecal samples from North Poblacion, Macasandal, Bagong Sikat and Cuyapa were collected and processed using a floatation technique, and microscopically examined for the presence of *Fasciola spp*. eggs. The fecal samples were then used for the estimation of prevalence of fasciolosis among large ruminants. Calculations were

done through WinEpiscope, with a prevalence of 30 percent, confidence level of 95 percent, and desired absolute precision of 10 percent as assumptions. Samples were processed using a formalin-ether concentration technique and liver fluke eggs were microscopically examined at the College of Veterinary Science and Medicine, Central Luzon State University (CVSM, CLSU).

As part of the study, a survey was also conducted. Smallholder rice farmers in Gabaldon who are owners of the animals enrolled in the study were interviewed. The questionnaire consisted of farm information (location, owner, animal identification, age and sex) as well as probable risk factors for transmission and clinical information questions.

Risk analysis of fasciolosis during the surveillance was conducted. All information was encoded using Microsoft Excel and analyzed using a chi square test of association at 10 percent level of significance and Fischer's exact test for covariates with less than five frequencies in a cell. A logistic regression analysis was also used to measure the association of the potential risk factors and occurrence of fasciolosis at five percent level of significance. All analyses were done using SAS.

The second phase took place in Science City, Muñoz. Records of the total population of goats, cattle and carabaos in all *barangays* of Muñoz were obtained from the City Veterinary Office. *Barangays* with the most goats, cattle and carabaos were listed. The top 10 chosen *barangays* with the largest numbers of goats were Bical, Mangandingay, Rang-Ayan, Curva, Mapangpang, Franza, Villa Isla, Calisitan, Calabalabaan and Bantug. The top six *barangays* with the highest number of cattle and carabao population were Bical, Mangandingay, Rang-Ayan, Calabalabaan, Palusapis and San Antonio.

As in the first phase, fecal samples were collected and subjected to fecal analysis. Three grams of samples were comminuted in a 1.2 percent saline solution. The mixture was strained through a double layered strainer using vigorous shaking to remove large fecal particles. One drop of the solution was placed on a slide, covered with a cover slip and examined under LPO for *Fasciola spp*. eggs. A number of possible factors influencing fasciolosis prevalence were considered. By using logistic regression analysis, variables found to be significant at 10 percent level of significance were included in a model.

Snail distribution was also determined in the *barangays* of Munoz, Nueva Ecija, where cases of fasciolosis have been consistently reported by the Provincial Veterinary Office for the last five years (2005-2010). Collection sites include irrigated farming areas, drainage ditches and boundaries of fields. Field data points were located on the image. Each collection site was specified as a 3 x 3 pixel area surrounding the site location as determined in the field by GPS measurements. Probable ecological correlates of *Lymnea spp.* snail habitats in Munoz were taken through observation, sampling and interviews. These included the existence of certain vegetation types, proximity of agricultural field edges, physical characteristics of water at the collection site (pH, turbidity and salinity), source of water at the collection site, and proximity of smallholder livestock farms to the collection site.

Farmers were interviewed on the different pesticide and fertilizer inputs they used in the rice fields to determine the chemical inputs to the soil and water that influence the presence of snails at a particular site. The potential influence of several factors on the presence of snails in an area was measured statistically. The chi square test or Fisher exact tests were used depending on the frequency distribution of these factors against the frequency distribution of snails. The variable area was categorized into two variables, rice field and the type of irrigation (fish pond, *tanggal*, river). The association of several factors to the distribution of snails in an area was also calculated. Correlation analysis for the physical characteristics of water such as pH, turbidity, and salinity was done using either the Fisher exact test or chi square test.

The team also looked into the effectiveness of phytochemical control of the intermediate host *Lymnea spp.* and field trials of phytochemical snail control. An in-vitro study through phytochemical control of *Lymnea spp.* snails was determined using the seeds of two plants, sugar apple (*Anona squamosa*) and neem (*Azadirachta indica*). The seeds of the two plants were dried and separately ground using a blender. The neem and sugar apple seeds were separately mixed with water (1 kg pulverized seeds/2 liters of water) overnight (15-18 hours) with repeated stirring every hour for 15 minutes. The suspension was sieved through a coarse cheese cloth and stored in clean bottles with a cotton plug and kept refrigerated (4°C) until use. The study was divided into two groups. Group 1 used only neem seeds in different dilutions with the following treatments: T1= pure concentration or stock solution, and T2=1:50 (1 ml of the extract and 50 ml of distilled water). Group 2 contained a combination of sugar apple and neem seed aqueous extract in 1 ml : 1 ml ratio. The same treatment setups as in Group 1 were prepared. Two methods were used, plate immersion. In the plate method, filter paper was moistened with the extract and was fitted in a Petri dish. Ten snails were placed in it and covered with gauze. In the immersion method, 25 ml of the extract was placed in a 50 ml glass beaker and 10 snails were placed in it. Three exposure periods (12 hours, 24 hours, 36 hours) per treatment were used with three replicates per exposure period. Death was based on mobility of the ventral foot of the snail after the snails were removed from the extract at the end of each exposure period.

For the field trial, a total of 600 *Lymnea* snails were collected randomly early in the morning from different ponds, rice paddies and rivers of Brgy. San Roque, Lupao, Nueva Ecija. Only adults measuring 1-3 cm were collected and placed in pails with water from the site where they were collected. The snails were transported immediately to the field for the experiment. Clean dry neem seeds were ground using a kitchen blender and soaked in plastic pails of water (10 kg pulverized seeds/10 liters of water) overnight (15-18 hr). The mixture was be stirred repeatedly (every hour for 15 minutes). The suspension was sieved using a coarse cheese cloth and stored in clean bottles with a cotton plug and kept refrigerated (4°C) until use.

The neem seeds were collected from different locations in Nueva Ecija. Three plots measuring 2 x 1.25 meter with a height of 5 inches were prepared. The plots were flooded first with approximately 10 liters of water from the irrigation source until the ground reached its threshold level of saturation. Three cages made of iron rods measuring 5 x 3 x 20 inches and covered with fine fish net and then submerged into the water with one half of its height deeply buried in the ground while the other half remained above ground. Each cage held 100 adult snails. Each cage was placed at the center of each plot. The first plot served as the negative control where only irrigation water was used. On the second plot, 10 liters of aqueous extract of neem seeds was poured into the water. The third plot served as the positive control where commercial niclosamide (0.014 ppm) was poured into the plot. After 12 hours of exposure to the treatments, the cages were taken out and washed with fresh water. The snails were removed and submerged in pails of tap water for one hour to allow the snails to recover at the end of every exposure period. All snails were evaluated for signs of mobility. The snails were turned upside down. Live snails extended their ventral foot to position themselves upright after a one hour recovery period, while dead snails did not. Scoring was done as follows:

- 0 = living snails: ventral muscular foot relaxes and extends and will be in an upright position after recovery period
- 1 = dead snails: ventral foot hidden inside the shell and not in the upright position after recovery period

After evaluation, live snails were returned in the cage and submerged again in the water of the rice paddies for another 12 hours. The entire procedure was repeated again for another 12 hours until all snails lost their mobility. The following data were gathered from the experiment:

- Mortality rate = the proportion of the snails that died relative to the number exposed
- Survival rate = subtracting the calculated mortality rate from 1
- Crude Mortality rate = number of dead snails / total number of original live snails X 100 Difference in snail mortality = difference in the number of dead snails between observation period by treatment

One week after application of the extract in the rice plot, a cage of the same specification and containing 100 live adult snails was placed at the center of a plot. Crude mortality was determined for 36 hours of observation to check on residual effects of the neem seed extract. Data were analyzed using analysis of variance, least significant difference and pairwise comparison tests to determine differences in all treatments in each week based on mortality rate, survival rate and difference in snail mortality. Also, a Kaplan Meier test was used to measure the probability of survival of snails in each treatment with length of observation period as the basis.

Results and discussion

Based on the microscopic examination of stools in Gabaldon, results showed that among the large ruminants, 13 out of 80 (16.25 percent) carabaos, and 15 out of 80 (18.75 percent) cattle were infected with liver fluke, whereas nine out of 85 (10.6 percent) goat fecal samples were positive.

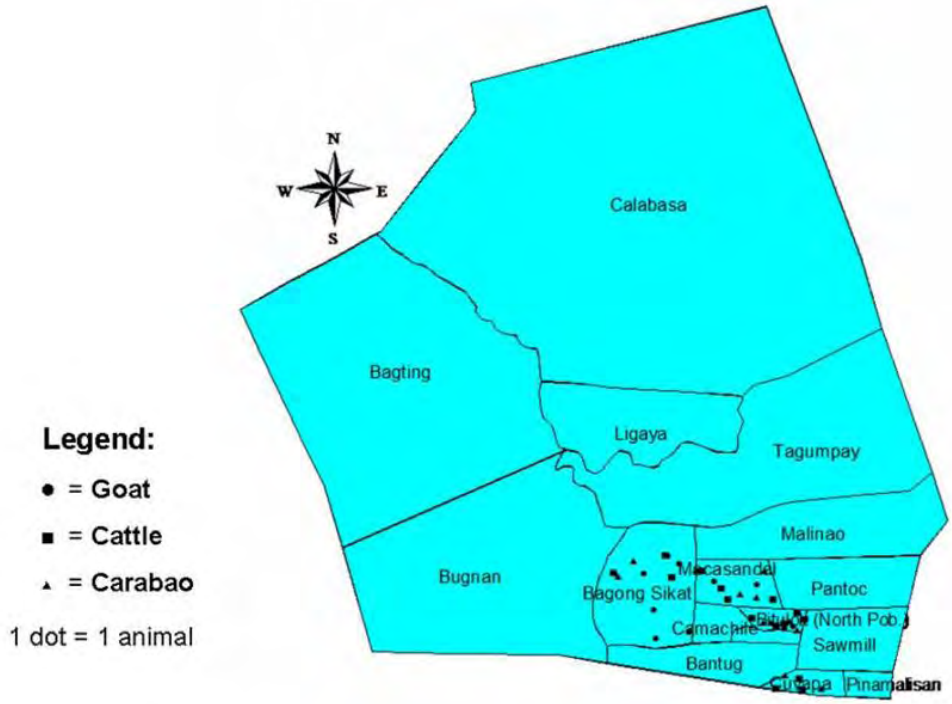

Figure 1: Distribution of fasciola infected animals in Gabaldon Municipality.

Overall prevalence of fasciolosis in Gabaldon was 37 out of 240 ruminants (15.42 percent). Risk variables were found to have a significant association (p value $\leq$ 0.10) with prevalence of fasciolosis among ruminants were: educational attainment of the farmer, knowledge of snail transmission of fasciolosis, use of carabao for draft power in rice fields, mixed housing of animals, and presence of *Lymnea* snails in the grazing area of ruminants. Results of the study confirmed the endemicity of fasciolosis in Gabaldon ruminant populations, despite the absence of reported cases from the Provincial Veterinary Office from 2005 to 2010.

In Muñoz, microscopic examination of stools showed that among large ruminants, 20 out of 105 (19 percent) carabaos, and 18 out of 75 (24 percent) cattle were infected with liver fluke, whereas 51 out of 300 (17 percent) goat fecal samples were positive. Overall prevalence of fasciolosis in Muñoz was 18.5 percent (89/480). Risk variables found to have a significant association (p value $\leq$ 0.10) with prevalence of fasciolosis among ruminants were: age of farmer, length of livestock raising experience, the use of the same dewormer (albendazole), mixed housing of ruminants, and the type of forage (river spinach) given to the animals.

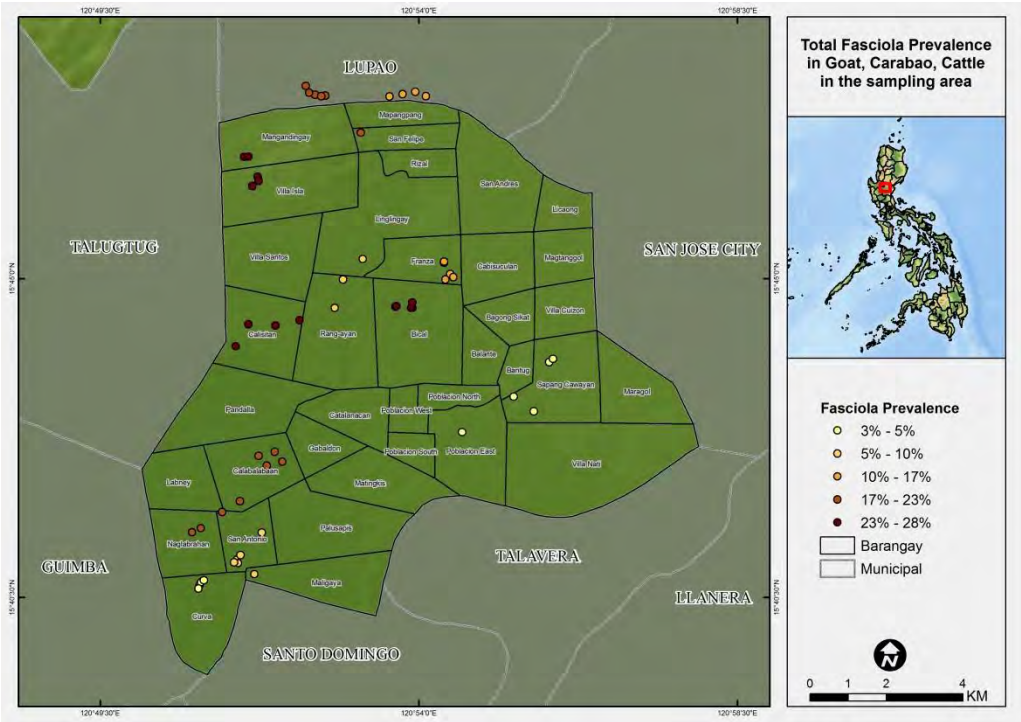

Figure 2: Prevalence of ruminant fasciolosis in representative *barangays* of Munoz, Nueva Ecija.

The following ecological factors were closely associated with *Lymnea* spp. snail habitats: rice fields (p=0.05), presence of river spinach (p=0.01), river as source of water (p=0.04), chemical inputs (p=0.0086) which influenced snail density, and presence of grazing goats at the collection site (p=0.015).

Field trials of the aqueous neem seed extract was made to determine its applicability. The neem seed extract, with a concentration of 1:20, did not differ significantly from the molluscicidal effect of niclosamide in terms of mortality rate and difference of snail mortality between observation times for each week and between the first and second week. This is further corroborated by the survivability of the snails in both treatments, which immediately dropped to 75 percent in less than five hours of exposure. The molluscicidal action of neem seed extracts was comparable to commercial niclosamide. Furthermore, the extract had residual effects after one week post application of the first extract, similar to niclosamide. Thus, neem seed extract using the concentration prepared in this study is an effective molluscicide and a safer alternative to the synthetic chemical niclosamide.

A workshop on 20 March, 2012, was held at the Philippine Carabao Center, Science City of Muñoz Nueva Ecija to present the findings and results of the study conducted on fasciolosis. The participants gave their recommendations for control of fasciolosis in smallholder production systems as follows:

1. The Philippine Carabao Center carries the legal mandate to develop the buffalo industry.
2. Smallholder farmers should be encouraged to join the existing cooperatives of dairy buffalo farmers supported by the Carabao Center. As members of the cooperative, farmers can avail of the regular seminars and technical services offered by the extension workers of the Carabao Center.
3. Public awareness on the prevalence and risk factors, and prevention and control of fasciolosis should be disseminated to farmers.
4. BAI, DARFU and local government units should take the initiative in these public awareness activities.
5. The Philippine Carabao Center can provide further assistance in public awareness activities targeted at buffalo raisers.
6. The most effective communication media and language (English or Tagalog) for farmers must be identified: school on the air, posters in DARFU and PVO, seminars, and comics.
7. Farmers should be made aware that irrigation canals and rivers are the common sites of lymnaea snails, which are the intermediate hosts of *Fasciola spp*. and that any contamination of irrigation water or rivers by fasciola infected ruminants or cercariae-releasing snails has the potential for spreading the parasite to animals and the environment.
8. Feeding river spinach should be limited to tops or the part of the stalk above 10 cm and avoid feeding the part submerged in water.
9. To ensure availability of safe forage for livestock, farmers must be encouraged to develop their pasture area. Cultivation of a pasture area can increase the herd size of the smallholder ruminant production.
10. Training of farmers on forage and pasture use through the Provincial Veterinary Office and City Veterinary Office may be provided by requesting personnel from BAI Research and Development.
11. The proper use, dosage (based on body weight) and frequency of dosing with flukecide according to manufacturer's recommendations must be administered and under supervision of a licensed veterinarian.
12. Fecal samples must be submitted to the RADDL/PAHC for fecal analysis before and after a deworming program for liver flukes.
13. This study successfully demonstrated the efficacy of neem seed extract at a concentration of 1:20 as a cheaper and effective phytochemical substance for reducing the population of the snail intermediate host.
14. There is a need for further study to quantify and compare the economic benefits and costs of the main fasciolosis disease control options as well as anthelmintic resistance studies.

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Acknowledgement

The author is grateful to Dr Fredelon Sison who supervised the sample collection and processing by his undergraduate thesis students, Dr Romeo S. Gundran and Dr Roderick Salvador, who did the statistical analysis of the data, Ms Judith Bulaong and Mr Rafael Umbrero who plotted the distribution of fasciola cases, snails and associated risks on maps using GPS software, and her undergraduate thesis students, who did the in-vitro experiment and field trials of herbal extracts for molluscicidal action.

Annex 6

Northern region sustainable livelihoods through livestock development project in Lao

Moua Yang and Syseng Khounsy
Northern Region Sustainable Livelihoods through Livestock Development Project
Department of Livestock and Fisheries,
Ministry of Agriculture and Forestry, Luang Prabang, Lao PDR

Introduction

Northern Region Sustainable Livelihoods through Livestock Development Project (NRSLLDP) aims to improve livelihoods by increasing income from livestock productivity in poor areas of northern provinces (Figure 1).

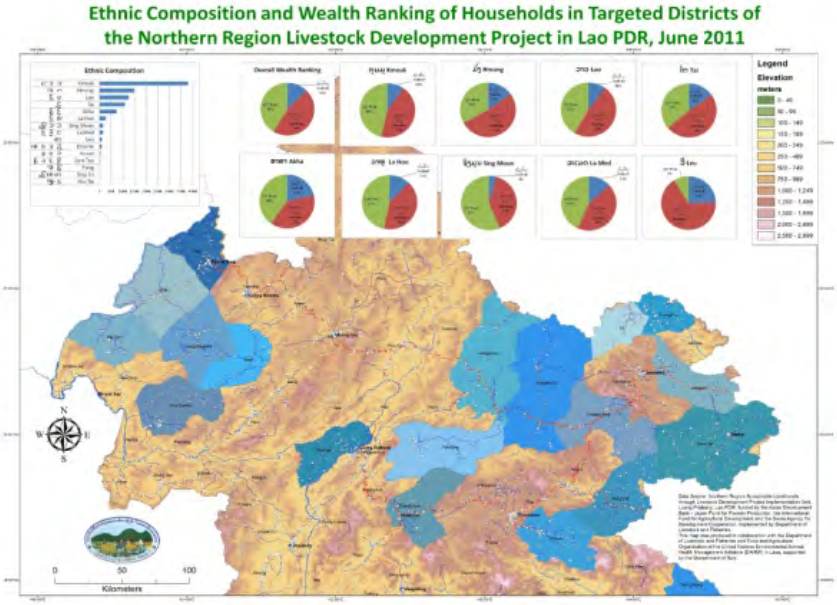

Figure 1. Ethnic composition and wealth ranking of households in targeted districts of the northern region livestock development project in Lao PDR.

Materials and methods

The NRSLLDP is being implemented by the Department of Livestock and Fisheries (DLF) Ministry of Agriculture and Forestry (MAF), Provincial of Agriculture and Forestry Office (PAFO) and District of Agriculture and Forestry Office (DAFO). The project covers 18 districts in five northern provinces: Luang Namtha, Bokeo, Luang Prabang, Huaphan and Xiengkhuang Provinces (Figure 2). The project started in June 2007 and will end in March 2014.

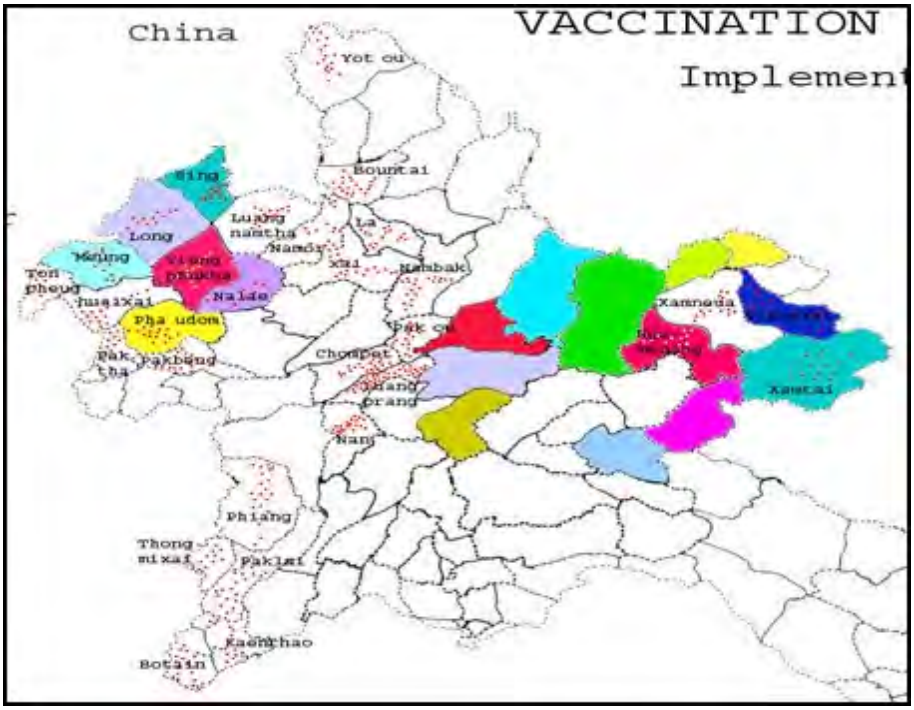

Figure 2. Map of FMS and HemoSep vaccination in northern region, Lao PDR.

Results and discussion

The project strengthens and supports livestock production in 321 villages and has provided 286 infrastructure improvements to provincial coordination offices, district implementing offices, village meeting halls and irrigation facilities through the Village Infrastructure Development Fund (VIDF). The project also offered Village Microfinance Loans to districts in the northern region (Figure 1). Vaccination campaigns are also being conducted by provincial and district livestock staff to prevent Foot and Mouth Disease, hemorrhagic septicemia outbreaks, and to increase ruminant survival rates. The vaccination activities covered seven provinces, 30 districts, and 272 villages (Figure 2)

Acknowledgement

This work was supported by the Asian Development Bank (ADB) and the International Fund for Agriculture Development (IFAD), the Swiss Agency for Development and Cooperation (SDC), the Asian Development Fund (ADF) and contributions from the Government of Lao PDR.

Annex 6
Capacity building for data analysis and GIS applications in Myanmar

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[1]EAHMI Myanmar, [2]Myanmar Information Management Unit

Introduction

Training on Geographical Information Systems (GIS) and Global Positioning Systems (GPS) devices is necessary in order for EAHMI-Myanmar partners and associates to strengthen links with and capacity to share information sharing with the Livestock Breeding and Veterinary Department (LBVD), Settlement and Land Registration Department (SLRD) and University of Veterinary Sciences (UVS), and to enhance data analysis and mapping capacity for the better understanding and wider dissemination of animal production and health information.

It was envisioned to have a pool of trainers on GIS and GPS to support various activities and training programmes for the township veterinary officers.

Materials and methods

Two training programmes were conducted in collaboration with the Myanmar Information Management Unit (MIMU), UVS and LBVD by EAHMI: Training of Trainers (TOT) on November 2012, and Basic Training on MS Excel, GIS and GPS for Township Veterinary Officers (TVOs) on January 2013 for phase one and August 2013 for phase 2.

Results and discussion

Training of Trainers (TOT) for Geographic Information System and Global Positioning System is a one-week training workshop conducted on November 2012 with a total of seven participants from the UVS, LBVD, SLRD and Myanmar Livestock Federation.

Basic Training on MS Excel, GIS and GPS for Township Veterinary Officers was designed to familiarize TVOs with data entry on MS Excel and the use of GPS devices and GIS software for data collection and mapping dairy cattle in the EAHMI Myanmar project areas. The first phase involved development of survey questionnaires, GPS and GIS familiarization and data entry. The training was conducted in January 2013 with a total of 21 participants from 15 townships, LBVDs and UVSs. The second phase involved data encoding, collation, analysis and mapping survey data that was concluded on August 2013.

EAHMI Myanmar acknowledges the support and commitment of FAO and the Government of Italy for implementation of project activities in Myanmar that will further strengthen the staffs capacities to apply environmental animal health management strategies.

Annex 6

Through capacity building for data analysis and GIS applications, EAHMI Myanmar is able to support the conduct of dairy profiling surveys in pilot townships of Mandalay, Yangon and Shan State. Figure 1 shows a collage of the three training programmes conducted.

Figure 1. Training of trainers and basic training on MS Excel, GIS/GPS.

Acknowledgement

This work was supported by the Food and Agriculture Organization of the United Nations GCPA/RAS/244/ITA and the Government of Italy.

Environmental animal health management initiative capacity building in Viet Nam

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[1,3]Department of Animal Health, Viet Nam

[2]Department of Remote Sensing Technology, GIS and GPS, Space Technology Institute, Hanoi, Viet Nam

[2]Department of Environmental Management, Hanoi University of Agriculture, Viet Nam

Introduction

The Environmental Animal Health Management Initiative (EAHMI) has been operating in Viet Nam since early 2012. The aim is to help the veterinary service assess the situation of animal disease outbreaks such as porcine respiratory and reproduction syndrome (PRRS), foot and mouth disease (FMD) and other zoonotic diseases such as *Streptococcus suis* (*S. suis*), Rabies, Highly Pathogenic Avian Influenza (HPAI), and identify potential environments for emerging or pandemic zoonotic threats to humans. It aims to strengthen capacities for database management, data analysis and GIS applications for the development of EAHMI strategies in the country.

Materials and methods

Two training courses, basic and intermediate training on data analysis and GIS mapping, were conducted with provincial and regional veterinary officers in collaboration with the Department of Animal Health, Space Technology Institute - Viet Nam Academy of Science and Technology (STI-VAST), and the Hanoi University of Agriculture (HUA).

Results and discussion

The Basic Training on Data Analysis and GIS Mapping were conducted in 2012 in three locations: Northern (Hanoi), Central (Danang), and Southern (Ho Chi Minh City) with a total of 74 participants (Figures 1, 2a and 2b).

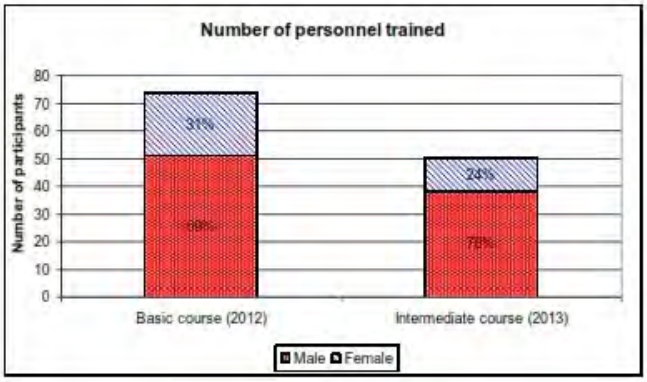
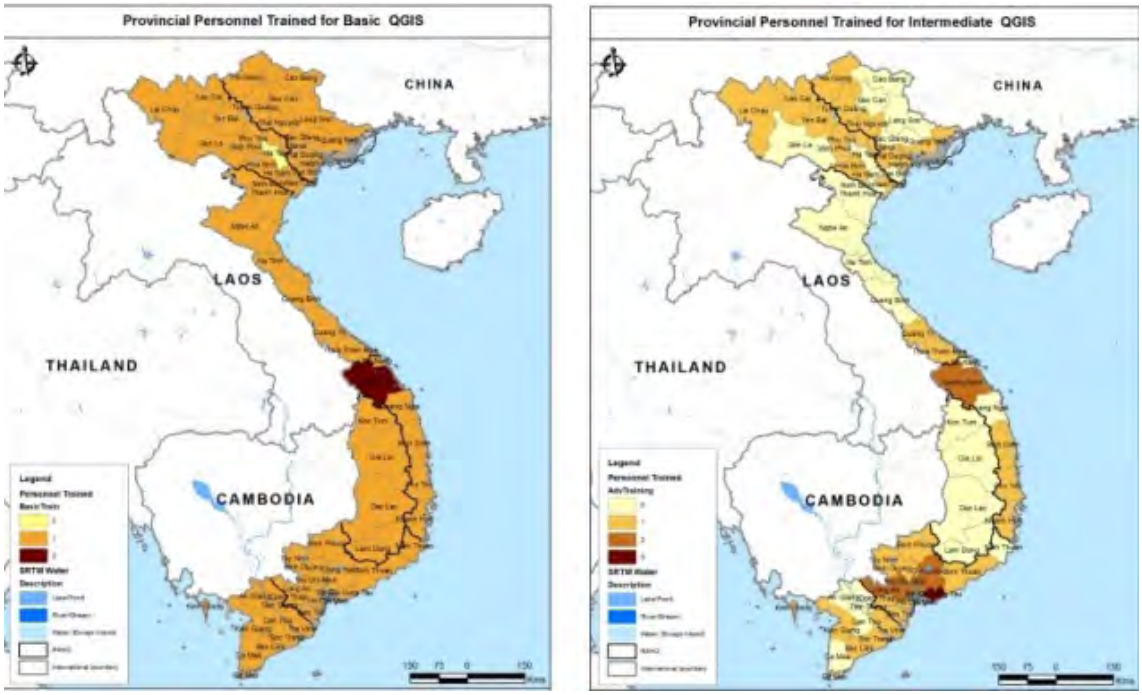


Figure 1. Number of Trainers.

Annex 6

Participants who performed well in the basic training were selected to participate in the Intermediate Training GIS Mapping that was conducted in 2013. A total of 50 veterinary officers completed the course.



Figures 2a and 2b. Distribution of provincial personnel trained for basic and intermediate QGIS.

The collaboration of EAHMI Viet Nam, DAH, RAHO, SDAH, and STI-VAST and HUA provided a good avenue for sharing expertise, resources and experiences in the pilot use of standardized veterinary disease mapping. The technical know-how and experiences in data collection and organization within the GIS environment complemented and supported the collection of veterinary information in the field. It also facilitated the preparation of an atlas of veterinary diseases in all provinces throughout the project areas.

Acknowledgement

This work was supported by the Food and Agriculture Organization of the United Nations GCPA/RAS/244/ITA and the Government of Italy.

Myanmar farm animal distributions at township level 2012 and 2013

Okkar Soe
National Focal Point, EAHMI Myanmar

Introduction

The Livestock Breeding and Veterinary Department in Myanmar gathers yearly statistics on livestock and poultry at the township level through its Township Veterinary Officers. The most recent data available is for the year 2012/13.

Materials and methods

Data on the distribution of livestock and poultry at township level were compiled and mapped. Population densities and keeper densities were expressed in numbers of animals per square kilometer.

Results and discussion

Based on the results, the highest density of cattle occurs in lowland areas of southern Sagaing, Mandalay, Magwe, northern Rakhine, coastal islands, Bago, Ayeyarwady and Yangon (Figures 1-8).

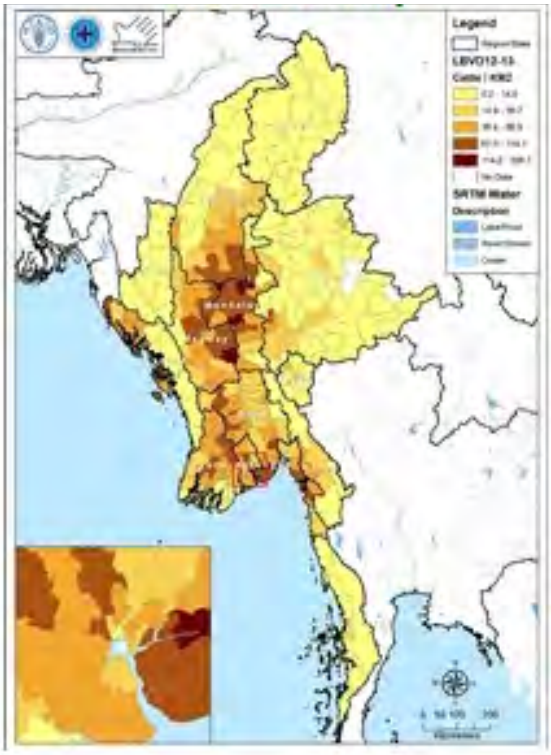


Figure 1. Cattle density.

Buffalo: highest densities in northern Rakhine, the southern Ayeyarwady delta, central Sagaing and Shan.

Pigs: highest densities in eastern Magwe, northern Shan, Bago, Ayeyarwady, Yangon and Mon.

Goats: highest densities in southern Sagaing, eastern Magwe, Mandalay and western Rakhine.

Sheep are far less numerous than goats and appear to be confined to southern Sagaing, eastern Magwe and Mandalay. Chickens are widespread throughout Myanmar, but the highest concentrations occur in scattered southern townships, especially around Yangon.

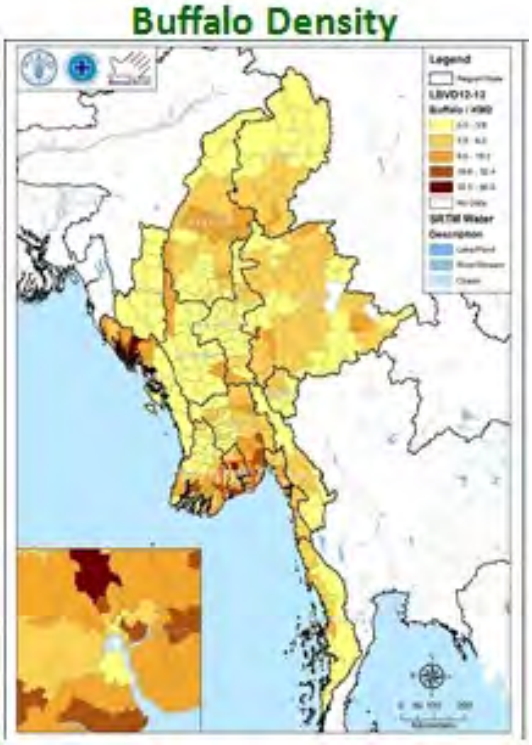


Figure 2. Buffalo Density.

Statistics for total animal keepers: 2.4 million cattle; 0.59 million buffalo; 0.17 million goats; 25 thousands sheep; 1.0 million pigs; 2.9 million chickens; 0.5 million ducks; 87 thousand turkeys; and 858 quail keepers.

Densities of animal keepers

Cattle: highest density occurs in lowland areas of southern Sagaing, Mandalay, Magwe, northern Rakhine, Bago, Ayeyarwady and Yangon.

Buffalo: highest densities in northern Rakhine, the southern Ayeyarwady delta, central Sagaing and Shan State.

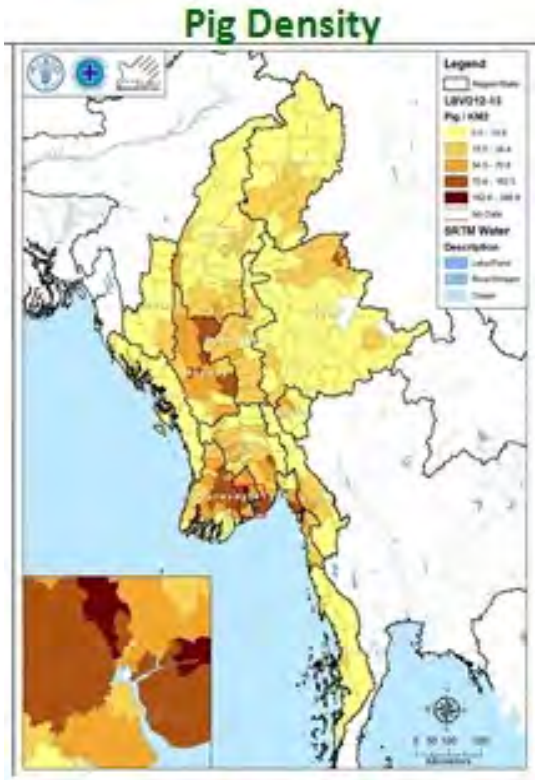


Figure 3. Pig Density.

Figure 4. Chicken Density.

Pigs: highest densities in Ayeyarwady, Yangon, Bago and Mandalay.

Goats: highest densities in southern Sagaing, eastern Magwe, Mandalay and western Rakhine.

Sheep are far less numerous than goats and appear to be confined to southern Sagaing, eastern Magwe and Mandalay. Chicken keepers are mostly around Yangon, Mandalay, Magwe, Ayeyarwady and Mon.

All maps were produced using Geographical Information System (GIS) software.

The average size of holdings in 2012/13 was: 6.0 cattle; 5.4 buffalo; 24.7 goats; 34.7 sheep; 10.8 pigs; 65.5 chickens; 37.3 ducks; 14.5 turkeys; and 1,047.1 quail per holding.

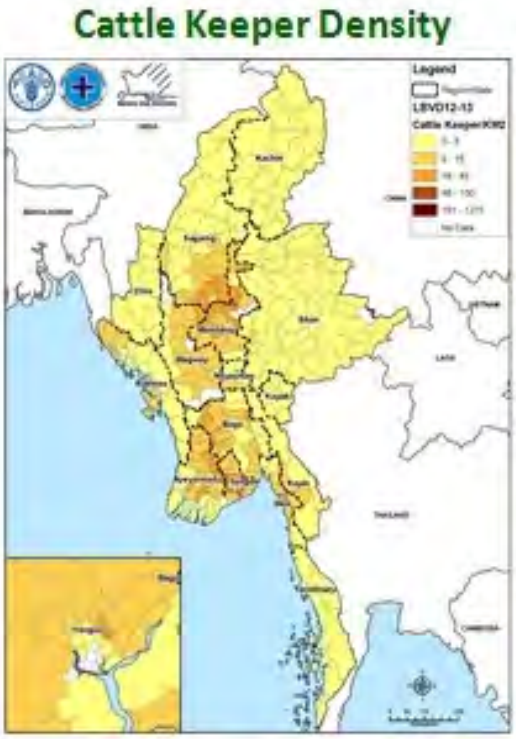


Figure 5. Cattle Keeper Density.

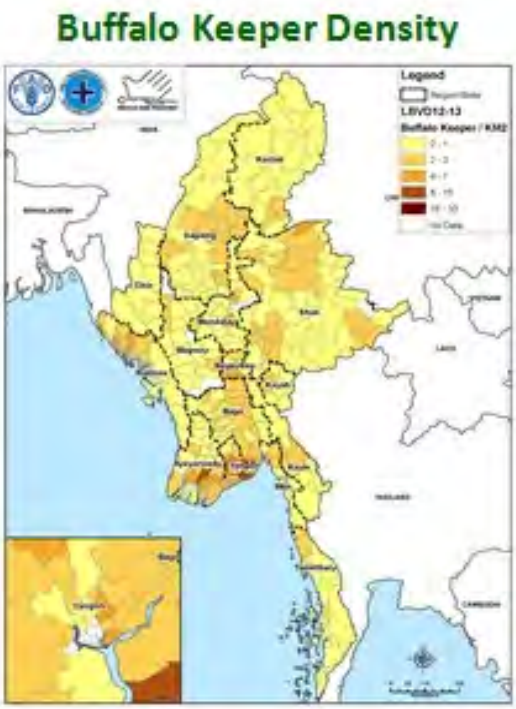


Figure 6. Buffalo Keeper Density

Figure 7. Pig keeper density.

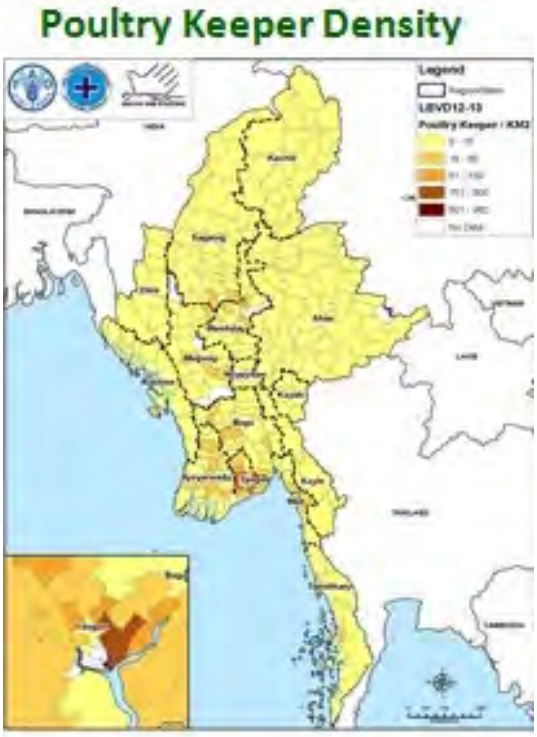


Figure 8. Poultry Keeper Density.

Acknowledgement

This work was supported by the Food and Agriculture Organization of the United Nations GCP/RAS/244/ITA, Livestock Breeding and Veterinary Department, Ministry of Livestock, Fisheries and Rural Development, Myanmar with funding from the Government of Italy.

Surra outbreak control response, 2008 outbreak and post-outbreak initiatives: the Agusan del Norte experience

Joseph Dargantes and Belen Aruelo
Provincial Veterinary Office, Agusan del Norte, Philippines

Introduction

Surra, or animal trypanosomis, is caused by a protozoa, *Trypanonoma evansi,* and is primarily transmitted by blood-sucking flies that belong to the genus *Tabanus*, commonly known as horseflies. It is considered the second most economically important livestock disease in the Philippines. In April 2008, Surra first broke out in the southern part of the province in the municipality of Las Nieves, engulfing 20 *barangays* (village, district or ward). It was precipitated by uncontrolled animal movement, which also affected the adjacent municipalities of Buenavista and Carmen, causing a total of 96 animal mortalities.

Materials and methods

Mass treatment of all susceptible animals was conducted in Surra outbreak areas. Prophylactic treatment was also facilitated in nearby barangays to control the spread of the infection. Serosurveillance were also performed to determine the extent of the infection. An Information Educational Campaign was carried out for livestock owners to encourage them to participate in the disease control campaign. Concerned agencies, academics, and local government units were linked. A population density map of Surra susceptible animals was generated using Geographic Information Systems software. Data were encoded in the Phil-AHIS for recording and analysis. Studies on the insect vectors were also conducted

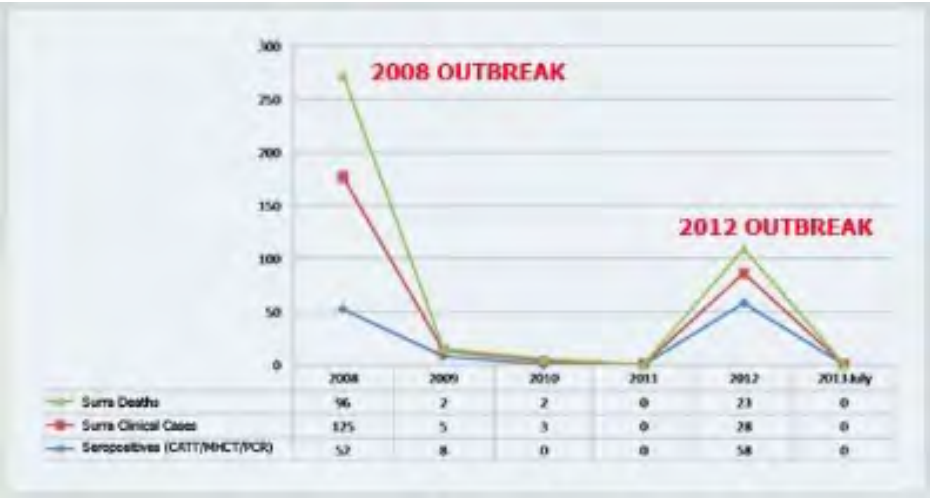


Figure 1. Surra situation in Agusan del Norte, 2008-2013.

Results

In 2012, a new Surra outbreak appeared in the northern part of the province causing 23 animal mortalities. The outbreak was immediately contained and was traced to the entry of un-examined dispersed animals. A protocol for moving animals for dispersal was later enforced.

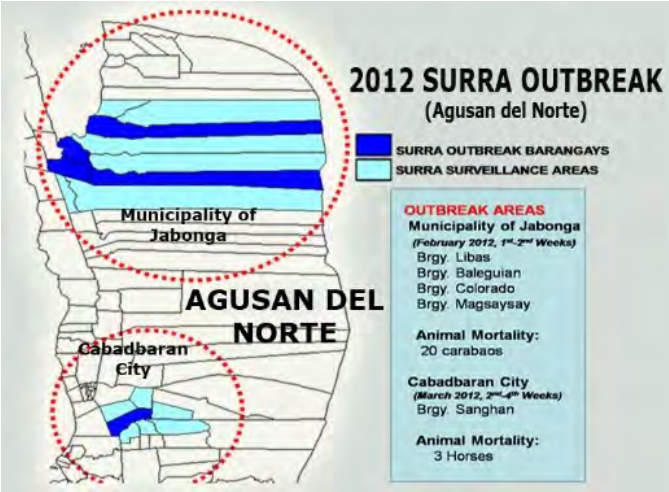


Figure 2. Surra affected *barangays* in Agusan del Norte, April-June 2013.

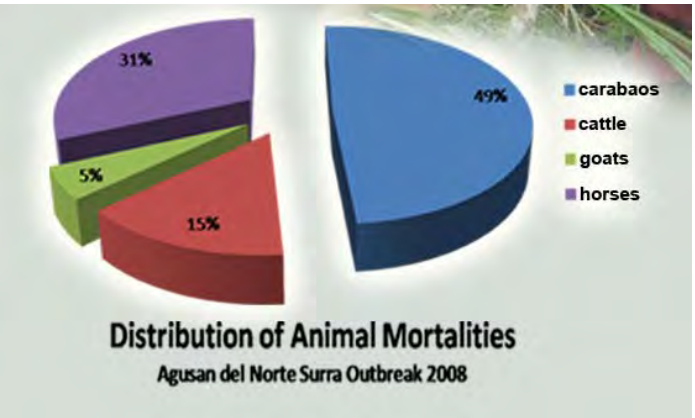


Figure 3. Distribution of animal mortalities, Agusan del Norte outbreak 2008.

Acknowledgement

Central Mindanao University, Mindanao Unified Surra Control Approach Program (MUSCA), DA-RFU XIII, RADDL-CARAGA, Bureau of Animal Industry.

Rabies prevention and elimination project

Ma. Cyrosa Leen Mabel Sinel and Rolly Billones
Office of the Provincial Veterinarian, Province of Aklan, Kalibo, Aklan, Philippines

Introduction

The project was conceptualized mainly to prevent and eliminate rabies in dogs in the province of Aklan and declare Boracay a rabies-free island. Specifically, the project aims to vaccinate at least 70 percent of the total dog population in the province, conduct information advocacy on responsible pet ownership, distribute information education and communication (IEC) materials, conduct dog shows and other related activities and provide veterinary services at a walk-in veterinary clinic.

Materials and methods

The project involves the following activities: installation and printing of IECs, conduct of dog shows, veterinary extension services, meetings and symposia, anti-rabies vaccines, and dog vaccinations as well as vaccine carriers.

Results and discussion

The results show that dog rabies cases dropped from 3 deaths in 2010 to zero death cases in 2012 and 2013 (Figure 1). Vaccination reached a peak of 35 736 dogs in 2012, which is equivalent to 73.57 percent of the total 48 571 dog population(Figures 3 and 4). The level of awareness about rabies also increased with the distribution of rabies pamphlets, leaflets, radio spots and interviews and the conduct of dog shows. Boracay Island was declared a rabies-free island by the Bureau of Animal Industry and the Department of Health and citations will be awarded on 28 September 2013 during the World Rabies Day Celebration in Boracay Island.

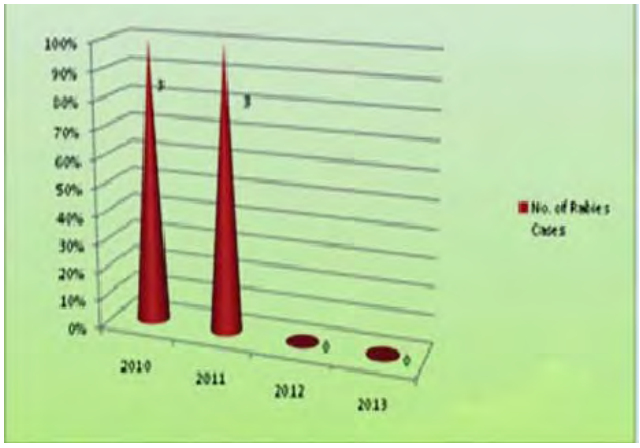


Figure 1. Number of rabies cases inAklan Province, 2010-2013.

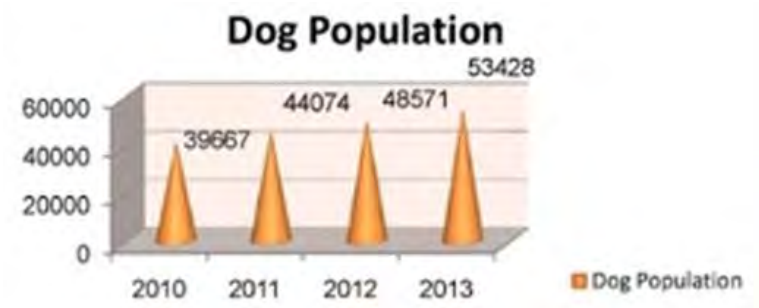


Figure 2. Dog population in Aklan Province, 2010-2013.

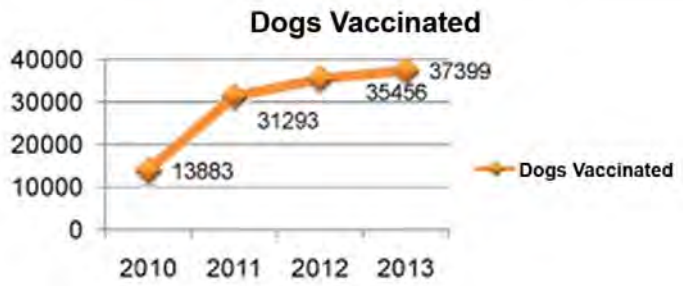


Figure 3. Dog vaccination coverage in Aklan Province, 2010-2013.

Acknowledgement

Aklan Provincial Veterinary Office, Provincial Health Office, Local Government Units, Aklan Dog Enthusiasts, Aklan Pet Owners, The Bill and Melinda Gates Foundation, DA-RFU VI, Bureau of Animal Industry.

Annex 6

Phil-AHIS as a significant tool in the strategic control of rabies in Batangas Province, Philippines

Batangas Provincial Veterinary Office
Province of Batangas, Philippines

Introduction

In 2012, the province of Batangas experienced an exponential increase in the number of human cases of rabies. From three rabies cases in 2010 and 2011, there was an upsurge in 2012 with 11 human cases. Cases then continued to rise despite the increase in vaccination coverage of 15 percent in 2009 to 39 percent in 2011.

Materials and methods

The Phil-AHIS served as a tool in identifying the specific locations of the 2012 rabies cases in the province of Batangas with the use of a Global Positioning System (GPS) device. A three kilometer and five kilometer radius from affected householdswas plotted using Quantum GIS to get the list of villages at risk of rabies. The information was presented to the Provincial Rabies Prevention and Control Coordinating Committee to develop a strategic approach to controlling rabies in the province.

Results and discussion

Phil-AHIS provided the basis for the conduct of strategic vaccination in high risk*barangays* and the three to five kilometer radius coverage areas as shown in the municipality of Balayan (Figure 1). The information from Phil-AHIS also served as a basis for determining the volume of vaccines needed and other logistical requirements.

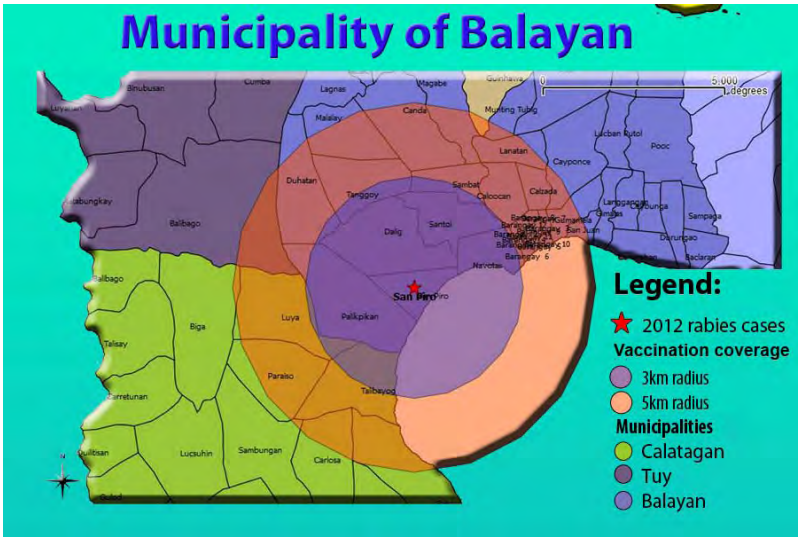


Figure 1. Vaccination coverage in the 3-5 km radius of the Municipality of Balayan.

Immediate interventions included strategic mass vaccination and an information and education campaign at elementary and secondary schools. A total of 1 081 elementary students attended lectures on rabies.

Vulnerable areas were determined based on the dog population density, human population, and presence of schools. For the municipality of Balayan, the vaccination coverage improved from 769 dogs vaccinated in 2012 to the first quarter of 2013.

Acknowledgement

Provincial Government of Batangas, Provincial Veterinary Office, DA-RADDL IV-A, Local Government Units (City and Municipality) of Batangas.

Application of GIS to improving veterinary services in Cebu Province, Philippines

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Introduction

Cebu is located in the heart of the Philippine archipelago and is one of the four provinces in Central Visayas. Tourism is important in this region and zoonotic diseases are always threats that need to be prevented and controlled. Rabies is endemic in Cebu and prevention at the animal source is the preferred strategy. The province has intensified its vaccination campaign to control and eradicate rabies. In 2011, two islands in the province, Camotes Island and Malapascua Island, were declared nationally as Rabies-Free Zones. Application of the Quantum Geographic Information System (GIS) in Phil-AHIS reports provides better visual information of the zoonotic disease in the province.

Materials and methods

Phil-AHIS reports from towns and cities were encoded into the database for the descriptive study. Quantum GIS was employed to describe the spatial distribution of Rabies cases and vaccination coverage. Microsoft Excel was used to describe animal, time and place distribution.

Results and discussion

The rabies vaccination coverage in Cebu in 2010 was only 13 percent. In 2011, it increased tremendously to 90 percent due to the availability of vaccines and other logistical support given to towns and cities. For 2012, vaccination coverage was also high at 88 percent, as 286 320 dogs were vaccinated out of the total population of 326 624.

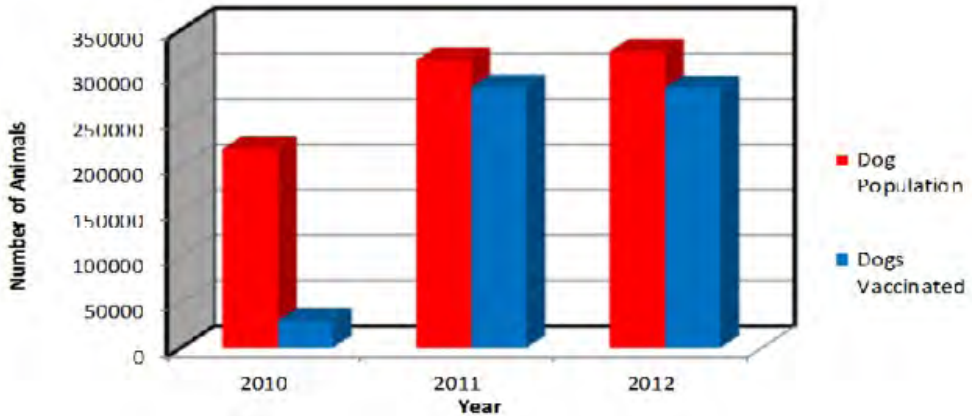

Figure 1. Vaccination coverage in Cebu Province, 2010-2012.

The highest number of dogs vaccinated both in 2011 and 2012 was in October. It appeared that it was in the second semester of each year that mass vaccination was done in the province of Cebu.

Among the 53 LGUs, Cebu City has the highest dog population and had eight canine rabies cases. The city was able to vaccinate more than 6 000 animals.

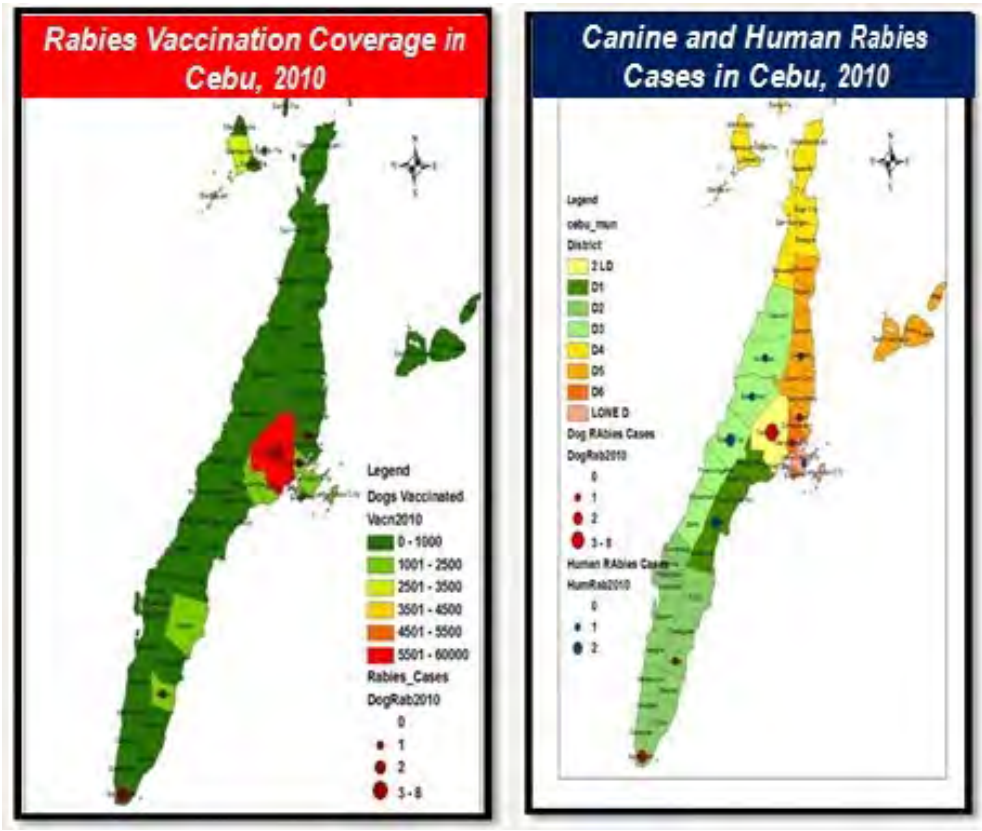

Figure 2. Rabies vaccination coverage in Cebu, 2010.

Though much lower compared to 2011, 2012, vaccination coverage (88 percent) was much higher than what was set by the World Health Organization. To eliminate the rabies virus in the dog population and thus reduce the risk of human rabies, WHO recommends dog vaccination coverage of 70 percent.

Conclusion

The application of GIS in veterinary reports is vital in decision-making. It provides better information and understanding of a veterinary program such as Rabies vaccination. Particularly it helps in policy and advocacy, monitoring and evaluation to improve the program interventions, budget and financial support, and feedback mechanism and report generation.

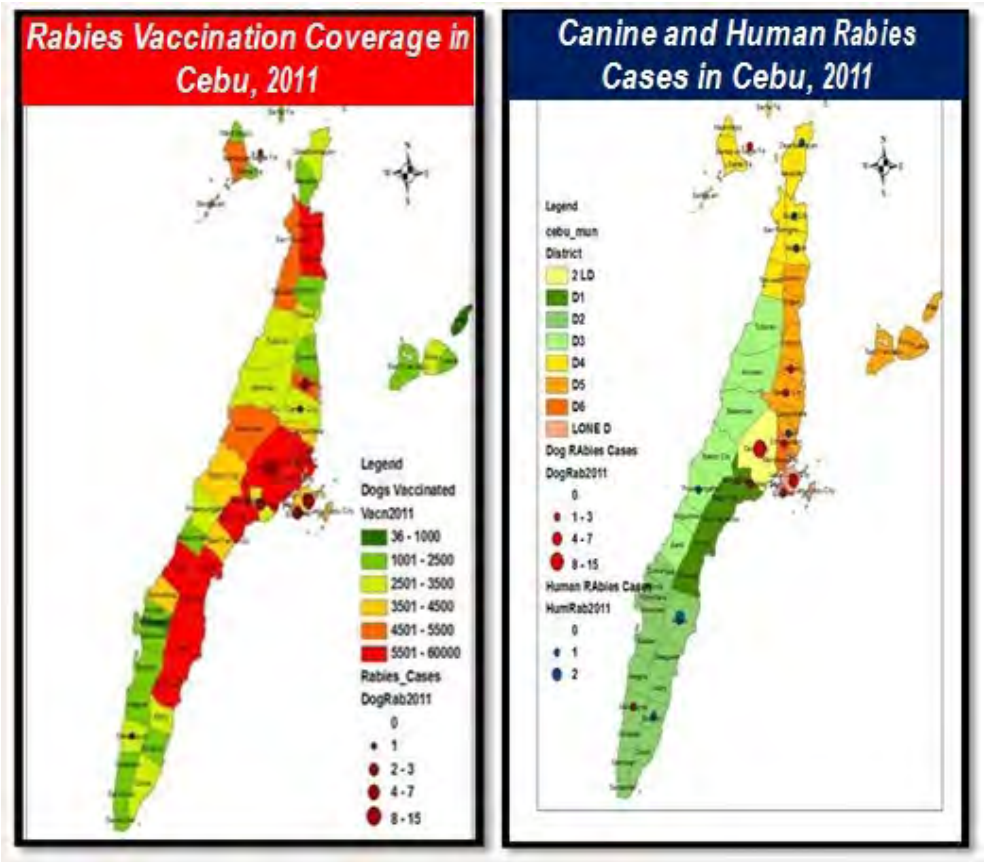

Figure 3. Rabies vaccination coverage in Cebu, 2011.

Recommendations

1. Prioritize vaccination in high risk Metro Cebu areas and those local government units with positive rabies cases.

2. A massive vaccination drive should be concentrated more in *barangays* where cases have been reported.

3. The Provincial Animal Disease Diagnostic Laboratory (PADDL) should have better laboratory diagnostic capacity.

4. Improve coordination with health officials in investigating reported rabies cases.

5. Enhance the knowledge of technicians and frontline implementers on rabies.

6. Emphasize good governance of veterinary services, better use of resources, and well-structured vaccination campaigns in domestic animals.

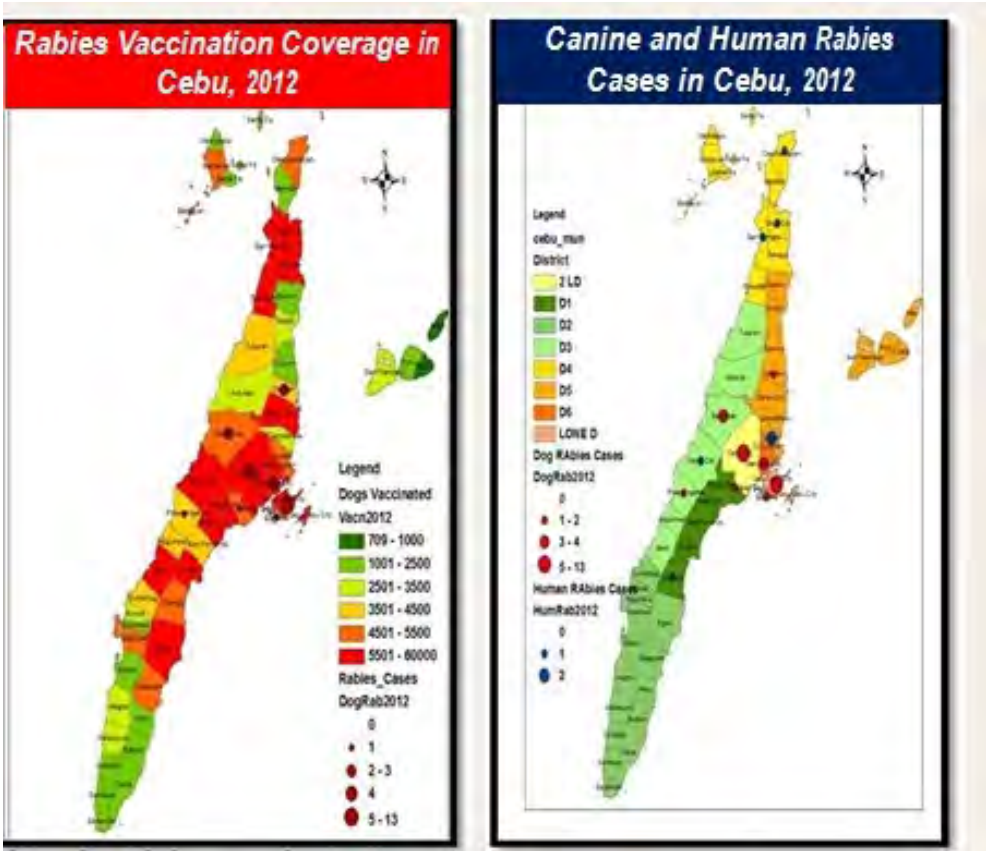

Figure 4. Rabies vaccination coverage in Cebu, 2012.

Acknowledgement

Cebu Provincial Veterinary Office, Office of the Provincial Governor, Province of Cebu, DA-RFU VII, Food and Agriculture Organization of the United Nations and the Bureau of Animal Industry.

Annex 6

Mapping and description of duck markets and duck market dynamics in seven provinces in Cambodia

Sorn San,[1] Davun Holl[1] and Sinel Holl[1]
[1]*National Veterinary Research Institute (NaVRI)*

Introduction

Ducks play an important role in the transmission and maintenance of Highly Pathogenic Avian Influenza (HPAI) virus. The major risk factors in spreading HPAI are the movement of live poultry, their products and contaminated materials. The study aimed to determine the dynamics of duck marketing in seven provinces, and identify critical risk points for disease transmission and develop measures to manage or reduce the risks of transmission from ducks to poultry and humans.

Materials and methods

The study was conducted in seven provinces: Pursat, Battambang, Preah Sihanouk, Svay Rieng, Banteay Meanchey, Takeo and Kampong Cham. Methods comprised the development of a survey questionnaire, management of a field survey team, sampling, data collection and data analysis. Figure 1 shows the location of duck markets in Cambodia.

Figure 1. Location of duck markets in Cambodia.

Results and discussion

Duck marketing and trading in the provinces are mainly dependent on the supply of poultry within the province and the movement of poultry, which is driven by price and disease status. Poultry supply generally comes from local small to medium scale poultry producers within the province. When HPAI outbreaks occur, the supply of poultry within the province, for example, in Takeo, Kampong Cham and Banteay Meanchey, drops due to the implementation of disease control measures by the government. This causes the supply of poultry to be sourced from other provinces to meet the demand.

Critical risk points in disease transmission were identified as: movement of live poultry, close mixing of ducks and chickens at markets, management of unsold birds, and disposal of poultry waste (Figure 2).

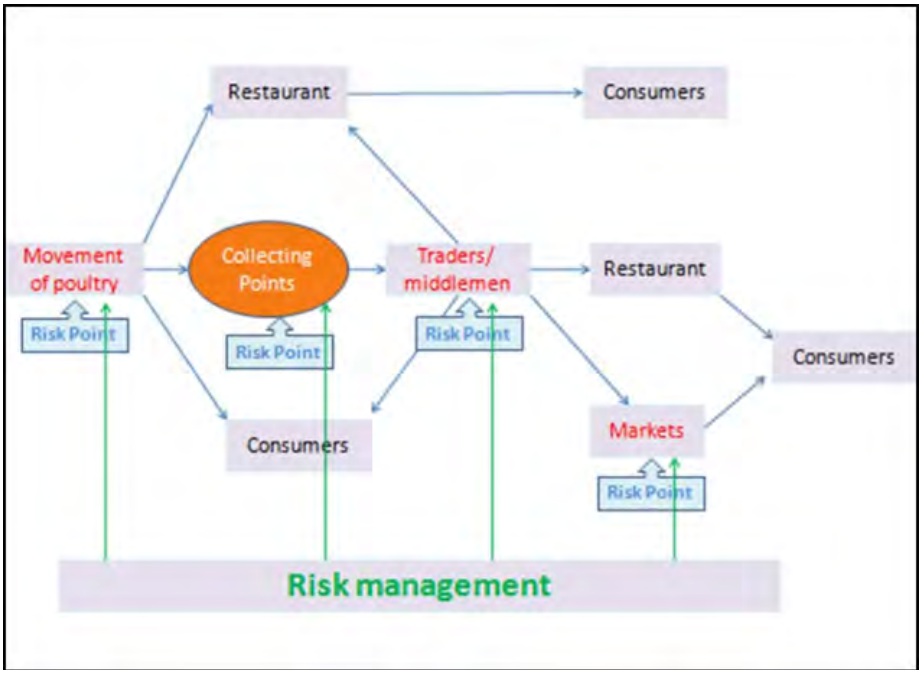

Figure 2. Flowchart of risk points.

Poultry movement is a major risk point for disease transmission. The driving forces for the poultry movement are price differences of poultry products, low level of enforcement on cross border activities, and lack of supply of poultry products within the province.

Acknowledgement

The Food and Agriculture Organization of the United Nations, DAHP/MAFF, NaVRI, Local authorities and poultry sellers, funding from the Government of Italy.

Annex 6

Smallholder dairy survey in pilot townships of Mandalay, Yangon and Shan State, Myanmar

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Introduction

A smallholder dairy survey was conducted in fifteen townships of Mandalay, Yangon Regions and Shan State in Myanmar. The study aimed to collect standard information about smallholder dairy production from a broad range of producers in the area, determine farm profiles, assess productivity and identify constraints for future development plans for dairy cattle.

Materials and methods

The survey comprised personal interviews and a questionnaire. A total of 1 017 respondents were interviewed in the townships included in this survey: Amarapura, Hlegu, Kalaw, Kyaukse, Meikhtila, Mingalardon, Patheingyi, Pyawbwe, PyinOoLwin, Sintgaing, Tada-U, Tatkone, Taunggyi, Tharzi and Yamethin Townships. Approximately 10 percent of the collected data were omitted during data analysis after record validation and checking due to some misunderstandings during the interviews or errors in data encoding.

Results and discussion

Results showed that there is a wide range of differences between the numbers of cattle owned by a farmer. The median number of cattle owned by a farmer is seven, while the average was 12 head per farm. It was also noted that 16 percent of respondents use their own bulls for breeding while the rest seem to be using artificial insemination or bulls from other farms. Sixty four percent also reported a calving interval minimum of 300 days to a maximum of 750 days after removing the outliers of less than 250 days. A total of 61.4 percent said their cows had yearly calving intervals. A minimum of two viss[1] of milk and a maximum of 700 viss could be produced in the study townships.

[1] Viss: traditional unit of measure; 1.63293 kg

Figure 1. Map of townships where the survey was conducted.

Acknowledgement

The survey was implemented by the Livestock Breeding and Veterinary Department (LBVD) and Township Veterinary Officers in collaboration with the Environmental Animal Health Management Initiative (EAHMI) Project of the Food and Agriculture Organization of the United Nations (FAO) funded by the Government of Italy.

Targeting surra interventions in Mindanao using geographic information system tools

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Introduction

The main draught and transport animals in the Philippines, horses, carabaos and cattle, are greatly affected by the protozoan (*Trypanosoma evansi*) infection called Surra. Surra is mechanically transmitted mainly by Tabanid flies to domestic animals. This disease causes low productivity, abortion, infertility and ultimately death in the infected animals.

The Mindanao Unified Surra Control Approach (MUSCA) program, established in 2002, has identified the impacts of this economically important disease. Surveillance conducted in Mindanao from 2002 to 2009 indicated that the parasite is present in most areas. However, the data on the disease distribution is still inadequate because it lacks information on the status of the risk based on environmental and climatic factors associated with the disease. The use of remotely sensed data, Geographic Information Systems and Global Positioning Systems can help improve the quality of information provided to decision makers, particularly in the prioritization of areas for monitoring and control of Surra. In general, the aim is to improve the existing support system on planning Surra Control by producing Mindanao Surra risk maps and specifically identifying locations of high and low risk.

Results and discussion

In the study of seasonality and abundance of Tabanids in Davao del Norte and Compostela Valley in 2011, a total of 2 088 Tabanids present in high density areas were collected using Nzi traps over two months from 17 villages. Five species belonging to the genera Tabanus and Chrysops were identified: *Tabanus partitus Walker*, *T. ceylonicus Schiner, T. philippinensis Krober, T. reducens Walker, Chrysops cinctus Bigot*.

Rainfall data was collected from 12 weather stations in Mindanao and reclassified as very low, low, moderate, high and very high (Figure 1). The breeding potential and survival of vectors increases during the wet season and is widespread in lowland areas. Surra is present where rainfall is moderate to high. Potential high risk areas are Surigao del Norte, Agusan del Sur, Surigao del Sur, Zamboanga del Sur, Zamboanga Sibugay, Compostela Valley, Davao del Norte, Davao del Sur and North-South Cotabato.

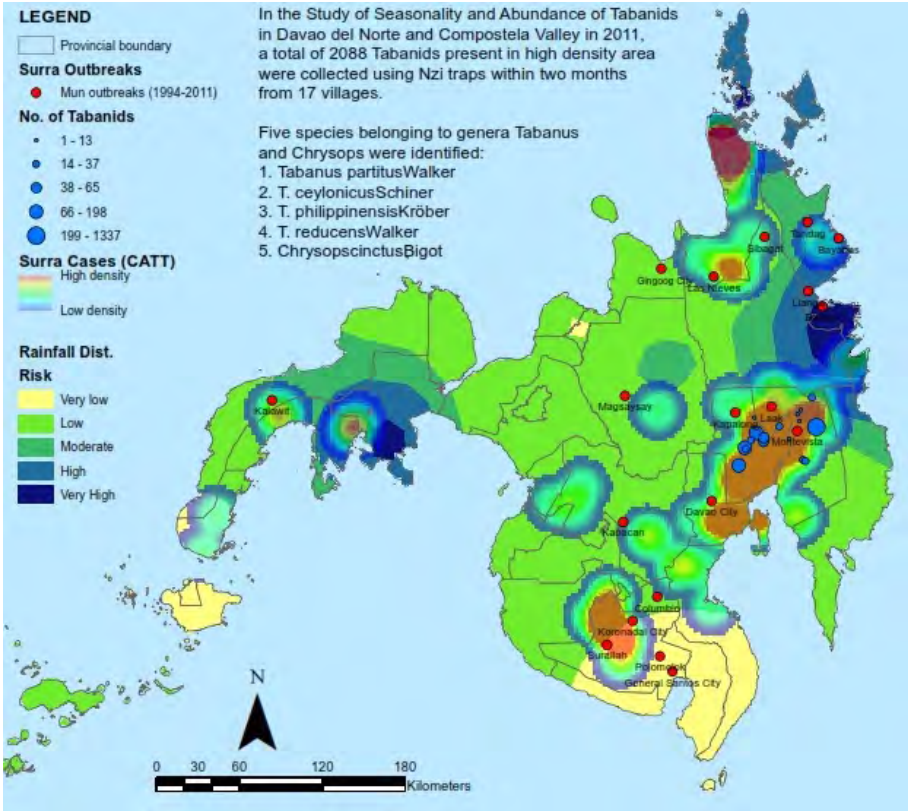

Figure 1. Distribution of tabanids in the study area.

Surra cases are also more prevalent at lower than at higher elevations. Moreover, Surra vectors are observed in croplands, open/closed canopy, cultivated areas mixed with brushland and grassland, arable land, coconut plantations and mossy forest.

Conclusion and recommendations

Based on a rainfall land cover and elevation model, Surra high and low risk areas were identified. Decision makers can better allocate resources for surveillance and monitoring activities. The efficacy of prevention efforts can be enhanced because of effective targeting of high-risk areas. Movement of animals from identified high risk areas should be minimized as a result of more accurate and directed information dissemination on Surra high risk areas.

Acknowledgement

Mindanao Regional Field Units and Surra Coordinators, Local Government Units, University of Southern Mindanao, Central Mindanao University, Australian Center for International Agricultural Research, Food and Agriculture Organization of the United Nations, Livestock Development Council, Bureau of Animal Industry.

Annex 6

Agricultural land-use mapping for environmental animal health management in Nueva Ecija Province, Central Luzon, Northern Philippines

Nueva Ecija, University of Science and Technology
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Introduction

This study gathered a wide range of geo-spatial information together from various sources, including: biophysical environmental characteristics, socio-economic conditions, infrastructure, crop production, livestock and poultry resources, and animal diseases. The province is comprised of 27 municipalities, five cities and 849 *barangays*.

Materials and methods

Spatial information was obtained from various sources. Most datasets originated from Local government units (LGUs), specifically the Municipal Agricultural Offices, and were obtained by survey form with assistance from the Office of the Provincial Agriculturist and EAHMI. Livestock population figures were obtained from the 2010 Livestock Population Survey conducted by the Bureau of Agricultural Statistics (BAS). GIS maps on climate, soil, water resources and roads were sourced from the Bureau of Agricultural Research (BAR). Shuttle Radar Topography Mission (SRTM) elevation data was downloaded from the United States Geologic Survey (USGS) and the position of roads was obtained from Google and Openstreet Maps.

Results and discussion

In 2007, the total human population was 1.95 million, most of whom depend on agriculture for their livelihoods (Figure 1). The highest proportion of people live in the municipalities of Gabaldon (94 percent) and San Antonio (84 percent). An average of 27 percent of the province's total population are engaged in agricultural activities. Nueva Ecija is the top rice producer in the country. Post-harvest facilities and other infrastructure are limited or lacking in most municipalities, considering the land area and population size. Carabao, cattle, swine, goats and sheep are raised in all parts of Nueva Ecija. San Jose City and Aliaga had the highest carabao densities, while Cuyapo, Nampicuan and Peñaranda had the highest cattle densities. San Isidro had the highest swine density, while Cabanatuan City had the highest concentration of chickens. Muscovy and Mallard ducks are raised in Rizal, San Isidro and Sto. Domingo, while turkeys, pigeons and geese are kept by smallholder farmers. The main animal diseases reported to the Provincial Veterinary Office were: hemorrhagic septicemia in carabao and cattle; fasciolosis in both large and small ruminants, colibacillosis in swine, and chronic respiratory disease (CRD) and Newcastle disease (NCD) in poultry.

Collaboration between NEUST, LGUs provincial government offices and EAHMI has demonstrated the potential utility of standardized data collection, input and storage. The information gathered and maps generated have benefited LGUs and provincial

government offices, especially with regard to the development planning and intervention targeting in the agricultural sector.

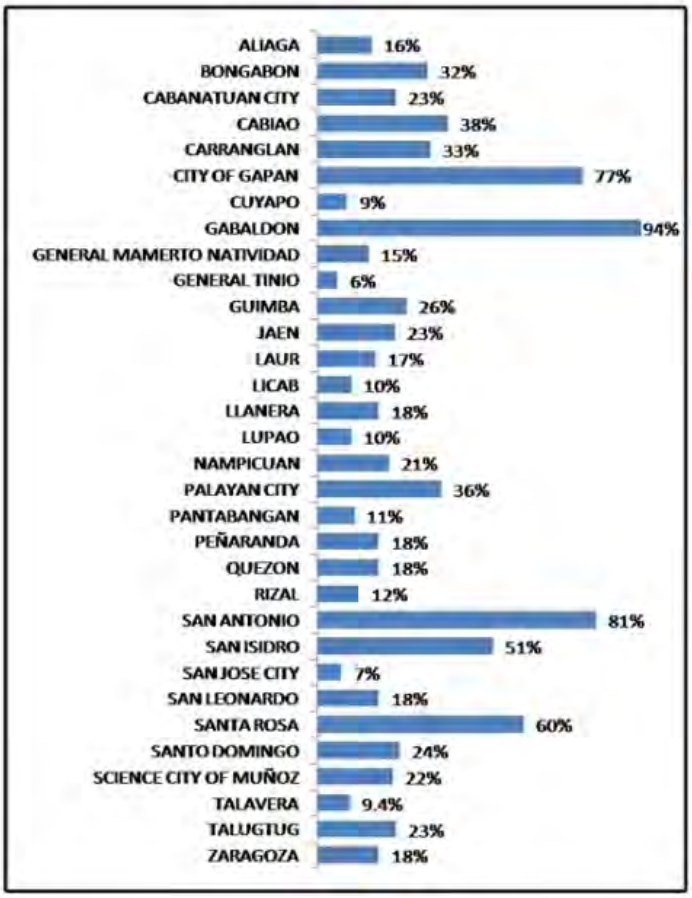

Figure 1. Percentage of population engaged in agriculture.

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Acknowledgement

This work was supported by the Food and Agriculture Organization of the United Nations GCP/RAS/244/ITA and funded by the Government of Italy.

Annex 6

An investigation of farming system and environmental factors relating to the seroprevalence of Reston Ebola virus in northern Philippines

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Introduction

This study was conducted to review the previous findings of various surveillance studies of pigs and bats and to assess possible ecological factors associated with Reston Ebola virus (REBOV) antibody detected in pigs, and the characteristics of swine production systems in central and southern Luzon Island, northern Philippines.

Materials and methods

Data were obtained from various sources, including a REBOV antibody detection survey of pig samples from abattoirs, a survey of pig raisers, bat surveillance reports and environmental characteristics from the Department of Agriculture and the National Mapping and Resource Information Authority (NAMRIA).

Results and discussion

Results of the review showed that the mean REBOV seroprevalance in 3 575 samples from abattoirs across the study area was 50.7 percent. A wide range of seroprevalence was detected, from 17.8 percent in Pangasinan Province to 78.9 percent in neighboring Tarlac Province. A dynamic trade and movement of swine exists between provinces.

Table 1. Seroprevalence of REBOV and proportion of backyard farms by province.

Province	Seropositives	Samples	Seroprevalence %	Proportion of Backyard Farms
Batangas	417	845	49.34	45.37
Bulacan	472	713	66.19	64.95
Cavite	120	265	45.28	31.43
Laguna	51	157	32.48	32.26
Nueva Ecija	124	268	46.26	70.91
Pampanga	149	220	67.72	6.67
Pangasinan	80	449	17.81	92.19
Quezon	77	198	38.88	10.26
Rizal	129	213	60.56	7.81
Tarlac	195	247	78.94	30.88
Total	**1814**	**3575**	**50.74**	

The REBOV seroprevalence was inversely correlated with the proportion of backyard farms (Pearson correlation = -0.634; p = 0.049), i.e. the higher the proportion of smallholder farms, the lower the prevalence. It was also inversely correlated with annual rainfall (Pearson correlation = -0.132; p = 0.033), i.e. the higher the rainfall, the lower the prevalence. No other statistically significant associations could be established with other parameters examined such as climate type, temperature, slope, landcover, rice areas, distance from forest areas and distance from rivers. One possible explanation for the lack of statistically significant correlations with the various other factors tested is that the locations of seroprevalent farms could only be approximated to their reported *barangay*, so precise ecological profiles could not be established. Moreover, the seroprevalent farms are so widespread across production systems and environmental conditions that no correlation exists with the various factors tested. In future studies, an alternative approach would be to conduct more detailed profiling of prevalent and non-prevalent farms separately.

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Acknowledgment

The Food and Agriculture Organization of the United Nations, FAO-EAHMI Philippines and the Bureau of Animal Industry and funded by the Government of Italy.

Annex 6

Summary report on livestock and poultry data extracted from Viet Nam's General Statistics Office 2011 Agricultural Survey

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Introduction

The national census of rural agriculture and aquaculture is conducted periodically by the General Statistics Office (GSO) to collect basic data on the status of resources and assess development trends. To date, Viet Nam has conducted four censuses (1994, 2001, 2006 and 2011). Decision No. 1785/QD-TTg to conduct an Agricultural and Rural Census on 1 July 2011 was signed by the Prime Minister on 27 September 2010. The 2011 Agricultural and Rural Census collected information from 16 million households, more than 10 000 communes and more than 20 000 large commercial farms. The study aimed to analyze trends in livestock-keeping households in Viet Nam nationally and regionally, and provide recommendations for relevant organizations and those interested in livestock and poultry husbandry in Viet Nam.

Materials and methods

Data from the agricultural census of 2011 and other agricultural surveys conducted by the GSO of Viet Nam were used for descriptive and analytical study. Stata® software was used to extract data from the agricultural census database. MS Excel was used to describe the distribution of livestock-keeping households.

Results and discussion

Viet Nam had an estimated 4.13 million pig-keeping households (HH), accounting for 25 percent of the total HH involved in the census. The northern midland and central regions accounted for over 80 percent of the pig-keeping HH. The majority of (77.5 percent) of pig-keeping HH were smallholders, with 1-5 pigs per HH (Figure 1).

Chicken-producing is estimated to be 7.9 million, accounting for 50 percent of surveyed HH. Similar to pig-keeping HH, chicken-keeping HH were concentrated in the northern and central regions, while the Mekong River Delta has the most small scale producers (67.3 percent).

Buffalo-keeping HH were estimated at 1.4 million, while cattle-keeping HH were estimated at 1.98 million, accounting for 8 percent and 12.3 percent of all surveyed HH.

Goat and sheep-keeping HH were estimated at 167 000 HH accounting for 1 percent of all surveyed HH.

An estimated 89.3 million domestic waterfowl (including ducks, Muscovy ducks and geese) were counted in Viet Nam. Ducks were the most common species and were found mainly in the lowlands.

The human population was estimated to be 87 million, with 71 percent engaged in agriculture. Almost two-thirds (65 percent) of all HH are poultry producers and more than half (57 percent) are livestock producers.

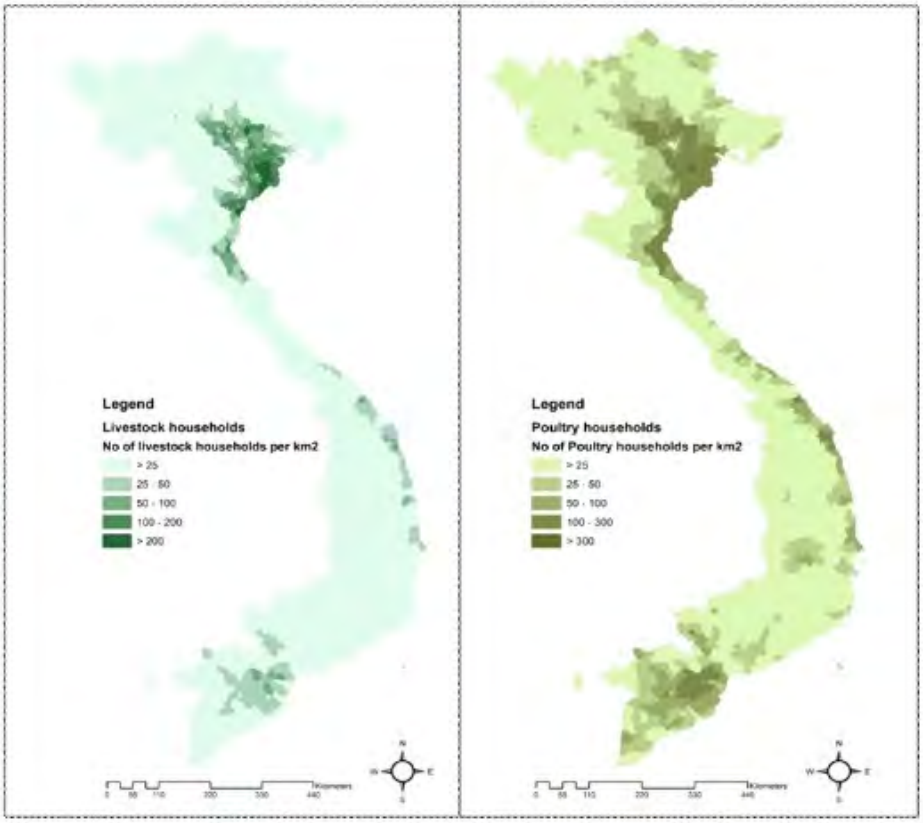

Figure 1. Number of livestock and poultry households per km^2.
Source: Dept. of Animal Health, Viet Nam.

Table 1. Number of livestock and poultry.

	2006	2011
Buffalo	2 923 227	2 551 956
Cow	6 584 785	4 368 610
Milk cow	95 325	236 614
Pig	25 569 413	21 795 582
Chicken	150 094 990	236 364 460
Duck	52 399 674	77 903 693
Swan	12 465 743	12 813 284
Goat	1 805 211	988 888
Sheep		90 900

Annex 6

Conclusion

The study provided the latest high resolution data on farm animal populations and farm animal keepers in Viet Nam, at commune and district levels. This information plays an important role in decision making at the Department of Animal Health and is essential for disease risk analysis and determining the size of animal populations at risk during disease outbreaks.

Acknowledgement

Department of Agricultural Forestry and Fishery Statistics, General Statistics Office.

Infrastructure of veterinary services in Viet Nam

Nguyen Van Long, Pham Thi Thu Hien, Hoang Thi Le Phoung and Phan Quang Minh
Department of Animal Health, Viet Nam

Introduction

Under the Environmental Animal Health Management Initiative for Enhanced Smallholder Production in Southeast Asia funded by the Italian Government, a national survey of the infrastructure of veterinary services in Viet Nam was carried out between 5 January and 31 March 2013.

Materials and methods

A total of 13 835 data records were collected for the five main classifications of infrastructure data of veterinary services in Viet Nam: animal quarantine checkpoints, district veterinary stations, animal breeding farms and disease-free farms, live animal markets and live bird markets, and slaughter houses or abattoirs.

Results and discussion

These data were linked with statistics from animal census data collected through the General Statistics Office (GSO). This allowed analysis of the survey data including geo-referencing of all collected data in this survey and under the previous GSO contract. Maps were generated to present all locations of the veterinary infrastructure services including descriptive results that provide useful information to support better management of animal health in Viet Nam (Figures 1-4). These collected infrastructure data can be used for various purposes within DAH and as well as sharing with FAO as useful references. The results indicated that the infrastructure data was very likely biased because many areas of the country did not provide sufficient information. Data analysis of the survey results, therefore, should be interpreted within these limitations.

A national field survey is essential to collect sufficient information about the infrastructure of veterinary services in Viet Nam. This is important to map the locations of veterinary services which are equally important for spatial analyses of animal health data. To date, no infrastructure data is available at any office of the veterinary system in Viet Nam and no such survey has been carried out before. A long-term plan for a national online database system should be developed to capture not only these infrastructure data, but other information such as outbreaks, surveillance activities and animal movements. The GIS database of DAH has been outdated for a number of years and should be updated. To collect these data, legal regulations should also be available using standardized forms at all levels from the commune to the regions. The data collection should be integrated into the routine activities of SDAH staff.

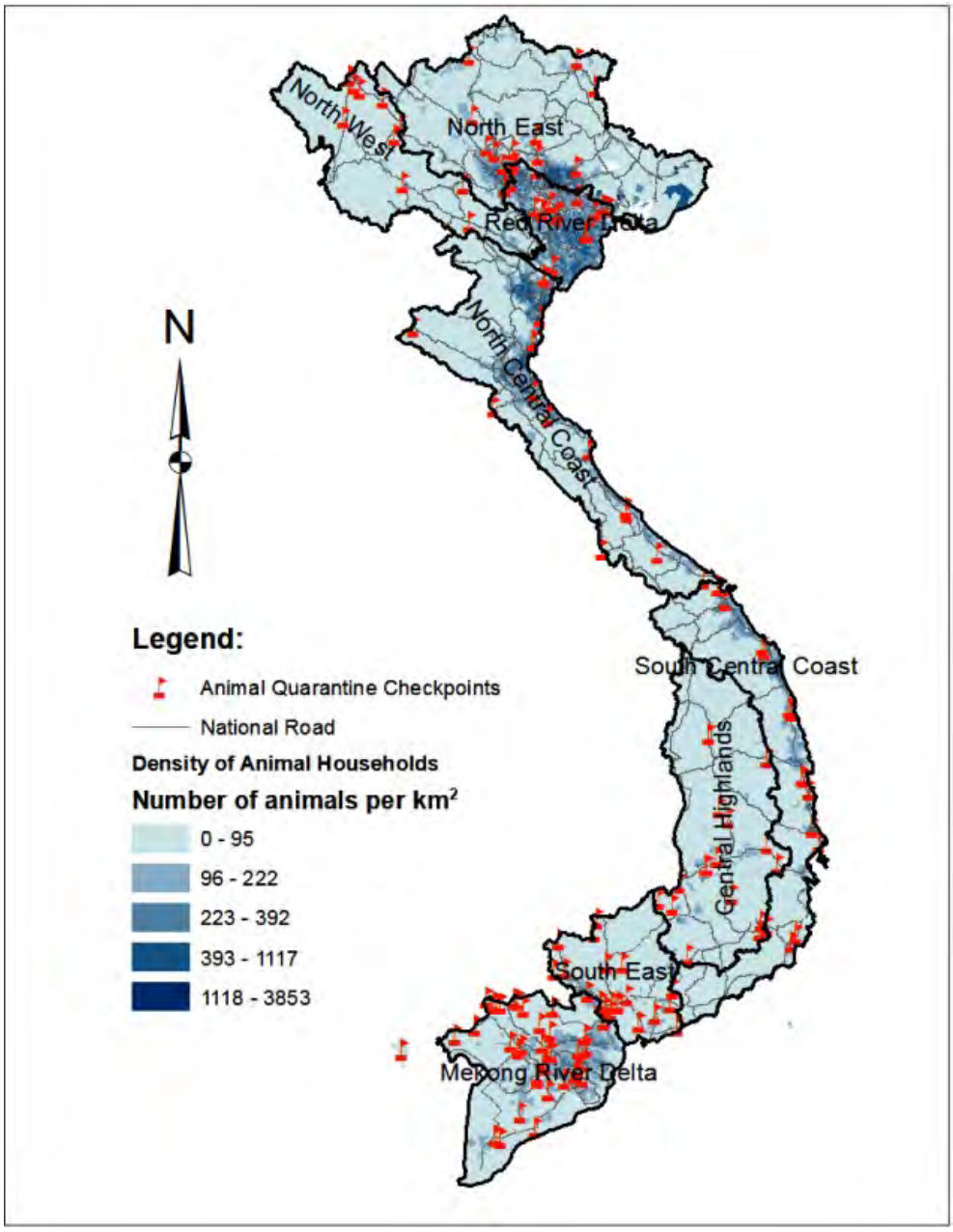

Figure 1. Map showing locations of animal quarantine checkpoints and density (the number) of animal raising households per square kilometer.

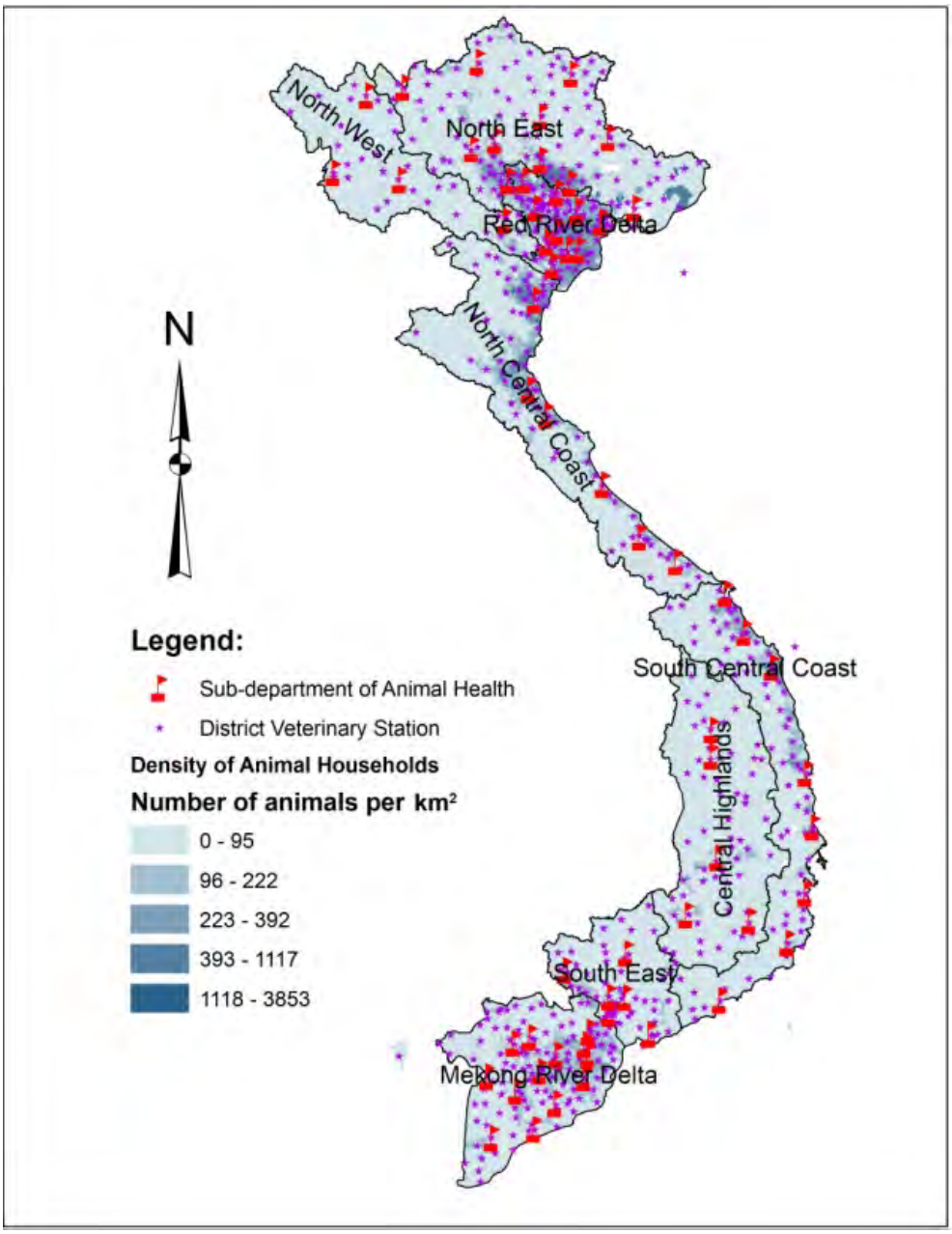

Figure 2. Map showing locations of District Veterinary Stations, Sub-department of Animal Health and density (the number) of animal raising households per square kilometer.

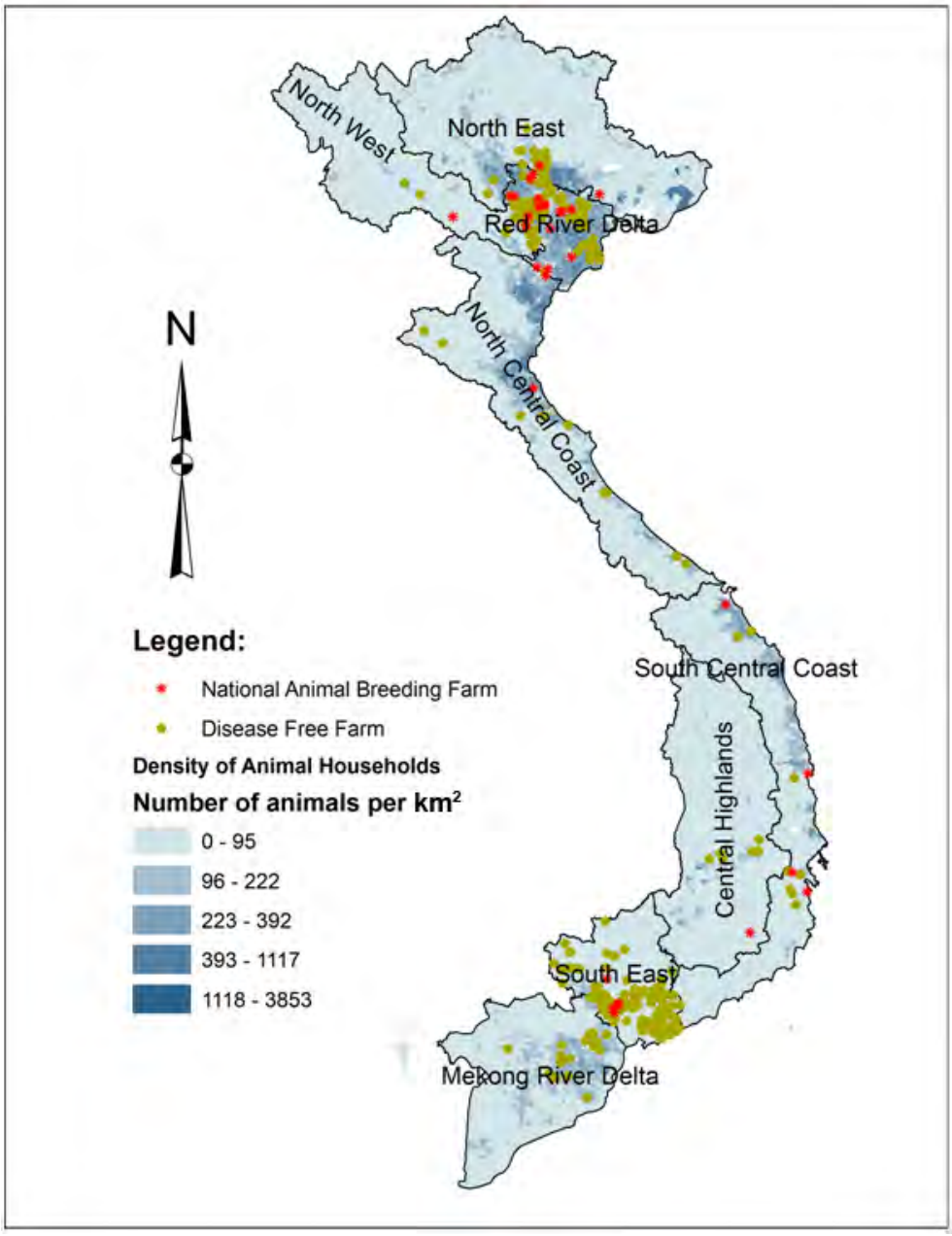

Figure 3. Map showing locations of national animal breeding farms, registered disease-free farms and density (the number) of animal raising households per square kilometer.

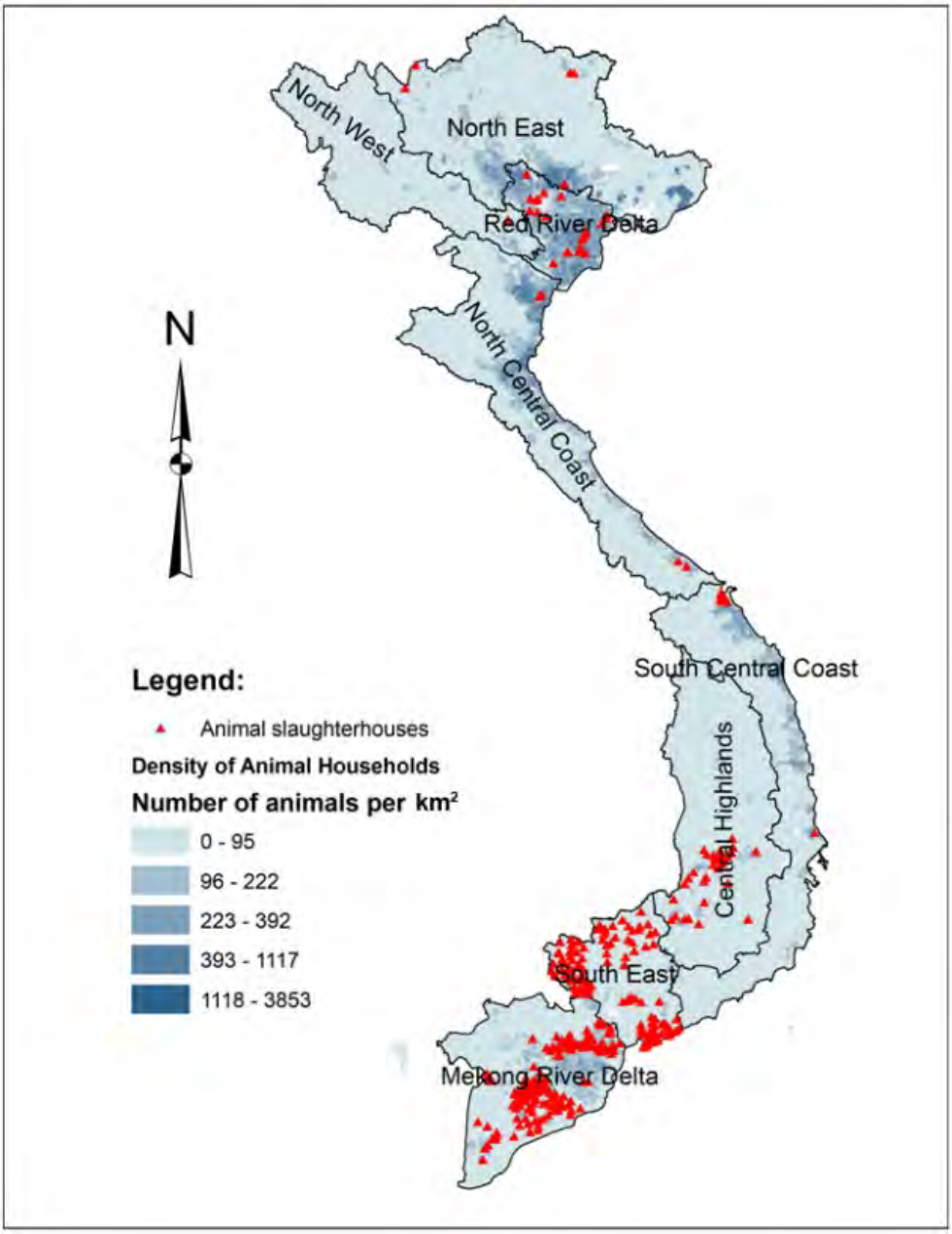

Figure 4. Map showing locations (red triangles) of animal slaughterhouses and density (the number) of animal raising households per square kilometer.

Annex 6

Conclusion

The study provides the most recent high resolution data on farm animal populations and farm animal keepers in Viet Nam at commune and district levels. This information plays an important role in decision making at the Department of Animal Health and is essential for disease risk analysis and determining the size of animal populations at risk during disease outbreaks.

Acknowledgement

We are grateful to DAH for permission to use their data and for logistic support. The survey was funded By EAHMI. We sincerely thank staff of RAHOs, SDAHs and field staff.

Epidemiology, modeling and mapping fasciola risk and control measures of cattle fasciolosis in Cambodia

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Introduction

Fasciolosis is caused by the liver fluke Fasciola gigantica and is transmitted via water snails as intermediate hosts. Fasciolosis is one of the most widely distributed and economically important parasitic diseases across most humid tropical regions of Asia, including members of the Association of South East Asian Nations (ASEAN).

Fasciolosis causes major losses to the agricultural economy of Cambodia (and many other countries in the subregion), in terms of: reduced reproductive performance, limited weight gain, poor quality meat and liver products; and significantly reduced draught power for harrowing and ploughing with consequent reduction in area planted and crop production.

Materials and methods

The potential extent of fasciola disease risk has been assessed using Geographical Information Systems (GIS) software for spatial modelling and integration of various disease risk factors including: proximity to rivers, land use, slope, elevation, and the density of cattle and buffalo.

Results and discussion

The predicative disease risk map (Figure 1), clearly indicates the areas of highest risk of fasciolosis is in the extensive primarily rice growing lowlands around Tonle Sap Lake, and southwards on either side of the Tonle Sap and Mekong Rivers in Kampong Cham, Prey Veng, Kandal and Takeo Provinces towards the Mekong Delta in Viet Nam.

Three forms of fasciolosis control are recommended to farmers:

- Environmental control, involving the collection and storage of feces in a pit or trench for two months to heat and destroy fasciola eggs. This form of control is implicitly incorporated within the ongoing National Bio-digester Programme.
- Modified grazing management and provision of uncontaminated water and fodder.
- Drug treatment once or twice a year, according to drug type and local conditions.

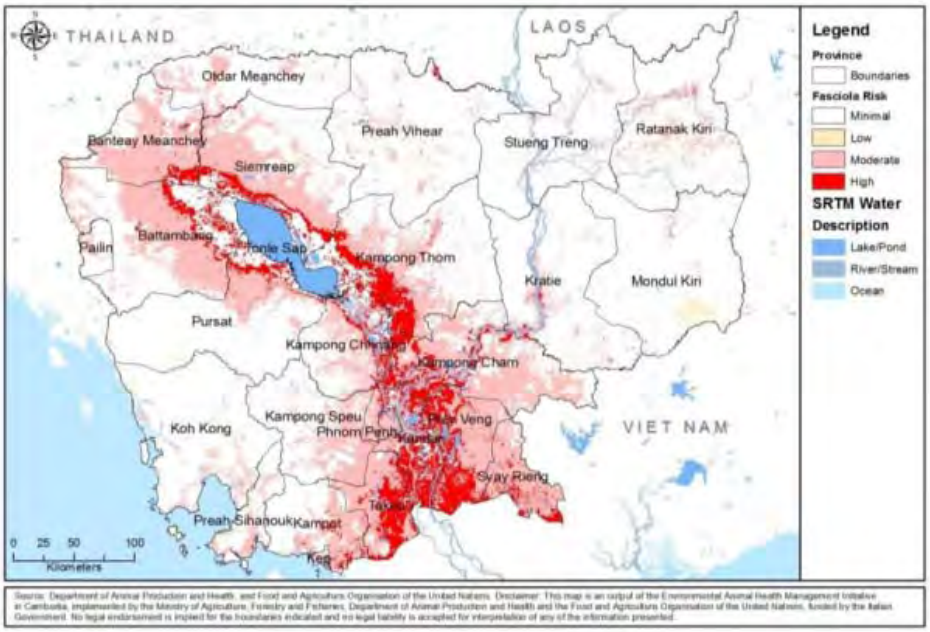

Figure 1. Predicted risk of fasciolosis in Cambodia.

Acknowledgement

Department of Animal Production and Health, commissioned by the Ministry of Agriculture, Forestry and Fisheries' Department of Animal Production and Health (DAPH) and the Food and Agriculture Organization of the United Nations Sub-regional Environmental Animal Health Management Initiative for enhanced smallholder production in South-East Asia (GCP/RAS/244/ITA), and funded by the Government of Italy.

Status of Cambodian livestock and poultry breed and type

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Introduction

Cambodia's farm animal genetic resources are poorly documented and existing information is widely scattered and difficult to access. Therefore, EAHMI supported a study to review and consolidate information about Cambodian livestock and poultry breeds/types

Materials and methods

A comprehensive body of formally published and grey literature relating to Cambodia's farm animal genetic diversity, both mammalian and avian species, was compiled for review of Cambodian entries in the Domestic Animal Diversity Information System (DAD-IS), with a view to identifying and recommending appropriate amendments and revisions, and also for review of international guidelines for animal genetic resources AnGR management and to identify gaps in knowledge and constraints on implementing those guidelines.

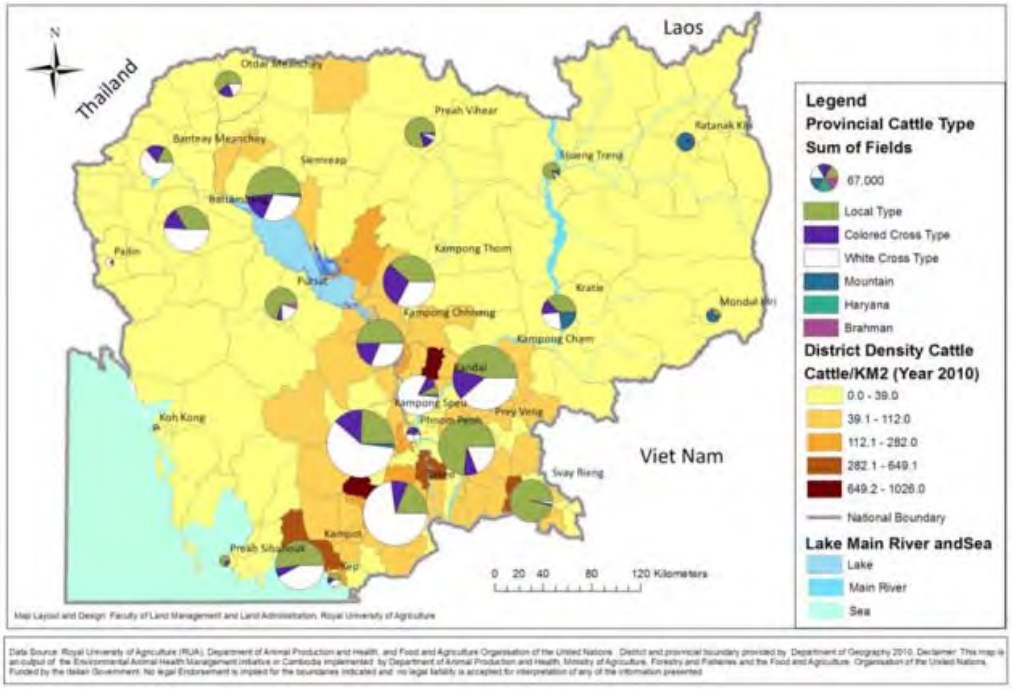

Figure 1. Cattle distribution by district and phenotype proportions by province.

Annex 6

Results and discussion

There were about 14 available reports and studies related to animal genetic resource in Cambodia, mostly consultations, reviews and surveys on the phenotype and genotype characterization in livestock and poultry. Based on the DAD-IS, the following are the breeds recorded per species:

Goats and horses: 1 each
Buffalo, chickens and ducks: 2 each
Pigs: 4 each
Cattle: 10 each

Conclusions and recommendations

Few documents have been published on Cambodian animal genetic resources, either scientific or grey literature. The majority of entries in the DAD-IS lack important characteristics. No information could be found to support the inclusion of some recorded breed types, and some breed types known to exist are not included. The following actions are proposed to address these and other related issues:

- Hold consultation workshops to establish a consensus on local and common names of domestic animals in Cambodia and their international equivalents.
- Update Cambodian entries in DAD-IS with currently available information.
- Identify potential studies to support additional characterization and advance characterization of selected breeds and types of cattle, pigs and chickens.
- Develop a national strategic plan for animal genetic resource management and development, consistent with national priorities and international guidelines.

Acknowledgement

The study is commissioned by the Ministry of Agriculture, Forestry and Fisheries, Department of Animal Production and Health and the Food and Agricultural Organization of the United Nations FAO GCP/RAS/244/ITA, funded by the Government of Italy.

Porcine reproductive and respiratory syndrome outbreak control response in Bulacan Province, May 2010

Environmental Animal Health Management Initiative

Poster presented and awarded "Best Overall Map" during the 2013 Philippine ESRI GIS User Conference held on 21-22 January 2013 in Mandaluyong City, Philippines

Introduction

Porcine reproductive and respiratory syndrome (PRRS) is a viral disease affecting countries in Southeast Asia including the Philippines. Clinical symptoms of PRRS include reproductive failure in breeding stock and respiratory tract illness in young pigs which can cause significant economic losses to swine producers. In 2010, Bulacan was one of the affected provinces in the Philippines.

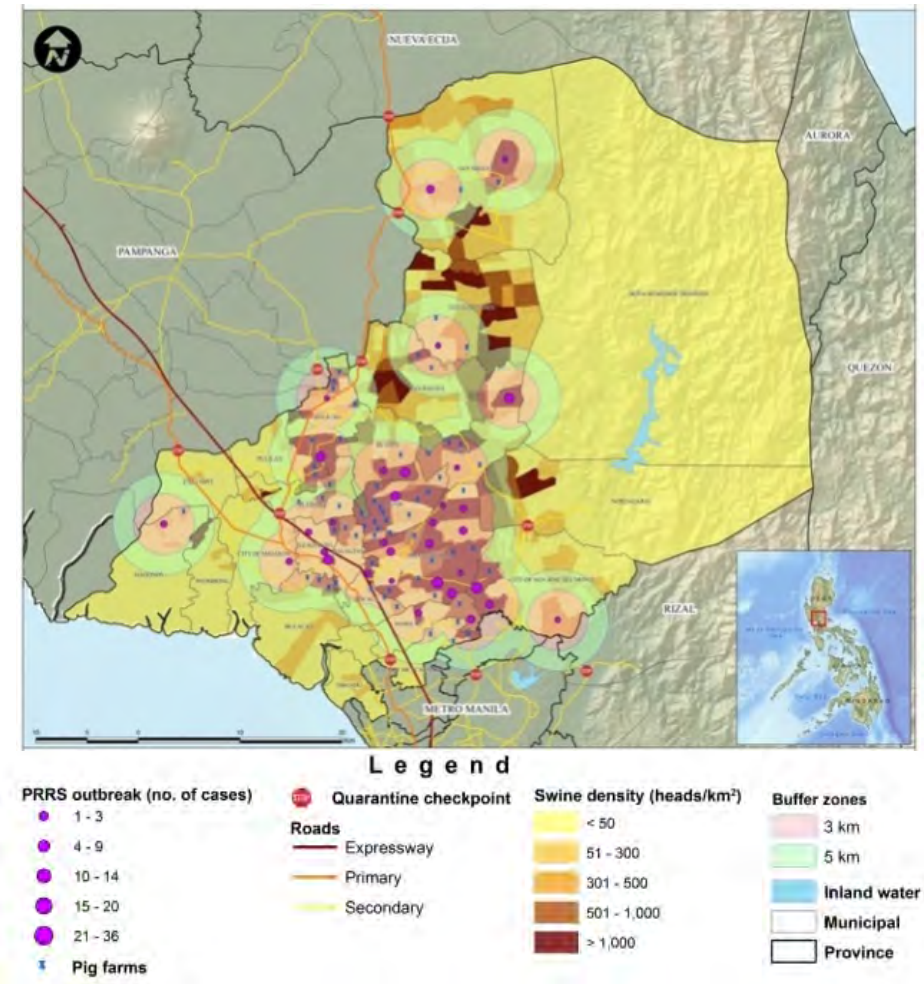

Figure 1. Map of Bulacan showing PRRS outbreak cases, swine density and quarantine checkpoints.

Annex 6

Materials and methods

GIS was used to identify possible affected pig farms within buffer zones, estimate the number of pigs for vaccination and determine quarantine checkpoints that helped during disease control and management.

Results and discussion

Figure 2 shows that Sta. Maria town has the highest swine population in Bulacan and has the most farms affected by PRRS, followed by the town of Pandi Calumpit town has the highest swine population with zero farms affected.

Municipality	Total Swine Population	Estimated Swine Population for Vaccination	Number of Commercial Farms Affected
ANGAT	78 176	67 935	33
BALAGTAS	10 036	8 706	5
BALIUAG	50 408	42 137	14
BOCAUE	5 644	5 422	5
BULACAN	3 923	3 018	5
BUSTOS	42 495	38 774	6
CALUMPIT	122	58	0
CITY OF MALOLOS	475	438	0
CITY OF MEYCAUAYAN	3 213	3 027	14
CITY OF SAN JOSE DEL MONTE	44 612	42 962	39
DONA REMEDIOS TRINIDAD	375	14	0
GUIGUINTO	4 789	4 789	4
HAGONOY	841	630	3
MARILAO	10 129	10 117	15
NORZAGARAY	29 907	11 672	0
PANDI	143 104	136 099	27
PAOMBONG	3 300	68	0
PLARIDEL	3 073	2 295	4
PULILAN	7 241	5 771	5
SAN ILDEFONSO	16 177	2 784	6
SAN MIGUEL	123 145	117 420	11
SAN RAFAEL	22 699	11 112	4
SANTA MARIA	178 655	178 652	77
GRAND TOTAL	**782 539**	**693 900**	**277**

Figure 2. Percentage of population engaged in agriculture.

Acknowledgement

This map was created by the Food and Agriculture Organization of the United Nations Sub-regional Environmental Animal Health Management Initiative for Enhanced Smallholder Production in South-East Asia GCP/RAS/244/ITA), hosted and coordinated by the Department of Agriculture's Bureau of Animal Industry, Visayas Avenue, Quezon City, Metro Manila, Philippines, with funding from the Government of Italy.

Seasonal abundance and molecular detection of trypanosomes and host's blood in tabanids in Mindanao, Philippines

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Introduction

Trypanosoma evansi, the causative agent of an important livestock disease known as surra, is transmitted mainly by tabanids. Surra is widespread in the Philippines but information on the exact distribution and diversity of tabanid vectors in the entire archipelago is limited, particularly in the southern part (Mindanao) where most of the outbreaks of surra have occurred in recent years. It is therefore important to study the species composition, diversity and dynamics of tabanids as well as their potential role as mechanical transmitters of *Trypanosoma evansi* among livestock in Mindanao.

Materials and methods

One-year trapping of tabanids using Nzi traps was conducted in 2007-2008 in selected villages in high and low surra risk provinces in Mindanao to determine the local tabanid fauna and their abundance as affected by environmental factors like elevation and rainfall, detect trypanosomes in tabanids and determine the hosts of the flies using genetic markers. Tabanids were identified using published identification keys for tabanids. Conventional and nested polymerase chain reactions (PCRs) for Trypanozoon and Trypanosome 18s genes were used to detect trypanosome DNA in tabanids. Tabanid hosts were identified by sequencing the mammalian cytochrome b amplified in tabanids. *Tabanus partitus, T. philippinensis, T. ceylonicus, T. reducens* and *Chrysops cinctus* were identified and were more abundant in low than high altitude areas where abundance was significantly associated with high rainfall.

Results and Discussion

Trypanosoma evansi and *T. theileri* were detected from at least one fly of every tabanid species caught. Buffalo, pigs, goats, humans and chickens were identified as hosts in Mindanao. All five species of tabanids identified in Mindanao are potential transmitters of *T. evansi*, yet their active role in the transmission of *T. evansi* in livestock and their control remains to be explored (Figure 1 and 2). Tabanid fauna and diversity in other areas in Mindanao and other parts of the country where surra is endemic should be determined.

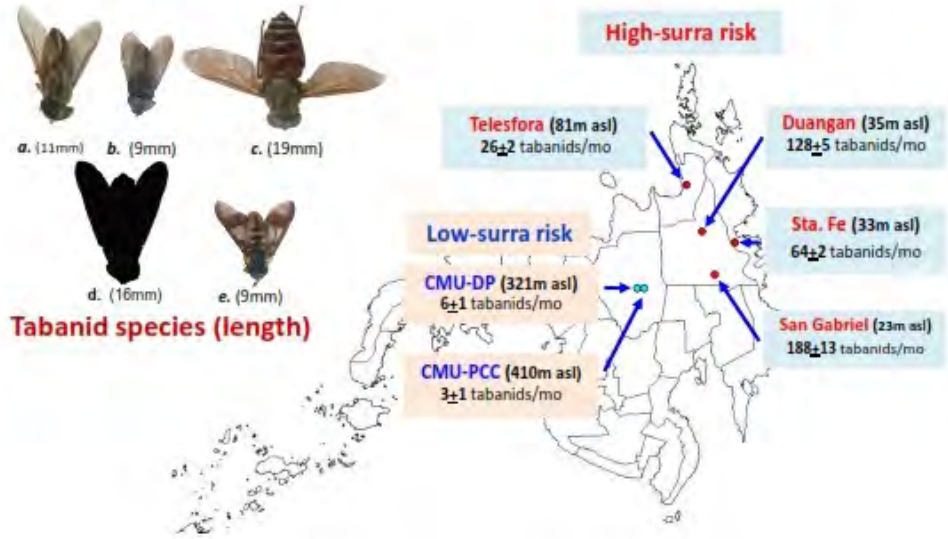

Figure 1. High surra risk areas in Mindanao.

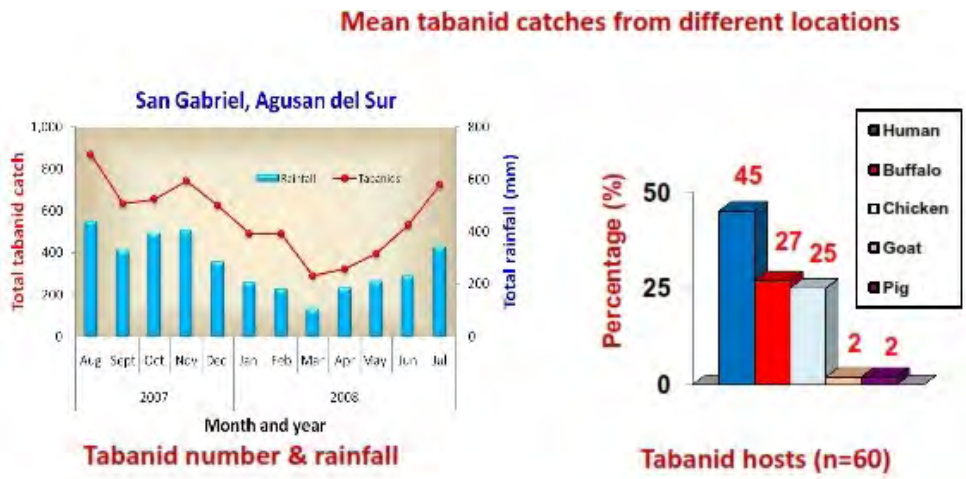

Figure 2. Mean tabanid catches from different locations.

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Trypanosoma *irwini* n. sp (Sarcomastigophora: Trypanosomatidae) from the koala (*Phascolarctos cinereus*). *Parasitology* 136: 875–885.

Hemorrhagic septicemia in Bohol, Philippines

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Introduction

Hemorrhagic septicemia is one of several economically important animal diseases in the Philippines that seriously affects revenues of livestock farmers, particularly smallholders who mainly rely on livestock raising as a source of income. This study aimed to describe the hemorrhagic septicemia situation, vaccine distribution and environmental factors in the province of Bohol for better planning of control and management of HS.

Materials and methods

Data from Philippines Animal Health Information System (Phil-AHIS) was used for description and analysis. MS Excel was used to describe animal, time and place distribution of hemorrhagic septicemia cases Epi Info version 3.5.4 was used to analyze associations between hemorrhagic septicemia vaccination coverage and disease occurrence.

Results and discussion

A total of 679 hemorrhagic septicemia (HS) cases were reported in Phil-AHIS from January 2011 to July 2012, all in cattle, carabao and goats (Figure 1). The highest number of cases was reported in the first six months (407 cases) with the month of February 2011 having the highest number of cases in the whole observation period (158 cases). Looking at the temporal distribution, three consecutive months had the highest number of cases although in a downward trend.

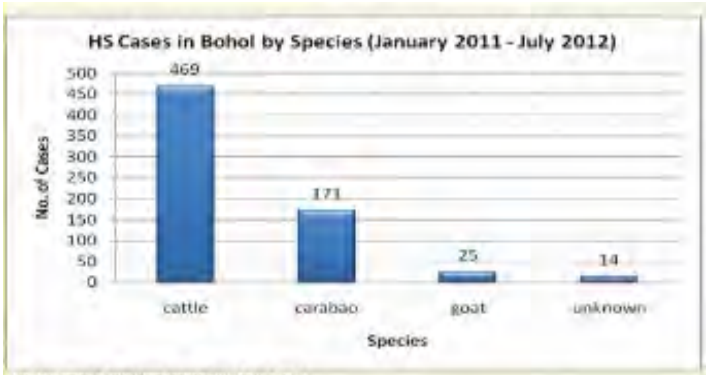

Figure 1. Cattle, Carabao and Goats.

These are February, March and April 2011. Looking at individual animal prevalence regardless of species, the prevalence is only 0.33 percent. At the species level, cattle had the highest individual prevalence at 0.65 percent, followed by carabao at 0.26 percent and goats with 0.04 percent(Figure 2).

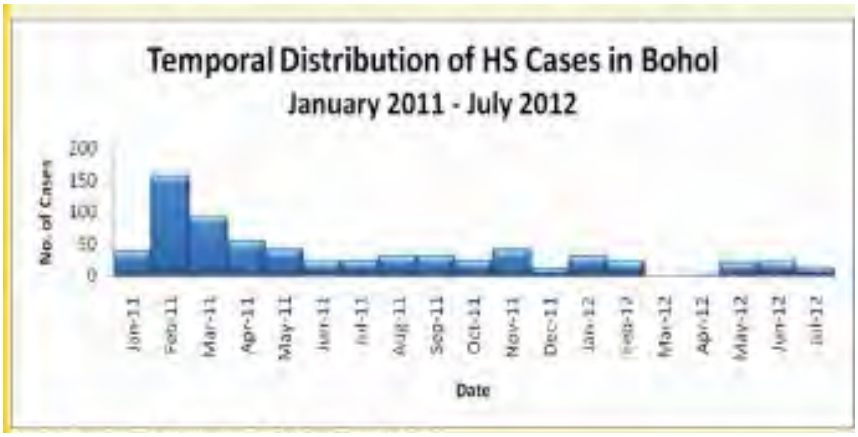

Figure 2. Temporal Distrubution of HS Case in Bohol.

The peak of vaccine distribution by the Office of the Provincial Veterinarian (OPV) was in February 2011 and 2012. It was in February 2011 when the highest number of hemorrhagic septicemia cases was observed. The overall vaccination coverage for the whole province is 3.4 percent only. It was observed that 47 municipalities out of 48 had a vaccination coverage of less than 20 percent. Although cattle were the most affected species, the proportion of cattle vaccinated against hemorrhagic septicemia was only 38 percent, unlike in carabao and goats wherein the vaccination percentage is approximately more than half of the proportion of animals affected.

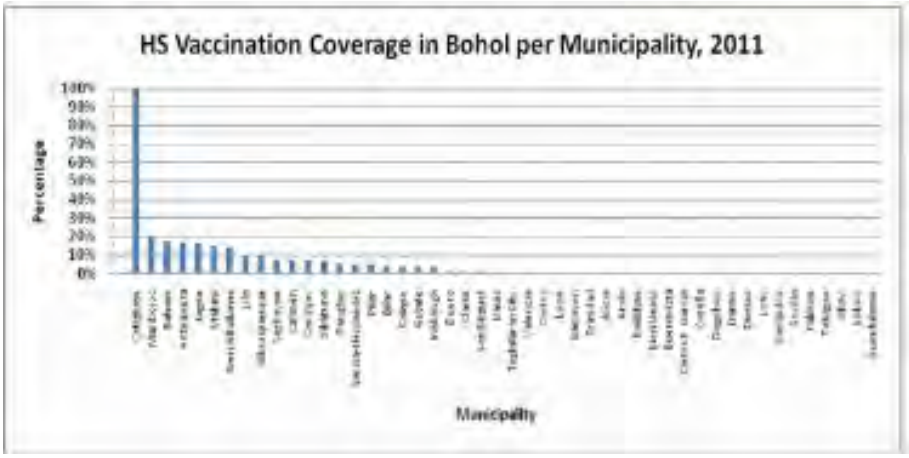

Figure 3. Hemorrhagic septicemia vaccination coverage in Bohol per municipality, 2011.

The majority of hemorrhagic septicemia cases were distributed in municipalities with low land elevation that serve as catch basins during rainy season. Hemorrhagic septicemia spreads quickly in wet conditions particularly if susceptible animals are closely herded. However, correlation analysis showed that there is no significant association between

hemorrhagic septicemia and land elevation in a given municipality. Likewise, results showed there is no significant association between hemorrhagic septicemia cases and annual rainfall while the correlation between average annual temperature and hemorrhagic septicemia is not statistically significant.

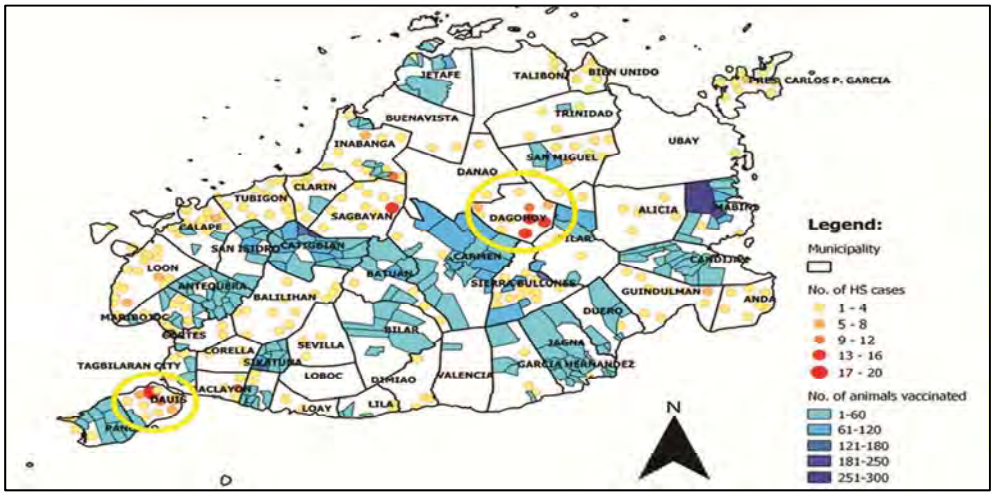

Figure 4. Distribution of hemorrhagic septicemia cases and vaccine distribution in Bohol, January 2011-July 2012.

The association between disease prevalence and vaccination coverage of ≥70 percent was evaluated. It is presumed that vaccination coverage of at least 70 percent of susceptible animals in a village is sufficient to elicit herd immunity and therefore prevent spread of disease in an area.

Similarly, the odds ratio and P value or Fisher exact test were used to determine the association between hemorrhagic septicemia prevalence and vaccination coverage for each species and the total ruminant population. The results suggest that there are no significant relationships between prevalence and vaccination coverage for cattle (OR = 1.42; 95 percent CI: 0.62- 3.24), carabao (OR = 0.88; 95 percent CI: 0.30-2.57) and the total ruminant species (OR = 1.34; 95% CI: 0.49-3.67). For goats, the OR (13.64) is statistically significant if based on the interpretation of the confidence interval (1.53-121.41) alone. However, the Fisher exact test (0.08724) suggests otherwise. Still, the results indicate that vaccination coverage may not be sufficient to elicit herd immunity. Most likely, misdiagnosis of hemorrhagic septicemia played a big role in the analytical results.

Recommendations

Vaccination drives should be concentrated in barangays or villages where cases have been reported. Cattle and carabaos need to be prioritized in so far as vaccination. A very pronounced maximum rain period can be observed from December to February, so vaccination schedules could be set on October or November at the latest to prevent epidemics. The province of Bohol through its Provincial Animal Health Care Unit and Laboratory (PAHCUL) must be equipped with laboratory equipment and supplies for the

diagnosis of hemorrhagic septicemia and other livestock diseases of economic and public health importance. Being bacterial in etiology, hemorrhagic septicemia elimination may be difficult, but the disease can be controlled efficiently through a holistic management program including a well-organized disease reporting system, a reliable diagnostic capability, sound vaccination program and well informed farmers.

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Acknowledgement

Field Epidemiology Training Program for Veterinarians, Food and Agricultural Organization of the United Nations EAHMI, Bohol Provincial Veterinary Office.

Annex 7

Photos during the conference

Philippine Department of Agriculture Assistant Secretary for Livestock, Dr Davinio Catbagan, welcomes the conference guests and participants during the opening ceremony.

Mr Daniele Salvini, Senior Programme Officer at FAO Regional Office for Asia and the Pacific, delivers his message during the opening ceremony.

Dr Alfonso Tagliaferri, Chárge d'Affaires Embassy of Italy in Manila, gives his message.

Philippine Department of Agriculture Assistant Secretary for Livestock, Dr Davinio Catbagan, and Bureau of Animal Industry Director and EAHMI Philippines National Focal Point, Dr Rubina Cresencio, presents the National Atlas of Philippine Farm Animal Resources to Dr Alfonso Tagliaferri, Chárge d'Affaires Embassy of Italy in Manila.

Dr Alfonso Tagliaferri, Daniele Salvini, Dr Davinio Catbagan, Lead Technical Officers Dr Raffaele Mattioli, Dr Carolyn Benigno, FAO Philippines Assistant Representative (Programme) Aristeo Portugal, and the EAHMI National Focal Points, pose in a group photo.

EAHMI Conference guests and participants in a group photo.

Mr Daniele Salvini, Dr Davinio Catbagan, and Dr Rubina Cresencio officially open the poster exhibits.

Guests and participants view the poster exhibits.

Mr Aksonsavanh Sihabandith,
Third Secretary of the Embassy of Lao PDR in Manila (left),
Mr Aristeo Portugal, FAO Philippines Assistant Representative (center), and
Mr Roth Phally, First Secretary of the Royal Embassy of Cambodia (right),
during the opening ceremony.

Annex 8

Conference programme of activities

EAHMI Conference 2013

Theme: Use of Environmental Animal Health Management Strategies for Decision-Making (18-19 September, 2013, Fairmont Hotel, Makati City, Philippines)

Programme of Activities

DAY 1 - WEDNESDAY, 18 SEPTEMBER 2013		
0830-0930	Registration	
0930-1000	Opening Ceremony of EAHMI Conference	
1000-1030	Formal opening of exhibit and poster gallery followed by morning snacks	
SCIENTIFIC AND TECHNICAL SESSIONS		
1030-1130	PLENARY PAPER The Application of Environmental Animal Health Management Strategies in Animal Production and Health	Raffaele Mattioli (Lead Technical Officer, FAO AGAH)
Session 1: Capacity Building Chair: Sar Chetra (National Focal Point, Cambodia)		
1130-1150	Overview of Capacity Building under EAHMI	Imelda Santos
1150-1205	Use of Environmental Animal Health Management Strategies in the National Veterinary Services: Philippines Experience	Rubina Cresencio
1205-1220	Use of Environmental Animal Health Management Strategies in the National Veterinary Services: Myanmar Experience	Khin Ohnmar Lwin
1220-1230	Summary	
Session 2: Information Management System Chair: Reildrin Morales (Animal Health Officer, RSU)		
1230-1330	Lunch	
1330-1350	Lessons learned from the pilot program on standardized reporting forms on animal production and health in Cambodia	Sar Chetra
1350-1410	Lessons learned from the pilot program on standardized reporting forms on animal production and health in Lao PDR	Settha Sinthasak
1410-1430	PhilAHIS and its applications to national veterinary services planning and implementation	Marites Gealone
1430-1500	Discussion	
1500- 1530	Coffee/tea break and poster viewing	

Session 3: Commissioned Studies as examples of GIS applications on animal production and health Chair: Rubina Cresencio (National Focal Point, Philippines)		
1530-1550	Strategy and Action Plan for the Management of Cambodia's Farm Animal Genetic Resources	Mom Seng
1550-1610	National Assessment of Cambodia's Main Crop and Fodder Resources	Aum Sitha
1610-1630	Review of Culled Animal Disposal Methods and Regulations in Viet Nam and Demonstration of Using GIS to Identify Potential Disposal Sites	Phan Quang Minh
1630-1650	Pig and Poultry Market Supply Chain Study in Quang Nam Province, Viet Nam	Nguyen Quang Linh
1650-1730	Discussion	
1900	Welcome Reception Dinner by BAI and FAO	
DAY 2 - THURSDAY, 19 SEPTEMBER 2013		
Session 4: Integration of EAHM in veterinary services planning and implementation Chair: Phan Quang Minh (National Focal Point, Viet Nam)		
0900-0930	Use of EAHM for development of a national animal health strategy	Emelinda Lopez
0930-1000	Epidemiology of Fasciolosis, Assessment of Ecological Factors and Recommended Snail Control in Nueva Ecija Province, Philippines	Clarissa Domingo
1000-1030	Coffee/tea break and Poster Viewing	
Session 5: Networking Chair: Carolyn Benigno (Lead Technical Officer, FAO RAP)		
030-1045	Inclusion of EAHM in the ASEAN WGL Cooperation	
1045-1100	Networking Platforms	
1100-1130	Discussion	
1130-1200	Final Poster Viewing	
1200-1300	Lunch	
1300-1430	Summary and Conclusions	
1430-1500	Closing	

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