



Livestock sector training needs assessment report for Southeast Asia, China and Papua New Guinea

ILRI

INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

LIVESTOCK SECTOR TRAINING NEEDS ASSESSMENT
REPORT FOR SOUTHEAST ASIA, CHINA
AND PAPUA NEW GUINEA

Beatriz P Del Rosario, Albert P Aquino, Anita G Tidon and Roberta V Gerpacio

February 2008

Editing, design and layout—ILRI Publication Unit, Addis Ababa, Ethiopia.

Table of Contents

List of Tables		iv
Preface		v
Executive summary		vi
1	Introduction	1
	1.1 Rationale	1
	1.2 Background of the study	1
	1.3 Purpose and objectives	1
	1.4 Methodology	2
2	Review of related literature	3
	2.1 Livestock industry situation in Southeast Asia, China and Papua New Guinea	3
	2.2 Key research and research management issues related to capacity strengthening of the livestock sector in the region	3
	2.3 Capacity strengthening experiences and initiatives in the region	4
	2.4 Strengthening farmers organizations in developing countries	10
3	Results and discussion	12
	3.1 Capacity strengthening gaps	12
	3.2 Key research issues	14
	3.3 Alternative suppliers and potential partners in the region	16
4	Summary, conclusions and recommendations	23
	4.1 Research and research management issues	23
	4.2 Suggested priority learning and capacity strengthening priorities for ILRI	23
	4.3 ILRI's potential partners	24
	4.4 Limitations of the study	24
References		25
Annex 1	Livestock industry situation in Southeast Asia, China and Papua New Guinea	27
Annex 2	Previous findings on key issues related to livestock in the region	41

List of Tables

Table 1. Key research management issues for livestock research managers in Southeast Asia and China, October 2007	12
Table 2. Ranking of knowledge and soft skills deemed essential for an effective livestock researcher and/or manager, Southeast Asia, October 2007	14
Table 3. Identified research issues and constraints related to technical aspects of livestock production in Southeast Asia, October 2007	14
Table 4. Identified research issues and constraints related to the economic aspects of livestock production in Southeast Asia, October 2007	17
Table 5. Some training providers and potential partners for collaboration in the region	17

Preface

The recent World Development Report concluded that in the 21st Century, for the agriculture-based countries, agriculture continues to be a fundamental instrument for sustainable development (World Development Report 2008). The lack of capacity has been a major limiting factor in a wide range of development programs and initiatives that have failed in the past.

Research-based capacity building is a core priority of ILRI because of the important role that research plays in economic growth and development as well as in addressing the rapid changes in bio-physical, socio-cultural, technological and the policy environments of the agricultural innovation systems in the developing as well as the developed world.

An effective innovation system in the livestock sector requires a cadre of professionals with a specific skill mix. The new paradigms and the ongoing transformation processes within the agricultural research and development system require a changed behaviour of the change agents. To be relevant any capacity strengthening activity should be geared towards some specific outcomes. These outcomes are tied to skills and performance levels of the various actors in the innovation system. Capacity strengthening therefore should contribute to the overall performance of individuals, organizations and the society at large and should support the strategic directions of agricultural research for development and the broader developmental goals.

As a development input, capacity strengthening is a dynamic phenomenon that must always be present, but should truly reflect the changing conditions and ongoing transformations. To make capacity strengthening activities more relevant in addressing the needs of the livestock innovation system the Capacity Strengthening Unit of ILRI, in collaboration with APAARI, conducted during 2007 an assessment of livestock capacity requirements of the Southeast Asia, China and Papua New Guinea regions—a needs assessment study aimed at revisiting its priorities for capacity strengthening. The initial results of this study were presented during a multi-stakeholder workshop organized jointly by APAARI and ILRI in Bangkok, Thailand (October 2007) for validation. The key findings of this study are presented in this report. The overall purpose is to identify common priorities across countries in the region for collective action.

This task would not have been possible without the support and commitment of a number of individuals. We would like to appreciate and acknowledge the contributions made by Beatriz P Del Rosario, Albert P Aquino, Anita G Tidon, Roberta V Gervacio and Iain Wright, ILRI's Regional Representative in Asia, in conducting this study and preparing this report. All organizations and individuals who responded to the survey questionnaire and attended the consultative workshop are recognized for spending their valuable time and making significant contributions towards the study. The support and continuous encouragement provided by ILRI senior management is also gratefully acknowledged and appreciated.

We recognize that the regional priorities identified in this document need to be complemented with focused national and sub-regional activities. It is our sincere hope that the findings of this study will pave the way for developing and implementing the livestock-related capacity strengthening activities in Southeast Asia, China and Papua New Guinea. We will make every effort to support the national and regional initiatives in implementing these priorities.

P Anandajayasekeram
Manager, Capacity Strengthening Unit
ILRI

Bruce Scott
Director, Partnership and Communication
ILRI

Executive summary

ILRI commissioned a training needs assessment study (TNA) for Southeast Asia including China and Papua New Guinea in 2007. The study used a standard questionnaire and interviewed key informants and stakeholders. An extensive and comprehensive review of relevant secondary livestock data and statistics was conducted to supplement the primary data obtained from key informants and stakeholders. Together the two datasets with inputs from Australian Centre for International Agricultural Research (ACIAR) were compiled, analysed and synthesized to identify gaps and envision the strategies and policies necessary for a strengthened capacity in livestock and related research in Southeast Asia, China and Papua New Guinea. The preliminary findings were presented and validated during a regional multistakeholder workshop held in Bangkok, Thailand in October 2007. Following are the salient findings of the study:

Livestock is important in the livelihoods of the rural poor in the Southeast Asia region. It provides vital contribution to agriculture and industry, and year-round employment of agricultural workforce. Livestock enhance crop production, generate cash income for rural and urban populations, and provide fuel and transport. In fact, the livestock industries of Southeast Asia, China and Papua New Guinea contribute about 10–25% of agricultural gross domestic product (GDP). While the contribution of agriculture to GDP is declining, livestock-to-agriculture GDP ratio is rising. In terms of meat production, the region is a major global player. For the period 1979–2004, it contributed roughly 13–33% of world meat production.

Livestock production systems are generally subsets of Asian farming systems and take place under very diverse conditions in different countries across the region. Cattle and small ruminant production across the region is predominantly smallholder or backyard while varying degrees of commercial operations are observed for poultry and swine especially in countries like Indonesia, Malaysia, the Philippines and Thailand. In fact, Thailand accounts for 25% of global poultry meat exports.

All countries have a formal institutional structure (an agency, bureau or department) within their respective Ministries of Agriculture that is responsible for the development of the livestock industry. The range of public-led programs and services include breeding quarantine and other regulatory services, veterinary and health, disease control and management, extension and technology promotion, credit and financing, research and development, and support to input systems.

Innovation and wide application of technology in the region depend on a research and development system that is mostly public sector-led. The key research management issues in the region include: inadequate research resources (funds, equipment and human resources) for strategic planning, priority setting, resource mobilization, conducting research in selected areas (emerging technologies and socio-economic issues); complete absence of monitoring and evaluation system; and poor dissemination of research results.

Lack of clear guidelines for research prioritization, mismatch in donor-research institute priorities, and ineffective human resources policies especially with respect to incentive systems were also identified as issues needing immediate attention.

Weakness in livestock extension figured prominently in a survey of policymakers, researchers and officials from developing countries in the Asia-Pacific region. The survey indicated that research results are not adequately conveyed to farmers. The poor performance of many extension services can be attributed to inappropriate organization, and inadequate training and lack of incentives for extension agents.

One of the most cited livestock production constraints pertains to health and diseases. These diseases range from Foot-and-Mouth-Disease for cattle, avian flu for poultry to hog cholera for swine. In Laos, for instance, about 80% of the chicken population in upland areas died due to diseases and in China more than 10 million pigs were lost to diseases during 2006–07. Hence, most of the production related discussions in the individual country reports zeroed in on the public sector efforts to address livestock diseases.

Past studies have identified a number of areas that require attention in order to achieve the full potential of the livestock sector. These include addressing animal health constraints; improving feed quantity and quality; enhancing reproductive and genetic technological development; paying attention to post-harvest technologies and processes; and minimizing the negative environmental effects of livestock production. The identified key research issues of the livestock sector are related to animal production, animal health, marketing and trade, and policy and institutions.

A recently completed in-depth consultation process by DFID (2007) in China also identified a number of priority issues which validate the emerging consensus from the regional study. The priority issues that need immediate attention include the following:

- Basic scientific research, e.g. on climate change modelling, but with emphasis on the linkages with social science and policy research
- Social science research, e.g. on vulnerability and impacts
- Institutional and policy research
- Research on innovation and technological development and transfer
- Multidisciplinary and cross-sectoral approaches and methodologies for research design and implementation
- Methodologies for monitoring and evaluating current experiences to identify lessons that can be shared and
- Building and nurturing effective partnership for collaborative research.

There is consensus that pro-active investment in learning and capacity building within local, national and international organizations will facilitate flexibility and adaptation to emerging challenges, such as trade and economic liberalization, natural resource degradation, climate change and other stresses. The stakeholders feel that capacity should be built both within the research system as well as at the farmer level.

In terms of technical knowledge, there is need to strengthen skills in core research areas such as forage production, breeding and animal health, and in emerging and frontier fields such as biotechnology, genetic diversity research, and the use of ICT in simulation and modelling.

In downstream livestock research, there is need to train scientists and development staff in participatory and on-farm research methods. There is need to strengthen capacities in socio-economic evaluation and impact assessment as formal, explicit and integral part of livestock research. Formal monitoring and evaluation (M&E) systems, an essential component of any livestock research and development project, need to be strengthened.

Training in research methods is needed in various technical fields like biotechnology and waste recycling. On animal health, capacity strengthening is needed mainly for herd health and disease management, and quarantine regulations, referring in particular to trans-boundary diseases such as the avian flu, and possible livestock–human transmission.

Lastly, domestic and global marketing and trade seem to be poorly understood and hence are identified as priority training needs. Most livestock research considered only aspects of the production system up to the farm gate. Researchers ignore post-farm and downstream issues, such as the linkage/coordination/integration of smallholder and commercial production systems. This is due to lack of knowledge and skills needed to perform this type of research. For example, they require competency skills in value addition, food safety and product quality.

Respondents consistently referred to inadequate and inefficient allocation of research funding, for which they felt that a skills training on innovative resource mobilization will be important. Some also expressed the need for training courses on effective leadership, decision-making, negotiation and conflict resolution. Networking skills are highly needed by research managers to continually learn from each

other new approaches to NARS management, e.g. national innovation system and thematic approaches. NARS need skills in intellectual property management, technology management policies, and technology foresight as tools in strategic planning for the livestock industry. Communicating results seem to be deficient in substance and style, with many livestock researchers in the region lacking skills in scientific writing and presentation.

Knowledge and skills on innovation systems is highly needed by all those involved in livestock research and capacity strengthening. This confirms the earlier discussion on the need for a shift in NARS research that will focus on technology development, innovation, promotion and commercialization efforts.

A large number of training providers such as universities in the region are currently offering training in a number of technical areas identified in this study. The efforts of these universities are complemented by other groups such as the government institutes involved in livestock production, private institutions, NGOs, farmer organizations, religious organizations and regional and international institutes in providing some of the soft skills identified on *ad hoc* basis in selected countries. A numbers of the soft skills identified are multidisciplinary, and cross-commodity and cross-sectoral in nature. Therefore, a well coordinated effort is needed to make the capacity building efforts more effective and efficient.

The ASEAN secretariat has already started providing leadership in capacity building for 10 of its member countries, through the support from China in a number of areas including biotechnology application, dairy cattle and swine production. The recently concluded ASEAN charter whose goals are one vision, one identity and one community offers better opportunities for collective action including capacity strengthening activities in the region.

Pressure for institutional reform and reorganization is now increasing within the university system in Asia—especially in Thailand and China where much experimentation is taking place. The universities are being forced to reconsider their traditional roles as sources of ideas, basic scientific knowledge, and teaching resources and hence to embrace new ones like contributing to regional development through innovation. They are being asked to transform themselves from ‘knowledge containers’ to ‘entrepreneurial universities’. ILRI should work closely with universities to retool staff skills in these areas.

Conventional management tools in planning, priority setting, and M&E will have to be enhanced. Research managers will have to be trained to use skills such as technology forecasting and scenario building, knowledge and technology management, supply/value chain analysis, and impact assessment. ILRI will play a role in effecting these changes especially in partnership with other training providers in the region.

Technical skills and training needs in research methods in various technical fields like biotechnology, waste recycling, and socio-economic impact assessments, participatory and on-farm research techniques, scientific writing and report/paper presentation are high training priorities. Crucial soft skills in terms of the quest for additional knowledge on innovation systems and its implication to conduct and coordinate research are deemed most important.

While networking arrangement has been recognized as a cost-effective pro-poor mechanism to conduct research and share knowledge in the region, a livestock knowledge and resource network is not in place. Such networks could evolve into learning alliances or communities of practice. Intergovernmental organizations such as the Association of Southeast Asian Nations (ASEAN) could be an entry point for ILRI as partners for capacity building consortia. These consortia will fully harness the pool of talented researchers and experts in high quality institutions in the region.

Donors are currently supporting capacity building of farmer organizations so that they will have a bigger voice in policymaking at the global level. The growing interest in engaging farmers’ organizations in agricultural research for development for greater impact is an opportunity to showcase innovation

system approach through supply chain development of the livestock sector. Partnership with the private sector could be a critical element in this endeavour. ILRI will seek potential collaboration with national, regional and international partners with commitment to capacity strengthening to meet the identified skills and knowledge gap.

1 Introduction

1.1 Rationale

The International Livestock Research Institute (ILRI), one of 15 'Future Harvest' centres of CGIAR, serves as the knowledge network for international cooperation in livestock research. It aims to carry out high quality science and capability building that will impact on poverty reduction and sustainable development.

ILRI has a Capacity Strengthening Unit (CaSt) whose function is to reinforce the scientific knowledge and technical capacity of NARS scientists and technicians in developing countries. The unit is currently preparing its learning and capacity strengthening (L&CS) strategy and policy on the basis of broad-based participation and locally-driven agenda, developing local capacities, and sustaining long-term investments and integration of activities at various levels to address complex problems. Along this end, a key activity to develop the strategy is a training needs assessment (TNA) exercise, a tool to identify the essential L&CS activities to help enhance the productivity and performance of all stakeholders concerned.

1.2 Background of the study

Research needs to be supported by an enabling environment with appropriate policy framework, institution and human resources development that includes the strengthening of both managerial and technical capacities in the national agricultural research (and extension) system (NARS or NARES).

In the livestock sector, there is growing perception that ILRI has to provide and sustain a variety of training activities that suit the heterogeneous needs of NARS. In a rapidly changing world, the R&D systems in developing countries confront new and increasingly complex challenges brought about by technical, organizational/institutional and resource constraints, among others. Over the years, there has been an enormous erosion of both individual as well as organizational capacity in developing countries, and the need to build their capacity to achieve development goals and objectives has been recognized in many recent studies (Inter Academy Council 2004; NEPSD 2004; Commission for Africa 2005; UN Millennium Project 2005).

As a prime concern in the NARS, *capacity strengthening* is a process by which individuals, groups, organizations and societies increase their ability to perform core functions, solve problems, define and achieve objectives, and understand and deal with their development in a broader context and sustainable manner. The absence of a critical mass of well-trained professionals will diminish the quality and quantity of research and returns to global investments in agriculture. The terms *capacity strengthening* and *capacity development* do not however imply the absence of capacity; rather they mean the building up and strengthening of capacity, usually on the basis that the existing one has been eroded or destroyed. Both terms encompass the development of required capabilities to meet immediate and future needs. Capacity strengthening is an ongoing process that has direct links with human development. As a development input, it is a dynamic phenomenon that must always present, but truly reflect, the changing conditions and ongoing transformations. Capacity strengthening means empowering people on a sustained basis and this can happen by developing competencies (skills, knowledge, and attitudes) that will enable people to develop themselves.

1.3 Purpose and objectives

This training needs assessment (TNA) study aims to identify the priority learning and capacity strengthening activities to be facilitated and/or undertaken by ILRI. At present, there is a growing

awareness that ILRI needs to continue providing a variety of training types, themes and delivery modes to suit the heterogeneous needs of NARS across subregions based on existing geopolitical grouping. The five subregions identified are: West Africa (CORAF Region), Eastern and Central Africa (ASARECA Region), Southern Africa (SADC Region), South Asia and Southeast Asia. For this particular TNA, the scope of the study is Southeast Asia, China and Papua New Guinea (PNG).

ILRI recognizes the activities of the other national and regional players in strengthening NARS capacity and is keen in identifying its niche in L&CS, based on its mission, mandate and research base as well as on its competitive and comparative advantages. ILRI's goal is to reinforce and add value to the ongoing national, regional and global initiatives by working through innovative partnership and networking arrangements. For example, ILRI anticipates an increase in demand for specialized short courses, individual non-degree and higher degree training. However, it does not intend to compete with the national institutes and courses offered by universities throughout the world, but aims instead to support and collaborate with them. Given its strong research base, ILRI hopes to influence developing country national R&D systems in the most sustainable ways.

1.4 Methodology

Key informants and stakeholders around the Southeast Asian region, China and PNG were contacted and interviewed using the ILRI-developed questionnaire. The pre-identified livestock expert-respondents (30) came from Cambodia, China, Myanmar, Papua New Guinea, Philippines, Thailand and Vietnam. Their responses (18), together with inputs from ACIAR, were compiled and synthesized for this report.

An extensive and comprehensive review of relevant literature was also conducted to supplement the primary data obtained from key informants and stakeholders with secondary livestock data and statistics. Analysis of data employed mainly descriptive methods (e.g. the use of Likert scales for relevant tables) with simple tabulation of results synthesized from the key informant interviews, and of the secondary data and information from the literature. Together, the two datasets were analysed and synthesized with the end goal of identifying the gaps and envisioning the strategies and policies necessary for a strengthened NARS capacity in livestock and related research in Southeast Asia, China and PNG.

2 Review of related literature

2.1 Livestock industry situation in Southeast Asia, China and Papua New Guinea

A full review of the livestock industry situations of various countries in the region is provided in Annex 1. The following discussion is a synopsis of the salient points found in the review.

Livestock provide vital contribution to agriculture and industry, and year-round employment of agricultural workforce in the region. Livestock enhance crop production, generate cash incomes for rural and urban population, and provide fuel and transport, among other contributions to societies. In fact, livestock industries of Southeast Asia, China and Papua New Guinea contribute about 10–25% of agricultural gross domestic product (GDP) of their respective countries. The review also shows that while the contribution of agriculture to GDP is declining, livestock-to-agriculture GDP ratio is rising. In terms of meat production, the region is a major global player. For the period 1979–2004, it contributed roughly 13–33% of world meat production.

Livestock production systems are generally subsets of Asian farming systems and take place under very diverse conditions in different countries across the region. Cattle and small ruminant production across the region is predominantly smallholder backyard while varying degrees of commercial operations are observed for poultry and swine especially in countries like Indonesia, Malaysia, the Philippines and Thailand. In fact, Thailand accounts for 25% of global poultry meat exports.

One of the most cited livestock production constraints pertains to health and diseases. These diseases range from Foot-and-Mouth-Disease for cattle, avian flu for poultry to hog cholera for swine, among others. In Laos, for instance, about 80% of the chicken population in upland areas died due to diseases. And in China, more than 10 million pigs were lost to diseases during 2006–07. Hence, most of the production related discussions in the individual country reports zeroed in on the public sector efforts to address livestock diseases.

All countries have a formal institutional structure (an agency, bureau or department) within their respective ministries of agriculture that is responsible for the development of the livestock industry. Its range of public-led programs and services include breeding, quarantine and other regulatory services, veterinary and health, disease control and management, extension and technology promotion, credit and financing, research and development, and support to input systems, among others.

2.2 Key research and research management issues related to capacity strengthening of the livestock sector in the region

This section summarizes findings from the literature as discussed elaborately in Annex 2 in order to highlight some important issues and concerns affecting the region's livestock sector, and more specifically, its research and technological development.

Innovation and wide application of such depend on a research and development system that is mostly public sector-led. The scarcity of public funds, however, impacts not only on the conduct of research but also on the human and institutional capacity of research. Institutional arrangements between NARS as well as regional and global development agencies must also be re-examined with the view to improving efficiency and effectiveness.

In terms of meeting emerging challenges and opportunities of the region's livestock sectors, the literature enumerates some technological options or solutions. These pertain to addressing animal health

constraints (and to conducting of risk analysis and animal health economics research), improving feed quantity and quality, enhancing reproductive and genetic technological development, paying attention to post-harvest technologies and processes, and minimizing the negative environment effects of livestock production.

Weakness in livestock extension figured prominently in a survey of policymakers, researchers and officials from developing countries in the Asia-Pacific region. The survey indicated that research results are not adequately conveyed to farmers, particularly in regard to feeding practices and animal health. The poor performance of many extension services can be attributed to inappropriate organization, and inadequate training of and lack of incentives for extension agents or workers.

Historically, the NARS/NARES in the region invariably benefited from the capacity building interventions of the CGIAR centres such as the former ISNAR on research management tools (planning, priority setting, M&E, technology transfer) and through joint research projects in network or consortia mode with most CGIAR centres (personal communication). Regional forum such as APAARI aims to further strengthen the NARS, facilitate both regional and inter-regional collaboration based on regional priorities collectively identified by its members and stakeholders, and promote information and knowledge exchange. In the ASEAN, capacity building on livestock has been through exchange of experts and study visits supported through the ASEAN-PROC agreement during the last 10 years.

2.3 Capacity strengthening experiences and initiatives in the region

Some lessons from capacity strengthening activities in the region

a. Crop-Animal Systems Research Network (CASREN)

The project started in 1998 as one of the first projects of ILRI based in China and Southeast Asia. It aims to sustainably improve the integration of crop and livestock production by making better use of nutrients. The following Southeast Asian countries were involved: Indonesia, the Philippines, Thailand, Vietnam, Cambodia and Laos, with significant support from the Asian Development Bank. The approach of CASREN is also to develop a basket of options with farmer-partners, with a focus on making better use of feeds for livestock and manure as a crop fertiliser, and use of legumes and other strategies to increase soil fertility. There are two major links between ILRI initiated project on 'sustainable parasite control' (SPC) and CASREN efforts. First, nutrition has a big impact on resistance to disease, and parasites reduce the efficiency of feed use. Second, the participatory approaches being used by the projects are similar and have led to a deeper understanding of how and why these technologies are adopted by farmers.

Reports indicated that CASREN proved to be successful in increasing technical capability of both the farmer partners and development workers in the Philippines, in using recommended technologies for crop-animal productivity, such as the urea molasses block (UMB). Similar successes were attained in China through collaboration with Chinese scientists and institutions in Yunnan in 1999 and in Sichuan in 2002. The success of CASREN's work in Sichuan, where many farm households more than doubled their incomes by adopting CASREN potato silage technologies, has induced the CGIAR System-wide Livestock Program to fund related research within China and Southeast Asia.

b. Research Cooperation for Livestock-Based Sustainable Agriculture in the Lower Mekong Basin: MEKARN

The MEKARN program is a regional research co-operation program for livestock-based sustainable farming systems in the Lower Mekong Basin established in 2001 with support from SIDA. It aimed to strengthen the cooperation in research and training, increase the availability of information and promote

livestock as an essential part of sustainable farming systems in the Lower Mekong basin. A website (<http://www.mekarn.org>) provides up-to-date information on project activities. Regional workshops are held annually and the proceedings are published on the website, in paper form and on CD-ROMs. Training material based on research findings is produced for scientists and agriculturalists in the region and study tours and exchanges are encouraged and supported.

The program includes 13 universities and research institutes in Vietnam, Thailand, Laos and Cambodia, and is co-ordinated by the Nong Lam University (former University of Agriculture and Forestry), Ho Chi Minh City, and supported by the Department of Animal Nutrition and Management, the Swedish University for Agricultural Sciences. The co-operation includes MSc and PhD training, i.e. three Vietnamese universities offer MSc and PhD degrees in animal science, a research fund, and networking activities. The disciplines represented among the researchers are livestock-based farming systems, animal nutrition and feeding, renewable energy, integrated farming systems, agro-forestry, aquaculture and biometrics/statistics.

The program strengthened the capacity of the participating institutions in terms of conducting research, and upgrading their research facilities. Most of the students that graduated are now working at their home universities or research institutes or continue with PhD training.

c. Community agricultural technology program

The project is being undertaken by the International Institute for Rural Reconstruction in the Philippines with funding support from Australian Centre for International Agricultural Research. The project started on January 2006 and will end on December 2007. While still ongoing, some lessons can be drawn from the project.

The project used the action-learning approach which involves analysis and planning, implementation (adoption/behavioural change) and review and learning. This resulted in an interaction and start of exchanges between researchers, extension workers and farmers on ideas and information on past ACIAR technologies and innovations that can help farmers improve their agricultural production and increase their income.

To date most of the participating NGOs have satisfactorily complied with the request to incorporate results of past ACIAR researches in their field activities. Most of them took the initiative to contact researchers from Leyte State University (LSU) who were previously involved in past ACIAR researches. Some of these researchers have already conducted trainings in the NGOs' covered communities. Farmer-beneficiaries are now adopting improved practices they learned, e.g. goat management system and correct feeding practices as well as soil and water conservation technologies (such as the use of natural vegetative strips and planting of forage which are also used for livestock feed, among others).

d. Poultry feeding systems in PNG

This project was funded by ACIAR. It aimed to improve the profitability of smallholder broiler chicken production in Papua New Guinea (PNG) by identifying cheaper local food sources and reducing reliance on imported feed.

The project team established a national feed testing facility in Labu to allow technicians to accurately evaluate the nutritional values of locally available feed resources. The facility is based on similar establishments in South Australia. PNG technical and professional staff is being trained in the relevant techniques. Lae Feed Mills formulated and distributed new rations for testing in on-station feeding trials at the PNG National Agricultural Research Institute at Labu. This allowed researchers to compare production performance and select the most suitable diets for specific areas, seasons and chicken growth phases.

Communicating with PNG farmers was an important part of the project. The project team trained extension officers to disseminate information, conduct demonstration trials on village farms, produce training materials such as posters and leaflets, and conduct workshops on feed mixing and feeding and broiler management. Farmers recognized the value of the extension officers' visit to provide advice on poultry, sources of low cost feed, disease control, business management, planning and financial opportunities.

Some ongoing capacity strengthening projects and activities in the region

a. Improving the pig and pig meat marketing chain to enable small producers to serve consumer needs in Vietnam and Cambodia

This is a two-year (2006–07) collaborative project under the DURAS (Promoting Sustainable Development in Agricultural Research Systems) project of GFAR funded by the French Ministry of Foreign Affairs, with the theme linking farmers to market and support to small and medium agro-enterprises. It is implemented in Cambodia and Vietnam, led by a NARI (the Agrarian Systems Department, Vietnam Agricultural Science Institute (VASI)). Nine collaborators represent government, private sector, NGOs, advanced research institution, farmers' organization, women, and CGIAR (ILRI).

The objectives are to: (1) enhance smallholder access to high-value markets for pig and pig meat; (2) increase the share of end-market prices obtained by smallholders for their pigs and pig meat; (3) increase the scale of operation and total value of pig and pig meat marketed by smallholders; and (4) increase the number of smallholders marketing pig and pig meat.

The innovative aspect of the project is building on approaches tried and tested elsewhere in the development context such as mobilization of communities, organization and empowerment through participatory approaches. The project's value added is its contribution to better income and employment generation, especially for women. Through capacity building and strengthened institutions serving women, the project will help increase women's income opportunities by enabling them to become active participants in rural development.

The project activities are consistent with increasing new interest in strengthening mechanisms and approaches for voluntary associations (e.g. specialized cooperatives in North Vietnam) *vis-à-vis* imposed associations (e.g. traditional coops). It is expected that the findings from this project will generate new insights to tackling the issues of intensification and increasing feed costs through the technology and institutional options introduced, tested and monitored. Such insights will be useful in facilitating pro-poor livestock development pathways through appropriate choices of technology-policy interface that has potential for generating public goods for the region.

b. Supply chain development of dairy in China

The case of supply chain development with small farmers through public-private partnership in China was implemented by Zhejiang University, and supported by Small Farmers Adapting to Global Markets Project (SFAGMP), a China–Canada Agriculture Development Program. The emerging new food system in China is characterized by rapid diffusion of supermarkets, fast food chains, large agro-industrial firms, new generation of wholesalers and new way of farming, i.e. value-added farming. These have provided new opportunities for small farmers which could play bigger role in poverty reduction in the countryside. Linking small farmers with the new market is not necessarily a good or bad thing, but some small farmers are more ready than others who needed more skills training to be able to meet the new requirements of the markets. Small farmers need specialized inputs, technical assistance, credit and assured markets.

The SFAGMP piloted supply chain development for potato, pork, dairy and vegetables in two provinces in China using key approaches, namely: facilitating linkages with stakeholders along supply chains on farm quality assurance (e.g. China GAP), conservation agriculture practice, farmers' cooperative and association development, participatory agriculture extension, agribusiness training, and branding strategy.

There are many examples of public industry initiatives in China, including (1) Nestle model to work with small dairy farmers in Northern China, (2) Wuchuan potato for supermarket sale through forming cooperatives, (3) rapeseed oil from Santai, Sichuan, for supermarket sale through branding, (4) China GAP for small farmers through association (pork, vegetable and dairy).

Indeed the changing food systems in China have provided new opportunities to small farmers. Supermarkets are one of these opportunities that will become more significant as China further develops economically. Farmer associations, cooperatives, or alternative group action could provide 'bridge' to link small farmers with buyers. There are many forms of 'middle carriers' to link farmers with markets, namely: clusters + farmers, franchising, NGOs +farmers, producer associations +farmers, cooperatives +farmers, lead farmer + small farmers, companies + production base +farmers, specialized distribution centre + farmers etc.).

c. Extension approaches to scaling out livestock production in northern Lao PDR

Shifting cultivation of livestock practiced in northern Laos limits both the number of animals grazed and their growth rates. A past ACIAR project, in conjunction with CIAT and AusAID, introduced poor farmers to forage and livestock technologies and approaches that accelerated animal growth, while minimising the reliance on shifting cultivation. The success of these technologies, in concert with extension methods that enhanced farmer learning, resulted in farmer number doubling within two years, with the time until impact halving. Two major initiatives, by the EU and ADB, intend to broaden the geographic focus of this work, while ACIAR will evaluate existing extension approaches with the aim to modify these for greatest uptake and impact.

d. Management of CSF and FMD at the village level in Lao PDR

Livestock diseases like classical swine fever (CSF) and Foot-and-Mouth-Disease (FMD) are major constraints to village livestock production systems in Lao PDR. A previous project (AS1/1994/038) identified CSF as causing substantial deaths in village pig production systems. This project aims to introduce a CSF vaccination program at the village level, together with husbandry strategies to maintain herd immunity against future disease outbreaks. The development of a simple, rapid diagnostic test will be combined with implementation of a village-centred vaccine delivery system. Epidemiological data will be gathered to build national and regional understanding of both CSF and FMD, and simple extension materials for animal health and production services produced.

e. Development of cattle and buffalo breeding strategies and activities based on BREEDPLAN in Thailand

A previous ACIAR project helped Thailand to establish a national system of recording and evaluating the breeding and performance of beef cattle and buffalo. This system, which has been run by the Department of Livestock Development (DLD), uses a PC-based software system—Herd Magic—to record the data for genetic evaluations to rank animals for genetic merit and monitor genetic progress within and across herds. This ACIAR project developed the HerdMASTER program using a more recent Microsoft tool, giving it Thai language capability to collect data more efficiently. This work specifically altered HerdMASTER screens to Thai language labels, converted 'online help' documentation, developed basic 'help' into Thai language and converted existing Thailand Herd Magic systems to HerdMASTER. The work included the training of a Thai officer from DLD in the use of the package.

f. Capacity building management of avian influenza in Southeast Asia

This ACIAR funded project with support from USAID aims to upgrade the animal health information system in Cambodia, Lao PDR and Vietnam for the management of avian flu. The project involves public and private veterinarians, technicians and other animal health workers, sales force of private companies and operators of medium- and large-scale poultry farms. This is being done through training and distribution of technical materials/manuals of biosecurity and control of avian flu, epidemiological investigation of disease outbreaks and diagnosis of avian flu.

Among its other partners are the Academy for Education Development, Kenan Institute Asia and the National Veterinary Services in Cambodia, Lao PDR and Vietnam.

g. Building capacity in the knowledge and adoption of Bali cattle improvement technology in South Sulawesi

In South Sulawesi (Sulsel), beef production is constrained by the quantity, quality and continuity of forage supply, and inappropriate herd management practices. Previous ACIAR projects have developed strategies to redress these constraints at the farm level, by establishing annual feed-plans based on crop residues, perennial or annual forages, tree legumes, or diet supplements in association with appropriate herd management strategies. This project is building on earlier project experience to increase the scope and cover a wider range of agro-ecological zones and socio-economic systems in Sulsel, extending adoption practices to an additional 12 communities. The modality deployed in this project is intended to become the model for extension services in Sulsel.

Collaborating institutions for the project are Hasanuddin University, Indonesia, Assessment Institute for Agricultural Technology in Makassar, Indonesia, and Livestock Services of South Sulawesi Province.

h. Establishment of virtual information centres for livestock PigTrop—the information centre about pig production in developing countries

PigTrop website, developed through the assistance of CIRAD, is devoted on pig production and pork commodity chains in developing countries. It mainly addresses stakeholders involved in the pig commodity chain, but also anyone else with an interest in tropical pig breeding.

The site is devoted to gather a maximum of research and development institutions working on pig production and wild hogs in tropical regions, in order to promote research results. With a strong commitment to create a 'Tropical Pig Network', PigTrop website aims to be a collective platform to share experiences and exchange information towards the final users in Southern countries (farmers, rural organizations, NGOs, researchers and students).

LivestockNet (www.livestocknet.ch)

This is Swiss network of university, private sector, NGO and government stakeholders working in livestock development.

Some upcoming and emerging regional cooperation

a. NARS/NARES, CGIAR and APAARI

On knowledge sharing and management

The NARS or NARES, an in-country institutional arrangement for RD/E management, was formed for a more efficient and effective coordination of efforts along the R&D-technology transfer and

commercialization continuum. This arrangement though varies from country to country. The Philippines has an apex body such as PCARRD-DOST with a strong network of research institutions and a consortium approach for managing such at the subnational level. A parallel network of research agencies managed by the Philippine Department of Agriculture', Bureau of Agricultural Research, was set up in 1986. Indonesia has managed to decentralize its agriculture and forestry research and extension system at the district level through a World Bank project during the last 5 years. Historically, the NARS/NARES in the region invariably benefited from the capacity building interventions of the CGIAR centres such as the former ISNAR on research management tools (planning, priority setting, M&E, technology transfer) and through joint research projects in network or consortia mode with most CGIAR centres (personal communication). Five (5) NARS/NARES from SEA (and 15 from other subregions in Asia Pacific) and PNG, 15 CGIAR centres and 5 regional organizations are currently members of the Asia-Pacific Association of Agricultural Research Institutions (APAARI) whose mission is to strengthen NARS/NARES through partnership, networking and interregional collaboration (<http://www.apaari.org>). The more than 10 networks associated with APAARI (rice-wheat, banana, rice, maize, fisheries, cotton, underutilized species, biotechnology, cereals and legumes etc.) are facilitated by the CGIAR centres. At the moment, there is no livestock network in place associated with APAARI though some initial discussions were already held regarding a livestock knowledge network to be co-facilitated by ILRI and APAARI.

Though the less developed NARS/NARES such as Cambodia (Laos and Myanmar) are not members yet, they have benefited from the capacity building initiatives of APAARI in the areas of ICT, participated in many conferences, expert consultations, and policy dialogue to increase their awareness about global and regional issues, and received APAARI publications (such as success stories, proceedings, newsletters, APAARI on CD etc.). Most of the publications and expert consultations are on crops or are crop-related, very limited on livestock.

On research reorientation and prioritization

Donors have funded the reorientation of research from production focus to a market-oriented approach, as well as decentralization of research and extension system, for instance in Indonesia and the Philippines as mentioned above. With globalization, regional free trade agreements, market concentration and advances in science such as biotechnology and ICT, the concern for a more effective transfer and commercialization of technology, including proprietary technology, has led other donors and NARS to consider other tools such as technology management, IPR management, supply/value chain analysis, and ICT, among others.

The traditionally NARS/NARI dominated consultative processes are becoming more and more inclusive and participative, while recognizing shared responsibility and partnership with other stakeholders (also involving other sectors such as trade and industry, health, environment and energy). At the regional level, regional forums such as APAARI aim to further strengthen the NARS/NARES, facilitate both regional and inter-regional collaboration based on regional priorities collectively identified by its members and stakeholders, and promote information and knowledge exchange. APAARI has recently amended its constitution to reflect the importance of the civil society such as the NGOs and the farmers groups in defining its priorities and creating greater impact. Its most recent priority setting exercise ensured balance between biological/biophysical and social/socio-economic research, recognized livestock as a priority sector (improved genetic materials, feeds/feeding system, market and market information), and capacity building as a cross-cutting theme (APAARI 2006).

Indeed, the conventional RDE system has been evolving into a more pluralistic and dynamic system generating new or improved products (tools, technologies) through new or innovative processes. Such will entail new core competencies, knowledge, skills and attitudes not only in livestock research but in agricultural research for development in general for which investments in capacity development should be provided.

b. Regional cooperation in the ASEAN

Agriculture (livestock)

In the ASEAN, agricultural cooperation among 10 ASEAN member countries aims to promote close and friendly relations among member countries. For instance during the January 2007 ASEAN Summit held in the Philippines, a Memorandum of Understanding between the ASEAN Secretariat (on behalf of the 10 member countries) and the Ministry of Agriculture of the People's Republic of China was signed. China will provide training for ASEAN member countries in many areas including livestock, i.e. China will hold 2–3 training courses, especially on dairy cattle and swine production. In conducting activities related to this Memorandum of Understanding, the Chinese side will cover all the expenses of international travel, salaries and daily subsistence allowance for the specialists sent by China, while the receiving participant will provide accommodation, local transportation, office and related facilities. Regarding specialists sent by the ASEAN member countries to China for the cooperative research or training programs, the Chinese side will cover the expenses of their international travel, local travel in China, accommodation, and subsistence allowance, while the sending participant will cover their salaries.

On the role of civil society groups and farmers organizations (FOs)

The ASEAN has been in existence for 40 years and has recently formulated its ASEAN Charter whose goals are one vision, one identity, one community which it hopes to realize by 2015. The Charter will give the ASEAN a legal personality. The charter is market and trade oriented, building on the previous initiatives on the areas of competitiveness (product quality, standards, certification), access to knowledge, skills and resources (credit), among others. It hopes to provide an enabling environment for member countries to be able to compete in the global market. The charter could be an opportunity for the farming sector to rally the concerns of the small farmers so their voices could be heard (personal communication, ASEAN Secretariat). The civil society and farmers organizations are encouraged to get organized, expand their network, and work with other stakeholders. Capacity building for farmers' organizations though will have to be supported. The ASEAN Foundation which will become an organic body under the ASEAN could be tapped for this purpose. The ASEAN Foundation has supported farmer exchange visits which provided the springboard for the establishment of the Asian Farmers Association for Sustainable Development, now composed of 9 countries, 5 of which are from Southeast Asia: Philippines, Indonesia, Thailand, Vietnam and Cambodia.

2.4 Strengthening farmers' organizations in developing countries

Scope and funding

'Farmers Fighting Poverty' is about capacity building (of farmers' organizations) for the purpose of combating poverty. This is a global program supported by the following: Producer Support Programme (DGIS, Netherlands), Organizational Capacity Building Support Programme (ACDI/CIDA, Canada), Building Capacity of Farmers' Organizations in Developing Countries (Ministry of Foreign Affairs, Finland), Building Capacity of Farmers' Organizations in sub-Saharan Africa and Supporting the Farmers' Forum Process (IFAD), and Market Based Agricultural Development Through Farmers' Cooperative Business (SIDA, Sweden). The program is for 3 years and is managed by AgriCord, a consortium of agri-agencies based in Leuven, Belgium. The International Federation of Agricultural Producers (IFAP) through its Development Cooperation Committee (DCC) has the role of giving policy and strategic direction to the capacity building work of AgriCord so that its programs support the policy agenda of IFAP. The target group consists of smallholder farmers and their farmer-controlled organizations that are membership-based and democratically managed, covering the four continents: Asia, Africa, Latin America and the Mediterranean.

'Farmers Fighting Poverty' allows for capacity building in a broad range of areas of interest for a farmers' organization. Based upon the inventory of past experience, reflecting the existing dynamics of farmers' organizations, 17 different areas of support to farmers' organizations can be supported within this program, namely: participatory policy generation, farmer-to-farmer technical exchanges, rural development, financial management, banking, credit, insurance, women in farmer organizations, financial management, internal organization, productivity and chain development, information and communication (ICT), stakeholder relations, agricultural education/publications, diversified agriculture, grassroots participation, farmer-controlled economic initiatives, processing agricultural products, training modules and facilitation, and research for development in agriculture.

The project approach includes farmer-to-farmer advisory services and technical expert assistance as well as funding action research. The results expected are: strengthening national producer organizations, policy proposals, efficient financial management, lobbying processes, implementation of profiling of farmer organizations, business plans and chain innovations, promotion of farmer field schools and horizontal agricultural training with farmer organizations, trade capacity building and farmer-controlled business-type activities, and increasing women's participation in farmers organizations' project activities to 30%.

On capacity building needs of FOs in Asia

IFAP Asian Committee meetings are avenues to share experiences, raise awareness and collectively plan for the benefit of IFAP member FOs, so that they could be more empowered and have greater voice in policy decision making at all levels. During its last meeting in Hanoi, November 7–8, 2007, members recognized the many emerging issues along the areas of competitiveness (food safety, standards, quality, certification), access to resources (credit and financing), knowledge and skills, and thematic issues on climate change and sustainable development. Though they recognized that governments, research institutions and donors have provided tools, technologies and other mechanisms to enable them to compete, these are very limited and they have not benefited from them. Farmers wish that they be capacitated through knowledge exchange (standards, certification, bio-fuels, and climate change), exchange visits, showcasing best practices, training (technology, credit), and supply chain development, among others. The meeting recognized that the roles of research institutions such as the CGIAR and universities are very important and that linkages with them should be further strengthened. The IFAP FO members from Southeast Asia appreciated the experience of China in supply chain development for dairy linking smallholder dairy farmers to the global market through the CIDA program (Chen 2007). There is potential for South-South collaboration on credit and financing, with Korea's offer to assist and train other IFAP members from the region (Thailand, Philippines, Vietnam, and Cambodia).

3 Results and discussion

This section provides a detailed discussion of the findings from the key informant interviews of selected livestock stakeholders in the region. The key informants included NARES leaders/administrators/managers, donor program manager, extension officer, regulatory/quarantine officer, academe and farmer leader.

3.1 Capacity strengthening gaps

Key research management issues and important trainings needed

Research management issues identified by the respondents were categorized by major aspects ranging from (lack of proper) resources to strategic planning and priority setting, to conduct, monitoring, evaluation and dissemination of research outputs (Table 1).

Table 1. Key research management issues for livestock research managers in Southeast Asia and China, October 2007

Research management aspect	Issues identified as confronting livestock research management	Additional skills and training identified to help address the issues
Resources	Inadequate and inefficient (funding and equipment) resource allocation Priorities of local and external funding agencies are more on technology transfer rather than on R&D Facilities are often not well equipped for new technologies Need for more stable source of research funds (to avoid donor-driven research)	Innovative ways to generate resources for research
General research management	Complexity of managing researchers. Not all researchers are good managers; need to train them on what research management is all about. Reluctance of some research managers to see themselves as part of a team or network.	Leadership and decision-making Negotiation and conflict resolution skills Continuous networking on new approaches in research management (e.g. innovation system, thematic approaches)
Strategic planning and priority setting	Poor ability to design and fit short-term activities into longer-term plans A lack of evidence-based decision making and ability to conceptualize and analyse information Research opportunities from donor agencies are sometimes not aligned with NARS priorities.	Planning and organizational skills
Conduct of livestock research	Limited qualified human resource capacity in core livestock research areas and in new technologies Limited capacity and experience in socio-economic research Very limited researcher skills on data and information management and analysis	Trainings on: Research methods and experimentation Management and analysis of experimental data Participatory and on-farm research techniques Global technology and information source and technology forecasting Biotechnology and its application to animal production Simulation and modelling, and biometrics Genetic diversity research
Research monitoring and evaluation	An almost complete absence of monitoring and evaluation against initial performance indicators	Monitoring, evaluation and impact assessment skills
Dissemination of research outputs	Weak scientific writing and presentation skills Difficulty in communicating research outputs	Training on scientific writing and presentation

Respondents consistently referred to inadequate and inefficient allocation of research funding, for which they felt that a skills training on innovative ways to generate research resources will be important. Some also expressed the need for training courses on effective leadership and decision making, and negotiation and conflict resolution. One respondent zeroed in on the need for research managers to continually network in order to learn from each other new approaches to NARS management, e.g. national innovation system and thematic approaches. Another respondent indicated additional knowledge on the emerging concerns of NARS regarding intellectual property and technology management policies, and technology foresight as a tool in strategic planning for the livestock industry.

In terms of research conduct *per se*, most responses pertain to the lack of competence, as evidenced by inadequate knowledge and skill, among the current researchers and scientists both in core research areas such as forage production, breeding and animal health, and in emerging and frontier fields such as biotechnology, genetic diversity research, and the use of ICT in simulation and modelling. This is reportedly compounded by the 'waning interest among young researchers to pursue research.'

Meanwhile, those in downstream livestock research reportedly have limited experience in participatory and on-farm researches. As is typical in most agricultural researches, socio-economic evaluation and impact assessment are nearly absent as formal, explicit and integral part of livestock research. Formal monitoring and evaluation (M&E) systems, an essential component of any livestock research and development project (and of any other project for that matter), is almost non-existent.

The research data and information management and analytical skills of many livestock researchers in Southeast Asia are also considered poor. As such, the improvement of existing knowledge base and skills in research methods and experimentation in various technical fields related to livestock research are in order.

Communicating results from these researches seems to be also deficient in both substance and style, with many livestock researchers in the region reportedly lacking appropriate skills in scientific writing, output presentation and communication.

The oft-repeated cross-cutting research management issue however dwells on linkages, coordination and networking. Scientists are by nature individualistic but as one respondent expressed categorically, the benefits to team work and collaboration are enormous. The same respondent pointed out that this collaborative working arrangement must also be internalized by the various livestock research and development institutions. They must view themselves as networked in their collective pursuit of contributing to alleviating the constraints facing the livestock industry in their respective countries.

Additional knowledge and skills

A long list of soft skills crucial to being an effective livestock researcher and/or manager was also generated in the stakeholder interviews. By assigning numerical values to the (range of) responses, an ordinal ranking of the respondent-identified soft skills emerges (Table 2).

First, in terms of the quest for additional knowledge and skills, that on monitoring, evaluation and impact assessment is deemed the most important (of 20 that were identified by the respondents). Respondents also recognize the importance of grassroots involvement in the implementation of livestock researches based on the demands and requirements of the market. Hence, knowledge on participatory research methods and supply chain management also figured very prominently in the ranking.

The respondents also recognized the importance of having knowledge of innovation systems and its implication to conduct and coordinate livestock research. This confirms the earlier discussion on the need for a shift to a systems perspective in managing NARS research, technology development, innovation, and technology promotion and commercialization efforts.

Table 2. *Ranking of knowledge and soft skills deemed essential for an effective livestock researcher and/or manager, Southeast Asia, October 2007*

Rank	Respondent-identified knowledge and soft skill	Rank	Respondent-identified knowledge and soft skill
1	Monitoring, evaluation and impact assessment	11	Effective communication
2	Participatory research methods	12	Facilitation skills
3	Value chain analysis, market orientations and implications to R&D	13	Poverty, vulnerability, and risk analysis
4	Convincing proposal writing	14	Sustainable use of animal genetic resources
5	Strategic planning	15	Negotiation and conflict resolution skills
6	Innovation systems perspective and implications to R&D	16	Scientific writing
7	Design, implementation and assessment of networks and partnerships	17	Intellectual property rights policy
8	Planning and priority setting	18	Climate change; implications and adaptation strategies
9	Leadership and decision-making	19	Management of gene bank
10	Interaction of crop–livestock–water	20	Gender analysis
Frequency counts in the top ten by type of issue		Frequency counts in the top ten by type of outcome	
Research management–6		Skill–6	
Thematic–2		Knowledge–4	
Cross-cutting–2			

Intellectual property rights, climate change and gender analysis were also mentioned as being important, although not as important as the themes cited above. Gender and its mainstreaming in livestock production system analysis appear to be the least interest of livestock researchers and/or managers in so far as additional knowledge is concerned.

Summary frequency counts of the responses on important knowledge and skills indicate that, interestingly, livestock researchers and/or managers feel that they need to learn more skills than to acquire more knowledge. This finding appears to be consistent with the importance that respondents gave to strengthening livestock research management (Table 2).

3.2 Key research issues

A spectrum of research issues (and constraints) related to livestock production system in the region was cited by the respondents (Table 3).

Animal production

Research issues on animal production were deemed to include those related to production and management practices, genetic improvement and conservation, value addition and livestock economics, as well as those related to training and public–private partnerships. One respondent emphasized the need for a systems perspective in animal production research to consider its link with proper nutrition and the sanitary requirements of the growing ‘formal’ market. An interesting point cited by this respondent is the fact that most livestock in developing countries are not raised in production systems but are mostly in user or keeper systems, with limited or no access to technical innovation.

Table 3. *Identified research issues and constraints related to technical aspects of livestock production in Southeast Asia, October 2007*

Research issues related to animal production	Research issues related to animal health
<p>Production and management practices</p> <p>Systems approach to livestock development in crop–livestock systems</p> <p>Recognizing and understanding the linkage between proper nutrition and animal production</p> <p>Better research on performances of current/ existing livestock production systems</p> <p>Formulation and production of suitable animal feeds using local resources</p> <p>Appropriate and efficient animal feeding practices, resources and technologies</p> <p>Genetic improvement and conservation</p> <p>Sustainable use of animal genetic resources</p> <p>Genetic conservation, improvement and utilization of native/indigenous breeds</p> <p>Value addition and livestock economics</p> <p>Lack of benefit–cost analysis of most animal production technologies</p> <p>Very weak demand for and consumption of (dairy) products</p> <p>Product differentiation</p> <p>Inefficient or lack of analysis of opportunities for livestock</p> <p>Others</p> <p>Inadequate academic training of livestock researchers and practitioners, both in quality and quantity</p> <p>Apart from the private sector, the working relationship between livestock researchers and practitioners is almost non-existent</p> <p>Emphasis on the application of western industrial livestock production systems, rather than on local alternative systems</p> <p>Constraints confronting animal production</p> <p>Non- or slow adoption of new and improved livestock technologies</p> <p>Erosion of indigenous genotypes with continuous infusion of exotic breeds</p> <p>Weak demand for and consumption of dairy products</p> <p>High cost of production inputs (commercial feeds, medicines, labour etc.)</p> <p>Most livestock are in user or keeper systems, which are outside the range of most technical change</p>	<p>Herd health and disease management</p> <p>New or improved herd health management systems</p> <p>Development of new biological products for animal disease prevention</p> <p>Animal diseases and food hygiene and safety</p> <p>Development of strategies to control/eradicate economically important diseases and parasites</p> <p>Quarantine regulations</p> <p>Regulation of movement of animals and animal diseases within and outside borders</p> <p>Management of trans-boundary animal diseases, especially on livestock-to-human transmission</p> <p>Privatization of government extension services</p> <p>Regulation of animal health services</p> <p>Lack of preparedness to deal with emerging health problems (e.g. avian flu)</p> <p>Others</p> <p>Privatization of government extension services</p> <p>Constraints confronting animal health</p> <p>Lack of adequate facilities for prompt and accurate diagnosis of emerging, re-emerging and exotic animal diseases</p> <p>Lack of resources to implement and sustain national animal disease control programs</p> <p>Weak basic animal health service from the public and private sectors</p> <p>Serious lack of animal health practitioners leading farmers to self-diagnose and self-medicate</p>

Animal health

On animal health (Table 3), the research issues cited mainly covered herd health and disease management, and quarantine regulations, referring in particular to trans-boundary diseases such as avian flu, and possible livestock–human transmission. Constraints mentioned as confronting the animal health discipline mainly included lack of resources (inadequate facilities, lack of practitioners) and weak public and private sectors.

Policy and institutions

Meanwhile, the research issues cited for policy and institutions were not empirical issues in themselves but rather those that impinge on the NARS smooth management of livestock research (Table 4). One respondent opined that in most Southeast Asian countries, agricultural and even macro policies tend to be partial towards large-scale livestock production, thereby favouring the commercial sector to the disadvantage of smallholder producers. Others also mourn the lack of appropriate policies governing product certification and standards, waste management and animal welfare. For example, it is a case of policy failure when the country is unable to regulate animal movement despite explicit policies on transport and quarantine.

Research and extension policies

Most of the research management issues mentioned above are again cited in terms of research and extension policies. These include, among others, lack of clear guidelines for research prioritization, mismatch in donor-research institute priorities, and ineffective human resources policies especially with respect to incentive system.

Domestic and global marketing and trade Issues

Lastly, domestic and global marketing and trade issues seem to be poorly understood and hence are eventually mainstreamed as important concerns in livestock research (Table 4). Most livestock researches considered only all aspects of the production system up until the farm gate. Post-farm and downstream issues, such as those related to the linkage/coordination/integration of smallholder and commercial production systems, value addition, food safety and product quality, certification and labelling, and traceability, have not been given equal emphasis. Issues of competition, globalization of trade (and its attendant problems like smuggling of meat and meat products), and comparative advantage do not factor into research prioritization as if the country is self-sufficient.

3.3 Alternative suppliers and potential partners in the region

Training providers

Apart from academic institutions (universities and colleges), alternative training providers in the region include government institutions involved in livestock development (Table 5). International organizations like ACIAR provide leadership training on the issues earlier discussed while the Crawford Fund and FAO Regional Offices can also provide some work in these areas. The International Institute for Rural Reconstruction could be tapped for participatory planning, monitoring and evaluation and other soft skills enhancement.

Table 4. *Identified research issues and constraints related to the economic aspects of livestock production in Southeast Asia, October 2007*

Research issues related to marketing and trade	Research issues related to policy and institutions
Need for new and improved post-production technologies (especially those relating to value addition, processing and product storage)	Proper and efficient land use and zoning of livestock production areas
International trade issues, including product certification and labelling, food safety and product quality protocols and techniques, traceability etc.	Policies and regulations influencing smallholder livestock production
Issues on related intellectual property rights	Better methods of addressing animal welfare concerns
Closer examination of the concept of competition and capacity in international trade	Policy impacts on the development of both smallholder and large-scale livestock producers
Closer examination of the concept of comparative advantage in agricultural (livestock) production	Structural adjustment of the sector to accommodate emerging disease and food security issues
Poor participation of smallholder livestock farmers in major domestic and export markets	Adaptive research on livestock
Livestock market prediction	
Constraints related to marketing and trade	Constraints related to policy and institutions
Lack of local standards for meat and milk products (Philippine products often do not meet export standards)	Institutions
Need for appropriate system of certification for livestock products	Complex structure of livestock research and extension
Lack of public incentives and support services to encourage smallholder livestock producers to participate in markets	Absence of a good balance of coordinated work between the private sector and the public sector
Limited public-private sector partnership in service delivery	Lack of guidelines for livestock research priorities
Tendency for some countries to have better value for livestock products meant for the global market than for the domestic market.	Lack of incentives for livestock researchers
Livestock stakeholders have poor understanding of the market and changing consumer demands.	Funding institutions sometimes impose their own research priorities.
Limited markets and ineffective marketing strategies for livestock products	Weak and insufficient government support system for the livestock sector
	Need to reform the agricultural education and extension system to better address the needs of the livestock sector
	Policy
	Lack of or weak capacity to control animal movement (both for health and market reasons)
	Poorly targeted donor funds
	Seeming lack of stakeholder commitment to formulate, update or improve policies appropriate to the livestock sector

Table 5. *Some training providers and potential partners for collaboration in the region*

Regional	Potential partner
Regional Forum	APAARI www.apaari.org
Intergovernmental organization	ASEAN Secretariat, Jakarta, Indonesia www.asean.org FAO Regional Office for Asia and the Pacific, Bangkok, Thailand www.fao.org
Regional foundation	ASEAN Foundation www.aseanfoundation.org
Farmers organization	International Federation of Agricultural Producers (IFAP) www.ifap.org

Regional	Potential partner
Country	Service providers/potential partners
Philippines	<p>Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD — Dept of Science and Technology</p> <p>Agricultural Training Institute — Dept. of Agriculture</p> <p>Department of Agriculture — the Livestock Development Council, Bureau of Animal Industry, National Meat Inspection Commission, National Dairy Authority, Bureau of Agricultural Research</p> <p>University of the Philippines Los Baños</p> <p>Central Luzon State University, Philippine Carabao Center</p> <p>Central Mindanao State University</p> <p>Municipal and provincial agricultural officers of local government units</p> <p>Private institutions</p> <p>Transnational companies, e.g. Bayer Phil</p> <p>Consulting firms, e.g. Mandala Agricultural Development Corporation</p> <p>Heifer International Philippines</p>
Indonesia	<p>NGO — International Institute for Rural Reconstruction</p> <p>Central Research Institute for Animal Science</p> <p>Directorate General of Livestock Services, Dept. of Agriculture</p> <p>Indonesian Agency for Agricultural Research and Development</p> <p>Institut Pertanian Bogor</p> <p>Heifer International Indonesia</p>
Malaysia	<p>Ministry of Agriculture and Agribusiness</p> <p>Malaysian Agricultural Development and Research Institute</p> <p>Dept. of Veterinary Services</p> <p>Federation of Livestock Farmers' Associations of Malaysia</p> <p>University Putra Malaysia</p>
Thailand	<p>Chulalongkorn University</p> <p>Khon Khen University</p> <p>Mahidol University</p> <p>Chiang Mai University</p> <p>Thailand Development Research Institute</p> <p>Department of Livestock Development (DLD)</p> <p>National Institute of Animal Health (NIAH)</p>
Cambodia	<p>FAO Regional Office for Asia and the Pacific</p> <p>Ministry of Agriculture, Forestry and Fisheries</p> <p>Royal University of Agriculture</p> <p>Cambodian Agricultural Research and Development Institute</p>
Vietnam	<p>Ministry of Agriculture and Rural Development</p> <p>National Agriculture Extension Dept.</p> <p>National Institute of Animal Husbandry</p> <p>Institute of Animal Science</p> <p>Can Tho University</p>
Lao PDR	<p>Hanoi University of Agriculture</p> <p>Dept. of Livestock and Veterinary Services, Lao Ministry of Agriculture and Forestry</p> <p>National Agricultural Training Centre</p>

Regional	Potential partner
Myanmar	Ministry of Livestock Breeding and Services Myanmar Academy of Agricultural, Forestry, Livestock and Fishery Sciences World Concern Care (Myanmar) Myanmar Baptist Convention FREDA
China	Ministry of Agriculture South China Agricultural University Chinese Academy of Tropical Agricultural Sciences Chinese Academy of Agricultural Sciences Zhejiang Agricultural University
Papua New Guinea	FAO Regional Office for South Pacific South Pacific Economic Community National Agriculture Research Institute
Australia	Australian Center for International Agricultural Research CSIRO Livestock Industries in Australia CSIRO's Australian Animal Health Laboratory (AAHL)
Brunei	The Ministry of Industry and Primary Resources (Brunei Halal brand project) Brunei Islamic Religious Council, Ministry of Religious Affairs and the Ministry of Health

Potential partners for collaboration

The list of institutions in Table 5 can be potential partners of ILRI to deliver training courses or to support capacity building initiatives for the livestock sector. For example, the regional and international organizations such as the ASEAN Foundation could be approached for collaborative undertaking and co-financing capacity building activities. IFAP could be tapped for demand-driven capacity building for farmer organizations, through action research which would lead to increased capacity for policy dialogues, or integrating the farmers in the entire supply chain, among others.

Opportunities and challenges for capacity strengthening in the region (Based on survey responses and secondary sources)

Advances in science and ICT

Livestock researches in particular and agricultural research for development in general have to address the needs of the poor farming community for food security, profitability and environmental sustainability. Knowledge and information sharing through knowledge banks such as those of ILRI's sister CGIAR centres, i.e. IRRI and the virtual academy of ICRISAT, and the Asia-Pacific Agricultural Research and Information System (APARIS) of APAARI, the growing livestock resource networks cited above use available tools from ICT and could provide livestock researchers and managers and its key stakeholders access useful information on advances in science and major global and regional developments.

National system of innovation demands multiple partners and diverse skills, and looks at the entire supply chain.

The IFPRI 20/20 Vision and the ILRI Challenge Papers emphasize that dynamic and rapid changes are occurring in the livestock sectors of developing countries. Concomitant to these, therefore, are concerted and sustained L&CS efforts to enable the livestock sectors to evolve. To manage the NARS/NARES, respondents attached highest priority to knowledge and skills in applying the systems approach, e.g. national system of innovation, in coordinating all R&D, and technology transfer, promotion and commercialization efforts.

Existing national and international institutions, and educational and R&D organizations will be inadequate to address the multiple roles and functions of agriculture (IAASTD ESAP Chapter 4, 2007). The balance between public and private sector investments and capacities for innovation will continue to shift towards commercial interests. Current linear R&D models and technology transfer approaches will be increasingly inadequate to address emerging concerns/challenges. Increasing capacities within public sector ARD organizations will depend on the development of flexible institutional arrangements. Multiple and varied demands of the agriculture sector will increase the pressure on current educational and R&D organizations to evolve to work with a diverse range of partners. Skills will have to be enhanced to include social, political and legal knowledge. Increased investment in science and technology, and enhanced innovation capacity, will play an increasingly important role in providing adaptive responses for agriculture to stressors such as climate change, increasing natural hazards, avian flu and other transboundary diseases.

For NARS researchers, available literature and the survey responses seem to validate some of the research areas cited in the ILRI Challenge Paper (Wright et al. 2007). Areas needing further research and technology development pertain to production and management practices especially on efficient feeding technologies and feed formulation; reproductive/breeding technologies and genetics; animal health and disease management; post-harvest technologies, processing and value addition; and environmental effects of livestock production, specifically, waste management and utilization. In terms of socio-economics, the survey results point to the need for empirical works on supply chain management (especially with the growing importance of formal markets, e.g. supermarkets), food safety and regulatory policies, domestic and global marketing and trade issues. However, it cannot be overemphasized that knowledge and skills in these research themes, as already mentioned in Section 2.3.2, are wanting.

Networks and emerging learning alliances

While networking arrangement facilitated by most CGIAR centres in the ARD networks associated with APAARI has been recognized as a cost-effective pro-poor mechanism to conduct research and share knowledge in the region, a Livestock Knowledge and Resource Network is not in place yet but could be forthcoming (APAARI 2006). Such networks could evolve into learning alliances or communities of practice, an example of which is an NGO-facilitated Global Partnership Program on Promoting Local Innovations (ProInnova) currently participated in by two Asian countries, Cambodia and Nepal <http://www.proinnova.org>.

Changing role of universities and increasing importance of functional and non-formal education

Pressure for institutional reform and reorganization is now increasing within the university system in Asia, especially Thailand and China where much experimentation is taking place. The universities are being forced to re-consider their traditional roles (as sources of ideas, basic scientific knowledge, and teaching resources) and embrace new ones like making contributions to regional development through innovation. They are being asked to transform themselves from 'knowledge containers' to 'entrepreneurial universities'.

Pro-active investment in learning and capacity building within local, national and international organizations will facilitate flexibility and adaptation to emerging challenges, such as trade and economic liberalization, natural resource degradation, climate and other stresses. However, agricultural education investments are likely to decline in the formal University or Agricultural University set up (Byerlee and Echeverria 2002). But investments in private and public sector higher education and research as well as investments in the form of farmer field schools, training programs at various levels of participatory research and extension, and also most importantly in the form of functional education and non-formal education for sustainable development, are likely to increase in all the ASEAN, APEC,

and SAARC countries (UNESCO 2006). Investment in informal education in the Asia Pacific region is increasingly seen by donor agencies and governments as a mechanism for (a) enhancing skills and capacities for better livelihoods and incomes, (b) enabling employment opportunities, especially non-farm rural employment, (c) reducing the gender bias and thereby poverty in rural areas and in agriculture, and (d) increasing capacities for technology uptake, especially through functional education (IFPRI 1995; Ooi 2001; UNESCO 2006).

New management tools in planning, priority setting, M&E

Conventional management tools in planning, priority setting, M&E, will have to be enhanced. Research managers will have to be retooled using new tools such as technology forecasting and scenario building, knowledge and technology management, supply/value chain analysis, and impact assessment, among others. Planning and implementation of strategic programs aimed at enhancing the development of the livestock sector must be underpinned by a comprehensive understanding of two inter-related approaches or analytical tools, namely: (1) innovation systems and (2) supply chain management methodology. These are crucial since both have holistic, broad and system/industry-wide perspective anchored on fundamental principle of stakeholders' inter-connectedness.

Growing interest in engaging farmers organizations in R4D and policymaking

Globalization and trade issues and how they will benefit the small-scale livestock producers must be well understood by researchers as well as other stakeholders. With the emergence of the supermarkets, the spot markets are threatened. Small livestock producers will have to be organized and be capacitated to become active players in mainstream supply chain. Learning alliances and communities of practice are avenues to share knowledge and experiences. Livestock researchers, producers and research managers could actively link and participate and benefit from others' best practices.

Donors are currently supporting capacity building of farmer organizations so that they will have a bigger voice in policymaking at the global level. Policy formulation tools and other international public goods generated by the CGIAR centres which are science-based and policy-relevant could contribute to better understanding important and emerging issues, such as those on climate change, and bio-energy (which are also related to livestock). The growing interest in engaging farmers' organizations in agricultural research for development for greater impact is an opportunity to showcase innovation system approach through supply chain development of the livestock sector. Smallholder livestock raisers will have to be organized for economies of scale through institutional innovations such as clustering and their capacities need to be developed and knowledge be updated (regarding what the market requires in terms of standards) so they could compete in the market. Partnership with the private sector could be a critical element in the chain. Potential link with IFAP and the CIDA-China program on supply chain development for the livestock sector could yield policy relevant best practices.

Intergovernmental organizations such as the ASEAN could be entry points for ILRI and the farmers organizations to lobby and advocate for more government support for research, credit, marketing and animal health and regulatory services. They can also be partners for capacity building and regional networking program which will fully harness the pool of talented researchers and experts in high quality institutions in the region.

The aging farming and research communities

The challenge concerning human resource capacity building should be both at the research and farm level. The research community in Asia is aging. The youth in the rural areas have no incentive to stay because of lack of economic opportunities. If the livestock research community is getting more geriatric, there will be a need for second generation and young generation scientists/researchers. The same holds

true for farmers in general and the livestock raisers in particular. The challenge could be how to attract the young generation to commit themselves to agricultural research or raising livestock.

4 Summary, conclusions and recommendations

Pro-active investment in learning and capacity building within local, national and international organizations will facilitate flexibility and adaptation to emerging challenges, such as trade and economic liberalization, natural resource degradation, climate and other stresses.

4.1 Research and research management issues

- The majority of livestock producers in the region are small scale. The contribution of the livestock industry to agricultural GDP is significant and increasing.
- Farmers need to be provided with market opportunities, capacity to comply with export market requirement particularly phyto-sanitary regulations and participate in the mainstream supply chains. The phenomenon of linkages to the market appears to be an important issue. However, moving them beyond the subsistence level to market-oriented and environmentally sound production systems may not be easy.
- Domestic and global marketing and trade issues seem to be poorly understood by researchers and managers, and hence are eventually not mainstreamed as important concerns in livestock research.
- Most livestock researches considered only all aspects of the production system up until the farm gate. Post-farm and downstream issues, such as those related to smallholder and commercial linkage/coordination/integration, value addition, food safety and product quality, certification and labelling, and traceability, have not been given equal emphasis.
- There are technology needs and prospects in the areas of improved animal health, feeds and feeding systems, reproductive and genetic technologies, post harvest, and environment (waste disposal).
- There are political and institutional issues. There is no comprehensive policy in many countries. Livestock producers have no political influence; hence policymakers give low priority to livestock industry, i.e. meager budgetary support to research, credit, animal health services, and little regulatory intervention in marketing, health and environment. Farmers need to lobby to achieve their objectives.
- Research management issues include lack of strategic planning skills, lack of clear guidelines for research prioritization, mismatch in donor–research institute priorities, lack of incentive system, lack of formal M&E system and communication skills (scientific writing and research results). Linkages, networking and coordination skills are wanting.

4.2 Suggested priority learning and capacity strengthening priorities for ILRI

In all of the following areas, learning and training opportunities should be provided for both men and women, including the youth:

- Training in research management in the areas of effective leadership and decision making, and negotiation and conflict resolution and facilitation skills.
- Training in strategic planning, and priority setting, project monitoring and evaluation.
- Technical skills and training needs in research methods (and experimentation) in various technical fields like biotechnology and waste recycling, animal health, feeds and feeding systems, reproductive and genetic technologies, post harvest, and environment (waste disposal).
- Socio-economic impact assessments, participatory and on-farm research techniques and scientific writing and report/paper presentation.
- Crucial soft skills in terms of the quest for additional knowledge, innovation systems and its implication to conduct and coordination of research.
- Grassroots/farmers organization involvement in the design and implementation of researches based on the demands and requirements of the market, through participatory action researches and supply chain management.
- Skills in forging stronger networks and partnerships and innovative resource generation.
- Learning network on new approaches to NARS management, e.g. national innovation system and tools for technology development, technology promotion and commercialization.

4.3 ILRI's potential partners

- ACIAR, Crawford Fund, FAO Regional Offices, and IIRR as alternative training providers in leadership, management and thematic areas indicated above.
- Academic institutions (universities and colleges), government training and research institutions involved in livestock research and development as indicated in Table 5.
- Apex national planning and coordinating research and extension bodies, NGOs and private sector (Table 5).
- Inter-governmental organizations such as the ASEAN, and regional forum such as APAARI.
- Regional foundation such as the ASEAN Foundation, and farmers' organizations such as IFAP.

4.4 Limitations of the study

The study is limited by the number of respondents across countries and stakeholder categories. While the study gives an overview of the learning and capacity building needs at the individual and institutional levels considering past experiences and as demanded by the changing environment within which the livestock sector in the SEA region operates, it could be desirable to have a more in depth follow-up assessment by stakeholder category for more meaningful well targeted L&CS interventions by ILRI and its partners.

References

- ASEAN Cooperation in Food, Agriculture and Forestry. Livestock Publications Series No. 3 D. ASEAN criteria for accreditation of livestock establishment. Poultry for breeding. <http://www.aseansec.org>.
- ASEAN Secretariat. 1994-2005. List of projects—Food, agriculture and forestry sector. <http://www.aseansec.org>.
- Blokland K and Woodhill J. 2006. Farmers fighting poverty. Conference and Seminar Proceedings. Agritertra, The Netherlands.
- Brunei Dept. of Agriculture: www.brunet.bn/gov/doa/doa.htm.
- CASREN http://www.cgiar.org/pdf/China%20and%20the%20CGIAR_Oct2007_Chinese.pdf.
- CASREN http://www.pcarrrd.dost.gov.ph/s&t%20highlights/2007/feb/snt0207_3.htm.
- Chen K. 2007. Supply chain development with small farmers: Public–private partnership in China. Presented during the IFAP Asian Regional Committee Meeting, Hanoi, Vietnam, 7–8 November 2007.
- Community Agricultural Technology Program, ACIAR. <http://www.aciar.gov.au/project/ASEM/2006/059>
- Delgado C, Rosegrant M, Steinfeld H, Ehui S and Courbois C. 1999. *Livestock to 2020: The next food revolution*. Food, Agriculture, and the Environment Discussion Paper 28. IFPRI (International Food Policy Research Institute), Washington, DC, USA, FAO (Food and Agriculture Organization of the United Nations), Rome Italy, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 72 pp.
- Diagnosis and control of foot and mouth disease in Thailand, ACIAR (<http://www.aciar.gov.au/project/AS1/1988/035>).
- Del Rosario B. 2006. A brief report on the status of APAARI activities: 2005–2006. APAARI, Bangkok, Thailand.
- Entwistle K and Lindsay DR. (eds). 2003. Strategies to improve Bali cattle in eastern Indonesia. Proceedings of a workshop, 4–7 February 2002, Bali, Indonesia. ACIAR (Australian Centre for International Agricultural Research), Canberra, Australia. (<http://www.aciar.gov.au/system/files/sites/aciar/files/node/470/pr110.pdf>).
- Extension approaches to scaling out livestock production in northern Lao PDR, ACIAR (<http://www.aciar.gov.au/project/ASEM/2005/124>).
- Elliot Stern (On behalf of Training Study Panel). 2007. Training and learning in CGIAR. Presentation to CGIAR Annual Meeting, Rabat, Morocco.
- FAO (Food and Agriculture Organization of the United Nations). Training events. <http://www.fao.org>.
- FAO (Food and Agriculture Organization of the United Nations). Statistics. Various years. (www.agriculture.gov.pg).
- FAO (Food and Agriculture Organization of the United Nations). 2004a. *Livestock sector brief: Cambodia*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, FAO, Rome, Italy. (<http://ergodd.zoo.ox.ac.uk/Mekong/Documents/LPB02.pdf>).
- FAO (Food and Agriculture Organization of the United Nations). 2004a. *Livestock sector brief: Thailand*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, FAO, Rome, Italy. (<http://ergodd.zoo.ox.ac.uk/Mekong/Documents/LSBThailand.pdf>).
- FAO (Food and Agriculture Organization of the United Nations). 2004a. *Livestock sector brief: Viet Nam*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, FAO, Rome, Italy. (<http://ergodd.zoo.ox.ac.uk/Mekong/Documents/LSBVietnam.pdf>).
- FAO (Food and Agriculture Organization of the United Nations). 2004a. *Livestock sector brief: Lao PDR*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, Food and Agriculture Organisation of the United Nations, Rome, Italy. (<http://ergodd.zoo.ox.ac.uk/Mekong/Documents/LSBLaoPDR.pdf>).
- FAO (Food and Agriculture Organization of the United Nations). 2004. *Review of the livestock sector in the Mekong countries*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, FAO, Rome, Italy.
- FAO (Food and Agriculture Organization of the United Nations). 2005b. *Southeast Asia pro-poor livestock policy hub*. FAO, Rome, Italy (http://ergodd.zoo.ox.ac.uk/Mekong/Documents/SEA-Hub-Profile_Web_link.pdf).
- FAO (Food and Agriculture Organization of the United Nations). 2005c. *The political economy of pro-poor livestock policy in Cambodia*. Pro-Poor Livestock Policy Initiative. FAO, Rome, Italy. (http://ergodd.zoo.ox.ac.uk/Mekong/Documents/pb_wp26.pdf).
- FAO (Food and Agriculture Organization of the United Nations). 2005e. *Pollution from industrialized livestock production*. FAO Livestock Policy Brief 02. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, FAO, Rome, Italy. (<http://ergodd.zoo.ox.ac.uk/Mekong/Documents/LPB02.pdf>).

- Genetic improvement of Thai beef cattle and buffalo, ACIAR (<http://www.aciar.gov.au/project/AS1/1993/011>).
- Improved diagnostic and control methodologies for livestock diseases in Lao PDR and Yunnan Province, PRC (<http://www.aciar.gov.au/project/AS1/1994/038>).
- International Trade Strategies Pty Ltd and Center for Food and Agribusiness, University of Asia and the Pacific. 2004. A background paper for the strategic plan of action on ASEAN cooperation in food and agriculture (2005–2010).
- IAASTD-ESAP. 2007. Agricultural change and its drivers: A regional outlook. (draft). <http://www.iaastd.org>.
- Lapar L, Bihn VT and Ehui S. 2003. *Identifying barriers to entry to livestock inputs and output markets in Southeast Asia*. Livestock Information, Sector Analysis and Policy Branch, Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy.
- LivestockNet (www.livestocknet.ch).
- Joint Press Statement. The 26th meeting of the ASEAN Ministers on Agriculture and Forestry (26th AMAF). Yangon, Myanmar, 7 October 2004. <http://www.aseansec.org>.
- OIE. 2004d. The role of private veterinarians and veterinary paraprofessionals in the provision of animal health services. Editorial February 2004. (available at www.oie.int/eng/Edito/en_edito.htm).
- OIE. 2005. Current programmes, future plans and interactions for prevention, deterrence, emergency response, and mitigation of effects of accidental introduction or deliberate use of biological agents in food and agriculture. International Forum (available at <http://intlforum.tamu.edu/Thiermann.htm>).
- Oliveros O. 2007. Challenges of strengthening the involvement of stakeholders in innovation and research: The DURAS Project experience. Paper presented during the conference on Farmers First Revisited: Farmer Participatory Research and Development Twenty Years on. Institute of Development Studies, Brighton, UK.
- Poultry feeding systems in PNG (<http://www.aciar.gov.au/project/LPS/2001/077>).
- Programme of Action for ASEAN Cooperation in FOOD, Agriculture and Forestry (1995–1999). Asean Secretariat. <http://www.aseansec.org>.
- Report of the Review Panel. Second External Program and Management Review of ILRI. 2006. Science Council CGIAR.
- Research cooperation for livestock-based sustainable farming systems in the lower Mekong Basin (<http://www.mekarn.org/backgnd.htm>).
- Schneider H. Capacity building for veterinarians and veterinary paraprofessionals. FAO Capacity building programs. FAO (Food and Agriculture Organization of the United Nations), Rome, Italy. <http://www.fao.org>.
- S&T Projects. 2005 ASEAN Secretariat. <http://www.aseansec.org>.
- Strategic Plan of Action on ASEAN Cooperation in Food, Agriculture and Forestry. 2005 ASEAN Secretariat. <http://www.aseansec.org>.
- Tuan F, Qingbo C and Tingjun P. 2003. Livestock production competitive, but exports remain small. In: *China: Agriculture in transition*. WRS-01-2. Economics Research Service, USDA (United States Department of Agriculture), USA.
- Tyler SR. (ed). 2006. *Communities, livelihoods and natural resources: Action research and policy change in Asia*. Bourton on Dunsmore: ITDG. IDRC (International Development Research Centre), Ottawa, Canada.
- William T and Tesfaye Jemaneh. (eds). 2008. *Pig systems in Asia and the Pacific: How can research and development enhance benefits to the poor? ILRI/FAO regional workshop proceedings held at Bangkok, Thailand, November 21–22, 2006*. ILRI (International Livestock Research Institute), Nairobi, Kenya. (Forthcoming)
- Wright I, Staal S, Freeman A, Bezkorowajnyj P, Kristjanson P, Anandajayasekeram P and MacMillan S. 2007. Towards an action plan for pro-poor livestock research for sustainable development in south and Southeast Asia—A challenge dialogue with stakeholders.(ILRI Challenge Design Team). ILRI (International Livestock Research Institute), Nairobi, Kenya.
- Xiaoyun Li, Xiuli Xu, Gubo Qi, Min Lu and Ronnie Vernooy. 2007. China's higher education policy reform in practice: Rejuvenating rural development studies. Paper presented during the conference on Farmers First Revisited: Farmer Participatory Research and Development Twenty Years on. Institute of Development Studies, Brighton, UK.
- Zhou Ji. 2004. The 2003–2007 action plan for invigorating education. Beijing, China. http://www.cvae.com.cn/allfile/20040324/new1_005.html.

Annex 1 Livestock industry situation in Southeast Asia, China and Papua New Guinea

Livestock provides vital contribution to agriculture and industry and year-round employment of agricultural workforce in the region. Livestock enhances crop production, generates cash incomes for rural and urban population, and provides fuel and transport, among other contributions to societies.

Southeast Asia

Southeast Asia consists of two geographic regions: the Asian mainland and the maritime section consisting of island arcs and archipelagoes to the east and southeast. The mainland section is composed of Cambodia, Laos, Myanmar, Thailand and Vietnam. The maritime section consists of Brunei, East Timor, Indonesia, Malaysia, the Philippines and Singapore. The following section briefly describes the livestock situation in each of these countries.

Mainland region

Cambodia, Laos, Thailand and Vietnam comprised the Mekong region. Livestock is an important source of income for the large share of farmers in the region and its development has important repercussions for poverty reduction and income distribution, directly for the single household and through multiplier effects on local communities (Knips 2004). The four however do not form a homogeneous group but rather show significant differences concerning living standards, economic performance, per capita income and population size. Cambodia, Laos and Vietnam are among the poorest and least developed countries in Southeast Asia whereas Thailand belongs to the group of newly industrialising countries (NICs) in the region.

Livestock industry reports presented below was taken from Country Livestock Sector Briefs prepared in 2005 by the FAO Livestock Information, Sector Analysis and Policy Branch–AGAL.

Cambodia

As of 2005, 69.3% of the country's 9.6 million population belonged to the agriculture sector. The sector shared over one-third (36%) of the total gross domestic product (GDP). On the other hand, the livestock sector's share in agricultural GDP was 20.9%.

The livestock sector is dominated by smallholders. Poor families commonly have chicken and may raise one or two pigs while better-off farmers have usually a pair of draught and breeding cattle. Only less than one percent is engaged in large scale commercial livestock businesses.

The dominant mixed livestock farming system is rice-based, whereby rice production is heavily dependent on cattle and to a lesser extent buffaloes for draught power and manure. Milk production is also largely in the hands of small farmers and a few intensive production units located in areas close to Phnom Penh.

Livestock population witnessed a positive growth rate during the 1998–2003 after experiencing negative growth in previous years (Table 3). The number of cattle and buffaloes grew from 1,186, 000 in 1979–1981 to 3,691,000 in 2004 (Table 2). Meat production also exhibited positive growth (Table 6) attributed to an increase in the number of animals.

Production of all livestock species is constrained by infectious diseases. The Department of Animal Health and Production (DAHP) and Provincial Offices of Animal Health and Production are responsible for animal health. DAH, however, is constrained by insufficient skilled personnel in its central and provincial

offices. Aggravating the situation is the limited budget which is mostly expended on operation of public livestock farms and salaries of personnel. Private veterinarians are few and are constrained by lack of access to vaccines and drugs and lack of technical knowledge. Cold chain facilities are also lacking.

The government intends to develop appropriate veterinary and animal production technologies for the small producers. Village Livestock Workers and Village Animal Health System and Disease Control Program have been established to support major disease prevention for swine (swine fever), poultry (Newcastle), cattle and buffaloes. In addition to these, the government has identified the following development objectives to boost livestock productivity: (1) promote household animal raising, (2) reduce and eliminate animals diseases; (3) increase feed quality and improve breeding and animal husbandry techniques; (4) encourage medium-scale businesses and investments in animal raising; (5) develop meat processing industry to stimulate exports; (6) promote better management and control of animal drugs, and (7) develop community-based and private livestock services.

Laos

Laos is a low income economy with a 5.5 million inhabitants of which 76% are in the agriculture sector and with the livestock sector contributing around 9% to GDP. Virtually the entire livestock sector is traditional and low input production is a common practice. Cattle and buffalo are mostly found in the central region of the country where they grazed on the vacant cropping areas for most of the year as well as in the sloping zones where they also graze extensively. Pig production is an important livelihood activity of people in the highland. Most farmers tend to raise local chicken. Commercial pig and poultry operations are found near population centres such as Vientiane, and are mostly cottage industries with few employees.

About 75% of cattle and buffalo produced are consumed domestically and the remaining 25% is exported. Thailand is a major export market.

Meat production in the country has been increasing and this is accounted for by the increased number of animals (Table 1, 2 and 3). Egg production exhibited negative growth during 1980–90 but has a turn around growth of 9.9% in the succeeding decade. Milk production has likewise increased from 4.1% in 1980–90 to 4.7% in 1990–2000.

The 2001 Socio-Economic Development Plan of 2001–2005 emphasized increased livestock production and productivity as strategic poverty alleviation measure. The National Growth and Poverty Eradication Program (NGPEP) recognizes low productivity and livestock diseases as priority issues for the poor, and loss of livestock as one of the main causes of poverty. Development targets include a meat supply of 60 kg/capita/year and increased export of meat products for a total value of around USD 50 million by 2020.

A serious constraint to livestock production is the high mortality rate due to widespread incidence of animal diseases. More than 80% of chicken are said to die every year near upland areas, sporadic epidemics frequently kill most pigs, and the mortality rate of buffalo calves due to internal parasites is estimated at 30–40%.

The Animal Health Division (AHD) of the Department of Livestock and Fisheries is responsible for disease diagnosis and control, quarantine, the veterinary extension network, and vaccine production, distribution and use. ADH, however, has only the most basic information system to record and analyse animal health status, and find it difficult to prioritize the use of scarce resources for animal diseases.

One relevant AHD activity is the training and support of village veterinary workers (VVs) who are smallholders to assist in animal health matter at the village level and receive no official salary. Approximately 6400 VVs have been trained and AHD intends to train at least one VV for each of the 12 thousand villages in the country.

Vietnam

Vietnam is a poor rural economy with livestock sector accounting for 5.6% of GDP. The country's agriculture has shifted from collectivized production system to a system based on individual land use rights to promote household initiatives.

Livestock production is undertaken in small-scale household production units which supply the majority of meat in the market. Livestock production growth rate increased considerably to 6.6% between 1999 and 2004 from a low of 3.8% in 1998–2003 (Table 3). Domestic meat demand is all met by local supply.

Beef cattle production is undertaken mostly in the central provinces. Cattle are also relatively common in peri-urban areas and in the upland areas in the north, where they are kept for draught purposes. Small farms usually keep 1 to 4 cattle for dairy, beef or manure.

Poultry production is generally based on traditional systems at smallholder level. The main locations for chicken production are close to urban areas and provinces with large amounts of waste from food processing industries. State owned hatcheries supply day-old chicks for fattening and supply feed and veterinary supplies for household farms (Quirke et al. 2003).

The industrial poultry farming system in Vietnam is so far not fully integrated across all production levels and eggs and day-old chicks have to be imported from overseas. Broiler chicken production is carried out by private farm, which are still financially weak and lack access to technology, health care and marketing facilities (Lapar et al. 2003).

Pigs are the most important livestock species in Vietnam, with 95% of the pigs being kept on family farms which are integrated into the local agricultural system. The remaining 5% are kept either by state-run semi-industrial farms or medium size commercial farms which are more market oriented (Quirke et al. 2003, PRISE). Households typically own 2 to 3 pigs and also the average commercial farm is small (5 to 100 pigs) while only a few state owned enterprises have operations with 500 to 1,000 pigs. Especially on very small farms much of the feed is scavenged. Production is mainly in the north of Vietnam, and in areas with high concentrations of cassava, rice and soybeans. Pig production is largely dependent on crop by-products and residues and on employing family labour (Kaufmann et al. 2003).

A variety of diseases constrain the productivity of different livestock species. Among the reasons for the high incidence of livestock diseases are poor nutrition and sanitation, inappropriate management practices, poor access by farmers to information on how to control and treat diseases and poor veterinary support resulting in incorrect disease diagnoses, movement of diseased animals and limited vaccination coverage (Stür et al. 2002).

The government is prioritizing swine and dairy cow sectors with the objective of boosting pig meat exports as well as reducing reliance on imported milk products. The government sees the need to strengthen its veterinary services and has created sanitary legislations that seek to conform to international standards.

Thailand

Thailand is a middle income economy with livestock accounting to about 2.5% of the GDP. Domestic demand for meat is largely met by domestic production. The country imports small amount of beef and pig meat, and at the same time is the fourth largest exporter of poultry meat in the world.

Over the last 15–20 years, farm sizes have increased significantly, breeds have improved along with enhanced feed technology, housing and farm management. Contractual arrangements in production are common.

The livestock industry has grown in close proximity to Bangkok, and heavy concentrations of animals in peri-urban areas are causing environmental damage. The country is unique among Asian countries for its successful forage seed production industry which has evolved through research, pilot projects and a government supported village seed production enterprise. Village farmers were guaranteed purchase at a predetermined price for seeds which was produced and cleaned on farm. Factors contributing to the success of the program were favourable climate for seed production, extreme preparatory research, intensive initial supervision, realistic price incentive, and good market demand.

In 2002, Thailand's meat industries generated more than USD 1 billion of export earnings, much of which came from the poultry sector.

Animal diseases are a major threat to the livestock sector with cross border theft being a constant concern to livestock holders. To ensure that livestock standards meet importer's requirements, the Department of Livestock Development (DLD) has established the regulation of 'standard form' in 1999 for swine, poultry and cattle farms. These farm standards are based on 'Good Agricultural Practices' guidelines to maintain high quality of livestock products from producer to consumer.

The government, attempting to eradicate Foot-and-Mouth-Disease, has established a disease-free zone in three eastern provinces. However, cattle smuggling is hampering eradication efforts. The National Institute of Animal Health (NIAH) serves as reference laboratory to confirm diagnosis, and collaborates with other organizations on outbreak investigation and animal disease surveillance. The government is supporting research on vaccines and manages a commercial scale vaccine production unit in Nakorn Rachasima province.

Myanmar

Burmese farmers raise a variety of animals including cattle, water buffalo, goats, sheep, chicken, and pigs. Oxen and water buffalo serve as draught animals in agriculture and for rural transportation. The GDP share of the livestock has increased slightly during the past decade. Most of the cattle are raised in the dry zone in the north.

The livestock sectors hold vast potential for further expansion and export of the products. Livestock breeding of pedigree stock like cattle, buffalo, sheep, goat, pig, and poultry etc. forms an integral part of the rural economy. Ownership of livestock is characterized by small individual herds and flocks. Cattle and buffalo are being bred primarily for use in cultivation, while pig and poultry are for consumption. For the development of the cattle industry, vast pasture lands with suitable climatic conditions are available in different regions.

Livestock population covering cattle, buffalo, sheep/goat, pig and poultry has been increasing through the years. Cattle production grew from 9.5 million head in 1991–92 to 11.3 million in 2001–2002. For the same periods, pig production grew from 2.6 million head to 4.4 million while poultry grew remarkably from 31.2 million to 61.7 million.

Cattle, buffalo, pig, poultry, and small ruminants like sheep and goat are raised for local consumption. Beef cattle breeding are non-existent and dairy cattle breeding are still at an infant stage.

With a view to ensure an adequate supply of draught cattle and to achieve a steady growth in animal population, the Livestock Breeding and Veterinary Department has given special emphasis to extension services and animal health services. Artificial insemination on cattle and pig are carried out extensively to upgrade the present breeds.

For prevention and control of infectious diseases, the National Vaccine Production Laboratory produces vaccines for cattle diseases (FMD, haemorrhagic septicaemia, anthrax and black quarter, hog cholera, and poultry diseases (fowl cholera, Newcastle, fowl pox, gumboro and pullorum).

All forms of commercial breeding and marketing of livestock and livestock products are owned, managed and operated by private entrepreneurs. The Government provides extension services needed by the farmers, such as improving the genetic resources of indigenous breeds, control of infectious diseases, distribution of pedigree stock and transfer of technical know-how to livestock farmers.

The maritime region

Malaysia

Livestock (mostly poultry and pork) are among the fastest growing in the agricultural sector of Malaysia since 1980. The introduction of the Third National Agricultural Policy (NAP3) after the financial crisis in 1997–98 moved for even faster commercialization of poultry production for export, deeper integration of livestock production with plantation crops, and the building of Malaysia's status as an 'international *halal* food hub'. The overall approach is to achieve self-sufficiency through large-scale livestock production: 'Small producers with backward technologies will be encouraged to expand their scale and employ advanced technologies.' (Tuong Vu 2007).

Since the 1960s, the livestock sector has been receiving more government attention in an attempt to raise self sufficiency rates particularly for beef and dairy products. Poultry and pig producers, however, have received limited government help. For religious reasons, the pig sector is tolerated but not supported by the federal government. It is something national Malay politicians 'can't swallow but can't spit out'. The country is self sufficient in pork with excess capacity for export. It accounts for 20% of national livestock production and quite competitive in the regional market. In contrast, cattle make up for less than 5% of output and are internationally competitive. This partly explains the importance given to self-sufficiency for beef.

Despite government neglect to the swine industry, it has been able to survive and prosper thanks to strong Chinese demand for pork and Malaysia's proximity to Singapore which closed all pig farms in 1990. Before the outbreak of the Nipah virus in 1998–99, the pig industry exported one-quarter of its total output to Singapore as live pigs. The value of this trade was RM449 million, making Malaysia the biggest pig exporter in Southeast Asia at the time (Abdul Rahman 2001).

Since the introduction of NAP3, the government has drafted a Food Trade Balance Plan which aims at changing the current food trade deficit of RM4 billion to a surplus of RM 1.7 billion in 2010. Plantations are exhorted to integrate cattle rearing with palm oil with the goal of raising the current number of plantation cattle from less than 100,000 to 1 million by 2010. The new Ninth Five-Year Plan (MP9) for 2006–2010 has allocated 2,000-hectare feedlot dubbed 'Beef Valley' that can keep up to 150 thousand cattle scheduled to start operating in 2007; this feedlot would singly double Malaysia's self-sufficiency rate in beef.

The Department of Veterinary Services (DVS) under the Ministry of Agriculture and Agribusiness is the agency primarily responsible for livestock development and animal health in the country. In each state, DVS has a livestock office and a veterinary service centre. This office in turn supervises district offices in the state. The DVS has launched several programs to improve food safety and strengthen disease control and surveillance. These programs include a national SPS plan, an accreditation scheme based on Good Animal Husbandry Practice, and a Veterinary Health Mark Scheme. The accreditation program is on a voluntary basis and has involved many farms which export livestock products to Singapore.

Livestock services such as extension and credit are also provided by other agencies, including the land development authorities and the Farmers' Organization Authority (FOA). FOA offers training and loans to Malay smallholders, some of whom borrow to raise livestock. As concerns the land development agencies, they also view livestock keeping as a supplementary activity to improve the income of smallholders and plantation workers, especially during periods of replanting long-term industrial crops.

The Federation of Livestock Farmers' Association of Malaysia (FLFAM) is the only association of its kind which currently represents (mostly Chinese Malay) producers' interests all over the country. The association functions effectively in disseminating information and coordinating joint decisions on price and production targets.

Government plantations now keep about 20% of the national cattle herd but this activity is considered a 'social responsibility'. Because plantations are organized around industrial crops, adequate support services are not available for livestock production, including the supply of genetic material, veterinary services, capital for expansion, and marketing opportunities for livestock keepers.

Livestock research is primarily located in the Malaysian Agricultural Research and Development Institute (MARDI) and in universities with veterinary or animal husbandry programs. Most research focuses on cattle and, to a lesser extent, poultry. Pigs are largely ignored.

Indonesia

The country is one of the largest poultry and dairy production centres in Asia. The livestock sector shared 12.5% of agricultural GDP in 2005 (FAO 2005 Livestock Sector Brief: Indonesia).

Livestock population grew by 14.1% during the period 1999–2004 from negative growth rate of 1.1% in 1998–2003 (Table 2). Poultry is supported by a fast growing feed industry which has adopted modern processing facilities. At the same time, the processed meat industry has developed rapidly. Beef cattle production is being supported under the nucleus smallholder scheme to assure raw materials supply and market for the produce. Most cattle farmers are subsistence farmers as judged by the ownership status of cattle. They only raise cattle to obtain the benefit of having offspring and the increase in body weight when the animal is fattened. Given the excellent opportunity for beef cattle production, the nucleus smallholder scheme aimed to give local farmers a chance to increase their income and improve their capability and skill to manage small-scale feedlots.

In poultry, the government through the Directorate General of Livestock Services of the Ministry of Agriculture has embarked on a program to minimize the effects of avian flu by encouraging more hygienic production and processing of poultry. Farms have adopted better bio-security measures and modern housing system to limit the spread of diseases. In 2005, the poultry industry was hit by the bird flu outbreak in South Sulawesi province and spread 21 out of 30 provinces in Indonesia with the number of chicken killed by the virus. Bird flu cases have been found in at least 132 regencies and cities across Indonesia. Since late 2003, Indonesia has lost around 9 million fowl to the deadly disease. Being a major concern, CSIRO Livestock Industries in Australia has been involved in a two-year collaboration to help strengthen Indonesia's defences against the avian influenza virus. With USD 1.6 million funding from AusAID, veterinarians at CSIRO's Australian Animal Health Laboratory (AAHL) in Geelong have been working to increase the capacity of Indonesian researchers to diagnose and monitor outbreaks of the deadly H5N1 strain of bird flu. Indonesia is working hard to contain outbreaks of bird flu, which last year spread to humans.

The Decentralized Agricultural and Forestry Extension Project aims to assist Indonesia in enhancing farmers' capacity to participate in extension activities and in strengthening the capacity of the district-level integrated agricultural and forestry extension system, which will promote economically feasible, environmentally sustainable, and socially acceptable farming practices and increased farmers' income.

Philippines

Livestock and poultry comprised about 22% of the agriculture GDP (<http://ldc.da.gov.ph>). The swine industry has been the largest and the most developed among animal industries in the country. The industry provides additional income to smallholder swine raisers who keep 76.6% of the pig population

in the country (www.pcarrd.dost.gov.ph/cin/swin/default). Moreover, the industry also sparks the development of related industries (i.e. veterinary drug and feed milling). The preference of Filipino consumers for fresh warm or chilled pork over frozen pork gives the local industry market assurance of its products. However, the importation of low-priced beef, buffalo meat and poultry meat may create a shift in consumption from pork to these cheaper alternatives. The establishment of large-scale (1,000 to 120 thousand sow level) integrated pig farms by foreign investors in free port zone using imported breeder stocks, technology, and other production inputs is an indirect importation of pork with minimal or no tariff at all. This scenario poses a threat to the local swine entrepreneurs. Hence, the local swine industry needs to modernize to ensure that it can withstand any form of competition. To enhance its global competitiveness, the government should work with the private sector in providing the livestock sector with policy reforms on importation, trade, pricing of inputs and support in terms of technology and infrastructure.

The chicken population in the Philippines increased from 82 million in 1992 to about 136 million in 2005 (www.pcarrd.dost.gov.ph/cin/poultry/default.htm). However from 1996, the poultry industry is facing a very difficult time. Poultry producers are incurring substantial losses due to over production resulting from its aggressive expansion, coupled with rising cost of grains and other feed materials both in the local and international markets. While the poultry producers have trimmed down growth to more moderate levels, the industry is now faced with an even greater challenge—global competition. The local producers will not only be competing among themselves, but also with the world poultry producers. The livestock and poultry sector are major growth contributor to the Philippine economy.

Ducks rank next to chicken for egg and meat production. In 2005, the duck population was estimated at 10.44 million, of which 7.94 million or 77% were in the backyard farms while the rest were in commercial establishments. Duck meat production in 2005 was 49 thousand tonnes which was 8% lower than 2004 production. Duck egg production in 2005 was 53 thousand tonnes, a decrease by 5% over the 2004 production.

Among the avian species, duck is considered as the most versatile because it can subsist under a wide range of climatic and nutritional conditions. Also, duck raising is inexpensive and requires non-elaborate housing facilities and less space for rearing compared to chickens. Moreover, ducks are shown to be relatively hardy, resistant to common avian diseases, and subsist on a variety of feeds.

Eggs are the most important products of the duck industry, because of the increasing demand for duck eggs. Mallard duck eggs are primarily utilized for the production of balut. Other uses of duck eggs are in either fresh form, as component of bakery products or in processed form such as penoy, salted eggs and century eggs.

The country's beef cattle industry is predominantly of the smallholder or backyard type and traditionally led by the private sector (www.pcarrd.dost.gov.ph/ruminants/). Commercial feedlot fattening operation emerged and proliferated on account of the huge demand for meat and meat products. Three things accounted for this great demand—the ever increasing population, changing food preferences of the Filipinos, and import liberalization. It is, however, heavily dependent on the importation of feeder stocks coming mostly from Australia. From 1990–1999, feeder cattle importation totalled to 1,156,505 head against breeder cattle importation of only 46,213 head. However, due to very high dollar-peso exchange rate, importation decreased tremendously from 253,032 head in 1999 to only 100,109 head in 2003.

On the other hand, commercial ranches engaged in cow-calf operation are steadily decreasing in number. This is largely due to combination of factors such as poor 'peace and order' situation in production areas, implementation of the comprehensive agrarian reform law, land use conversion, lack of domestic source of quality stock, changing policies on pasture lease, increasing input costs, poor herd and pasture management among others. This scenario shrank the country's cow-calf operations both in number and production performance.

The Department of Agriculture through the Livestock Development Council formulates policies, plans and programs envisioned to attain self sufficiency in food of animal origin. This is done in collaboration with stakeholders and other government agencies like the Bureau of Animal Industry, National Meat Inspection Commission, National Dairy Authority, Philippine Carabao Centre, Bureau of Agricultural Research and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development.

Brunei

Agriculture in Brunei, which makes up only 1.1% of the country's GDP, comprises mainly the production of poultry, vegetables, fruits, livestock, rice and other crops (www.brunet.bn/gov/doa/doa.htm) Agriculture, however, remains a priority sector in the country's economic development with production activities dominated by a large number of small producers with smaller number of commercial entrepreneurs. For the most part, commercial producers are concentrated in poultry production with vertically integrated businesses.

Brunei Darussalam has among the highest consumption per capita in Southeast Asia of red meats, chicken and eggs which comprised 8.3 kg, 44.6 kg and 289 eggs, respectively.

In 2005, the livestock sector including processed products continued to dominate the agricultural sector development and contributed about 66 and 34% to the total agriculture output, respectively. Poultry and eggs are commodities that have attained self sufficiency level.

The country's hatchery sector is still at its infant stage; however the Department of Agriculture has put much emphasis on poultry breeding, particularly on the production of quality fertilized eggs. Currently, there are two (2) broiler breeder farms producing 7.84 millions eggs in 2005 which manage to cater about 62% of national requirements. The population of the broiler parent stocks has increased to the current stock of 163,199 birds. The remaining 4.83 million of fertilized eggs requirements are still imported from neighbouring countries. In view of the expanding food processing sector in the country, the poultry industry, particularly the broiler and layer sectors, are expected to expand in the future. In order to meet the great demand, at least 2 or 3 new breeder farm establishments are required. Such establishment could increase the breeder population in order to produce sufficient fertilized eggs for the hatchery sector in the country. The country has yet to establish layer breeder farm to cater the fast expanding layer industry.

The population of local cattle and buffaloes fluctuated from an estimated around 2000 heads and 6000 heads in 1997 to around 1079 heads and 4790, respectively, in 2005. There are at present at least four types of cross-breed cattle and one type of swamp buffalo which has been reared intensively and extensively. Breeding has never been emphasized, and improvement in breeds has to rely on good husbandry management and better breeding technology. The buffalo sector is facing inbreeding problem, hence buffalo breeding technology is one of the top priority in the country.

A daily farm which started as a pilot project and subsequently privatized has been producing fresh milk and flavoured fresh milk to partly supply the local market in Brunei Darussalam. Production fluctuates dramatically for the past decade— 98,700 litres in 1995, 100,060 litres in 1999 and 63,409 litres in 2005. The demand for these products is expected to increase in time along with awareness and promotional program. The local daily stocks are imported initially from Australia (Holstein Friesian heifers) and much later the AFS. The country welcomes potential investors to establish modern daily farm and milk processing plant, not only to serve the growing domestic demand but also for export market.

The goat population shows a slight decrease in 2005, which is 2578 heads compared to 2799 heads in 2002. Deer production, however, is decreasing to 202 heads in 2005 from 231 heads in 2002. It is

projected that the goat population will continue to increase as demand is expected to grow especially during the religious festivities in the country. Demand for deer meat (venison) is less due to its high price and limited number of caretaker. The Department of Agriculture is now actively promoting the goat and deer production, with the objective to reduce the nation's dependence on imports and at the same time able to meet the demand during religious festivities. The Department of Agriculture welcomes potential investors in this area and encourages the adaptation of modern farming system, namely, the intensive feedlot or the semi-intensive grazing system. The prospect of developing goat and deer industry is great. This is in parallel to the development of the agro-food processing sector.

The Eighth and Ninth National Development Plan aims to improve the primary production and processing sectors as well as to develop a vibrant, market-driven agribusiness. A way forward is to facilitate the development of agri-food processing industry for the manufacturing of export-oriented and value-added agri-food products.

The Ministry of Industry and Primary Resources initiated the Brunei Halal brand project along with the cooperation of the Brunei Islamic Religious Council, Ministry of Religious Affairs and the Ministry of Health. The creation of the Brunei Halal brand is in line with Brunei Darussalam's aggressive effort with the Islamic nation moving towards developing a diversified, competitive and sustainable economy. Through the Brunei Halal brand, Brunei Darussalam has set their sights in becoming one of the major players of the Halal brand globally, both in terms of Halal Food production and certification, with the sheer aim of catering Halal food including other Halal products of high quality for Muslim populations worldwide. The Brunei Halal Standards has been developed as guidelines for the use of Brunei Halal Certification.

The Livestock Veterinary Services provide services on public health, animal health and quarantine, laboratory services, livestock production technologies, and project development services.

China

Despite a long history of livestock-raising activities, China's livestock industry did not begin to develop rapidly until the mid-1980s. This is based on the study conducted by Tuan et al. 2007. The same study indicated that even today, most meat is still produced with traditional 'backyard' methods, that is, rural households raise animals on a small-scale to supplement their farm income. However, households specializing in livestock production activities as their principal occupation now account for an increasing share of production. These 'specialized households' rely far less on home-grown grain and farm by-products and are more responsive to grain prices than traditional backyard operations.

As recently as the early 1980s, most of China's domestic animals, including hogs, cattle, goats, sheep, and chicken, were fed in the backyards of farm households. Hogs ran free or were kept in small partially roofed pigsties. Cattle, goats, and sheep were either fed in small pens or herded along the sides of roads and edges of fields, where they could eat weeds. Before the 1980s, cattle were raised primarily for ploughing, and because manufactured fertilizer was scarce, manure was a valuable by-product of animal husbandry.

Pork production is the core of China's livestock industry. Pork contributed about 84% of China's red meat production and 65% of total meat output. About 80% of China's pork output comes from backyard operations, 15% comes from specialized households (that are principally employed in hog raising), and 5% comes from large-scale commercial operations. Improved feeding efficiency helped reduce seasonal variations in pork supplies, largely eliminating dependence on frozen meat during seasons when production was traditionally low. Improved feeding efficiency in livestock production over the past 10–15 years significantly shortened China's livestock production cycles.

Other meats, including poultry, have grown significantly as a share of China's total meat output in the same period. Poultry production, with its high feed-conversion ratio, has made more efficient use of China's feed supply. Poultry's share of China's total meat production grew up to nearly 19% in 2006.

Livestock production is geographically concentrated in major corn-producing provinces of north eastern China (Jilin, Liaoning, and Heilongjiang) and the north China plain (Hebei, Henan, Shandong, and Shanxi). Many provinces in this region doubled or even tripled meat output.

Apart from pork consumption, China's per capita consumption of livestock products is still low, compared with Japan, Hong Kong, Taiwan, and Korea (Crook). Meat consumption, however, is growing steadily. Over the past two decades, both rural and urban per capita meat consumption has increased. Rural households (nearly 70% of China's consumers) raised their per capita consumption of meat and fish from 12.4 kg in 1983 to 20 kg in 1999, an increase of over 60%. Urban households consumed more than twice as much meat and fish per capita as did rural households in 1983 (30.6 kg). Urban households also increased consumption, but the increase from 1983 to 1997 was only 15%.

China's imports and exports of livestock products, in terms of both volume and value, are small shares of total agricultural trade. Until 1970, the animal products' (mostly pork and live hogs) share of total value of agricultural exports was about 10%. Since the early 1980s, the quantities of exported meat and live animals, in general, have been stable. Livestock products' share of total agricultural exports has decreased as agricultural trade expanded due to foreign trade liberalization and government promotion of other agricultural exports, such as grain, horticultural products, and processed food.

It is important to note that world meat and other livestock product trade is also constrained by issues such as sanitary standards. China's hog and chicken exports, for example, are constrained because most countries prohibit the importation of livestock products from disease-endemic nations.

China has lost over 10 million pigs as a result of Porcine Reproductive and Respiratory Syndrome (PRRS) in 2006 and 2007. PRRS is also known as Blue Ear Disease. PRRS is an infectious disease characterized by reproductive disorders, premature delivery, miscarriage, and stillbirth as well as abnormal breathing in piglets. The series of outbreaks began in May 2006 in Jiangxi Province, one of China's largest swine producing provinces, and then quickly spread to many other provinces. PRRS occurred in 26 out of 31 provinces at 826 locations with 257 thousand cases, 68 thousand mortalities and 175 thousand culling. Backyard swine suffered heavily because of low quality feed, weak bio-security measures, poor veterinary support and untrained employees. FAS Beijing believes real losses have been under reported. This result to domestic shortages in hog and pork supplies which is expected to continue into 2008 and will likely drive China's pork imports up by 15% to 150 thousand tonnes in 2008 from estimated 130 thousand tonnes in 2007. Traditionally, pork is the largest source of meat in the Chinese diet.

Swine and pork production are not expected to recover this year. Although China has developed a vaccine, its effectiveness is difficult to gauge. One problem is that the vaccines are difficult to use. They require refrigerator storage under a constant temperature at 2–8 degrees Celsius. They then must be taken out and kept at room temperature for 2–3 hours before usage. Most farmers do not have this kind of infrastructure in place. To make matters worse, inappropriate usage may cause sow miscarriage or other problems.

Recovery is seen to be slow because high piglet prices have encouraged farmers to reduce herd size. Market uncertainty makes farmers more willing to place sows to obtain government subsidies, or send fattening swine at 50–60 kg too early to slaughter before the October holidays.

Although pork's share in China's total meat production will gradually decrease, other meats cannot replace pork completely as China's largest traditional meat.

FAS Beijing believes PRRS will have a short-term impact on China's swine and pork production. Once it is under control, the production can probably recover quickly. However, the long-term future of the sector is more problematic. Many farmers are giving up raising swine because of increasing costs. Although there is still cheap labour in countryside that helps small-scale production with low cash outlays, higher wage jobs are available in large metropolitan areas. Disease is also a persistent problem. Outbreaks of swine streptococcosis, high swine fever, and PRRS in 2005–2007 have hit backyard or small-scale farms frequently. In addition to these costs, producers face other issues such as high energy costs, limited water supplies, and stricter environmental requirements. Although the swine and grain conversion ratio has been above the profit and loss critical point (1:5.5) during the last eight months, profit margins are shrinking. As a result of these changes, the remaining small-scale swine producers are becoming consolidated into commercial entities.

New government policies have been issued to ensure sufficiency and safety of meat in the country. These include the following:

- **State pork reserves:** On August 13, 2007, the Ministry of Commerce (MOFCOM) and the Ministry of Finance (MOF) jointly announced the Measure on State Meat Reserve Management (Memo #9) effective on September 15, 2007. This is the first time China has regulated state meat reserves so actively in recent years. In the future, they will be used to curb abnormally high meat prices, natural disasters, accidents, sudden public health crises or other major events. Actually, state reserves started in 1979 mainly for frozen pork. As living standards rise, consumers prefer fresh meats. Frozen reserves have been gradually replaced by live animal reserves. In the past, central frozen reserves were about 150 thousand tonnes/year. The quantity has been reduced to 60 thousand tonnes/year since 2004. Provincial meat reserves will be established according to local conditions. This will no doubt help constrain meat prices in the future. Large pork imports are expected to continue in 2007 and 2008 due to insufficient domestic substitutes, but for the long run China is not expected to import large quantities for state reserves.
- **Animal Disease Quarantine Law:** On August 30, 2007, China announced its new 'Animal Quarantine Law' effective on January 1, 2008. The new law stresses animal disease monitoring, risk assessment, and reporting. It requires the government to pay for any losses due to compulsory vaccines, culling or destroying of animals or animal products for disease control. This will make farmers more willing to destroy sick animals instead of selling them quickly to avoid economic losses, thus encouraging animal disease control.
- **Cash Subsidy and Insurance Subsidies for Sows:** This policy was announced by the MOF in June 2007. The total subsidy in 2007 is RMB 6.5 billion (USD 886.7 million) from the central and local governments with the central government investing RMB 38 million (USD 506.7 million). Farmers will get RMB 50 (USD 6.7) cash subsidy for each producing sow per year. The insurance fee for each producing sow is RMB 60 (USD 6.7) for an insurance value at RMB 1000 (USD 133). Farmers only pay RMB 12 (USD 1.6) and the government pays the remainder. The policy will likely see positive results in 2008 and beyond. However, most farmers think a USD 6.70 cash subsidy is not enough for one producing sow per year. Also, the insurance procedure is very complicated while piglets and fattening swine are excluded.

High pork prices have encouraged Chinese consumers shift to poultry and other meats that cost less. Poultry meat is the most popular substitute for pork in China because it is also a traditional meat that can be cooked in many ways and consumed all the year round. Beef, sheep and goat meat are normally consumed in cold weather for hot pot or consumed outdoors. Although sheep and goat meat production has been increasing fast (4.7 million tonnes), they only account for 6% of China's total meat production (81.5 million tonnes) in 2006 – not enough to be close substitutes for pork. Also, about 94% of the Chinese population is Han Chinese, many of whom do not prefer the taste and smell of sheep and goat meat. Although beef is slowly winning market share, production already lags demand, resulting in high prices.

Muscle pork meat is popular in most provinces in China. The Chinese also like to eat meat with bones such as pork feet, legs and ribs. Women often prefer pork feet because they believe consuming pork feet improves their complexion. Pork offal or by-products, such as tongues, livers, and ears are popular for cold dishes, while kidneys and tripe are popular for deep fried dishes or soup.

China was the world's 10th largest exporter in 2006, exporting about 400 thousand tonnes mainly to Hong Kong, Japan, and North Korea. China is not big player in the export market. Exports account for only one percent of China's total pork production. Some processing plants are not interested in exports because domestic demand and prices are good. Exports are also more difficult as AQSIQ has apparently stricter inspection and quarantine requirements for exports than domestically produced products.

China will continue focusing on prepared pork exports due to food safety related restrictions by other countries for animal disease outbreaks in China. However, its fresh and chilled pork exports to Hong Kong increased rapidly in 2007 and will likely continue growing in 2008. Despite the domestic shortage in swine and pork supplies, China tries to guarantee hog and pork supplies to Hong Kong with limited profit margins for policy purposes. Vietnam has become China's 4th largest market in 2006 from almost nothing before that. After China signed the Free Trade Agreement with Southeast Asian countries, convenient land transportation links between China and Vietnam have supported trade. On the other hand, China's pork exports to Russia fell nearly 91% compared to shipments in 2002–2004 partly due to Russia's implementation of import meat quota system and partly due to outbreaks of swine disease in China.

Papua New Guinea

The majority of the population in the country lives in traditional societies and practice subsistence-based agriculture (www.agriculture.gov.pg). The agriculture sector contributed 26% to country's GDP in 2004/2005. On the other hand, the livestock industry contributes 13% to the total domestic food production. Meat consumption is increasing at 5% per annum. The estimated per capita consumption of meat is 21 kg (compared to 40 kg in the Philippines and 115 kg in Australia), and has not changed since 1990.

The beef cattle industry has proved its presence for over forty years, but is facing difficulties to maintain sustainable growth despite the existence of favourable natural environment in many parts of the country and no major disease problems.

The industry is based on large-scale ranching and smallholder cattle production. The size of the national herd increased from 1950s and peaked in 1976 to around 153 thousand head with more than 1000 smallholder cattle farms holding 50 thousand and the rest were on large properties. At present there are 28 large properties with an estimated 65 thousand head and another 18 thousand on 550 smallholder cattle farms. The decline in cattle numbers is attributed to poor skills in animal and pasture management, withdrawal of services, particularly extension support to smallholders, land ownership disputes due to uncertainty of land tenure, lack of suitable credit facilities, and increasing law and order problems.

Reports indicate low herd fertility (50–60%) and calf survival percentages are low (about 50–60%). Losses also arise from wild dogs being a major problem. Average growth rates and time to reach slaughter weight are long. Annual beef production has been virtually static around 2000 t, but in recent years production has increased slightly through higher turn off and higher carcass weights and is estimated at about 2800 t. The annual importation of beef is around 13 thousand tonnes with the canneries accounting for 70% of the imported beef.

Like the poultry industry the commercial pig industry developed rapidly under the ban of pig meat imports introduced in 1983. The current industry is based on a small number of large-scale piggeries located on the outskirts of the major cities and domestic pigs kept by various families. The industry, as in the case of poultry industry, has a high dependence on imported feed ingredients.

Pig production grew rapidly since 1983 and stabilised between 1000 and 2000 t/year, which satisfies the local demand at the current consumption level. However, there is still growing demand for 'baconers', which encourage small goods processors to import bacon for processing. Village pig numbers are estimated to be between 1.5 and 2 million, with production of 6000 t.

Although sheep was introduced into PNG in the 1980's, organized sheep development commenced only in 1975 with the establishment of a breeding station in Goroka with technical assistance from the New Zealand Government aimed to establish a village based sheep industry in the country. Between 1975 and 1994, temperate sheep were imported and crossed with local tropical breed to develop a suitable breed for the highlands region.

It is estimated that there are about 10 thousand sheep in the country, and most of the animals are on smallholder farms in the central highlands. Demand for breeders is high but Government breeding stations are unable to meet this demand, which is further exacerbated by losses due to stealing of sheep from the breeding stations. To overcome this problem, in collaboration with farmer groups, nucleus sheep breeding farms have been established to multiply and distribute breeders to satellite sheep farms.

Annual import of sheep meat, mostly the cheaper cuts, has increased from 4000 t in the late 80s to almost to 40 thousand tonnes in recent years. This is attributed to a substitution effect as a result of lower price of the sheep meat compared to other meats in the market and increased meat consumption.

Goats were introduced in PNG in late 1800s as a source of meat. More were imported after World War II and distributed to Missions and small village communities. It is estimated that at present there about 25 thousand goats in the country and mostly found in Morobe, Eastern highlands and Simbu Provinces.

Head numbers vary, with many owners having more than 50 goats that usually graze free range. Demand for breeding animal is high. Hitherto no serious efforts have been made to promote goat production in an organized way. Despite this, goat industry has grown considerably due to local interest and to religious direction. Animal numbers are however still small due to high kid mortality and low productivity as a result in breeding, poor feeding and management.

Rabbit was introduced in the early 90s on an experimental basis and has become popular in many villages. Currently there are 2 000 rabbit farmers in the country. And the meat produced is consumed within villages. Rabbit production has shown promise as source of meat and income although to date the production is not substantial. Rabbits can be easily integrated into the local farming systems. Other livestock include dairy cattle, deer, crocodile, guinea pigs, cassowaries, native birds etc. These animals have social and economic significance and should be researched and developed.

PNG is currently relatively free of the major pest and diseases. One of the most feared diseases is avian influenza or bird flu. PNG has to be prepared to prevent the invasion, apart from bird flu, of diseases affecting both birds and humans such as the Newcastle disease of chicken, swine fever or hog cholera of pigs. Developing and instituting appropriate legislation on agricultural quarantine, import and export quality assurance, and environmental aspects of safe agriculture and livestock industries are being undertaken by the government.

The livestock sector has been neglected for the past 20 years, resulting in the general decline of the sector. Under the National Agriculture Development Plan 2006–11, it is proposed to revitalize the sector to enable it to contribute to the socio-economic development of the country by reducing imports of meat and meat products, improving the nutritional status and income generation of the rural communities. Under the proposed plan cattle, pigs, sheep, goats, poultry and draught animals will be promoted.

The traditional cattle ranching provinces such as Morobe, and Madang will be targeted. Large-scale cattle ranches will be established in collaboration with the private sector. The existing ones will be further

developed to ensure a 50% increase in beef production by 2011. Commercial pig production will be promoted through distribution of improved breeds, provision of credit and strengthening of marketing facilities. Draught animal development will be undertaken to assist and promote transportation of agricultural produce and in farm work. Dairy goats and egg production will also be promoted at the subsistent level to improve household food security and nutrition.

Annex 2 Previous findings on key issues related to livestock in the region

This section scours the literature in order to highlight some important issues and concerns affecting the region's livestock sector, and more specifically, its research and technological development backbone.

Research investment and approach

Most countries in the region rely on public investment in agricultural research and extension in maintaining productivity growth (ILRI 2001). Since public resources are scarce, however, the need to use available resources efficiently is critical. Moreover, it is necessary to enhance the competence of scientists and the quality of research managers, and to provide them accordingly adequate operating funds and technical support.

Oram (1990) suggested that the division of responsibilities and working relationships between the international and national research centres be re-examined with a view to increasing efficiency. He further suggested that regional decentralization of research to the farmer participants, and based on agro-ecological characterization, may be the most effective approach because it provides better farmer input and feedback to upstream researchers and policymakers.

Improvement in linkages between public agricultural research and small research-based firms and informal farmer research could have high payoffs. Farm-based research often specializes in choosing varieties or breeds specific to micro-environments and can be highly complementary with the formal research systems (Lipton 1994).

Technology needs and prospects

The IFPRI–FAO–ILRI Vision 2020 discussion paper is entitled 'Livestock to 2020: The Next Food Revolution' (Delgado et al. 1999), albeit generalized on technological requirements to meet global efforts to improve the productivity of animal food production, identifies similar technological needs of the Southeast Asian livestock industry. The discussion below relies heavily on Delgado et al. (1999) enumeration of some of these technological options or solutions.

First, infectious and parasitic diseases affecting livestock remain major constraints to profitable livestock operations in many developing regions. Some of the technological options needed to address animal health constraints include vaccination and surveillance programs to keep diseases in check, and biotechnology (more specifically, genomics) for improved diagnosis and treatment of animal diseases. However, the authors emphasize that 'farmers in developing regions typically lack low-cost, easy-to-use diagnostics, vaccines, and control strategies for disease organisms and vectors'. On top of this, empirical works are also needed on 'risk analysis and animal health economics to determine where disease control investment will have its greatest benefit.'

Second, the authors recognize that 'ruminants in pastoral and low-input mixed farming systems suffer either permanent or seasonal nutritional stress' and hence, the need for more researches on improving feed quantity and quality. Specifically, they opined that much work is still needed to reduce cost and improve efficiency of feed rations, define chemical composition and digestibility characteristics, enhance the quantity and quality of available tropical feed resources, use abundant fibrous biomass, and improve the feed conversion of monogastrics (given advances in genetics).

Third, livestock productivity can be enhanced through improved reproductive and genetic technologies. Apart from works related to crossing of local breed in developing countries with highly productive breeds from developed countries, they emphasized that studies on characterization, conservation and use of

tropical animal breeds, and genetics to improve livestock (e.g. marker-assisted selection and detection of quantitative trait loci, use of maps of genetic linkages to identify gene location of economically important traits) must be sustained.

Fourth, there is a need to also pay particular attention to post-harvest technology, mainly because of overriding concerns such as protecting public health and increasing the value of livestock output. As for the first concern, much effort by the developing countries relates to the three elements of risk analysis, namely: risk assessment, management and communication. Increasing value will mean increasing the share of output passing through marketing and processing channels, and this calls for support technology development and transfer efforts like technologies for ultra-pasteurized dairy products and vacuum-packed meat.

And fifth, there must be efforts to minimize the negative environment effects of livestock production. Studies must continue on mixed farming systems especially in areas such as enhancing nutrient and energy flows between crops and livestock, and area-wide crop–livestock integration. Technology development must also be intensified in terms of processing animal wastes into useful products coupled with empirical works on the economics of waste disposal.

Extension services and technology transfer system

Weakness in livestock extension figured prominently in a survey of policymakers, researchers and officials from developing countries in the Asia-Pacific region conducted during an FAO workshop in Bangkok in February 2001. The survey indicated that research results are not adequately conveyed to farmers, particularly in regard to feeding practices and animal health.

The poor performance of many extension services can be attributed to inappropriate organization, and inadequate training of and lack of incentives for extension agents or workers. In China, for example, productivity increases in livestock production have been observed in recent years, but low educational levels of the producers and weak extension systems hinder increased technology adoption (Liu 1995).

The approach used in many developed countries of providing extension services on a user pay basis is however viewed as inappropriate to small farmers as they have no capability to pay for extension services.

Lacking technical knowledge can spell failure in livestock production. For instance, incorrect applications of drugs to control diseases or pests may result in drug resistance developing on the farm. Inadequate control of diseases then raises the likelihood that the animals belonging to other small farmers nearby will become infected. This is especially more likely to happen when the animals are grazed communally or where there is inadequate fencing. It helps to explain why animals are often tethered if left to graze alone or supervised by the farmer and/or family members. To a small farmer and his farm household, the loss through disease of an animal can have severe financial consequences extending beyond the loss of the animal. If the animal is a cow or buffalo, the farmer's ability to plough his land to produce food may be adversely affected.

To provide the necessary information dissemination and training for new livestock technologies, extension services in the region need to be upgraded.

Political/institutional issues

The FAO survey also indicated that livestock farmers have little political influence and as a consequence government policymakers give low priority to livestock industry. Farmers need to lobby to achieve their objectives.

The livestock industry is considered a minor part of the agriculture sector and most countries in the region have no comprehensive policy in place for the livestock sector. Government support is in the form of meagre budgetary support for research and credit animal health services. There is little regulatory intervention in marketing, health and environment as reflected in the condition of slaughter/processing areas and meat in market stalls. Where regulatory policies and framework exist, these are not well implemented. Procedures to obtain licenses and permits to trade livestock commodities are generally lengthy and rent seeking opportunities are ample.

Marketing

Concerns are often expressed about the marketing activities of middlemen, particularly in regard to their dealing with farmers. The FAO survey indicated the need for providing farmers with market opportunities. Information asymmetries were mentioned as a problem and that small farmers would benefit greatly from the establishment, through public funds, of a village-based livestock market. Scales to weigh livestock would prevent farmers' exploitation by the middlemen/traders, who through their experience are apparently much better at gauging the weight of animals produced.

Farmers' access to export market is also a problem. Non-tariff barrier, particularly phyto-sanitary regulations, is a form of government intervention in developed countries that developing countries, particularly in Asia, lack the capacity to comply with or influence through negotiations.

Moreover, with emergence of supermarkets in the region, structural change has been observed in the way meat, dairy products and eggs are collected, inspected, processed, packaged and supplied to consumers (Steinfeld et al. 2006). Such change impacts on the livestock producers, specifically in determining who can and cannot participate in the mainstream supply chains. Market segmentation is observed between the rapidly growing formal and the stagnating or declining informal supply chains, and between the 'wet' markets for fresh meat and the supermarket outlets of processed, frozen, packaged and branded meat.

The relative significance of each market segment is closely linked to the purchasing power of households and individuals, their demand for leisure, their preferences to form and texture of meat upon purchase, and the value they give to food that are considered 'safe'.

Large-scale retailers compete in delivering consistent product quality that is demanded by their main market. The concept of 'quality' from the producers' perspective is complex, and its attributes evolve over time. The definition of quality varies according to suppliers' strategies on the one hand, and to cultural influences on the other. It includes food safety, nutrition and attributes related to the commercial differentiation of the products. Large retailers require a reliable supply of agricultural products from their suppliers (producers) with consistency in volume and in quality. Vertical coordination presents the opportunity to keep control of operating and transaction costs while at the same time meeting high standards of food safety. It demands organizational and institutional changes in the relationship between the primary producer and the agri-food processor or supermarket distributor, giving rise either to various forms of vertically coordinated transactions (the retailer contracts suppliers and/or processors), or in the extreme form, to fully integrated systems (all units in the food chain owned by one company). Large retailers in developing countries are increasingly tending towards vertical coordination, although vertically coordinated chains may interact with informal markets that supply inputs of live animals or products.

Influence of religion

The importance of religion as an influence on the consumption of livestock products in the region is another concern (FAO–RAP 2002). Religious issues might become an issue with the use and disposal of animal by-products, including manure. Mulyono (1998) discussed the waste disposal problem associated

with the pig meat industry in Indonesia's Special Province of Jakarta. Past initiatives to use pig wastes for fertilizers or as a source of energy failed because of a Muslim prohibition on touching or consuming any part of the pig. Livestock production is also influenced by religious customs in the Himalayan Kingdom of Bhutan but at a different stage in the production process. Bhutan's pork industry is relatively large, and its productivity could be increased by large-scale facilities involving a couple of hundred breeding sows. However, religious beliefs prevent animal production taking place in this scale because Bhutanese people will not kill more animals than are required for their own requirements. A strategy to get around this would be for farmers to be given responsibility for raising animals on behalf of others and this happens, with Nepalese workers being employed to slaughter animals.

Impact on environment

Emission of considerable amount of carbon dioxide, methane and nitrous oxide from livestock activities is fast becoming a concern especially in China (and India). In Malaysia, the industry is trying to cope with the environmental pollution issues due to the country's rapid urbanization and has to continuously upgrade its waste disposal system.

Likewise, livestock use of water and contribution to water depletion trends are high and growing. An increasing amount of water is needed to meet growing requirements in livestock production process. These issues could no longer be ignored. Better waste management and improved water use efficiency and water productivity are in order.

www.ilri.org

headquarters

box 30709 Nairobi 00100, Kenya
phone +254 20 422 3000
fax +254 20 422 3001
email ilri-kenya@cgiar.org

principal site

box 5689, Addis Ababa, Ethiopia
phone +251 11 617 2000
fax +251 11 617 2001
email ilri-ethiopia@cgiar.org

ILRI via USA direct

phone +1 650 833 6660
fax +1 650 833 6661