Status of postgraduate training in the livestock sector in Southeast Asia and priorities for ILRI's support

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Status of postgraduate training in the livestock sector in Southeast Asia and priorities for ILRI's support

Consultancy study

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Acronyms

ABU Ahmadu Bello University

ARIs Advanced research institutes

ASARECA Association for Strengthening Agricultural Research in Eastern and Central Africa

BASIC Building African Scientific and Institutional Capacity

BECA Biosciences eastern and central Africa

CaSt Capacity Strengthening

CAADP Comprehensive African Agricultural Development Programme

CBRT Centre for Biotechnology Research and Training

CIRAD Centre de coopération internationale en recherche agronomique

CIRDES Centre internationale de recherche-développement sur l'élevage

CGIAR Consultative Group on International Agricultural Research

CORAF Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles

DNA Deoxyribonucleic acid

EISMV École inter-États des sciences et médecine vétérinaires

ENSA École Nationale Supérieure d'Agriculture

ESA École Supérieure de l'Agriculture

FARA Forum for Agricultural Research in Africa

FAO Food and Agriculture Organization of the United Nations

GDP Gross Domestic Product

ICRAF World Agroforestry Centre

ICRISAT International Crops Research Institute for the Semi-Arid Tropics

ICT Information and Communication Technology

IFPRI International Food Policy Research Institute

ILCA International Livestock Centre for Africa

ILRAD International Laboratory for Research on Animal Diseases

ILRI International Livestock Research Institute

INRA Institut National de Recherche Agronomique (France)

INSAH Institut du Sahel

IPR–IFRA Institut Polytechnique Rural–Institut de Formation et de Recherche Appliquée

IRD Institut de Recherche pour le Développement (France)

ITC International Trypanotolerant Centre

LMD Licence-Master-Doctorat

MDGs Millennium Development Goals

NAPRI National Animal Production Research Institute

NARES National Agricultural Research and Extension System

NARI National Agricultural Research Institute

NARS National Agricultural Research System

NEPAD New Partnership for Africa's Development

PRSP Poverty Reductions Strategy Plans

SADC Southern African Development Community

SCARDA Strengthening Capacities for Agricultural Research and Development in Africa

UFR Unité de Recherche et de Formation (Research and training Unit)

UN United Nations

UNAAB University of Agriculture, Abeokuta

UNESCO United Nations Educational Scientific and Cultural Organization

WECARD West and Central African Council for Agricultural Research and Development

Preface

Research-based capacity strengthening is one of the priority activities of the International Livestock Research Institute (ILRI). The mission of ILRI's Capacity Strengthening Unit (CaSt) is to strengthen the capacity of the livestock research and development community to contribute to the overall mandate of ILRI in achieving livestock-mediated poverty alleviation. The purpose of Cast is to strengthen the capacity of ILRI's partners to apply their skills and resources to accomplish their goals, satisfy stakeholders' needs and improve performance and impact.

One of the five objectives of ILRI's Capacity Strengthening Strategy is to facilitate building sustainable capacity of institutes to build capacity. This could only be achieved through building the capacity of the agricultural higher learning institutes and by facilitating the effective integration of research-based learning outputs (tools, methods and approaches) into the curricula of the learning institutes.

ILRI is primarily a research institute and not a university. Thus, in terms of building the capacity of the educational institutes, ILRI would like to complement the ongoing national and regional initiatives using the principle of subsidiarity. ILRI would like to add value to the efforts of the higher learning institutes in sub-Saharan Africa and South Asia based on ILRI's comparative and competitive advantage in research and capacity strengthening. Given the limited resources, to be effective and efficient, ILRI should identify its niche and priorities to generate the maximum benefit. It is also important to seek regional consensus on the priority areas for collaboration.

In order to establish the priorities for collaborative capacity strengthening activities of the learning institutes in the areas of animal production and veterinary services, ILRI commissioned five studies covering the following subregions: Eastern and Central Africa (ASARECA region); Southern Africa (SADC region), West Africa (CORAF region); South Asia; and Southeast Asia. This report summarizes the findings of the gap analysis study for the Southeast Asia region. ILRI will make every effort to share and validate these findings and use this information in designing and implementing capacity strengthening activities in this region.

This task would not have been completed without the support and dedicated commitment of a number of individuals. We would like to appreciate and acknowledge the contribution made by Orville L Bondoc in conducting this study and preparing this report. A number of individuals provided inputs and responded to the survey questionnaires. The staff of the Knowledge Management and Information Services (KMIS) unit of ILRI assisted in editing, layout and cover design of the report. The contribution of these individuals and the support of the Senior Management of ILRI and the staff of CaSt in completing this study is gratefully acknowledged and appreciated.

The overall purpose of this study was to identify areas for collaborative action to build the capacity of learning institutes in the region. Given the different stages of development of the various universities it may also be necessary to initiate some carefully selected national level activities to complement the regional undertakings. ILRI will make every effort to facilitate and support the national and regional initiatives in strengthening the capacities of the universities especially the postgraduate research and training in the region.

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Executive summary

The consultancy study commissioned by the International Livestock Research Institute (ILRI) through its Capacity Strengthening unit (CaSt) aimed to identify the gaps in the postgraduate training programs in animal production and veterinary science in Southeast Asia and to identify the roles and priorities of ILRI in bridging this gap.

The livestock sector worth USD 19.8 billion in 2007 constitutes a significant portion (16.6%) of the agriculture sector that supports more than 565 million people in Southeast Asia living on a total land area of 434.1 million hectares. The animal inventory in 2007 consisting of 15.2 million buffalo, 45.6 million cattle, 0.8 million horses, 26.8 million goats, 69.8 million pigs, 2.13 billion chickens, and 167.5 million ducks are the major providers of animal food products consumed annually including poultry meat (3.23 million tonnes), pig meat (2.56 million tonnes), whole milk (2.54 million tonnes), eggs (2.09 million tonnes), and bovine meat (1.30 million tonnes). The annual livestock imports and exports in the region composed of 11 countries are worth USD 400.4 million and USD 169.1 million, respectively.

Based on a survey of 27 universities in 7 countries of Southeast Asia, the most common areas for specialization in MS and PhD level postgraduate programs on animal production and veterinary science in Southeast Asia are animal nutrition, animal production, animal breeding, and animal science. The commonly cited academic areas of strengths are in agriculture or agricultural sciences, veterinary medicine/science, animal breeding and genetics, and animal nutrition. However, the common weaknesses of the current postgraduate programs related to the livestock sector are the limited or lack of research facilities and materials, research funds, and qualified teachers.

Intra-university collaborations were commonly made through the faculty/departments related to agriculture, agricultural industry and technology, veterinary medicine/science, and medicine, pharmacy, and dentistry. Collaborations with regional and international universities and institutes were commonly done through teaching of related core and minor courses, exchange of faculty/students, and conduct of research especially with universities from Malaysia, Indonesia and Thailand.

Collaboration with the national research system were mostly through the provision or as source of research funds/grants, scholarships, implementation of national research activities/programs/projects and joint researches, and exchange of lecturers/researchers/students. Collaboration with the national research system was mostly rated as ‘very good’.

Collaboration with the national extension system commonly involved the conduct of national extension activities such as training and action programs. Collaboration with the national extension system was mostly rated as ‘good’.

Collaboration with farmer training institutes is through the conduct of training both on and off campus, mass media broadcasting including online information dissemination, hosting seminars/symposium/forum among farmers, technical assistance, and providing community services including routine extension activities for selected farmer groups.

The critical constraints to the implementation of the postgraduate programs related to the livestock sector in Southeast Asia are usually associated with the lack of student enrolment in the graduate programs, lack of qualified graduate faculty, lack of laboratory facilities and equipment, and limited budget and financial support for research programs.

The commonly cited emerging issues/challenges currently being addressed in postgraduate programs for the livestock sector were food safety issues and policy, animal genetic resources and conservation, emerging and re-emerging animal diseases, biotechnology, climate change, and animal welfare.

In Southeast Asian universities, the most common skill areas currently offered in postgraduate training programs are: scientific writing, participatory research methods, strategic planning, convincing proposal writing, effective communication, leadership and decision making, facilitation skills and monitoring, evaluation and impact assessment. Skill areas that are not yet offered in postgraduate programs are mostly on: intellectual property right policy, implications and adaptation strategies to climate change, innovation systems perspective and implication to R&D, and poverty, vulnerability and risk analysis.

The perceived roles of ILRI commonly include local and international trainings, seminars, and study tours for lecturers, teachers, and students and funding support for university facilities in joint research and extension programs within the university, other universities and ILRI.[1] However, as part of its efforts on building the capacity of the educational institutes in Southeast Asia, ILRI should take the lead in effectively integrating some skill areas into the curricula of postgraduate studies in Southeast Asia. The skill areas commonly identified as 'extremely important' include: intellectual property right policy, disease surveillance and preparedness, biosafety, implications and adaptation strategies to climate change, and interaction of crop–livestock–water. Furthermore, ILRI has important roles to establish and improve intra-university and inter-university collaboration, with the national research and extension systems, and with farmer training institutes in Southeast Asia.

Efforts have been made at varioius levels to maximize the benefits of collaboration with affiliated university and institutional research facilities through experience in collaborative research in animal production and veterinary sciences worldwide. It is also proposed that an inter-university alliance in Southeast Asia in cooperation with ILRI act as secretariat, associate member or adviser to a major support program to improve postgraduate studies for the livestock sector in the region.

For comparison purposes, relevant information for higher educational agricultural institutions and the livestock sector was also gathered for China and compared with that of Southeast Asia. An attempt was also made to contact prospective respondents from agricultural universities in China, but their reply to the invitation to participate in the survey is still pending.

1. ILRI is not a funding agency.

1 Introduction

1.1 Background and rationale

The International Livestock Research Institute (ILRI) is one of 15 future harvest centres that conduct food and environmental research to help alleviate poverty and increase food security while protecting the natural resource base. Building on three decades of experience, ILRI works at the crossroads of livestock and poverty by bringing high-quality science and capacity building to bear on poverty reduction and sustainable development (ILRI 2008). Capacity is the engine for enhancing the output and performance of individuals and organizations. As part of its research-based outreach and capacity strengthening, ILRI assists its partners by offering opportunities for long- and short-term training for researchers and development practitioners. The Capacity Strengthening unit (CaSt) is designed to build and strengthen the scientific knowledge and capabilities of ILRI's partners in developing countries.

The overall mission of the CaSt unit is to strengthen the capacity of the livestock research and development (R&D) community to contribute to the mission of ILRI to achieve livestock-mediated poverty alleviation. The purpose is to strengthen the capacity of ILRI's partners to apply their skills and resources to accomplish their goals, satisfy stakeholders' needs and improve performance and impact.

Within the broader framework of ILRI's strategy to 2010 and proposed Medium Term Plan (MTP), the five strategic objectives to be pursued by the CaSt unit are:

- Effective integration of capacity strengthening activities into project planning, implementation and evaluation.
- Building sustainable capacity of institutes to build capacity (major shift in focus).
- Test and implement innovative and cost-effective training approaches and delivery mechanisms and develop and disseminate research-based training materials.
- Building skills of individuals and groups.
- Developing a functional need-based monitoring and evaluation system to communicate with partners and to assess the performance and impact of CaSt.

ILRI recognizes that the long-term solution to address the continuous and dynamic nature of capacity strengthening needs is to develop sustainable capacity within the relevant organizations which are mandated to build capacity of the various stakeholder groups engaged in the livestock innovation system. This could be only achieved through building the capacity of the universities and by facilitating the effective integration of research-based learning outputs (tools, methods, approaches and results) into the curricula of learning institutes. ILRI strongly believes that universities must play a pivotal role in providing the human resources for the agricultural led broad-based economic growth needed to achieve the Millennium Development Goals.

However, in terms of building capacity of the educational institutes, ILRI would like to complement the ongoing regional and national initiatives, using the principle of subsidiarity. ILRI would like to add value to the efforts of the higher learning institutions based on ILRI's comparative and competitive advantage. Therefore, it is important to clearly identify the niche in which ILRI could effectively contribute to the efforts of the tertiary educational institutes especially in postgraduate training.

1.2 Objective/terms of reference (see Appendix 1)

The overall purpose of this study is to strengthen the postgraduate training and research capacity of the tertiary educational institutes in the livestock sector in sub-Saharan Africa and Asia. The specific objective is to identify the gaps in the postgraduate training in animal production and veterinary sciences and to identify the roles and priorities of ILRI in bridging this gap.

In order to achieve this, five consultancy studies covering SSA, (using the existing geopolitical grouping—SADC, ASARECA, and CORAF), South and Southeast Asia are conducted.

1.3 Procedure followed

The study was conducted to:

- Review and document the role of livestock in the regional Southeast Asia economy and the emerging challenges confronting the livestock sector,
- Review and document the current status of postgraduate training in the livestock sector in the region (including an inventory of institutes),
- Discuss the collaboration and linkage between tertiary educational institutes and research and extension systems and their strengths and weaknesses,
- Identify the critical constraints and challenges facing the agriculture higher learning institutions in the region,
- Identify the missing elements and capacity gaps in the existing curricula (especially at the postgraduate level) to address the emerging needs and challenges of the livestock sector,
- Identify the role and priorities of ILRI in bridging the capacity gaps identified, and
- Make recommendations/suggestions.

Primary (survey) data collected from key informants as well as secondary data (mainly from FAO statistical bases) were used to prepare the report. A standard questionnaire developed by ILRI–CaSt (see Appendix 2) was used to collect the primary data from universities in Southeast Asia through the internet (by email). Follow up communications were then made by phone and/or fax messages.

Based on internet connections especially with members of the Association of SEARCA scholars, graduate students and friends, a list (and directory of email addresses) of respondents including deans and/or presidents of agricultural and veterinary colleges/universities in Southeast Asia was initially established. A major limitation of the study, however, was the scarcity of colleges/universities with postgraduate programs on animal production and/or veterinary science that participated in the survey after a thorough search of their university websites. Several universities required considerable amount of time (weeks in some cases) mainly because of the language problems (poor English) to complete the survey forms.

1.4 Outline of the report

Section 1 (Introduction) presents the background and rationale of the consultancy study, the objective/terms of reference, and the procedure followed. In Section 2, the current profile of livestock training in the Southeast Asia describes the importance of the livestock sector in the region, emerging challenges confronting livestock sector, different categories of livestock training institutes, and the different programs offered. Collaboration and linkages (i.e. intra-university collaboration, with the national research system, with the national extension system, with farmer training institutes, and with other regional and international institutes) are also given. The effectiveness of the current collaboration with the national research and extension system are especially highlighted.

Section 3 summarizes the critical constraints, strengths, weaknesses and gaps in capacities and graduate curricula currently offered by Southeast Asian universities. The importance of training offered and not offered is likewise reviewed.

Sections 4 and 5 discuss the needs and recommendation and conclusion and recommendations, limitations, respectively. A review of specific areas that need to be strengthened including the possible role of ILRI in bridging the possible gaps as well as suggestions on strengthening partnerships are also provided.

2 Current profile of livestock training in the region

2.1 Importance of the livestock sector in the region

There are 11 countries belonging to the Association of Southeast Asian Nations (ASEAN), namely Brunei Darussalam, Cambodia, Indonesia, Lao Peoples' Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, and Vietnam. For the map of Southeast Asia, see Appendix 9.

Many countries in Southeast Asia have moved from the low income to the middle income category in the past few decades, with economic policies designed to stimulate growth and investment in education, infrastructure and science and technology (e.g. Indonesia, Malaysia, Philippines and Thailand) with a significant drop in the percentage contributions of agriculture to GDP. Despite this, there are still significant numbers of poor livestock keepers who are not benefiting. Most small countries in Southeast Asia (Myanmar, Cambodia, Lao PDR, and Vietnam) still have low per capita incomes, although they too are experiencing higher levels of economic growth than in the past (NIER–Japan 1998).

Some important statistics of Southeast Asia related to its livestock sector are reviewed in terms of the human population, land resources, value of livestock and agriculture production, import and export value of livestock per year, animal inventory, and average consumption of meat, eggs and whole milk per year (FAO–STAT 2009), see Appendix 3. A comparison of key information about the agriculture and livestock sector of China and Southeast Asia is also given in Appendix 4.

There are more than 565 million people in Southeast Asia in 2006, growing 1.52% annually from 1997 to 2006. About 46% of the human population in the region depended on agriculture. About 311 million people (55%) comprise the rural population while the remainder (254 million or 45%) represent the urban population.

The 11 countries of Southeast Asia has a total land area of 434.1 million hectares including 117.7 million hectare of agricultural land, 17.1 million hectares of permanent meadows and pastures, and 15.3 million hectare of inland water.

In 2007, the livestock subsector in Southeast Asia was worth 19.81 billion I$ (international dollars), comprising about 17.2% of the agriculture sector worth 115.51 billion I$. On average, the livestock sector grew by about 5.01% per annum from 1998 to 2007.

The annual livestock imports from 1997 to 2006 in Southeast Asia was about USD 400.4 million, mainly from imports of cattle (USD 181.2 million), chickens (USD 111.5 million), and pigs (USD 54.2 million). Annual livestock exports, on the other hand, was about USD 169.1 million, mainly for chickens (USD 75.8 million), pigs (USD 47.9 million), and ducks (USD 24.1 million).

In 2007, the animal inventories in Southeast Asia included 15.2 million buffalo, 45.6 million cattle, 0.8 million horses, 26.8 million goats, 69.8 million pigs, 2.13 billion chickens, and 167.5 million ducks.

The average annual consumption of livestock meat in Southeast Asia from 1994–2003 were 3.23 million tonnes poultry meat, 2.56 million tonnes pig meat (pork), 1.30 million bovine tonnes meat (beef), and 157 thousand tonnes mutton and goat meat. Per capita consumption per year of livestock meat was highest for poultry (11.78 kg/capita per year), followed by pork (7.26 kg/capita/yr), and bovine meat (4.54 kg/capita/yr).

The average consumption of eggs in Southeast Asia from 1994–2003 was 2.09 million tonnes or a per capita consumption per year of 5.36 kg. The average consumption of whole milk in from 1994–2003 was 2.54 million tonnes or a per capita consumption per year of 12.12 kg.

2.2 Emerging challenges confronting the livestock sector in the Southeast Asian region

Much of the emerging challenges confronting the livestock sector (particularly smallholders and poor livestock keepers) focus on poverty reduction and gender and environmental issues. Hence, the growth of the smallholder livestock sector is commonly aimed to contribute directly to poverty reduction and employment growth and over time provide much of the effective demand for the employment in intensive rural non-farm sector (Mellor 2003).

About 100 million people in Southeast Asia depend on livestock for their livelihoods. More livelihood options should thus be provided for rural populations especially in marginalized areas as economic inequity widens between urban and rural areas. Rising human populations and incomes, coupled with increased urbanization, are also causing demand for livestock foods to grow. As people's incomes increase, they tend to consume less grain-based foods and greater amounts of milk, eggs and meat. Trade liberalization is likewise opening up new markets for livestock products.

Human resource development is also one of the major challenges to meet the demand of the ever changing job market both nationally and internationally. This has become more complex with the globalization, rapid change of technology, international labour mobility, open market economy and the exploitation of information technology.

However, expansion and intensification of livestock production is associated with the growing public concern about its environmental impacts (Steinfeld et al. 2006). Some livestock production systems pollute the air, soil or water and reduce biodiversity. Furthermore, emerging and re-emerging animal diseases are threatening trade and productivity.

While there is a great need for technical assistance to smallholder livestock to reduce its cost of production and improve physical infrastructure and veterinary services, the same concerns above should be incorporated in postgraduate training programs to develop action programs that shall promote (for example):

- Improvement of market efficiency, quality and safety of traditional livestock foods without compromising market access for the poor (i.e. input and service supply).
- Improvement of livestock productivity through improved breeding and feeding,
- Improvement of animal health through development of new vaccines, diagnostic tools, and service delivery programs,
- Development of coping strategies to mitigate climate change impacts on poor livestock keepers such as better housing design, waste processing and handling, and
- Identification of trade-offs in production of crops for biofuel rather than food and fodder.

2.3 Different categories of livestock training institutes

Higher education. Higher education refers to post-secondary institutions that offer associate degrees, BSc degrees, MSc degrees or PhD degrees or equivalents. It includes teaching, research and social services activities of universities, including both the undergraduate level (i.e. tertiary education) and the graduate (or postgraduate) level (sometimes referred to as graduate school). Higher education may be provided by universities, vocational universities, community colleges, liberal arts colleges, institutes of technology and other collegiate level institutions, such as vocational schools, trade schools and career colleges that award academic degrees or professional certifications. Higher education is very important to national economies, both as a significant industry in its own right and as a source of trained and educated

personnel for the rest of the economy. In most developed countries, a high proportion of the population (up to 50%), now enter higher education at some time in their lives (RIHED–SEAMO 2009).

In 2007, there are 5800 public and private universities, polytechnic and community colleges in Southeast Asia (see Table 1). The systems of higher education and types of higher education institutions (HEIs) are different among Southeast Asian countries and China (see Appendix 5). The number of HEIs offering curricular programs in agriculture (and specifically related to the livestock sector) are however much smaller. It may thus be difficult to categorize the countries (by size of economy, animal inventories, production capacity, consumption values etc.) and identify a common set of priorities in each category.

Table 1. *Number of public and private universities, polytechnic and community colleges in different countries of Southeast Asia (2007)*

Country*	Public universities	Private universities	Polytechnic college	Community colleges	Total
Brunei	1	2	–	–	3
Cambodia	21	30	–	–	51
Indonesia	82	2778	–	–	2860
Lao PDR	3	31	11	–	45
Malaysia	20	559	21	35	635
Myanmar	156	–	–	–	156
Philippines	182	1465	–	–	1647
Singapore	3	7	6	–	16
Thailand	78	67	–	12	157
Vietnam	94	17	119	–	230
Total	640	4956	157	47	5800

* No data yet for Timor Leste. (Timor Leste joined the UN in 2002 and ASEAN Regional Forum in 2005 only).
Source: Commission on Higher Education, updated: 26 /11/2007 (http://www.rihed.seameo.org).

Definitions:

- A **college** conducts academic and professional education in one particular discipline.
- A **university** consists of several faculties conducting academic and/or professional education in several disciplines, technologies and/or the arts.
- A **polytechnic**, like an academy, is a form of higher education categorized as professional education, conducts applied science education in several particular fields.

HEIs with postgraduate program for the livestock sector. Very few higher education institutions (HEIs) in Southeast Asia offer a graduate degree program related to the livestock sector. Colleges and universities in Brunei Darussalam, Cambodia, Singapore, and Timor Leste do not offer a graduate program in animal production or veterinary science. In some Southeast Asian countries, there is only one major HEI that offers postgraduate program in animal production or veterinary science. Such is the case of Lao PDR (National University of Laos—NUOL) and Myanmar (University of Veterinary Science—Yezin). Only a few public universities in Indonesia, Malaysia, Philippines, Thailand, and Vietnam were thus considered the major respondents of the survey.

SEAMO and SEARCA.[1] To promote cooperation in education, science and culture in the Southeast Asian region, the Southeast Asian Ministers of Education Organization (SEAMEO) was established on 30 November 1965 as a chartered international organization. The seven areas of priorities include: quality and equity in education, preventive health education, culture and tradition, information and communication technology, languages, poverty alleviation, and agriculture and natural resources.

1. The directory of SEARCA scholars was initially used to determine the list of prospective survey respondents from HEIs in Southeast Asia together with their contact numbers and addresses. Respondents were then contacted mainly by e-mail, phone, and/or fax messages.

The SEAMEO founded the Regional Centre for Higher Education and Development (RIHED)—http://www.rihed.seameo.org. The SEAMO RIHED plays a crucial role in the capability building of SEAMEO Member Countries in the field of higher education. It is hosted by the Thai government, located on the Commission on Higher Education Building in Bangkok, Thailand.

On 27 November 1966, the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA) was founded with the mandate to strengthen institutional capacities in agricultural and rural development in Southeast Asia through graduate education, short-term training, research, and knowledge exchange. The SEAMO SEARCA office—http://www.searca.org is located in UPLB campus, Los Baños, Laguna, Philippines.

In 1989, SEARCA launched the Southeast Asian University Consortium for Graduate Education and Natural Resources or the University Consortium (UC)—http://www.uc.searca.org, as a commitment made among leading Southeast Asian higher education institutions to share academic expertise and resources. The member universities from Southeast Asia are: Institut Pertanian Bogor (IPB) and Universitas Gadjah Mada (UGM)—Indonesia; Universiti Putra Malaysia (UPM)—Malaysia; University of the Philippines Los Baños (UPLB)—Philippines; and Kasetsart University (KU)–Thailand. The UC is an effective network linking strong universities in Southeast Asia with associate members such as the University of British Columbia (UBC)—Canada; University of Queensland (UQ)—Australia, Georg-August University of Goettingen (UG)—Germany, Tokyo University of Agriculture (TUA),—Japan.

2.4 Review of different programs offered

The analysis of postgraduate training in the livestock sector in Southeast Asia was based on 30 survey respondents from 27 universities in 7 countries. The 27 universities were mainly from the Philippines (14), Indonesia (4), Thailand (4), Vietnam (2), Lao PDR (1), Malaysia (1), and Myanmar (1). A total of 30 responses were received from the Philippines (PHI)—16, Indonesia (INA)—4, Thailand (THA)—4, Vietnam (VIE)—3, Malaysia (MAL)—1, Lao PDR (LAO)—1, and Myanmar (MYA)—1. Three universities (two from the Philippines and one from Vietnam) each had 2 respondents representing animal science and veterinary science. The names of college/universities in Southeast Asia included in the survey are summarized in Table 2. (The names, addresses, and contact numbers of the survey respondents are listed in Appendix 6.). Several agricultural universities in China were also invited to participate in the survey. The list of prospective respondents from agricultural universities in China is also given in Appendix 7.

Table 2. *Names of college/universities in Southeast Asia included in the survey and year when graduate program in animal production or veterinary science was first offered, by country*

Country	Name of college/university
Indonesia (4)	Bogor Agricultural University (IPB—1975), Diponegoro University (UNDIP—1999), Mataram University (UNRAM—2004), Padjadjaran University (UNPAD—1984)
Lao PDR (1)	National University of Laos (NUOL—2009)
Malaysia (1)	Universiti Putra Malaysia (UPM—before 1982)
Myanmar (1)	University of Veterinary Science—Yezin (UVS—1992)
Philippines (14)	Aklan State University (ASU—2004), Benguet State University (BSU—1981), Camarines Sur State Agricultural College (CSSAC—1985), Capiz State University (CapSU), Central Luzon State University (CLSU—1970s), Central Mindanao University (CMU—1980), Dr Emilio B. Espinosa, Sr. Memorial State College of Agriculture and Technology (DEBESMSCAT—1995), Don Mariano Marcos Memorial State University—North La Union (DMMMSU-NLU—1986), Laguna State Polytechnic University (LSPU—1995), Pampanga Agricultural College (PAC), University of the Philippines Los Baños (UPLB—1965), University of Southern Mindanao (USM—1983), Visayas State University (VSU—1989), West Visayas State University (WVSU—1986)
Thailand (4)	Chiang Mai University (CMU—2003), Chulalongkorn University (CU—1991), Khon Kaen University (KKU—1980), Maejo University (MU—2000)

Vietnam (2)	Hanoi University of Agriculture (HUA—1977), Ho Chi Minh University of Agriculture and Forestry—Nong Lam University—1995)

Note: Numbers in parentheses indicate the number of college/universities included in the survey.

Graduate degrees/programs (MS and PhD) in animal science and veterinary science are commonly offered through the graduate school and administered separately or jointly by a department, faculty, institute, cluster, or college (see Table 3).

Table 3. *Name of office/base unit offering postgraduate program in animal production or veterinary science in Southeast Asian universities*

Country	Name of office/base unit*
Indonesia	Animal Resources Management Postgraduate Study; Faculty of Animal Agriculture; Faculty of Animal Science; Fakultas Peternakan
Lao PDR	Faculty of Agriculture
Malaysia	Department of Animal Science, Faculty of Agriculture
Myanmar	Livestock Breeding and Veterinary Department; Department of Livestock, Feedstuffs and Milk Products Enterprise
Philippines	Animal and Dairy Sciences Cluster, College of Agriculture; Department of Animal Science; College of Agriculture; College of Agriculture and Forestry; College of Agriculture, Forestry and Environmental Sciences; College of Agriculture Science and Technology; College of Veterinary Medicine; College of Fisheries and Animal Science; College of Veterinary Science and Medicine; Graduate Studies and Applied Research; Institute of Agriculture and Forestry
Thailand	Faculty of Agriculture, Faculty of Animal Science; Faculty of Veterinary Medicine; Faculty of Veterinary Science
Vietnam	Faculty of Animal Science; Faculty of Animal Science and Aquaculture; Faculty of Veterinary Medicine

* Some local universities have the names of the office or basic unit in their native language.

Postgraduate studies in the livestock sector are offered in 27 Southeast Asian universities in the fields of animal production (26) and veterinary science (11), see Table 4.

Table 4. *Postgraduate programs offered in the livestock sector in Southeast Asia*

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of survey respondents	4	1	1	1	16	4	3	30
No. of universities	4	1	1	1	14	4	2	27
Major field of postgraduate study:								
Animal production	4	1	1	1	14	3	2	26
Veterinary science	1	1	1	1	2	3	2	11
Total	5	2	2	2	16	6	4	37
Postgraduate degrees in:								
Animal production:								
– Master of Science	4 1975– IPB	1 2009– NUOL	1 1982– UPM	1 1992– UVS	14 1965– UPLB	3 1980– KKU	2 1977– HUA	26
– Doctor of Philosophy	2 1975– IPB	0	1 1982– UPM	0	10 1969– UPLB	3 1998– KKU	2 1977– HUA	18
Veterinary science:								
– Master of Science	1 1975– IPB	0	1 1982– UPM	1 1992– UVS	3 1986– UPLB	3 1980– KKU	2 1992– HUA	11
– Doctor of Philosophy	1 1975– IPB	0	1 1982– UPM	1 2003– UVS	0	2 1999– CU	2 1994– HUA	7

Total:								
– Master of Science	5	1	2	2	17	6	4	37
– Doctor of Philosophy	3	0	2	1	10	5	4	25

Note: Data in parentheses indicate earliest year of postgraduate offering in the country.

In the data set of 27 Southeast Asian universities, there are 26 MS and 18 PhD programs offered in the field of animal production, and 11 MS and 7 PhD programs for veterinary science.

In the field of animal production, the earliest MS and PhD program was offered in 1965 and 1969, respectively at UPLB (Philippines). In Indonesia, the first MS and PhD programs related to animal production was started in 1975 by Bogor Agricultural University (IPB). In Vietnam, the first MS and PhD programs related to animal production was started in 1977 by the Hanoi University of Agriculture (HUA). In Thailand, the first MS and PhD program in animal production was offered in 1980 and 1998, respectively at Khon Kaen University (KKU). In Malaysia (Universiti Putra Malaysia—UPM), the MS and PhD programs in animal production were first offered before 1982. In Lao PDR, the first MS program in animal production was offered in 2009 by the National University of Laos (NUOL). In Myanmar, the first MS program in animal production was first offered in 1992 by the University of Veterinary Science—Yezin (UVS).

In the field of veterinary science, the MS and PhD program was first offered in 1975 by IPB in Indonesia. In the Philippines, only an MS program is offered in the field of veterinary science, first offered by UPLB in 1986. In Thailand, the first MS and PhD program in veterinary science was offered in 1991 and 1999, respectively at KKU and Chulalongkorn University (CU). In Vietnam, the first MS and PhD programs related to veterinary science was started in 1992 and 1994, respectively by HUA. In Malaysia, the MS and PhD programs in veterinary science were first offered by UPM before 1982. In Myanmar, the first MS program in veterinary science was first offered in 1992 and the first PhD program in veterinary science in 2003 by UVS.

More universities offering postgraduate programs on animal production and veterinary science was observed in the Philippines than any other country in Southeast Asia probably due to its long traditional use of English as the medium of instruction.

In Table 5, the various disciplines related to the livestock sector in Southeast Asian college/universities are given for each country. Based on 27 universities, the most common areas for specialization are: for the MS degree—Animal nutrition (13), Animal production (13), Animal breeding (9), and Animal Science (8); and for the PhD program—Animal breeding (10), Animal nutrition (10), and Animal production (10).

2.5 Collaborations and linkages

2.5.1 Intra-university collaboration

Of the 27 universities surveyed, all except 2 universities (from the Philippines and Vietnam) reported intra-university collaborations to implement the postgraduate studies or training related to the livestock sector in Southeast Asia (see Appendix Table 8.1).

Based on at least 68 cases of intra-university collaborations, the most number of intra-university class collaborations was reported in the Philippines (31) and Indonesia (14) and least in Vietnam (6), Thailand (6), Malaysia (6), Myanmar (4), and Lao PDR (1). The average number of intra-university collaborations per university was however lowest for the Philippines (2.3), Thailand (1.5), Laos PDR (1.0) and highest for Malaysia (6).

Table 5. *Various disciplines in postgraduate studies in livestock sector in Southeast Asia, by country*

Country	Areas of specialization in the livestock sector
Indonesia	
– MS (8):	Animal nutrition—3, Animal production—3, Feed and animal nutrition/Feed science—2, Animal breeding and genetics, Animal breeding and reproduction, Agribusiness management and animal industry, Socio-economics of animal husbandry, Veterinary public health
– PhD (7):	Animal nutrition—3, Animal production—3, Animal breeding and genetics—2, Feed and animal nutrition/Feed science—2, Animal breeding and reproduction, Socio-economics of animal husbandry, Animal product processing technology
Lao PDR	
– MS (1):	Sustainable agricultural resources management—1
Malaysia	
– MS (8)	Animal behaviour and welfare, animal genetics and breeding, animal nutrition, animal physiology, animal production, animal reproduction, animal waste management, meat science
– PhD (8)	Animal behaviour and welfare, animal genetics and breeding, animal nutrition, animal physiology, animal production, animal reproduction, animal waste management, meat science
Myanmar	
– MS (5)	Animal physiology/biochemistry, anatomy/parasitology, microbiology/pharmacology, animal reproduction/public health, veterinary medicine/animal science
– PhD (4)	Animal physiology/biochemistry, anatomy/pharmacology, public health/animal reproduction, microbiology
Others (1):	Diploma in livestock industrial studies
Philippines	
– MS (17):	Agriculture (animal science), animal science—8, Animal production—6, Animal nutrition—4, Meat science, animal breeding—3, Animal physiology—2, Veterinary public health—2, Veterinary anatomy, veterinary epidemiology, veterinary internal medicine, veterinary microbiology, veterinary parasitology, veterinary pathology, veterinary physiology, veterinary surgery, theriogenology
– PhD (7):	Animal production—4, Animal science—3, Animal nutrition—3, Animal breeding (2), Animal physiology (2), Agricultural sciences (animal science)—2, Agriculture (animal science)
Others (17):	Cattle production (2), Dairy production (2), Goat production (2), Poultry production (2), Swine production (2), Duck production, Quail production, Basic veterinary ultrasonography, Basic animal orthopaedic surgery, Small animal ultrasonography, Diagnostic laboratory methods in companion animal practice, Rapid hands-on training on routine laboratory diagnosis of parasites and rickettsiae of dogs and cats, Radiographic interpretation in small animals, Basic animal acupuncture, Swine health, Small animal soft tissue surgery, Canine dermatology: diagnosis, treatment and management of common dermatological diseases
Thailand	
– MS (17):	Animal nutrition—2, Veterinary public health—2, Animal breeding, Animal production and management—2, Reproductive physiology/Theriogenology—2, Animal physiology, Applied veterinary anatomy, Forage crops, Genetics and Breeding, Meat science, Non-ruminant nutrition, Veterinary biosciences, Veterinary medicine, Veterinary pathobiology, Veterinary pharmacology, Veterinary science, Veterinary surgery,
– PhD (13):	Animal production, Animal science, Animal physiology, Genetics and Breeding, Forage crops, Meat science, Non-ruminant nutrition, Reproductive physiology/Theriogenology, Veterinary biosciences, Veterinary medicine, Veterinary science, Veterinary pathobiology, Veterinary public health
Others (2):	Postgraduate diploma in animal production; Postgraduate diploma in veterinary science
Vietnam	
– MS (11):	Animal breeding—2, Animal nutrition—2, Genetics and breeding, Animal husbandry, Nutrition and feeding, Animal production, Aquaculture science, Veterinary science, Microbiology, Parasitology, Pathology
– PhD (14):	Animal breeding—2 (also Animal genetics and breeding, genetics and animal selection), Veterinary microbiology—2, Animal pathology—2, Animal science, animal husbandry, animal nutrition, animal nutrition and feeding, animal reproduction and reproductive diseases, animal reproduction and obstetrics, epidemiology, veterinary science, animal parasitology

Note: Numbers in parenthesis indicate the number of areas of specialization in MS/PhD program.
Number following each area of specialization is number of universities (>1) offering it.

The intra-university collaborations were most commonly reported with the faculty/departments related to agriculture,[2] agricultural industry and technology (13), veterinary medicine/science (10), medicine, pharmacy, and dentistry (8), and business administration, economics and management (6). Collaborations with the faculty/departments related to food science/technology, engineering and agrotechnology (5), arts, school of arts and sciences (5), and community education/rural development/social sciences (4) were also commonly reported.

The intra-university collaboration is mainly through teaching of related core and minor courses (20) especially in the case of the Philippines. Other forms of intra-university collaborations are the use of research and laboratory facilities (9), conduct of research (8), and when serving as member/adviser of student advisory committee (7).

2.5.2 Collaboration with the national research system

Of the 27 universities surveyed in Southeast Asia, 25 universities reported collaboration with the national research system to implement the postgraduate studies or training related to the livestock sector (see Appendix Table 8.2). One university each from Indonesia and the Philippines surprisingly reported no collaboration with the national research system. No reasons or details were given by the two respondents.

The nature of collaboration with the national research system was mostly in terms of conduct or implementation of national research activities/programs/projects—joint researches (11), provision/source of research funds/grants, scholarships (11), and exchange of lecturers/researchers/students (7). In some cases, collaboration involves provision or utilization of research/laboratory facilities or as source of biological materials such as animal stocks, feeds etc. (6), conduct of attendance in faculty/staff training and seminars (4), and when serving as co-supervisor for students or serve as external critic (4).

2.5.3 Collaboration with the national extension system

Of the 27 universities surveyed in Southeast Asia, 22 universities reported collaboration with the national extension system to implement the postgraduate studies or training related to the livestock sector (see Appendix Table 8.3). Five universities (2 from Indonesia, 2 from the Philippines, and 1 from Thailand) had no collaboration with the national extension system.

Collaboration with the national extension system commonly involves the conduct of national extension activities such as training, action programs etc. (17).

2.5.4 Collaboration with farmer training institutes

Of the 27 universities surveyed in Southeast Asia, 24 universities reported collaboration in farmer training programs related to the livestock sector (see Appendix Table 8.4). One university each from Indonesia, Myanmar, and Vietnam had no collaboration with farmer training institutes.

The common involvement of universities in farmer training programs is through the conduct of training both on and off campus (18), mass media broadcasting (e.g. school on the air etc.) including online information dissemination (10), and conduct of seminars/symposium/forum among farmers (10).

The other ways by which universities are involved in farmer training programs are: providing community services including routine extension activities for selected farmer groups (7), implementation of action programs or pilot projects (7), establishment of model farms for hands-on training (7), provision of technical assistance (6), provision of training manuals, brochures, techno-guides etc. (3), and farm visits (3).

2. Agriculture includes agribusiness, agronomy, aquaculture, agricultural economics, agricultural technology, entomology, horticulture, plant pathology/protection, plant/crop science, soil science/management, and tropical agriculture.

2.5.5 Collaboration with other universities and institutes (regional and international)

Of the 27 universities surveyed in Southeast Asia, 19 universities reported inter-university collaborations to implement postgraduate studies or training related to the livestock sector (see Appendix Table 8.5). Seven universities from the Philippines admitted lack of collaboration with other regional and international universities and institutes.

The highest number of inter-university collaborations was reported in Thailand (17), Malaysia (14), Philippines (13), and Indonesia (12), and least in Lao PDR (4), Vietnam (2), and Myanmar (1).

The inter-university collaborations were most commonly reported with universities from Indonesia (6), USA (6), Japan (5), Malaysia (4), Philippines (4), Thailand (4), Australia (3), China (3), Germany (3), Iran (3), and Taiwan (3). Collaborations with at least one university/institute from France, Korea, Laos PDR, Netherlands, Sweden, United Kingdom, and Vietnam were also reported.

Inter-university collaborations are commonly done through teaching of related core and minor courses (10), exchange of faculty/students (8), and conduct of research (5). Other forms of inter-university collaborations include serving as member/adviser of student advisory committee (3), use of research and laboratory facilities (2), serving as external examiner (2), curriculum development (1), provided training (1), and joint publication (1).

2.5.6 Effectiveness of the current collaboration with the national research and extension system

Collaboration with the national research system

Collaborations with the national research system were mostly rated as 'very good' (60.0%) or 'good' (32.0%). About 8.0% of the respondents noted the collaborations with the national research system to be 'weak or poor'. (See Appendix Table 8.2)

To improve future collaborations with the national research system, it was commonly suggested that additional financial support should be provided (7), researchers/teachers should be re-engineered, retooled or retrained (7), and joint research projects both at local and international levels including students should be conducted (6).

Collaboration with the national extension system

Collaborations with the national extension system were rated as 'very good' (31.8%) or 'good' (59.1%). About 9.1% of the respondents noted the collaborations with the national extension system to be 'weak or poor'. (See Appendix Table 8.3)

To improve future collaborations, the following were suggested: provision of additional financial support (7), regular consultation (4), training/retooling of extension personnel (4), extension programs must be (institutionalized) a national priority (2), and greater involvement of graduate students in extension activities (2). Identification of training needs of stakeholders, pooling of experts, and increase incentives to staff were likewise suggested.

3 Strengths, weaknesses and gaps

3.1 Critical constraints faced by institutes in implementing programs

The critical constraints to the implementation of the postgraduate programs related to the livestock sector (by country) are given in Table 6. The major constraints are commonly associated with the lack of laboratory facilities and equipment (12), lack of qualified graduate faculty (10), lack of student enrolment in the graduate programs (8), and limited budget and financial support for research programs (7).

Table 6. *Critical constraints to implement the postgraduate programs related to the livestock sector*

Country	Critical constraints
Indonesia	Slow increase in livestock population (1)
	Limited improvement of farmers' knowledge and incomes (1)
	Lack of budget support from the university (1)
Lao PDR	Lack of laboratory facilities (1)
	Lack of graduate faculty (1)
	Poor English (1)
Malaysia	Lack of research grants (1)
	Lack of technical support, laboratory equipment (1)
	Lack of qualifications and expertise in practical quantitative techniques used in data analysis (1)
	Small size of production data sets (1)
Myanmar	Lack of modern laboratory equipment (1)
Philippines	Lack of student enrolment (8)
	Lack of qualified graduate faculty (7)
	Lack of laboratory facilities/equipment (7)
	Lack of funds for the conduct of thesis or dissertations (3)
	Lack of updated references—library materials, books and other publications (3)
	Lack of scholarships to enrol full-time as graduate students (2)
	Lack of animals (1)
	Lack of graduate courses related to livestock production and health (1)
	Low honoraria/incentives to members of the graduate faculty (1)
	Unavailable graduate faculty to teach graduate courses on Saturdays—preferred by prospective graduate students (1)
	Lacks periodic review of the curriculum for government accreditation (1)
Thailand	Limited research budget (1)
	Low emphasis on animal welfare (1)
	Lack of promotion of friendly animal production systems (1)
	Lack of integration and multi-department cooperation in some graduate programs (1)
	Lack qualified/expert faculty members (1)

Vietnam	For the university—
	Limited budget and financial support for research program (2)
	Poor facilities for graduate students to practice and carry out experiments (2)
	Poor classrooms, practical facilities, library and information systems (2)
	Poor practical training program (2)
	Fewer training facilities than the number of postgraduate students (1)
	Lack of books and references (1)
	Poor international cooperation (1)
	Inflexible program (i.e. limited elective/optional courses) (1)
	Curriculum is revised and updated slowly. The program is not updated with the international standards (1)
	Very few areas of specialization (1)
	Many subjects are not really necessary (1)
	Postgraduate management is not professional (1)
	For teachers—
	Lack of postgraduate teachers (2)
	Poor English (1)
	Training program is in Vietnamese language (1)
	Limited knowledge on computing (1)
	Teachers do not have enough teaching experience and knowledge.
	Inappropriate training skills/methodology (1)
	Lack of highly qualified lecturers (1)
	Lack of lectures in several subject areas (1)
	Poor international exposure (1)
	For graduate students—
	Poor English (1)
	Too busy with regular jobs and family affairs (1)
	Poor ability for self study and active learning (1)
	Motivation is for degree rather than for knowledge (1)
	Limited awareness on postgraduate studies (1)

Note: Numbers in parentheses indicate the number of universities which suggested the critical constraint.

3.2 Gaps (strengths and weaknesses) in capacities and existing curricular programs

Strengths of postgraduate programs

The academic areas related to animal production or veterinary science where the Southeast Asian university respondents are deemed strong are listed (by country) in Table 7. The commonly cited academic areas of strengths are: agriculture or agricultural sciences (10), animal nutrition (5), veterinary medicine/science (5), animal science (4), and animal breeding and genetics (4).

Weaknesses of postgraduate programs

Out of the 27 universities surveyed, all except for 4 universities (2 from Indonesia and 2 from the Philippines), reported no weakness in their current postgraduate program. Hence, based on the responses of 23 universities, the weaknesses of the current postgraduate programs related to the livestock sector in Southeast Asian universities are summarized (by country) in Table 8. The commonly cited weakness was the limited or lack of research facilities and materials (10), limited or lack of qualified teachers (7), and limited or lack of research funds (6).

Table 7. *Areas with strong academic programs of Southeast Asian universities, by country*

Country	Strong academic areas/programs of Southeast Asian universities
Indonesia	Animal breeding and genetics (2), animal nutrition (2), agriculture or agricultural sciences (1), animal agriculture (1), animal resources management (1)
Lao PDR	Animal production (1), Animal nutrition (1)
Malaysia	Animal behaviour and welfare (1), animal genetics (1), animal nutrition (1), animal production (1), animal reproduction (1), meat science (1)
Myanmar	Animal physiology/biochemistry (1), anatomy/pharmacology (1), public health/reproduction, microbiology (1)
Philippines	Agriculture or agricultural sciences (9), veterinary medicine/science (4), education (4), animal science/husbandry (4), agricultural teacher education (2), agricultural technology education (1), animal breeding and genetics (1), dairy production and milk processing (1)
Thailand	Animal nutrition (2), veterinary public health (2), ruminant production (1), animal slaughter and processing (1), elephant and wildlife medicine (1), large animal medicine (1), veterinary medicine/science (1), veterinary surgery (1), veterinary physiology (1), veterinary pathology (1), veterinary pharmacology (1), veterinary theriogenology (1), veterinary microbiology (1)
Vietnam	Animal husbandry (1)

Note: Numbers in parentheses indicate the number of universities which suggested the strong academic area or program.

Table 8. *Weaknesses in the current postgraduate training program, by country*

Country	Weaknesses in the current postgraduate program in animal production and veterinary science in Southeast Asia
Indonesia	Limited or lack of research funds (3)
	Limited or lack of research facilities (e.g. laboratory) and materials (2)
	Limited scholarship grants (1)
	Research results are not usually adopted by the industry or do not match community needs (1)
Lao PDR	Limited computers (1)
	Poor English comprehension (1)
	Limited practical applications (1)
Malaysia	Lack of postgraduate program by course work (1)
	Lack of modern farm facilities for some species (1)
	Lack of funds for both postgraduate courses and research (1)
	Lack of animal performance recording systems (1)
Myanmar	Limited laboratory facilities (1)
	Limited internet access (1)
	Limited international scientific journals (1)
Philippines	Limited or lack of qualified teachers (5)
	Limited or lack of research facilities and materials (5)
	Low number of enrolees both from local and abroad (3)
	Limited or lack of research funds (2)
	Limited scholarship grants (2)
	Poor professional growth of graduate faculty (2)
	Low honoraria for professors (1)
	Non-permanency (security of tenure) of faculty (1)
	Curriculum is slow to be revised and updated (1)
	Courses do not meet the needs of the industry/practitioners (1)
	Classes are held on weekends to give working students chance to study (1).
	Linkage with foreign universities (1)

Thailand	Weak in animal molecular genetics and animal toxicology (2)
	Lack integration and multi-disciplinary concept (1)
	Limited number of qualified graduate faculty (1)
	Limited researches (1)
	Limited international publications (1)
Vietnam	Poor practical training program for students (2)
	Limited or lack of research facilities and materials (1)
	Limited or lack of qualified teachers (1)
	Curriculum is slow to be revised and updated (1)
	Complicated curriculum (1)
	Research results are not usually adopted by the industry or do not match community needs (1)
	Poor English or language barrier (1)
	Management staff are not professional (1)

Note: Numbers in parentheses indicate the number of universities which suggested the weakness in the current postgraduate programs.

3.3 Review of importance of training offered and not offered

Skill areas currently offered in postgraduate training program

Based on the answers of 30 respondents, the most common skill areas currently offered in postgraduate programs on animal production and veterinary science in Southeast Asia are: scientific writing (24), participatory research methods (19), strategic planning (17), convincing proposal writing (17), effective communication (17), leadership and decision making (15), facilitation skills (15), and monitoring, evaluation and impact assessment (15). The other skill areas currently offered by Southeast Asian universities (by country) are given in Table 9.[3]

Table 9. *Skill areas currently offered in postgraduate programs for the livestock sector by Southeast Asian universities, by country*

Skill areas currently offered in postgraduate programs	Number of responses							
	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
1. Scientific writing	3	1	–	1	13	3	3	24
2. Participatory research methods	3	1	1	1	10	3	–	19
3. Strategic planning	3	1	–	1	9	3	–	17
4. Convincing proposal writing	3	1	–	1	7	3	2	17
5. Effective communication	3	–	–	1	10	3	–	17
6. Leadership and decision making	3	1	–	–	8	3	–	15
7. Facilitation skills	3	–	1	1	8	2	–	15
8. Monitoring, evaluation and impact assessment	2	1	–	1	9	2	–	15
9. Biosafety	2	1	–	1	4	3	3	14
10. Planning and priority setting	2	1	–	1	9	1	–	14
11. Sustainable use of animal genetic resources	3	1	–	1	6	2	1	14
12. Interaction of crop–livestock–water	3	1	–	–	7	3	–	14
13. Gender analysis	1	1	–	–	8	3	–	13
14. Design, implementation and assessment of networks and partnerships	3	1	–	1	5	2	–	12

3. One respondent (from Indonesia) suggested that the skill areas currently offered in the postgraduate programs should also be subjected for classification by importance. This was because the questionnaire asked the importance of skill areas only if they are not yet offered.

15. Bioinformatics	2	–	–	1	4	3	1	11
16. *Ex situ* conservation of animal genetic resources	3	–	–	1	4	2	1	11
17. Value chain analysis, market orientations and implications to R&D	2	1	–	1	6	1	–	11
18. Management of gene bank	2	–	–	1	4	2	1	10
19. Poverty, vulnerability and risk analysis	1	1	–	1	6	1	–	10
20. Negotiation and conflict resolution skills	2	1	–	–	5	1	–	9
21. Disease surveillance and preparedness	1	1	–	1	3	2	1	9
22. Intellectual property right policy	1	1	1	–	3	3	–	9
23. Innovation systems perspective and implication to R&D	2	1	–	1	4	1	–	9
24. Climate change: implications and adaptation strategies	1	–	–	–	6	2	–	9
25. Others (food safety, feed resources, animal welfare)	–	–	–	–	3	1	–	4

Importance of skill areas not yet offered

Based on total responses from 30 respondents, Table 10 shows that the common major skill areas that are not yet offered in postgraduate programs are: intellectual property right policy (21), disease surveillance and preparedness (20), climate change: implications and adaptation strategies (20), innovation systems perspective and implication to R&D (20), and negotiation and conflict resolution (20).

Table 10. *Importance of skill areas not yet offered in postgraduate programs of Southeast Asian universities*

Skill areas not yet offered in postgraduate programs	Number of responses			
	Extremely important (EI)	Moderately important (MI)	Not important (NI)	Total
1. Intellectual property right policy	13	7	1	21
2. Disease surveillance and preparedness	14	5	1	20
3. Climate change: implications and adaptation strategies	12	6	2	20
4. Innovation systems perspective and implication to R&D	11	9	–	20
5. Negotiation and conflict resolution skills	6	9	5	20
6. Poverty, vulnerability and risk analysis	9	8	2	19
7. *Ex situ* conservation of animal genetic resources	11	7	–	18
8. Value chain analysis, market orientations and implications to R&D	11	6	1	18
9. Management of gene bank	12	5	1	18
10. Bioinformatics	11	6	–	17
11. Design, implementation and assessment of networks and partnerships	11	5	1	17
12. Gender analysis	3	11	3	17
13. Sustainable use of animal genetic resources	10	6	–	16
14. Biosafety	15	–	–	15
15. Interaction of crop–livestock–water	12	3	–	15
16. Planning and priority setting	9	5	1	15
17. Monitoring, evaluation and impact assessment	11	3	–	14
18. Leadership and decision making	6	8	–	14
19. Facilitation skills	2	9	3	14

20. Convincing proposal writing	7	5	–	12
21. Effective communication	6	5	1	12
22. Strategic planning	4	8	–	12
23. Participatory research methods	5	4	1	10
24. Scientific writing	2	2	–	4
25. Others (food safety)	1	–	–	1
Total	214	142	23	379

Most skill areas not yet offered in postgraduate programs were classified as 'extremely important' (56.4%) and 'moderately important' (37.5%). Only 6.1% of the responses considered the skill areas not yet offered as 'not important'.

The skill areas commonly identified as 'extremely important' were: biosafety (15), disease surveillance and preparedness (14), intellectual property right policy (13), climate change: implications and adaptation strategies (12), management of gene bank (12), and interaction of crop–livestock–water (12). Negotiation and conflict resolution skills (5), gender analysis (3), and facilitation skills (3) were commonly considered as 'not important'.

4 Needs and recommendation

4.1 Review of specific areas that needs to be strengthened: Emerging issues/challenges of the livestock sector

Of the 27 universities surveyed, only 15 universities claimed that their postgraduate program is adequately addressing the current and emerging issues/challenges of the livestock sector. The other 11 universities who claimed otherwise were from Indonesia (2), Philippines (7), and Vietnam (2). The current and emerging challenges in the livestock sector in Southeast Asia (by country) are summarized in Table 11.

Based on the answers of 15 respondents, the commonly cited emerging issues/challenges currently being addressed were food safety issues and policy (3), animal genetic resources and conservation (3), emerging and re-emerging animal diseases (3), biotechnology (2), climate change (2), and animal welfare (2).

Table 11. *Emerging issues/challenges of the livestock sector that the postgraduate program is adequately being addressed (by country)*

Country	Emerging issues/challenges not addressed 5 years ago but currently being addressed*
Indonesia	Animal biotechnology (2), Animal genetic resources and conservation (2), Animal product and waste product processing (1), Sustainable animal production system (1), Sustainable animal resources (1)
Lao PDR	Sustainable small and medium livestock farms (1), Organic production systems without antibiotics and chemicals (1)
Malaysia	Rise in feed costs (1), Molecular characterization of indigenous breeds (1), Meat quality during slaughter, storage and processing (1), Animal welfare (1), Halal slaughtering (1)
Myanmar	Histopathology (1)
Philippines	Biotechnology (2), Climate change (2), Food safety issues and policy (2), Current trends in research (1), Emerging and re-emerging animal diseases (1), Evaluation of national disease control and eradication program (1), Livestock importation (1), Low productivity of livestock (1), Project development/administration (1), Ruminant nutrition technology (1)
Thailand	Animal welfare (2), Food safety issues and policy (2), Emerging and re-emerging animal diseases (1), Genetics (1), Feed resources (1)
Vietnam	(no answer given)

Note: Numbers in parentheses indicate the number of respondents which suggested the emerging issue/challenges.

Areas that need improvement

For those universities whose current postgraduate programs are inadequately addressing the current and emerging challenge of the livestock sector, Table 12 enumerates the specific areas that need to be improved in the livestock sector in Southeast Asia (by country). No answers were given by universities from Malaysia, Myanmar, and Thailand.

Specific areas and recommendations for improvement in the livestock sector in each country were identified and categorized into policy and institution, animal production, service delivery, processing, animal health, and marketing, value addition, and trade). There was considerable variability in the responses between countries for each category and therefore necessitates separate and specific recommendations for each country.

Table 12. *Areas that need improvement in the livestock sector in Southeast Asia, by country*

Country	Areas for improvement in the livestock sector
Indonesia	Policy and institution
	• Protection of trade/exports and reduce the slaughtering of productive female cattle
	• Mutual collaboration with other institutes
	Animal production
	• Genetic and breeding selection
	• Quantity and quality of animal production especially research animals
	• Laboratory support for beef and dairy cattle
	Processing
	• Domestic processing of local raw materials (e.g. cattle products) instead of exporting them
	• Laboratory support for animal product technology
Lao PDR	Policy and institution
	• National livestock plan
	• Budget for national livestock program
	• Tax relief for small livestock farms
	Animal production
	• Increased production of cattle, pigs, chickens and goats
	Service delivery
	• Enhance practical skills
	Processing
	• Improve use of electrical power facilities
	Animal health
	• More veterinarians and laboratories
	Marketing, value addition, and trade
	• More government-led programs
	Others
	• International exchange programs
	• Foreign investments in livestock production
Malaysia	(no answer given)
Myanmar	(no answer given)

Philippines	Policy and institution • Design, implementation and assessment of networks and partnerships in the livestock sector • Policy on Intellectual Property Rights (IPR) • Policy on local animal genetic conservation • Priority setting • Policy on faculty recruitment • Review of RDE agenda Animal production • Climate change: Implications and adaptation changes (3) • Sustainable use of animal genetic resources • Utilization of emerging fodder crops for ruminant production • Livestock and poultry production the 'Halal' or organic way • Protocols in managing livestock and poultry to reduce animal stress • Defining breeding systems for increased productivity • Biotechnology in livestock production • Biosafety • Vulnerability and risks • Livestock integration with crops and trees • Interactions of crop–livestock–water • Animal waste management • Additional funds for training and farm projects Service delivery • Enhancing extension services for the delivery of technologies to stakeholders • Lengthening shelf life of products utilizing non-cancerous preservatives • Bioinformatics • Innovation systems • Additional funds for vehicles to reach far flung areas • Enhance technology transfer systems Processing • Quality control and HACCP related activities • Additional funds for processing plants • Proper use of preservatives • Proper hygiene and sanitation in meat and milk production Animal health • Postgraduate training in epidemiology, diseases surveillance and monitoring • Postgraduate training in food animal medicine including public health and food safety • Training courses in poultry and livestock health management • Disease surveillance and preparedness, strategic herd/flock health programs, biosafety (3) • Mobile veterinary clinic to be used for veterinary extension activities and services to farmers • Utilization of medicinal and aromatic plants in the treatment of animal diseases • Good management practices/best management practices or protocols to prevent diseases in livestock • Additional funds for diagnostic centre • Analysis of residues of antibiotics and other drugs in meat and meat products

	Marketing, value addition, and trade • Value chain analysis, market orientations and implications to R&D (2) • Eco-labelling • Linking livestock producers to market • Value adding of products • Improvement of livestock auction markets • Skills training and facilities for product commercialization
Thailand	(no answer given)
Vietnam	Policy and institution • Information on government policies on livestock development • Evaluation of economic efficiency of animal production • Need for policy to attract good scientists to join university for teaching and conduct of research • Policy to improve assessment of projects to reflect the quality of the project/study Animal production • Sustainable development of livestock based production systems • Matching genetic potentials with available feed resources under tropical conditions • Advanced animal production techniques Service delivery • Sustainable development of production services systems (e.g. veterinary extension etc.) Processing • Slaughtering techniques and facilities • Meat, eggs and milk processing • Quality control and HACCP related activities Animal health • Zoonoses • Diagnostic of new diseases Marketing, value addition, and trade • Impact analysis of GATT on animal production • Value chain analysis, market orientations and implications to R&D • Marketing animal products

4.2 Role of ILRI in bridging possible gaps

Out of the 27 universities surveyed, all except for four universities from the Philippines and Indonesia reported to be familiar with ILRI.

The various assistance needed from ILRI that is related to the implementation of postgraduate programs in animal production and veterinary science (by country), is given in Table 13. Based on the answers of 30 respondents, the assistance from ILRI commonly suggested are: local and international trainings, seminars, study tours etc. for lecturers, teachers, and students (18); funding for university facilities (e.g. laboratory, equipment, vehicle, diagnostic centre, library materials/references etc.) for research and extension programs (11); support for joint researches within the university, other universities and ILRI (9), and establishment of linkages with other universities/research institutes to enhance postgraduate program (6).

ILRI's role would largely be in initiating and coordinating programs that should regularly update and standardize the postgraduate curriculum on animal production and veterinary sciences in most countries in Southeast Asia. By hosting (or sponsoring) regular symposia or conferences on postgraduate curricula in the region, ILRI may be able to enhance collaborations intra-university, inter-university, with the

national research and extension systems, and with farmer training institutes. Please see specific proposals on paragraph 80 to 86 on pages 30 and 31. These are interrelated suggestions aimed at building and sustaining capacity of institutions.

Table 13. *Assistance needed from ILRI to strengthen postgraduate training programs in Southeast Asian universities, by country*

Country	Assistance needed from ILRI by Southeast Asian universities
Indonesia	Joint researches within the university, other universities and ILRI (3)
	Funding for universities' facilities (e.g. laboratory, equipment, library materials etc.) for research and extension programs (2)
	Scholarship for postgraduate students (1)
	Establishment of linkages with other universities/research institutes to enhance postgraduate program (1)
	Advice and training from international experts (1)
Lao PDR	Training programs to improve breed and feeds and feeding systems (1)
	New processing methods and equipment (1)
	Financial support to infrastructure, conduct research, and upgrade staff (1)
Malaysia	Support lecturer and postgraduate student placement in universities and research institutions abroad (1)
	Support expert resource persons for training workshops abroad (1)
	Support funds for graduate student research (1)
Myanmar	Provide modern laboratory facilities (1)
	Send full-time or part-time experts to our university to give lectures or do research together(1)
	Allow teaching staff and graduate students to gain exposure and experience at ILRI(1)
Philippines	Local and international trainings, seminars, study tours etc. for lecturers, teachers, and students (10)
	Funding for universities' facilities (e.g. laboratory, equipment, vehicle, diagnostic centre, library materials/references etc.) and for research and extension programs (6)
	Establishment of linkages with other universities/research institutes to enhance postgraduate program (4)
	Scholarship for postgraduate students (3)
	Support for a capacity building program for faculty and researchers (2)
Thailand	Joint researches within the university, other universities and ILRI (3)
	Scientists/professor exchange program (1)
	Provide teaching materials (1)
	Provide needs assessment in animal production and veterinary science to strategic planning of graduate programs (1)
	Advice and training from international experts (1)
	Invite faculty in some subjects (1)
	Funding support (1)
	Training, study tours, workshops and conferences (1)
	Research collaborations (1)
Vietnam	Local and international trainings, seminars, study tours etc. for lecturers, teachers, and students (4)
	Curriculum development (1)
	Joint researches within the university, other universities and ILRI (1)
	Advice and training from international experts (1)

Note: Numbers in parentheses indicate the number of universities which suggested the assistance needed from ILRI.

4.3 Specific suggestions on strengthening partnerships

While there are problems confronting postgraduate training program on animal production and veterinary sciences, there is still the need to invest in postgraduate training programs through strong partnerships among Southeast Asian countries since they play key roles in ensuring the implementation of government policies aimed at food security and rural poverty alleviation. They have multiplier effects if trained personnel are properly employed as extension agents, trainers/teachers, researchers, program managers, and policy makers in both government and private sectors.

The universities however must assume primary responsibility in institutional reform particularly adapted to specific needs. Focus should be on quality and consolidation.

The national universities should strive to increase the share of government budget for higher education. Postgraduate programs on animal production and veterinary sciences should also be pursued through the assistance from many countries and other international organizations. In order to attract international assistance, and gain international recognition, the universities in Southeast Asia should emphasize on fostering relationships and substantial technical cooperation with overseas institutions.

The private sector may also be encouraged to expand and steadily increase student enrolment in private universities in partnership with the government system. The universities in the provinces and countryside should encourage and allow greater access (enrolment) to postgraduate programs especially for female graduate students and ethnic minorities.

Increasing the number, quality, and connectivity (partnerships) of large multi-disciplinary universities offering postgraduate programs in animal production and veterinary science in some countries of Southeast Asia (especially Myanmar, Lao PDR, Cambodia, and Timor Leste) is highly justified due to the importance of livestock sector in the national economy—in terms of human and land resources, animal inventory, value of production including imports, exports, and consumption of livestock food products. On the other hand, establishment of a large number of small and scattered institutions with poor facilities, weak and inefficient management and narrowly specialized programs should be avoided.

The importance of international cooperation should be emphasized as this shall contribute to the development of higher education in Southeast Asia through the establishment of strong relationships with similar institutions in other countries in the region. International cooperation for institutional development should be pursued to ensure access to and in facilitating the transfer of knowledge and giving the best practice. The universities in Southeast Asia through SEARCA–SEAMO should thus promote international cooperation through bilateral and multilateral cooperation where benefits are based on national, regional and international needs. In particular, international cooperation should be promoted in order to exchange experiences, facilitate staff and student exchange, provide opportunities for training teachers, and develop joint research and development programs.

An inter-university alliance in Southeast Asia in cooperation with ILRI to act as secretariat, associate member or adviser is proposed as a major support program to improve postgraduate studies for the livestock sector in the region. Its strong research base that allows collaboration on a range of cross-cutting livestock problems is ILRI's main strength and advantage for postgraduate research and training.

Through a Memorandum of Agreement (MOA) among ILRI (through its Partnerships and Communications Division and Capacity Strengthening Unit) and member universities in Southeast Asia, the inter-university alliance will be tasked to promote the exchange of graduate students and scholars (professors, lecturers and researchers), exchange of academic information and materials of mutual interest, exchange of periodical academic publications (e.g. MSc and PhD dissertation abstracts on animal production and veterinary science of Southeast Asia), and organization of collaborative postgraduate research and training programs.

With outstanding HEIs in Southeast Asia selected as members and ILRI as associate member or adviser, the inter-university alliance shall aim to contribute to the development of relevant science and the larger social good by training outstanding animal and veterinary scientists and professionals who will play leading roles in a broad array of areas by means of advanced skills and innovative thinking. Graduate students will thus be prepared to become livestock scientists and veterinary public health specialists with a broad international/regional perspective and crisis control skills who are able to respond to problems in relevant areas by taking prompt yet pragmatic action.

Initially, the inter-university alliance and ILRI shall lead to undertake a comprehensive review of its curricula and syllabi and bring a new dimension to postgraduate animal and veterinary education by building strong ties between faculty and students in Southeast Asia. Interdisciplinary courses as well as faculty-led dissertation research will be integrated into the curriculum, thereby facilitating cross-disciplinary communication and international careers. These include new courses on animal welfare and ethics, food safety, biotechnology, and other emerging issues in the livestock sector.

An information and communications network linking universities and research institutes throughout Southeast Asia and ILRI may be developed. In particular, enhanced courses in scientific English and communication will be promoted so that the graduate student may benefit from international research information and cross-disciplinary and cross-cultural communications.

Special lectures may also be given by a select group of faculty members from inside and outside the alliance and ILRI staff to cover the importance of ethical conduct in animal and veterinary research and basic skills in scientific presentation and writing.

The establishment an animal science society of the Southeast Asian region (e.g. ASEAN–SAS—ASEAN Society of Animal Science) with ILRI serving as associate member is also proposed. The ASEAN–SAS shall publish its own journal of animal science in Southeast Asia and hold of annual or biannual scientific meetings rotated among member universities in Southeast Asia.

5 Conclusion and recommendation, limitations

Role of livestock in the regional Southeast Asia economy and emerging challenges confronting the livestock sector

For the more than 565 million people (growing 1.52% per year) in Southeast Asia with a total land area of 434.1 million hectare including 117.7 million hectare of agricultural land and 17.1 million hectare of permanent meadows and pastures, livestock production was worth 19.8 billion I$ in 2007 (growing 5.01% per year). Livestock production represents 16.6% of the total value of production in the agriculture sector (115.51 billion I$). The average value of livestock imports per year is USD 400.4 million, mainly from imports of cattle, chickens, and pigs. The annual livestock exports are worth USD 169.1 million, mainly for chickens, pigs, and ducks. The total animal inventory in 2007 in Southeast Asia consists of 15.2 million buffalo, 45.6 million cattle, 0.8 million horses, 26.8 million goats, 69.8 million pigs, 2.13 billion chickens, and 167.5 million ducks. Annual consumption of animal food products from 1994–2003 was highest for poultry meat (3.23 million tonnes), followed by pig meat (2.56 million tonnes), whole milk (2.54 million tonnes), eggs (2.09 million tonnes), and bovine meat (1.30 million tonnes).

The livestock sector in Southeast Asia provides be a sustainable livelihood option and an appropriate medium of socioeconomic growth through employment and entrepreneurship development, gender equality and education empowerment for millions of people in the region. Value addition at the farm level may also be pursued to bring additional income to livestock farmers and saves food products of animal origin from deterioration and wastage. Especially for commercial and intensive production systems, however, environmental protection through proper shelters, drainage, waste disposal and recycling are important issues to be considered.

Current status of postgraduate training in the livestock sector in the region

While there are more than 5800 public and private universities, polytechnic and community colleges in Southeast Asia, only a few higher education institutions (HEIs) offer a graduate degree program related to the livestock sector. Postgraduate programs for animal production and veterinary science are known to be offered in 7 countries (i.e. none in Brunei, Cambodia, Singapore, and Timor Leste), with only one HEI noted each in Laos PDR and Myanmar.

Based on a survey of 27 universities in 7 countries of Southeast Asia, the analysis of postgraduate training in the livestock sector revealed the following:

- The most common areas for specialization in postgraduate programs (MS and PhD) on animal production and veterinary science in Southeast Asia are animal nutrition, animal production, animal breeding, and animal science.
- The commonly cited academic areas of strengths of a university in Southeast Asia are agriculture or agricultural sciences, animal nutrition, veterinary medicine/science, and animal breeding and

genetics.
- The most common skill areas currently offered are: Scientific writing, participatory research methods, strategic planning, convincing proposal writing, and effective communication. Other skill areas not yet offered include: intellectual property right policy, implications and adaptation strategies to climate change, innovation systems perspective and implication to R&D, and poverty, vulnerability and risk analysis. The skill areas considered as extremely important include: intellectual property right policy, biosafety, climate change: implications and adaptation strategies, disease surveillance and preparedness, and interaction of crop–livestock–water.[4]

Collaboration and linkage between tertiary educational institutes and research and extension systems

Intra-university collaborations and collaborations with the national research system and with farmer training programs are most common in Southeast Asian universities. Other forms of collaboration are also reported with the national extension system and with other regional and international universities and institutes.

The intra-university collaborations were commonly made through the faculty/departments related to agriculture, agricultural industry and technology, veterinary medicine/science, and medicine, pharmacy, and dentistry. On the other hand, inter-university collaborations are commonly done through teaching of related core and minor courses, exchange of faculty/students, and conduct of research especially with universities from Malaysia, Indonesia, and Thailand.

Collaborations with the national research system were mostly through the implementation of national research activities/programs/projects or joint researches, provision/source of research funds/grants, scholarships, and exchange of lecturers/researchers/students. Collaborations with the national research system were mostly rated as 'very good'. The common suggestions to improve future collaborations include: additional financial support, retooling/training of researchers and teachers, and conduct of joint research projects both at local and international levels.

Collaboration with the national extension system commonly involves the conduct of national extension activities such as training and action programs. Collaborations with the national extension system were mostly rated as 'good'. The common suggestions to improve future collaborations include: additional financial support, regular consultation, training/retooling of extension personnel, extension programs must be (institutionalized) a national priority, and greater involvement of graduate students in extension activities. The effectiveness of current collaborations with farmer training institutes was not captured in the survey questionnaire.

Collaboration with farmer training institutes is through the conduct of training both on and off campus, mass media broadcasting including online information dissemination, conduct of seminars/symposium/forum among farmers, and providing community services including routine extension activities for selected farmer groups.

More and strong (i.e. with good to very good effectiveness rating) collaboration is recommended for the following (by country):

- Indonesia (national research and extension system, and farmer training institutes),
- Myanmar (farmer training institutes)
- Philippines (intra-university, inter-university, national research system, national extension system)

4. The number and distribution of universities (by country) that participated in the survey are Philippines (12), Indonesia (4), Thailand (4), Vietnam (2), Lao PDR (1), Malaysia (1), and Myanmar (1). Several other universities were not contacted or failed to respond to the survey invitations due to the language problem and limited access to the internet by school officials. Getting more respondents from different countries would have allowed statistical analysis of the survey data to determine relationships among different postgraduate training variables.

- Thailand (intra-university, national extension system)
- Vietnam (intra-university, farmer training institutes).[5]

Critical constraints and challenges facing the agriculture higher learning institutions in the region

The critical constraints to the implementation of the postgraduate programs related to the livestock sector in Southeast Asia are usually associated with the lack of laboratory facilities and equipment, lack of qualified graduate faculty, lack of student enrolment in the graduate programs, and limited budget and financial support for research programs.

Missing elements and capacity gaps in the existing postgraduate level curricula to address emerging needs and challenges of the livestock sector

Strong academic programs at the postgraduate level in Southeast Asian universities are commonly cited in the areas of agriculture or agricultural sciences, veterinary medicine/science, animal breeding and genetics, and animal nutrition. However, the common weaknesses of the current postgraduate programs related to the livestock sector include limited or lack of research facilities and materials, limited or lack of qualified teachers, and limited or lack of research funds.

In the postgraduate curriculum related to the livestock sector, the commonly cited emerging issues/challenges currently being addressed were food safety issues and policy, animal genetic resources and conservation, emerging and re-emerging animal diseases, biotechnology, climate change, and animal welfare.

The most common skill areas currently offered in postgraduate training programs are: scientific writing, participatory research methods, strategic planning, convincing proposal writing, effective communication, leadership and decision making, facilitation skills and monitoring, evaluation and impact assessment. Skill areas that are not yet offered in postgraduate programs are mostly on : intellectual property right policy, poverty, vulnerability and risk analysis, innovation systems perspective and implication to R&D, implications and adaptation strategies to climate change, negotiation and conflict resolution skills, and disease surveillance and preparedness. The skill areas commonly identified as 'extremely important' were: biosafety, disease surveillance and preparedness, intellectual property right policy climate change: implications and adaptation strategies, management of gene bank, and interaction of crop–livestock–water.

Role and priorities of ILRI in bridging capacity gaps identified

The commonly identified roles of ILRI in bridging the capacity gaps include local and international trainings, seminars, and study tours for lecturers, teachers, and students and funding support for university facilities in joint research and extension programs within the university, other universities and ILRI. While ILRI is not a university or a training college, it offers individual or group training courses that are aimed to building and strengthening both institution as well as individual capacities (ILRI, 2008).

It should be noted that ILRI is not a funding agency. The Capacity Strengthening and Training Unit (CaSt) of ILRI is the one engaged with national and international livestock research and development partners and provides both group and individual training through regional and global fora. A written reference

5. A university from Malaysia reported active collaborations intra-university, inter-university, with the national research and extension system, and with the farmer training institutes.

to policies and procedures for training at ILRI is available at the ILRI website (http://www.ilri.org), (ILRI 2009).

While the above roles of ILRI match with the constraints to the implementation of the postgraduate programs related to the livestock sector, specific assistance by ILRI should however consider and prioritize separately the identified areas that need improvement for each country in Southeast Asia in terms of policy and institution, animal production, service delivery, processing, animal health, and marketing, value addition, and trade.

As part of its efforts on building capacity of the educational institutes that will complement the ongoing regional and national initiatives, ILRI should take the lead in effectively integrating into the curricula of postgraduate studies in Southeast Asia the skill areas commonly identified as extremely important such as intellectual property right policy, disease surveillance and preparedness, biosafety, implications and adaptation strategies to climate change, and interaction of crop–livestock–water.

Furthermore, ILRI has the major roles to establish and improve collaboration intra-university and inter-university (i.e. with other regional and international universities), with the national research and extension systems, and with farmer training institutes in Southeast Asia.

Some recommendations/suggestions

The higher educational institutions offering postgraduate programs in animal production and veterinary sciences are expected to generate high quality manpower needed to perform the technological backstopping at the field or farm level, through scientific and technology development in the livestock sector. At the minimum, graduates of MSc programs must have the enhanced practical skills and comprehensive knowledge of the entire subjects, while PhDs should prove as specialists in their field of specialization.

International cooperation is envisioned to maximize the benefits of collaboration with affiliated university and institutional research facilities through experience in collaborative research in animal production and veterinary sciences in Southeast Asia and other parts of the world.

An inter-university alliance in Southeast Asia in cooperation with ILRI to act as secretariat, associate member or adviser is proposed as a major support program to improve postgraduate studies for the livestock sector in the region. This can be integrated effectively with CaSt activities related to ILRI's research programs, partnerships, communications, and knowledge management.

Alternatively, countries in Southeast Asia (except Singapore and Brunei who have insignificant livestock sector compared to its neighbours) may be arbitrarily categorized according to the average annual value of livestock production. Thus, some national universities in Indonesia, Philippines, Vietnam, and Thailand (i.e. those with livestock sector worth 3.4 billion to 4.9 billion US dollars per year) may be categorized into the 'first' group while the rest—Cambodia, Myanmar, Lao PDR, and Timor Leste may form the 'second' group. (Malaysia may be included in the first group even if its value of livestock production is lower than that of Myanmar.)

The first group shall include universities that had long offered postgraduate programs in the past and are oriented to sustaining their curricular and faculty development programs. The second group on the other hand, may learn from the experiences of the 'first' group and are currently involved in institutionalizing a new postgraduate curricula and active recruitment program to develop and upgrade its local graduate faculty.

The top universities in the first group may be convened regularly, i.e. intra-university and inter-university but within the country. Universities in the second group shall convene inter-university from different

countries and jointly plan on programs that shall establish the new postgraduate curricula and recruit young graduate faculty with PhD degrees, all based on the lessons learned from the first group and even China.

Limitations of the study

While there exist extensive areas of commonality among most countries in Southeast Asia especially with regard to (smallholder) livestock production and marketing systems and their value to the national economy, it will be difficult to categorize specific recommendations and priorities for postgraduate research and training in the livestock sector in the region. In this study, the limited number and uneven distribution of survey respondents (universities) from the different countries will restrict the recommendations and conclusions mostly on a case-to-case basis.

Except for the southern (tropical) part of China, the livestock sector of Chinese agriculture could also be different with that of Southeast Asia. While the Chinese experience could be a good reference for postgraduate programs in Southeast Asia, a separate study of the status of the postgraduate program for the livestock sector in China might be more appropriate.

The language barrier (or lack of proficiency in a common language such as English as the medium of instruction and communication in the region), unfavourable government policies and requirements, lack of government financial support for higher education institutions, variability in sustainability of livestock development, unstable peace and order situation, national traditions, and varied incidence of poverty may all limit cross enrolment, faculty exchange, international training and symposia, and infrastructure (i.e. instruction, research and extension facilities) development and therefore sharing and updating of the curricular programs between universities from different countries in Southeast Asia.

Finally, the conclusions drawn from the information collected in this consultancy study will require initiative and active coordination and participation among various universities in Southeast Asia and perhaps in partnerships with SEARCA–SEAMO and ILRI, with the aim to strengthen and streamline postgraduate research and training programs in the livestock sector.

Special acknowledgement

The efforts put in by all survey respondents from different Southeast Asian universities with postgraduate programs in animal production and veterinary sciences are gratefully acknowledged and highly appreciated.

Additional comments from the survey respondents

- We fully support any initiative of ILRI in taking an active role to develop training program in partnership with tertiary educational institutions in Southeast Asia. [UPLB, Philippines]
- ILRI should create specific and intensive programs for Southeast Asian countries in AnGr, e.g. joint research project and training. [IPB, Indonesia]
- Our university especially our department must have some information regarding ILRI. We need some copies of journals or books from ILRI. [ASU and WVSU, Philippines]
- We may work together by establishing memorandum of understanding (MOU) between our university and ILRI. [UNDIP, Indonesia]
- We hope that our university will be included in some RDE projects in the Asian region. [CMU, Philippines]
- We thank ILRI for taking the initiative to know the current status of postgraduate training program in Southeast Asia. We hope that ILRI will support the higher education institutions (HEIs) in Southeast Asia as we become more capable to train farmers in raising livestock for food security and sustainable development. [BSU, Philippines]
- Thank you for sending this questionnaire. [DMMSU–NLUC, Philippines]

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Appendix 1 Terms of reference of the study

Current status of postgraduate training in the livestock sector in Southeast Asia and priorities for ILRI's support

Purpose and objectives

The overall purpose of this study is to strengthen the postgraduate training and research capacity of the tertiary educational institutes in the livestock sector in sub-Saharan Africa and Asia. The specific objective is to identify the gaps in the postgraduate training in animal production and veterinary sciences and to identify the roles and priorities of ILRI in bridging this gap.

In order to achieve this, five consultancy studies are conducted covering SSA, (using the existing geopolitical grouping—SADC, ASARECA, and CORAF), South and Southeast Asia.

Terms of reference for the consultancy

The broader terms of reference for the consultancy study are to:

1. Review and document, the role of livestock in the regional Southeast Asia economy and the emerging challenges confronting the livestock sector
2. Review and document the current status of postgraduate training in the livestock sector in the region (including an inventory of institutes)
3. Discuss the collaboration and linkage between tertiary educational institutes and research and extension systems and their strengths and weaknesses
4. Identify the critical constraints and challenges facing the agriculture higher learning institutions in the region
5. Identify the missing elements and capacity gaps in the existing curricula(especially at the postgraduate level) to address the emerging needs and challenges of the livestock sector
6. Identify the role and priorities of ILRI in bridging the capacity gaps identified and
7. To make recommendations/suggestions and to move forward.

Available secondary data as well as primary data collected from key informants will be used to prepare the report. To make sure that the three studies are comparable, a standard questionnaire will be used to collect the primary data from the universities.

Appendix 2 Questionnaire

Current status of postgraduate training in animal production, veterinary science, strengths, gaps and priority areas for support

A) Information about the key informant (person completing this questionnaire)

Name: _____

Position: _____

Contact details:

Mailing address: _____ Phone: _____

_____ E-mail: _____

_____ Fax No. _____

B) Information about the university

Name: _____

_____

Address: _____

_____

_____

Web site: _____

C) Programs offered

C.1 Does your university offer postgraduate training in

a. Animal production	Yes	☐	No	☐
b. Veterinary science	Yes	☐	No	☐

C.2 If yes, at what level

a. Animal production	MSc	☐	PhD	☐	Others (Specify)_
b. Veterinary science	MSc	☐	PhD	☐	Others (Specify)_

C.3 In which year did your university start this program? Please specify the year.

MSc _____ PhD _____

C.4 Please specify the areas of specializations offered:

MSc	PhD

D) Critical constraints:

Please list the critical constraints that your university is facing in implementing the postgraduate program.

E) Collaboration with other departments/universities/institutes in implementing the postgraduate program.

E.1 Does your department/faculty collaborate with other departments in your university in implementing the postgraduate training program?

Yes ☐ No ☐

E.2 If yes, please provide the following information.

Department/faculty	Nature of collaboration

E.3 Does your department/faculty collaborate with other universities in implementing the postgraduate program?

Yes ☐ No ☐

E.4 If yes, please provide the following information.

Name of university and country	Nature of collaboration

F) Collaboration with research and extension institutes

F.1 Does your university collaborate with your national research system?

Yes ☐ No ☐

F.2 If yes, please list the nature of this collaboration

F.3 How would you rate this collaboration?

Very good ☐ Good ☐ Weak/Poor ☐

F.4 If yes, please list the nature of this collaboration (Please list the type of action to be taken).

F.5 Does your university collaborate with your national extension system?

Yes ☐ No ☐

F.6 If yes, please list the nature of this collaboration

F.7 How would you rate this collaboration?

Very good ☐ Good ☐ Weak/poor ☐

F.8 If yes, please list the nature of this collaboration (Please list the type of action to be taken).

_____

_____

_____

G Program strengths/weaknesses/gaps

G.1 In which specific areas do you think that your university has a strong academic program? Pleas list

_____

_____

_____

G.2 Do you see any weaknesses in your current postgraduate program?

Yes ☐ No ☐

If yes, please specify.

_____

_____

_____

G.3 Please indicate whether your current postgraduate training program offers training in the following areas? If not indicate how important to include them in the curriculum.

Skill areas	Yes/No	If no, degree of importance (EI = Extremely important, MI = Moderately important, NI = Not important)
1. Participatory research methods		
2. Leadership and decision making		
3. Strategic planning		
4. Intellectual property right policy		
5. Negotiation and conflict resolution skills		
6. Facilitation skills		
7. Design, implementation and assessment of networks and partnerships		
8. Monitoring, evaluation and impact assessment		
9. Planning and priority setting		
10. Climate change: Implications and adaptation strategies		
11. Poverty, vulnerability and risk analysis		

12. Value chain analysis, market orientations and implications to R&D
13. Innovation systems perspective and implication to R&D
14. Interaction of crop–livestock–water
15. Gender analysis.
16. Sustainable use of animal genetic resources
17. Management of gene bank
18. Convincing proposal writing
19. Scientific writing
20. Effective communication
21. Bioinformatics
22. Disease surveillance and preparedness
23. Ex-site conservation of animal genetic resources
24. Biosafety
25. Others (please specify)

G.4 Do you think that your current postgraduate program is adequately addressing the current and emerging challenge of the livestock sector?

Yes ☐ No ☐

G.5 If yes, which current and emerging issues that were not being addressed 5 years ago are currently being addressed?

a. _____
_____
b. _____
_____
c. _____
_____
d. _____
_____

G.6 If no, please indicate the areas that needs improvement.

Policy/institution (specify)

_____

_____

_____

Animal production (specify)

_____

_____

_____

Service delivery (specify)

_____

_____

_____

Processing (specify)

_____

_____

_____

Animal health (specify)

_____

_____

_____

Marketing/value addition/trade (specify)

_____

_____

_____

Others (specify)

_____

_____

H. Involvements in farmer training

H.1 Does your university currently involve in training the farmers?

Yes ☐ No ☐

H.2 Yes, list the different ways in which the university contributes to farmer training?

_____

_____

_____

_____

_____

I ILRI's potential role in supporting the postgraduate training.

I.1 Are you familiar with the International Livestock Research Institute?

Yes ☐ No ☐

I.2 How can ILRI assist your university in strengthening the postgraduate training program in animal production and veterinary science? (Please use the gaps and weaknesses identified in section G to answer this).

_____

_____

_____

_____

_____

J Any other comments

_____

_____

_____

_____

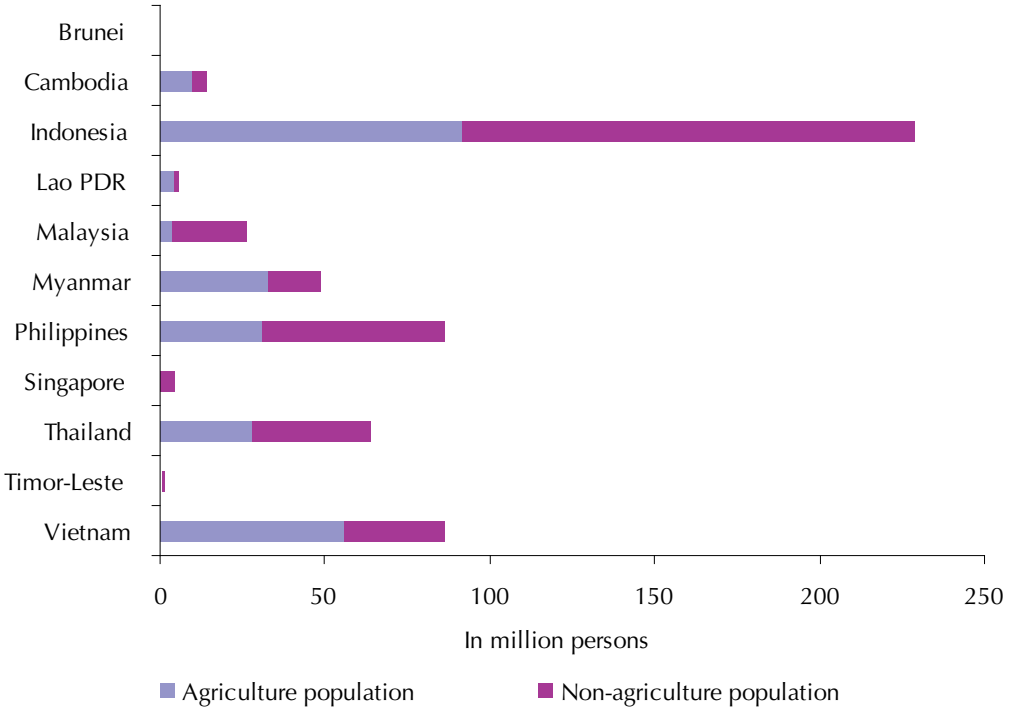
_____

Thank you very much for completing this questionnaire. Your response will assist us in identifying the strategic support needed and the role of ILRI in supporting the tertiary educational institutes in Southeast Asia.

Appendix 3 Livestock sector statistics in Southeast Asia

Human and agricultural population statistics

The ASEAN is home to more than half a billion people (i.e. 565 million people in 2006) and growing 1.52% annually from 1997 to 2006. Population size ranged from 382,000 persons (Brunei) to 228.9 million people (Indonesia). The next populous countries are the Philippines and Vietnam (86 million people each) and Thailand (63 million people) (see Figure 1).

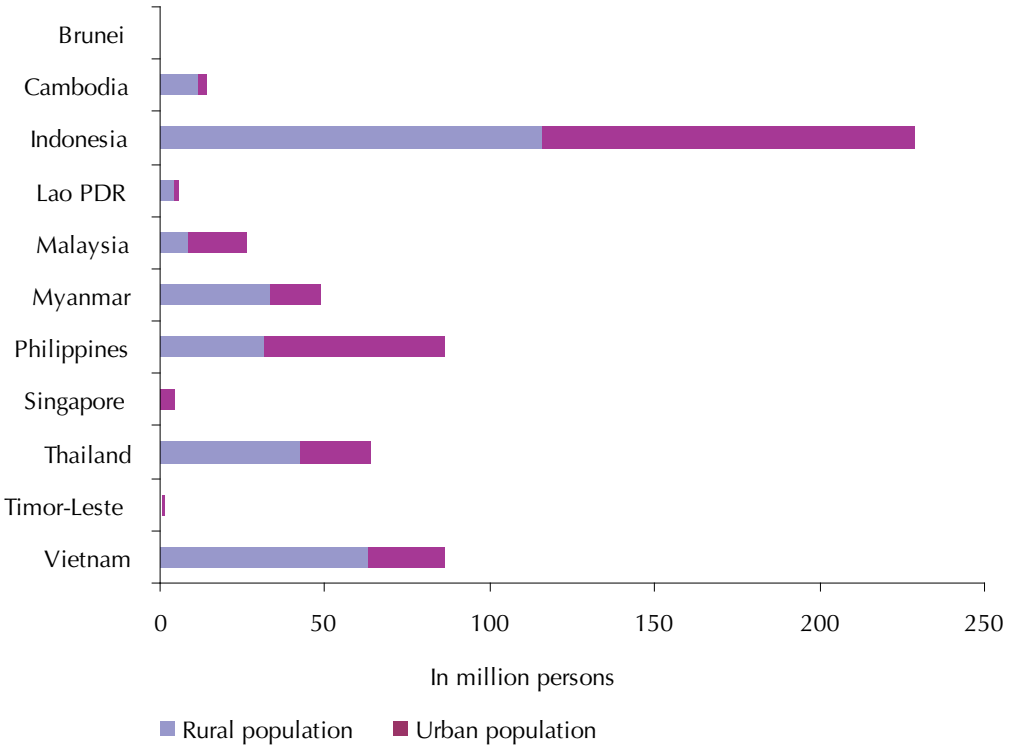


Based on FAO–STAT 2009 (http://www.fao.org).

Figure 1. *Agriculture and non-agriculture population statistics in Southeast Asia, 2007.*

About 46% of the human population in Southeast Asia depended on agriculture. The agricultural population increased by 0.18% annually from 1997 to 2006. The non-agricultural population increased at a rate of 2.93% per year. The most number of people involved in agriculture comes from Indonesia (91.8 million people), Vietnam (55.9 million people), Myanmar (33.0 million people), Philippines (30.8 million people) and Thailand (28.0 million people). In each country, the percentage of people involved in agriculture are (arranged from highest to lowest): Timor Leste (81.0%), Lao PDR (75.4%), Vietnam (64.8%), Myanmar (68.3%), Cambodia (67.7%), Thailand (44.2), Indonesia (40.1%), Philippines (35.8%), and Malaysia (13.8%). Most people in Singapore (99.01%) and Brunei (99.5%) are not engaged in agriculture.

The Southeast Asian region has 55% rural (i.e. 311 million people) and 45% urban population (i.e. 254 million people), with annual growth rates of –0.05% and 4.2%, respectively (see Figure 2). Singapore with a population of 4.4 million people is totally an urbanized country. The countries with a high percentage of urban population are Brunei (74%), Malaysia (69%), and the Philippines (63%). Other countries have a higher proportion of the rural population, namely Cambodia (80%), Timor Leste (74%), Vietnam (73%), Lao PDR (72%), Thailand (68%), and Indonesia (51%).



Based on FAO–STAT 2009 (http://www.fao.org).

Figure 2. *Human population statistics in Southeast Asia, 2007.*

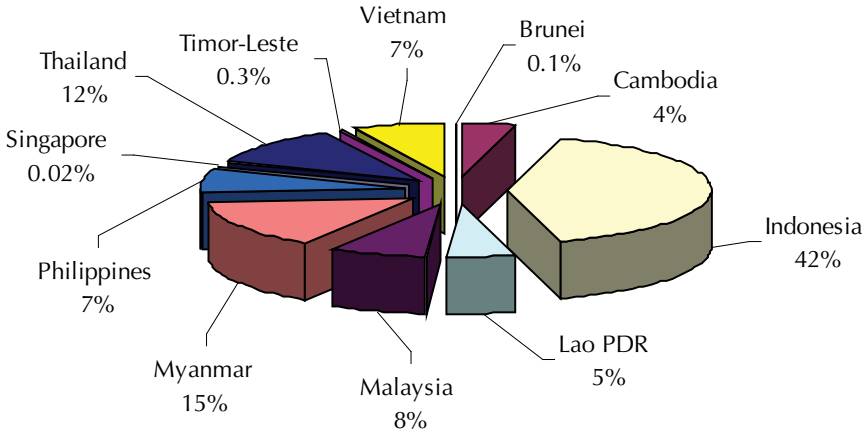
Land resources

The countries of Southeast Asia cover a total land area of 434.1 million hectare including 117.7 million hectare of agricultural land and 17.1 million hectare of permanent meadows and pastures. About 15.3 million hectare of inland water are also found in Southeast Asia, increasing annually by 1.18%.

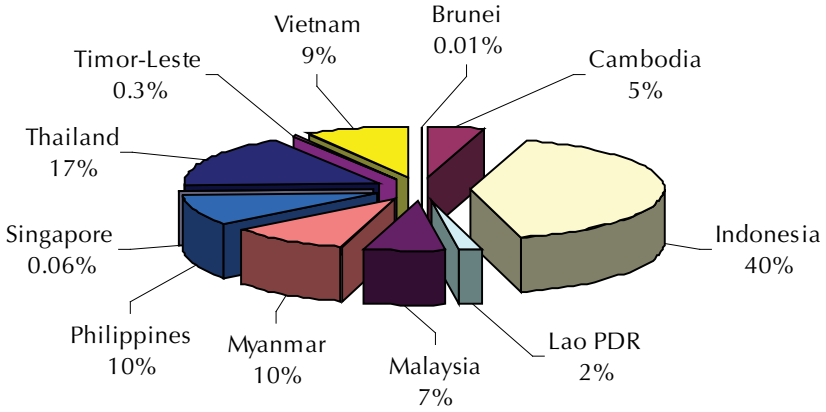
The largest countries in Southeast Asia based on land area are Indonesia (181.2 million hectare), Myanmar (65.3 million hectare), Thailand (51.1 million hectare), Malaysia (32.8 million hectare), Vietnam (31.0 million hectare), Philippines (29.8 million hectare), Lao PDR (23.1 million hectare), and Cambodia (17.6 million hectare). The smallest countries are Singapore (71 thousand hectare), Brunei (52 thousand hectare) and Timor Leste (1.5 million hectare).

The total agricultural land in Southeast Asia increases by about 1.11% per year (1998 to 2007). The largest agricultural areas are found in Indonesia (48 million hectare), Thailand (19.8 million hectare), Myanmar (12.0 million hectare), Philippines (11.5 million hectare), Vietnam (10.1 million hectare), Malaysia (7.9 million hectare), and Cambodia (5.4 million hectare).

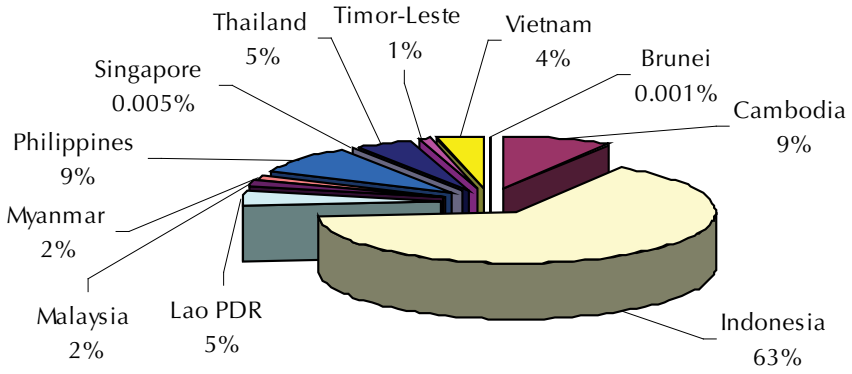
The annual increase in permanent meadows and pastures was 0.43%. Large pasture meadows and pastures are found mainly in Indonesia (11 million hectare), Cambodia (1.5 million hectare) and the Philippines (1.5 million hectare). For further details about land resources, see Figure 3.



Land area, 2007



Agricultural area, 2007



Permanent meadows and pastures, 2007

Based on FAO–STAT 2009 (http://www.fao.org).

Figure 3. *Land resource statistics in Southeast Asia, 2007.*

Value of livestock and agriculture production

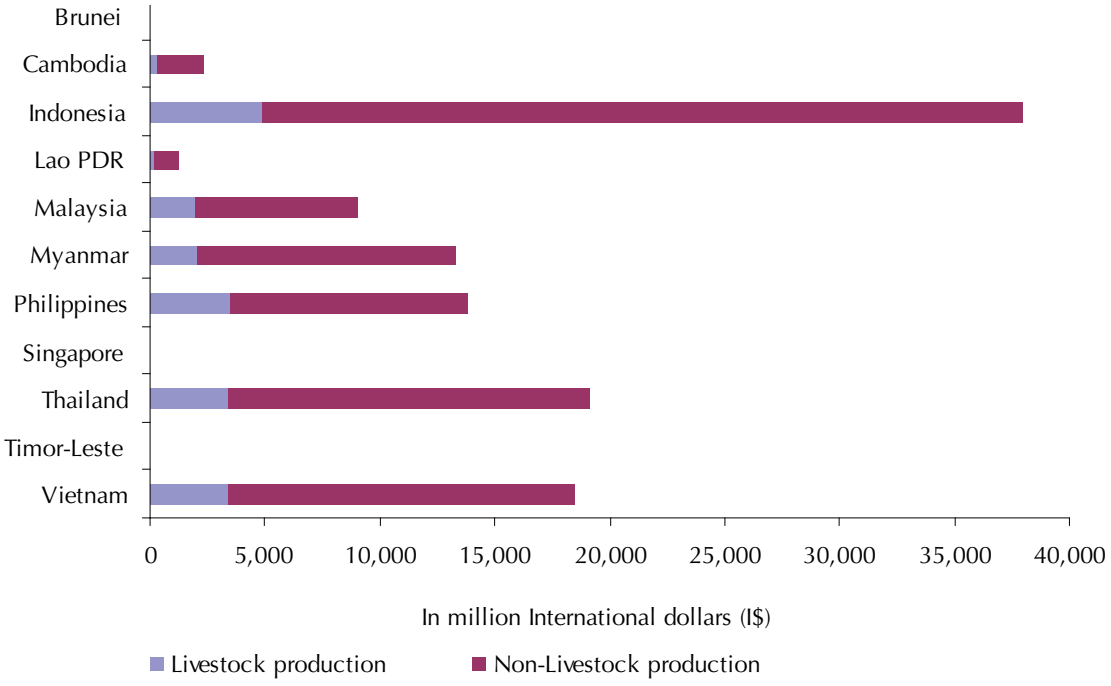
The value of gross production of livestock subsector in Southeast Asia was 19.81 billion I$ (international dollars) in 2007. The livestock sector grew by about 5.01% per annum from 1998 to 2007. The value of livestock production was 17.2% of the total value of production in the agriculture sector (115.51 billion

I$). On the average, the agriculture sector in Southeast Asia grew by 5.17% per year from 1998 to 2007.

The value of livestock production was highest in Indonesia (4.89 billion I$) followed by the Philippines (3.52 billion I$), Vietnam (3.41 billion I$), Thailand (3.40 billion I$), Myanmar (2.04 billion I$), and Malaysia (1.98 billion I$). Smaller value of production from livestock was recorded for Timor Leste (18.2 million I$), Brunei (25.6 million I$) and Singapore (30.2 million I$).

The value of livestock production as a percentage of gross domestic product (GDP) is low, i.e. Brunei (0.13%), Cambodia (1.20%), Indonesia (0.54%), Lao PDR (1.19%), Malaysia (0.51%), Myanmar (2.99%), Philippines (1.10%), Singapore (0.01%), Thailand (0.62%), Timor Leste (0.72%), and Vietnam (1.42%). This highlights the importance of livestock production to the national economy especially of Myanmar, Vietnam, Cambodia, Lao PDR, and the Philippines.

Percentage wise, the livestock sector grew fastest in Myanmar (17.07% per year) followed by Brunei (9.28% per year), Indonesia (7.46% per year), and Vietnam (6.25% per year) from 1998 to 2007. (Note: According to the World Bank's report of 2008, as a measure of the size of the national economy, the total gross domestic product (GDP)—2008 estimate of countries in Southeast Asia (in decreasing order) are: Indonesia (USD 908.242 billion), Thailand (USD 546.095 billion), Malaysia (USD 384.119 billion), Philippines (USD 320.384 billion), Vietnam (USD 240.364 billion), Singapore (USD 238.755 billion), Myanmar (USD 68.203 billion), Cambodia (USD 28.239 billion), Brunei (USD 19.683 billion), Lao PDR (USD 13.792 billion), and Timor Leste (USD 2.518 billion). (See: World Bank world development indicators database, 1 July 2009, Gross domestic product 2008.) For further details about the value of livestock and agriculture production, see Figure 4.



Based on FAO–STAT 2009 (http://www.fao.org).

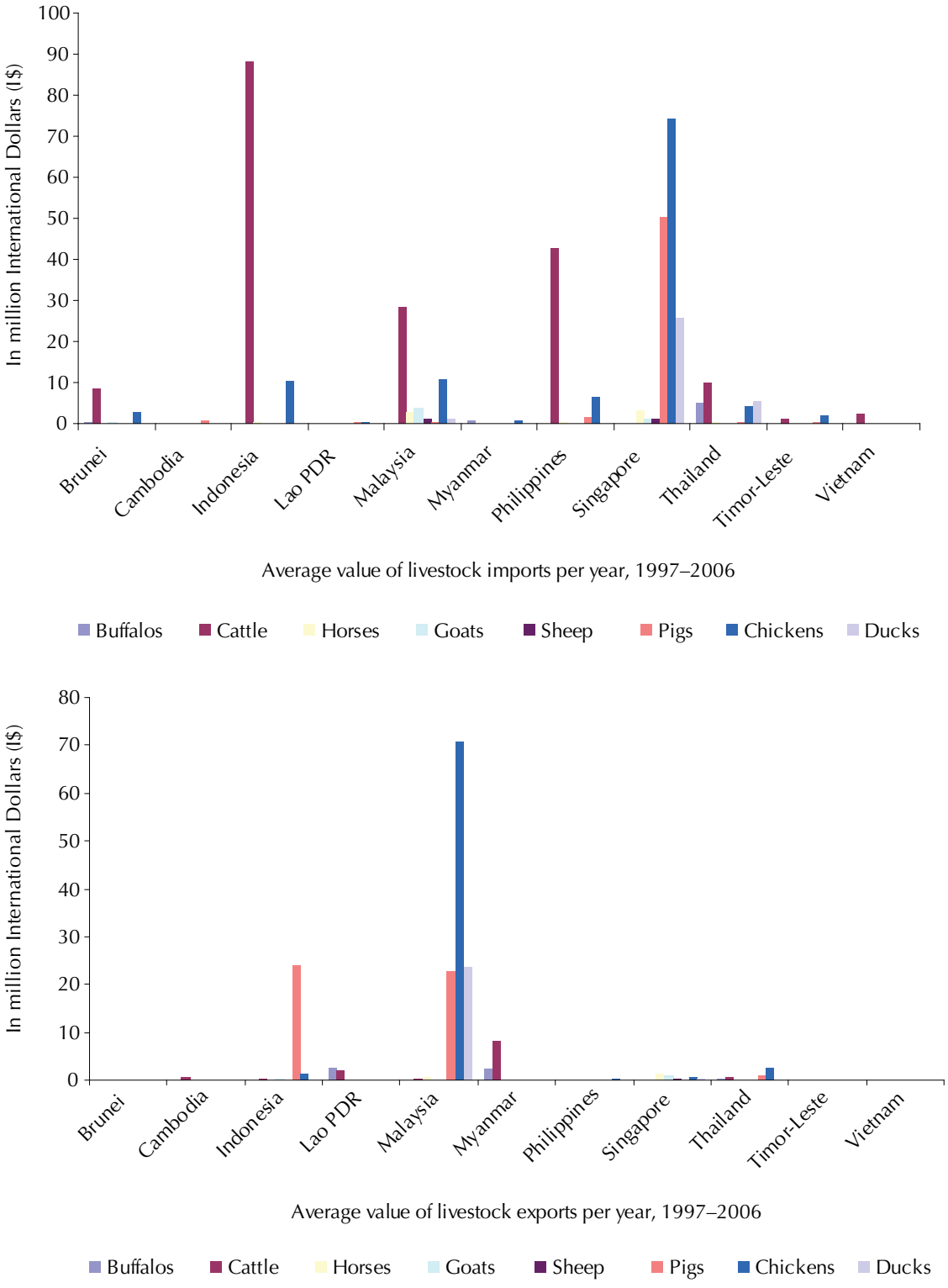
Figure 4. *Value of livestock and agriculture production in Southeast Asia.*

Import and export value of livestock per year

The average value of annual livestock imports from 1997 to 2006 in Southeast Asia was USD 400.4 million, mainly from imports of cattle (USD 181.2 million), chickens (USD 111.5 million), and pigs (USD 54.2 million). The large importers of livestock were Singapore (USD 155.2 million), Indonesia (USD 98.9

million), Philippines (USD 51.257 million), and Malaysia (USD 49.1 million).

The average value of annual livestock exports from Southeast Asia was USD 169.1 million. The exports are mainly for chickens (USD 75.8 million), pigs (USD 47.9 million), and ducks (USD 24.1 million). The largest exporters of livestock were Malaysia (USD 118.5 million), Indonesia (USD 25.8 million), and Myanmar (USD 10.6 million). See Figure 5 for import and export value of livestock per annum.



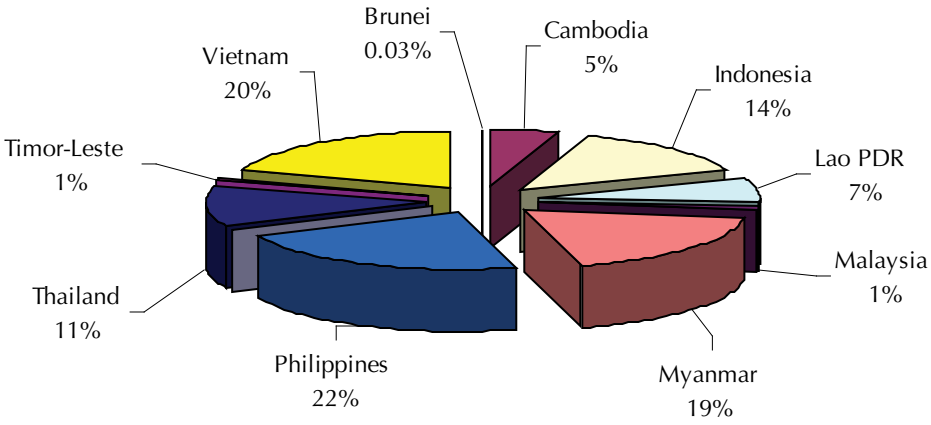
Based on FAO–STAT 2009 (http://www.fao.org).

Figure 5. *Import and export value of livestock per year in Southeast Asia (1000 I$), 1997–2006.*

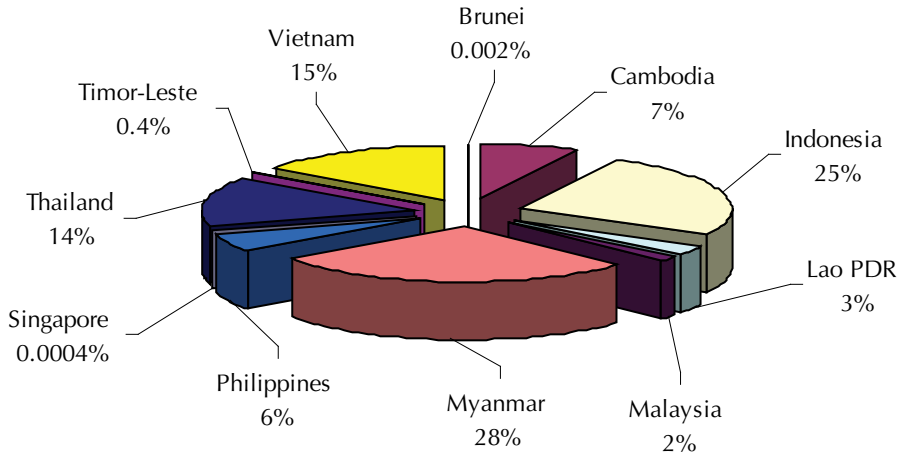
The average annual trade deficit (exports minus imports) in Southeast Asia was –USD 231.2 million. The major net exporters were Malaysia (+USD 69.4 million)—mainly from chicken exports and Myanmar (+USD 9.8 million)—mainly buffalo and cattle exports. The major net importers were Singapore (–USD 152.2 million)—especially imports of pigs and chickens, Indonesia (–USD 73.1 million)—especially cattle and chicken imports, Philippines (–USD 50.6 million)—especially cattle and chicken imports, and Thailand (–USD 20.9 million)—especially imports of chickens and pigs.

Animal inventories

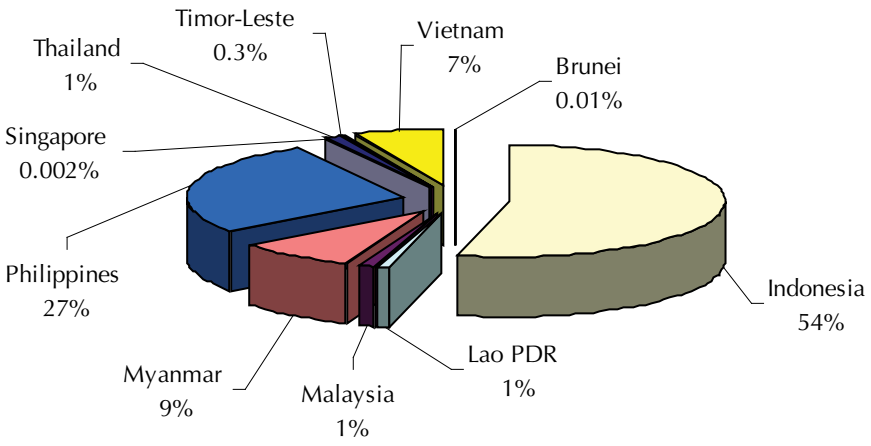
The animal inventories in Southeast Asia in 2007 were: buffalo (15.2 million), cattle (45.6 million), horses (0.8 million), goats (26.8 million), pigs (69.8 million), chickens (2.13 billion), and ducks (167.5 million). For further details on animal inventory, see Figure 6.



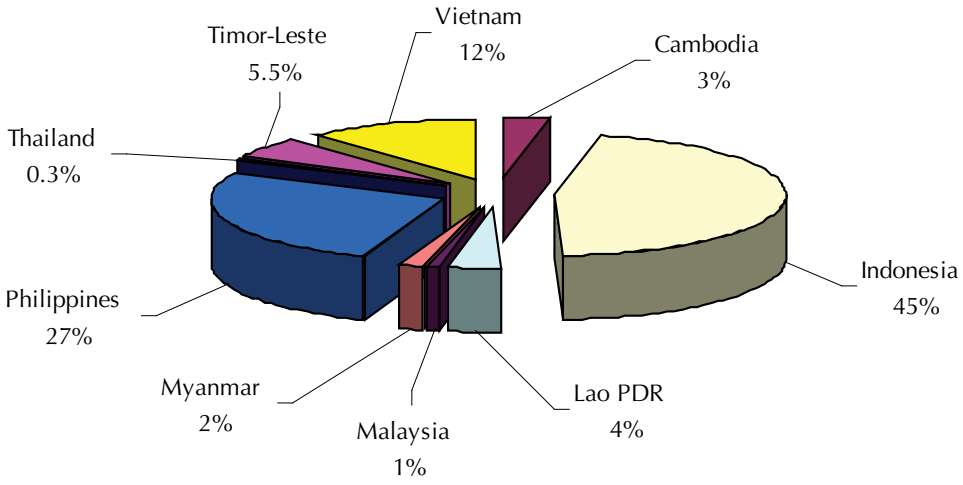
Buffalo population, 2007 (15.2 million head)



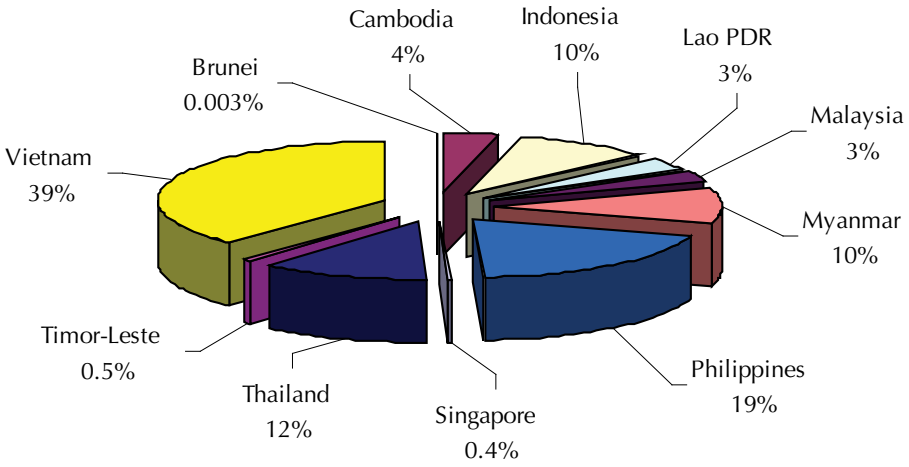
Cattle population, 2007 (45.6 million head)



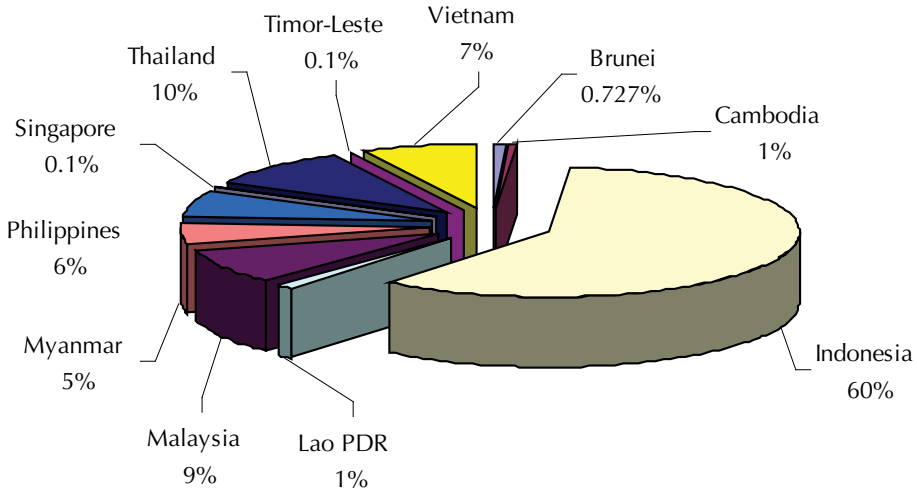
Goat population, 2007 (26.8 million head)



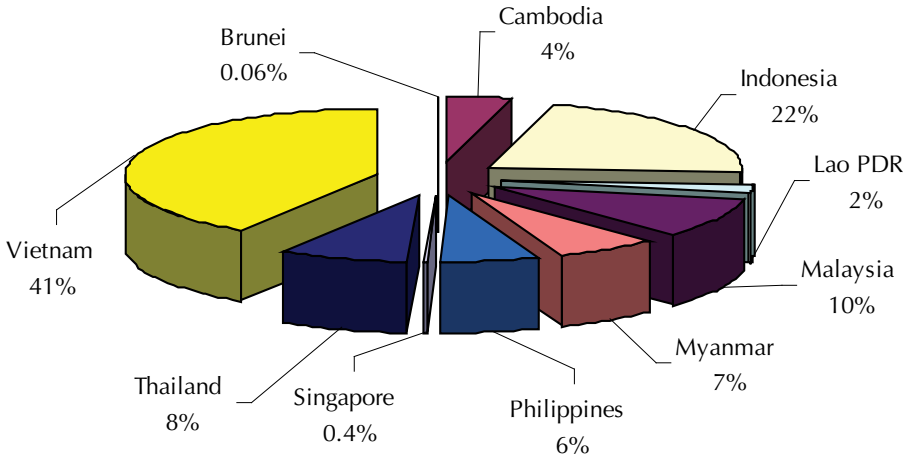
Horse population, 2007 (867 thousand head)



Pig population, 2007 (69.8 million head)



Chicken population, 2007 (2.13 billion head)



Duck population, 2007 (167.5 million head)

Based on FAO–STAT 2009 (http://www.fao.org).

Figure 6. *Animal inventory in Southeast Asia.*

- Largest number of buffalo: Philippines (3.4 million), Vietnam (3.0 million), Myanmar (2.8 million), and Indonesia (2.1 million).
- Most number of cattle: Myanmar (12.6 million), Indonesia (11.5 million), Vietnam (6.7 million), and Thailand (6.5 million).
- Highest horse population: Indonesia (0.401 million), Philippines (0.232 million), and Vietnam (0.103 million).
- Largest number of goats: Indonesia (14.5 million), Philippines (4.3 million), Myanmar (2.4 million), and Vietnam (1.8 million).
- Most number of pigs: Vietnam (26.6 million), Philippines (13.5 million), Thailand (8.4 million), Myanmar (7.4 million), and Indonesia (6.7 million).
- Highest chicken population: Indonesia (1,275.4 million), Thailand (209.1 million), Malaysia (190.0 million), Vietnam (158.2 million), and the Philippines (135.6 million).
- Largest inventory of ducks: Vietnam (67.8 million), Indonesia (35.9 million), Malaysia (16.0 million), Thailand (13.6 million), Myanmar (11.1 million), and the Philippines (10.2 million).

The annual growth rates of animal populations in Southeast Asia from 1998–2007 were: buffalo (0.20%), cattle (2.09%), horses (–2.28%), goats (2.45%), pigs (3.94%), chickens (7.23%), and ducks (2.21%) (see Figure 6 above).

Average consumption of livestock meat per year

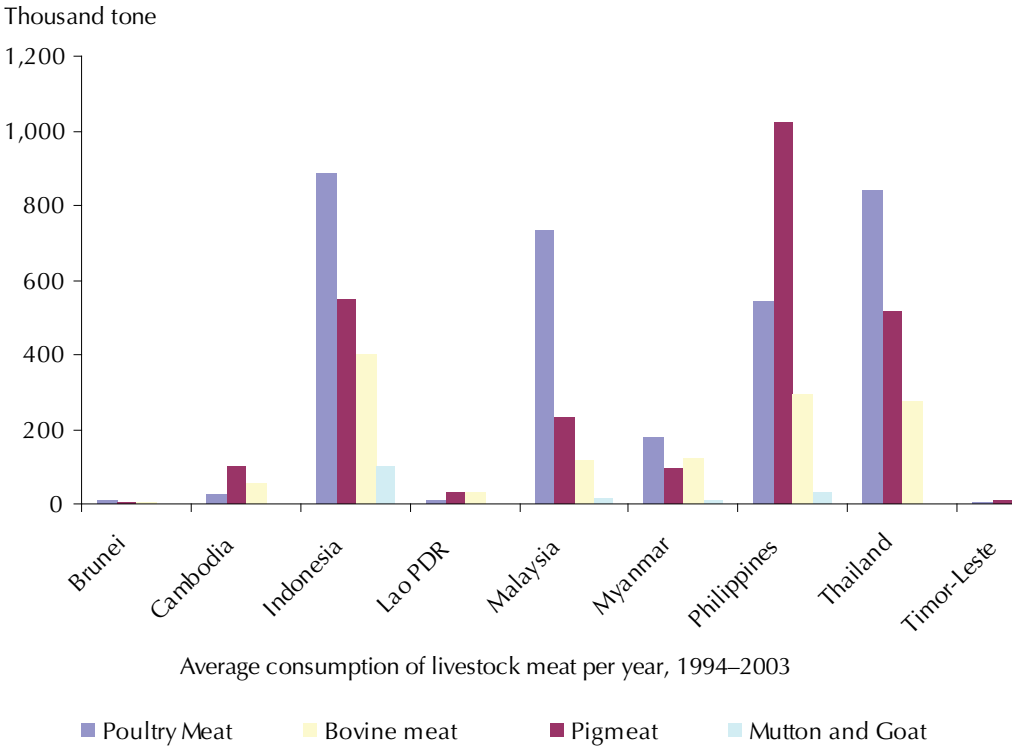
The average annual consumption of livestock meat in Southeast Asia from 1994–2003 was highest for poultry meat (3.23 million tonnes), followed by pig meat or pork (2.56 million tonnes), and bovine meat or beef (1.30 million tonnes). Only 157 thousand tonnes of mutton and goat meat were consumed every year in Southeast Asia.

- Total poultry meat consumption per year was highest in Indonesia (885 thousand tonnes), followed by Thailand (839 thousand tonnes), Malaysia (736 thousand tonnes) and the Philippines (541 thousand tonnes).
- Total pork consumption per year was highest in the Philippines (1.021 million tonnes)—i.e. Philippines is the largest Christian population in Asia; Indonesia (549 thousand tonnes), Thailand (515 thousand tonnes); and Malaysia (234 thousand tonnes).
- Total bovine meat consumption per year was highest in Indonesia (402 thousand tonnes), followed by the Philippines (293 thousand tonnes), Thailand (273 thousand tonnes), Myanmar (122 thousand tonnes) and Malaysia (116 thousand tonnes).

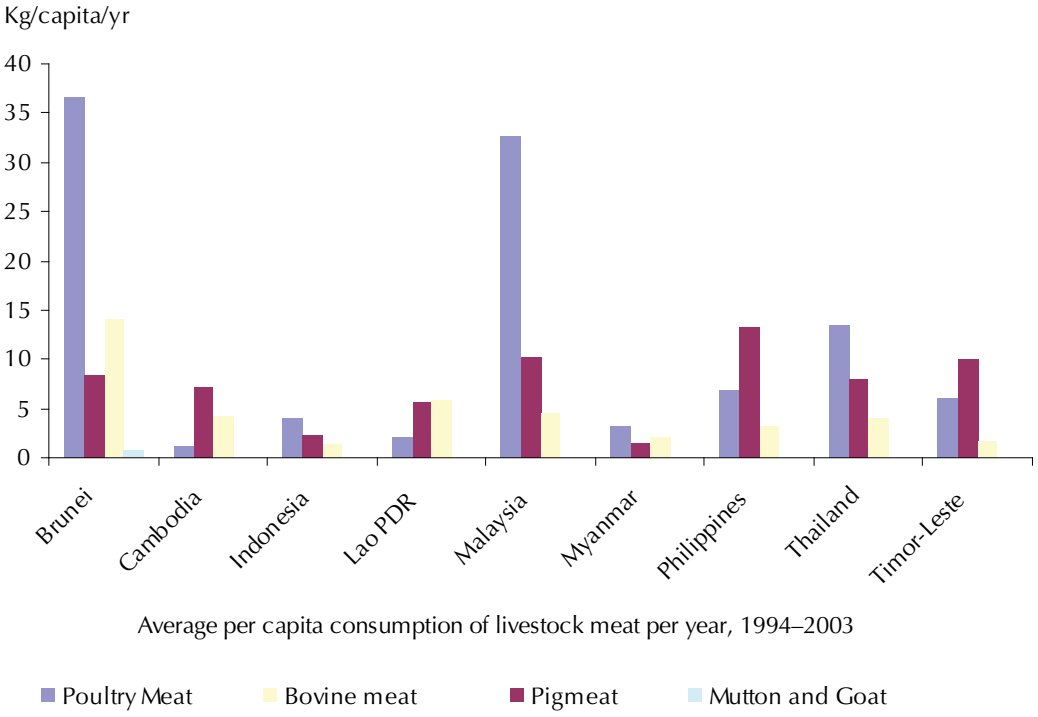
Per capita consumption per year of livestock meat in Southeast Asia was highest for poultry (11.78 kg/capita/yr), followed by pork (7.26 kg/capita/yr), and bovine meat (4.54 kg/capita/yr).

- The consumption per capita per year for poultry meat was highest for Brunei (36.5 kg), Malaysia (32.7 kg) and Thailand (13.5 kg).
- The consumption per capita per year for pork was highest for the Philippines (13.2 kg), Malaysia (10.3 kg) and Thailand (10.1 kg).
- The consumption per capita per year for Bovine meat was highest for Brunei (14.0 kg), Lao PDR (5.9 kg), Malaysia (4.6 kg), Cambodia (4.1 kg) and Thailand (4.0 kg).

The highest per capita consumption of livestock meat seems to be associated with countries with the highest per capita gross domestic product or GDP (2008 estimate), i.e. Brunei (USD 50,116), Malaysia (USD 14,071) and Thailand (USD 8225). Other countries with lower per capita GDP are: Indonesia (USD 3986), Philippines (USD 3546), Vietnam (USD 2783), Timor Leste (USD 2364), Lao PDR (USD 2204), Cambodia (USD 2066), and Myanmar (USD 1160). Singapore had a per capita GDP of USD 51,142 in 2008. For average consumption of livestock meat per year, see Figure 7.



Average consumption of livestock meat per year, 1994–2003



Based on FAO–STAT 2009 (http://www.fao.org).

Figure 7. *Average consumption of livestock meat per year in Southeast Asia (1994–2003).*

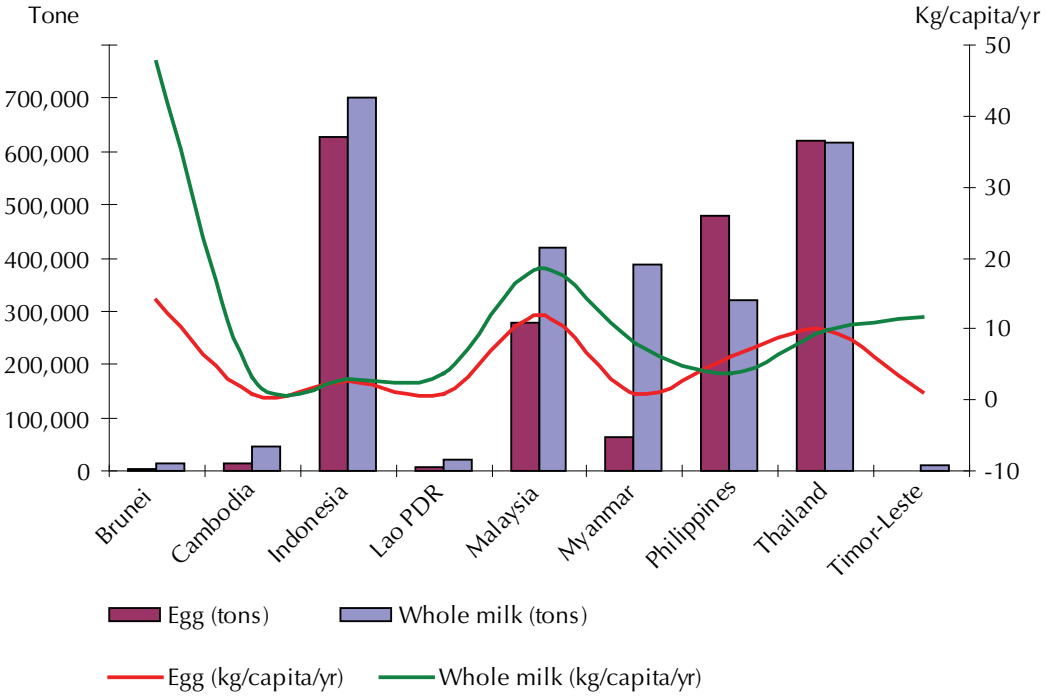
Note: No data on consumption of livestock meat were available from Vietnam and Singapore.

Average consumption of eggs and whole milk per year

The average consumption of eggs in Southeast Asia from 1994–2003 was 2.09 million tonnes or a per capita consumption per year of 5.36 kg. Total consumption of eggs per year was highest in Indonesia (628 thousand tonnes), followed by Thailand (620 thousand tonnes), the Philippines (478 thousand tonnes), and Malaysia (277 thousand tonnes). The egg consumption per capita per year was highest for Brunei (14.1 kg), Malaysia (11.9 kg), Thailand (9.9 kg), and the Philippines (6.0 kg).

The average consumption of whole milk in Southeast Asia from 1994–2003 was 2.54 million tonnes or a per capita consumption per year of 12.12 kg. Total whole milk consumption per year was highest in Indonesia (702 thousand tonnes), followed by Thailand (617 thousand tonnes), Malaysia (421 thousand tonnes), Myanmar (388 thousand tonnes) and the Philippines (320 thousand tonnes). The consumption per capita per year for whole milk was highest for Brunei (47.5 kg), Malaysia (18.5 kg), Timor Leste (11.6 kg), Thailand (9.9 kg), and Myanmar (8.0 kg).

The highest per capita consumption of eggs and whole milk was also associated with the high per capita GDP of Brunei, Malaysia, and Thailand. For average consumption of eggs and whole milk per year, see Figure 8.



Based on FAO–STAT 2009 (http://www.fao.org).

Figure 8. *Average consumption of whole milk and eggs per year in Southeast Asia (1994–2003).*

Note, however, that no data on consumption of eggs and whole milk were available from Vietnam and Singapore.

Appendix 4 Comparisons between Southeast Asia and China

	ASEAN	China
Total population (2008)	582.6 million	1.353 billion
Annual growth rate (%)	1.52	0.66
Rural population (%)	52.62	55.64
Urban population (%)	47.37	44.35
Agricultural population (%)	43.90	61.41
Non-agricultural population (%)	56.10	38.59
Gross domestic product (USD, 2008)		
Total GDP	2.770 trillion	7.973 trillion
Per capita GDP	4,750	6,000
Annual value of production (1000 I$, 2007)		
Agriculture, 2007	115,512,797	386,448,200
Agriculture, % annual growth	5.17	3.60
Livestock, 2007	19,812,253	120,801,200
Livestock, % annual growth	5.01	3.63
Land resources ('000 hectare, 2007)		
Land area	434,094	932,749
Agricultural area	117,729	552,832
Permanent meadows and pastures	17,062	400,001
Inland water	15,303	27,060
Value of live animals per year (1000 USD, 1997–2006)		
Imports		
Buffalo	6,047	NA
Cattle	181,249	39,641
Horses	7,260	2,030
Goats	5,269	2,298
Pigs	54,189	3,322
Chickens	111,489	14,699
Ducks	32,333	1,124
Exports		
Buffalo	5,379	NA
Cattle	12,362	35,792
Horses	2,213	60
Goats	1,119	298
Pigs	47,861	240,832
Chickens	75,756	70,045
Ducks	23,819	2,289
Animal inventory, 2007 (% growth per year, 1998–2007)		
Buffalo	15,189,659 (0.20)	22,722,010 (–0.06)
Cattle	45,614,388 (2.09)	82,066,855 (–2.18)
Horses	867,888 (–2.28)	7,197,465 (–2.42)
Goats	26,834,414 (2.45)	137,871,757 (0.36)
Pigs	69,776,207 (3.94)	425,672,621 (0.25)
Chickens (1000 head)	2,132,916 (7.23)	4,511,613 (4.69)
Ducks (1000 head)	167,490 (2.21)	752,162 (4.92)

Average consumption (1000 t) per year (1994–2003)		
Bovine meat	2,541	10,402
Mutton and goat meat	157	2,483
Pig meat (pork)	2,559	39,037
Poultry meat	3,231	11,410
Whole Milk	2,541	10,407
Eggs	2,094	19,273
Average per capita consumption (kg) per year (1994–2003)		
Bovine meat	4.54	3.20
Mutton and goat meat	0.10	1.50
Pig meat (pork)	7.26	30.30
Poultry meat	11.78	8.50
Whole Milk	12.12	7.70
Eggs	5.36	14.70

Source: FAO–STAT 2009 (http://www.fao.org).

Appendix 5 Systems of higher education and types of higher education institutions (HEIs) in Southeast Asia and China

Country	Systems of higher education	Higher education institutions (HEIs)
	There exist varying levels and types of certificates, diplomas and degrees (university only) given for post-secondary education The tertiary institutions include Universiti Brunei Darussalam and various technical and vocational institutions (TVE) of varying levels; Institut Teknologi Brunei, Technical Colleges of Sultan Saiful Rijal Technical College and Jefri Bolkiah College of Engineering, Sinaut Agriculture Training Centre, Pengiran AnakPuteri Rashidah Sa'adatul Bolkiah College of Nursing and Brunei Arts and Handicraft Training Centre	University of Brunei Darussalam (UBD) is the only higher education system of Brunei Darussalam It does not offer a postgraduate program in animal science or veterinary science
	All higher education institutions providing degree programs in Cambodia are public. Higher education is almost completely free. Students, whether poor or rich, pay nothing for tuition Some tertiary institutions and vocational and technical secondary education institutions are under the governance of other technical ministries (Ministry of Agriculture, Health, Labour etc.)	Nine public higher education institutions have been established for agriculture, medicine, economics, industry, technology, teacher training, science, art and culture There are 4 agricultural institutions in Cambodia (Prek Leap National School of Agriculture, Kampong Cham National School of Agriculture, Moharussey Vedic University, and the Royal University of Agriculture—RUA) The RUA is a public HEI in Dangkor District of southwest Phnom Penh Municipality in Cambodia and is operated by the Ministry of Agriculture, Forestry and Fisheries. It has 5 faculties, including a Faculty of Animal Health and Production (now called the Faculty of Animal Science and Veterinary Medicine). It offers a course leading to MSc degree on integrated farming system, but no graduate degree yet in animal science and veterinary medicine
 Indonesia	The Ministry of National Education, through the Directorate General of Higher Education, exercises authority over both state and private institutions, including: Universities, both private and public; Institutes and teacher training institutes (Institut Kegurun dan ilmu pendidikan or IKIPs); Islamic institutes (under the Ministry of Religious Affairs); Schools (Sekolah Tinggi) offer academic and professional university-level education in one particular discipline; Single-faculty academies offer diploma/certificate technician-level courses; Polytechnics offer subdegree junior technician training Private universities are under the Directorate of Private Universities within the Directorate General of Higher Education	There are 51 state/public universities (including several teacher training institutions), 26 state/public polytechnics (engineering, commerce and agriculture) and 1,328 private higher education institutions (including academies, polytechnics and teacher training institutions)

 Lao PDR	Higher education institutions in Lao PDR are public and are managed by the government directly	There is 1 National University located in the city of Vientiane offering Bachelor's Degree and Diploma Degree Courses. The National University of Laos (NUOL) is a state-run university under the supervision of the Ministry of Education
	There are no private institutions that can award the high degree level (at post-secondary level) in the country, except for a limited provision of vocational training by proprietary schools	There is 1 College of Law offering Diploma Course located in the municipality of Vientiane. This college was transformed into the college of Magistrate serving especially the Ministry of Justice
	Ten higher learning institutions (university-level institutions and higher technical institutions) located in Vientiane have been merged and reorganized into faculties in a multi-campus national university	There are 4 Teachers Training Colleges offering Diploma in Pedagogy located in Luang Prabang, Vientiane, Savannakhet and Champassack for teachers in lower secondary schools. These colleges were transformed into Regional Colleges to better serve the community and also NUOL
 Malaysia	Institutions of higher learning are classified into three categories: polytechnic, college and university	There are 30 teacher training colleges in Malaysia, and 2 public colleges, i.e. Institut Teknologi MARA (ITM), and Kolej Tunku Abdul Rahman (KTAR) which provide certificate, diploma and pre-university programs especially in the fields of commerce, applied science and technology
	The Higher Education Division of the Ministry of Education coordinates and monitors the activities of institutions of higher learning in Malaysia	Malaysia has 9 public universities, 1 international and 2 institutes.
	The administration of polytechnics falls under the jurisdiction of the Technical and Vocational Education Division of the Ministry	There are more than 300 private institutions/centres/colleges—23 of them are engaged in twinning programs mainly with universities in the United Kingdom, United States, Canada, Australia and New Zealand
	There are 6 polytechnics (for engineering and commerce): Politeknik Port Dickson—Negeri Sembilan; Politeknik Ungku Omar—Perak; Politeknik Sultan Abdul Halim Mu'adzam Shah—Kedah; Politeknik Sultan Haji Ahmad Shah—Pahang; Politeknik Kota Bahru—Kelantan; Politeknik Kuching—Sarawak	The Universiti Putra Malaysia (UPM) in Selangor, Terangganu, and Sabah specializes in Science, Agriculture and Technology. It has the only College of Veterinary Medicine in the country. First founded as the School of Agriculture, it became the College of Agriculture in 1942 and finally incorporated as the Universiti Pertanian (Agriculture) Malaysia (UPM) in 1971 by merging with the Faculty of Agriculture of the University of Malaya
 Myanmar (Burma)	The Burmese higher education system is entirely state-run. Myanmar's 150 plus universities and colleges are administered by various government ministries	The Yezin University of Agriculture (YUA) is the only centre of higher learning in agriculture in the Union of Myanmar. YAU is administered by the Ministry of Agriculture
	The Department of Technical, Agricultural and Vocational Education is responsible for technical training at the technical higher schools and institutes; agricultural training at agricultural schools and institutes	
	Liberal arts and sciences universities, medical schools, and technological universities are run by the Ministry of Education, Ministry of Health, and the Ministry of Science and Technology, respectively	

 Philippines	State universities and colleges (SUCs) are institutions funded by the national government. They have their own charters and are thus autonomous from Commission on Higher education (CHED) CHED-supervised institutions are non-chartered colleges, whose annual budget allocation is integrated in the government budget appropriation for CHED Local universities and colleges previously called community colleges are operated, supported and maintained by local government units Government schools offering bachelor's degrees and/or graduate degrees and advanced training such as military and police academies, are supervised and regulated by the Department of National Defense and Philippine National Police	There are 1282 higher education institutions in the country, including 98 state universities and colleges, 105 CHED-supervised institutions, 35 local universities and colleges, 14 other government schools, and 1,030 private institutions Private institutions (sectarian or non-sectarian) are owned and administered by private individuals, groups or corporations. Sectarian schools (279) are non-stock, non-profit institutions, owned and operated by religious orders. Non-sectarian schools (751) are owned by private corporations not affiliated to any religious organizations; majority are stock, a few are non-stock, non-profit corporations, and a number are foundations
 Singapore	The Ministry of Education (MOE) controls the development and administration of state schools receiving government funding. It also has an advisory and supervisory role in respect of private schools The education system follows the British model	Singapore has 2 public universities (National University of Singapore; Nanyang Technological University, and 2 private universities (Singapore Management University; SIM University or UniSIM) Singapore has 6 Higher Education Institutions (HEIs). The National University of Singapore (NUS) regarded as the flag ship of Singapore's educational system has 8 faculties on Architecture and Building, Arts and Social Sciences, Business Administration, Dentistry, Engineering, Law, Medicine, and Science There are 4 major polytechnics in Singapore: Ngee Ann Polytechnic, Singapore Polytechnic, Temasek Polytechnic, and Nanyang Polytechnic
 Thailand	Higher education institutions in Thailand are classified as public universities and institutes (under the supervision of the Ministry of University Affairs), private universities and colleges (under the supervision of the Ministry of University Affairs), and institutes and colleges under the other ministries The Rajamangala Institute of Technology, Rajabhat Institutes, technical and vocational colleges, agricultural colleges, physical education colleges, dramatic arts colleges, and fine arts colleges are under the Ministry of Education; nursing colleges under the Ministry of Public Health; and professional training institutions under other ministries such as military and police academies under the Ministries of Defence and Interior, respectively	There are 24 public universities and institutes—21 universities and 3 institutes. The National Institute of Development Administration offers only graduate programs of study. There are 2 open universities: Ramkhamhaeng University and Sukhothai Thammathirat Open University. There are 4 autonomous universities: Suranaree University of Technology, Walailak University, Mae Fah Luang University, and King Mongkut's University of Technology Thonburi Other specialized training institutions include the Asian Institute of Technology, Mahamongkut Buddhist University, and Mahachulalongkorn Buddhist University There are also 41 private universities and colleges—23 universities and 18 colleges

 Vietnam	Big multi-disciplinary universities have been established by merging former small HEIs, i.e. Hanoi National University, University of Hue, University of Thai Nguyen, University of Da Nang, and Ho Chi Minh City National University	There are 126 HEIs in Vietnam, i.e. 110 public and 16 private, not including the system of the military and security HE institutions. The HEIs include 8 Comprehensive Universities and Colleges, 9 Universities and Colleges of Engineering including 2 Open Universities; 3 Agricultural, Forestry, Fishery colleges; 5 Universities and Colleges of Economics, Management and Law; 2 Colleges of Foreign Languages and Foreign Studies; 7 Colleges of Medical Sciences and Sport; 7 Colleges of Culture and Fine Art; 4 Teacher Colleges (outside Universities); 47 National and Provincial Teacher Training Junior Colleges; 8 Other Junior Colleges; and 16 Private Colleges The 4 leading Vietnamese universities in the agricultural sciences are: Hanoi Agricultural University, Thai Nguyen University of Agriculture and Forestry, Can Tho University, and Nong Lam University
 Timor Leste	There is one recognized university, the National University of Timor Leste in Loro Sae, East Timor created in 2000 after the merger of Timor University Dili and Dili Polytechnic. Several private universities have been created in 2002 but are not yet recognized by the Ministry of Education	The National University offers a Diploma in the field of Education and Engineering after 3 to 4 years of study. A Bachelor's degree is offered after 3 years and a Bachelor's Honours Degree after 4 years in the following fields: Economics, Agriculture, Social and Political Sciences and Teacher Training (Education)

Source: http://www.rihed.seameo.org.

 China	The reform of the Higher Agricultural Educational Institutions (HAEI) in China was launched in 1996. The major stakeholders include the Ministry of Agriculture, Ministry of Education, Provincial Department of Agriculture, Provincial Department of Education, Ministry of Personnel, and Ministry of Labour and Social Security	The pilot merging of universities administered by the Ministry of Agriculture and provincial agricultural universities started in 1994 and produced the following: Northeast China Agricultural University (Heilongjang province), Hebei Agricultural University (Hebei province), China Agricultural University (Beijing), Zhejiang University. The other 63 agricultural universities were eventually merged with multi-disciplinary universities or put under local education or agriculture departments The Ministry of Education currently administers the Chinas Agricultural University, Northwestern China University of Agricultural and Forest Science and Technology, Nanjing Agricultural University, Huazhong Agricultural University, Beijing Forestry University, and Northeastern China Forestry University The largest university in China is Zheijang University

Source: Liu and Zhang (2004).

Appendix 6 List of survey respondents (by country)

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Appendix 8 Summary tables for collaborations and linkages

Appendix Table 8.1. Intra-university collaboration in implementing postgraduate studies or training, by country

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of universities surveyed	4	1	1	1	14	4	2	27
No. of universities with intra-university collaborations	4	1	1	1	13	4	1	25
Nature of collaborating faculty/departments*								
Agriculture, Agricultural Industry, Technology	4	–	1	1	7	–	–	13
Veterinary Medicine/Science	1	–	1	1	6	–	1	10
Medicine/Pharmacy/Dentistry	2	–	1	1	3	1	–	8
Bus. Admin./Economics and Mgt.	1	–	–	–	3	1	1	6
Food Science/Techn., Engineering and Agro-Technology	–	–	1	1	1	2	–	5
Arts/School of Arts and Sciences	–	–	–	–	4	–	1	5
Community Educ./Rural Devt./Social Sciences	–	–	–	–	2	–	2	4
Animal Science	–	–	–	–	2	–	1	3
Biological Sciences	2	–	–	–	1	–	–	3
Chemistry, Mol. Biology, Bioscience, Biotechnology	–	–	1	–	–	2	–	3
Fishery and Marine	2	1	–	–	–	–	–	3
Mathematics, Natural Science/Statistics	1	–	–	–	1	–	–	2
Environmental Science	–	–	–	–	1	–	–	1
Forestry	1	–		–	–	–	–	1
Halal products research	–	–	1	–	–	–	–	1
Total	14	–	6	4	31	6	6	68
Nature of collaboration*								
Teaching related core and minor courses	2	1	1	–	12	2	2	20
Use of research and laboratory facilities	3	–	1	1	4	–	–	9
Conduct of research	2	–	1	–	3	2	–	8
As member/adviser of student advisory committee	1	–	1	–	4	1	–	7

* Multiple responses.

Appendix Table 8.2. Collaboration with national research systems in implementing postgraduate studies or training, by country

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of universities surveyed	4	1	1	1	14	4	2	27
No. of universities with collaborations with the national research system	3	1	1	1	13	4	2	25
Nature of collaboration with national research system*								
Conduct/implementation of national research activities/programs/projects (joint research)	–	1	1	1	7	1	–	11
Provision/source of research funds/grants, scholarships	2	–	–	–	7	1	1	11
Exchange in lecturers/researchers/students	1	1	–	–	1	–	4	7
Provision/utilization of research/laboratory facilities and as source of biological materials (e.g. animal stocks, feeds etc.)	1	–	1	–	2	1	1	6
Act as co-supervisor for students or serve as external critic	1	–	1	–	1	–	1	4
Conduct or attendance in faculty/staff training and seminars	–	–	–	–	2	2	–	4
Collaboration rating								
Very good	1	–	1	1	7	3	2	15
Good	2	1	–	–	4	–	1	8
Weak/Poor	–	–	–	–	1	1	–	2
Actions to improve collaboration*								
Provide financial support	–	–	1	1	3	1	1	7
Retooling or retraining of researchers/teachers	–	–	1	–	6	–	–	7
Conduct joint research projects at local/international levels including students	3	1	–	–	1	–	1	6
Regular consultation	–	–	–	–	2	–	1	3
Sustain submissions of research proposals for funding	–	–	–	–	2	–	–	2
Let students participate in seminars and workshops	–	–	–	–	–	–	1	1
Increase incentives to staff	–	–	–	–	1	–	–	1
Pooling of experts	–	–	–	–	1	–	–	1
Improve monitoring	–	–	–	–	1	–	–	1
Signing MOU and stimulate the staff to do some activities	–	–	–	–	–	1	–	1
(No answer)	1	–	–	–	3	1	–	5

* Multiple responses.

Appendix Table 8.3. Collaboration with national extension systems in implementing postgraduate studies or training, by country

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of universities surveyed	4	1	1	1	14	4	2	27
No. of universities with collaborations with the national extension system	2	1	1	1	12	3	2	22
Nature of collaboration with national extension system*								
Conduct of national extension activities (training, action programs etc.)	2	1	–	1	8	3	2	17
Provision of scholarships, source of funding	–	–	–	–	4	–	–	4
Preparation of extension materials	1	1	–	–	–	1	–	3
Act as co-supervisor for students	–	1	–	–	–	–	1	2
Sharing of resources (experts/facilities)	–	–	–	1	1	–	–	2
Provision of contacts/information on farmers for postgraduate research	–	–	1	–	–	–	–	1
Attendance to related task force meetings	–	–	–	–	1	–	–	1
Development and monitoring of demonstration farms	–	–	–	–	–	–	1	1
Collaboration rating								
Very good	1	–	–	–	3	3	–	7
Good	1	1	1	1	7	–	2	13
Weak/Poor	–	–	–	–	2	–	–	2
Actions to improve collaboration*								
Provide additional financial support	–	1	–	1	4	1	–	7
Regular consultation	–	–	–	1	2	1	–	4
Training/retooling of extension personnel	1	–	–	–	3		–	4
Greater involvement of graduate students in extension activities	–	–	1	–	–	–	1	2
Extension programs must be (institutionalized) a national priority	1	–	–	–	1	–	–	2
Identification of training needs of stakeholders	–	–	–	–	–	1	–	1
Pooling of experts	–	–	–	–	1	–	–	1
Increase incentives to staff	–	–	–	–	1	–	–	1
	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
Identify continuing education needs of veterinarians	–	–	–	–	–	1	–	1
(No answer)	1	–	–	–	5	–	2	8

* Multiple responses.

Appendix Table 8.4. Involvement of universities in farmer training programs, by country

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of universities surveyed	4	1	1	1	14	4	2	27
No. of universities with collaborations with farmer training institutes	3	1	1	0	14	4	1	24
Nature/ways of involvement*								
Conduct training/short courses both on and off campus	1	1	1	–	10	2	3	18
Mass media broadcasting (e.g. school on the air, road show /clinics etc.) including online information dissemination	–	–	1	–	6	2	1	10
Conduct seminars/symposium/forum among farmers	–	1	–	–	8	1	–	10
Providing community services including routine extension activities for selected farmer group	2	–	1	–	2	2	–	7
Implementation of action programs/pilot projects	1	1	–	–	4	–	1	7
Establishment of model farms for hands-on training	–	–	–	–	6	–	1	7
Provision of technical assistance	–	–	–	–	4	2	–	6
Provision of training manuals, brochures, techno-guides etc.	–	–	–	–	2	–	1	3
Farm visits	–	–	–	–	2	1	–	3
Conduct of R&D projects	2	–	–	–	–	–	–	2

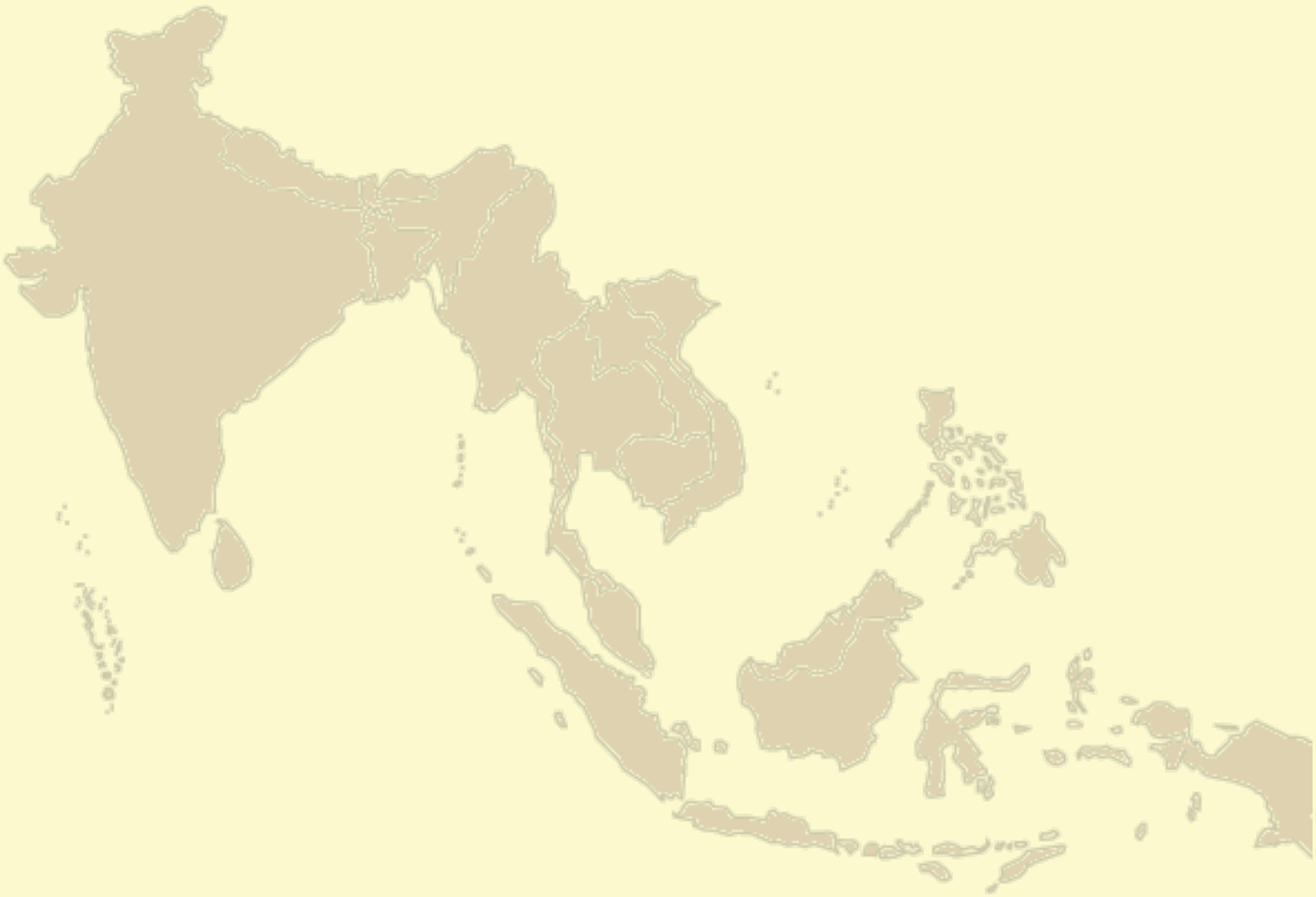
* Multiple responses.

Appendix Table 8.5. Inter-university collaboration in implementing postgraduate studies or training, by country

Item	INA	LAO	MAL	MYA	PHI	THA	VIE	Total
No. of universities surveyed	4	1	1	1	14	4	2	27
No. of universities with inter-university collaborations	4	1	1	1	6	4	2	19
Name of collaboratinged university/country*								
CSIRO, Australia	–	–	1	–	–	1	–	2
Meat and Livestock Australia (MLA)	–	–	1	–	–	–	–	1
University of New England, Australia	1	–	–	–	–	–	–	1
Beijing University, China	–	–	1	–	–	–	–	1
Huachung University, China	1	–	1	–	–	–	–	1
Huazhong Agricultural University, China	1	–	1	–	–	1	–	2
Toulouse University, France	1	–	–	–	–	–	1	1
Free University of Berlin, Germany	–	–	–	–	–	1	–	1
Goettingen University, Germany	2	–	–	–	–	–	–	2
Martin Luther University, Germany	1	–	–	–	–	1	–	1
University of Andalas, Padang, Indonesia	–	–	1	–	–	1	–	1
Bandung Institute of Technology, Indonesia	1	–	–	–	1	–	–	1
Bogor Agricultural University, Indonesia	2	–	1	–	–	–	1	3
Diponegoro University, Indonesia	–	1	–	–	1	–	–	1
Institut Pertanian Bogor, Indonesia	1	–	–	–	1	–	–	1
Universitas Gadjah Mada, Indonesia	1	–	1	–	–	–	–	1
University of Ghulan Basht, Iran	–	–	1	–	–	–	–	1
Rovan Institute, Iran	1	–	1	–	–	–	–	1
Institute of Animal Research, Gorgan, Iran	–	–	1	–	–	–	–	1
Kagawa University, Japan	1	–	1	–	1	1	1	5
Kyushu Tokai University, Japan	1	–	1	–	1	–	1	3
Okayama University, Japan	1	–	1	–	–	–	1	3
Tottori University, Japan	1	–	1	–	–	–	–	2
Tokyo University of Agriculture, Japan	1	–	1	–	–	1	–	3
National Animal Science Institute, Korea	1	1	–	–	1	–	–	3
Champasak Agriculture and Forestry College, Lao PDR	–	–	–	–	1	1	–	2
Joint publication	1	–	–	–	–	–	–	1
Luang Prabang Agriculture and Forestry College, Lao PDR	–	–	–	–	8	1	–	9
Universiti Malaya, Malaysia	–	–	1	–	–	–	–	1
National University of Malaysia, Malaysia	–	–	1	–	–	–	–	1
Universiti Sains Malaysia (UKM)	–	–	1	–	–	–	–	1
Universiti Putra Malaysia, Malaysia	1	–	–	1	–	–	–	2
Barneveld College, Netherlands	–	–	–	–	–	1	–	1
Aklan State University (ASU), Philippines	–	–	–	–	1	–	–	1
Central Mindanao University (CMU), Philippines	–	–	–	–	1	–	–	1
University of Southern Philippines (USP), Philippines	–	–	–	–	1	–	–	1
University of the Philippines Los Baños (UPLB), Philippines	1	–	–	–	–	–	–	1
National Chiayi University, Taiwan	–	–	–	–	–	1	–	1
National Chung Hsing University, Taiwan	–	–	–	–	–	1	–	1
National Pingtung University of Science and Technology, Taiwan	–	–	–	–	–	1	–	1
University of Kasetsart, Thailand	–	1	–	–	–	1	–	2
University of Chiang Mai, Thailand	–	–	–	–	–	1	–	1
University of Khon Kaen, Thailand	–	1	–	–	–	1	–	2
University of Mahidol, Thailand	–	–	–	–	–	1	–	1
Swedish University of Agricultural Science, Sweden	–	1	–	–	–	–	–	1
Uppsala University, Sweden	1	–	1	–	–	–	–	1
University of Newcastle, Tyne, U.K.	1	–	1	–	–	1	–	2
Arkansas State University	1	–	–	–	–	–	1	1
Cornell University, USA	–	–	–	–	–	1	–	1
Kansas State University	2	–	–	–	–	–	–	2
Ohio State University, USA	1	–	–	–	–	1	–	1
University of Florida, USA	–	–	1	–	–	1	–	1
University of Wisconsin, USA	1	–	–	–	1	–	–	1
Can Tho University, Vietnam	2	–	1	–	–	–	1	3
Hanoi Agriculture University, Vietnam	–	1	–	–	1	–	–	1
Thai Nguyen University, Vietnam	1	–	–	–	1	–	–	1
Total	12	4	14	1	13	17	2	63
Nature of collaboration*								
Teaching related core/minor courses or joint degree programs	2	–	1	1	2	2	3	10
Exchange of faculty/students	2	–	1	–	2	2	1	8
Conduct of research	2	–	1	–	1	–	1	5
As member/adviser of student advisory committee	1	–	1	–	–	–	1	3
Use of research and laboratory facilities	1	–	1	–	–	–	–	2
As external examiner	1	–	1	–	–	1	–	3
Curriculum development	1	1	–	–	1	–	–	3
Provided training	–	–	–	–	1	1	–	2
Joint publication	1	–	–	–	–	–	–	1
Others	–	–	–	–	8	1	–	9

* Multiple responses.

Appendix 9 Map of Southeast Asia



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