

Research and development strategies for the livestock sector in South-East Asia through national and international partnerships

Proceedings of a workshop held in Bangkok, Thailand, 11-15 March 2002



Food and Agriculture Organization of the United Nations



Japan Livestock Technology Association



International Livestock Research Institute

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Thailand, 11–15 March 2002

editors

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ISBN 92-9146-130-X

Correct citation: Frio A.S. and Gray G.D (eds). 2002. *Research and development strategies for the livestock sector in South-East Asia through national and international partnerships. Proceedings of a workshop held in Bangkok, Thailand, 11-15 March 2002.* ILRI (International Livestock Research Institute), Nairobi, Kenya. 286 pp.

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Foreword

When the International Livestock Research Institute (ILRI) was established in 1995 as a global institute, one of the highest priorities was to establish a development-oriented research programme in Asia. Extensive consultation from 1995 to 1997 among partners with interest in the region – donors, international and national organisations, government and non-government agencies – led to a research programme for South-East Asia which commenced in 1998. This programme was funded by ILRI's core donors (including the World Bank, Rockefeller and Ford Foundations and the European Union). Project-specific funding was provided by the Asian Development Bank (ADB), International Fund for Agricultural Development (IFAD), Australian Centre for International Agricultural Research (ACIAR) and the Systemwide Livestock Programme (SLP) of the CGIAR.

A key feature of this programme has been that all research implemented by ILRI is with partners in the region and that ILRI has not established its own laboratory of field research facilities. Extensive links have been established in the region during implementation of these projects, and one that is of increasing importance is the collaboration with FAO in areas of animal health, animal production, animal genetic resources and food quality and safety.

It is timely to review the direction of ILRI's programme in the region, to look forward to the research and development needs of the livestock sector and to ensure that it continues to meet the needs of smallholder farmers. The issues raised by the huge increase in demand expected for the region in the next 20 years have been highlighted in the joint IFPRI–ILRI–FAO study *Livestock to 2020: the next food revolution*, and have been embraced by the mission of ILRI to make the livestock revolution work for the poor. It is essential that these changes do not further disadvantage poor livestock keepers and that livestock research and development addresses both rural and urban poverty.

With generous support from the Japan Livestock Technology Association, and hospitality from the Department of Livestock Development, Thailand, this workshop on research and development strategies for the livestock sector in South-East Asia through national and international partnerships has been organised jointly by ILRI and FAO.

The objectives of the workshop were to:

- provide an overview of the development-oriented research completed and planned by ILRI, FAO and partners in the region
- develop concepts for livestock research and development in the region, and
- prepare plans for presentation to a range of donor organisations.

The outputs from the meeting will have considerable impact on several proposals under preparation in the areas of increased production, marketing, safety and quality of food from livestock, especially meat from all species; milk from cattle, buffalo and goats; and eggs from chicken, ducks and quail. This was also an opportunity to re-assess the ways in which international research organisations, especially FAO and ILRI, can effectively participate and contribute to livestock research in the region.

The organisers of the meeting, while trying to keep the workshop to a workable and affordable size, were able to assemble a distinguished group of livestock scientists and

development specialists, planners from the public sector and key players from the private livestock sector with a wide range of interests and responsibilities. Some of these have been closely involved in ILRI and FAO projects while others have a special interest in proposed activities.

We thank all who have contributed their time, energies and ideas to the workshop and our special thanks to our hosts in Thailand who made the workshop both productive and a milestone in the development of new partnerships in the region.

G. D. Gray
Regional Co-ordinator
ILRI-Philippines

Session I

Opening session

Opening address

R. Vongdee

Director General
Department of Livestock Development, Thailand

On behalf of the Department of Livestock Development of Thailand and on my own behalf, may I extend our very warm welcome to all of you who are attending this workshop on 'research and development strategies for the livestock sector in South-East Asia through national and international partnerships' here in Bangkok.

As most of you know, the livestock sector affects all other aspects of agriculture by using either the products or by-products of crops and forages to produce highly desirable products and food. Especially, the livestock sector contributes substantially to national gross domestic products (GDP) and supports national mandates of providing nutritional security, employment, and rural development.

In this twenty-first century, the livestock sector faces new challenges of food safety and quality, maintaining environment, animal welfare, bio-diversity, disease eradication, international trade, and above all, improving production and productivity using sustainable production systems.

The South-East Asian region has one of the largest and fastest developing livestock industry, and it also has the most rapidly rising demand for livestock products.

Today, high-level government representatives from Brunei Darussalam, Cambodia, China, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Vietnam, and Thailand and other international partners are participating in this workshop to discuss ways of formulating policies and strategies on research and development for the livestock sector in the region.

Before I conclude, I must convey that I am happy to see that this workshop is hosted by Thailand. I would like to thank all participants and the organising committee, and I trust that you will make use of your stay in Thailand not only to confer on technical matters but also to enjoy what Thailand can offer in hospitality, scenic beauty, tradition, and culture.

My best wishes are also with you and may your workshop discussions be continued and concluded in the most successful and meaningful way.

Thank you very much.

Opening remarks

T. Fujita

Executive Director, Japan Livestock Technology Association (JLTA)

I am very pleased to join this important workshop on 'research and development strategies for the livestock sector in South-East Asia through national and international partnerships', as one of the organisers of this workshop, and on behalf of the Japan Livestock Technology Association (JLTA). JLTA was re-organised about ten years ago in order to strengthen its functions regarding international collaboration in the field of livestock as well as to facilitate livestock development activities in Japan through encouragement of technology development.

I would like to extend my sincere thanks to Dr Rapeepong for his generosity to host this workshop here in Bangkok, Thailand and for his enthusiastic support to livestock development in the Region.

In addition, the Food and Agriculture Organization of the United Nations (FAO) strongly supports this workshop as one of the organisers through its headquarters based in Rome, Italy and its Regional Office based in Bangkok. I understand that FAO has had collaboration with the International Livestock Research Institute (ILRI) as one of its important partners, for mutual interests in the development of the livestock sector not only in South-East Asia but also globally.

Dr Carlos Seré, who has quite recently taken up the important post of ILRI's Director General, and his colleagues from ILRI's various institutions in Africa and here in Asia are attending this workshop with us.

Livestock is the main and promising component of agriculture in the world and has been kept by a lot of smallholders in poor countries to preserve their livelihoods and sustain livestock production.

ILRI had focused its research activities on livestock development in Africa for a long time, and with its experience and expertise accumulated, this international institute widened its mandate several years ago from Africa to a global one. Thus ILRI's research priority has been placed on Asia as well, where livestock production has been predominant, and has rapidly developed to meet the strong demand for livestock products from consumers for the last decades, mainly through the mixed farming systems and the peri-urban intensive production systems.

However, the sound development of the livestock sector further needs strong support from research and development institutions, as livestock in the developing world are still under severe conditions of low productivity, lack of feeds, tropical animal diseases as well as lack of proper development policies, insufficient marketing systems and so on.

Some constraints could be solved only through an integrated research and development in biotechnology, policy development etc. and a practical application of the research-oriented programmes which should be conducted by national administrative authorities.

ILRI is the only institute with a global mandate to carry out livestock research, and works to improve the well-being of people in developing countries, which is well co-ordinated with CGIAR mandates.

In promoting ILRI's work to meet the increasing demand for livestock foods, especially from developing countries, collaborating linkages with national partners as well as relevant international organisations are most important to achieve the targets with a long-term solution.

The collaboration among these institutions is really necessary to obtain the tangible outcome for common interests of those partners, and to optimise limited resources, in particular under the current conditions of heavy constraints of funds from donors to those institutions.

Now we have a very good opportunity to review the past or on-going programmes of research and development and to develop our strategic framework for the livestock sector in South-East Asia, particularly by taking into account the agricultural conditions in the region.

Our workshop is expected to identify some priority areas or projects to support such strategic framework for the region, with short-term programmes envisioned probably for the forthcoming five years.

Discussions during this workshop may be made on new research programmes including food safety, to cope with the recent and emerging demand for solutions to livestock problems. Such new areas support not only livestock producers but also consumers and people engaged in marketing, through collaborative research with other partners. For example, work on the bovine spongiform encephalitis (BSE) disease brings strong global and regional attention to a problem that causes serious socio-economic losses to the livestock sector in various countries.

I do hope, as one of the supporters of this meeting and personally, as one of the Members of the ILRI Board of Trustees, that this workshop will exchange frank views and opinions for the mutual interests and challenges in livestock development. Further, I believe that this workshop will produce fruitful results in terms of research and development strategies for the livestock sector by strengthening partnerships with national and international institutions and organisations.

Thank you for your kind attention.

The global livestock sector: Challenges and trends

S. Jutzi

Food and Agriculture Organization of the United Nations (FAO)

I would like to do two things in my short introduction: first, I would like to give a general framework and the situation which we in the livestock sector are facing in research and development. Then I would introduce to you the programme of the FAO Livestock Division to indicate opportunities where we might be involved in developing strategies for research and development in this region.

The external environment

As general framework conditions, I list here seven challenges and trends in the external environment. These would help us in deciding which general framework conditions to consider when we deal with the development of the livestock sector.

- 1) Role and functions of the state. The state will continue to withdraw from functions that the private sector and the markets can perform better, and international agreements will reduce the policy instruments of the state. Government services will continue to be privatised.
- 2) Continuing globalisation and trade liberalisation. Globalisation of markets and financial markets will continue. Trade liberalisation in agriculture will also continue and technology transfer will happen more and more through private investments and trade.
- 3) Widening gap between the affluent and the poor. The disparity between the rich and the poor will grow despite public calls and goals to the opposite. We should consider that economic growth *per se* is generally not reducing food and security of the poorer segments of society. Hunger is primarily a distribution, and not a production problem.
- 4) Demands on agriculture in increasingly urbanised societies. There is a rapidly expanding urban population and the access to food is becoming more complex as an increasing proportion of the food is acquired through market exchange. Agriculture production is becoming more intensive and commercial and is increasingly animal protein-based. This requires further increases in productivity of labour and land. Increased consumer awareness on food safety and environmental issues will give rise to requirements for enforcing relevant standards in national and international trade with livestock products.
- 5) Pressure on natural resources and competition for their use. The pressure on natural resources is going to increase as competition for its use also increases. Use of natural resources will also intensify.

- 6) Progress in research and development (R&D) and inequality in access to its benefits. Technological advances in all areas will be considerable but not equally accessible to all countries. Agricultural research is increasingly becoming localised, with the private sector conducting most of the technology research. The needs of resource-poor farmers are unlikely to be addressed adequately by the private sector. In addition, the information and communication revolution is likely to benefit primarily the developed countries.
- 7) Nature and composition of funding for agricultural development. Finally, the total pool of external assistance resources is not expected to expand significantly and it may indeed fall. This is particularly true for bilateral and multilateral funding for development. It is only non-profit organisation funding which may expand to support development.

Global production trends

Global meat production is rising faster than cereal production (Figure 1). The term 'green revolution' was introduced 40 years ago in the cereal sector and it is noteworthy that the term 'revolution' was applied to livestock only recently, despite the fact that the development of the livestock sector has been more revolutionary than that of the cereal sector for quite some time.

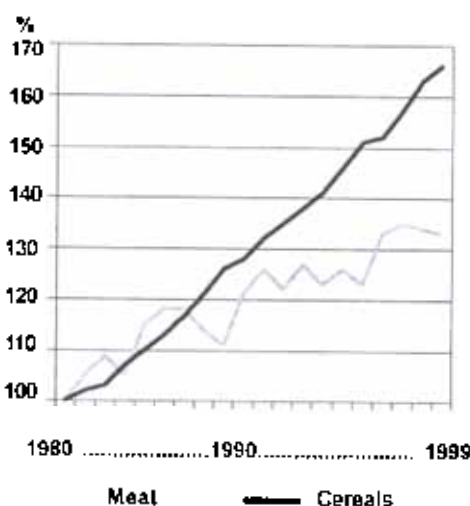


Figure 1. Global cereal and meat production, 1980–1999 (1980 = 100%).

Trends in meat output in the developing countries and the developed world show that while production stabilises in the developed world, there is a vigorous increase of meat output in the developing countries (Figure 2).

The livestock output in the developed world is stagnating except poultry, the only sector that is still growing (Figures 3–6). On the other hand, pork and poultry production in the developing countries is growing fast, almost at the same rate. Similarly, beef and milk production is growing significantly.

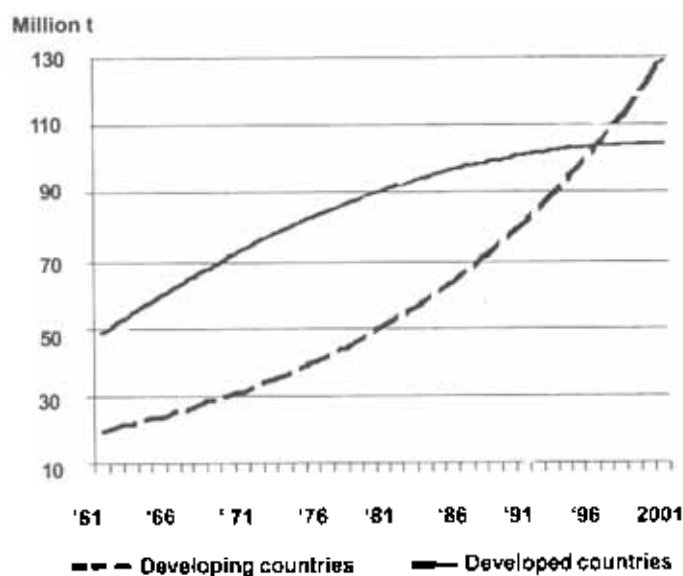


Figure 2. Trends in total meat production, 1996-2001.

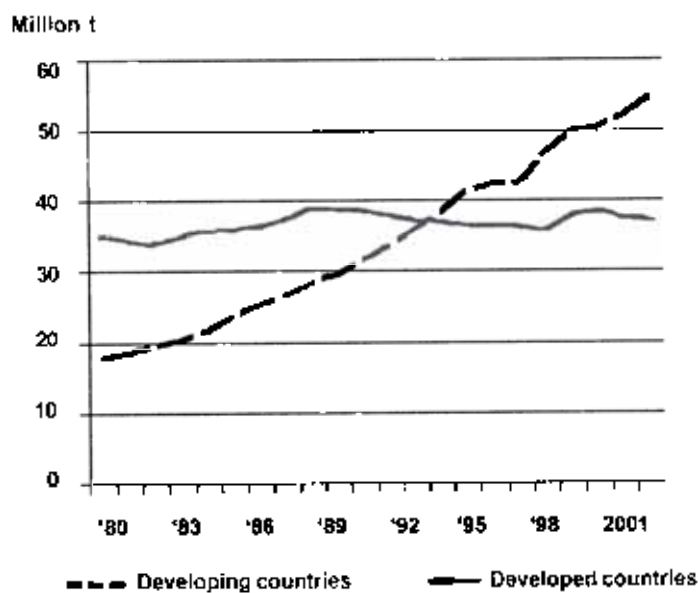


Figure 3. Livestock production in developed and developing countries: pigmeat, 1980-2001.

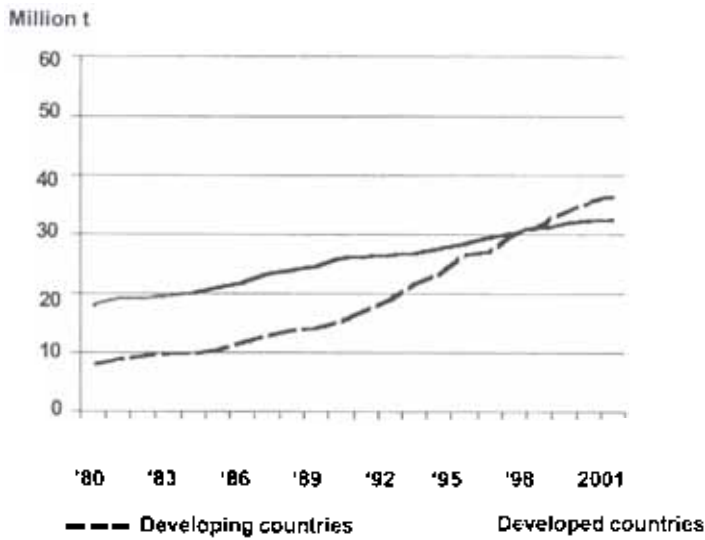


Figure 4. Livestock production in developed and developing countries: poultry meat, 1980–2001

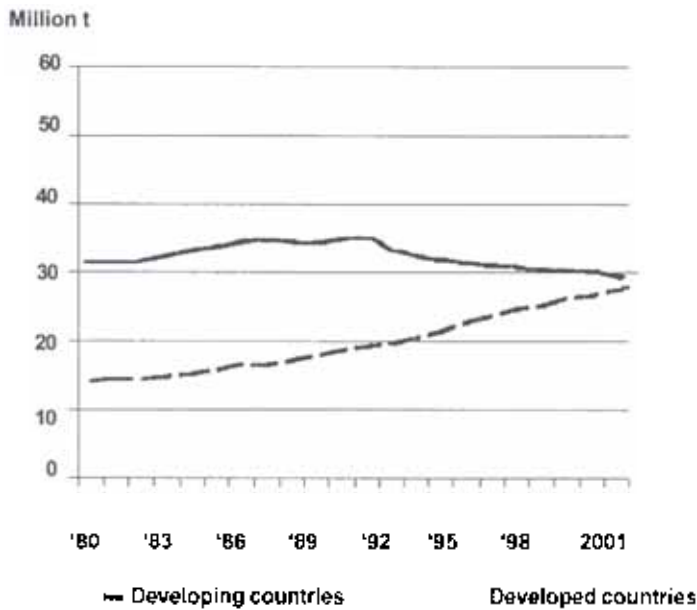


Figure 5. Livestock production in developed and developing countries: beef and veal, 1980–2001

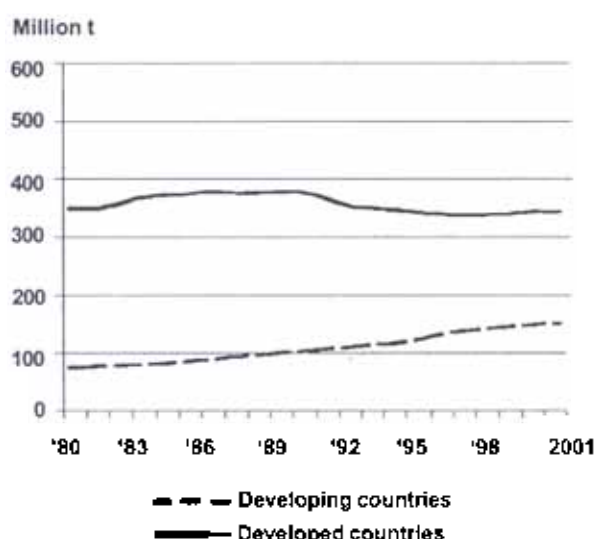


Figure 6. Livestock production in developed and developing countries: cow milk, 1980–2001.

The ILRI-IFPRI-FAO study *Livestock to 2020* indicates that there is an enormous expansion of consumption of pork and poultry products. This is due to rising incomes and populations, and to urbanisation.

It is important to note that structurally, a strong change in the livestock sector is leading toward industrialisation of production. It is also important to note that this is a trend that is valid throughout the world. Asia leads in this regard. The productivity of its industrial systems is growing six times faster than those of mixed farming systems. The pastoral systems in Asia are declining.

The rapid expansion of the poultry and swine production sector implies an enormous expansion of cereal production for feed with great implications for field crops production. Figures show that an anticipated 50 million hectares are needed for cereal production for feed. What is happening in fact is a migration of livestock production globally from temperate to tropical areas where livestock densities are increasing. The implication here is that the likelihood of disease outbreaks in warm humid areas poses greater challenges.

Livestock production and consumption in Asia

The livestock revolution is already happening in Asia and will continue to happen in the coming years. East Asia strongly expands its meat demand, while South Asia, in turn expand its milk demand very vigorously.

In 1987–1997, annual increments in production figures in East Asia and South Asia show data for cereals, fruits, vegetables, fish, pork and poultry (Table 1). It can be seen that pork and poultry production are expanding at very high rates. Poultry in both regions had a double-digit increase in production.

Table 1. Production growth (per cent per annum) in South and East Asia, 1987–97.

Commodity	South Asia	East Asia
Cereals	3.6	2.5
Fruit	3.6	7.1
Vegetables	2.2	7.3
Fish	5.2	6.5
Pork	3.8	6.8
Poultry	10.2	12.9

Projections for food consumption in the two regions from 1965 to 2030 show that very large amounts of meat and milk and dairy will be consumed in East Asia and South Asia (Table 2). By 2030, South Asia will consume three times more meat, milk and dairy products than in 1965. In 2030, East Asia is projected to consume four times more of these food items than in 1965.

Table 2. Commodity composition of food consumption (kg/person per year) in South and East Asia in 1965 and 2030.

Commodity	South Asia		East Asia	
	1965	2030	1965	2030
Cereals, food	145	192	146	187
Roots and tubers	13	30	94	63
Sugar	20	33	5	16
Vegetable oils	5	15	3	15
Meat (carcass weight)	4	12	9	55
Milk and dairy	37	16	4	19

With respect to total cereal and total meat production, developing countries in Asia will experience an exponential increase in total meat production. Cereal production will continue to increase at a slightly lower pace. This is also true for India where increase in milk output is higher than that of rice production.

The FAO AGA livestock programme

The mandate of the FAO Agriculture-Animal (AGA) Division's Livestock Programme is to clarify and facilitate the role of the fast expanding global livestock sector in food security and food safety, poverty alleviation, and in sustainable use of natural resources.

AGA has situated the Programme within the framework of global public goals which are affected by livestock: equity, the sustainability of natural resources used in livestock production and veterinary public health.

AGA has eight programmes. Of fundamental importance are two programmes dealing with livestock information and knowledge management and livestock sector analysis and strategy development. They support the six technical programmes of the Division: (1) contribution of livestock to poverty alleviation, (2) global strategy for the management of farm animal genetic resources, (3) veterinary public health management and food and feed safety, (4) technologies and systems for efficient and sustainable natural resource use in intensifying and expanding livestock production, (5) Emergency prevention system (EMPRES) -livestock (infectious transboundary animal diseases), and (6) environmental management of insect-borne diseases.

AGA also runs a service agreement programme, a facility that responds to member countries' requests for FAO's involvement in priority needs.

Selected medium-term outputs of the AGA animal production and health programme

In the medium-term (2002-2007), the Programme has identified 34 outputs to be achieved. One output for each Programme is listed here:

1. Global Livestock Information System and Knowledge Framework, including Global Animal Agriculture Atlas
2. Livestock Development Strategy Negotiation Framework
3. Decision Support for R&D Allowing Smallholder Livestock Producers to Enter Competitive Markets
4. Environmental Impact of Livestock Production Assessed
5. State-of-the-World Report on Animal Genetic Resources
6. Feed and Food Safety Codes and Best Practices in Animal Production
7. Integrated Trypanosomiasis Control in Priority Areas
8. The World Without Rinderpest

As our discussions this week focus on 'an animal-agriculture alliance in support of sustainable rural livelihoods' and as we try to join efforts from the research to development points of view, we are prepared to very actively participate in this endeavour to build bridges and to assist the countries of the region in the important challenges that lie ahead for the development of the livestock sector.

The International Livestock Research Institute

C. Seré

International Livestock Research Institute (ILRI)

It is a great pleasure for me to be with you here this morning.

Let me start my presentation by saying that the mission of the International Livestock Research Institute (ILRI) is to reduce poverty, hunger, and environmental degradation through livestock research that enhances the productivity and sustainability of agricultural systems in the developing world. The world is clearly facing an important challenge and livestock research in many situations can make contributions to addressing broad global concerns. We are all evolving in our thinking that livestock development is not a goal in itself, but an instrument to achieve broader societal goals.

ILRI was created by the merger of two institutes, the International Livestock Centre for Africa (ILCA) and the International Laboratory for Animal Diseases (ILRAD) in 1995. Our headquarters are in Addis Ababa and Nairobi, with smaller teams hosted in the Philippines, in Hyderabad, India, in Lima, Peru, in Cali, Columbia and in West Africa. When we were merged, we were also asked to take on a global mandate and very extensive consultations were undertaken in Asia to think through how to best serve this part of the world.

What came out of these consultations was the view that the research focus was very much one of looking at problems in a broad systemic way. Basically, we are looking at livestock-based livelihoods in mixed crop rainfed systems in South-East Asia.

ILRI strategy in South-East Asia

The way we address problems is very much one of having a clear problem focus and then bringing to bear the different research disciplines. One aspect of ILRI's research matrix is the problem-oriented programme, which is the case for South-East Asia (Figure 1). Clearly, this is viewed as a chain that starts from livestock production through livestock markets to livestock consumption. This is affecting real people who belong to the poorest strata of society.

Our current projects in South-East Asia include crop-animal systems, internal parasite management, policy work in Thailand, Vietnam and The Philippines, and impact and control of foot and mouth disease.

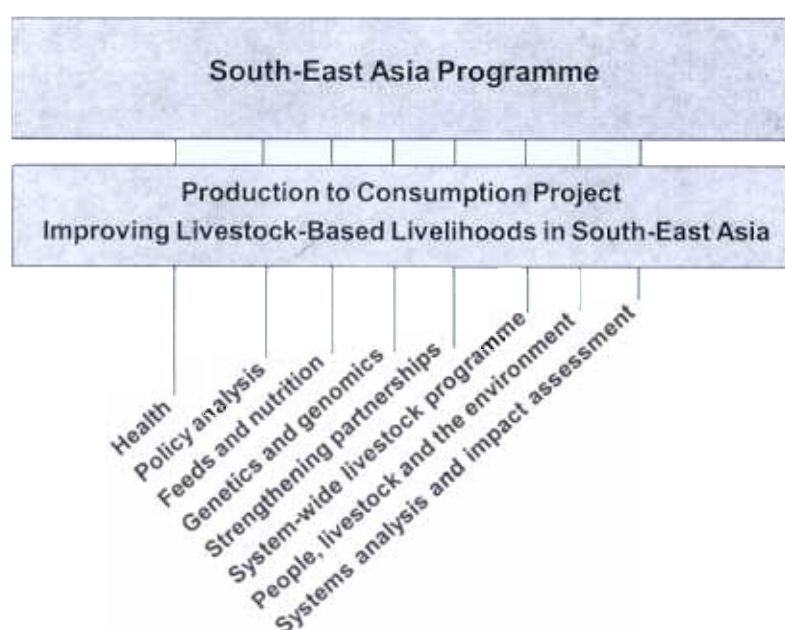


Figure 1. ILRI's research and development strategy in South-East Asia to 2010.

ILRI's activities in South-East Asia started at a relatively difficult time for international co-operation and research and for ILRI in particular. In the mid-90s, there was very little support for livestock research. So, we made the decision to place emphasis on specific projects because that was the way we could attract funding to start the implementation of our mandate. In a way, this was a process of building from different pieces with different arrangements, if you may, rather than a planner's ideal that starts from a clean slate. So we have a number of activities that broadly fit into this overall mandate. But this is an evolving portfolio.

Again, we would like to stress that within ILRI, and the Food and Agriculture Organization of the United Nations (FAO) as well, there is a clear view of the importance of this part of the world. In December 2001, ILRI opened a liaison office in China. We believe that this is a very important step to boost ILRI's presence and contribution in Asia.

The changing context

I will not go into great detail on the changing context of the livestock situation in Asia, as other speakers in this forum will cover these points. But let me emphasise that ILRI and FAO see that the context is very rapidly changing for this task of achieving development goals through livestock research and development.

For instance, a number of national issues have become international issues. For research, there are a number of alternative suppliers. The world has changed; it is not just ILRI, FAO or the Consultative Group on International Agricultural Research (CGIAR) working in this area. We have the private sector, the non-government organisations (NGOs), developed country universities, and national research organisations in the developing countries themselves. There is a wide range of actors in the research and development arena.

The national institutes in many of these countries have, over the last 20 years or so, acquired substantial training for their staff. Many have studied overseas and came back to their countries. So, although many shall have difficulty funding projects, capacity of research in the region is constantly increasing.

We have already mentioned that the private sector is getting more and more involved in the research role. We have also seen that core funding for agricultural research has been declining, and we find that we are facing a new development agenda, which involves issues such as peace, migration, and human diseases. A number of these issues are much brighter on the radar screen of decision makers than the agricultural issues. So, we are clearly competing for good use of the development budgets of the world.

Evolving ILRI role

ILRI has to respond to a changing world. This is to be addressed aggressively if we want to be useful players in this changing context. We are challenged to identify strategic areas of research, which can provide real impact to real people in real places. As Ian Johnson, CGIAR chair, says: 'The world does not want to fund institutions, the world wants to fund outcomes'.

The very limited money available for research has to go to international public goals. The CGIAR budget for livestock research is only 4% of the total R&D expenditure in agriculture for development and we have to use this amount very strategically. We realise that today's research problems are extremely complex and the only way to address them is by working with real partnerships involving many diverse actors. This means that individual parties have to provide real resources in a sharing mode and being capable to agree, from the onset, on specific agendas and on taking up significant pieces of work under their own responsibilities in a co-ordinated manner.

What I imply here is a new mode of research for development, a much more decentralised model in which disciplinary skills are much more diverse. At the same time, we have very significant changes in the information and communication technology, which allow us to work in new different ways. In a sense, we are moving from the bricks-and-mortar institutions where we have the critical mass in one place to a much more decentralised research and development network linked through the Internet and similar technologies.

Finally, we would like to stress that this forum provides a very opportune time for me and my colleagues at ILRI to listen to the needs and issues in this region's livestock R&D. We want to take stock of what has worked, what has changed, and where you would like to see us going in the future. The future is in real partnerships that need to address real problems.

Acknowledgements

I therefore finish this presentation by thanking the 51 organisations, nations, and foundations that are all making it possible for ILRI to be here and help. For Asia, we wish to acknowledge the very significant contribution of the Asian Development Bank, the Australian Centre for International Agricultural Research, the European Commission, the International Fund for Agricultural Development, and the Government of Japan.

I would like also to particularly thank Dr Teruhide Fujita of the Japan Livestock Technology Association, who has been a driving force of this event. We would not be here if he had not insisted on creating this opportunity for us to be here. And to all of you, thank you very much.

Session II

Regional overviews

ILRI and science responding to a changing world

D. Taylor

International Livestock Research Institute (ILRI)

Introduction

Science applied to livestock production is changing rapidly. In the last few years, there have been some amazing changes in our understanding of biology and in methods to apply to problems of livestock health and production. Solutions have been found to problems, which previously seemed intractable; problems which scientists have been investigating for 20–30 years, and for which it seemed there might be no solutions.

What is changing in the world and how can the International Livestock Research Institute (ILRI) respond? We have heard that in the local market place, demand for meat and milk will double by 2020. We have seen those dramatic changes, particularly in the developing world where there is a rapid increase in production. Further, we have new international regulations emanating from the World Trade Organisation (WTO). Some of these will be very positive for livestock production on large farms, but some of them may be less beneficial for smallholder farmers. One of ILRI's major objectives is to be able to raise the productivity of smallholder farmers, bringing them from informal markets into formal markets so that they can, in a chain, contribute to international trade and benefit all nations.

Industrialisation can have a massive negative impact on the environment and changes in climate can affect our ability to grow crops and the transmission of diseases. Urbanisation can affect the way we access food for our communities, in the way in which disease transmission occurs, and the types of diseases that humans suffer from. This is crucial when we think of agriculture in its broadest sense.

Changes in the sciences are brought into focus by the biotechnology revolution which is moving extremely fast. A good example is vaccination to prevent meningitis, the disease of the brain. In Europe and in the USA, investigations over 30 years tackled the development of a vaccine for the disease. The very nature of the bacterium is that it defied all attempts to produce a vaccine. Yet within just two years, with the publication of the complete genome of this bacterium, experimental vaccines were available. This shows us the power of the genomics revolution, the power in this whole new area of biology. What we must do is to harness this power for the development of poor people and their livestock.

Changes in information technology will definitely improve communications. One of the key issues here is that we should be a sharer of knowledge. And it is through information

technology that we can effectively share this knowledge with others. Other technologies which are having a major beneficial impact on our activities are based on geographic information systems (GIS).

The abovementioned changes are quite specific and we need to put them in the context of global events. Malnutrition is still rising, even in this year 2002, and it is affecting a lot of people. It deeply affects the poor, not only because it stunts their growth but also actually impinges on mental development. Poor young children who lack certain nutrients fail in school and are in fact, confined in life in their ability to achieve better career opportunities.

Infectious diseases are increasing. We have talked about livestock diseases but there is a need to think more broadly in terms of human infection. We need to bear in mind that 75% of all human infection primarily comes from animals. There are new, emerging diseases, and we cannot ignore the problem of human immune deficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) which further expose infected people to new infections.

All of the above relate to food and water safety and security which are becoming increasingly important issues. Industrialisation in many of our production processes can have a detrimental effect on the supply of safe and secure water.

How ILRI responds to changes and challenges

So how do we respond? We have to admit that we are a small organisation that can never work on our own. Our success will depend on the success of our partners. It is through partnerships that we are formulating, and have over many years developed, that can help us achieve success.

It is a question of philosophy here – the policy and the structure under which we operate, and the technology we seek to adopt. The best molecular biologist in the world may produce a new vaccine, but if there is no enabling policy to deliver that vaccine to the people who need it, the effort is wasted. And vice-versa, we may have the enabling policy but if we do not have the technology to back it up, we still would not improve.

There are three general elements in the framework under which ILRI operates. We aim to have more effective and purposeful collaboration at the local, national, regional and international levels (Figure 1). I need to emphasise that we are an international agency doing work for international public goals. So we have to balance our activities in any one region or site and make sure that that work not only contributes to that community but also has a broader international impact.

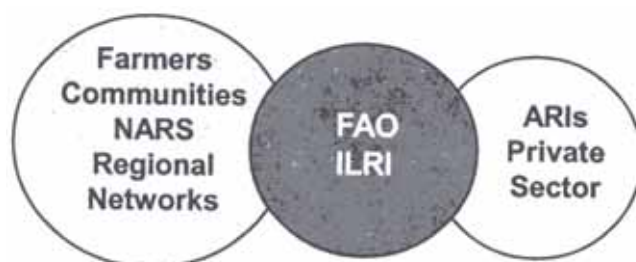


Figure 1. Collaboration scheme of ILRI with its partners.

Linkage between our partners and ILRI means that it is not only for us to determine what the research agenda is. It is really for the people who we serve to determine that. So we are looking to farmers in their communities to give us a lead on what is actually needed in their farms. Obviously we will operate and implement our research through national agricultural research organisations for most countries in the region. There will be regional networks so that lessons learned from one region can be transferred to another. In this context, we are looking to further strengthen our partnership with the Food and Agriculture Organization of the United Nations (FAO). Our scientific results need to be channelled through FAO and other international organisations to deliver them to the right spot in the world.

We are also a conduit for information. We may not always be implementing things, but we should be identifying the knowledge produced by the advanced research institutions and bring these to focus on problems in the developing world.

The other significant point I wish to make is that we are aiming for our science to have impact. We no longer wish to do science for the sake of research; it is rather research for a particular product. And this has made a significant change in the whole philosophy of our institution.

Researchable areas

Figure 2 shows how we look holistically at the 'production-to-consumption' systems—systems in which all aspects of production, marketing and consumption are considered as researchable issues. This systems approach is the only way forward for our research. The disciplines that we are able to bring to bear from our partners in the advanced research institutions should feed into the demands of that production to consumption system. Again I emphasise the link between the enabling policy and technology. Without the two being linked and integrated, we cannot achieve our objectives.

There will be more about this in the coming sessions but I would like to present a list of some of the ideas where we can actually contribute our efforts to.

- 1) Improvement of feeds - good nutrition for our stock is essential for their productivity.
- 2) Improved genetic stock - preserving the genetic diversity of our livestock breeds is important because different livestock breeds are known to perform better in different circumstances.
- 3) Improved diagnostics - one of the reasons why the foot and mouth disease (FMD) outbreak in the UK spread so quickly is that there are no rapid diagnostic tests available although the genomics technology will soon be able to do that.
- 4) Vaccines - a good example is meningitis.
- 5) Vector control - ILRI, in collaboration with its colleagues in the UK, has recently discovered a plasmid in tsetse fly that can be modified into a lethal "tsetseicide" (not really an insecticide because it is so species-specific in its activity). This technology is now being developed for a whole range of arthropod pests and vectors of disease.

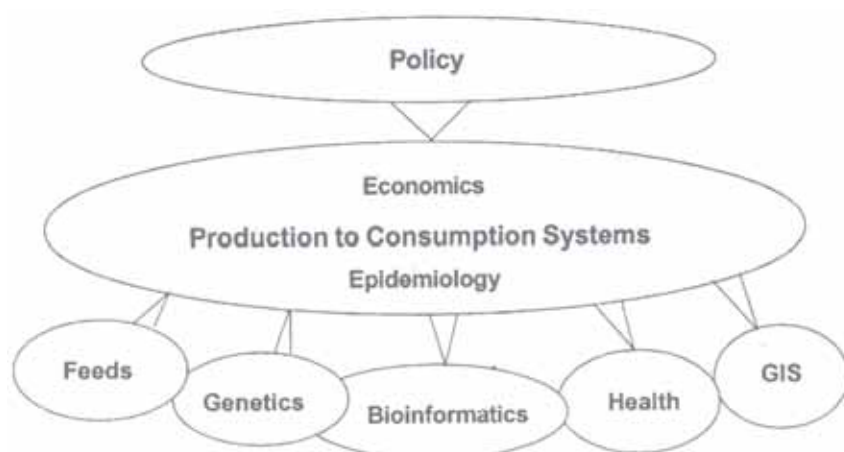


Figure 2. Holistic nature of ILRI research.

The genomic revolution is producing solutions to previously intractable problems.

Geographic information systems (GIS) employ spatial analysis that aids us in arriving at epidemiological decision tools. The analysis here and the predictions about how changes in the environment and changes in climate can alter productivity can actually help us to prevent diseases in a very effective way and pinpoint exactly where there might be outbreaks and epidemics. These are crucial modern technologies that we need to apply in our particular situations.

Before I end, let me just go back briefly to what I have earlier mentioned about market access (Figure 3). It is a crucial component of our research. We want to assist the smallholder farmers to move from informal markets through formal markets and international trade.

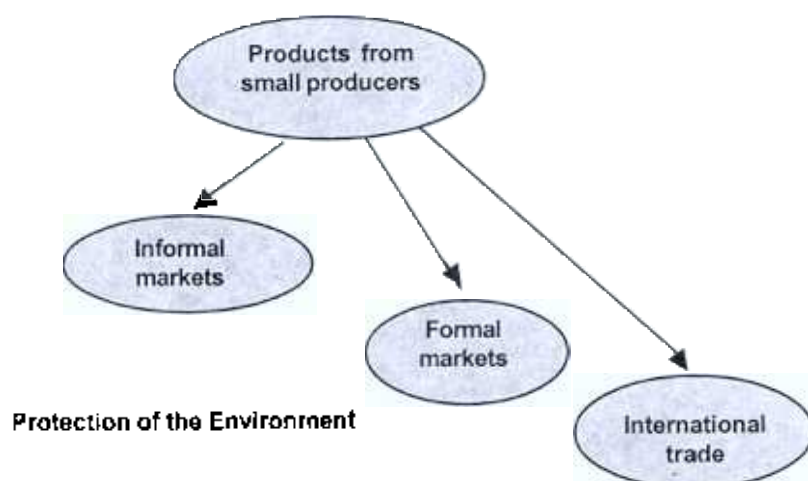


Figure 3. Opportunities for smallholders.

What we would like to achieve in this workshop is to develop ideas on where our focus should be, and determine what constraints are present in the different routes to formal markets and international trade. As we have said earlier, we are in listening mode. We believe that we should be listening closely to what civil society tells us. We need to know the priorities of individual countries and communities and regions. This information comes to us from the national agricultural research systems and international agencies that have this umbrella view of what is happening and of what are the trends. We seek to set up an appropriate agenda, an agenda that is determined to find appropriate solutions to particular problems.

We need also to look into the question of mobilisation of human and financial resources. It was previously mentioned that core support for research is declining. This means that most of our work now should be individual projects which seek funding for themselves. Implementing and delivering solutions will then be part of our collaborative effort.

In summary, we believe that our success depends on the success of our partners.

HOPE-A — A regional small-scale start-up project for household poultry enterprises in Asia

D. Hoffmann

Food and Agriculture Organization of the United Nations (FAO)

Background

Increasing the diversity of agricultural products is now widely regarded as a critical step towards food security and is a major strategy in FAO's Special Programme for Food Security (SPFS). In many countries in Asia, livestock are a significant part of the move toward agricultural diversity. Of the livestock species, poultry in particular provide excellent opportunities for improving dietary nutrition and increasing income of the rural poor, in return for comparatively modest inputs. Many indigenous breeds of poultry exist in Asia and have been part of rural life for hundreds of years. Nearly all farming families carry out traditional village-level poultry raising to varying degrees and in most families women manage and benefit from householder poultry flocks.

But the potential productivity of indigenous breeds has not been realised. Constraints include inadequate husbandry, heavy reliance on scavenging for feed, lack of marketing opportunities and, perhaps most importantly, outbreaks of disease.

The Animal Production and Health Commission of Asia and the Pacific (APHCA)¹ along with FAO and others has recognised the huge potential value of village poultry to the rural poor and has endorsed a regional programme aimed at enhancing income and food security through improved poultry production. The programme, called HOPE-A (Householder Poultry Enterprise-Asia), will include components relevant to FAO's Agriculture-Animal Alliance's (AGA) eight Programme entities and contribute directly to the objectives of FAO's SPFS.

1. Formed in 1975, APHCA is an intergovernmental agency that actively promotes and supports livestock development in member countries. There are currently 15 member countries. HOPE-A was approved as an APHCA initiative at their annual meeting in Bangladesh in 2000 and strongly endorsed and supported as a long-term activity at the 25th meeting in The Philippines in 2001.

During the development of HOPE-A, strong evidence has emerged that a number of countries require urgent help to improve control of infectious diseases and to enhance capacity in other aspects of poultry management. The needs are greatest in the poorer rural areas where women and children are the principal caretakers of village poultry and the main beneficiaries of their productivity.

Technical support will aim to increase the availability to farmers of effective and reliable vaccines against the most serious diseases. The technical assistance provided will also enhance capability in the region's veterinary and extension services to improve poultry management skills among farmers, most of whom are women.

Since the problem is regional, the project will include a regional operations and reference centre. As well as addressing the more urgent issues, this centre will be developed as a forerunner to a Regional Coordination and Information Unit (RCIU) for the HOPE-A programme, which will act as an ongoing reference and support service for regional poultry development. The centre will be located in FAO Regional Office for Asia and Pacific (RAP)/APHCA, Bangkok and use the APHCA electronic database in its role as a central operations centre. This location within the FAO/APHCA framework will underpin the unit's sustainability.

Goal and objectives

The broad aim of the project is to provide urgent assistance required to reduce the cost and improve the quality and availability of vaccines and other health-care interventions for village poultry and to enhance the capability of farmers and their support services in poultry management.

As well as addressing urgent needs for technical assistance, the project will form a platform for the HOPE-A programme, and thus is well-aligned with FAO's broad objectives in livestock production. It includes elements appropriate to virtually all of AGA's Programme Entities. In particular, the project will fill a crucial gap in RAP213A3 (Contribution of Livestock to Poverty Alleviation), that is, a lack of decision support technology aimed at small scale poultry farmers in the region. The project includes linkages with the International Livestock Research Institute (ILRI) in relation to the Animal Genetic Resources project, and the International Network for Smallholder Poultry Development. Additionally, the project will form linkages with other projects being funded by, for example, the European Union (EU) and the Asian Development Bank (ADB).

Specifically, the project's objectives will be to:

- Provide technical and advisory support in the development and implementation of vaccination programmes and other disease control strategies that are widely applicable to village poultry management in the region
- Identify specific training needs associated with the application of the disease control strategies that are developed and take appropriate steps to address these needs
- Initiate collection of development extension packages for regional use in training farmers and their support services in enhancing poultry management

- Identify other needs for assistance in managing and conserving village poultry that should be addressed, either regionally or bilaterally, with funding support from other sources
- Establish a regional reference centre that provides information, advice and extension material relevant to the development and conservation of rural poultry in participating countries.

The location of the regional reference centre in FAO–RAP–APHCA provides an infrastructure for effective regional operations and sustainability. For its communication and information exchange activities, the Unit will use existing FAO–APHCA facilities, including an existing APHCA web site and a server provided by FAO.

Annex. HOPE A – Proposal 2000



HOPE-A

proposal 2000

Animal Production and Health Commission for Asia and the Pacific (APHCA)



Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific (FAO-RAP)



Introduction

HOPE-A is designed to assist and encourage village poultry production in Asia including intensification if the conditions are right. It aims to benefit the rural poor, especially woman and children through assuring food security and providing opportunities for income generation.

It is proposed that HOPE-A be established as an initiative of the members at their 25th Anniversary Session to be held in Bangladesh in November 2000.

The development of livestock as an integral part of agriculture and rural development has always been an objective of APHCA. The strategy for achieving this goal has been founded on collective self-reliance and mutual assistance between the developing countries, and this successful model will be followed with HOPE-A.

Through time, the focus of food security has shifted from national and international food security concerns (food supplies) to individual and household food security (access, vulnerability, entitlement) (from FAO Homepage www.fao.org)



HOPE-A will therefore be an active enterprise, of and for APHCA member countries with the specific aims of:

- promoting joint action, co-operation, coordination and information exchange among the members for better householder poultry production;
- overcoming existing constraints to householder poultry production in Asia to the extent achievable;
- developing appropriate agricultural education and research that relates to Asian householder' poultry systems;
- seeking co-operation and assistance from relevant UN and other international and intergovernmental organisations to help implement HOPE-A activities;
- carrying out the above functions so as to raise the output and income of farmers, by developing profitable village poultry production.

For HOPE-A, poultry production assistance has a broad meaning. It includes research, development, extension, training, and support activities relevant to the production, marketing and management of village poultry in Asia.

HOPE-A will not directly undertake all the above-mentioned activities but will commission groups in Asia such as private, public and non-governmental organizations and individuals to carry out this work under umbrella partnership agreements.

HOPE-A, as an initiative of APHCA, will operate within the framework of the APHCA constitution, established 25 years ago, which stipulates management by the members and annual international audit of accounts. APHCA presently consists of 15 member countries; Australia, Bangladesh, Bhutan, India, Indonesia, Iran, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, The Philippines, Sri Lanka, and Thailand. Any country, which is a member of FAO, can easily join APHCA and therefore becomes a part of HOPE-A by requesting membership in writing, and acknowledging the existence of and willingness to follow the articles of APHCA.

Improving poultry production at the householder level should improve food security and assist with poverty alleviation. The guiding principles of the FAO's Special Programme on Food Security and the Department for International Development of the United Kingdom's (DfID) Sustainable Livelihood Approach will be followed to achieve this objective. The majority of householders in Asia live in rural environments and raise poultry, usually chickens which are relatively cheap to buy and maintain. In many cases, little or no supplementary feeding is given and the birds roost in trees or in the owner's home. Village chickens in particular fulfil a range of functions, e.g. the provision of meat and eggs, food for special festivals, offerings for traditional ceremonies, pest control, and petty cash. They require minimal external inputs, minimal human attention and cause minimal disruption to the environment. Village chickens are also the livestock most likely to be owned and cared for by women and children. Pigeons, quails, turkeys, ducks, geese and pheasants are also raised on a small scale with similar requirements.

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintains or enhances its capabilities and assets both now and in the future, while not undermining the natural resource base. (from DfID Sustainable Livelihood Approach)



FOOD SECURITY AND SUSTAINABLE LIVELIHOOD

Food security has been defined in a number of ways, but in any discussion on food security it is inferred that all people at all times need and deserve access to enough safe and nutritious food to maintain a healthy active life. Food security in practice, however, depends on activities carried out at various levels of aggregation such as the global, regional, national, household and individual. At the national level, food security has often been equated with the maintenance of a balance between availability of food and requirements for adequate nutrition (based on assumed needs per individual), known as the food balance. Food balance at any level, however, is not an adequate criterion for defining food security, because poor distribution and lack of purchasing power means not all of the national population would always have access to sufficient food, even though the food balance may be adequate.

Household food security relates to the ability of a household to meet its requirements from a variety of activities including food production, income generation, and gifts or assistance that can be used to provide the household with food. However, meeting household needs does not ensure individual food security because within a household food distribution may be based on social status, age and sex, rather than need, which makes estimating individual food security an extremely complex task.

By the year 2020 it is expected that the population in Asia will represent 57% of the world's population and rural poverty is expected to increase.
(from FAO Statistics)

For decades, the egg has represented the reference sample food, perfectly balanced, containing most essential amino acids, large amounts of calcium, phosphorus, magnesium, iron and zinc. It represents one of the main sources of vitamin A and of vitamin B complex. The egg represents the most affordable well-balanced source of protein, especially in developing countries where it can also represent a relatively easy source of income for vulnerable people. One egg provides 11.5% of the daily protein requirement and 5% of the daily energy requirements. It can be consumed directly through many delicious, easy to prepare recipes, or be incorporated in many well-elaborated products.



Our mission

To improve food security and reduce poverty of householders in Asia, by means of sensible interventions, involving participatory decision-making, in sustainable, affordable, village poultry production.



Our goals

To assist people living in rural areas of Asia who wish to improve their own lives, that of their communities, and the coming generations.

Our principal goals are:

- though increased poultry production to reduce poverty, enhance food security and conserve the natural resource base
- analyse and respond to local needs and resources in poultry production
- survey local farming systems and the social and cultural contexts in which poultry production is carried out in each country in the region
- promote and support community-based food security and nutrition programmes that encourage self-reliance, utilising participatory planning and implementation processes
- foster the growing appreciation in the region of the benefits of indigenous breeds and the inefficiency of improved breeds in resource-poor environments
- encourage rural households and communities to adopt low-cost technologies and innovative practices for improved poultry production
- promote policies and programmes which encourage appropriate input technologies, farming techniques, and other sustainable methodologies associated with local integrated poultry production
- promote, concurrently, regional collaboration in poultry disease control and sharing of information
- give assistance to national policy-makers and regional bodies involved in the development of legal, institutional and economic mechanisms which affect poultry production.



- support applied research including the continued collection, analysis and dissemination of data already available in numerous locations to foster greater regional and world understanding of agro-ecosystems
- undertake studies based on economic principles to demonstrate the benefits gained from activities undertaken with donor financing
- encourage participatory studies of women's involvement in poultry production
- training programmes to determine constraints to their involvement; development of planning procedures and training approaches which improve women's involvement in poultry production.

Stakeholders

HOPE-A's primary investors are FAO, APHCA and its member countries who contribute to the APHCA trust fund as well as members of the international donor community who may be encouraged to invest in this initiative.

HOPE-A's partners include those invited national and international agricultural research centres, scientists and administrators in national governments, policy and planning groups and agencies, non-governmental organizations and private individuals that can assist us in our mission.



Our vision and values

HOPE-A's vision as part of APHCA is expected to be recognised as an organisation that:

- contributes to improvements in food security and the lives of the people in rural communities in Asia
- assists with poverty alleviation in Asia
- is a partner in facilitating collaboration in the aid community in overcoming the problems of the future, and
- acts as an information source for the region and the world.

Livelihoods are sustainable when they: are resilient in the face of external shocks and stresses are not dependent upon external support (or if they are, this support itself should be economically and institutionally sustainable) maintain the long-term productivity of natural resources and do not undermine the livelihoods of other people, or compromise the livelihood options open to them. (from DFID Sustainable Livelihood Approach)

Some critical conceptual and operational issues

When examining the possibility of productivity gains in household poultry through better feeding, improved genetic material, health care, extension, the provision of credit and marketing, value adding to poultry outputs, and the encouragement of private sector investments in inputs and output processing, we are aware of critical conceptual and operational issues such as:

- reflecting the identified needs and priorities of our target group(s)
- recognising that possible solutions for problems within any community may differ from those applicable to others, and the importance of local ownership and devolution of decision-making
- the importance of delivery of solutions to problems to the sufferers
- ensuring implementation of programmes planned, with sensitivity and timeliness
- involvement of the private sector
- the effects of national macro-economic policies on small-scale poultry production and concomitant food security
- local area, national, and regional human capacity building needs.



Outcomes, indicators and strategies

Outcome 1. Productive and sustainable village poultry production in Asia is enhanced

Indicators

Evidence of HOPE-A activities providing:

- increased levels of village poultry outputs
- reduction in the costs of production
- adoption of appropriate technologies
- improved policy adoption relating to the above-mentioned, and
- significant social, economic and environmental benefits for target group/s in participating countries.

Strategies

- Seek funding for and commission bilateral projects that address the constraints to rural householder poultry production.
Broaden the information base and develop effective decision-making tools
- Promote appropriate technologies
- Develop effective interactions and communication.

Outcome 2. Efficient, transparent, accountable utilisation of donated resources

Indicators

- HOPE-A's stated project objectives achieved within budget
- Regular meaningful reviews of progress published
- Appropriate levels of stakeholder interactions.

Strategies

Timely problem identification and addressing
Programme completed on time and within budget
Pertinent delivery of benefits of research and development technologies
Implementing communication network
Attracting external resources.

The future

Food security is an important issue and agricultural production including livestock production plays an important part in providing food security for small-scale farmers in Asia.

Advances in human-environment understanding made in recent times mean that it is no longer enough for us to say 'We are increasing livestock (poultry) production' or 'We are preventing or controlling (poultry) diseases' and to be content that these activities are by definition good things. It is now necessary for us to provide evidence of the sustainable benefits to the whole environment to be derived from our actions in livestock production and animal health. The need to determine these benefits/actions is an imperative throughout the world, and livestock production specialists are not alone in having to come to grips with the problem of defining their role within this context. HOPE-A participants need to be aware of this, and to review progress, and commission cost-benefit analyses both *ex ante* and *ex post* of activities.

Food security is one aspect of livestock production and livestock production is one aspect of food security. Livestock production needs to be viewed in the broader context of sustainable rural development and food security is part of that broader context.



For further information, please contact:

HOPE-A

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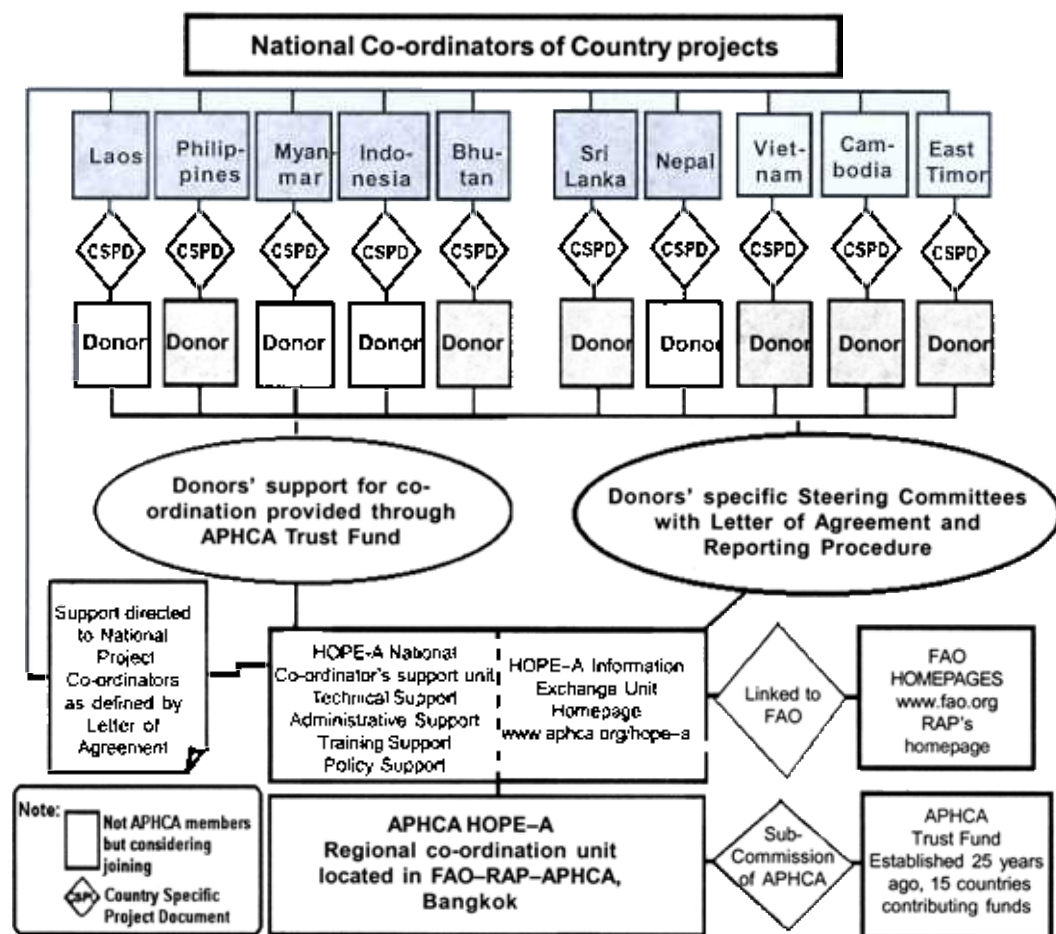
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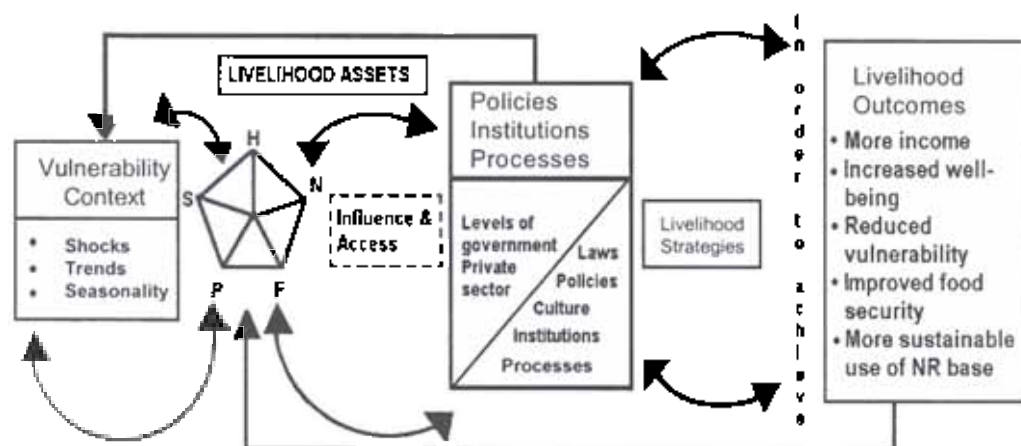
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HOPE-A Organisational Structure



Sustainable Livelihood Framework



(Source: DFID, www.livelihoods.org)

Key
 H = Human capital
 N = Natural capital
 F = Financial capital
 S = Social capital
 P = Physical capital

Managing and co-ordinating research in South-East Asia: The SEARCA R&D programme

R.L. Villareal

SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA)

Background

The Southeast Asian Ministers of Education Organization (SEAMEO) established the SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA) almost 35 years ago to serve the agricultural development needs of its 10 member countries: Indonesia, Thailand, Malaysia, Brunei Darussalam, Singapore, Cambodia, Lao PDR, Vietnam, Myanmar, and the Philippines. In addition, it benefits from the support of associate members Australia, Canada, France, Germany, the Netherlands, and New Zealand.

With the vision of becoming South-East Asia's leader in sustainable agriculture, SEARCA is committed to strengthening institutional capacity in sustainable agriculture for a food-secure South-East Asia through human resource development, research, knowledge exchange, and policy support.

The Center's focus on sustainable agriculture has moved it beyond the confines of traditional agriculture to a much wider perspective that gives equal emphasis to conservation and preservation of the natural environment. A systems approach to natural resource management requiring multiple and interdisciplinary work and close attention to the complexity of social, cultural, economic, and political dimensions in the use of natural resources is a marked shift in SEARCA's research and development (R&D) programme.

Specifically, SEARCA's functions include:

- 1) Provision of graduate scholarships (MS and PhD) and short-term training courses in agriculture and related fields to nationals of its member countries
- 2) Promotion, management, and coordination of research activities related to the needs and important problems of agriculture in South-East Asia
- 3) Dissemination of the findings of research to enhance agricultural development in the region and in support of policy formulation and
- 4) Provision of development services through consulting to address the needs of its member countries.

Philosophy of SEARCA's research

The Center espouses a holistic approach in conducting major functions. Correspondingly, SEARCA's R&D programmes and activities complement, support, and are related to its other major functions, particularly human resource development (which covers both graduate scholarships and short-term training), information dissemination/networking, and consulting.

The following philosophies or principles guide SEARCA in the implementation of its research activities:

- 1) SEARCA primarily co-ordinates and manages research. The Center identifies and develops research projects but relies on partnerships and collaborations with individuals and institutions to implement the research. SEARCA undertakes in-house research on a limited scale, primarily for project development, piloting, and resource and socio-economic profiling.
- 2) SEARCA's R&D programmes are integrated. SEARCA works at closely integrating its various R&D programmes, adopting the interdisciplinary and multidisciplinary approach. This effort includes its focus on strategic issues that require an interplay of its major programmes and its special concerns. This means that the Programmes relate substantively as well as on a site-specific and geographic plane. Necessarily, the Center's research staff is also evolving into a core discipline-based team for more effectiveness in contributing to the goal of integration.
- 3) SEARCA research is for development. The Center's research focuses on strategic issues of regional importance. It generates, assembles, and disseminates information important to agricultural development, and pilots and validates technologies and methodologies that promote sustainable agriculture. The Center coordinates research to provide a basis for decision-making and policy formulation.
- 4) SEARCA research is downstream and applied. The Center facilitates technology development and adoption. It focuses on technology transfer, methodology development, and lessons learned. It espouses participatory and community-based approaches. Ultimately, SEARCA research efforts contribute to policy formulation.
- 5) SEARCA research is geographically focused or located across three major ecosystems, covers production to post-production processes, and integrates crosscutting concerns within its activities. Research focuses on upland, lowland, and coastal zones in a landscape continuum that underscores the holistic and integrated nature of ecosystems and landscapes.

Identifying research priorities

SEARCA operates on the basis of Five-Year Strategic plans, through which it aims to meet its mandate and to respond to current and emerging needs of its member countries. The Plan serves as the blueprint of the Center for its development efforts and operational programmes for the period, including R&D.

The Plan is a product of a myriad process of consultations and validation, particularly on the aspect of identifying research priorities. To be attuned to the development priorities of the region, SEARCA conducts and participates in consultative meetings, workshops, and numerous scientific fora participated in by representatives from member countries, partner institutions, and donors. It conducts needs assessments and short-term training, the results of which help SEARCA direct its development efforts, including those on research. The Center also uses its established networks, particularly its University Consortium, as feelers to determine the prevailing problems and gaps in agricultural development in South-East Asia. More importantly, the Center undertakes continuing purposive appraisal of the situation faced by the agriculture and rural sectors of the region and provides appropriate assistance to its member countries.

It is imperative to note that while the targets of SEARCA's R&D efforts are ultimately the resource-poor farmers and fisher folks, the Center does not directly deal with them. Instead, SEARCA works through institutions like government line agencies, local governments, academic institutions, research organisations, and non-governmental organisations (NGOs) that are directly involved in agricultural and rural development.

As an input to the current Five-Year Strategic Plan, information gleaned from the aforementioned combination of consultations with research partners in the different countries, donors, and the pool of experts from the University Consortium was processed and subjected to a planning workshop of the R&D group of the Center. The resulting research priorities passed various screening and approval levels within SEARCA.

To validate the Plan and further enhance its assessment of the region's needs, SEARCA also consulted and sought the approval of its Governing Board, which is composed of a representative from each SEAMEO member country nominated by their respective Ministers of Education and appointed by the SEAMEO Council. The SEARCA Governing Board is responsible for determining operational policies, strategic planning, review of the Center's programmes and budget, and annual evaluation.

Finally, the Plan is submitted for approval by the SEAMEO Council. The complex process undertaken to formulate the Plan seeks to chart general directions for SEARCA's programmes crucial to ensuring its relevance and fulfillment of its mandate in South-East Asia.

Under its Seventh Five-Year Plan, SEARCA implements four major R&D programmes that represent its identified thrusts for the period. These are: Natural Resource Management Programme, Agro-Industrial Development Programme, Knowledge Management Programme, and Special Projects, which include the crosscutting concerns of Gender and Development and Policy Studies.

SEARCA's research is characterised by functional integration of its identified programme thrusts in terms of geographic location, interrelated activities and focus, and pursuit of the overall goals of increased adoption and practice of sustainable agriculture in the region. A major effort is being made toward the integration and complementation of projects and important crosscutting concerns along the priority themes. A variety of strategies are employed to attain the intermediate outputs of packaged sustainable agriculture and decision support models, knowledge products, policy recommendations, pilot-tested sustainable agriculture technologies, and strengthened capacities of institutions.

These efforts are all geared toward a food-secure South-East Asia in consonance with the mission of the Center.

Priority research themes

At present, SEARCA focuses its R&D programmes on important issues that fall within the five priority themes indicated in its Seventh Five-Year Strategic Plan. For the period 1999–2004, these themes compose the bedrock of SEARCA's programmes and activities, particularly those of its R&D, as regional conditions dictate.

Food security

Escalating global population translates to increased demand for one basic commodity – food. In South-East Asia, home to about 530 million people representing about 12 percent of the world population, the effects of food scarcity are more severely felt by a large percentage of the population living in poverty. Food needs in the region are expected to nearly double in 30 to 40 years.

The issue of food security covers a wide range of socio-economic, land use, and cultural variables. Food security concerns also include activities related to accessibility of food supply made possible by ensuring sustainability of production, narrowing the gap between changing market demand and dwindling supply, and searching for new ways to improve enterprise handling in agro-industrial communities.

Food security is likewise inherently linked to food safety. Food safety concerns are complex, as there is a need to look at the issues of rapid urbanisation, emerging pathogens, and introduction of novel foods and technologies for it to be appropriately addressed.

Approaches to food security were developed as a result of several SEARCA-completed research. However, in line with the global food summit's objectives of improving the food security of low-income food-deficient countries through rapid increases in productivity and food production, and by reducing year-to-year variability in production on an economically and environmentally sustainable basis, SEARCA uses its advantage of having strategic partners in South-East Asia to further promote sustainable agriculture through agro-industrialisation and natural resource management.

Biotechnology

Biotechnology offers many new opportunities for meeting the challenges of food security, natural resource management, and agro-industry. It represents a viable solution to food production problems through genetic modification of crops to increase yield without the excess use of chemicals and soil-degrading farm practices.

The advances made in this field have generated a sense of concern in the scientific and research community as well as among various governments. These have highlighted the need for risk assessment and management, and focus on safety concerns. Thus, significant

applications and new practices as well as biotechnology products have to be critically examined, evaluated, and controlled. Consequently, the ethical and policy implications of biosafety standards need to be assessed.

The Center aims to build information based on research and assessment studies on the possible effects of genetically modified organisms and other newly introduced technologies on the environment, the economy, health, and the agriculture sector in developing countries based on biosafety guidelines. This will help solidify the stand and policies that governments in the region may adopt on biotechnology issues.

One of our initial activities related to this priority theme is the establishment of the Biotechnology Information Center (BIC), initially in partnership with the International Service for the Acquisition of Agri-biotech Application (ISAA). As a public information center, BIC will cater to the needs of the general public for factual, credible, and balanced information on biotechnology in South-East Asia. We desire it to be a one-stop place where the public can go to and learn about the pros and cons of biotechnology. We are designing it to be a venue of critical research-based debate on matters concerning biotechnology.

Biodiversity conservation

SEARCA's biodiversity research and development programmes will continue to focus on biodiversity maintenance, promotion, enhancement and rehabilitation. Among the important concerns are: 1) environmental profiles through resource inventory; 2) application and impact evaluation of biotechnologies and indigenous knowledge systems concerning biodiversity conservation; 3) policy analysis and advocacy specifically on bioprospecting and indigenous knowledge systems; 4) generation of knowledge on population dynamics, corridor links, and habitat connectivity vis-à-vis biodiversity conservation.

The priority theme has been concretely validated by research partners like the Netherlands Development Assistance Research Council or RAWOO, which is now working with SEARCA in implementing a five-year 'Biodiversity Research Programme: Focus on Mt. Malindang'. This programme has multi-sectoral participation and operates on a South-North collaboration framework.

It is uniquely anchored on six agreed basic working principles, namely: partnership, participatory, community-driven, multi-sectoral, interdisciplinary, and location-specific.

Water resources management

Worldwide, the gap between water consumption and availability has been widening. The United Nations projects that the share of the world's population in countries undergoing moderate or high water stress could rise to two-thirds by 2025. Though water supplies are abundant globally, these are not evenly distributed among and within countries. Agriculture accounts for about 70 percent of water consumption, but irrigation services for agriculture are free or minimally priced compared with water uses in other sectors. The water situation is expected to worsen over the next three decades, with population growth and socio-economic development as the primary driving forces for increased water demand.

The challenges, therefore, are manifold. Among the urgent concerns are: 1) institutionalising water sector reforms, i.e. water pricing and distribution; 2) establishing more efficient water management systems; 3) mitigating pollutive effects of industries; 4) incorporating biodiversity concerns in river/lake development projects; and 5) promoting responsible water use.

Environmental risk management

The Center continues to work toward improved understanding of the intrinsic and evolving processes, dynamics, and mechanisms by which agriculture contributes to resource degradation. This is in support of the drive toward developing and extending technologies and enhancing policies that will ensure the continued productivity of natural ecosystems, cleaner production from agro-industries, and internalisation of negative externalities from agriculture-related operations.

Enhancing research through knowledge management and policy

SEARCA believes that the value and impact of its research may only be felt if it reaches a critical mass of its users and it is translated into action that can spur development. The Center will concentrate its efforts in two areas seen as effective vehicles for its research results: knowledge management and policy support.

Knowledge management entails an extra step to process information generated by research projects to knowledge that is usable and applicable for development. Distillation and documentation of lessons learned and packaging these into multimedia products are seen as integral activities that increase the impact of research activities. Also within the purview of knowledge management is the development of specialised databases and information networks to facilitate dissemination and access to information and knowledge by a wide spectrum of users. Knowledge management is an area that SEARCA has begun to invest on and will pursue in the coming years.

On the other hand, the importance of the Center's entry into the area of policy studies cannot be overemphasised. The underlying logic is that if the products of research could be converted to policy recommendations or to formulate policies, then the impact would be much greater. Laying empirical and scientific basis for decision- and policymaking is the ultimate goal that SEARCA has set for its research. As such, whenever possible, research projects at SEARCA have a policy component. The Center also convenes strategic fora to discuss important issues affecting the region and co-ordinates policy research to address these issues.

Concluding remarks

The true worth of SEARCA as a regional centre for agriculture lies in its capacity to address the needs of the region it is mandated to serve. Among its more recent efforts in this area is the organisation and co-ordination of the Third Regional Experts' Workshop on Food and Agriculture Policy held in Singapore and the Food Safety Conference in Bangkok in 2001. The Center also serves as regional coordinator for the ASEAN-APEC Post-harvest Conference, a series of conferences that will be done every two years. Likewise, it coordinated the FAO Asia Regional Consultation on Post-harvest, done in The Philippines last year. In addition, SEARCA is a member of the technical team and, as such, has been actively involved in the Asia Pacific Roundtable for Cleaner Production, with discussions to be conducted every other year.

Many other similar Center initiatives are slated this year. It looks forward to the continuing and unstinting support and cooperation of its partner institutions to help make these initiatives redound to the greater benefit of the South-East Asian region.

A living from livestock: The pro-poor policy initiative

J. Otte

Food and Agriculture Organization of the United Nations (FAO)

Introduction

Before going into some of the details of the Pro-poor livestock policy initiative, I wish to quickly recapitulate the rationale behind the project, which at the moment is still very much in its starting phase.

Much has been said about this time as a time of very rapid change in the livestock sector, and about the nature of the changes, e.g. intensification, growth in scales, vertical integration, etc. but often we don't seem to think explicitly of the main driving force behind this rapid change, namely human demography. As human population increases, associated changes in the global environment include:

- growing pressure on natural resources
- increased conflicts and crises
- increased interdependency
- reduced roles of national states
- accelerated rate of technological change and
- the 'livestock revolution'

Statistics on the future human population show a high growth rate of the urban population with very little or no growth in the agricultural population. This trend has severe implications for food production and food markets. It is projected that in approximately 30 years time, more or less the same number of people in agriculture will have to supply food for about two billion additional urban consumers.

Let's look at the annual growth rates in consumption of livestock products. A decade ago (1987–1997), consumption of livestock products was growing at over 3% while that of cereals was growing at under 2%. Now these rates of change are slowing down so that perhaps the peak of the livestock revolution may have passed. However, if the figures are projected over the next 30 years, even at the lower growth rates, the cumulative impact on livestock numbers is still very large. For East Asia, numbers of almost all livestock species are predicted to grow by about 50%. In South Asia, poultry is expected to grow by 150%. In West Asia, Latin America and Sub-Saharan Africa livestock populations are also predicted to grow at a cumulative rate of about 50%. When one converts these growth rates into actual numbers, they add up to very substantial increases in total numbers of animals. In

East and West Asia, poultry is predicted to grow by about 3 billion additional chickens, 150 million additional sheep and goats, and 100 million additional cattle and buffaloes. Where and how will these additional animals be kept?

Parallel to the increase in livestock populations, we are seeing an increase in trade of livestock products. Not just domestic production is growing, but more livestock products are being shipped around. Poultry meat trade has been growing by about 10% per year and trade in the other meats has been increasing at about 4% per year.

Societies are rapidly urbanising (earlier it was pointed out that 10 of the 15 mega cities in the world are in Asia), and more mega cities will evolve. So how are the urban societies going to be supplied with livestock products? Will it be by trade, by domestic production around the cities, or by domestic production somewhere in the more rural areas?

Projections of net trade in meat show that South Asia, East Asia, Sub-Saharan Africa, Northern Africa and West Asia will, on the whole, become net importers. The industrialised countries are the major net exporters and their net exports are predicted to grow. So there is a large and growing trade flow of livestock products from the industrialised countries to Asia and Africa.

Despite these projected increases in trade in livestock products, domestic livestock production will be the major means of satisfying increased demand for livestock products from growing and wealthier urban populations. In developing countries, a vast majority of people still make their living from agriculture. In large areas of Africa, more than 75% of the people are still in agriculture. In Asia, some areas have between 50 and 75% of the people in agriculture while in other areas the figure is between 20 and 25%, which still is very high compared to the proportion of people in agriculture in developed countries.

Thus, in the developing countries we have a strongly growing demand for livestock products, large populations engaged in agriculture and livestock keeping, and a large number of rural poor people. From the above, one can conclude that:

- the livestock sector can be an important entry point for rural development and poverty alleviation
- the demand stimulus will increasingly come from rapidly growing urban populations and markets
- current policies favour the development of peri-urban agro-industrial complexes e.g. through importation of 'cheap' animal feed leading to growing animal and human health, environment and social problems and
- small-scale livestock producers do not have a strong voice in livestock policy decision-making.

The project

The overall goal of the Pro-poor policy initiative project is to contribute to poverty reduction through the formulation and promotion of livestock policies at national and international levels that ensure equitable, safe and clean livestock farming. This implies that trade-offs

will have to be made between the environment, social/equity and food safety/public health issues affected by livestock keeping. By making these trade-offs explicit and by ensuring that all relevant stakeholders are involved in the policy formulation process the project endeavours to contribute to a policy environment that allows small-scale livestock keepers to participate in the growing market for livestock products rather than being squeezed out.

The project consists of a Central Livestock Policy Facility at the FAO headquarters in Rome and foresees the establishment of Regional Livestock Policy Modules. The regional modules would be situated in 'regions' which comprise a group of fairly 'homogenous' countries facing similar situations, and, ideally, with established economic ties. So, for example, a module is envisaged for East Asia, one for South Asia and another for the Greater Horn of Africa. Currently, funding has been made available by DfID for the headquarters facility while the regional modules are still in a design phase and funding will have to be sought.

Public policy making is a complex process that involves management of conflicting views and the reconciliation of diverging interests. The process is currently further complicated by increasing pressure from national and transnational organisations of civil society on public institutions to create new venues for access and political participation, to better address the intricacy of political and social issues and interactions, and to compensate for the diminishing competence and 'power' of national governments. The general acceptance of public policies is thus intimately linked to the perceived 'legitimacy' of the policy-making process, which essentially 'involves getting the right kind of people into the right kind of interactions over the right issues inside the right structures'. To be considered legitimate, the process of policy-making must therefore be transparent, inclusive, and consultative. In addition, policy options will have to be explored which grant poor, vulnerable and otherwise disadvantaged groups access to means of development and improvement of human welfare.

Although livestock products are consumed in all societies and livestock are part of the economies of all continents, livestock are kept in widely varying eco- and production systems and the sector is subject to highly variable regulatory frameworks, political and economic conditions and cultural settings. A 'one-size-fits-all' approach to public policy is unlikely to lead to concrete, situation-specific outcomes and emphasis will thus be placed on a decentralised approach addressing regional concerns; i.e. regional public-policy networks covering sufficiently homogeneous clusters of countries with similar concerns and cultures are required (e.g. Horn of Africa). The objective of the project is to then stimulate responsive domestic political processes leading to the emergence of locally generated strategies that will enhance the share of the poor in the Livestock Revolution.

It is envisaged that the process goes beyond the generation of scientific/technical knowledge and exchange of views and leads to clearly defined regional implementation plans, which are widely supported and implemented by regional actors. At the same time, the regional processes should contribute to the global dialogue so as to establish a self-reinforcing process.

The following four, intimately related, key elements are therefore proposed as the foundation for the building of both the headquarters facility as well as the regional public-policy networks:

- Stakeholder engagement
- Research and analysis
- Communication and information
- Negotiation and conflict resolution

Stakeholder engagement

A large number of actors from all sectors of society are directly or indirectly involved in, or affected by livestock. These actors range from the individual, small-scale producer to multinational agribusiness, from local councils to international standard-setting bodies and from local charities/self-help groups to international, well-organised non-governmental organisations (NGOs). All of these actors have legitimate interests but none should claim to be the primary reference point in livestock and poverty issues. The only possible way to approach the complex inter-relationships is through collaboration and enlistment of the voluntary cooperation of other actors, while recognising that each will have a distinct view.

Research and analysis

Decision-makers often suffer from a lack of information, knowledge and tools to understand and respond to the complexity of policy issues in the liberalising and globalising world and its extremely rapid technological advances on all fronts. Countries are more and more entangled in increasingly complicated webs of political, economic and environmental dependencies; one of the results being that assessing the options and range of consequences of alternative courses of action has become exceedingly difficult.

Without rigorous scientific research and analysis the process of policy-making may not be trusted because it is perceived to be poorly informed. Research and analysis produce information that is vital to enlighten the social dialogue while the social dialogue helps to inform research by defining what it is that people want to know and what technical solution to chose.

Communication and information

The exchange of information between stakeholders is generally weak and hampered by mutual distrust and poorly developed communication channels. A high degree of openness and transparency, constant communication with all stakeholders and effective and timely dissemination of project results are essential to promote higher levels of confidence and trust among stakeholders. Furthermore, the project should be highly visible and create general awareness amongst a variety of audiences worldwide.

Negotiation and conflict resolution

The numerous stakeholders directly or indirectly involved in livestock have differing, at times opposing, interests and views. Examples are the livelihoods focus of the South versus the environmental concerns of the North, the controversy over property rights to genetic material between farmers and transnational companies, or local versus regional animal health priorities. The core task of the project will be to articulate the opposing positions and to facilitate negotiation and reconciliation of views between stakeholders leading to agreed standards, policies and actions.

The project commenced in October 2001 and is envisaged to run for a period of six years. The first year will be dedicated to recruitment of the facility's core staff, the development of detailed proposals for the regional modules and the preparation of assessments/studies such as:

- The development of a refined typology of livestock-dependent poor taking into account differences in asset base, labour endowment, proximity to markets, etc.
- Quantitative assessment of the sub-regional distribution of the identified types of livestock-dependent poor
- Spatial analysis of the demand growth and the competitiveness of smallholders vis-à-vis commercial producers and international competitors to satisfy growing demand
- Analysis of the political economy of livestock sector policy making at all levels, from the World Trade Organization(WTO) down to national and sub-national policy making, and an assessment of the inter-relationships between the various levels of policy making as well as their relevance for small-scale livestock producers
- Pathways for poverty alleviation tailored to specific macro- and micro-economic circumstances.

With this, I hope to have provided an overview of the essence of the Pro-poor livestock policy project, the details of which will undoubtedly evolve over time. I am sure that the project is complementary to many of the more technically oriented research and development activities where many of you are involved in this region. I hope that through continuous exchange of information we can exploit synergies to the largest extent possible.

Livestock to 2020 in South-East Asia: Implications for policies and development strategies¹

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From the beginning of the 1970s to the late 1990s consumption of meat and milk in developing countries increased by 175 million tonnes, more than twice the increase that occurred in developed countries. The market value of the increase in meat and milk consumption over the period in the developing countries was about \$155 billion (1990 US\$), more than twice the market value of increased cereals consumption under the green revolution (Table 1). Factors driving the demand for livestock products in the developing countries are primarily population growth, urbanisation and income growth. These factors are expected to continue to fuel the increase in milk and meat consumption in the next millennium, creating a veritable livestock revolution.

Table 1. Value of food consumption increases for meat, milk, fish and major cereals (1970-1995).

Commodity	Developed countries	Developing countries
	(billion 1990 US\$)	
Meat	37	124
Milk	14	29
Fish	27	68
Major cereals	3	65

In the developing world, consumption of meat and milk products grew fastest in South-East Asia where income grew by 7-8% annually during the past two decades. Total meat consumption in the region rose from 4 million tonnes in 1983 to 9 million tonnes in 1997. Figure 1 shows that within South-East Asia, the growth rate in meat consumption for the same period was most significant in Indonesia (133%) and the Philippines (100%).

Due to rapid income growth, per capita meat consumption increased rapidly in the region from 11 kg in 1975 to 18 kg in 1997. It was fastest in Malaysia where meat consumption per person increased from about 26 kg to 55 kg over the same period (Figure 2). Despite

This article is based on the reports Delgado et al. (1999a) and Delgado et al. (1999b). The references for the data and findings presented in this article can be obtained from Delgado et al. (1999a).



Figure 1. Total meat consumption by country (1975, 1983, 1997).

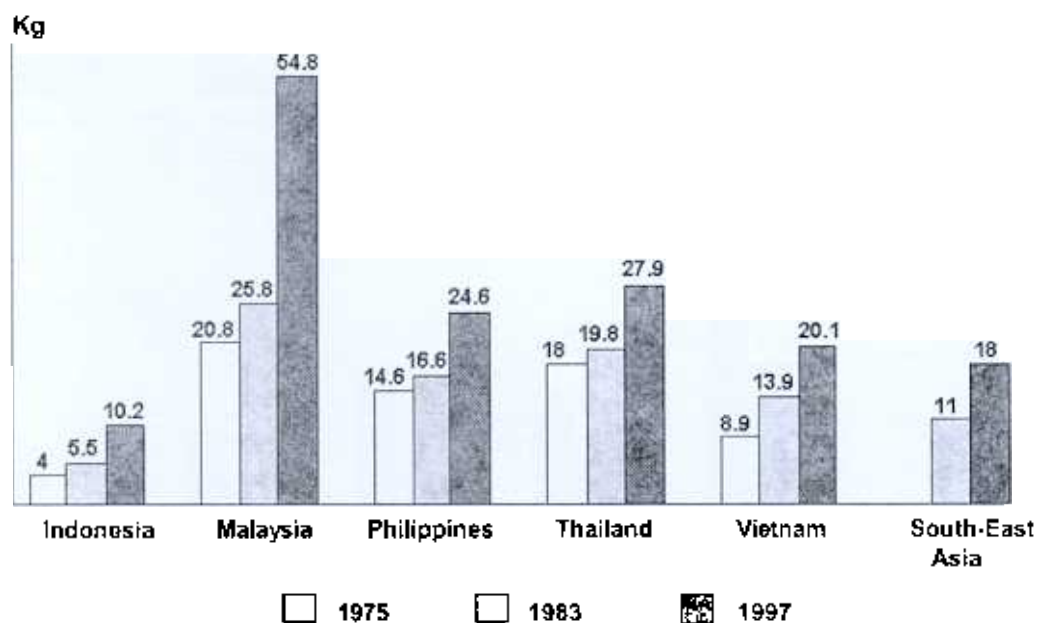


Figure 2. Per capita meat consumption by country (1975, 1983, 1997).

the rapid increase in demand for livestock products, the impact on prices of grains over the same period has been limited. In fact real prices of grains such as maize have been on a declining trend since the early seventies.

Will such trends in livestock products consumption continue in the future? The population growth, urbanisation, and income growth that brought about the increase in meat and milk consumption are expected to continue well into the 21st century. Compared to 1997 levels, the share of the world's meat consumed in developing countries is projected to rise from 53 to 65% by 2020, while their share of the world's milk consumption is projected to rise from 44 to 57%. By 2020, South-East Asia is projected to consume double the amount of meat and milk it consumed in 1997.

Within South-East Asia, total consumption of meat will be highest in the Philippines and in Indonesia where they are projected to increase from 1.8 and 2.1 million to 4.3 and 4.2 million tonnes respectively (Figure 3). By 2020, per capita meat consumption will have increased across South-East Asian countries and will remain highest in Malaysia at 67.6 kilograms (Figure 4).

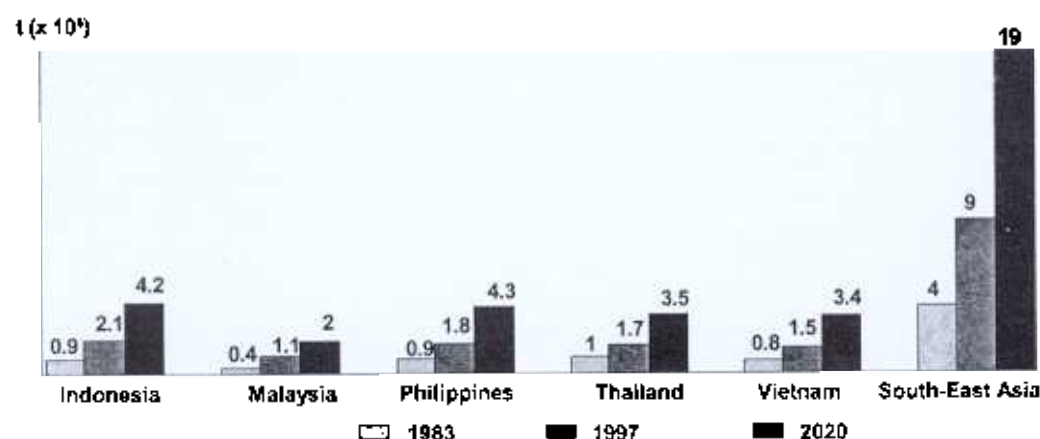


Figure 3. Total meat consumption by country (1983, 1997, 2020).

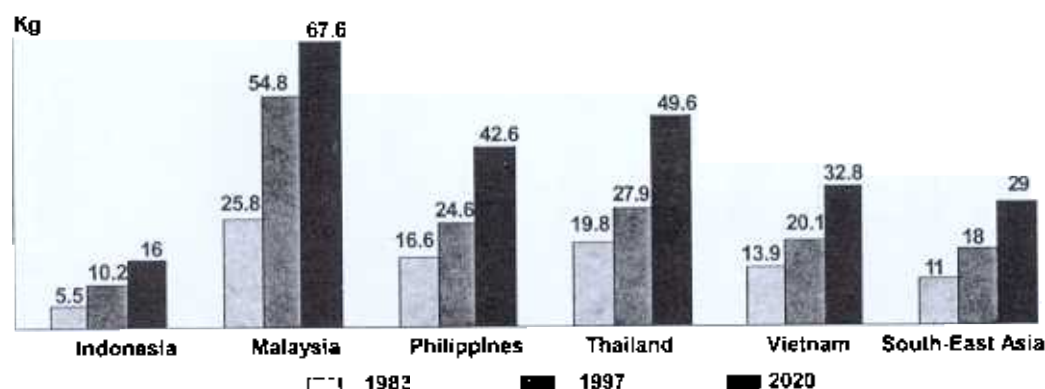


Figure 4. Per capita meat consumption by country (1983, 1997, 2020).

Production patterns closely follow consumption patterns. Due to the relatively high cost of handling perishable products, most meat and milk in South-East Asia will be produced where it is consumed, aided by increasing feed imports. Because much of the expansion in meat production will come from monogastric livestock such as pigs and poultry, this will create heavy demand on high-energy feed such as cereals. According to projections for 2020, developing countries will significantly increase the use of cereals as feed to 432 million tonnes as compared to 235 million tonnes in 1997. In South-East Asia cereals used for feed purposes will increase by 80% to 27 million tonnes in 2020 compared to their 1997 level of 15 million tonnes (Figure 5).

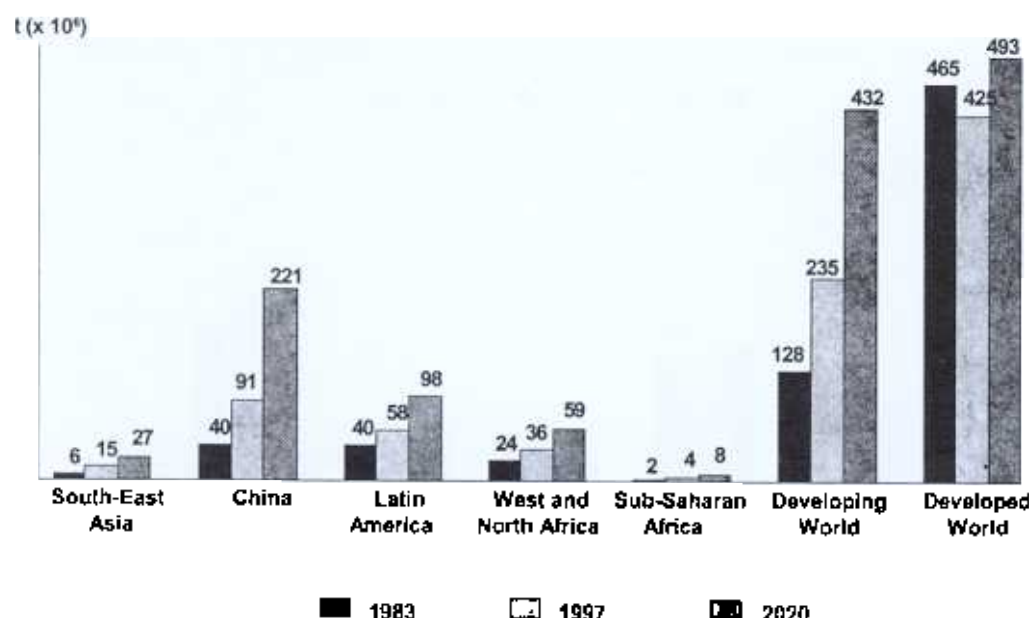


Figure 5. Cereals used as feed by major region (1983, 1997, 2020).

Despite the projected boost in the consumption of livestock products and cereals used as feed, the real prices of feed and livestock products is anticipated to fall in the next twenty years, although not as rapidly as in the last two decades. Maize prices fall the least by 2020, reflecting high demand for feed (Figure 6)

The study also shows that changes in production efficiency matter greatly to the competitiveness of individual countries to the use of cereal as feed but barely affect livestock consumption. Assuming that between 1997 and 2020 the amount of feed required to produce a unit of meat and milk in developing countries rises by 60%, world maize prices would increase by only 21% in 2020 than the baseline projection period. In real terms that level is still half the prevailing prices in the early 1980s (Figure 7).

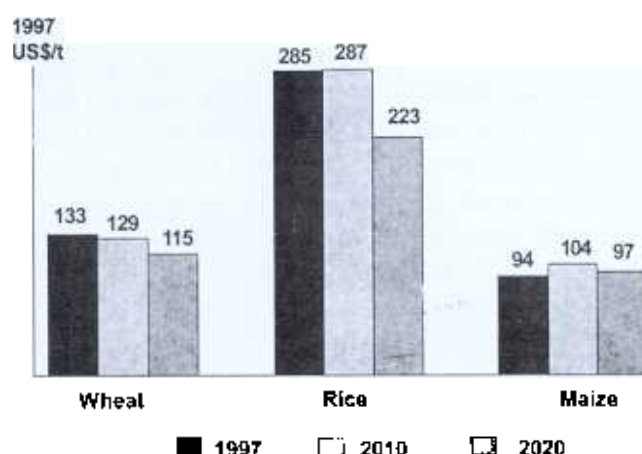


Figure 6. Real prices of wheat, rice and maize.

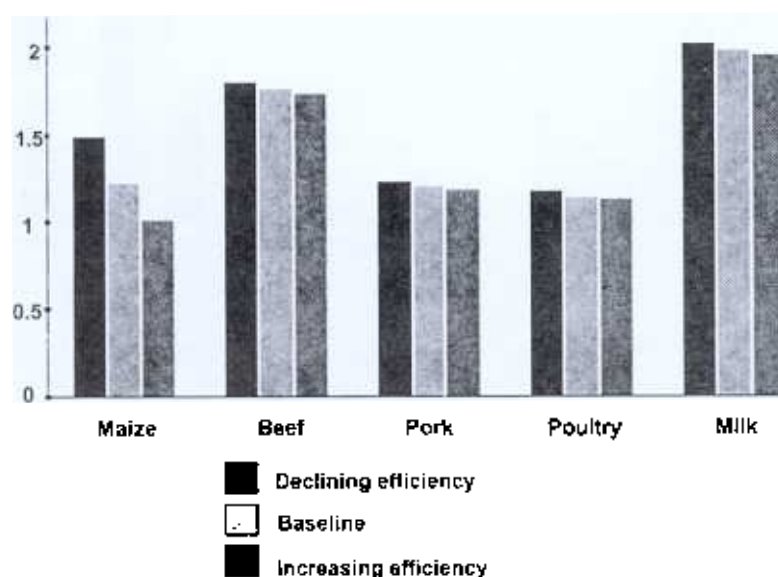


Figure 7. Projected real prices, 2020.

The expected significant increases in demand for livestock products in South-East Asia will have significant implications on the livelihoods of poor livestock producers, human health, and the environment, thus raising vital concerns for poverty alleviation. The Livestock Revolution can raise farm income significantly, but whether poor smallholders and landless agricultural workers who need it most will have a share in that gain is still undetermined. In many of the South-East Asian countries, ownership of livestock can provide a key income

supplement for the landless and otherwise asset-poor. Increased consumption of livestock products therefore creates an opportunity for improving the incomes of poor farmers and food processors. However, the rapid industrialisation of livestock production due to the wrong policies can supplant small producers, preventing them from taking advantage of the dynamisms of the markets. Unless market distortions favouring large-scale producers are removed, and poverty-alleviating policies are geared towards small producers, there is a risk that industrial livestock producers may drive the poor out of the market.

Policies that are pro-poor will go a long way in alleviating the livelihoods of the poor. Distortions in domestic capital markets that often promote inefficient, large-scale pig, milk, and poultry production in the peri-urban areas of South-East Asian countries need to be removed.

The Livestock Revolution may also worsen environmental problems. Animals will likely be produced more intensively in places where financial capital is cheap relative to land, worsening waste and air problems. In addition to the environmental risks, the Livestock Revolution poses also some other public health risks concerns. The larger concentrations of animals and people in many urban areas of South-East Asian countries raise the incidence of zoonotic diseases (animal diseases that are transmissible to human beings). As the consumption of livestock products increases in tropical climates of South-East Asia, there is also a concern that food safety risks from microbial contamination will become more prevalent.

Greater intensification of livestock production has caused a build-up of pesticides and antibiotics in the food chain in many places of both the developed and developing world. There are also concerns as to whether biotechnology and the policies of the World Trade Organization will leave room for the poor. With sanitary and phyto-sanitary measures becoming more prevalent for agricultural and especially livestock commodities, poor livestock producers will not be able to access international markets unless they reform their domestic policies to maintain acceptable veterinary and human health standards.

Public action is required to guarantee smallholders and low-income agricultural workers to benefit from the possible gains of the Livestock Revolution. Policies need to be geared towards removing distortions. For instance, pro-poor policies will have to remedy distortions that promote artificial economies of scale such as cheap credit targeted to large scale producer.. On the other hand, economies of scale in inputs and marketing need to be secured while smallholder producers need to be empowered to increase negotiation skills and organisation capacity as well as overcome information barriers to extension services, markets etc. Institutions that link small-scale producers vertically with processors of perishable products have to be created. In addition, there is a need to generate policies that can:

- increase access to markets by smallholders and improve the competitiveness of the smallholder under increased trade liberalisation
- create public goods for livestock development (for example technology development)
- internalise environmental costs to avoid perverse financial incentives
- develop regulatory mechanisms for dealing with health and environmental problems from livestock and
- promote nutritional programmes for consumption by the rural poor.

Government policies towards infrastructure development, pollution abatement, access to capital, and rural organisation will affect the comparative advantage of smallholders versus large industrial enterprises.

The Livestock Revolution provides a unique opportunity for securing higher incomes for smallholder producers in South-East Asia. However, unless governments take responsible action to secure the possible benefits to smallholders, the potential gains in the livelihoods of the rural poor, food security, poverty alleviation, growth, and environmental sustainability will be seriously undermined.

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A global study of poverty and livestock¹

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The UK Government's Department for International Development (DfID) is committed to achieving International Development Targets in poverty reduction. Given this wider focus on poverty reduction, there is an urgent need for research and development agencies to reconsider how best to operate in ways that will benefit poor people.

There are various fundamental questions that need to be answered if livestock research and development activities are to contribute effectively to the goals of organisations such as ILRI and DFID. For example:

- How do livestock contribute to the livelihoods of poor people?
- Where are significant groups of poor livestock keepers located?
- What other features characterise these groups of poor people?
- How are these populations likely to change in size and location over time?
- How are their physical environments expected to change in the future?

In general, our ability to answer such questions satisfactorily is very patchy, both spatially and temporally. In-depth study of communities in terms of the sustainability and vulnerability of their livelihoods can provide very useful information at a case-study level. However, there is a real need for poverty assessments at the national, regional and even continental level to assist in targeting research and development activities that may have a positive impact on large numbers of poor people.

The objective of the study described here, commissioned by DfID in 2001, was to produce sets of maps locating the significant populations of poor livestock keepers in the world, and to assess in very broad terms how these populations are likely to change over the next three to five decades. The outputs were to include maps illustrating the global distribution of poor livestock keepers, and the project was to make use of existing data and spatial data layers, together with information from the literature and the opinion of appropriate experts.

The general flow of data to achieve these objectives is shown in Figure 1. The central element is a global livestock classification based on that of Seré and Steinfeld (1996). We defined the classification primarily in terms of climate and human population density (Figure 2). Previously, we had developed population scenarios to 2050 for Africa (Reid et

1. This paper is taken from "Poverty and livestock mapping," final report to the UK Department for International Development by Thornton et al. (2002), and is presented on behalf of Russ Kruska, Norbert Henninger, Patti Kristjanson, Robin Reid, Fred Arieno, Andrew Odeto and Thomas Ndegwa. Many people gave freely of their input, and their contributions are acknowledged in the main report. Keywords: Poverty mapping, poor livestock keepers, systems characterisation, systems evolution.

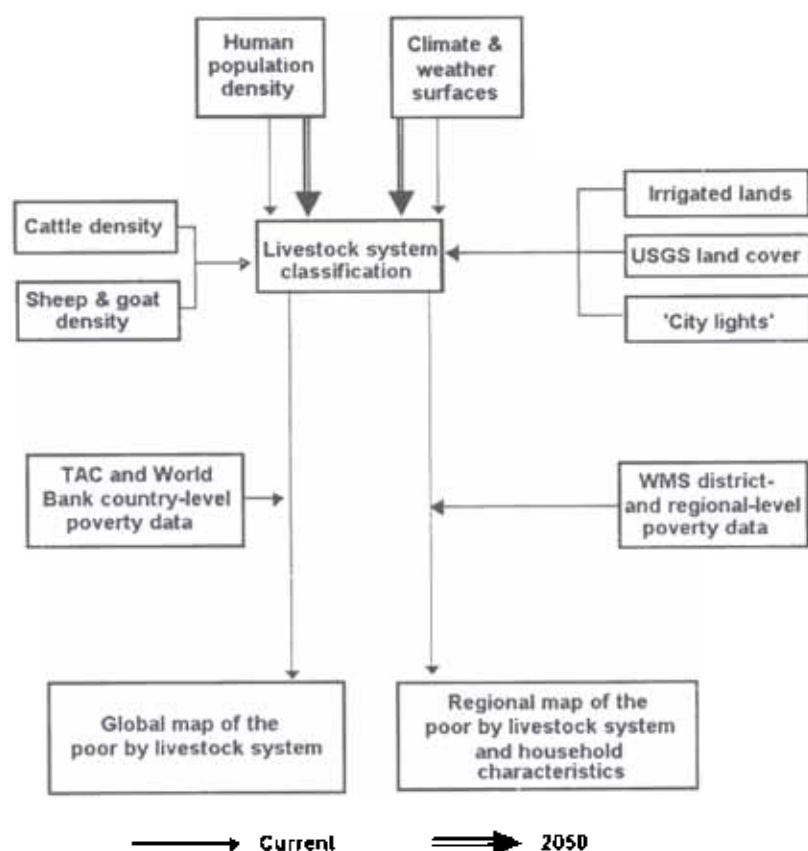
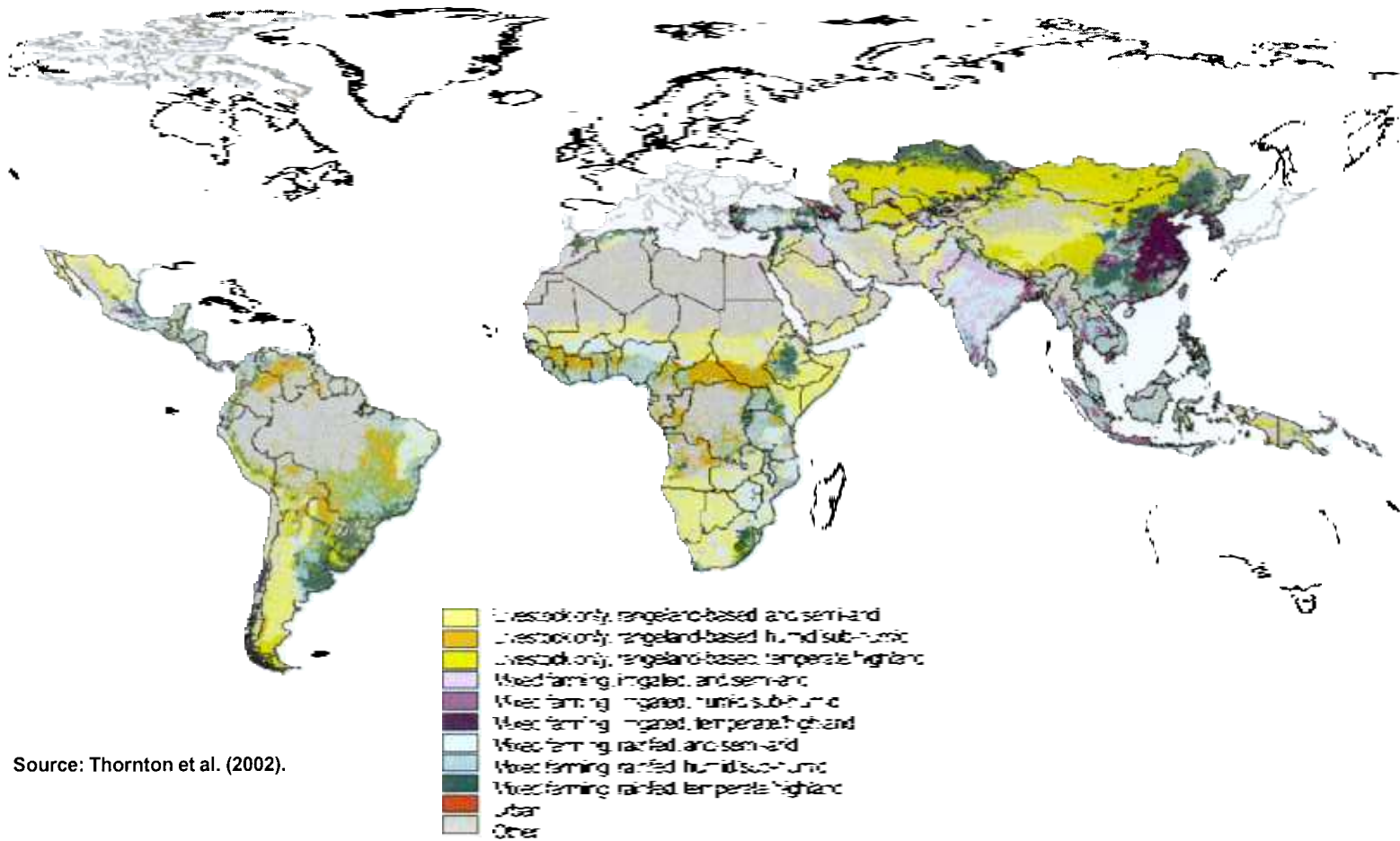


Figure 1. Data inputs for the production of global (Africa, Asia, Latin America) and regional (Kenya, Tanzania, Uganda) poverty maps.

al., 2000). We developed similar scenarios for Latin America and Asia. These, together with other work from the International Centre for Tropical Agriculture (CIAT) and ILRI that has resulted in climate surfaces to 2050 for Africa (incorporating what is currently known about the likely effects of climate change; Jones and Thornton, 2002), enabled us to map livestock system changes to the middle of the present century by 'rerunning' the livestock system classification with population densities and climate variables that may be indicative of conditions at that time. To date, we have done this only for Africa; the analysis needs to be completed for Asia and Latin America.

For current livestock systems, we attached poverty data from various sources to produce a set of poverty maps by country and production system with greater resolution than the poverty figures currently available for all countries of the globe. Thus, strictly, the poverty



Source: Thornton et al. (2002).

Figure 2. Global livestock production systems.

maps relate more to 'the poor in agriculture' than to 'poor livestock keepers' *per se*, but we attempted to describe the importance of livestock and livestock keepers in the various production systems. We carried out some illustrative further analysis to give a more complete picture of where the poor livestock keepers are located (Figure 3), using some published differential poverty rates by broad livestock production system (LID 1999).

Recent global satellite images of land use/land cover and other global datasets have enabled us to carry out relatively sophisticated spatial analyses at the global level that would not have been possible even 18 months ago. Despite various caveats, and the sometimes heroic nature of the assumptions that we have had to make because of data gaps, global-level analyses can effectively identify foci where research and development activities aimed at specific communities or groups of people might profitably be targeted. At higher resolutions, where more effective targeting is required, there is no substitute for high-resolution poverty mapping approaches, and to be most effective these should be based on small-area estimation. This approach to poverty mapping, which links national census data with household survey data, has been undertaken in various countries around the world, and is currently underway for six countries in East and southern Africa.

Major conclusions of the study include the following:

- 1) In terms of the numbers of poor and, so far as the analysis is capable of distinguishing, the numbers of poor livestock keepers, the critical regions are South Asia and sub-Saharan Africa. Our analysis indicates that while the rangeland systems contain relatively few poor (some 60 million), most of these households are dependent on livestock for their livelihoods. Almost half of the poor in rangeland systems are located in sub-Saharan Africa. The mixed systems contain large numbers of poor (over 1 billion), and the numbers of poor that depend to some extent on livestock are considerable; the mixed irrigated systems contain approximately 103 million poor livestock keepers, and the mixed rainfed systems some 366 million poor livestock keepers. In terms of the magnitude of poverty and the importance of livestock to poor households in the developing world, this analysis suggests that there are at least 550 million poor livestock keepers globally.
- 2) Population growth and climate change will produce substantial changes in livestock production systems over the next three to five decades. There are indications that the magnitude of these systems changes, and the consequent need for adaptation and mitigation work, will be particularly large in sub-Saharan Africa. These analyses remain to be completed for Asia and Latin America.
- 3) Considerably more work is required to better inform donors and the research and development community of where hotspots of change are located, who is likely to be affected, and how. More collaborative assembling of global data sets is indicated, together with high-resolution poverty mapping based on small area estimation techniques, collation of geo-referenced household surveys, and better understanding of poverty-resource degradation links.

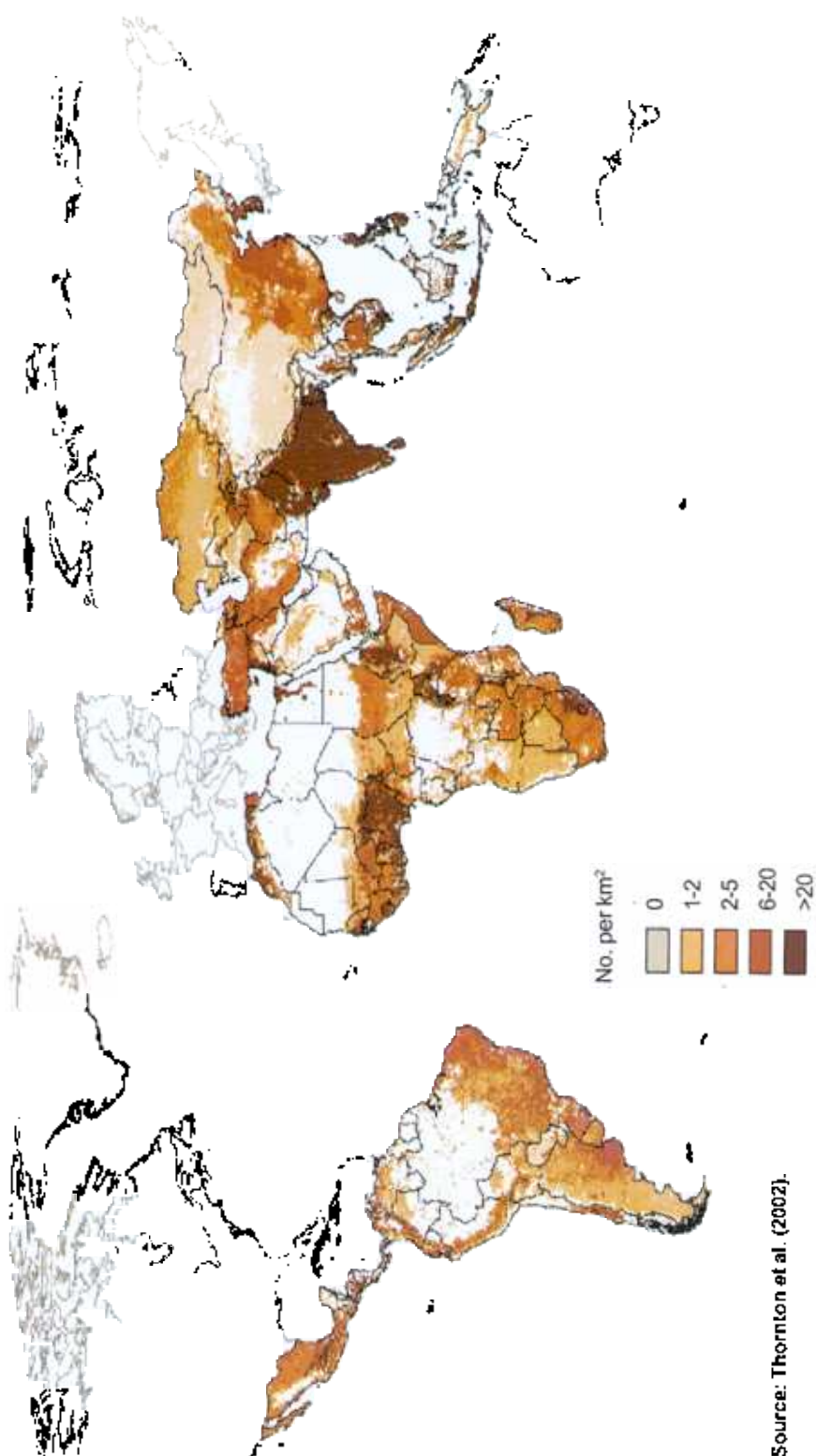


Figure 3. Density of 'poor' keepers' by farming system.

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An overview of the livestock industries of South-East Asia

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Introduction

The South-East Asian countries that will form the basis of the discussion in this paper are Brunei Darussalam, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, The Philippines, Singapore, Thailand and Vietnam. Their combined population in 1999 was 511 million people, an increase of more than 59 million from 1990 (Table 1). Indonesia, with a population in 1999 of 209 million people, is the most heavily populated, whilst Brunei Darussalam with 322,000 people has the smallest population.

There is considerable variability across these countries in terms of economic development and income levels. Brunei Darussalam has the highest per person income, and this is based almost entirely on its oil resources. Singapore, the smallest of the countries in terms of area, also has a high level of income and an economy based upon services and manufacturing with almost no agricultural sector and few natural resources. Indonesia, Malaysia and Thailand, up until the Asian financial crisis of 1997, were referred to as the Asian Tigers. That crisis showed their vulnerability to economic forces. They had been working their way up the development ladder through rapid economic growth accompanied by high rates of savings and investment. In all three countries, the agricultural sectors are important, providing employment to over 50% of the workforce in the case of Indonesia and Thailand, and about one-quarter of the workforce in the case of Malaysia.

Vietnam has been experiencing rapid economic growth and the economy is undergoing a major restructuring as the government adopts more market-oriented policies. Laos began along this path in 1991 earlier than Vietnam – while Myanmar remains under military rule, a state it has been in for years. Myanmar, Laos, Cambodia and East Timor are the poorest countries in the region. In each of these four countries, agriculture is the major employer, with over 70% employed in agriculture.

There are political differences between the countries as well. Cambodia has been recovering from decades of political conflict that resulted in over one million deaths, while East Timor is only just beginning to find some political stability following its gaining of independence from Indonesia in 2000. Indonesia itself is experiencing instability in some of its regions because of ethnic unrest. With the exception of Thailand, all of the countries in South-East Asia have a colonial legacy, and Indonesia and Vietnam fought bitter wars of independence.

Table 1. Characteristics of the countries of South-East Asia.

Country	Area ($\times 10^3$ ha)	Population ($\times 10^5$)				Per person GNP		Agriculture as percent of GDP	
		1990		1999		1990	1998	1990	1998
		Rural	Total	Rural	Total	US\$	US\$	(%)	(%)
Brunei Darussalam	577	88	257	92	322	na			
Cambodia	17,652	7139	8652	8447	10,945	na	280	na	51
East Timor	682	740	806	871	na	na	na	na	
Indonesia	181,157	126,889	182,812	127,231	209,255	570	680	22	16
Laos	23,080	3402	4152	4085	5297	200	330	na	
Malaysia	32,855	8970	17,845	9495	21,830	2320	1600	na	12
Myanmar	65,755	30,535	40,520	32,745	45,059	na	na	na	59
The Philippines	29,817	31,075	60,687	31,514	74,454	730	1,050	22	17
Singapore	65	0	3,016	0	3,522	11,160	30,069	0	0
Thailand	51,089	45,185	55,595	47,926	60,856	1420	2200	12	
Vietnam	32,549	53,532	66,689	66,223	78,705	na	330	na	26
Total	416,367	307,497	440,965	325,564	511,116				

na = Not applicable

Notes: GNP per person data are in nominal US\$; agriculture's share of GDP in 1998 is measured as value added in agriculture as a percentage of GDP.

Source: Area: FAO (1998b), p.3; population: FAO (2000a); GNP: World Bank (1992 and 2000); agriculture in GDP World Bank (1992 and 2000). Area, income and sector size data for Singapore and Brunei Darussalam from CIA (2000). In the countries in the South-East Asian region, the numbers of people living in rural areas increased between 1990 and 1999.

Religion and the ethnic mix of the population are important influences on food consumption and therefore on industries such as livestock. Local custom in Vietnam dictates that Vietnamese Buddhists should be vegetarians for a day or so each month. In Indonesia with its predominant Muslim population, during the holy month of Ramadan, nothing at all is eaten or drunk during daylight hours. Some Asians will not consume duck during the first few days of each lunar month since to do so is believed to bring the family of the consumer bad luck. Because all of the countries of South-East Asia have a minority Chinese population, pork, an important part of many Chinese dishes, is consumed even in Muslim countries where one would expect there to be little or no pork consumption.¹ Some foods, such as the meat from native chickens, are believed to have medicinal value – this is

1. Among some Chinese consumers, the preferred form of pork is suckling pig. As a result, domestic breeds of pigs that the Chinese favoured were those that produced large litters, frequently. Exotic breeds, such as the Large White which is a large animal when finished, would not be a Chinese consumer's first choice of breed.

certainly the case in Vietnam² – and so there is a preference among some consumers for this meat.

The share of agriculture in GDP exhibits considerable variability. In Cambodia, Laos and Myanmar it represented over 50 % of the economy, whereas in Singapore its share was almost negligible. It is important to note that the contribution of agriculture and of livestock to GDP is likely to be substantially understated, except for Singapore.

A vast amount of agricultural production is done in developing countries by unpaid labour, overwhelmingly by women and children. In Laos, Malaysia and The Philippines, for example, over 50 % of the labour provided by women in 1990 was unpaid. More recent data up until the mid-1990s indicate the situation is worsening in many parts of South-East Asia (Eccleston et al. 1998). Also, in many of these countries, a large proportion of production occurs in the subsistence, non-market part of the economy and is therefore excluded from the income statistics reported in Table 1. Interestingly, in many of the countries of the South-East Asian region, the number of people living in rural areas increased between 1990 and 1999.

Diversification of agriculture

Rice has been the dominant agricultural industry throughout South-East Asia and indeed most of Asia. In the 1950s, rice accounted for 40 to 50 % of the total value of crops in The Philippines (Hayami et al. 1979, p. 122) while in Thailand the share of rice was in the range of 40–45 % (Thailand Development Research Institute Foundation 1995, p. 13). Indonesia's production in 1998 of 48 million tonnes made it the world's third largest producer, after China and India (FAO 1999a). Vietnam, Thailand and Myanmar are also major producers, harvesting over 69 million tonnes out of total global production of 563 million tonnes in 1998 (FAO 1999a).

During the 1970s and 1980s agricultural diversification became an important policy objective for many of the countries in the region. The reason for this is that the use of high yielding varieties of rice and wheat during the Green Revolution removed the spectre of food shortages and contributed to a decline in the real price of rice. Tomich et al. (1995, p.129) point out that the area sown to high yielding varieties of rice across South and South-East Asia increased from 13,800 ha in 1965–66 to 35.7 million hectares by 1982–83. Rising incomes, a higher value placed on time, greater female participation in the workforce and a more urbanised population increased the demand for foods other than rice.

Other objectives that governments had which provided the rationale to diversify agriculture included import substitution, the gaining of export markets, the generation of (rural) employment and more value adding in agriculture. Agricultural diversification involves more than a change in the production mix from agriculture. It involves changes in the infrastructure servicing agriculture (e.g. roads, port facilities and extension services), changes in the way the product is marketed (through supermarkets rather than wet markets) and

2. This is the black fleshed Ae chicken.

changes in the production technology (e.g. the use of organic farming practices and the use of new plant breeds).

Livestock are a part of this diversification of agriculture, as evidenced by the dramatic growth of the livestock industries as compared to agriculture in aggregate. Between 1961 and 1999, the Food and Agriculture Organization of the United Nations (FAO) index of gross livestock production increased by a factor of at least three for all countries in South-East Asia, with the exception of the city state of Singapore where production declined.³ Table 2 shows that the gross livestock production index showed the largest increase in Malaysia, followed by Brunei Darussalam and The Philippines. In the first two of these countries, the growth in livestock production was more than double that recorded for agriculture. For the world, meat production between 1967 and 1997 grew on average by 2.9 % per year (FAO 2000a).

Table 2. *Indices of gross agricultural production (A) and gross livestock production (L) in South-East Asia, selected years.*

Country	1961	1970		1980		1990		1999	
		A	L	A	L	A	L	A	L
Brunei									
Darussalam	100	123	175	180	373	161	329	273	680
Cambodia	100	146	191	69	74	119	281	165	398
Indonesia	100	131	128	187	188	296	396	341	496
Laos	100	162	153	186	167	282	286	397	550
Malaysia	100	159	180	239	325	368	784	473	1215
Myanmar	100	127	161	186	224	210	261	303	377
The Philippines	100	134	160	208	246	252	338	313	583
Singapore	100	170	176	261	290	149	170	49	56
Thailand	100	146	140	226	186	277	285	342	377
Vietnam	100	112	112	148	136	232	266	379	453

Source: FAO (2002).

Livestock production

In quantity terms, the production of meat in South-East Asia expanded from 2,155,464 t to 9,492,025 t between 1965 and 1999 (Table 3). Data on the individual countries showed that meat production increased more than eight-fold in Malaysia, and over four times in Brunei Darussalam, Indonesia, The Philippines and Vietnam. Even in the least developed countries of the South-East Asian group⁴ (Cambodia, Laos and Myanmar), meat production in 1999 was about three times higher than in 1965.

3. The FAO indexes of gross agricultural production and livestock production are calculated by the Laspeyres formula. The prices used in weight production are 1989/91 average international prices.

4. Separate data were not available for the former Indonesia province of East Timor.

Table 3. Meat production in South-East Asia, selected years.

	Year	Unit	Brunei Darussalam	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	Total
Meat production	1995	$\times 10^3$ t	1.6	44.2	379.6	26.9	123.9	134.6	461.5	47.5	501.2	432.5	2153.5
Pigmeat		%	29.7	52.7	30.4	49.8	47.3	24.4	62.8	51.5	29.9	53.5	45.7
Chicken		%	37.7	10.6	14.5	25.0	30.7	13.5	17.3	39.8	23.3	10.4	17.8
Beef & Veal		%	1.4	33.4	34.1	7.8	5.6	45.6	13.3	0.7	15.5	5.2	17.7
Buffalo		%	29.5	0.9	10.5	15.9	8.0	7.8	4.0	8.0	20.3	11.2	12.8
Meat production	1998	$\times 10^3$ t	4.5	24.6	616.9	30.7	291.4	249.1	789.7	131.5	894.5	544.2	3580.1
Pigmeat		%	10.8	21.3	28.5	54.1	46.5	31.8	52.2	48.5	29.8	53.7	40.5
Chicken		%	74.3	15.0	27.2	12.0	39.3	22.0	27.9	47.5	32.1	20.0	28.7
Beef & Veal		%	8.8	33.1	25.9	9.1	4.0	32.9	12.2	0.2	13.8	5.8	14.6
Buffalo		%	6.0	22.0	6.3	23.3	2.4	6.5	3.9	0.0	17.0	11.0	9.0
Meat production	1999	$\times 10^3$ t	5.6	153.5	1932.5	67.3	959.8	335.4	1623.0	147.0	1034.4	1383.5	8443.1
Pigmeat		%	2.1	53.1	30.5	42.8	24.2	29.0	59.8	50.3	25.7	72.8	42.4
Chicken		%	75.0	9.8	45.3	13.5	68.8	29.5	24.6	40.5	44.5	9.0	37.4
Beef & Veal		%	20.8	25.8	16.1	19.7	1.7	28.2	6.0	0.1	12.7	6.0	10.5
Buffalo		%	1.3	8.2	2.5	22.5	0.4	5.6	3.1	0.0	5.7	7.0	4.1
Meat production	1999	$\times 10^3$ t	7.4	164.9	1937.7	80.6	1031.5	427.1	1996.7	119.8	1083.8	1040.6	9490.0
Pigmeat		%	1.8	53.4	39.2	39.2	21.4	28.3	56.2	41.7	22.5	71.5	43.6
Chicken		%	75.1	10.9	35.2	12.6	71.5	36.1	26.8	57.1	57.7	14.7	37.5
Beef & Veal		%	20.9	24.9	18.3	23.0	1.7	23.6	8.3	0.0	10.0	4.5	10.2
Buffalo		%	1.5	7.7	2.3	23.8	0.4	4.7	2.9	0.0	4.7	7.0	3.5

Source: FAO (2000b).

The industry recording the largest output growth was the chicken meat industry: regional production in 1999 was nine times higher than in 1965. As a consequence, this industry's share of meat production from all species grew from 17.8 % in 1965 to 37.5% in 1999. Part of the reason for this is that the feed conversion ratio for poultry (the quantity of feed to produce one kilogram of meat) is much lower at two than for pigs (four) or beef (eight).⁵ The feed conversion rate for fish, also an important part of the diet throughout Asia, is also close to two.

Notwithstanding the growth in the poultry industry, the main source of animal meat in the South-East Asian countries is provided by another monogastric – the pig. Pork's share of meat production was 45.7 % in 1965 and 43.6% in 1999. The importance of buffaloes and cattle as a source of meat has declined from 30.3% of meat production in 1965 to 15.7% in 1999. The development of large, modern production systems using western capital-intensive technology to produce poultry and pigs under factory-like conditions is an increasingly important feature of the South-East Asian region and is a major part of the reason for the decline in relative importance of cattle and buffalo.

Policy makers and the representatives of the meat industry in The Philippines have for years seen The Philippines as a major meat producer in the region. Production data shows that The Philippines has indeed been consistently making a major contribution to South-East Asian meat production for the last three decades at least. In 1999, its share of production (21%) from the ten countries making up the region was almost unchanged from its share in 1965. Indonesia, Thailand and Vietnam contributed 20.4%, 19.9% and 19.4%, respectively, in 1999 and 17.6%, 23.3% and 20.1%, respectively, in 1965.

Cameron (2000) explains that although the industrialisation of pig production has been taking place in western Europe and North America for 20 years or more, widespread use of this style of production is a more recent development in Asia. There are also substantial cross-country differences in the extent to which industrial production is used. In Thailand, about 80% of pigs are from intensive farming systems and about 56% of production is from farms with over 1000 pigs. On the other hand, about 82% of the 9.7 million pigs in The Philippines are from backyard operations (Cameron 2000).

Large multinational corporations, the state or private investors own the large farms in the South-East Asian region. In the industrial facilities first used, breeding sows and boars were all located at one site and often under one roof. Pregnant sows and boars were tethered or confined to individual stalls for their entire life. Animals were finished at 16 to 24 weeks (Cameron 2000). This system has undergone modification because of concerns about health, welfare and the disposal of animal waste. The typical system is now less intensive. Although all production stages may still be on one site, multi-site production facilities have become more common, particularly since the late 1980s. In these multi-site facilities, breeders are on one site, weaners on another, and finishers on a third site. Further details of these production systems can be found in Cameron (2000).

5. These estimates vary, and can be improved through genetics and improvements in feed quality and in feeding technology. Reportedly some US feedlot operators have achieved rates in the range of 5 to 7 (FAO 2000a).

Chickens make up the major part of the poultry population, and ducks are second in importance. Native chickens are common at the village level and the meat and eggs they provide are produced with almost no inputs, apart from labour provided by women and children for egg collection. Disease, particularly Newcastle Disease, is the major constraint to increased production. Efforts to control disease are, in the words of Aini (1999), 'lacking, very minimal, or unheard of'. Nonetheless, in developing countries, native chickens are hardy and are selected primarily for their meat production, not egg production (Branckaert, et al. 2000).

In the South-East Asian region, the role of native poultry differs between countries. Ramlah (1999), for example, says that in 1994, only about 3% of Malaysia's chicken population were in backyard operations, whereas in Indonesia, the native fowl population was about 26% of the total population. In The Philippines, in the mid-1990s, about 70 % of the poultry population was in backyard operations.

Most poultry production takes place near to large urban areas and/or in regions where the food processing industries are located as the waste material from food processing can be used as feed. Private firms such as the Chareon Pokphand Group, with its head office in Thailand, are important through the region in the production of chickens. Often these are linked to feed milling companies through ownership or through close business arrangements. This form of integration is the most sophisticated, while the small backyard producers are the least sophisticated form of production, in the western sense at least. Many of the foreign-financed operations are export-oriented, supplying markets in Japan and Taiwan in particular, because of their much lower production costs.

In some countries, such as Indonesia and Vietnam, the government has only permitted the establishment of large, vertically integrated operations if they are export-oriented. The establishments operated by the large multinationals are not the only part of the commercial poultry industry. There are many comparatively small poultry farms that source day-old chicks from specialised operations, some of which (for example in Vietnam) are state-operated.

There are many unique breeds of chicken and ducks in South-East Asia, and these tend to be popular with local consumers. Concerns have been expressed about the possible loss of the genetic resource embodied in these breeds due to the growth of the large integrated operations that use imported grandparent stock from the USA, the Netherlands, France and elsewhere. Stanton et al. (1996) report for example that in the mid-1990s there were five indigenous breeds of chicken and one breed of duck in Vietnam that were endangered.

The marketing channels for poultry are extremely divergent. At the village level, the farmer after meeting the family requirements, might market the residual as live birds or slaughter them and sell the poultry meat in the wet market. Another channel involves brokers. They work at the village level collecting the live birds, and then (most usually) slaughtering them and selling the meat in the wet market. Independent commercial growers are likely to transport the live birds to traders (sometimes these are also wholesalers) or to the co-operative, of which the farmer will be a member. Wholesalers then process the poultry in plants near the wholesale market for eventual sale to retailers. The large integrated commercial operations have their own dressing plants to process the birds that they have

produced, or which have been produced for them under contract, for sale domestically, possibly through outlets owned by the group of which the commercial operation is a part, or for export. In rural areas, the processing operations are important employers (particularly of women) by virtue of the labour-intensive nature of their operation.

Data on milk production from cows are not particularly reliable. Some of the milk produced by small farmers is consumed by the farm family or is otherwise disposed of without entering the market and without being recorded. This milk is most often sold in their local area, after being transported by small vendors using bicycles, motor bike or on foot.⁶ The advantage of this system is that it enables a highly perishable commodity to be made available to the local community, without the need for the milk to be pasteurised or packaged. The disadvantage is that the milk might be adulterated at some stage in the marketing chain or it might not be sanitary.⁷

The FAO statistics used in this paper do not record buffalo milk production for a number of countries in the South-East Asian region, specifically Thailand, Indonesia, Laos and Cambodia (Table 4). Anecdotal evidence however, indicates that buffalo milk can play an important role at the village level. According to the available data on milk production, it has been increasing, with growth averaging 5.1% between 1965 and 1998. The rate of growth has been fairly constant with there being no noticeable difference between the growth rates for the periods 1965 to 1979, and 1980 and 1998.

The countries producing the largest quantities of milk are Indonesia and Myanmar, while the Thai dairy industry is the one that has shown the fastest growth. By Western standards, the productivity of the dairy industries in the countries of South-East Asia is very low. However, the industries use few tradable inputs and they are an important (perhaps the only) source of income for women living in low-income households that have been given – through the assistance of governments or non-governmental organisations – one or two dairy cows. There have been few economic analyses of the region's dairy industries. A recent study by Riethmüller et al. (1999) found that although there were efficiency losses associated with policy arrangements then in use for the Indonesian dairy industry, these losses might not be great when weighed up against the social benefits (these include the recycling of waste products and the provision of employment for women and children) of having a dairy industry.

Generally, dairy cattle in South-East Asia are raised in areas where the temperatures are cooler. In Myanmar, for example, during the colonial era, the British went to highland areas to escape the heat and towns such as Mandalay thrived. Dairy industry development (based upon European breeds) in surrounding areas followed to meet their needs. In Indonesia, the industry developed in the cooler elevated parts of Java Island. Java has the

6. In some developing countries, including India, the owner of a cow would actually walk the cow from house to house and milk as much milk as the customer wanted.

7. The National Milk Drinking Campaign Board (NMDCB) of Thailand has sold franchises to milk shops and vendors to reduce the size of the informal marketing channel. There are about 2500 small milk shops and a large number of milk hawkers all over the country. Anyone can be a franchisee after undertaking a training programme and agreeing to abide by the NMDCB regulations. These involve the purchase of milk from dairy cooperatives or recognised private dairies, and meeting sanitation requirements. A franchise costs about US\$ 25 and the total investment for a street hawker is about US\$ 250.

advantage of being where the majority of Indonesians live – particularly the more affluent ones – making the market on Java the largest. Of Indonesia's 17 thousand or so islands, Java also has the best developed transport infrastructure. The Philippine dairy industry, which is now almost insignificant, was concentrated in the north-eastern highland areas of Luzon, the main island of the Philippine archipelago.

Table 4. Milk production in South-East Asia and the contribution made by individual countries to milk production.

Country	1965	1980 (% contribution)	1995	1998
Brunei Darussalam	<0.01	<0.01	<0.01	na ¹
Cambodia	3.3	2.0	1.1	1.0
Indonesia	43.4	34.0	41.6	39.5
Laos	0.5	0.4	0.3	0.3
Malaysia	7.4	5.1	2.5	2.2
Myanmar	35.0	46.0	31.6	30.6
Philippines	5.7	4.1	1.6	1.9
Thailand	0.5	2.5	17.5	20.2
Vietnam	4.3	5.7	3.7	4.2
Total production (tonnes)	461,046	724,211	1,756,552	1,927,700

Source: FAO (1999a).

1. Not applicable

Most of the dairy farming operations in the South-East Asian countries involve processing companies from the United States, Europe, Australia and New Zealand. Companies such as Nestle, Unilever, Friesland Frisco Domo are heavily involved in the dairy industries of Thailand, Vietnam, Indonesia and Malaysia. In some cases, such as Vietnam, these processing companies have integrated backwards to the farm level (Stanton et al. 1996), while in other cases, such as Indonesia, the foreign companies have the same local firms as partners.

Importance of animal products in the diet

Just as increased agricultural productivity, improved incomes, new transport and processing technologies led to changes in western European diets in the nineteenth century (Grigg 1999), broadly similar factors have helped shape Asian diets a century later. Consumption of meat and dairy products increased while the consumption of coarse grains and starchy staples has declined. Per person dietary energy supply is regarded as the most important single indicator of food adequacy levels since it is a measure of the food available to each person on average in a country. Although dietary energy availability in South-East Asia is less than in developed countries such as Australia and Japan,⁸ with the exception of

8. Energy availability in Australia in 1994–96 was 2975 Kcal per person and in Japan, it was 2898 Kcal per person (FAO 1998, p. 185).

Cambodia,⁹ all countries in the region were able to meet the average energy requirements of their populations (Table 5). According to FAO (1996), taking age, gender, height and weight into account, an adult needs about 1,300 to 1,700 calories per day to maintain metabolic activity (breathing, the pumping of blood, and so on). To perform moderate levels of work, an adult needs about 2,100 calories per day. Chronic undernutrition occurs when calorie intake is less than 1,900 calories per day. Undernourishment hampers economic growth because workers are not able to work at their full potential and are also more vulnerable to illness.

Table 5. Characteristics of diets in selected South-East Asian countries

Country	Energy requirement Kcal	Availability		Availability from animal products		Proportion undernourished	
		1983-85 Kcal	1994-96 Kcal	1983-85 %	1994-96 %	1979-81 %	1995-97 %
Cambodia	2136	1749	1981	4.9	8	62	33
Indonesia	2194	2351	2880	3.8	4	26	6
Laos	2032	2162	2103	5.9	5	32	33
Malaysia	2147	2684	2849	15.5	20	4	2
Myanmar	2153	2628	2711	4.3	4	19	7
Philippines	2108	2143	2366	11.1	14	27	22
Thailand	2256	2204	2351	9.5	11	28	24
Vietnam	2097	2259	2449	7.0	9	33	19

Source: FAO (1998b), pp185-93; FAO (1999b)

An FAO analysis of 98 developing countries found that the ability of a country to meet the nutritional requirements of its population is positively associated with GNP growth (FAO 1998a). In light of the high growth rates generally in South-East Asia, it is perhaps not surprising therefore that food needs in the region in general have been met.

The International Livestock Research Institute (ILRI) points out that animal food products such as milk, eggs and meat provide high quality protein and energy as well as essential micro-nutrients such as calcium, iron, zinc, retinol, thiamin and vitamins A, B6 and B12 that are often lacking in cereal-based diets (ILRI 2000). Increased intake of animal products is often associated with improved health. For some people, the consumption of milk results in stomach cramps and related ailments. This comes about because of insufficient lactase (the enzyme that breaks down lactose) in the intestine. About 75-85% of Oriental people and 65-75% of blacks suffer from insufficient lactase. For whites, the problem affects between 15 and 25% of the population. If the quantity of milk consumed per day is not high (roughly no more than 300 ml), consumers are unlikely to experience any problems.

9. According to FAO (2000b) years of war and civil strife left traditional irrigation systems in ruins and fields abandoned to landmines. The 1979 peace settlement opened the door for recovery.

The rapid economic growth in these economies created a rapidly increasing demand for livestock products, but the importance of animal products in the diets varies substantially across the countries. In Malaysia, for example, 20% of energy availability was met by animal products, while in Indonesia and Myanmar, only 4% of available energy came from animal products. Pingali (1997) cites North-East Thailand as providing a 'striking example' of changing food consumption patterns in rural areas of South-East Asia. In the 1960s, meat consumption was limited to special occasions such as festivals and was consumed perhaps once or twice per year. This pattern has changed so that now more meat is purchased and that this has been made possible through improved transport infrastructure and increased family income earned through seasonal migration to take advantage of seasonal employment opportunities.

The role of livestock in rural areas goes far beyond food production. Animals are kept for draft power, manure, rural transport, fuel and meat. Quite often, the animals are able to perform these functions under very poor conditions. They also provide farmers with an opportunity for the accumulation of capital. Ashdown (1992) describes how in the South Sulawesi province of Indonesia, the slaughtering of buffaloes at funerals is tied to the belief that the buffalo is 'a vehicle to reach heaven'.

Sato et al. (1996) point out that farmers in the northern region of Vietnam continue to raise pigs when the sale of animals for meat is not profitable because pigs are able to convert low quality feed into manure and this manure is the only available source of fertiliser. The sum of each of these factors makes livestock an important part of rural life particularly for resource-poor farmers. The introduction of tractors, attributable to an increase in the opportunity cost of labour for the farmer and the farm family, has led to a decline in the use of draught animals.

Increased production in the South-East Asian region to meet the increase in demand discussed earlier came about through an increase in the number of livestock rather than productivity (Steane 1999).

A measure of productivity is the offtake rate.¹⁰ Using beef and veal as an example, the offtake rate is calculated by dividing the liveweight of slaughtered animals by the number of cattle in the national herd. The offtake rate takes into account, albeit fairly roughly, the time it takes to raise the animal and the weight the animal achieves in that time. A high offtake rate implies a more rapid slaughter and a higher slaughter weight. It is important to recognise that the offtake rate is very much a function of the quality of feed and the genetic characteristics of the animal. Hence, not too much should be read into cross-country comparisons, particularly if there are differences in feed, climatic conditions or breed composition.

Nonetheless, the calculations show that offtake rates in South-East Asia are markedly below those for the rest of the world, although the gap was narrowing over the period 1988 to 1998 (Table 6). This narrowing of the gap seems to be the case in particular for The

10. There are other measures that could be used, such as production per animal. According to FAO data (FAO, 1999a), milk production per cow increased from 703 kg in 1961-63 to 1077.4 kg in 1996, while beef production per indigenous animal increased from 15.8 kg to 22.7 kg over the same period.

Philippines in the beef cattle and pig meat industries, where offtake rates in 1998 were comparable to those in the rest of the world.

While it might be thought that the offtake rates indicate that there is untapped production potential, particularly in Cambodia, Myanmar and Laos, it is critically important to recognise that the offtake rates shown in Table 6 take no account of the inputs or the quality of the animals that are used in these industries.¹¹ For farmers with limited resources available, it may make perfect sense for them to achieve outcomes on this measure far below that achieved by another farmer with many resources allocated to livestock.

Table 6. Offtake rates in the South-East Asian region for cattle, buffaloes and pigs, 1988 and 1999.

Country	Cattle		Buffalo		Pigs	
	1988	1998	1988	1998	1988	1998
Cambodia	12.5	14.1	13.5	16.4	4.5	4.5
Indonesia	21.3	28.4	14.4	16.9	71.3	75.4
Laos	6.5	13.0	8.0	15.0	15.1	21.4
Malaysia	18.4	25.8	23.9	25.3	77.0	70.9
Myanmar	9.6	9.6	8.5	8.5	27.1	33.0
Philippines	39.9	52.2	15.8	17.0	74.7	107.7
Thailand	32.0	28.6	11.5	17.1	71.2	76.8
Vietnam	22.5	20.9	29.9	35.5	56.9	67.7
Rest of World	52.1	49.6	32.3	42.8	96.6	107.3

Source: Calculated from FAO (1999a) data

Intensive production

Mention has been made already in this paper of the use of industrialised production facilities in the livestock sector. In South-East Asia, particularly in the major livestock-producing countries of Thailand, Indonesia and The Philippines, the potential for increasing livestock numbers and production through extensive systems is limited by the availability of suitable land. Hence, there is likely to be a continuing trend towards more intensive production systems for pig meat, poultry meat, eggs, beef and to a lesser extent for dairy. The use of such production systems implies a high degree of dependence on imported technologies and inputs. Typically they are located near the boundaries of urban areas and they are part therefore of peri-urban agriculture.

11. To give some idea of the extent to which feed conversion efficiency can be improved, the case of the poultry industry in Japan might be considered. Feed conversion in Japan decreased from 4.6 in 1966 to 2.5 in 1982. This was due to genetically improved stock, better diets and improved husbandry and management (Sugiyama 1998).

Steinfeld (1998) points out that industrial livestock production systems in which livestock production is detached from the immediate surrounding land in terms of feed supply and waste disposal hardly existed in Asia until a few decades ago. Steinfeld (1999) explains that with the transformation of the Asian livestock sector, livestock production has tended to become vertically integrated because of economies of scale. Production has concentrated in areas where the inputs – particularly feed – are cheap and where there are good markets for livestock products, such as meat, eggs and milk. Benefits associated with having production take place close to population centres include less transport and storage of feed, the possibility of employment opportunities being created and increased availability of fresh feed. However, there are drawbacks.

According to Steinfeld (1999), the trend towards more industrialised livestock is worrying for a number of reasons. First, intensive livestock production generates little employment, and the benefits associated with the growth of the intensive livestock industries accrue to a few. Second, because livestock production is land-detached, production units tend to concentrate in particular areas, causing massive environmental damage. Finally, there are a number of human diseases and illnesses associated with the concentration of animals on limited space. This comes about because the use of antibiotics in intensive animal production has led to antibiotic-resistant strains of *Salmonella*, *Listeria* and *E. coli* and because minerals (such as copper and zinc) introduced into animal diets have contaminated the environment already severely tested by the growth of urban areas.

Other writers have also commented on this development. Pingali (1997) attributes the growth of commercial agriculture in Asia generally, of which industrial livestock is a clear example, to an increase in the opportunity cost of the farmer's time. He says that commercialisation involves the substitution of traded inputs for non-traded inputs and leads to a decline in integrated farming systems.

Reviewing Pingali's paper, McCalla (1997) points out that Pingali (1997) does not explain how it can be that the opportunity cost of a farmer's time has increased. McCalla (1997) surmises it must be due to increased non-farm wages.

Heartfield (2000) cites developing country authors who argue that the involvement of corporations in developing countries' agriculture has made peasant farmers landless, pushing them into cities where few jobs exist. He does not call for arresting agricultural development since this would keep 'the third world poor' and subordinate to the first world. Rather, Heartfield argues that the fruits of progress should be shared by all without going into details of how this might be achieved.

White (2000) investigated the environmental impact of diet by estimating the area of cropland required to support the average diet across a sample of countries and regions. He found that in Asia in 1985, 0.182 ha was needed for the average diet, but that by 1995, the area needed had increased to 0.212 ha. This was the largest increase in land requirements for any of the regions studied – Africa, Europe, Oceania, North America and South America – and is due to the increased consumption of animal products. The estimates made by White (2000) involve a number of assumptions, including the feed conversion efficiency of different livestock and the grain yield per hectare of land.

Conclusion

This paper has outlined some of the important characteristics of the livestock sector in South-East Asia. There are many factors that indicate that consumption will increase but the extent of this increase must be a matter for conjecture. It is almost certain that pork and poultry will continue to underpin diets and that the importance of beef and buffalo meat will continue to decline in relative importance. The continued development of the intensive livestock industries will place increased pressure on the environment. As income levels increase, there is likely to be increasing opposition to these industries since the income elasticity of demand for the environment resource is positive.

Small farmers are one group in South-East Asia unlikely to benefit from the expected future development of the livestock industries. Their opportunities to supply meat to consumers will decline as distribution systems become more westernised and as more regulations are placed upon the traditional distribution systems. Expansion of intensive production facilities around urban areas will result in small farmers being displaced from their farms in these areas and forced to relocate to less agriculturally suitable areas. While some job opportunities may be created, these are likely to be relatively short-term as new processing technologies will result in labour being replaced by capital.

The growth of the intensive livestock industries will require increased investment in infrastructure for the food processing industries and the distribution systems of countries in the South-East Asian region. Barkema and Drabentstott (1996) have drawn attention to this problem in China and in Mexico. Diminished capital inflows into the South-East Asian region may well turn out to be significant impediments to future development of the livestock industries.

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Global meat markets: Short-/ medium-term outlook

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Introduction

This paper will focus on various market factors shaping global meat markets, the medium-term outlook for the meat sector and challenges for Asian meat producers, exporters, and policy makers. The mandate of the Commodities and Trade Division (ESCB) of the FAO is to identify and evaluate factors influencing international agricultural trade. As a meat trade analyst, my challenge is to analyse these factors and assess how regions like South-East Asia can compete in an increasing globalised meat economy.

The livestock revolution has been referred to in the previous presentations and you can identify the dynamism of global meat markets in Figure 1 which shows the growth in meat trade over the past two decades (1980–2002). There is growing demand in developing countries and it is evident that this demand served as a major catalyst in the growth of trade. According to FAO estimates, meat trade in 2000 is worth US\$41 billion which is approximately 10% of overall trade in agricultural products. Excluding European Union intertrade, this is about US\$20 billion.

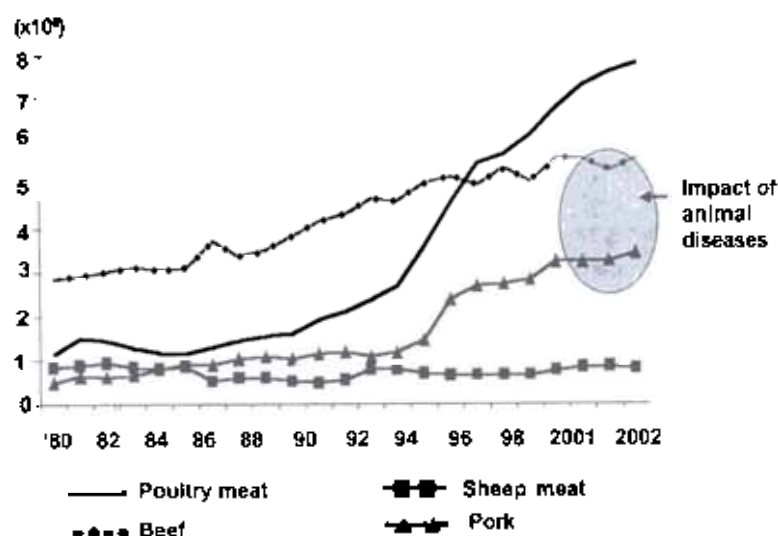


Figure 1. World meat trade (worth US\$41 billion).

The world meat economy: influencing factors

There has been a variety of factors that affected the world meat economy:

- Rising incomes/urbanisation
- Increasing productivity/vertical integration
- Concentration of output units/specialisation
- World Trade Organization (WTO) provisions on market access and export subsidies (Korea, Japan, US, EU)
- Economic/institutional reforms in former USSR/Eastern Europe
- Animal disease/regionalisation/ food safety issues

The WTO has served alternatively as a catalyst and a constraint to trade. In addition, financial crises have rippled across the globe, starting in Asia, moving to Russia in 1998, Brazil in 1999 and finally Argentina in 2001. In the last year and a half, the key factor influencing meat production and trade was animal diseases and food safety concerns.

It is interesting to note that in 2000, meat traders heaved a sigh of relief as financial markets around the world started rebounding, meat prices started to pick up while feed input costs stabilised, and trade started to recover. All of a sudden, the outbreaks of animal diseases in major export countries threw markets in turmoil. ESCB's preliminary estimates of trade losses for 2001 indicates a US\$ 2 billion trade loss due to animal diseases; however, this doesn't include the costs of disease eradication, surveillance, loss to producers, retail markets, and the multiplier effects through the various affected economies. Some preliminary estimates indicate a US\$ 50 million loss to Uruguay, US\$ 400 million to Argentina, and the EU estimates of US\$ 1 billion. Meanwhile, bovine spongiform encephalopathy (BSE) outbreaks in Japan, the world's largest meat importer (imports valued at US\$ 8 billion), led to a US\$ 300 million slide in meat imports.

One of the factors affecting market demand and trade of meat products is the increasing specialisation of production and processing in response to consumer requirements and preferences. Consumers are moving from buying meat to product cuts. When you look at the growth in trade, for instance in poultry, trade grew exponentially over the 1990's as China, Russia and some of other markets started buying. The composition of this trade is quite revealing. China, one of the world's largest importers, is receiving more than 800 thousand tonnes of imported products, 300 thousand tonnes of which are chicken parts. China is importing the wings and paws and Russia is taking the leg quarters. Meanwhile China, taking advantage of low labour rates, imports US leg quarters, debones them and repackages them for export to Japan. In a funny way, the growth in trade may be actually overestimated as you put all these chicken parts back in chicken meat equivalents.

The issue of specialisation becomes a challenge when identifying trading opportunities and assessing the comparative advantage of livestock producers and processors, especially in Asia. People tend to talk about livestock, but when you look at meat trade, trading takes place, not on a commodity basis, but on a product basis. This is where the growth in meat trade has been and the issues of critical importance to entry into this market are product quality and safety.

A look at 2001 and the impact of animal diseases, reveals the fragility of trading patterns. Growth in consumption and trade actually came to a roaring stop. In 2001, markets witnessed the slowest meat output growth in two decades (Figure 2) and the first estimated decline in per capita consumption in 30 years. The impact of food safety concerns was not only witnessed in developed countries but also in developing countries; in fact, the growth of per capita consumption of meat in developing countries, averaging about 4.4% over the last decade stopped with only a marginal increase estimated in 2001. There was declining global beef output. In the EU this was because of animal disease, massive animal culls and lower consumer demand while output in Uruguay was down by 15%. Overall trade declined as consumers shunned beef for food safety reasons and spending on meat was constrained by economic slowdown, especially after September 11, 2001 in the US and elsewhere.

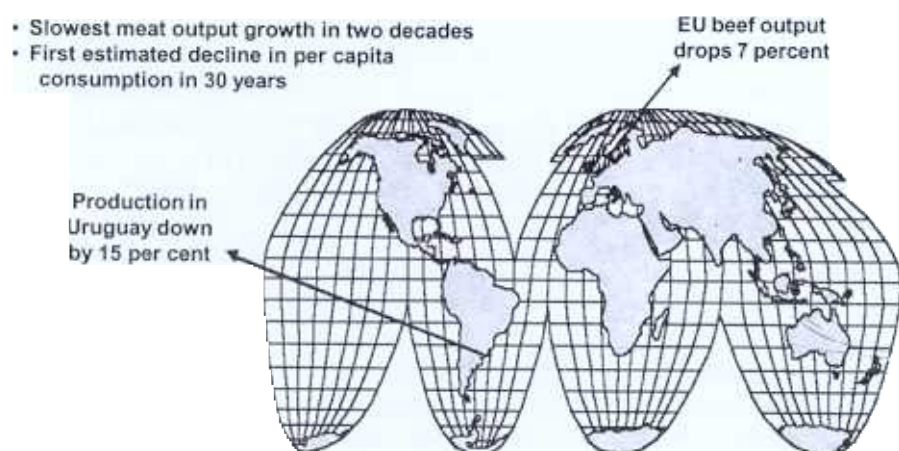


Figure 2. 2001 meat economy.

Meat trade performance

The stagnant meat trade performance in 2001 was marked by market disruptions and trade diversion (Table 1). Beef trade was down 5%; poultry, benefiting from switching consumer preferences was up 3% and pigmeat was stagnant because of FMD outbreak in certain EU countries. This resulted in countries closing their market to pigmeat products from the EU, the world's largest exporter.

The outlook for 2002 is more optimistic. We have Korea coming back to the market, and Uruguay and Argentina resuming fresh and chilled product exports to the EU. Obviously, the prospects of increase in trade depends on recovering consumer confidence in meats in Asia. We may, in fact, have a lot of meat out there but fewer markets are willing to take the product, thus putting downward pressure on meat prices.

Table 1. Meat trade performance.

2001	2002
Stagnant trade performance marked by market disruptions and trade diversion:	Recovering production, ample supplies strengthening trade prospects:
• Beef trade down by 5 per cent • Poultry up 3 per cent • Pigmeat stagnant • Sheepmeat up	• Four per cent rebound in beef exports • Poultry shipments robust at 3 per cent • Pigmeat exports up by 5 per cent • Sheepmeat slides on contracting exporting supplies

International prices

Meat prices were thrown into turmoil in 2001 as consumers shifted consumption patterns and preferences. We saw increased prices for lamb (UK wholesale price), obviously heavily influenced by BSE and foot and mouth disease (FMD). In Japan, steep price declines for beef revealed the huge impact of BSE in October and November. There were also steep increases in prices for alternative meats, particularly chicken which increased by 7% over the course of the year.

Again, the specialisation aspect of trade highlights the problem of looking at prices and international markets for meat. The difficulty lies in the fact that the meat is not a homogenous product, particularly beef; however, that said, it is useful to look at shifting prices for beef in the context of the BSE and FMD outbreaks.

Despite the increase in beef prices in Australia, the Australians would agree that everybody loses from animal diseases (Table 2). The Australian prices are for the manufacturing grade beef that they export to the United States. Unlike US exports, which are higher-value cuts from grain-fed animals, this type of Australian product is an input into the largest US fast food industry, the hamburger market. The US beef prices, on the other hand, is a free on board (FOB) export price. These prices, pressured by the higher domestic prices and the high value of the US dollar, were down by 11% in 2001 with significant price pressure stemming from the Japanese market where consumers in the context of sluggish economic growth and food safety concerns opted for cheaper imported beef cuts or other meat products. Consequently, the Japanese price dropped by 4%. The FMD-afflicted Argentine meat sector could not move their products, especially the high value fresh/chilled quality cuts to Europe and prices slid by 32%. Meanwhile, EU reference prices for cattle were down by nearly 20%.

The price differentials between the various prices reveal the extent that specialisation influences meat markets. These are all different types of products going to different markets. These prices also show the segmentation in the beef markets between Atlantic and Pacific markets, one FMD-affected and the other not. Unfortunately, after a decade of investment in select South America markets to eliminate FMD and this price gap, FMD outbreaks in Argentina and Uruguay in 2001 postponed the integration of these markets for another 3-4 years.

Table 2. Animal diseases and beef price movements (price in US\$/tonne).

Year	Australia	US	Japanese	Argentine	EU
1995	1947	3738	6160	1935	3596
1996	1741	3380	5538	1790	3168
1997	1880	3148	5269	1868	2910
1998	1754	2717	4756	2200	2907
1999	1894	2985	4844	1910	2598
2000	1957	3207	4693	1986	2309
2001	2138	2848	4486	1356	1904
Per cent changes 2000/1999	3%	7%	-3%	4%	-11%

South-East Asian meat markets in a global context

South-East Asian meat markets are very dynamic and are more and more interlinked with the international meat economy. The composition of growing regional exports indicates that a lot of the growth of the trade is in highly processed products, ready-cooked meat, a very sophisticated formulated product that goes to Japan.

Thailand is a major player in global poultry markets, supplying quality chicken products to Japan with exports accounting for nearly one-third of total production. Korea, before the FMD crisis in 2000, was a major player in the pigmeat export market, shipping high quality tenderloins to Japan. In China, a lot of Japanese investment has been directed at operations in the Shanghai area, with processed product destined for Japan. Poultry operations in southern China are importing US chicken legs, deboning them and re-exporting them. Vietnam is also becoming increasingly active as a major pigmeat exporter. However, consistency and quality of product remains a major constraint to product movement to sophisticated markets like Japan.

Some general facts about the South-East Asian markets include the following:

- Regional production (including China which produces 27% of world meat) is 40% of world totals; imports equal 20% of trade
- Imports constitute only a small part of regional meat consumption, 2.8% growing to 5%
- Nearly half of the growth in global meat demand over the 1990s is generated by the region
- Exports, while growing, constitute only 12% of global meat trade and consist mainly of very specialised products.

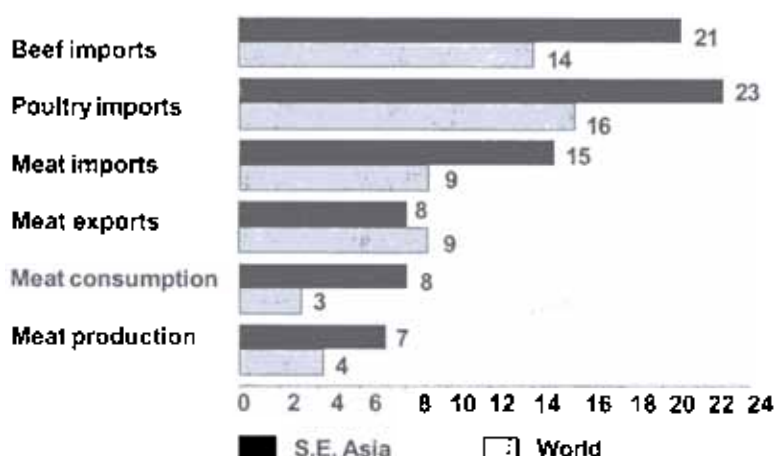


Figure 3. South-East Asian meat markets in a global context (Thailand, China, Korea, Vietnam), 1992–1999 average.

One of the challenges facing participants in this workshop is identifying factors affecting the future of livestock industries in South-East Asia and, within that context, identifying strategies on how to link small livestock producers in Asia to the growing demand for quality specialised products in international market places, which typically require a very sophisticated industry.

Medium-term outlook for the livestock sector

Conducting projections on the outlook for global meat industries is more of an art than a science. Even non-economists can make projections using the trends on Figure 3, which depict the positive relationship between growth in per capita incomes and meat consumption. Obviously as incomes in low-income countries increase (Vietnam, Philippines, and Malaysia), per capita meat consumption rises. We can actually make forecasts by looking at the per capita income in a certain country by estimating in five years what per capita income will be and then ‘guestimating’ the level of per capita meat consumption.

But the more complicated question is who will supply this product? Will countries import the meat or supply it through increased domestic production? In FAO, our commodity specialists in the Basic Foodstuff Service of the Commodities and Trade Division annually update medium-term commodity projections, using FAO’s World Food Model that has a 10-year projection period. Some of the features of this model are:

The model contains 13 commodity markets, including:

- Bovine meat
- Pigmeat
- Mutton and lamb
- Oilmeals (protein equivalent)
- Coarse grains

- 146 countries, covering all regions of the world
- A partial equilibrium, dynamic multi-market model where a commodity market is represented by a supply and demand schedule with appropriate fixed elasticities
- Income and population are specified exogenously
- International markets clear through adjustments in prices
- Price changes transmitted to national markets through transmission elasticities that capture certain policy instruments

This modelling exercise involves taking into account all the factors affecting developments in the livestock sector, such as the following:

- Growing incomes/urbanisation
- Population increases
- Market liberalisation and increasing market access for meat products
- Concentration and integration of livestock industries
- Technology issues related to animal productivity

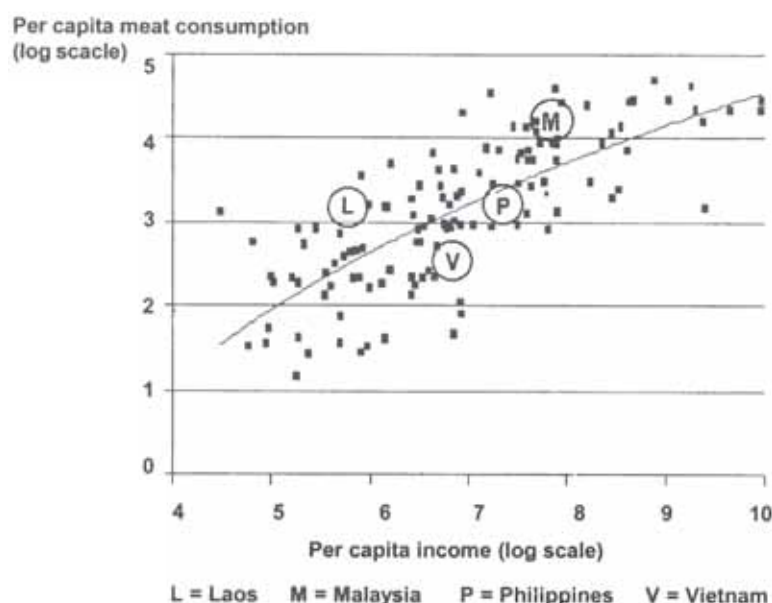


Figure 4. Relationship between income and per capita meat consumption.

The policy challenge facing us in this year's exercise is how to factor into the model China's accession to the WTO. Obviously other important issues for industries in developing countries are opportunities to enhance production through improved productivity. For example, in the case of concentration and integration of livestock industries, what does it mean for feed conversion, carcass weights and for increased slaughter as a share of animal inventories?

Last year's projection exercise was based on a more optimistic global economic picture than this year. For Southeast Asia, we had to revise our figures to a 4.3% increase in regional per capita gross domestic product (GDP) growth.

regional per capita gross domestic product (GDP) growth. Obviously, the meat outlook for South-East Asia is quite robust and the livestock industries in the region are growing faster than international averages. That should not come as a surprise to anyone. As I mentioned before, the critical question is who is going to supply this growth in consumption. What will be the gap between consumption and production? According to our most recent projections, the region is expected to witness a growing net trade situation, meaning that imports are going faster than exports and the region's meat consumption will increasingly be supplied by producers in other countries. The projections indicate that meat imports will increase annually by about 4.4%, mainly beef and poultry.

Five factors affecting South-East Asia's livestock industry are the following:

- 1) economic growth and development
- 2) gains in productivity, access to markets
- 3) ability to compete in an increasingly competitive export market which is focused on products, not commodities
- 4) policy developments/support for sector and
- 5) developments in Doha WTO talks (export subsidies, domestic support).

As an international trade economist, I would like to highlight the last factor – developments in the Doha WTO talks. Within this forum, the topic of the important role of poverty, trade and developing countries has been increasingly highlighted, with Mike Moore, the head of WTO, repeatedly emphasising that special consideration be given this issue. Specifically, there is interest in providing technical assistance to developing countries.

I would like to emphasise that this workshop is an ideal forum for the identification of issues constraining developments in South-East Asia's livestock industries and the generation of constructive and creative solutions on how to engage the poor in livestock industries, while making the linkage between poverty and international trade—a topic which is of keen interest to policy makers around the world, in FAO and WTO.

Common Fund for Commodities

At this point, it would be useful for us to look at the Common Fund for Commodities (CFC), an international agency which is a potential funding source for any project ideas generated by this workshop. The CFC is an intergovernmental financial institution composed of 104 member countries from the EU, Organisation of African Unity / African Economic Community (OAU/AEC), and the Common Market for Eastern and Southern Africa (COMESA). I would like to stress that the CFC can provide an opportunity for us to obtain funding for a well-conceived project which addresses the needs identified by stakeholders with the project benefiting from the synergies between research and development activities.

The following information on the CFC and the process of project proposal submission and approval may be helpful while looking at the project scope:

- 1) Types of projects funded – Commodity development measures aimed at improving structural conditions in markets and at enhancing the long-term competitiveness and prospects of particular commodities

- 2) Basic requirements and criteria for project appraisal/approval
 - project should be beneficial to several countries, have a spin-off effect – but, at the same time, project must remain manageable
 - target beneficiaries should be poorer strata of the population (small producers/exporters smallholders; small and medium sized enterprises involved in production, processing or trade)
 - pay due regard to sustainability and replicability of activities
 - pay due attention to private sector concerns (demand driven projects), national development policies, environmental aspects
 - project budget: small to medium size; indicative range: 2–6 million US\$ total project costs (including in-kind counterpart contributions)
 - duration: from 1 to 5 years
 - grant, loan or combination – depending on nature of activities
 - concentrate on CFC member countries
 - project objectives must be achievable within a specific period of time.
- 3) Factors known to increase chances of approval
 - significant amounts of counterpart contributions
 - particular focus on LDCs
 - project addressing market failure, diversification of production, productivity improvement.
- 4) Reasons for rejection
 - concentration on general training/extension
 - excessive international travel and meetings
 - disproportionate overhead
 - non-sustainable results
 - basic research/general marketing studies
 - work forming part of core activities of participating institutions
 - activities in non-CFC countries

Session III

Technology and
the adoption process

ILRI in South-East Asia

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International Livestock Research Institute (ILRI)

Diversity in the region

South-East Asia is arguably the most physically, economically and culturally diverse contiguous group of countries in the developed or developing world and success or failure in livestock research and development depends on understanding the constraints and opportunities posed by this diversity. The issues to be resolved for livestock research and development include the physical barriers to livestock movement, inequalities in purchasing power and market development and varying habits and principles governing production and consumption of livestock.

The political boundaries of the region extend from the borders of India and Bangladesh in the west, to China to the north, and the Pacific and Indian oceans to the south and east. However, major influences come from immediately outside the region — from India and China, the two largest countries in the world; Japan the world's second largest economy; and Australia, which, although relatively small in population and economy, has had a significant influence on agricultural research and development in the region.

Countries included in South-East Asia are the 10 member countries of the Association of South-East Asian Nations (ASEAN): Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, The Philippines, Singapore, Thailand and Vietnam. Singapore is unique in having no livestock and no rural population. South-East Asia contains the world's newest country, Timor. Pressures and variation within the region and influence from immediate neighbours have encouraged rapid changes in agriculture and a challenging environment for a programme of international livestock research.

Physical diversity

The natural vegetation of all 10 countries is humid wet, or humid dry tropical forest and there is natural and agricultural continuity outside the region among the uplands of the Mekong and Red rivers, which include southern China and northern parts of Laos, Thailand, Myanmar and Vietnam. Mainland South-East Asia (sometimes referred to as the Mekong countries) comprises Laos, Cambodia, Vietnam, Myanmar and central Thailand. Peninsular South-East Asia is formed by southern Thailand, Malaysia and Singapore and the third geographical group is formed by the vast archipelago of insular Malaysia, Brunei Darussalam, Indonesia and The Philippines that together comprise over 20 thousand separate islands. Indonesia and The Philippines have the second and fourth longest coastlines

in the world (54 thousand and 36 thousand km respectively). In contrast, Laos has no direct access to the sea but has a land boundary of over 5000 km. Consideration of these diverse and often poorly defined natural boundaries and geographical differences in national borders is important for livestock development and for transboundary trade and disease control.

Economic diversity

Among the 575 million population of South-East Asia there is wide variation in national income. Per capita gross national income (GNI) ranges from less than US\$ 350 per year (current US\$) in Laos, Cambodia and Vietnam and Myanmar (estimate), to greater than US\$ 20 thousand per year in Singapore and Brunei Darussalam. Despite a low per capita GNI of less than US\$ 1000, Indonesia contributes 24% to the GNI of the region due to its large population of 210 million. Thailand contributes 22% from a population of 60 million and Singapore alone contributes 18% from a population of just 4 million.

Laos, Myanmar, Cambodia, Indonesia and Vietnam are classified by the World Bank as low income and Laos and Myanmar and Indonesia as severely indebted. While recalculation of per capita GNI on the basis of purchasing power can greatly reduce variation between countries (e.g. for Laos, income based on purchasing power increases from US\$ 300 to US\$ 1500) the differences between the poorest countries (Laos, Cambodia, Vietnam, Malaysia), the richest (Singapore and Brunei), and those in between (Indonesia, Philippines, Malaysia and Thailand) are very high. The proportion of poor is 27% in Indonesia, 37% in The Philippines and around 50% in Lao PDR. There are major implications of such diversity of income and poverty for trade and ability to support interventions for livestock research, development and investment.

Cultural and political diversity

Buddhism, Islam and Christianity are the religions of more than 95% of Thais, Indonesians and the Filipinos, respectively. Other countries have mixtures of all three religions and varying proportions adopting indigenous belief systems. English is widely spoken in Singapore, Malaysia, Brunei Darussalam and The Philippines, and is an official language of Singapore. However, all countries in the region have distinct and separate official languages: Thai, Burmese, Vietnamese, Bahasa Indonesia, Khmer and Lao in addition to hundreds of local dialects.

Against a background of the indigenous Malay population there have been migrations into the region extending back many centuries, from the Tibetan plateau, mainland China, Melanesia and South Asia. In more recent colonial times there has been settlement from the Indian sub-continent and Europe and there has been widespread recent migration within the region from Vietnam, Indonesia and The Philippines for economic and political reasons.

The dominant political systems have been constitutional democracies, monarchies and democratic republics; and both centrally planned and market-oriented economies, with

some countries moving rapidly, and with some difficulty, between these conditions. These varied politics, cultures, religions and languages are sources of many different approaches to agricultural problems. They also create barriers to common understanding and joint endeavour in activities such as livestock research.

Changing demand and increased opportunities for livestock

Livestock research faces some difficult challenges. By 2020 the world population will approach 8 billion, with most of the increase in developing countries with only half the people of developing countries in rural communities; urban incomes will rise along with demand for livestock products. Trade and information will be globalised leading to new relationships between producers, consumers and the markets that serve them.

The livestock revolution in South-East Asia

The future for livestock production in South-East Asia is dominated by rapid increases in demand which are predicted to dramatically alter patterns of production and consumption. If handled correctly, this livestock revolution can provide means for the poor to increase their incomes by allowing them to take part in expanded and higher value markets. Negative effects could include exclusion of the poor from these markets, further pressure on resource inputs and on the environment to absorb waste; and uncontrolled peri-urban production with increased risk of disease spreading from livestock to humans. These trends are brought into sharp focus in South-East Asia where, together with East Asia, incomes grew between 4 and 8% between the early 80s' and 1998; population grew at 2-3 %, urbanisation at 4-6% and meat consumption between 4 and 8% per year. Such aggregated figures however do not reveal the large differences in both rate of growth and starting points for countries within the region (nor indeed for provinces within China).

Overall the rural population in South-East Asia is not predicted to grow between 2000 and 2020 although important increases will take place in Vietnam (16%), Laos (28%) and Cambodia (39%). The most dramatic changes will be in urban populations, with the megacities of Jakarta and Metro Manila increasing to 17.3 and 14.1 million respectively, and Bangkok becoming a megacity with a population of 10.1 million. Excluding Singapore (with no rural population) estimated increases in urban population in the region range from 60 to 150%.

In summary therefore, South-East Asia will need to feed an additional 140 million people, from under 600 to over 700 million, mostly in towns and cities, from an unchanging rural population and a land base under increasing pressure from urbanisation. The key questions are to what extent livestock production can change to meet this increased demand and the impact that these changes will have on the poor.

Meat, milk and other livestock products

Regional trends in South-East Asia have followed East Asia and South Asia (excluding India) with increases in annual per capita consumption of meat of around 50%, from 11.3 to 17.9 kg between 1983 and 1997. Once again however, these figures mask significant variation between countries as can be seen in Table 1 and differences between per capita consumption and total consumption. In Brunei Darussalam, meat consumption may have reached the limit of developed countries of around 1 kg per capita per week. In all countries there has been a substantial increase in domestic meat supply, ranging from 35% in Myanmar to almost 200% in Malaysia, with an average of 107%. This represents a doubling of domestic meat supply across the region between 1983 and 1997. Recent predictions are for this to double again between 2000 and 2020.

Table 1. Supply and consumption of meat and meat products in South-East Asia.

Country	Domestic supply of meat per capita (kg)		Per capita increase in consumption (%)	Total increase in consumption (%)
	1983	1993		
Brunei Darussalam	53.6	52.0	-6.5	37.6
Myanmar	8.2	8.6	4.9	34.8
Indonesia	5.5	9.4	70.9	117.6
Cambodia	8.7	14.4	65.5	170.4
Laos	10.6	15.6	47.2	114.6
Malaysia	25.8	54.0	109.3	196.6
Philippines	16.6	25.8	55.4	116.8
Thailand	19.8	24.6	24.2	54.4
Vietnam	13.9	23.8	71.2	126.4
Average	18.3	25.4	38.6	107.0
Weighted average ¹	11.2	17.7	57.9	

1. Average weighted by population size

Figures for domestic milk supply show similar variation from 10.0 to 21.5 kg per capita with substantial increases in all countries except Myanmar.

The increase in demand for meat is predicted to be met mostly by increases in pig and poultry production with a concomitant increase in demand for appropriate feed. Ruminant production will remain important and ruminants will retain their unique place in the mixed farming systems of South-East Asia by being able to utilise forages and feeds that are not digestible by monogastric livestock and providing important sources of manure to enhance soil fertility.

The importance of livestock is not only as a source of calories and protein. Livestock also play important roles in nutrient cycling by breaking down coarse feeds, forages, crop residues and wastes, as power for land preparation and transport, and as a means of building capital which can be transported and disposed of in times of need. These functions of livestock are difficult to value by conventional methods as they address the needs of the

smallholder farmer for food security, risk avoidance and of the farming systems for sustained soil fertility and moisture retention.

Priority areas for research partnerships

When ILRI was established in 1995 as a global institute, one of the highest priorities was to establish a development-oriented research programme in Asia. Extensive consultation from 1995 to 1997 among partners with interests in the region – donors, international and national organisations, government and non-government agencies – led to a research programme for South-East Asia which commenced in 1998 with funding from ILRI's core donors (including the World Bank, Rockefeller and Ford Foundations and the European Union) and project-specific funding from the Asian Development Bank (ADB), International Fund for Agricultural Development (IFAD), Australian Centre for International Agricultural Research (ACIAR) and the Systemwide Livestock Programme (SLP) of the Consultative Group on International Agricultural Research (CGIAR). A key feature of this programme has been that all research implemented by ILRI is with partners in the region and that ILRI has not established its own laboratory or field research facilities. Extensive links have been established with other international organisations in the region during implementation of these projects, for example with FAO in areas of animal health, animal genetic resources and food safety, and with the Centro Internacional de Agricultura Tropical (CIAT) in the areas of forage research and rural development.

Agroecological focus

Poverty reduction by increasing the quantity, quality and reliability of food production in rice-based crop-livestock systems is a compelling objective for South-East Asia. This is especially true for the neglected rainfed agro-ecological zones which are home to over 120 million poor, often marginalised peoples whose mixed farming systems were by-passed by the Green Revolution and where poverty is exacerbated by decrease in per capita land availability, shortening of fallow intervals, decline in soil fertility, and seasonal scarcity of feeds.

Mixed farming systems in these rainfed regions produce both food for subsistence and local marketing and feed for livestock production. Their efficiency and sustainability can be increased by the introduction of improved and more appropriate crops and livestock and farming practices, management of constraints such as endemic and epidemic disease and improving access to the rapidly emerging markets for livestock products. It is important that this so-called livestock revolution in demand for animal products also benefits the rural poor. To increase the focus on these systems they are often described as 'food-feed' systems to highlight their direct and indirect impacts on human nutrition, income and well-being.

Current ILRI activities in South-East Asia

ILRI collaborates with international research organisations: sister CGIAR centres, non-governmental organisations (NGOs), commercial companies and with government and non-government national research systems: universities, departments of agriculture and national institutes. The decision not to establish its own research facilities in the region and to work exclusively within the national research systems and on their priorities has led to 'obligatory collaboration' – there is simply no other way of working – and the benefits have been many. Of course the range of research topics is then limited by the range and capacity available in the region but in the case of South-East Asia this imposes few restrictions. The following is a list of some of the ongoing collaborative projects of ILRI in South-East Asia:

- Improvement of crop-animal systems through a better understanding of the interactions between plants and animals in the mixed farming systems that characterise South-East Asia and the economic and policy environment that may constrain their development in The Philippines, Vietnam, Indonesia, China and Thailand
- Sustainable worm control for goats and sheep through the application of integrated methods of chemical, management and genetic approaches to control and through participatory methods in communities in The Philippines, Indonesia, Thailand, Vietnam, Laos and Cambodia
- Economic impact of foot and mouth disease and its control through epidemiological and economic modelling in Thailand and The Philippines
- Policy options for rural income diversification and barriers to market participation by detailed analysis of household data in Vietnam, Philippines and Thailand
- Training activities and characterisation of livestock genetic resources among all the countries of South-East Asia through a series of workshops and the development of small research projects
- Diagnosis, epidemiological survey and impact assessment for *Trypanosoma evansi* in The Philippines through collaboration with local and national organisations, FAO and Office Internationale des Epizooties (OIE).

Underpinning all of these activities is a commitment to the supply of information, building research capacity using formal and informal methods and the absolute requirement that the end result shall be clearly identified pathways to reducing poverty in the region.

Future plans and possibilities

As a medium-sized research organisation with a small team of researchers based in South-East Asia our future plans depend heavily on the needs and capacities of partner researchers and their national and regional priorities. Core ILRI research capacity in the region includes livestock economics, animal nutrition, animal genetics, epidemiology and parasitology.

The skills and resources of colleagues in other ILRI campuses are regularly called upon for technical support of activities in South-East Asia, but the range of technical expertise directly available for regional projects is limited. Thus, there is a critical dependence on the creation of project teams across many countries, many disciplines and many types of organisations to implement an effective research programme. The role of ILRI ranges from providing direct technical inputs, supporting and training in our areas of expertise, facilitating interaction between partners and at times catalysing new partnerships in which ILRI has no further role.

The need for financial support is clear and dependence on donors that have traditionally provided funds to the CGIAR is increasingly linked to specific project outcomes. Thus, more direct financial arrangements with the public and private sector, linked to highly specific outputs and outcomes are likely to become more common as our regional programme develops. This will require changes within ILRI, within our partners and the way in which we nurture the partnerships on which our success depends.

The Crop-Animal Systems Research Network (CASREN)

C. Devendra and D. Pego

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Introduction

Rising human population, urbanisation and income-driven changes in food habits in South-East Asia will necessitate two- to three-fold increases in the supply of animal products by year 2020 (Delgado et al. 1999). In response to this increased demand, animal numbers and outputs will increase at a rapid rate (Devendra and Thomas 2002). This will require further intensification not only of the specialised non-ruminant industrial systems, but also of the crop-animal systems practised mainly by smallholders. In this process more attention must now necessarily be given to the arable land in rainfed environments, since the irrigated areas have been overused, and the relative importance of ruminants in those areas is declining.

Rainfed areas account for about 66% of the total arable land in Asia (TAC 1992). Further, they maintain almost one half of the total human, cattle and small ruminant populations (51.2, 51.0 and 55.0%, respectively) and support more than 120 million poor people. Improving productivity in these rainfed areas in South-East Asia is therefore potentially very important from the standpoint of fragility of the environment, preventing further resource degradation and finding opportunities for improving food security and livelihoods, and reduction of poverty. Associated with these aspects is the fact that the rainfed areas have been bypassed by the 'Green Revolution', and now present major challenges for research and development (Devendra 2000).

Within these environments, crop-animal systems are especially important on account of the diversity of crops grown and the presence of large populations of both ruminants (cattle, buffaloes, goats and sheep) and non-ruminants (pigs and poultry). Animals make a major contribution to draft for soil cultivation, manure for enhancing soil fertility, and conversion of crop residues to animal products.

This paper focuses on the background, approaches, and progress made over the last three years by the Crop-Animal Systems Research Network (CASREN) project carried out by ILRI in partnership with national agricultural research systems (NARS) in China, Indonesia, Philippines, Thailand and Vietnam.

Background of the project

In 1995, the International Livestock Research Institute (ILRI) started a series of regional consultation meetings with relevant stakeholders in different parts of the world in order to define an agreed global agenda for livestock research, as well as to identify partners in this endeavour. In the case of South-East Asia, the consultation was held at the International Rice Research Institute (IRRI) in Los Baños, The Philippines, on 10–13 May 1995 (Devendra and Gardiner 1995). This meeting confirmed Asia as one of the major challenges for ILRI, given its very large human and livestock populations. The meeting also defined crop-animal systems as the main focus of ILRI activities in South-East Asia, given the close integration of many livestock species into the prevalent smallholder farming systems.

A conference entitled "Development of Livestock Research Priorities in Asia" was held on 13–15 May 1997 in Hanoi, Vietnam (Devendra et al. 1998), as a follow up to the previously mentioned consultation. A similar meeting was held with the stakeholders in South Asia (Devendra et al. 1997). In this meeting, two *ad hoc* studies were analysed, one on crop-animal systems in rainfed areas of South-East Asia (Devendra et al. 1977) and another on priorities for livestock research in Asia in general (Vercoe et al. 1977). Based on those, NARS representatives were encouraged to indicate the following:

- a) Relevance to their country of the research priorities recommended for ILRI in Asia
- b) Extent to which their livestock research fits these priorities, amount and source of resources supporting livestock research in their country and
- c) Interest and ways in which their countries might participate in collaborative research and possibilities of funding.

All these efforts led to the formulation of the project entitled 'Increasing the Productivity of Crop-Livestock Systems in South-East Asia' which was funded by the Asian Development Bank (ADB) in December 1998. The project operated between January 1999 and December 2001. The project's general objective was 'to conduct collaborative, multidisciplinary research to generate technology and policy options to increase productivity of smallholder crop-livestock systems in South-East Asia'. ILRI and its NARS partners in that project created the Crop-Animal Systems Research Network (CASREN). In January 2002, the ADB funded a new project to support CASREN activities for another three years.

The CASREN project is a relevant mechanism for enabling South-East Asian multidisciplinary ecoregional research teams to improve integrated natural resource management, development of sustainable farming systems, increased productivity and improved livelihoods. In trying to find solutions to food insecurity and poverty, it covers the continuum of rainfed lowlands to uplands, and of production to consumption systems. The project applies holistic and participatory research and development approaches to crop-animal systems managed by resource-poor farmers, and recognises the importance of building research capacity and effective partnerships between NARS and all stakeholders.

The CASREN project involves three types of activities: (a) research and development, (b) research capacity building, and (c) monitoring and evaluation.

Research and development activities

The methodologies applied in CASREN research involved the following steps:

- a) Selection of one benchmark site (BMS) in each participating country, representing the most relevant biophysical and socio-economic conditions
- b) Detailed characterisation of the crop-animal systems in the rainfed environments to identify constraints and issues, in order to prioritise biological, socio-economic and policy research activities
- c) Ex ante evaluation of technology options that could help to overcome the main limitations of the prevalent crop-animal systems, their actual testing and the promotion of the adoption of the most promising alternatives
- d) Identification of appropriate macro- and sector- policy options to improve the contribution of ruminants to the economy of smallholder farmers.

The first two are important prerequisites to focus the eco-regional research and the relevance of the results to be obtained. The other two refer to the identification of technology and policy options that will help increase the contribution of the animal component of the system in improving the livelihood of smallholder farmers.

Specific criteria were developed and shared with participating NARS, and were finally used in the selection of each BMS. Both macro criteria and the kind of information required for BMS site characterisation were considered (Devendra 1999). The main elements were as follows:

- a) Biophysical characteristics: land use, cropping patterns and intensity, length of growing season, water availability, and crop-animal systems.
- b) Priorities: at national, provincial and county levels.
- c) Animals: types of ruminants (buffaloes, cattle, goats and sheep) and non-ruminants (ducks, pigs and poultry), animal population density, market access and market pull.
- d) Poverty and food security: extent and ethnicity.
- e) Accessibility.
- f) Institutional factors: NARS research capacity, linkages with farmer groups, co-operatives and NGOs.
- g) Perceived research constraints: resource degradation, dry season, availability of draft power, limited use of fodder trees, inadequacy of feed supplies (quality and quantity), and inefficiency in nutrient recycling.
- h) Potential for improvement and impact.

Concerning detailed characterisation, specific research domains were identified (rainfed lowlands and/or uplands) in which two villages were chosen. From these villages, 40–100 farms were selected. These were used for detailed participatory rural appraisal (PRA) as well as structured household surveys.

To illustrate some of the results obtained in the characterisation of the prevalent crop-animal systems, table 1 identifies the BMS and their locations in each country, the household and biophysical characteristics, predominant animal species, types of crop-animal systems and the major interactions between components. The results indicate that rice-based farming systems are common in three of the five sites, and include the presence of all ruminants (buffaloes, cattle, goats and sheep), non-ruminants (pigs and poultry) and fish.

The average farm size is especially small in the BMSs in China and Indonesia (0.27 and 0.55 ha, respectively), intermediate in The Philippines (1.26 ha), and larger in Vietnam and Thailand (2.59 and 5.24 ha, respectively). Interestingly, women managed 26–32% of the farms in all countries, except for Indonesia, but in the latter the role of women in animal feeding is extremely important.

Table 1 enables for important observations within the specific focus on sub-humid/humid agro-ecological zones. Firstly, the continuum of lowland and upland rainfed ecosystems provides a mix of both ruminants and non-ruminants. Secondly, rice-based cropping systems are common, including also other annual crops and tree crops. The presence of both animal and crop diversity thus provides a variety of crop-animal interactions, the effects of which provide major opportunities for research and development activities on productivity, livelihoods of people and sustainable agriculture.

Thirdly, all the BMS have overriding major constraints in 5–7 months of dry periods. This particular situation, along with the high stocking rates varying from 1.3 to 4.0 tropical livestock units (TLUs) per hectare were observed in all BMS except in Vietnam. This presents major challenges on the efficiency of use and/or protection of natural resources in these environments. Fourthly, the initial indications suggest a 10–25% level of contributions by animals to total farm income.

Table 2 summarises some of the results from several on-farm trials comparing farmers' practices and improved nutritional interventions. Among the options tested are: the use of multi-nutrient block licks (MNBL), concentrates formulated from local feed resources, cassava hay as a substitute for commercial concentrates, and cassava peelings to complement grazing. All options resulted in significant improvements in the biological and economic performance compared to the systems practised by farmers.

These on-farm research results show the following implications:

- UMB licks for cattle in China, Indonesia and The Philippines used for a period of 120 days during the critical dry season resulted in additional income per animal of between US\$ 10.80 to 51.60, after discounting all costs associated to the nutritional intervention. When these were used for milking cows, the additional income per cow per month was US\$ 12.60.
- In China, the use of local resources in the formulation of concentrates fed to calves for 90 days resulted in an additional income of US\$ 16.20 per animal. In the case of kids under 90 days old, this practice resulted in an additional income of only \$0.90 per animal.
- In Thailand, the use of cassava hay to partially replace commercial concentrates for dairy cows resulted in savings of US\$ 9.90/cow per month in feeding costs, and an additional income of US\$ 7.20/cow per month, due to the increase in milk production.
- In Vietnam, the use of cassava peelings and minerals to supplement grazing cattle for a period of 120-days resulted in an additional income of US\$ 45.60 per animal, after discounting costs of supplementation. Additionally, this is an option to utilise a by-product of starch production that was contributing to pollution.

Table 1. Some household attributes, biophysical characteristics and farming systems in benchmark sites of five countries.

	Vietnam Dong Tam, Binh Phuoc	Thailand Anphur Mueang Mahasarakham	Indonesia Dongang, Ciwidey, Garut	Philippines Dagupan, Marikina, Tarlac, Pangasinan	China Bei Xiang, Nanjing Yunnan
Household attributes					
Average farm size (ha)	2.99 ± 1.57	5.24 ± 2.74	0.55 ± 0.73	1.26 ± 0.44	0.27 ± 0.12
Household size (persons)	4.34 ± 1.74	4.79 ± 2.08	4.46 ± 1.54	5.52 ± 2.33	4.73 ± 1.29
Per cent of farms managed by women	28.4	31.6	4.2	30.0	26.0
Biophysical characteristics					
Mean rainfall (mm)	2170	1500	2200	2300	760
Dry season (months)	6	6-7	5-6	6	7
Farming systems					
Predominant crop-animal systems	Cumulative/pasture-based beef cattle production	Rice-based dairy cattle production	Rice-based cattle fattening and sheep raising	Rice-based beef cattle and goat production	Wheat/mulberry-based beef cattle and goat production
Predominant animal species ¹	BC, Pi, Po	DC, Pi, Po	BC, Bu, S, G, Fi	BC, Bu, G, Pi, Po	BC, Bu, G, Pi, Po
Number of animals (TLUs) ²	0.67 ± 1.69	7.34 ± 4.32	0.70 ± 0.78	2.26 ± 1.97	1.07 ± 0.73
Mean crop-animal interactions	Crop residues as feed, use of draft animals	Crop residues as feed, manure as fertiliser, use of draft animals	Crop residues as feed, manure as fertiliser	Crop residues as feed, manure as fertiliser	Crop residues as feed, manure as fertiliser, use of draft animals
Contribution of livestock to total income (%)	13	10-20	32-35	33-37	20-25

1. BC = beef cattle, DC = dairy cattle, Bu = buffaloes, S = sheep, G = goats, Pi = pigs, Po = poultry, Fi = fish

2. TLU = Tropical livestock unit, equivalent to a ruminant animal of 250 kg body weight. Only ruminant species have been considered for its estimation, according to the following equivalencies: cattle and buffalo = 1.0, sheep and goats = 0.01. In all species, mature male = 1.0, mature female = 0.75, growing animal = 0.5, pre-weaned animal = 0.25.

Table 2. Biological response (kg/head per day) and profit margins US\$/head per day) due to supplementation in smallholder farms in five countries.

Technology option	China		Indonesia		Philippines		Thailand		Vietnam	
	Biological response	Profit margin (US\$/animal/day)	Biological response	Profit margin (US\$/animal/day)	Biological response	Profit margin (US\$/animal/day)	Biological response	Profit margin (US\$/animal/day)	Biological response	Profit margin (US\$/animal/day)
Multi-nutrient block licks (MNBL) ²	Cattle	Cattle	Cattle	Cattle	Cattle	Cattle	Cattle	Cattle	Cattle	Cattle
	+0.187	+0.33	+0.215	+0.43	+0.063	+0.09	+0.12	+0.16	+0.12	+0.16
	Goats	Goats	-	-	-	-	-	-	-	-
	+0.03	+0.05	-	-	-	-	-	-	-	-
Concentrate formulated from local feed resources for feeding young animals	Calves	Calves								
	+0.208	+0.18								
	Kids	Kids								
	+0.012	+0.01								
Use of cassava bag as a partial substitute for commercial concentrates for dairy cows							Save 3 kg concentrates	+0.51		
							+ 1.2 kg milk			
Cassava peeling waste for									+0.24	+0.38

¹ Difference due to supplementation² MNBL is a feed supplement formulated from molasses, proteins and minerals from local sources and a binding agent (usually cement) to make nutrients available continuously. It is especially useful in the dry season and is easy to prepare. Farmers are already producing this at low cost in China, Philippines, Indonesia, Thailand and many other developing countries.

Several interventions on the cropping patterns aimed at the implementation of food-feed systems have also been tested by the CASREN project. These include intercropping of cowpea in cassava crops managed for hay and root-chips production in Thailand and Vietnam, intercropping of peanuts and red beans in Indonesia, and the use of mungbean or peanuts in rotation with rice in The Philippines.

Strengthening research capacity of NARS partners

A significant contribution of the CASREN project has been the strengthening of the research capacity of the national agricultural research system (NARS), recognising that the systems and integrated natural resource management approaches have been major weaknesses in most institutions and research programmes. In this context, CASREN has been able to fulfil the following activities:

- a) Trained 120 professionals in approaches and methodologies for crop-animal systems research, participatory approaches for systems characterisation, and systems analysis and impact assessment
- b) Provided opportunities for 11 MSc and 6 PhD students to pursue their research in topics covered by the project.
- c) Produced a training manual and a CD-Rom training resource on research methodologies and approaches for improving smallholder crop-animal Systems in South-East Asia
- d) Prepared a GIS-based report and geo-reference database on crop-animal systems in South-East Asia available in a CR-Rom.
- e) Developed two simulation models (beef and dairy cattle) adapted to the conditions of the prevalent crop-animal systems practised in South-East Asia
- f) Published six issues of the CASREN Newsletter, two workshop proceedings, 15 reports by national co-ordinators, 17 articles in proceedings and 9 articles in peer-reviewed journals
- g) Developed a bibliographic database on crop-animal systems in Asia, which includes almost 2000 entries (about 50% with abstracts)

Monitoring and evaluation

The CASREN project has held three workshops as part of its monitoring and evaluation efforts. It conducted in The Philippines the First Planning Workshop in June 1999, in which ILRI and its partners reviewed the general characteristics of the benchmark sites selected, discussed and agreed upon the methodologies for site characterisation (ILRI 1999).

In the Second Workshop held in Kunming, China in May 2000, results of the household surveys carried in each benchmark site were presented, as well as some methodologies for

data analysis. Procedures for *ex ante* evaluation of technical interventions were discussed (Devendra and Frio 2000). The Third Workshop held in Purwakarta, Indonesia in March 2002 conducted a comprehensive review of the activities carried out by the CASREN project during its three years of operation. The review placed emphasis on the results obtained after monitoring the year-round feeding systems, as well as the responses to technical interventions applied at farm level. This workshop also served as a planning meeting for the new CASREN project.

Besides the workshops, in June 2001 the project was subjected to an External Evaluation as requested by ILRI's Director General. The purpose of the evaluation was to look at what has been done by CASREN, where was the project going, and how the NARS partners perceived it. Also, ILRI management was keen to assess the progress of the project in the context of future programming and resource use.

The Evaluation Team identified CASREN as a process in which NARS activities were fully participatory. They also recognised CASREN as an important platform and effective partnership for ILRI efforts in South-East Asia (Tanner and Rola, personal communication).

What is next for the CASREN project?

Over the next three calendar years (2002–2004), the CASREN Project will continue supporting participatory and multidisciplinary research to increase productivity in crop-livestock systems and to reduce poverty in smallholder farming communities in rural areas in South-East Asia (ILRI 2002).

It will operate in the same five benchmark sites included during the first three years of the project, plus a new site still to be identified in Sichuan Province, China. In the new site, the project will study those crop-animal systems that involve the use of sweet potatoes as the main feed resource for pigs.

The specific study objectives of the new CASREN project are to:

- a) use participatory approaches to spread the application of appropriate technologies to enhance the productivity of crop-livestock systems
- b) develop and recommend policy changes to improve market participation competitiveness and trade for smallholders and
- c) continue developing the capabilities of the NARS to conduct independent research on crop-livestock systems, and advise other NARS in the region.

The new CASREN project comprises the following three sets of activities: research and development (R&D) work, policy research and capacity building. A detail of the activities to be covered is listed as follows:

1. R&D activities

- a) validate promising year-round feeding system technologies in the BMS, and field test them in alternative locations
- b) monitor the impacts of the technologies on animal productivity, farm incomes, and the environment
- c) diffuse the validated technologies on a large scale in the participating countries
- d) identify the factors that promote and/or constrain the adoption of improved technologies by smallholders.

2. Policy research

- a) assess the impact of livestock sector trends, trade and public policies on the competitiveness and market participation of different types of production units and on employment generation
- b) identify and recommend policy options that will improve technology adoption, promote equitable market participation and lower transaction costs.

3. Capacity building

- a) organise and conduct regional training courses for NARS and NGOs to disseminate information on appropriate crop-livestock systems research, and policy analysis
- b) develop highly interactive knowledge and information products to support R&D activities
- c) package information products generated from the project in a suitable form and distribute them across the region
- d) develop network linkages for technology transfer
- e) assist NARS to prepare appropriate R&D proposals on crop-livestock systems.

Conclusion

Crop-animal systems constitute the backbone of agriculture throughout South-East Asia, involving both crop and animal diversity, a variety of systems and interactions. However, improvements to these systems as a means to significantly increase farm productivity are limited by inadequate prioritisation of the major constraints and lack of concerted research and development (R & D) efforts that can lead to overcome these constraints. This is especially true for rainfed agriculture where extremes of poverty and resource degradation exists

The CASREN network project is an attempt to holistically address some of these issues, and is aimed at increasing productivity of crop-animal systems in rainfed agriculture and improved livelihoods. The challenges are enormous, but provide considerable opportunities for collective action by all those concerned with issues of efficient natural resource management and development of sustainable food security in crop-animal systems. From the R&D perspective, there is a need for interdisciplinary work and institutional partnerships to identify appropriate technologies and policies, to address the improvement of crop-livestock systems in order to reduce poverty and food insecurity in a sustainable manner.

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Indonesian approaches to technology adoption for livestock development

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The livestock subsector in agricultural development

The livestock subsector in Indonesia has played a significant role in agricultural development. It contributed 10–11% to agriculture and 2–3% to the national gross domestic product (GDP). The agriculture sector contributed around 17% to the national GDP, and in 1969, it reached almost 60%. During a 25-year period, the contribution of the livestock subsector to the agriculture GDP has increased significantly, from 6% in 1969 up to almost 11% in 2000 (Statistical Book 2001). The average growth of the contribution of livestock to the national GDP was close to 1% per year and has shown a positive trend (Figure 1).

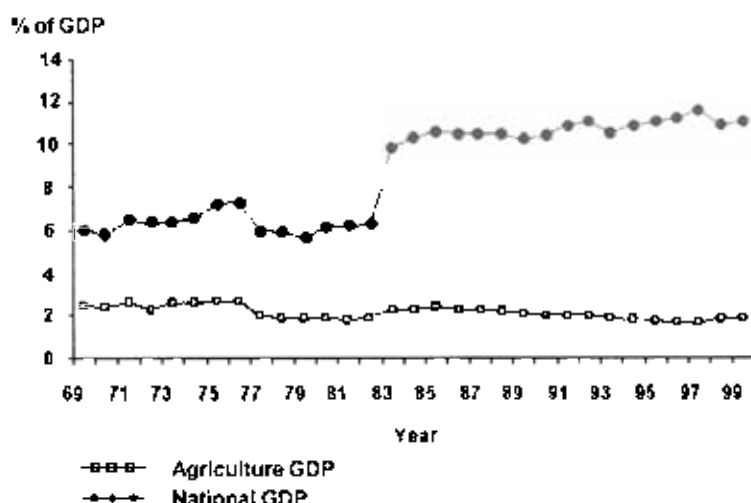


Figure 1. Contribution of the livestock sector to agriculture and national gross domestic products.

The livestock subsector provides almost all meat and eggs, and part of the milk for domestic consumption. The Government of Indonesia is keenly aware of the importance of the livestock subsector as a renewable supplier of animal protein for human consumption.

At the farm household level, livestock farming performs an important role by providing good quality food, cash income especially for rural people, and savings. It also has a social function in religious ceremonies. There is no doubt that livestock farming has also become an important component of the agricultural sector, which has contributed significantly to family income (Abdurachman et al., 1993; Haryanto et al., 1999). Although the contribution of livestock farming to household welfare is clearly recognised, improvements in the livestock subsector are still needed through the application of technology innovations. The relatively inefficient animal production systems require continued innovation in order to make larger contributions to household income and improve the national nutrition level.

Rapid economic progress in Indonesia during the last 20 years has brought rising consumer's income which in turn have led to the subsequent changes in consumption patterns that place increasing demand for animal products. During the year 2000, per capita consumption of meat, eggs and milk has increased by 22.8%, 23.4% and 24.3%, respectively compared to that of 1999 (Statistical Book, 2001). It has been indicated that there is some improvement in the country's nutrition as animal protein consumption reaches the standard of 6 g/capita per day (LIPI, 1998). The consumption trend from 1969 to the end of the year 2000 is shown in Figure 2.

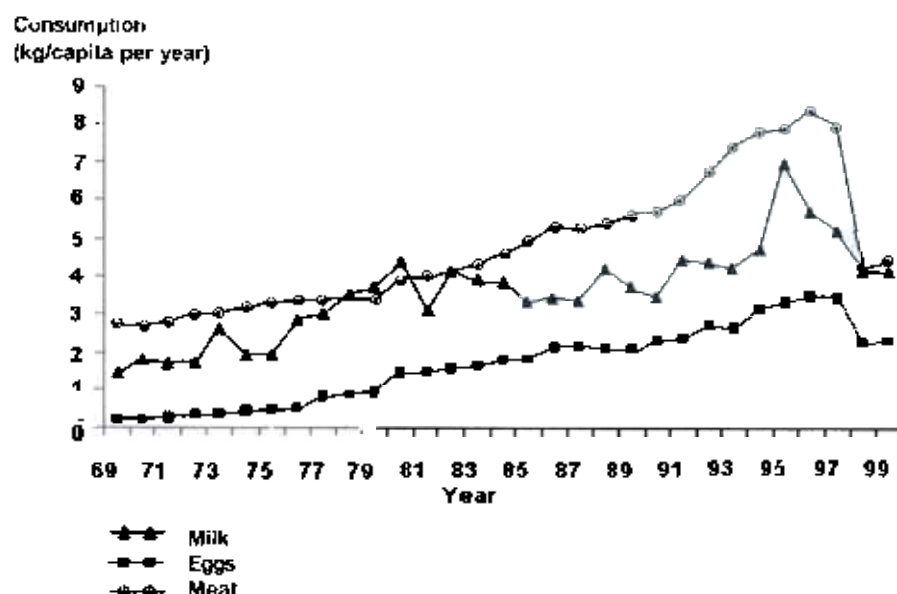


Figure 2. Consumption of meat, eggs and milk.

In the next 20 years, the livestock subsector will grow very rapidly due to changes in the demographic composition of the population and high urbanisation. It is predicted that the livestock subsector will be contributing almost half of the total output in agricultural development (Delgado et al. 1999). In Indonesia, continued growth in the livestock subsector absorbs the increasing labour force and promotes a stable transition to an industrialised economy.

As an agricultural country, most Indonesians reside in rural areas, and agriculture is the primary source of income. Non-agricultural activities in the rural areas consist of trading (13.6%), community services (8.3%), construction (3.3%), transportation and communication (7.8%). During the 1997 economic crisis, when most industries and banking companies were bankrupt, the agricultural sector played a very important role in employing the labour force coming from the bankrupt companies. The size of the agricultural labour force increased to 26.6 million in 1998, and the processing industry sector only absorbed about 8.7 million (CBS 1999).

The structure of the labour force in 1998, as an aggregate, showed that the agricultural sector played an important role in creating job opportunities for 59% of the total rural labour force (57.48 million people). The proportion of the agricultural labour force outside Java was higher than that in Java (67% vs. 51%). In contrast, the proportion of the non-agricultural labour force outside Java was less than in Java (33% vs. 49%).

The supply of meat is composed of broiler, beef, mutton, chevon, pork and meat of other animal species, while eggs are mainly produced by layers, native chicken and ducks. Domestic beef production has never met the national demand for beef meat, so that import of feeder cattle and meat has been ongoing since 1991 to balance the increasing domestic demand. Indonesia has experienced being a net exporter of live cattle in the 1970s but in the late 1980s, the rapid increase in the demand for beef could not be met by domestic production. The increased beef demand has put high pressure on the national standing stock and reduced off-take rates, therefore, meat in fresh or frozen form (with or without bones) import has become the only alternative to satisfy the national consumption requirement.

In contrast, export of broiler increased from 0.3 t in 1991 to 703.8 t in 2000 with trade values of US\$ 8700 to US\$ 1,298,500 respectively (Statistical Book 2001). Milk production meets only 35% of the national demand, hence the rest relies on imported milk. The Government of Indonesia has placed various regulations for the dairy industry, such as import ratio, import tariff, import licensing and restrictions. However, with the latest Presidential Instruction (Inpres No.4/1998) in response to the 50 items commitment with the International Monetary Fund (IMF), all the regulations have been lifted out.

The national egg consumption requirement has been met by domestic production since the 1980s, which indicates its potential for export. Export of eggs from Indonesia could be considered small and negligible, which started in 1996 with only 60 kg of eggs and jumped to almost 6 t in 2000. This is a good sign that Indonesia has the potential to export chicken eggs, unlike the years before 1984 when it was a net importer.

In terms of monetary value, the present state of the livestock subsector in Indonesia is far from being satisfactory. However, this should not discourage further development efforts as it is the type of farming with the most economic potential that affects directly the well being of the people. The challenges posed by the simultaneous globalisation and incorporation of profit and commercialisation approach make it important to elaborate further the operational steps towards livestock technology development.

Indonesia's technology adoption experience

Improving location-specific farming systems involves not only technological problems, but also includes appropriate management systems. One of these is the mechanism of transferring the appropriate technology to the farmers. Research and development (R&D) should start with the users' needs, continuing with users' participation in the field testing and ending with the technological results in the users' hand to gain wider acceptance in the community. The concept of adoption of technology means a conscious shift from commodity approach to a more context-oriented research that could systematically fit production technology to each unique agro-ecoregion.

The Agency for Agricultural Research and Development (AARD) is the central research organisation in Indonesia under the Ministry of Agriculture. AARD's main agricultural R&D programme consists of seven general and inter-related topics:

1. agricultural resource research
2. research on improvement of genetic potential
3. biotechnology research
4. assessment and development of location specific technology and agricultural farming systems
5. socio-economic and policy research
6. communication of research results and
7. institutional development.

The main duties and function of the AARD are widely divided into several Structural Echelon II work units, in accordance with their defined primary duties. Those main duties cover:

1. Technical and administration services
2. Guidance and programme formulation
3. Communication guidance, library management, science and technology (S&T) information transfer, and research on communication
4. Implementation of various disciplinary fields of research (socio-economic, agro-climate, agricultural equipment and machinery) and
5. Commodity research implementation (livestock, food crops, horticulture and estate crops).

The main duties and functions of each Echelon II work unit are further divided into lower echelon work units and researcher groups and installations of technical implementing units that handle research fields and commodities concerned. The Central Research Institute for Animal Sciences (CRIAS) implements research and development programmes on animal sciences. It has two research institutes, namely the Research Institute for Animal Production (RIAP) and the Research Institute for Veterinary Sciences (RIVS). These research institutes perform animal commodity research in a holistic manner, starting from evaluation, characterisation and sustaining genetic resource, improvement of genetic potential, postharvest and processing. Furthermore, to meet the need for technology generated from research in certain fields, research stations have been established. The AARD research organisation and institutions involved in AARD are shown in Figure 3.

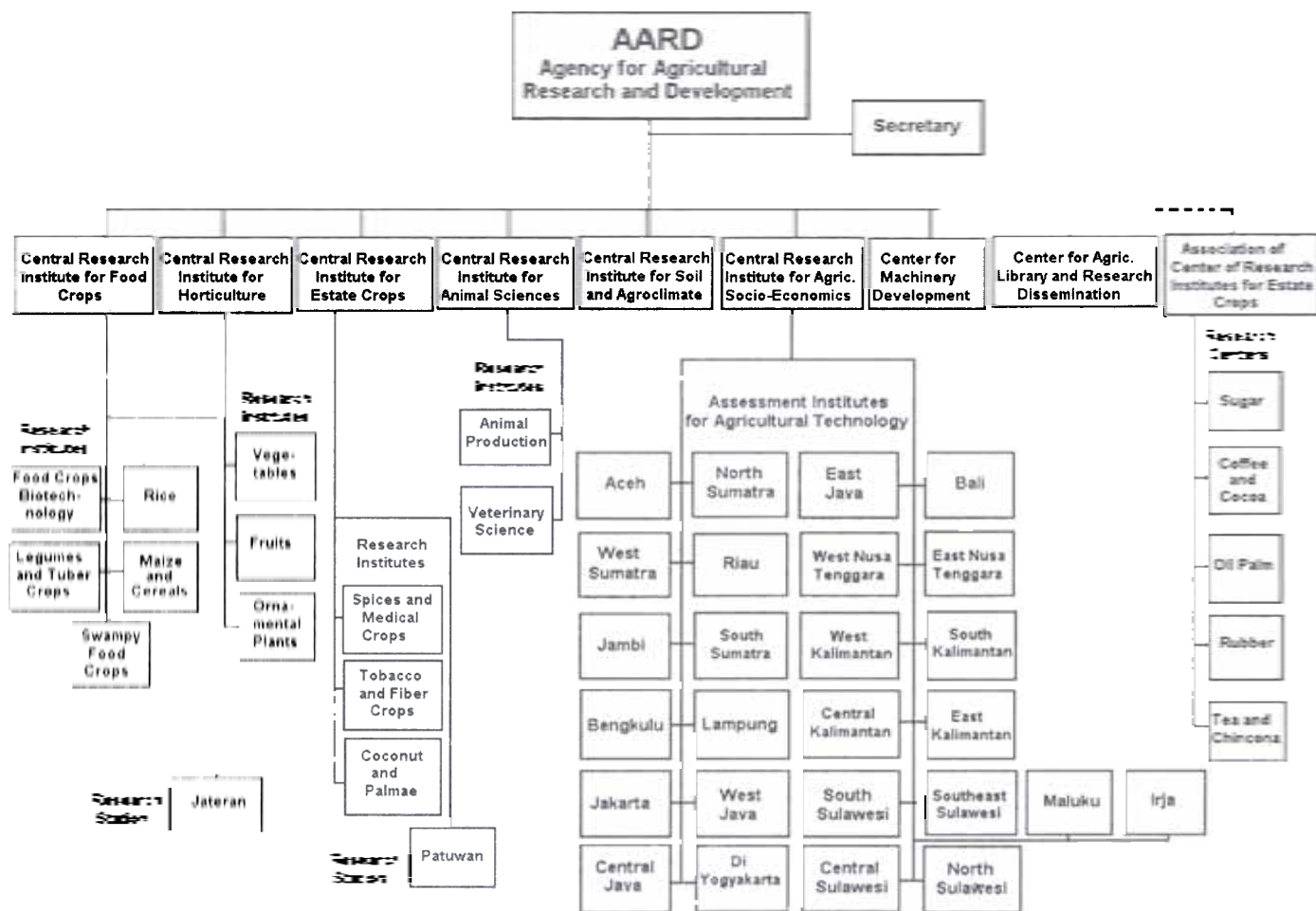


Figure 3. Organisational structure of the AARD.

The role of assessment institutes for agricultural technology

Appropriate agricultural technology application has a location-specific requirement in accordance with the local unique agro-ecological zone and socio-economic conditions. This means that adaptive research and technology engineering must be carried out in the area where the technology will be utilised.

In the early 1990s the AARD responded to these challenges by establishing assessment institutes for agricultural technology (AIATs) in every province in Indonesia. The AIATs were created by the Ministry of Agriculture's Decree No.798/Kpts/OT.210/12/94 on 13 December 1994. These are institutions under AARD at the provincial level that:

- provide the regionalisation and decentralisation of agricultural R&D, taking into account the local agricultural resource diversity,
- encourage the acceleration of agricultural rural development in related regions with agribusiness orientation through the preparation of the locally specific agricultural technology package engineering, and
- accelerate technology transfer to users and the dissemination of feed back to improve national agricultural research programmes and commodity research (CASER 1997).

Henceforth, this agricultural research network must accelerate the provision of location specific technology as well as enhance the diffusion and adoption of research results that can reach livestock farmers throughout Indonesia. Similarly, a problem-solving feedback mechanism to address production constraints being faced in each locality can be used immediately to channel information through the AIATs to reach the appropriate National Research Institutes (NRIs) and the Central Research Institutes (CRIs) for more rapid response and solution.

Each AIAT will assess research results produced by the NRIs and CRIs and other external research institutions, such as the universities, Agency for Technology Assessment and Application, Indonesian Institutes for Sciences, private sector and other foreign institutions. The AIATs will use the assessment, adaptation and development approaches of participatory farming and extension systems development which are relevant to each set of unique local agro-ecosystems and socio-economic conditions. These R&D activities will be supported by characterisation of the current condition of utilisation of natural resources, research on agricultural development policy alternatives and research communication enhancement. Research communication development will be directed toward the establishment of a collaborative communication network among various research institutions so that livestock technology innovations can be rapidly exploited for agricultural development.

Technology development and transfer

A new technology will be relevant to a group of farmers if it responds to their needs. The extent and speed of adoption is one way to assess the relevance of a technology that is widely available. Some of the introduced technologies by NRI's/CRI's have been used by some farmers, while others avoid them. This phenomenon indicates that application of

technology cannot be generalised and that a deeper understanding of the environmental interactions (farmers, land, culture and technology) is required, implying that introduced technology should be location-specific (Francis and Hildebrand 1989 cited in Norman and Douglas, 1994).

Why technology is adopted at one site and rejected by others can be answered by CRIs or NRIs by finding appropriate farming innovations and providing awareness to the research community. A number of variables concerning the characteristics of the technology itself help determine the extent of adoption. Among these are the profitability and social acceptability of the introduced technology, its importance to the producers' production systems, ease of access, timing of availability, degree of changes to current practices required in using the new technology, and whether or not it was developed in response to a clearly articulated demand from the producers or extension service (Soedjana and Kristjanson 2001).

The involvement of farmers at various stages of the research process is a central objective and responsibility to achieve successful adoption of introduced technology. Therefore, the AIATs need to have direct links with farmers to ensure that the technology developed is relevant to them, as inputs from technology transfer workers alone will not be sufficient. Seegers and Kaimowitz (1989) report that even though feedback from extension to research is more common in a system with good resources, extension workers are usually not the main source of researchable ideas. Therefore, livestock research must be not only innovative, but also relevant to the final users of its products (the farmers), and its results must be broadly disseminated.

There are four complementary sets of links to ensure that research results are relevant to farmers:

- a) direct links between researchers and farmers
- b) links between on-farm and off-station researchers
- c) links between researchers and technology transfer workers
- d) links between technology transfer workers and farmers (Merrill-Sands and Kaimowitz, 1989).

Strong links among these actors will ensure that:

1. Research tackle users' priority problems looking for options to solve them
2. Farmers and technology transfer workers keep up with research development
3. Available technologies are adapted to local socio-economic and agro-ecological conditions
4. Successful technologies are promoted and widely distributed to the farmers
5. Users have access to information, inputs and services required for the implementation of the promoted technology
6. Researchers can obtain feedback from farmers and extensionists regarding the relevance and performance of the developed technology.

Integrated crop-livestock systems

CRIAS has focused its programme on integrated crop-livestock systems on the basic principle that livestock utilise residues of rice plants (in the form of rice straw as well as the

product of rice milling in the form of rice bran) and on the other hand, the rice land areas receive manure produced by livestock as organic fertiliser.

This simple relationship between crop and livestock systems is expected to successfully maintain land productivity in terms of physical and economical aspects. In practice, the system of cattle management in the existing local conditions could be modified to fit in the availability of natural resources. In Yogyakarta, for instance, the farmers developed a communal cattle barn with a breeding management and fattening scheme. Rice straw becomes the primary fibrous feed for the cattle. The rice straw is obtained not only from the nearby areas but also from relatively far distances, often more than 20 km away from where the animals are. In other areas, a cattle fattening scheme in horticultural areas such as in Wonosobo (Central Java) and in Lampung use pineapple peelings, a waste product of the pineapple canning industry, to feed cattle.

Under the Crop-Animal Systems Research Network (CASREN), a collaborative project between CRIAS and ILRI, farmers in Cilawu, Garut, West Java used 23% of the available rice straw as feed, 39% as mulch and 30% burned (Djajanegara et al. 2001). In contrast, all corn stover produced is fed to animals and increasing the use of crop residues as feed becomes a goal as a locally available feed resource within a LEISA (low external input sustainable agriculture) approach. In a systems approach, the collection of manure for treatment was also introduced to complete the crop-animal systems cycle.

The project is still studying the long-term effort to improve the welfare of farmers (poverty alleviation) towards food sufficiency. Currently, CRIAS has developed the crop-livestock system in eight AIATs in the provinces. The ultimate goal is to use natural resources available in each location under the LEISA approach to support sustainability of agricultural production. Under this system, it is expected that the nutrient recycling systems will be sustained forever through the integration of livestock in the whole agricultural system. The regions include North Sumatra, Lampung, West Java, Central Java, Yogyakarta, East Java, Bali and South Sulawesi. The success of the integration systems of food crop and livestock management under study is foreseen and expected to be implemented in a wider area.

Upstream linkages

By establishing AIATs, Indonesia has created a three-stage flow model of knowledge and technology transfer. Technology generated from the NRIs and/or CRIs should be passed on to the AIATs for local testing, assessment and repackaging and then on to extension agents and the farmers.

Under this model, the AIAT becomes the focal point and may function cost effectively if it has functional upstream linkage with NRIs and CRIs, a horizontal linkage with other AIATs and a functional downstream linkage with extension agencies, farmer leaders and other local technology dissemination mechanisms. In several AIATs, the linkages with relevant NRIs and CRIs are still limited, *ad hoc* or weak. In certain cases, the constraints include funding for collaborative activities and lack of a clear institutional arrangement for an efficient linkage between the NRIs/CRIs and the AIATs.

To institutionalise a functional linkage between the AIATs and relevant NRIs and CRIs, AIATs need to allocate a regular budget and designate research specialists to work with staff at the appropriate NRIs and CRIs who are assigned to work regularly with all relevant AIATs. On the other hand, the NRIs and CRIs should also have regular budgets for this purpose and a small unit with designated staff to work closely with the AIATs designated staff. They should meet or visit regularly to give feedback and to receive new findings and technology from the NRIs and CRIs. In addition, the AIATs-designated staff in a given NRI or CRI could exchange experiences with each other during these meetings. Other mechanisms of AIAT/NRI and CRI linkages could include collaboration in multi-location trials and regular exchange of publications and research or extension materials. A more active use of the available internet must be an important component of the linkage between the NRIs/CRIs and the AIATs and between the AIATs.

Downstream linkages with extension and farmers

Almost all of the AIATs in Indonesia are actively linked with the local extension system, the livestock services and farmer leaders. This link is also evident with regional universities and the private sector. Some AIATs are introducing innovative mechanisms as linking the regional research institution with farmers such as the use of 'Contact Tani' and the use of 'Grouped Barn' for cattle raising in certain areas in Java. As an effective major linkage between research and extension at the local level in Indonesia, AIATs have significantly increased the testing and packaging of available appropriate technology for wider dissemination by the extension system to larger number of farmers and other end-users.

Even though Indonesian farmers, in general, are getting more educated and development-oriented, the level of progress differs from one province to another. Differences even occur among locations within a province. It is generally observed that the western part of Indonesia is more advanced than the eastern part in view of farmer's technology adoption and availability of farm business facilities and services. Farmers in the western part of Indonesia are also more exposed to technological information and, therefore, are more progressive in seeking better ways to optimise their agricultural activities (Martaamidjaja 1999). This unequal level of farmers' progress has posed a challenge to both extension and research community to develop location-specific extension programmes supported by provision of appropriate technologies that are suitable to the specific farming system of respective localities.

Increasing participation of the private sector

The increasing participation of the private sector and non-governmental organisations (NGOs) in livestock R&D has posed a challenge to the extension and research community. It implies that while a participatory and cooperative undertaking is an underlying policy of extension and research, its realisation has yet to be attained. There is a need to promote a

possible privatisation of R&D to increase livestock production. This can be done by simplifying bureaucratic procedures to allow private sector involvement.

The establishment of a science and technology (S&T) information network needs to be initiated. This network should accept information on incoming technologies from various R&D institutions as well as the private sector. The technology on livestock development in S&T information may not exist without developing communication, collaboration and partnership systems.

Approaches to technology adoption

CRIAS held a regular national seminar every year to disseminate research results. This featured discussions and formulation of research partnerships and collaboration. In the last three years, CRIAS had also invited international speakers during the seminars to enhance information exchange and knowledge as well as to forge new research collaboration.

Dissemination of research results is commonly performed through the national exhibitions and information meetings with the clients from various communities. The response to these events were good and indicated that the number of participants involved has increased from year to year. The other approach practised by CRIAS is publishing the *Animal Production and Veterinary Journal*, a regular journal four times in a year as well as a bulletin on the scope of livestock development (Wartazoa). The problem faced here is the publication does not reach all field extension workers as this is usually sent to selected people.

In Indonesia, livestock technologies have had very little impact on production and productivity at the farm level, even though livestock provides more than only food, for example, draft power, manure and fibers. The most important motive for keeping livestock is the function of capital assets. Farmers in Central Java proposed 78 technologies to be assessed, but ALAT Ungaran only published 34 assessment-based technologies from which only 18% met the farmers' requirements (Surachman and Prajogo 1999). This fact has shown that planning for developing new technologies need to be improved. These problems were probably caused by the methodology implemented and using inappropriate instruments, or inefficiency of the feedback flow that came from the farmers to the researchers. Or, it could be caused by many research publications that are too technical in presentation that even extension workers find it hard to understand.

Final remarks

Agricultural research in the livestock subsector is expected to produce innovations to be adopted by farmers through the field extension workers, ALATs and then by the private sector. The development of new technology appropriate for adoption by farmers should be the main objective of the R&D programme. At the initial stage of the research process, the criteria used to evaluate whether the new technology is or is not potentially beneficial and acceptable to farmers need to be considered. Factors that most frequently affect adoption of

technological innovations include farm size, land tenure, labour availability, credit and market access, risks and uncertainty, human capital and sociological factors.

Therefore, a systems research that involves farmers in the earliest stages of technology development is needed. This ensures that the new technologies are compatible with farmers' needs. Based on this, some observers had suggested that rapid adoption by farmers was the proper evaluation criterion for the appropriateness of new technology and implicitly for the validity of the procedures used to generate technology.

Another challenge for today's R&D community is the growing need for promoting strategic research that address poor farmers' concerns in view of the technology commercialisation era. Livestock R&D programmes are currently still focused on providing packages of technologies to support national or local government projects.

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Investment for livestock development: The Philippine case

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Introduction

This paper is based on the context of the livestock revolution which projects significant increases in the consumption of meat, milk and eggs in the coming years. The increased consumption is going to be much more substantial in developing rather than in developed economies. The revolution presumably will impact on many aspects of society – poverty, pollution, food prices, health and the overall economy. The livestock revolution offers an excellent opportunity for new and additional investments in livestock development. But as pointed out, the revolution carries with it attendant risks. Investments in livestock therefore must be designed to build on the benefits and reduce, if not eliminate, the risks. A parallel consideration is the overall goal of making the livestock enterprise an instrument for increased incomes, reduced poverty, and greater equity. These incorporate an additional dimension to what otherwise would simply be raising livestock for food and for income.

This paper will look at investment opportunities and requirements in the livestock and poultry sector in the context of the livestock revolution with The Philippines as the case. Within the Philippine setting, and consistent with the workshop theme, we shall attempt to provide an overview of investment opportunities – particularly research and development (R&D) investments – as basis for determining development directions. And, also consistent with the directions of ILRI, this paper seeks ways to ensure that the investment 'continues to meet the needs of smallholder farmers'.

The Philippine livestock sector

Livestock is a major contributor to the Philippine economy. In year 2001, livestock and poultry production accounted for 31% of the total value of agricultural production (Figure 1). This contribution had always been historically high.

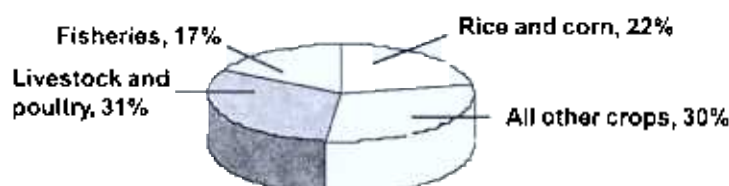


Figure 1. Share of livestock in total agricultural production.

The major commodities

The swine and poultry industries account for the major share of livestock output and value (Table 1). In 2001, hog production accounted for almost Philippine pesos (PhP) 84 billion (US\$1.68 billion) or 43% of the sub-sectors' output; chicken eggs and meat accounted for PhP 80 billion (US\$1.6 billion) or 42% of output. Ruminants including cattle, carabao and goats accounted for 12%.

Table 1. Share of different commodities in total livestock production.

Subsector	1998		1999		2000		2001	
	Value (PhP x 10 ⁶)	% Share	Value (PhP x 10 ⁶)	% Share	Value (PhP x 10 ⁶)	% Share	Value (PhP x 10 ⁶)	% Share
Hog	68,206	44.75	74,277	46.60	78,862	45.17	83,536	43.44
Chicken meat/eggs	61,246	40.18	61,106	38.10	68,581	39.37	80,372	41.80
Duck meat/eggs	4970	3.26	5173	3.23	4991	2.87	5521	2.87
Cattle	11,240	7.38	11,813	7.37	13,730	7.88	13,418	6.98
Carabao	3701	2.43	4097	2.55	4732	2.72	5288	6.98
Goat	2936	1.93	3325	2.07	3321	1.91	4011	2.09
Dairy	116	0.08	126	0.08	138	0.08	149	0.08
Total	152,423	100.00	160,367	100.00	174,175	100.00	192,295	100.00

Per capita consumption

The Filipino is basically a pork consumer. In 2000, the per capita consumption of pork was 16.1 kg representing more than half of total meat consumed (Table 2). The next most popular meat is chicken with 6.75 kg consumed per capita per year. Over a 20-year period, meat consumption had risen significantly. This observation is consistent with that of the Livestock Revolution.

Table 2. Per capita consumption of meat, Philippines (kg).

Commodity	1980	1985	1990	1995	2000	Per cent Increase
						1980-2000
Pork	9.18	9.20	13.26	14.00	16.10	75.3
Dressed chicken	3.94	3.52	3.73	5.83	6.75	71.3
Beef	1.45	1.30	1.89	2.31	2.81	93.8
Carabeef	0.74	0.68	0.83	0.98	1.46	97.3
Chevon	0.35	0.58	0.68	0.61	0.61	74.3

The production sources

In The Philippines, livestock producers are traditionally referred to as either backyard or commercial, the former referring to smallholders or those with small number of animal holdings and the latter referring to farms with relatively bigger holdings. Based on population, Philippine livestock farms are basically backyard. An overwhelming majority of livestock and poultry are in backyard farms (Table 3).

Table 3. Distribution of livestock in The Philippines, backyard and commercial farms.

	1980		1990		2000	
	Population (x 10 ³)	Per cent	Population (x 10 ³)	Per cent	Population (x 10 ³)	Per cent
Cattle						
Backyard	1.46	78	1.44	88	2.29	92
Commercial	0.42	22	0.19	12	0.19	8
Total	1.88	100	1.63	100	2.48	100
Carabao						
Backyard	2.81	98	2.76	100	3.02	99.8
Commercial	0.04	2	0.005	0	0.006	0.2
Total	2.85	100	2.76	100	3.02	100
Goat						
Backyard			2.19	99	3.11	99.6
Commercial			0.014		0.01	0.4
Total			2.2	100	3.12	100
Swine						
Backyard	6.53	82	6.77	85	8.33	77
Commercial	1.40	18	1.22	15	3.43	23
Total	7.93	100	7.99	100	10.76	100
Chicken						
Backyard	39.53	75	48.63	70		
Commercial	13.04	25	20.90	30		
Total	42.57	100	69.53	100		
Duck						
Backyard	3.28	70	6.49	88	7.07	77
Commercial	1.38	30	0.86	12	2.17	23
Total	4.66	100	7.35	100	9.24	100

There had been slight shifts recently. In swine, the population share of commercial farms had risen to about 23%. Estimates of its contribution to total output, however, are much higher. In poultry, categories of native, improved breeds and layers are now used to describe population. In the broiler market, the big commercial integrators dominate the industry, accounting for as much as 85-90 % of chicken meat supply.

The distinction between backyard and commercial production actually implies more than mere numbers. Backyard implies unimproved breeds, lower levels of technology and low input production system. Commercial production implies otherwise. However, it is not uncommon nowadays to see small numbers of animals being raised that possess good

genetic characteristics, fed commercial feeds and managed under relatively higher levels of technology. This is particularly true in hogs.

Competitiveness: Global and local

On a total basis, the Philippines is self-sufficient in its pork, chicken and egg requirement. There is about a 14 % dependence on beef and 29% on carabeef (buffalo meat) imports.

A recent study on the global competitiveness of livestock products indicated that local beef, pork and poultry could compete with imports at current peso-dollar exchange and tariff levels. This is true with beef and pork carcass and with whole chicken. It is not true with some pork cuts and chicken parts.

Investments in the livestock sector

At this point, we shall identify investment points for the livestock sector based on the analysis of the Philippine situation and in the context of developing the industry not simply to increase production and productivity but to serve social concerns of increased incomes, poverty alleviation and social equity. The monogastrics, swine and poultry dominate the Philippine livestock sector. These animals are heavy users of inputs – not simply grass. The resource-poor farmers would find it difficult handling this stock. This has implications in the over-all efforts to reach out to resource-poor small farmers.

1. Investments in the delivery of credit and extension services must be provided. Compared to monogastrics, ruminants have relatively smaller contribution to the economy but they contribute significantly in the effort to improve productivity and incomes. Among all livestock commodities, backyard production of cattle and carabao accounts for more than 90% of the total population. Particularly for cattle, the share of the backyard sector had significantly risen from 'only' 78% in 1980 to 92% in 2000. This indicates that ruminant production is not attractive to commercial operators. Among the livestock species, ruminants being able to use poor quality roughages, are the least costly to maintain. They are also a source of draft power and manure for the farms. This indicates the need to focus on ruminants as the 'livestock' for the resource-poor farmers. The matter though is how to bring the high-cost cattle/carabao to the poor farmer.
2. There should be investments in systems to 'commercialise' backyard production systems and where applicable, link the small with the big in a partnership arrangement. The commercial sector had consistently exhibited higher productivity compared with their backyard counterpart. This results principally from access of the commercial sector to resources like genetics, credit, technology, infrastructures etc. Again this has implications in terms of placing priority on the backyard producers over the commercial farmers. There is a growing trend towards 'commercialising' backyard production systems. As pointed out, some backyard farmers now have improved genetics. They also use commercial feeds and practise 'more modern technologies'. Relatedly, there are now institutional arrangements linking small producers with large, commercial integrators. These arrangements mutually benefit the big and the small in a commercial partnership.

This has implications on the need to improve productivity levels among backyard producers and to reach out to them more and more to significantly affect production and income levels.

3. It is worth investing in research on appropriate genetics for the smallholder farmers. Appropriate genetics is a related issue. Improved stock implies high cost inputs and higher levels of management. The native stock, on the other hand, is more prolific and could do with relatively fewer inputs.
4. Investments in 'safety nets' against reduced trade tariffs are required. At current tariffs and foreign exchange rates, local production is competitive. This may not be so when tariffs are correspondingly reduced under the World Trade Organization (WTO) and the Association of South-East Asian Nations Free Trade Agreement - Common Effective Preferential Tariff (AFTA-CEPT) commitments. A review of tariff commitments and the implementation of "safety nets" are required. This requires investments in these nets including cold-chain, post-harvest facilities, roads and transport.
5. There has to be investment in development of local feeds other than corn. While there is almost self-sufficiency in meat products, there is a growing dependence on imported feeds. While the dependence on corn has lessened, there is increasing dependence on imported feed substitutes like feed wheat, tapioca etc.
6. Investments in disease control, diagnostic labs, quarantine, and vaccine production are needed. While the Philippines had successfully eradicated certain diseases like the foot and mouth disease in Mindanao and Visayas, numerous other diseases of economic importance plague the industry. There is also the continuing threat of exotic diseases being introduced into the country.
7. Investments in market R&D are critical. In the broiler sector, the retail price is almost twice the farm gate price indicating several layers of middlemen-traders before the product reaches the market. The same is true, albeit not in the same degree, with pork, beef and other livestock products.
8. Investments in post-production concerns, e.g. storage, transport, roads, bulk handling facilities etc. are necessary. Post-production handling is expensive. It is a cliché that it costs more to ship corn from Mindanao to Manila than it is to do so from Bangkok to The Philippines. This is a function of lack of the ships' storage bottoms, many layers of handling etc.

Closing statement

The above is not the all-inclusive list of areas, which investments in the livestock sector should address. They are however, indicative of the diversity of areas and the magnitude of investment required to develop the industry and to ensure that the benefits of development reaches the smallholder farmer. We also feel that there are relevant applications of the matters discussed to other Asian neighbours.

Adoption of appropriate livestock technologies by smallholder farming communities

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Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)

Introduction

The Philippine livestock and poultry subsectors provide significant contribution to the positive growth of the country's agriculture sector. In 2001, these subsectors contributed 31% to total agricultural production (Philippine pesos 192 billion, current prices [US\$ 1 = PhP 50]) indicating a 9% increment from the previous year's earnings (Figure 1). The marked performance of these subsectors is attributed to the dramatic increase in the demand for meat and meat products brought about by the surging demand of the burgeoning population, urbanisation, improvement in income and changing food preferences.

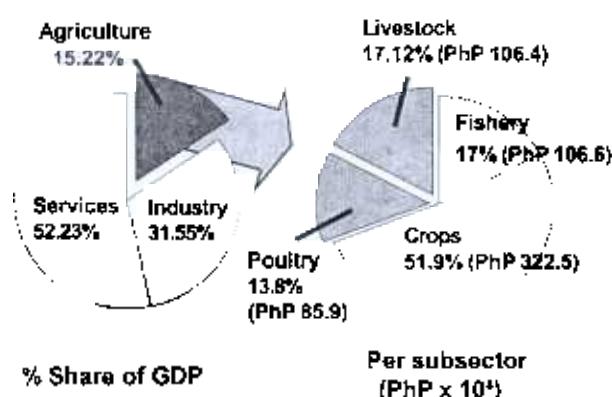


Figure 1. The livestock/poultry contribution to gross domestic product.

In 2001, the livestock and poultry subsectors produced 3 million tonnes of meat, 300 thousand tonnes of eggs, and 10.21 thousand tonnes of milk. Moreover, more than 40% of the Filipinos engaged in agriculture are also livestock and poultry raisers.

The Philippine animal industry is characterised by a well-developed poultry and swine industry and a less developed ruminant (carabao, cattle, goat, dairy) industry. The progressive poultry and swine productions are in the hands of big integrators who are highly import-dependent for their inputs. But in general, 80–95% of the country's livestock and poultry

production is contributed by smallholder farmers/raisers who usually have little access to farm cash inputs, education, technology, and other vital support services. Animal productivity in smallholder farms is generally low. Table 1 shows the 2001 livestock inventory in both smallholder and commercial farms.

Table 1. Livestock and poultry inventory, Philippines, 2001.

Species	Backyard		Commercial		Total
	Number (x10 ³)	%	Number (x10 ³)	%	
Cattle	2324	92.8	180	7.2	2504
Carabao	3109	99.8	6	0.2	3115
Goat	3221	99.7	11	0.3	3232
Pig	9074	76.8	2744	23.2	11,818
Chicken ¹					117,658
Broilers					(30,230)
Layers					(16,178)
Native/Improved					(71,250)
Duck	8241	80.0	2058	20.0	(10,299)

1. Based on January 2000 estimates; 2001 data not available.

Source: BAS (2000, 2001).

The livestock and poultry industries are vital to The Philippines' efforts to avert the food shortages in the coming years as the human population continues to increase at the current growth rate of 2.34%. While the country is nearly self-sufficient in pork and poultry products, beef and milk production is inadequate to meet local requirements. Hence, the country resorts to importations of meat, milk and live cattle for fattening which farther drains its dollar reserves.

To keep pace with the increasing demand for more food of animal origin, livestock production efficiency should be improved. This can only be possible if stocks are productive and the production system in the smallholder farms would be improved and become profitable. The use of technologies that are adapted to their resources and inherent capabilities and capacities coupled with adequate marketing strategies is imperative.

Some livestock technologies adopted by smallholder farmers/raisers

Much research has been done over the last 40 years that aimed at improving animal production efficiency. However, adoption of livestock technologies by smallholder farmers/raisers has been slow and limited. Various reasons could be cited – researches were too supply-driven, unresponsive to farmers' needs, inappropriate and unaffordable for smallholder farmers etc.

This paper aims to present examples of successful, but not necessarily widespread, adoption of livestock technologies in The Philippines, the factors responsible for the successful adoption, and the lessons learned from the experiences, which may have some bearing to the objectives of this workshop.

In this paper, technology adoption is defined as the practice of a new technology without or with minimal modification of the technology. There are just a few technologies that can be considered within this framework since most are 'adaptable' technologies.

In the Philippine experience, out of a few technologies that livestock farmers have adopted, five are presented in this paper. They are leucaena hybrid (KX2 F1), triple cross pig production, artificial insemination (AI) in pigs, improved management of Philippine native chicken, and layer duck production in confinement. These five technologies were chosen because they are still in use long after the completion of the project, their impacts in the lives of the adopters and/or the community are visible, and particular lessons could be drawn from the experiences.

Leucaena hybrid (KX2 F1)

Leucaena hybrid (KX2 F1) is an F1 cross between *Leucaena leucocephala* and *L. pallida*. The hybrid has high psyllid resistance and superior dry matter production (Mullen et al. 1998; Shelton et al. 1998). Its biomass production is four times greater than the existing variety (Castillo et al. 1998; Acasio, 2001). However, several factors limit its rapid propagation (Acasio, 2001). Only F1 seeds would produce the expected biomass. The F2 and subsequent generations segregate strongly (Mullen et al. 1998) and the hybrid seeds are very expensive and have to be imported from Hawaii, USA. Fortunately though, the hybrid could be vegetatively propagated through marcotting, grafting and the use of rooted stem cuttings.

L. leucocephala, locally known as 'ipikipil', has been in the Philippines for a very long time. It has an important role in both smallholder and commercial livestock production systems such that the psyllid infestation in the mid-1980s tremendously affected these industries.

In the province of Batangas, the improved variety of *Leucaena* (Giant *Leucaena*) was introduced in 1978 by then Governor Leviste as part of the 'greening' project in the province. *Leucaena* utilisation became so widespread as major source of fodder, fuelwood, and for erosion control on sloping areas. Before the psyllid outbreak, Batangas was known for its good quality beef and this was attributed to the farmers' use of 'supak' (forced feeding), an indigenous feeding practice using a mixture of chopped *leucaena*, rice bran, salt and water.

A study was conducted in the upland farming village in Mabini, a town of Batangas province. This village was chosen for the project because of the farmers' long experience on the use of *leucaena* for cattle fattening. The village is 163 km south-west of Manila. It is positioned on hills about 500 metres above sea level (masl). Its total land area is 124 ha. Landholding is small (approximately 0.5–1.5 ha). The village has 150 households, with a total population of 972. Soils in the village are formed from volcanic parent materials. Average rainfall is about 1200 mm per annum.

Farmers practise mixed cropping and cattle fattening. Crops grown are vegetables, banana, coconut, custard apple, mangoes, chico, corn, sweet potato and cassava. *Leucaena* is grown in hedgerows across slope, as farm boundaries, fence lines and as single trees throughout the area, and occupies about 42% of the total cropland. It is cut 3-4 times a year and the herbage is fed to cattle and goats.

Aside from *leucaena*, other feed resources for cattle fattening are crop residues from the crops grown in the area, naturalised grasses and weeds. *Leucaena* is also used to control erosion on sloping land, and serves as fuel wood, mulch for cropping and shade for animals.

The psyllid infestation in *Leucaena* significantly reduced the cattle population in the village from 200 to only 47 head. Before the outbreak, most farmers raised 2-3 cattle each but the infestation forced some of them to abandon cattle fattening. Consequently, cash income from cattle raising decreased from 80% of the total farm income to 0-20%.

The *leucaena* hybrid was promoted in the village through the following strategies/approaches:

- establishment of on-farm demonstration area where hybrid plants were planted for the farmers to observe the plants' superior attributes
- conduct of technology trainings with lectures and hands-on exercises on vegetative propagation techniques
- establishment of a village-level co-operative propagation area where the farmers could practise the techniques with technical assistance from the researchers
- production of instructional materials/primers/manuals
- regular monitoring/farm visits by the project team and
- regular dialogue between farmer-partners, local government officials and the project team.

The response of the farmers to the new *Leucaena* hybrid has been excellent. After two years of promotional activities, 100% of the farmers in the area were convinced of the good attributes of the hybrid and 99% were very willing to plant the trees (Acasio 2001). Several farmers wanted to expand their *Leucaena* production areas (mainly as source of animal feeds) and consequently, their animal holdings.

To date all the members of the farmer co-operative in the village have planted the *leucaena* hybrid in their farms. Some continue to use the grafting propagation technique while others use rooted seedlings from the Bureau of Animal Industry (BAI).

As expected, feed resources in the area have increased. Some farmers have increased the number of cattle they are raising. Others even decided to raise crossbred/upgraded goats because they believe that there will be ample feed supply from their *Leucaena* hybrid stands.

The successful and rapid adoption of the new *Leucaena* hybrid by the farmers is attributed to the following:

- a. There was an urgent and real need to increase feed supply in view of the continuing psyllid infestation. Farmers trusted the merits of the hybrid as presented by the project team and had high hopes that it would answer their need.
- b. The technology is simple, robust, affordable, compatible and complementary to the existing farming system, and has a visible advantage over the existing common variety.

- c. Cattle fattening is important to the farmers as it provides sure cash income to them.
- d. The farmers have trust and confidence on the project implementors (the BAI personnel and Australian collaborators) and the local government officials (village captain and the municipal agricultural officer).
- e. Farmers and local officials/technicians were actively involved in the process.
- f. There was continued enthusiasm and commitment by all concerned (farmers, project implementors, local government units).
- g. The technology adoption process was fully supported by international agencies as the Australian Centre for International Agricultural Research (ACIAR) and the University of Queensland (UQ), national offices like the Department of Agriculture (DA), the National Dairy Authority (NDA) and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and local institutions as the DA Region IV office and local government units (LGUs).

Triple-cross pig production under smallholder conditions

Swine raising is the most popular livestock enterprise in The Philippines. This popularity is demonstrated by its consistent positive contribution to the country's gross value added in agriculture over the past two decades. Moreover, the swine industry, which is represented by the large commercial and the smallholder sub-sectors, is the largest in terms of volume and value of production among local livestock industries in the country. The smallholder sub-sector keeps about 77% of the country's pig population while the remaining 23% are raised in large commercial farms.

The continuous improvement of the Philippine swine industry is largely attributed to the adoption of improved technologies by local swine raisers. One of these technologies is the triple-cross pig production scheme.

The triple-cross pig production technology involves a mating system where a Large White x Landrace F sow is mated to a terminal sire, which is a Duroc. This mating system results in a triple-cross pig. The triple-cross pig is a slaughter pig that possesses the following desired characteristics:

- Larger litter size both at birth and at weaning
- Shorter growing period
- Higher average daily gain
- Better feed efficiency
- Lower feed cost per kilogram gain in weight and
- Better carcass quality

Initially, adoption of this technology was limited to the large commercial sub-sector of the industry. Smallholder swine raisers then were not adopting the technology because many were not aware of the technology, and the few who knew of the technology were concerned about its cost and technical requirements.

In an effort to spread the benefits of the technology to the larger sub-sector of the swine industry, pilot projects that aim to promote and validate the performance of the triple-cross pig under smallholder conditions were launched by PCARRD-Department of Science and

Technology (DOST). These pilot projects were implemented at farmers' fields, in cooperation with local government units and farmer organisations and co-operatives. To boost adoption of the technology, information dissemination through printed materials, radio broadcasts and technology exhibits were also launched. Seminars and technology trainings and fora were also conducted to impart to potential adopters detailed information about the technology.

The apparent success of the aforesaid technology promotion activities was evidenced by the increasing number of inquiries about information on and/or sources of triple-cross pigs. Moreover, in response to the technology promotion activities, more smallholder farmers volunteered to be part of the pilot projects that were being implemented. The quick adoption of the triple-cross pig production technology could be attributed to the fact that swine raising is the most popular livestock production activity in the country. The promotional activities created awareness and provided important information to smallholder farmers who were already raising swine.

The results of the pilot projects conducted in smallholder farms were generally positive. Both the F1 sows and the triples-cross pigs demonstrated impressive performances. In most of the participating smallholder farms, the good performance of the animals translated into higher profits for the farmers. However, some technology adopters, particularly the resource-poor, incurred losses due to animal diseases and/or poor marketing and pricing systems. Despite the fact that not all adopters of the technology realised monetary gains, a large majority of the adopters showed positive and optimistic attitude towards their experience with the technology.

Adoption of the triple-cross pig production technology by smallholder farmers resulted in some direct and indirect benefits. Direct benefits derived from the technology included:

- improved productivity and production efficiency of pigs in smallholder farms
- higher profits from pig raising for smallhold farmers and
- productive utilisation of idle family labour.

Indirectly, adoption of the triple-cross pig production technology by smallholder farmers also resulted in:

- stable supply and availability of good quality meat in local meat markets for the pork-consuming public
- increased demand for feeds and other necessary inputs i.e. drugs and biologics that opened opportunities for the more enterprising sector of the community to engage in the trading and distribution of these pig production inputs
- increased demand for breeding animals (F1 sows and terminal boars) of good genetic quality that leads to the expansion and/or establishment of more swine breeding farms and
- increased demand for breeding/AI services that leads to the establishment of commercial swine breeding/AI centers

Similar to adopters of other livestock technologies, some adopters (particularly the resource-poor) of the triple-cross pig production technology also experienced problems (PCARRD, 2000b). More often than not these problems led to some monetary losses. Among these problems are:

Unavailability of triple-cross weanling pigs. Triple-cross pig production is yet to be popularised among smallholder farmers hence, during the initial stages, stocks have to be sourced from large commercial swine farms. Transportation access to the commercial farms and availability of stocks were among the major problems encountered by adopters from distant rural areas.

High capital investment and operating costs. Triple-cross pig production is an input-intensive enterprise where the bulk of the production inputs are bought, thus adopters need to have available cash (which is often lacking in resource-poor adopters) to sustain the requirements of the enterprise.

Unorganised marketing of live slaughter pigs. Some of the adopters incurred losses due to inefficient marketing of their pigs. In some areas, pricing of pigs was not based on weight but through eye-estimates. Farmers, particularly the inexperienced, are liable to being taken advantage of by the traders under this system of marketing.

Lack of technical support. Particularly in distant rural areas, losses due to diseases or death of the animal are more common due to the unavailability of livestock technicians, much less veterinarians to provide the much needed technical advice.

Artificial insemination (AI) in pigs

High productivity and efficiency in swine production is one of the primary concerns of the Philippine swine industry to meet the increasing demand of a growing human population. One of the strategies identified to achieve this goal is through genetic improvement.

A cheap and practical way to carry out genetic improvement in swine is through artificial insemination (AI). The major advantages of AI in swine include:

- increased breeding efficiency of boars to as high as 20 times
- reduced breeding costs
- more convenient means of disseminating good genetics to a wider area
- minimisation, if not total control of the spread of reproductive diseases
- allowing the use of physically handicapped or crippled, yet genetically superior boars that cannot normally perform natural mating
- preventing possible injuries on either the boar or the sow that may happen during mating, and immediate detection of infertile boars.

AI in pigs is a package of technology that involves several other component technologies. These component technologies include semen collection, evaluation, processing and storage; estrus detection, and deposition of semen into the female reproductive tract.

AI in swine was introduced into the country in the 1930s. However, its practical application commenced only in the late 1950s (Baguio and Argaños 1994). Unfortunately, due to some technical limitations that resulted in negative experiences on the part of the adopters, the AI technology then was not adopted by the local industry. It was only during the late 1980s and early 1990s that a more active effort was launched to reintroduce an improved version of the AI technology for swine to both the large commercial and the smallholder sectors of the Philippine swine industry.

Application of the improved swine AI technology in both the large, commercial and the smallholder farms yielded positive results. Data gathered by private commercial swine AI service centres indicated that reproductive performance (conception and farrowing rates, litter size and average birth weight of piglets) of sows/gilts bred through AI were comparable, if not better, with those bred through natural mating. Moreover, the application of AI in swine reproduction reduced breeding costs by as much as 50%, notwithstanding the higher genetic quality of the boar where the semen is taken from. In addition to the economic benefits, the quick adoption of the AI technology by both the smallholder and commercial sectors of the swine industry could also be attributed to the ready availability of AI materials and services and convenience compared to natural mating.

The reintroduction of the AI technology in swine was led primarily by the private sector. Private swine industry practitioners in cooperation with business groups engaged in the manufacture, sale and distribution of AI supplies and equipment aggressively campaigned for the adoption of the technology. Government agencies i.e. PCARRD-DOST, Bureau of Animal Industry of the Department of Agriculture (BAI-DA), University of the Philippines at Los Baños (UPLB), International Training Centre on Pig Husbandry of the Department of Agriculture (ITCPH-DA) and some LGU's lent support to the technology promotion efforts of the private sector.

Both government and the private sectors promoted the technology through distribution of printed materials in various formats intended for different audiences, conduct of seminars and product demonstrations, radio broadcasts, technology exhibits and delivery of AI services to both the large commercial and the smallholder swine farms. Particular to the UPLB, BAI-DA and some LGUs, technology promotion was also accomplished by providing AI services to smallholder farmers. The regular training courses on swine AI offered by the ITCPH-DA significantly expanded the adoption of AI. To date, a significant proportion of the swine producers in the country are using AI in breeding their animals.

The wide adoption of the AI technology has benefited swine raisers, particularly the smallholder sector in terms of:

- genetic improvement of swine in the country
- improvement in breeding efficiency of boars
- reduction in breeding costs and
- effective and convenient distribution of superior genetic materials to wider areas.

Improved management of Philippine native chicken

Raising of Philippine native chicken is an age-old activity of most rural households in the country. The Philippine native chickens that comprise about 60% of the total chicken population in the country serve as the main source of eggs and meat for rural smallholder farmers.

The Philippine native chicken is a mixture of different breeds. It is believed to have descended from the domesticated red jungle fowl (Arboleda 1987; PCARRD 2000a). The

known documented strains of the Philippine native chickens are the Banaba from Batangas; Bolinao from Pangasinan; Camarines from the Bicol Region; Darag from the Panay islands and Paraoakan from Palawan. There could be other strains present in the country that are yet to be documented.

Aware of the important role of the native chicken in the Philippines' rural economy, efforts have been launched to improve its productivity, production efficiency and product quality. It is on this premise that the technology on improved management of the Philippine native chicken was developed and promoted for adoption by smallholder farmers.

The technology on improved management of Philippine native chicken is centred on the selection and breeding of strains that possess the potential for higher meat and egg production. Lambio et al. (2001) identified the Paraoakan and Banaba strains of native chicken as possessing potential for growth and egg production.

The technology also involves artificial brooding of chicks from day-old to about 1-1.5 months (PCARRD, 2000a). During the brooding period, the chicks are fed commercial starter mash and provided with artificial heat from an incandescent bulb or from a kerosene lamp in areas where electricity is not available. After the brooding period, the chicks are allowed to roam free-ranged with strategic supplemental feeding until they reach market weight of not less than 1 kg body weight. Vaccination against common avian infectious diseases is also recommended.

Through improved management, egg production of the Philippine native chicken was increased from 40-60 eggs/year to 130-200 eggs/year each weighing 50 g. The growth performance was also improved from a body weight of 1 kilogram achieved at 18-20 weeks to 1-kilogram body weight at about 12 weeks (PCARRD 2000a; Lambio et al. 2001).

Realising the potential benefits that can be derived from the technology, promotional activities were launched by a number of government institutions. These activities included the implementation of pilot projects in several areas of the country and involved participation of smallholder farmers. Technology promotion through print and broadcast media were also launched. In addition, technology exhibits; seminars and trainings were also conducted to further highlight the merits of the technology.

As a result of the technology promotion activities, awareness on the economic importance of the Philippine native chicken has been raised. This is demonstrated by the increasing demand for products of the native chicken, which leads to the development of niche markets for its products. The adoption of the technology that leads to the increase in the productivity of the Philippine native chicken and the increase in demand for its products are among the parameters that indicate success in the promotion of the technology.

Among the problems identified relative to the promotion and eventual adoption of the technology are:

- Shortage in the supply of day-old native chicks
- Lack of cash to buy inputs such as feeds and vaccines
- Loss of chickens and mortalities due to theft, animal attacks and disease
- Strong influence of climatic condition on the performance of chickens on range
- Lack of marketing skills of some adopters, resulting in reduction in profits if not a net loss.

Despite these problems, more and more smallholder farmers in selected areas of the country are adopting the technology. Indicators are the growing popularity of roasted native chicken as a delicacy in Iloilo City, one of the cities in the Panay island, and the increasing availability of dressed native chicken meat in supermarkets and wet markets in some urban centres in the country.

Total confinement of layer ducks

The Philippine native mallard duck is one of the few domesticated fowls that produce high-value protein food products out of indigenous feed resources, which are otherwise considered as unwanted wastes or pests to crops and livestock. In The Philippines, duck egg production from the native Philippine mallard locally known as 'Pateros duck' is an age-old business activity of smallholder farmers residing near the coastlines of bodies of water, where indigenous feeds are abundant.

The Pateros duck is one of the mallard duck breeds that possesses the desired characteristics of high production of eggs of relatively bigger size (Arboleda et al. 1985; Arboleda 1987). Although very small compared to the chicken industry, the duck egg industry in the Philippines that is based on native breeds plays an important role in the country's rural economy. It has been proven to be a viable agricultural enterprise of small farmers particularly those residing along the shores of the Laguna de Bay. To these farmers duck raising is an important source of income. Moreover, ducks, through the egg and meat they produce, offer opportunity for rural families to improve their nutrition, which is generally deficient in protein.

Traditionally, smallholder farmers follow the semi-confinement management system, locally called 'pagala system', where the ducks are free-ranged at daytime and confined in sheds at night. Under this system, ducks are fed only supplemental rations composed of indigenous feeds like fresh water snails, small shrimps and rough rice. The bulk of the feed requirement is sourced from the lakeshores or rice paddies where the animals are allowed to feed.

Variability in the quality and amount of feeds availed of by the ducks from the field are expectedly high. The variability in feed volume and quality often results in a generally low and a highly variable production. Under the traditional system of duck raising, the average egg production ranges from 45–55% of the production potential for the entire 18 months laying period.

In an effort to improve duck egg production and minimise variability, total confinement of layer ducks with formulated duck feed supplementation was introduced. This technology involves full confinement of layer ducks during the entire laying period in a shed with a combination of litter and elevated slatted floors. Each layer duck is provided a floor space allowance of about 0.20–0.25 m² (Lambio and Alejar 1993).

Aside from full confinement, formulated duck feeds in the form of pellets was also introduced in addition to the traditional feeds composed of fresh water snails, shrimps, small fish and rough rice. This intervention has improved duck egg production from an

average of 45–55% to about 75% of production potential. In addition, the practice of total confinement has shown the following beneficial results:

- improved uniformity and quality of eggs
- stable supply of duck eggs
- less dependence on indigenous feed resources that are vulnerable to changes in climatic conditions and levels of water pollution
- more efficient utilisation of labour and space and
- increased income for the farmer.

Business outfits engaged in feed milling primarily led in the promotion of this technology. The participation of government agencies in the promotion activities of this technology is very minimal compared with the other livestock technologies. Like the other livestock technologies previously mentioned, promotion activities were accomplished through print and broadcast media, pilot projects, seminars and short course trainings.

Success in the promotion of this technology is demonstrated by its adoption by a large majority of the duck raisers, smallholder and large commercial enterprises alike. The quick adoption of this particular technology could be attributed to the dwindling (in terms of volume and quality) supply of indigenous feed materials from the Laguna de Bay. Moreover, the incidences of increased morbidities and mortalities of ducks, which were attributed to possible pollution of the lake also inspired the duck raisers to adopt the technology.

Like any other technologies, total confinement of layer ducks also caused some problems to the adopters. Among these problems are the higher cash requirement for the purchase of formulated feeds, air and water pollution due to accumulation of duck wastes in a limited area, and vulnerability of the duck egg industry to variations in prices of formulated feeds.

Some lessons learned

The five projects presented in this paper provide varied but valuable lessons that serve as eye opener and guide to all concerned in future undertakings. These are in no way unique to us and by no means all-inclusive. The following are some of the lessons learned.

New *Leucaena* hybrid

- A high level of technology adoption can be realised if the technology being offered to farmers has perceived economic value to them, is responsive to their needs, simple, affordable, compatible and complementary to their existing farming systems
- Farmers and local officials have to be actively involved in the process
- Enthusiasm, commitment and sincerity on the part of the project implementers also influence the level of adoption
- On-farm establishment of *leucaena* hybrid was an effective promotion strategy as it elicited quick, genuine responses and lasting positive impressions on the hybrid
- Farmers and local officials have to be empowered for the ripple effect
- Sustained and adequate financial support from the government and other partners should be accorded to the undertakings

Partnerships with all stakeholders are essential
Technology promoters should also be ready with other related technologies/improved practices and techniques that farmers may be interested in.

Triple-cross pig production technology under smallholder conditions

Input-intensive technologies such as triple-cross pig production are appropriate only for smallholder farmers who are blessed with sufficient non-farm source of income to sustain the cash requirements of the enterprise. Also, this technology is suited to communities where important facilities (i.e. market, support services, sources of stocks) are in place.

Despite failures in achieving objectives of technology promotion activities, participating smallholder farmers are, in general, empowered with new ways to improve their lives.

Livestock production though popular, is not the priority enterprise of many smallholder farmers. To most of the resource-poor farmers, livestock raising is only a supplemental income from crops, hence they easily gave up their livestock for cash in times of emergencies or when crop production needed additional inputs.

Artificial insemination in pigs

- Adoption of a technology is faster when all the necessary material inputs and services are readily available at costs lower than that of the traditional method.
- Technology promotion and eventual adoption is quicker if the private commercial/business sector is involved in the promotion.
- Technology adoption is faster and wider in magnitude if its promotion is well supported by human capability building through regular training programmes and/or other similar activities.

Improved management of Philippine native chicken

- Adoption of a new technology is faster if it clearly provides a better alternative to the traditional practice of farmers.
- To improve adoption rate of a new technology, an apparent incentive/motivation (higher income and/or ready market) for increasing production has to be recognised by potential adopters.

Total confinement of layer ducks

Adoption of technology is faster if the technology directly provides answers to current/urgent problems.

Conclusion

Based on the previously mentioned technology promotion activities, the factors influencing the adoption of livestock technologies by smallholders include the following:

- Choice of technology to be promoted. Technologies to be promoted have to be assessed first in terms of its technical feasibility, social acceptability, economic viability, environmental soundness, and even political acceptability. With this process, the suitability, appropriateness and relevance of a certain technology would be determined.
- Choice of farmers and site for the project. Careful farmer and site selection can make a big difference that can spell subsequent success or failure of the adoption process. Thus, a better and sounder understanding of the farmers' circumstances, resources, needs, and aspirations is in order. This is because farmers' responses to certain technologies rely heavily on their perceptions, circumstances, inherent characteristics and resources (Cramb 2000).
- The choice of site is equally important. The 'fit' of a technology in a certain area has to be carefully determined as this has some bearing on biophysical and socio-economic conditions affecting adoption of the technology. Technologies have to be promoted only in areas where they have a particular role/use and, therefore, are likely to be adopted.
- Appropriateness and adequacy of promotion strategies/methodologies. Technology promotion activities sometimes fail because of the use of ineffective and inadequate strategies, tools, and methodologies. The information, education and communication (IEC) activities need to be determined so as to develop and produce IEC materials that are responsive to the needs of potential adopters. There should be a continuous flow of information to and among farmers. Moreover, promotion activities have to be sustained, as these also help in empowering farmer partners and local government officials/technicians. Empowering the partners is essential to achieve a 'ripple effect' among the project participants.
- Presence of sustained institutional support in technology promotions campaign. This comes in terms of funding, delivery of support services, e.g. credit facilities, planting materials, market access, development directions, human skills development etc. In this context, partnership with all stakeholders becomes imperative. There is a need for effective pooling of limited resources, shared responsibilities and sustainability. As noted by Palmer et al. (2000), 'organisations working together can create more impact in the lives of people than when working alone.'

The wide adoption of the swine AI technology among smallholder swine raisers all over the country is largely attributed to the sustained efforts of both government and private (business sector) institutions in the promotion of the technology. One activity worth mentioning is the continued regular conduct of swine AI training course by the ITCPh-DA that effectively provided livestock technicians and swine raisers with the necessary skills required by the technology.

Effective partnership and organised participation among all stakeholders. As demonstrated by the experiences derived from the technology promotion efforts particularly on AI in swine and total confinement of layer ducks, the rate of technology adoption in terms of time and number of adopters is significantly enhanced by the participation of private business groups and other entities engaged in related industries. It must be recognised that different approaches in technology promotion elicit varying degrees of responses. The participation of more institutions in the promotion activities could achieve a significant increase in the number of potential adopters receiving the needed information in modalities most appropriate to them.

Role of R&D institutions and workers in the development and eventual adoption of technologies. Based on the different experiences gained from the promotion of the aforementioned livestock and poultry technologies, it is apparent that the technology itself – its relevance, technical merits, economic viability, environmental soundness etc. largely determines its eventual adoption and application in enterprises for which it is intended. Thus, the chances for a technology to be adopted by its target clients is determined starting from the initial stages of technology development. Hence, R&D institutions and its workers who are tasked with the responsibility of developing technologies play a vital role in the eventual adoption and application of technologies.

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Adoption strategies for forages—experiences of the Forages for Smallholders Project

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Abstract

This paper describes how development and research strategies for the Forages for Smallholders Project were formed, resulting from many years of experience of working with farmers. The project is implemented by partner institutions in China, Indonesia, Philippines, Thailand, Lao PDR and Vietnam. Because of the complexity of research issues in forage technology development, it was necessary to develop clear criteria for selecting new farmer communities. Participatory research approaches have been the key to adoption of forages by farmers. Initially little participation was evident, but presently farmers are the main decision makers in the research process. Ten steps have been identified in starting research with new communities, all the way to experiencing impacts, and feedback through monitoring and evaluation mechanisms.

The adoption process is a gradual one, starting with agronomic evaluation of forage germplasm and reaching evaluation of animal production systems several growing seasons later. Adoption of improved forage species is also influenced by availability and diversity of natural feed resources. The three dimensional relationship between farmer experience, adoption rate and ruminant productivity is explained. More farmers benefit from forages through scaling-up of the research and development activities. Capacity building happens through training of field staff but also through a novel active role of key farmers. An example of impact is presented in East Kalimantan, where return to labour has increased by 68%.

Key words: participatory, development, livestock, feed, farmers.

Introduction

The Forages for Smallholders Project (FSP) is convened by the International Centre for Tropical Agriculture (CIAT). It started in 1995 and aimed at moving research on tropical forages from the experiment stations to farmers' fields, which created opportunities for

evaluating the potential of improved forages in smallholder farming systems in Asia. The target farming systems were those in upland areas. The FSP now operates in six countries in South-East Asia through national partners as follows:

- Tropical Pasture Research Centre, Chinese Academy of Tropical Animal Science, Hainan, China
- Dinas Peternakan, Samarinda, East Kalimantan, and Directorate General of Livestock Services, Jakarta, Indonesia
- Livestock Division of the National Agriculture and Forestry Research Institute, Vientiane, Lao PDR
- Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Baños and Visayas State College of Agriculture and Department of Agriculture, Region 10, Philippines
- Animal Nutrition Division, Department of Livestock Development, Ministry of Agriculture and Cooperatives, Bangkok, Thailand
- National Institute of Animal Husbandry of the Ministry of Agriculture and Rural Development, Hanoi, and Provincial Departments of Agriculture and Rural Development in Tuyen Quang and Dac Lac, Vietnam

The project's strategy has been to concentrate farmer participatory research activities in one or two sites in each country, which subsequently have been used as focus sites for dissemination of forage systems developed. This paper describes the methods that the project developed and how they evolved, the meaning of adoption of forage technologies, how adoption was achieved, how dissemination took place in new areas, and an example of impact on farmers' livelihoods at these focus sites in Indonesia.

The term 'forages' as used in this paper are those crops that are specifically cultivated to provide feed for animals. This is different from the broader definition often used for forages as 'any plant or parts of plants used for animal feed, including agro-industrial by-products'.

Developing technologies with farmers and adoption

The project aims to work with resource-poor upland farmers. However, it can be argued that livestock keepers are not the poorest farmers, because keeping livestock means having some wealth. On the other hand, upland livestock keepers in South-East Asia do not have large herds, and it is uncommon to find smallholder livestock keepers with large pasture or fodder banks. This is likely to remain so even if numbers of livestock per household or production levels increase. Forage crops planted within a complex pattern of other food and cash crops, utilising farm space and labour in a multiple and optimal way, are common.

After many years of working with these farming communities, we now see the integration of a range of some 25 introduced grass and legume species in lines along contours on farm land; as cover or green manure crops in fruit trees, coffee and tea; as live fences for demarcation of external and internal boundaries; and as pastures and fodder banks in backyards or under young oil palm or coconut plantations.

The main difficulty with forage research is that it is complex. Unlike food crops, forage crops need to pass through an animal for an end benefit to be obtained. Inevitably, forages are often of secondary importance to poor farmers, as food security is their main concern. The interest of farmers in participating in evaluation of forages is influenced by these and other factors. The decision to conduct research work with new communities and farmers in forage technology development is guided by five questions:

1. Is there a genuine problem? Very often, when we meet farmers for the first time and we are strangers to them, they will say, 'Yes, we have a problem' because they would like to work with us. Maybe forages are just an entry point for them as they expect to receive free fertilisers or animals. In some places this has happened. For a couple of months, farmers planted and evaluated forages actively, but when they found that they were not getting a cow from the government dispersal programme, they abandoned their forage plots.
2. Are there committed local individuals who can work with farmers to solve this problem? There are few staff employed by the FSP project and we do not have field workers. At the field level, we depend on staff from the district agricultural services. We look for persons who are motivated and we will not go into an area where such people are not available to help us.
3. Do farmers think that this problem is important enough? During the dry season, farmers' cattle often do not have enough feed. At the same time, their children might not have enough food to eat. Farmers may place a higher priority on engaging in on-farm or off-farm activities that will bring in immediate cash to buy food, rather than on providing for animal feed needs. This may involve harvesting and selling non-timber forest products.
4. Are there many other farmers with the same problem in a region? If there is a real opportunity to work in a village with ten farmers, and in the next village there are only two farmers who are willing to work with the project, we decide not to work at the former village. Or, we may seek another district where there are many farmers who wish to participate in the project. We need to ensure efficient use of resources.
5. Do we have potential solutions for substantial benefits? There might be a problem of shortage of feeds but in certain circumstances we do not have options to offer. If the system, for instance, is irrigated rice, every square metre is cultivated and there is very little land to plant forages for the buffaloes that plow the fields. In this case, we do not have much to offer in terms of forages.

Role of participatory research

A major factor that has resulted in farmer adoption of forage technologies is farmer participatory research, where farmers are involved in planning and carrying out the evaluation of new species and in adapting the management of these to their farming system. Participatory research can broadly be classified into five types (Lilja and Ashby 1999). At one end of the spectrum is the scientist deciding what research to do, with some consultation with farmers. At the other end, farmers exclusively do the research with hardly any influence from the researchers.

Categories of participatory research are:

- Contractual – the research is carried out on-farm and scientists make decisions in design and implementation
- Consultative – scientists make the decisions, but are aware of farmers' opinions, preferences and priorities, as for example in designing a survey
- Collaborative – decision making is shared between scientists and farmers
- Collegial research – farmers make the decisions with scientists facilitating where necessary
- Farmer experimentation – farmers make all the decisions and there is no formal communication with scientists.

In practice, when scientists first begin to work with farmers in new projects, the degree of participation may be small. For example, it may be necessary to conduct a demonstration in a village to enable farmers to become aware of various options. As farmers gain interest and confidence, they naturally show more initiative and take on more responsibility.

FSP's research and development strategy

A research and development strategy using participatory approaches has been developed following many years of experience of working with farmers (Figure 1). The normal sequence of events is from 1 to 10 but there is no fixed formula. The first step is to gather secondary information and to carry out a rapid rural appraisal. Secondary information gives us an indication of the nature of the farming systems, livestock densities and farm problems. Sometimes useful diagnostic studies have already been carried out. Many stakeholders can be involved in this initial appraisal – farmers, veterinary officers, district and provincial staff. From this information, we can assess whether there is a need and opportunity for working in the area. If there is a need, we train extension workers from several districts in forage agronomy, participatory research and gender analysis. The training lasts for two weeks and may involve 20 participants. During this training, the more active and motivated extension workers who can effectively lead in the work in the project are identified.

After we have selected motivated extension workers, we conduct participatory diagnosis and planning in selected villages where the initial appraisal has shown there is a need and opportunity. This process normally may take from one to two and a half days. Problems are identified by the village community using participatory tools, such as mapping, calendars and flow diagramming. The problem diagnosis is followed by planning research and development activities to evaluate solutions to specific problems that might be solved using the farmers' own resources supplemented by seed and technical inputs from the project.

Farmer groups may already exist. If not, we work with those farmers who have identified themselves during the diagnosis as being willing to invest their time and resources in testing new technologies. Regular farmer meetings are facilitated by field workers, and often, stable groups develop from these meetings.

Research issues identified at step 3 often involve the evaluation, under farm conditions, of improved forage species for biomass production, drought resistance, and quality. Researchers and experienced field workers are able to provide forage species, and suggest forage systems

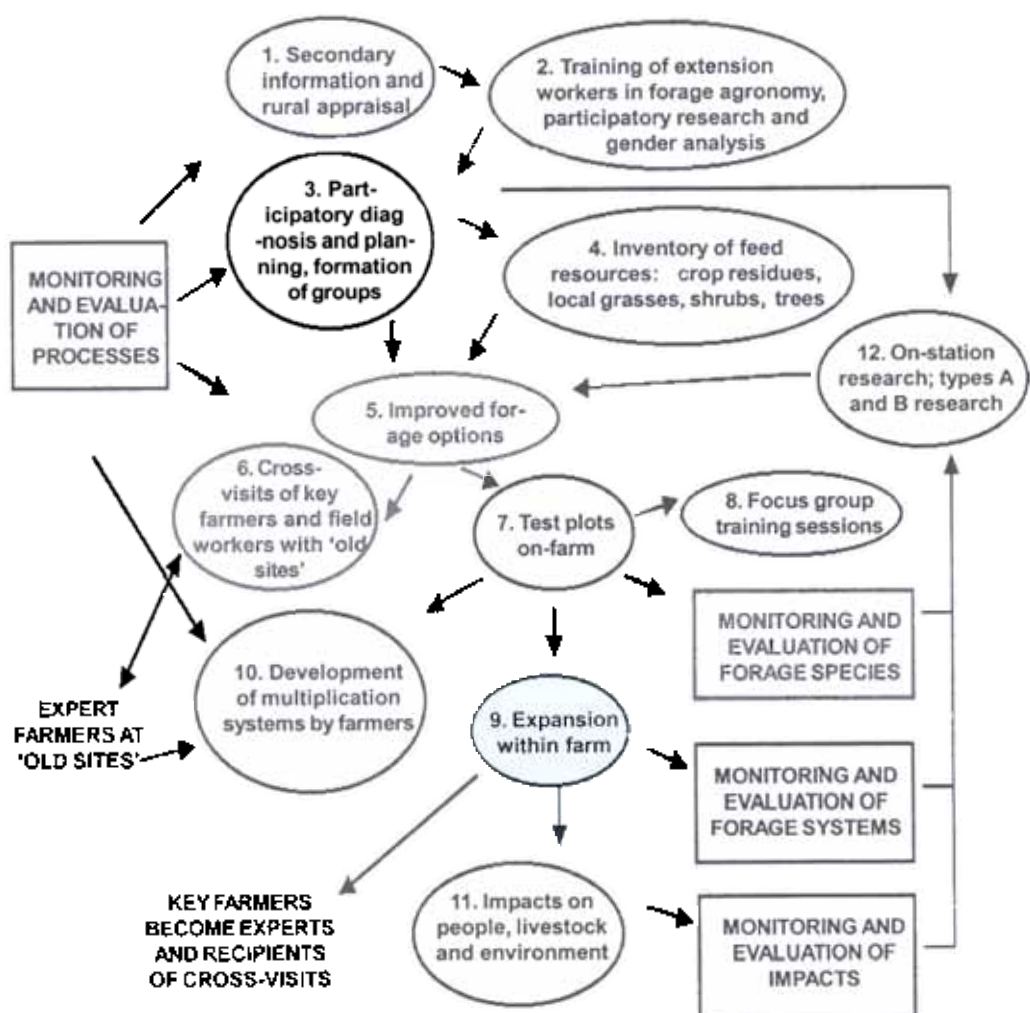


Figure 1. Research and development strategy of FSP.

that have been screened, modified and developed by other farmers in the region and that will meet the specific needs of the new group of farmers. The project initially evaluated some 500 species and accessions of forage grasses and legumes. Out of these, 25-40 are widely adapted and are recommended for evaluation by new farmers.

The choice of introduced forage varieties to offer to farmers depends on the seasonal availability of existing feed resources. For instance, if natural grasses are available during most of the year and if they can be complemented by crop residues of high digestibility during the periods of feed shortage, there is little need to introduce new grass species. Legume species would be highly complementary in this case.

Sometimes the quality and availability of existing feed resources cannot be easily assessed during the participatory diagnosis phase. If local trees and shrubs form an important part

of the animals' diet, their quantity, availability and nutritive quality are often unknown. A high availability of good quality local tree fodder would reduce the need for research on exotic fodder trees. If local tree fodders are only available during some months, there could still be a high demand for high quality forages during some seasons. The inventory of feed resources (Step 4) can be made a researchable issue if little is known about this. Nutritive value of local vegetation can be determined through participatory studies with key informants, and through laboratory analysis (Roothaert et al. 2001).

Where feasible, new farmers are taken on cross-visits to other farmers who have been working with the project for several years (step 6). Farmers with extensive forage experience are the best advocates to show how forages can make an impact on livelihoods, the livestock and the environment. Farmers learn a lot from other farmers. During these cross-visits, new farmers receive planting materials from the experienced farmers, and take them home to plant in their own farms. New farmers are encouraged to try other species aside from the ones that grow well on the farms that they have visited. The new farmers plant test plots or strips and are evaluated regularly by both farmers and field staff (step 7). In every new community, new champion farmers emerge whose enthusiasm and experience is captured by the project. They in turn will become key farmers able to receive other farmers from new areas and show them their experience in forage evaluation and utilisation.

Some key farmers receive training on certain topics that interest them and that complement their on-farm research (step 8). Such topics have included training in animal nutrition, nursery techniques for forage trees, and seed production. Farmers that have evaluated new forage germplasm in small plots or strips expand those species or accessions that show good growth (step 9). There are also other factors that determine whether or not a farmer expands, such as palatability of the forage, ease of harvest, ease of propagation, and low weediness potential. Later on, we find farmers take other factors into consideration, e.g. whether the introduced forages can play a role in improving soil fertility, whether they compete with crops, and usefulness in soil and water conservation.

Concurrently with the expansion activities, an interest in multiplication systems is developed (step 10). Often, the original test plots become multiplication plots to produce vegetative planting materials. Seed production is often low, especially in humid climates. If there is a strong market demand for seeds such as improved accessions of *Leucaena leucocephala* or *Centrosema pubescens*, some individual farmers may choose to develop seed production systems.

Availability of planting material can be a bottleneck for developing and expanding forage systems if it is not addressed. Unlike seeds of commercial crops such as tomatoes, rice, or maize, seeds of improved forages is rarely found in markets in rural areas. In the areas where FSP has been operating for five years, there is now a lively trade in vegetative planting materials and some legume seeds among farmers. Availability of planting material or seed is essential for sustainability of forage development. Sale of planting materials also contributes to farmers' incomes.

Monitoring and evaluation are used to provide feedback to farmers and project implementers. It is relatively easy to monitor and evaluate forage technologies in terms of test plots on-farm, expansion within farm, and impacts on people, livestock and the environment. What is more difficult to monitor and evaluate are the effectiveness of the

processes, such as collecting secondary information, conducting rural appraisal, participatory diagnosis, and cross-visits. How do we quantify the success of these elements? These processes are probably more appropriately evaluated by qualitative case studies than quantitative assessments.

Farmers' experience with growing improved forages often generates the need for new research. For instance, in Thailand *Brachiaria brizantha* is preferred to *B. nuziziensis* for its ability to produce fodder during the dry season. Low seed production of *B. brizantha*, however, prevents wider adoption of the species, because farmers in Thailand sow pasture mechanically. Researchers in Thailand are now assessing several accessions of *B. brizantha* for their seed yield, and developing new seed harvesting methods. The results of such research are fed back as new options for farmers to evaluate.

The adoption process

While farmers' evaluation is a prerequisite for adoption, it does not always result in adoption. They may decide this is not what they need. Out of all farmers we have worked with, about 25% drop out evaluating or using improved forages after 1–3 years. This is acceptable since we cannot force farmers to adopt certain technologies. On the other hand, when a farmer has experimented with a species or a forage technology, and subsequently expands his cultivated area with the technology using his own resources, then we can talk of meaningful adoption or an adoptable forage system.

What is a typical adoption process? First, the farmer tests grass and legume varieties and accessions in small plots and observes such things as yield and whether the grass stays green in the dry season or not. The second step is to evaluate the species by incorporating and/or adapting it in a forage system (Figure 2). The forage system includes the forage variety or species, the way it fits in with other crops, the cutting management, its contribution to soil fertility or degradation, the type of animals it can be fed to, and its effect on the animals. Some unique systems may be developed. In northern Vietnam, *Stylosanthes guianensis* CIAT 184 is planted in between tea rows in new plantings where there is enough light for the stylo to grow until the tea canopy closes after some years. The stylo is harvested and fed fresh or cooked together with cassava chips before it is fed to pigs.

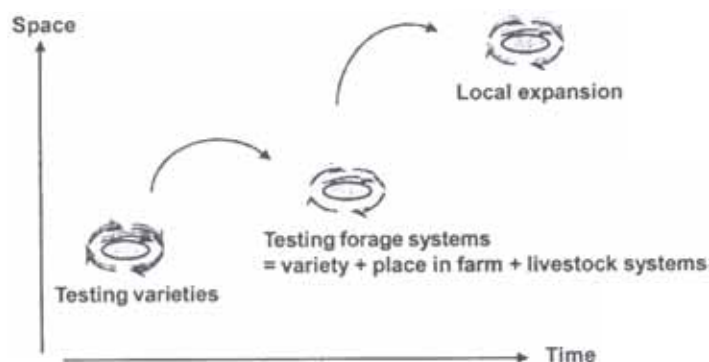


Figure 2. Adoption: from on-farm test plots to on-farm expansion.

Another example of a unique forage system developed in Vietnam is the planting of *B. brizantha*, *Panicum maximum* and *Paspalum atratum* on pond banks and waste areas near fish ponds and feeding the young cut material to grass carp. Originally these forages were evaluated for feeding cattle, but farmers discovered that feeding them to fish proved much more profitable. When such forage systems are tested and developed on-farm, and they are appreciated, more land is allocated to grow forages and expansion within the farm occurs. Expansion usually happens after every planting season, and can take place over many years.

Some FSP research highlights

A publication titled 'Developing forage technologies with smallholder farmers' (Horne and Stür 1999) was the outcome of screening of some 500 accessions of forage germplasm, on experimental stations in Indonesia and the Philippines, and ending with about 40 varieties that are now widely adopted by farmers in more than 6 countries. The booklet is meant for field workers and gives practical information about the most popular forage species and varieties. The way the forages can be grown and utilised, their adaptation to climates and soils, and their comparative advantages are all explained. The publication is also available in Chinese, Indonesian, Lao, Thai and Vietnamese.

The complementary nature of improved forages and existing feed resources was the basis of a study on indigenous fodder trees in Lao PDR (Roothaert and Phengsavanh 2001). Ethnic Hmong farming communities who live in the forest margins in the hills of Luang Prabang Province use many local trees for animal feed. These trees supplement the unimproved grasslands.

We were interested in the quality of the tree fodder, in particular the perception of quality by the farmers. Palatability to livestock and availability of the fodder were important criteria for the farmers. Availability was defined in three ways: the density of the tree species in a certain area, the availability of tree fodder throughout the year, and the distance between people's homes and the location of the trees. Nutritive value was little mentioned as a criterion. Perhaps the reason is that tree fodder is not often used to fatten cattle, but more often given to certain animals within the herd, for example sick cattle that need to recover, or to cows that have just calved. A mixture of species is used which makes it difficult for farmers to assess nutritive value of an individual tree species. Using farmers' criteria, matrix rating of the most used tree fodder species was carried out. Figure 3 shows that large and consistent differences can be demonstrated among species, in this case when the criterion 'regrowth after harvesting' was used. Regrowth of *Trema orientalis* was considered 'poor', while regrowth of *Bauhinia variegata* was 'good'. *T. orientalis* grows very fast, produces a lot of palatable biomass, but dies after frequent pruning.

The relation between natural feed resources, improved forages, and adoption of forage technologies is shown in Figure 4. Traditionally, farmers in South-East Asia have been using natural grasses and crop residues to feed their cattle, goats and sheep. 'Adoption' of this system is 100% but ruminant productivity is only 25-35 % of its potential. In terms of animal nutrition, the limiting factor for productivity is energy intake and year round feed supply.

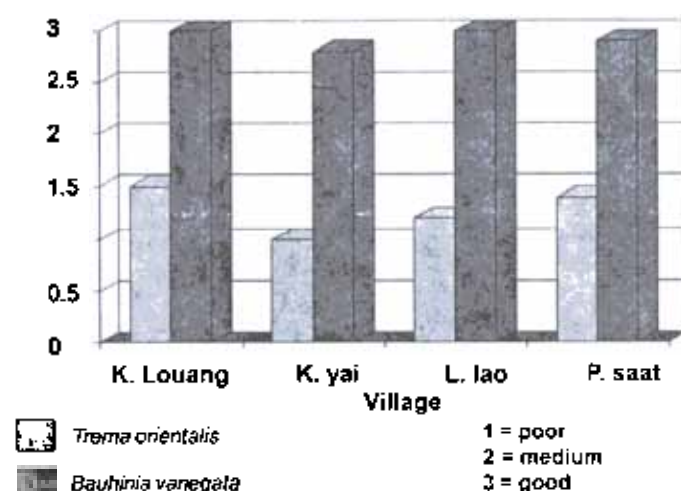


Figure 3. Farmers' rating of "regrowth" of two fodder trees.

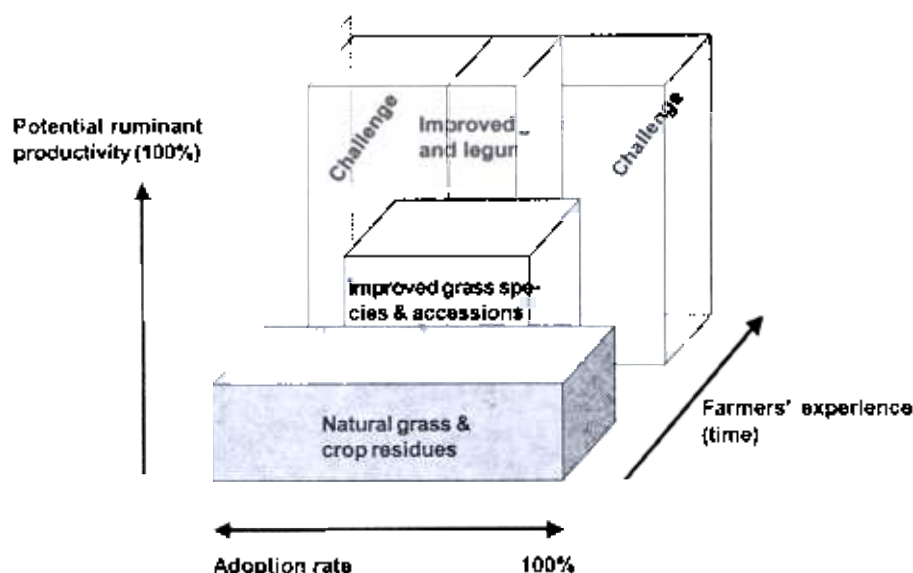


Figure 4. Relation between adoption rate of forage technologies, potential ruminant productivity and time.

The first forage innovation that farmers usually adopt is the cultivation of new grass species. The new grasses establish easily and show impressive growth and biomass production. Most grasses are readily accepted by cattle. Adoption rates for improved grass accessions are high; about half of the farmers with livestock within the community that we work with start growing them within a year after introduction. Livestock productivity improves because of higher dry matter intake, more available energy, and good quality feed in the dry season. Maximum ruminant productivity, however, is still not obtained, due to limita-

tions of available rumen nitrogen and shortage of by-pass protein. It is only in the very intensive systems, such as the dairy cattle and dairy buffalo systems in Mindanao, Philippines, that farmers realise the protein limitation. In those systems, there is a demand for herbaceous and tree legume species that, when fed, cause a remarkable and immediate increase in milk production or milk fat content. Young stock fed on a mixture of grass and legumes get all the nutrients they need and can attain potential growth rates. The challenge of the project is to have more farmers experimenting with the optimal feed regimes, and to overcome constraints of initial slow establishment of legumes, seed availability, and misconceptions of cattle and buffaloes not being able to eat herbaceous or tree legumes.

Scaling-up

If all stakeholders, that is the farmers and government staff, are happy with the results of the forage evaluation and adoption, the next challenge is to allow more farmers to benefit. Replicating a forage system on new farmers' fields would seem ideal, but experience has taught us that this doesn't work. No two smallholder farms are the same, and farmers need to experiment with and develop their own forage systems. In addition, farmers need to learn to manage new systems. Identifying new areas where there is a need is another challenge. The FSP therefore, uses the same strategy as described in Figure 1 when it comes to scaling-up, proceeding through all ten steps. However, the process can be speeded up by using farmer-to-farmer visits and ensuring there is ample planting material or seed.

Skilled and motivated local staff are essential for scaling-up. New staff need training about forage accessions, agronomy, systems, and participatory approaches. They must be equipped with good listening and facilitating skills, and they need to be able to analyse data and write reports. During the training courses, field staff with potential can be selected. Apart from skills, attitudes are also an important criterion for staff selection. Only those staff that are willing to accept change and learn new principles can learn about participatory approaches. Even then, it often requires a big mental change to be prepared to learn from farmers, listen and respect them.

In very remote areas, extension workers can be scarce. Another option that has worked well in the FSP is the use of experienced farmers as extension workers. In East Kalimantan, Indonesia, this is now a common practice. These farmers have detailed agronomic knowledge about the forage accessions and can provide useful tips that they have learned by experience. Cross visits being facilitated by these leading farmers are lively and very convincing to new farmers. In every village key farmers can be found and used for extension purposes, if a modest remuneration for their service is provided.

Other lessons we have learnt: it is important that focus sites where the technology is first developed are readily accessible; it is important to have 'buy-in' at the provincial or other level that is responsible for decisions on extension, and involving district officers as well, in the process.

FSP scaling up in 2001

Table 1 shows how the FSP scaled up its activities during 2001 with many more farmers beginning to evaluate forages and forage systems. Some 2170 farmers participated in 151 participatory diagnosis sessions conducted in the participating countries. Not all these farmers are necessarily adopters. Field staff identify which farmers show enthusiasm and they are offered a trip to visit more experienced farmers who are evaluating and adopting forages. Although only 1330 farmers participated in the cross visits, 1537 farmers planted forages. The higher number can be attributed to the 'ripple' effect of these visits; many farmers are organised in groups and share new experiences in group meetings.

Table 1. Scaling up of FSP and number of farmers involved in 2001.

Country	Number of PDs ¹ conducted	Number of farmers participating in PLs	Number of groups (old and new)	Number of cross-visits organised	Number of farmers participating in cross-visits	Number of new farmers planting forages
Vietnam	19	380	92	19	330	664
Indonesia	16	396	16	12	83	272
Thailand	3	30	4	10	54	143
China	5	90	10	11	93	73
Philippines	46	797	57	40	734	320
Lao PDR	24	480	na ²	5	36	65
Total	51	2173	179	97	1330	1537

1. Participatory diagnosis

2. Not applicable.

Multiplication systems are essential for scaling up and without planting material, scaling up cannot happen. In East Kalimantan, farmers have organised themselves in groups for the purpose of producing planting materials. In several cases a piece of land is made available by a farmer who has spare land. Every Friday, farmers come together to work on this multiplication area. They weed the field, uproot plants of improved species such as *P. atratum*, *P. Maximum* T58, and *Setaria sphacelata*, divide them into splits, bag them and sell the material to other farmers. A few splits are returned to the land to produce more splits. If the forage becomes rank, the owner of the land is entitled to harvest fodder for his animals, a reward for making his land available. The whole group benefits from the income of the sales of planting material. Members of the group can obtain materials free of charge.

Production of seeds is more difficult and is usually done by individual farmers. Regulations on seed importation are still a problem in some countries. Seed-producing countries such as China, Thailand and Vietnam face difficulty in trading with other countries because of the lack of knowledge on individual countries' export-import regulations.

Quantifiable benefits

A socio-economic study was conducted with farmers in East Kalimantan who had been with the FSP project for two years or more (Bosma et al. 2002). The aim of the study was to measure impact. Both participatory techniques and conventional surveys were used to compare the situation before and after the introduction of improved forage species. Table 2 provides some data from one of the sub-districts, Sepaku, where the original livestock system consists of Ongole cattle grazing on unimproved grassland. The average farm area of the participating farmers, including grassland, was 3.4 ha and the average number of cattle was 4.1. After cultivating forages, return to labour in the livestock system increased by 68% and the number of days of labour dropped by 14%. When the saved labour was valued in money, the income per day more than doubled. The drastic reduction in labour requirements was caused by the fact that farmers had to spend less time collecting the natural forages which are traditionally stall fed at night. Direct income increased through better condition of the cattle when they were sold, faster growth rates, and increased sales of manure.

Table 2. Comparison of economic parameters (x 1000 Rp) of a grazing cattle system before and after introduction of FSP, Sepaku, Indonesia (n=24).

Parameter	Before FSP	After FSP
Return to labour	3168	5133
Estimated days worked (number)	376	324
Household labour income per day	9.6	16.3
Household income + labour saved	9.6	22.6
Income per 8 hours	-	10.8

Conclusion

Several lessons were learned that have helped to develop the current research and development strategy used in the FSP:

- We need to provide 'building blocks' and not 'finished products'. In other words, the project should show the farmers the species and forage systems that have worked in other places and at the same time allow the new farmers to evaluate a range of optional species and develop their forage systems within their overall farming system.
- Adoption is a continuous process, taking into account that farmers modify the technology options that we provide and expand the areas cultivated with forages only if benefits are experienced. Training of field staff on attitudes and skills is more difficult than training on technical subjects, but it is not less important. Results of some of these training courses can only be observed in the field.

There are no short cuts in scaling-up. New farmers need time to experiment as did the old farmers. However, advantage should be taken of the 'momentum' that is generated by the enthusiasm of staff, and the rapid expansion of training, development and research activities in the initial years of the project.

Participatory approaches are fragile. Even if the project is highly effective at the local level, but if officials at higher levels do not appreciate the use of participatory approaches, the project field staff will receive little support for what they believe in.

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Meeting the demand for livestock feeds in developing countries

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It is well accepted that the Livestock Revolution is occurring, but few mention that it is being preceded by the 'Feed Revolution', simply because of the substantial amount of feed required to supply the demand by the increased animal population.

However, the opportunities to meet the demand for feed depend on the existing production systems. In Table 1 we use the FAO Classification of Production Systems (Seré et al. 1996) to disaggregate where the projected production of milk and ruminant meat in year 2020 will occur. By year 2020, 75% of the global ruminant meat will be produced in mixed crop-livestock systems, 15% will come from grassland-based systems and the rest (10%) from industrial systems. In the case of milk, the majority (88%) will also be produced in mixed crop-livestock systems. For pork and poultry production, at least in the case of South-East Asia, 60-70% will come from industrial systems.

Table 1. Production of meat and milk by 2020 (%).

Production System	Ruminant Meat ¹	Milk ¹	Pork and Poultry ²
Mixed (crop-livestock)	75	88	30-40
Grassland based	15	12	-
Landless (industrial)	10	-	60-70

1. Global, estimated from Seré et al. 1996.

2. For South-East Asia, Devendra et al. 1997.

Under these circumstances there is a need for a breakthrough to meet the increased demand for feed, but at the same time preventing the degradation of the resource base, especially in the case of smallholder systems. We often hear that generally, the adoption of feed-related technologies has been slow and has not reached large-scale proportions. Therefore, there is a need to look at what is new and what have changed.

With the projected amounts of milk and meat to be produced, there is a strong demand for feed, mostly in the crop-livestock systems which are predominantly practised by smallholders. Therefore, poor, small-scale crop-livestock producers with limited resources will constitute the main clientele for new technology. However, to get better chances of adoption, technology development should be demand driven. In that context, over the last few years, the application of participatory approaches to assess demand and to test interventions has proved to be adequate.

Also, it is clear that technologies are more easily adopted when they are associated to market-oriented systems, where policies, institutional factors and effective delivery mechanisms favour the adoption of these technologies. New science like informatics, and new research tools such as Geographic Information Systems (GIS) can help to put together information and scale up the work on livestock feeds and animal nutrition. Also, biotechnology and genomics show potential in helping produce feeds that come from more productive and disease-resistant crops. However, we know that there are no magic solutions and these technologies must find their specific niche in a system.

All these are the elements considered in a proposal by the Department for International Development of the United Kingdom (DFID) which is called the Feed Resources Initiative.

In most farming systems, the feeds are basically classified in four categories and the relative importance of these feeds varies across systems (Table 2). In industrial systems, the most important feeds are grains and concentrates. In mixed crop-livestock systems, the more relevant are the dual- or multi-purpose crops and forages, but depending on the level of intensity, and purpose of production, grains and concentrates can also be important. In general, cultivated forages are dominant feeds in grassland-based systems, and are also part of the cropping systems in mixed farming systems, but are very minor in industrial systems. The last feed category, rangelands or native vegetation, is important only in some grassland-based systems.

It has been mentioned that the use of grains and concentrate feeds is increasing by about 4% annually and most of this is used in the industrial system. There is also a strong trend to increase the use of dual-purpose and cultivated forages, whilst the importance of range is diminishing.

Table 2. Feed resources in main production systems.

System	Grains, concentrate feed	Food-feed crops	Cultivated forages	Range
Grassland-based	X	XX	XXX	
Crop-livestock	XX	XXX	XX	X
Landless (industrial)	XXX	X	X	
Trends	↑	↑	↑	↓

There are differences between regions on the emphasis to be given to each one of the four types of feeds used in the major animal production systems (Table 3). For example, feed grains have potential for meeting the demand of the livestock revolution in the case of pig and poultry industrial systems in South-East Asia and China, and in dairy systems in South Asia, sub-Saharan Africa (SSA) and West and North Africa (WANA).

The main outputs in relation to feed grains should be on policy options, improved crops germplasm and cropping systems. On the other hand, food-feed crops play an important role in producing the feed demanded by the increase in animal population in mixed

Table 3. Indicative regional focus and feed outputs.

Item	Feed Type			
	Feed grains with emphasis on pigs, poultry and dairy	Food-feed crops with emphasis on mixed systems	Cultivated forages with emphasis on mixed systems	Range, pastures with emphasis on pastoral systems
Regional focus	SE Asia, China (pigs, poultry, dairy) and peri-urban systems in SSA, Asia, and WANA	Asia, SSA, and mountain regions of Latin America, SSA and Asia	Crop-livestock systems in wetter semi-arid and sub-humid tropics and mountains	SSA, WANA, East Asia, Central America and Caribbean (CAC)
Main outputs	Policy options, improved crops and cropping systems germplasm	Food-feed systems, improved crops and management strategies, approaches	Best bet forages for specific niches or systems, information systems	Policy and institutional options

systems in Asia and the mountain regions of Latin America. The outputs of research efforts with this type of feeds should be improved dual-purpose germplasm and management strategies to increase the productivity of food and feed from these crops.

What activities are therefore needed? For all types of feeds, the first step is to assess the demand for feed across regions and to have a clear mechanism for technology delivery in order for these feed technologies to reach the users. The other is the development of technologies and understanding how these influence the natural resource base in small farms and what sort of policy and institutional mechanisms would be required for these technologies to be effective (Table 4).

ILRI's current research in livestock feeds and nutrition

The research agenda of the Livestock Feeds and Nutrition Programme of ILRI follows the principles stated in the ILRI Strategy to 2010 (ILRI, 2000). It is focused on poverty alleviation, smallholders and mixed farming systems. It tries to cover the discovery-to-delivery continuum, and building effective partnerships with national research institutions in developing countries, regional and sub-regional organisations, other CGIAR (Consultative Group on International Agricultural Research) centres, and advanced research institutions.

Research activities in livestock feeds and nutrition are also developed through the Market Oriented Production to Consumption Systems projects (MOPCSP), which constitute mechanisms for integrating and focusing on problems and outputs. These production-to-consumption projects are: the Market Oriented Smallholder Dairy (MOSD), Market Oriented

Table 4. Indicative needs for livestock feed and nutrition research.

Item	Feed Type			
	Feed grains with emphasis on pigs, poultry and dairy	Food-feed crops with emphasis on mixed systems	Cultivated forages with emphasis on mixed systems	Range, pastures with emphasis on pastoral systems
Demand assessment and delivery mechanisms	Needs <i>ex ante</i> assessment, uptake paths	Needs <i>ex ante</i> assessment, uptake paths	Needs <i>ex ante</i> assessment, uptake paths	Needs <i>ex ante</i> assessment, uptake paths
Feed technology development	Genotypes and crop management for increased grain production, feed formulation	Germplasm evaluation Development of dual purpose genotypes and management options	Best bets, databases including adaptive traits, molecular characterisation and geographic domains	Adaptation of best bet management strategies in high potential areas
	Feed quality			
Natural resource management	Land use conflicts and pollution in peri-urban systems	Trade-offs among alternative uses of crop residues	Effect on soil fertility, erosion and salinity Carbon sequestration	Preventing degradation and overgrazing in low potential areas
Policy options	Access of poor to inputs and outputs markets	Development of private seed sector	Constraints to adoption	Policies and institutions to prevent degradation
	Development of feed industry	Constraints to adoption of improved varieties		Access rights Risk management Conflicts among users

Livestock Systems (MOLS) in West Africa, Crop-Livestock Systems (C-L) in the Mountains, and Crop-Livestock Systems (C-L) in Rainfed Areas of South-East Asia.

In addition, for those problems of broad relevance, the Livestock Feeds and Nutrition Programme works closely with the other programmes. These include Animal Health, Genetics and Genomics, Livestock Policy, Systems Analysis, People, Livestock and Environment (PLE), and the Systemwide Livestock Programme (SLP).

In the area of livestock feeds and nutrition, ILRI's research projects are covering several issues. The MOPCSP projects are very much involved in assessing the demand for feed technologies. The Systems Analysis and Impact Assessment Programme has conducted a number of studies on both *ex ante* and *ex post* analysis of feed technologies. Some examples of these are the *ex ante* assessments of dual-purpose crops (Kristjanson et al. 1999) and *ex post* analysis of the adoption of forage technologies in West Africa (Elbasha et al. 1999).

The Livestock Feeds and Nutrition Programme, mostly together with the MOPCSP projects, is very much involved in conducting research work on production and utilisation

of feeds and feeding systems. It also links with the People, Livestock and Environment Programme in addressing issues such as the environmental effects of feed production and feeding systems on nutrient recycling and more recently, on methane release by emission in livestock systems.

The Livestock Policy Programme and the MOPCPS projects are working on the constraints to adoption and together with SLP and in partnership with other institutions, are looking at the delivery mechanisms for feed technologies. At this stage, in some countries there are already clear examples of systems in place to deliver technologies on dual-purpose crops.

It must be emphasised that the work done by ILRI on Livestock Feeds and Nutrition goes beyond testing of feeds and looking at their potential impact. There is substantial activity in identifying what needs to be done (demand-driven approaches) and how these technologies can reach the small farmers.

Feed production and utilisation projects

In the case of feed production and utilisation, the Livestock Feeds and Nutrition Programme has four projects that focus the research work on basically two types of feeds: forages and dual-purpose crops. The work with forages involves characterisation and conservation of genetic resources, whereas the work on dual-purpose crops aims at improving these food-feed crops, but such work is done in collaboration with some of the crop-oriented CGIAR centres such as the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) and the International Institute of Tropical Agriculture (IITA), as well as with a number of national institutions. There is also some work on managing the rumen microbial ecosystem for increased feed efficiency by removing some of the toxic components contained by some tropical feeds. Finally, there is a fourth project which aims at improving ruminant production under nutritional stress, caused by fluctuating feed supply, presence of anti-nutritional factors (ANFs) and other causes.

The expected outputs and the approaches used in these four projects are summarised in Table 5. The main outputs being targeted by the Forage Genetic Resources Project are databases and conservation methods of a rich collection of forage germplasm, as well as to identify 'best-bets' of forage germplasm for particular niches. In the case of the Food-Feed crops project, the main output is the identification of food-feed strategies to incorporate dual-purpose crops into the feeding system, and the improvement of some crop varieties that can be used for food and feed. The Rumen Microbial Ecosystems Project is basically investigating specific microbes that have the ability to degrade some secondary compounds in selected forages which could have toxic effects on rumen microbes and/or animals. The main expected output of the Nutritional Stress Project is to understand the metabolic principles involved in coping with nutritional stress as a basis for the design of improved feeding strategies.

The main feeds that are being researched by the Livestock Feeds and Nutrition Programme, in collaboration with the MOPCSP and national partners are presented in Table 6. For the purpose of this paper we will only stress on the work done in South-East Asia. In this region, there is work on the evaluation of grasses, legumes and tree crops, and some of the dual-purpose crops like cassava and sweet potato. This work is being conducted

by CIAT's Forage for Smallholders Project and ILRI's Crop-Animal Research Network (CASREN), in partnership with national research and development institutions.

Complementary to the ongoing work on feed detoxification carried out in Africa, there is also an Australian-funded project in Indonesia working on removing a toxin from acacia. Acacia is a tree fodder species that shows significant potential in terms of high biomass yields and concentration of nutrients, but presents some problems of toxicity.

Table 5. Outputs and approaches of food and feed utilisation research projects.

Project	Outputs	Approaches
Forage Genetic Resources	Breeding criteria, molecular markers, improved cultivars, food-feed systems	Evaluation of selection criteria Conventional breeding Molecular markers
Food-Feed Crops	Conservation methods, data bases, DNA, genes information, 'best bets'	Microbes in wild ruminants Detoxification, Microbial Genetics
Rumen Microbial Ecosystem	Strains of rumen microbes, microbial genes	Conservation and characterisation (adaptability, quality traits, molecular)
Nutritional Stress	Metabolic principles understood, feeding strategies	Effects of ANFs, Response to improved nutrition, Support other projects, Feeding systems

Table 6. Feed crops studied in the research projects

Project	Dairy	West Africa	Mountains	South-East Asia
Forage Genetic Resources	Napier, Legumes, Trees	Cowpea	Napier, Legumes, Trees	Crasses, Legumes, Trees ^{1,2}
Food-Feed Crops	Maize – EA; Sorghum – India	Sorghum, Millet, Cowpea, Cassava	Maize	Grain-legumes (e.g., cowpea, groundnut, mungbean), Cassava, Sweet Potato ²
Rumen Microbial Ecosystem	Adaptation to feed fluctuations	Detoxification, tolerance to tannins	Detoxification, tolerance to tannins	Detoxification (Indonesia)
Nutritional Stress	Fluctuating feed, Nutrient management	Under-nutrition, Nutrient management	Fluctuating feed	Mineral-nutrient-block-lick (MNBL) supplementation, use of crop residues and other local feed resources ²

1. CIAT-FSP

2. CASREN

Opportunities for research in livestock feeds and nutrition in South-East Asia

Livestock production systems

It is accepted that mixed farming systems constitute the backbone of small-scale agriculture in South-East Asia. Almost all smallholder farming systems have a livestock component of non-ruminants or a combination of ruminants and non-ruminants (Devendra and Tomas 2002a). However, in the case of monogastrics (pigs and poultry), large-scale industrial production systems, practised mostly in peri-urban areas, contribute the most in meeting the demand for those species products (Devendra 2000; ILRI 2000).

In smallholder systems, most pigs and poultry are raised in traditional low input systems. Local breeds are commonly used and animals are allowed to scavenge outdoors, and are fed some household residues and crop by-products (Pezo et al. 2000). In such systems animal productivity is low (ca. 100 g LWG/day in pigs, and 50 eggs/bird per year for poultry), but production costs are low as well (Vercoe et al. 1997). In those cases where the main purpose of pigs and poultry in smallholder farms is to generate income, farmers use improved breeds, keep animals corralled, offer concentrates and other feeds, and under these circumstances productivity is much higher. For example, in Vietnam, where sweet potato, cassava and other crops are grown for feeding pigs, productivity is 250–500 g/day (Peters et al. 2001).

The ruminant production systems practised in South-East Asia can be grouped in three major categories:

- a) systems integrating arable crops and livestock
- b) extensive grazing systems
- c) systems integrating animals and perennial tree crops.

Ruminant systems combining crop and livestock activities are the most common. In these systems, livestock are controlled in intensive cropping areas by stalling or tethering and shepherd grazing of roadsides, idle land and crop stubble (Devendra and Thomas 2002a). It is common to 'cut and carry' grasses, weeds, and/or crop residues to animals maintained in pens or even to those tethered. Supplementation with concentrates is seldom practised and it occurs mainly during the dry season.

Extensive management of native or naturalised grassland systems is not as common in the region as it is in Africa and tropical America. Extensive systems tend to be low-input/low-output systems, in which animals graze native pastures or the under-story vegetation of upland primary or secondary forests. Poor control of cattle in extensive systems often causes problems to crop producers who have to use precious labour and capital resources to build fences. Livestock in extensive systems are more likely to be owned by absentee owners.

Integrating ruminants in coconut areas is common, but has often been discouraged in other plantation crops such as palm oil, rubber and fruit trees, although there is considerable opportunity for expansion. Several benefits have been attributed to the integration of

ruminants in plantation states (Stür and Shelton 1991; Reynolds 1995). Among these are: (a) reduced competition of under-story vegetation on woody plants; (b) reduced costs associated to weed control; (c) easier collection of fruits dropped onto the soil; (d) increase in soil fertility; and (e) increase and diversity of farm income. However, the adoption of these systems by a large number of farmers will depend on resource endowment, supporting infrastructure, market potential and policies favouring intensification, diversification, and specialisation (Devendra et al. 1997).

Feed resources in smallholder farming systems

Ruminant feeding systems in South-East Asia are characterised by the use of a wide diversity of feed resources grouped as pastures, crop residues, agro-industrial by-products and non-conventional feed resources. However, poor quality native grasses and the fibrous residues of a wide range of crops form the principal feeds used for ruminants in smallholder crop-animal systems (Devendra and Sevilla 2002).

Permanent pastures represent only 3.9% of the total land in South-East Asia. However, native and naturalised forages, as well as 'weeds' are normally found in crop fields, roadsides, river banks, rice bunds and areas under fallow, and even as under-story vegetation in the forest, as well as in plantation states (coconut, oil palm, rubber). In South-East Asia, the estimated availability of these native forages out from arable land is 110 million tonnes dry matter (DM) per year, which in theory would allow the maintenance of almost 30 million ruminant livestock units (RLU) (Pezo et al. 2000). These feed resources are utilised by either tethered or free-grazing animals.

The fibrous crop residues constitute by far the majority of the total volume of feeds produced in South-East Asia, and are the basic feed resources for most crop-animal systems. The amount of available cereal straws in South-East Asia is 158 million tonnes, 86% of which is from rice. Considering the ruminant population, the average availability per RLU is 2.9 tonnes per year, which is in excess of the potential intake of this resource, which is 1.28 and 0.73 t per year, for buffaloes and cattle, respectively (Devendra, 1997). However, there is a wide variation among countries, for example in Vietnam and Indonesia there are large excesses (4.7 and 4.1 t/RLU per year), whereas the availability in Cambodia and Laos (0.5 and 0.9 t/RLU per year) is below the potential intake of an RLU (Pezo et al. 2000). Theoretically, the available crop residues and the agro-industrial by-products could provide all the roughage needed by the present ruminant population. However these estimates are based on the assumption that all residues are exclusively used for feeding, are readily accessible to animals, and all the above-ground biomass is consumed. There is a need to quantify how much of these crop residues are actually used, and to study what proportion could be consumed under stubble grazing, considering different crop and animal management conditions.

The use of supplemental feeding is very haphazard in smallholder farms, despite the considerable research work done in the region. Devendra and Sevilla (2002) consider the following as factors that explain this situation: (a) poor appreciation of the value of supplementation; (b) inadequate knowledge of types and ways of using supplements; (c) high cost of purchased concentrates; and (d) ignorance of opportunities for on-farm

preparation of supplement mixtures. Also, the weak extension services and the lack of solid links of these with researchers have resulted in limited number of demonstrations of supplementation undertaken on small farms.

Research and development opportunities

Considerable work of component research, along disciplinary lines, has been undertaken in the region with some success, but most of the work has been carried out on research stations and has lacked the systems and demand-driven approaches (Devendra 2002). In many cases, relevant interactions between animal and crop production and important constraints of the farming systems have been ignored, resulting in limiting adoption of most of the technologies that had been proved effective at the experiment station level. Moreover, in many institutions, natural resource management issues are neglected and there exist disciplinary barriers between the soil, plant and animal sciences – even between animal scientists and veterinarians – that preclude a holistic approach.

On the other hand, the increased demand for products of animal origin associated to the livestock revolution is resulting in some farmers' initiatives for intensification, modifying their management and feeding strategies. For example, in few cases there has been stratification of the industry where cattle are bred on extensive systems and then moved to other areas for fattening, such as in the case of the Philippines, where cattle bred in Masbate are moved to Luzon for fattening (Pezo et al. 2000). In other cases, improved grasses and legume trees and shrubs are being planted for cut-and-carry and fed to cattle and small ruminants (Gabunada et al. 2000). Also, other forms of intensification such as the ammonification of rice straw using urea and the utilisation of urea-molasses or multi-nutrient block licks are now better accepted by those smallholder farmers exposed to those technologies (Devendra and Pezo 2002). Therefore opportunities for adoption exist, if appropriate technologies are proposed, adequate links from problem identification to technology delivery are established, and policies that favour their implementation are in place.

Some areas of research in livestock feeds and nutrition in South-East Asia to be addressed are the following:

- 1) Feed budgeting. In the prevalent crop-livestock systems, feeding strategies are quite diverse in terms of the feeds used and in many cases several feeds are offered at the same time. However, there is little quantitative information on the seasonality of feed supply and its synchronisation with animal requirements throughout the year. Therefore, there is need for monitoring current changes in feed availability and demand of nutrients, assessment of the impact of cycles of nutritional stress within the year, and determining the effect of the combination of feeds and frequent changes in diet composition.
- 2) Integrated nutrient management. The sustainability of major cropping systems is declining due to the decrease of organic matter, and under these circumstances nutrient cycling provides through manure, the link between crops and animal production. Strategies for manipulating diets for more efficient recycling of nutrients need to be examined.

- 3) Food-feed systems. In the prevalent crop-animal systems, there is a strong dependence on animal feed produced by crops. In this context, the use of dual-purpose crops and legumes to increase the much needed demand for feed and food, and at the same time contributing to the sustainability of crop-animal systems, is another promising area for research.
- 4) Integration of animal production in plantation systems. The use of perennial crops (e.g., coconuts, oil palm, rubber, fruit trees) in plantation schemes is a common activity in the region. Few research results indicate that the introduction of improved forages as under-story cover crops and their utilisation by grazing animals is economically feasible and ecologically sound. However, there are many aspects in the tree-crops/animal interactions that need to be evaluated.
- 5) Adoption of feed technologies. Several feed technologies, such as the use of improved forages (grasses, legumes and tree foliages), urea treatment of crop residues, supplementation with protein and energy sources and urea-molasses block licks, have been evaluated in many sites throughout the region over the last 30 years. Despite this, the adoption has been slow. There is a need to understand the reasons why some of this technologies were adopted in some areas and not in others. It will serve to identify socio-economic and policy issues that would enhance adoption of specific feed technologies, as well as niches (recommendation domains) where each technology fits.

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Possible roles for ILRI genetics and genomics research

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Introduction

This paper raises some issues on how genetics and genomics research at the International Livestock Research Institute (ILRI) can play a role in assisting livestock development in this region. The principal purpose of this meeting is for ILRI and the Food and Agriculture Organization of the United Nations (FAO) to listen to what our colleagues in this region see as opportunities for research where we can fit into.

The genetics and genomics programme of ILRI consists of nine scientists and a substantial number of post-doctoral fellows and graduate students. Our research team consists of expertise ranging from pure molecular genetics and genomics, to highly quantitative statistical applied genetics, design of breeding programmes, integrated management, and more recently, economics. So we try to have a balanced team of not simply of one type of genetics expertise, but expertise across the spectrum.

Fundamentals of livestock production

Taking a step back to the fundamentals of livestock production, and thinking of the genetic role within that, it is obvious that the starting point of every livestock production system is a livestock genotype. Everything is added on to this. Obviously it is an interactive system – how we manage the system depends on the genotype used, and vice-versa. The best genotype to use in a system depends on the system that is envisaged.

Our starting point therefore, is genetic material and we have the advantage of being able to draw from a huge number of breeds. FAO estimates that there are 6000–7000 breeds of livestock worldwide, which are the result of what is arguably the biggest genetic experiment ever performed. This is the result of 10 thousand years of domestication, selection, and adaptation to environments around the world.

Our concern is that this livestock diversity is under threat, but we know very little about the genetic characteristics of the vast majority of livestock breeds. Most of this genetic diversity has never been characterised. We know quite a lot about the performance characteristics of a very small number of breeds in the developed world and even a smaller number of breeds in the developing countries, but the vast majority of this material has never been looked at in any detail.

What is clear, with the information we have available, is that livestock are generally well adapted to the environment in which they evolved. What is less easy to document and what comes quite clear from the grey literature and from anecdotal evidence, is that livestock have generally evolved resistance to diseases that are endemic to the region in which they evolved.

The ILRI genetics and genomics research programme

Taking all these as a background and as a starting point, how do we then envisage our programme? Guided by a principle that ILRI research activities should have impact and relevance, we have identified three broad domains of potential applications when it comes to livestock genetic resources (Figure 1).

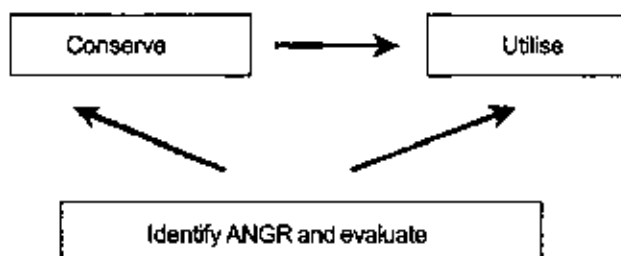


Figure 1. Broad domains of potential applications of livestock genetic resources

The first is utilisation of genetic resources in the production system. If we want to utilise resources effectively, we have to make decisions on which resources to use and how we should develop such resources. That implies that we already know what the animal genetic resources are, and what value they have. In fact, in many cases, we do not. So documenting these, i.e. identifying the animal genetic resources, where they are, what are their characteristics, and what are their value, etc. is itself an important activity.

Identification of the genetic resources can then lead to other decisions for conservation or utilisation. There is a link between conservation and utilisation. The only real purpose of conserving genetic resources is because it is envisaged that at some point in the future, we see a potential role for that genetic resource as a whole, or as a part, perhaps the genes contained in that genetic resource, for some future utilisation. We design our research programme in such a manner that we will have various impacts on these broad domains. So we have projects on characterisation, the status of genetic resources and the molecular diversity of genetic resources.

More recently, we have put all the collected information in a database called DAGRIS (Domestic Animal Genetic Resources information System) which we hope will interface

with the FAO's Domestic Animal Diversity Information System (DADIS) in the future. Apart from getting all these information, we have to know something about the potential value of all these genetic resources. So we have recently started projects on developing methods for valuing genetic resources both at the local and global levels. We have also a collaborative research programme on developing decision tools to take all the information collected and provide guidance on conservation and utilisation of animal genetic resources.

Another increasingly important area is capacity building. We have a training programme financed by the Swedish Government for further developing capacity for utilisation and conservation of genetic resources. So far we have focused on Africa, but we shall soon move into Asia.

The species that we are currently working on include cattle, sheep and goats, yaks, camels, and chickens. For the last couple of years, it has been very much in our strategy to move this work out of Africa into Asia to make a comprehensive survey. So one of the reasons why we are here today is to find ways to formulate that strategy.

We also have a number of projects on molecular genetics of disease. We are looking at the molecular genetics of trypano tolerance in N'Dama and Boran cattle breeds and helminth resistance in Maasai and Dorper sheep. We have a molecular genetics study using mice as a model of disease in livestock, in exactly the same way as using mice as a powerful mammalian model of human disease research.

The objective of all this research is to determine both the potential in improving disease resistance in livestock and disseminating disease resistance to other breeds of livestock and to understand the biological mechanisms of disease resistance. By understanding these mechanisms, we believe that we can suggest routes for development of new therapeutics, or possibly even vaccine development. So this is not just a one-output project. It is very much long-term fundamental research that is looking at a series of possible applications – livestock genetic development, therapeutic development, vaccine development and so on.

We have an integrated management project in South-East Asia which is very much on the ground, working with collaborators and smallholder farmers, and looking at different mechanisms of an integrated approach to management of disease which includes the genetic option. It recognises the fact that while the livestock host provides a degree of genetic tolerance to disease, this is not a solution in its own right. This has to be combined with appropriate management strategies.

Highlights of previous research

The following are the highlights of what our research has achieved over the last couple of years:

- First genome wide mapping of a livestock disease locates genome regions controlling tolerance of trypanosomosis in cross of African N'Dama and Boran cattle. This disease is the cattle form of the human sleeping sickness and it is the most costly and wide-spread cattle disease in sub-Saharan Africa.
- First genome wide mapping of helminth resistance in mice as powerful model of livestock and human disease.

- Genome wide mapping of helminth resistance of Red Maasai sheep leads the way to gene discovery and application for disease control.
- Major contribution to global genetic variation revealed and history of human-livestock associations traced. This has substantial implications for genetic resources conservation, improvement, and utilisation.
- Work in South-East Asia
 - Resistance to benzimidazole (BZ) dewormers mapped in goats using modification of Australian technique to tropics
 - Breed susceptibility identified and government policies influenced
 - Communities established and now available for broader community-based studies
- Released first version of DAGRIS, a computerised information system on indigenous animal genetic resources of Africa. This database also aims to complement FAO's DADIS.
- New global and regional decision tools for conservation developed.
- Planning Workshop conducted in the Philippines on November 2001 identified characterisation and utilisation of genetic diversity of chickens as highest priority and buffalo as second priority.
- Animal genetic resources training for South-East Asia sets first training course in January 2003 in collaboration with Kasetsart University, Bangkok. It is recognised however, that the needs for training are much broader than a single training course can provide.

In summary, what services can ILRI provide to assist livestock genetics research in Asia? We have genomics research laboratories and expertise, a biodiversity assessment and gene mapping laboratory of the highest international standard. We can certainly backstop at the highest level of molecular genetics and genomics research. We have experience in training in characterisation, extensive experience in breeding programme design and operation, and experience in an integrated management approach.

The key word here is integration. The research we may get involved in is not just genetics research, but genetics as a component of integrated management for the development of systems to benefit smallholders, and thus achieve poverty alleviation.

Session IV

Markets and
smallholder participation

The livestock sector: a component of the agro-industrial development in South-East Asia

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Introduction

The agricultural sector is making headway in agricultural production. In Asia alone, cereal production doubled to a 650 million metric tonne level and livestock production to a 140,000 population level, giving rise to an increased proportion of animal food products going into everybody's diet. However, problems still beset the agriculture sector as its declining share in gross domestic product (GDP) is a regional if not a world wide phenomenon. Given this scenario, there is a need to look at agricultural development within a bigger context to allow for evaluation of opportunities and threats and a better appreciation of why, despite continuing development efforts, progress is slow.

Questions like 'How have issues such as increase in population pressure, high urban migration, prevailing poverty and malnutrition, technological breakthroughs, globalisation and financial crisis, led to development setbacks or potentials?' and 'How can various sectors, livestock in particular, best be viewed within an agribusiness and agro-industrial development perspective?' need answers.

In the Association of South-East Asian Nations' (ASEAN) economies where the majority of the population is dependent on agriculture, the agribusiness sector plays a crucial role in absorbing agricultural surpluses and at the same time in meeting the needs of both the urban and rural populations through its value adding activities. As the vital link between agriculture and industries, agribusiness is likewise seen as the vehicle for agro-industrial development and consequently, economic growth. The role of agribusiness in economic development faces an enormous challenge as a result of the steady long-term decline in raw agricultural commodity prices and amidst the pressure of globalisation (Figure 1).

Agribusiness and agro-industrial development

Developing countries look at agribusiness through varying perspectives depending on their level of agro-industrial development. There are those whose view of agribusiness is confined to the system of input provision, particularly those in a production expansionary level or to the processing system when their economies are already characterised by a number of agri-based industries.

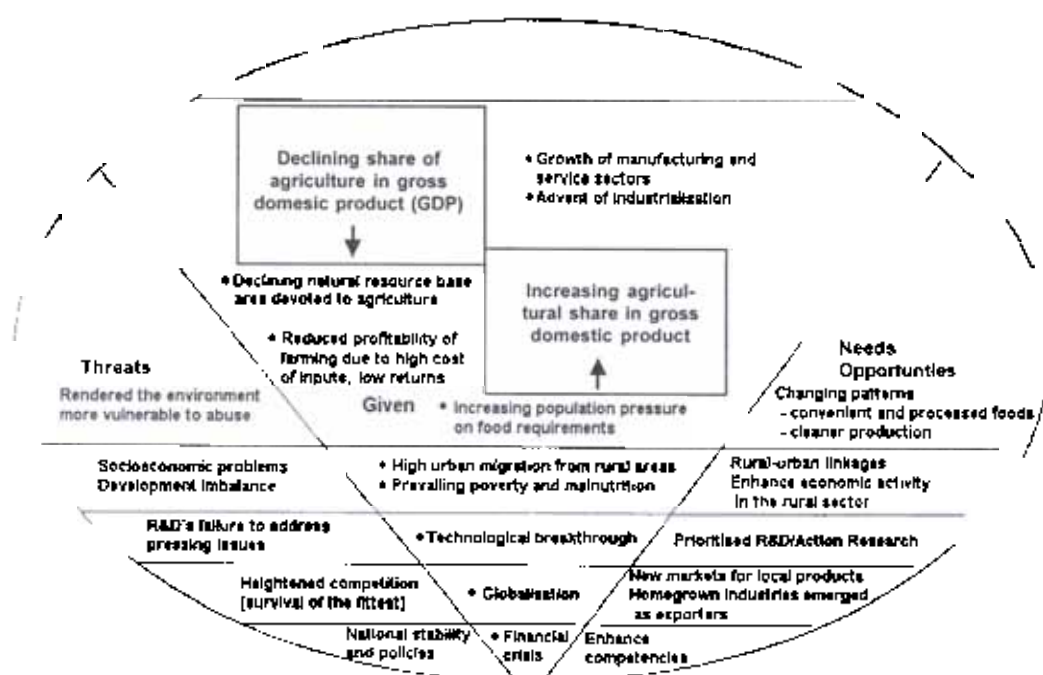


Figure 1. The regional agricultural development scenario.

This paper defines agribusiness as a concept that includes the primary production of agricultural produce; the upstream economic activities (production and distribution of all inputs and services used in on-farm production); the downstream industries (processing, manufacturing, transportation and related services); and the transformation of raw agricultural produce into finished products either for domestic consumption or export.

Agro-industrial development, of which agribusiness is an integral component, is the process of striking a balance between agriculture and industrial development where one provides the requirement of the other and where rural and agribusiness development are recognised as strategic development prerequisites. For sustainability, it should have thriving rural enterprises that can compete in a global market while taking care not to disrupt the conservation of its natural resource base.

Agro-industry or value adding in agriculture comes in varying forms in terms of raw material transformation, namely: physical or chemical alteration, storage, packaging and distribution. Each of the foregoing forms requires varying raw material quality. The usual starting point is the basic processing of fresh/live produce such as cleaning, grading and storage activities (Table 1). It then graduates to more physical processes such as heat and cold treatments and then chemical alteration, as in levels II-IV. In general, capital investment, technological complexity and managerial requirements increase as the degree of transformation moves from primary to complex processing.

Table 1. Categories of industries by level of raw material transformation.

Item	Level I	Level II	Level III	Level IV
Selected processing activities	Cleaning Grading Storage	Grinding Milling Slaughtering Cutting Mixing	Cooking Dehydration Weaving Extraction Assembly Cutting	Chemical alteration Texturisation
Illustrative products	Fresh fruits Fresh vegetables Eggs Livestock (live)	Cereals Meats Spices Animal feeds Jute Cotton Lumber Rubber Flour	Dairy products Canned or frozen cooked meats Textiles and garments Refined vegetable oil Furniture Sugar Beverages	Instant foods Textured vegetable products Tires

Source: Austin (1992).

All these are done for the purpose of adding value, which are translated into better storability and transportability. On the consumer side, that value is expressed as the amount the consumer is willing to pay for the convenience provided, in addition to the inherent quality of the product. The practicality and attractiveness of the package are additional selling points of the product.

Seasonality is a unique feature of the raw materials processed by agro-industries. Seasonality leads to supply problems of surpluses or shortages in a situation where demand is relatively constant. Perishability requires storage and care in handling as well as speed in delivery, while variability demands sorting, grading for preservation of physical attributes and nutrition quality. This being the case, post-production handling, better known as post-harvest activities, becomes a major agro-industrial concern both for crops and animal produce. The requirement is exacerbated further by the fact that processing demands raw material attributes far different from those expected of fresh produce or live and fresh livestock. Thus, processors are confronted further with the challenge of ensuring that processing products are still acceptable in the market and that the raw materials selected will afford them processing quality and efficiency.

Key decisions on competitiveness and cost efficiencies start as early as input determination. As the old adage goes, the fruit is greatly dependent upon the seed planted, or in the case of livestock, the offspring is greatly affected by the parent stock (Figure 2). As one passes through the agro-industry commodity subsystems, varying decision points already have a bearing on resultant output and the kind of production and post-harvest activities demanded, as well as on the environmental issues.

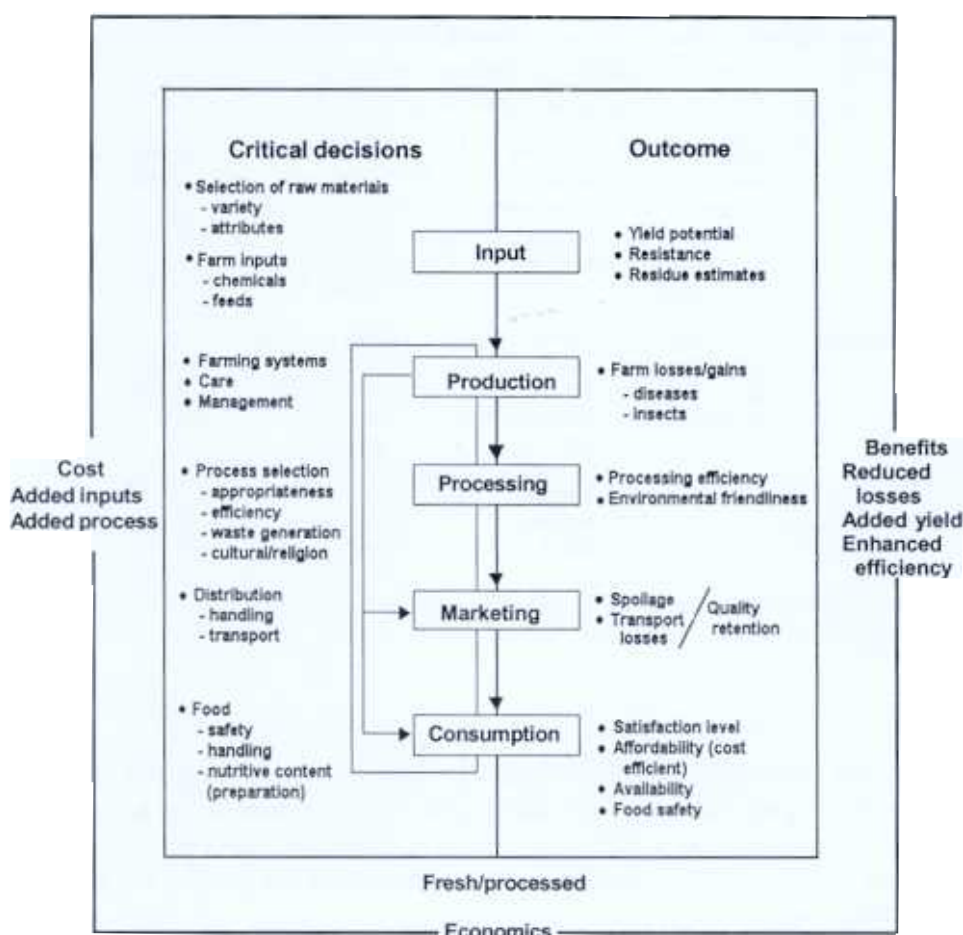


Figure 2. Production and postharvest requirement by decision.

The livestock sector

A major component of the agribusiness sector is livestock which accounts for 6–20% of total agricultural produce. About 95% of the domestic animals in South-East Asia are found in small resource-poor farms in rainfed areas, where they are associated with crop-ping. Figures 3 and 4 show the animal populations and growth rate in South-East Asia. According to Delgado et al. (1999), buffaloes, mainly of the swamp type, are found in the rice-growing areas and are used for draft purposes and meat production. Cattle are mainly dual-purpose, producing both meat and milk. Goats are more widespread than sheep throughout the region.

Amongst non-ruminants, the populations of chicken are the largest followed by those of ducks and pigs. Commercial production systems for non-ruminants are efficient, intensive operations that are associated with the successful transfer of developed country technology.

These systems are greatly dependent on purchased feeds, improved breeds, disease control and good market opportunities. Ducks remain to be developed more intensively while chickens posted the highest average annual growth rates in recent years.

In terms of consumption of animal products, South-East Asia is not far behind from other Asian subregions (Figure 5). In terms of consumption growth, it is next only to East Asia (Figure 6).

The development in the livestock sector is usually evolutionary responses to population pressure, resource endowment and marketing opportunities (Steinfeld 1997). There are three farming systems in the sector, namely, grazing, mixed farming and industrial systems. The mixed farming systems accounts for 50% of the world's meat supply while grazing and industrial systems contribute 13 and 37%, respectively (Figure 7). Of the three systems the industrial system shows the fastest growth rate (Figure 8). In terms of responses to animal product demands when demand increases rapidly, land-based systems such as grazing fail to respond, resulting in animal concentrations that are beyond the land capacity for waste absorption and feed supply, moving to mixed farming and industrial systems.

Problems of the livestock sector

The problems of breeding materials, animal feeds, animal health, animal husbandry, marketing, capital and infrastructure support are among the major problems of the livestock sector in ASEAN, particularly Vietnam, Thailand, the Philippines, Lao PDR and Indonesia. (Table 2).

Research priorities were likewise put forward to address these problems (Table 3). Looking at these problems within the context of the agroindustrial level where they are encountered will help situate things and options (Figure 9).

Need for answers to problems

The livestock industry has to be viewed within the food systems perspective. The food system, according to Tansey and Worsley (1997) is about how food is produced and reaches our mouths and why we eat what we do and it subsumes the terms food chain and food economy.

As a system, it links three different aspects of life: biological – the living processes used to produce food and their ecological sustainability; economic and political – the power and control which different groups exert over the different parts of the system; and social and cultural – the personal relations, community values, and cultural traditions which affect people's use of food.

How then can a sustainable livestock development in the light of the agro-industrial and food system requirements be achieved?

How do we make animal products available where they are needed most, a need that is based not merely on paying capacity but on nutrient requirements as well?

How can a smallholder production which accounts for the bulk of the sector be sustained and integrated into a thriving livestock market?

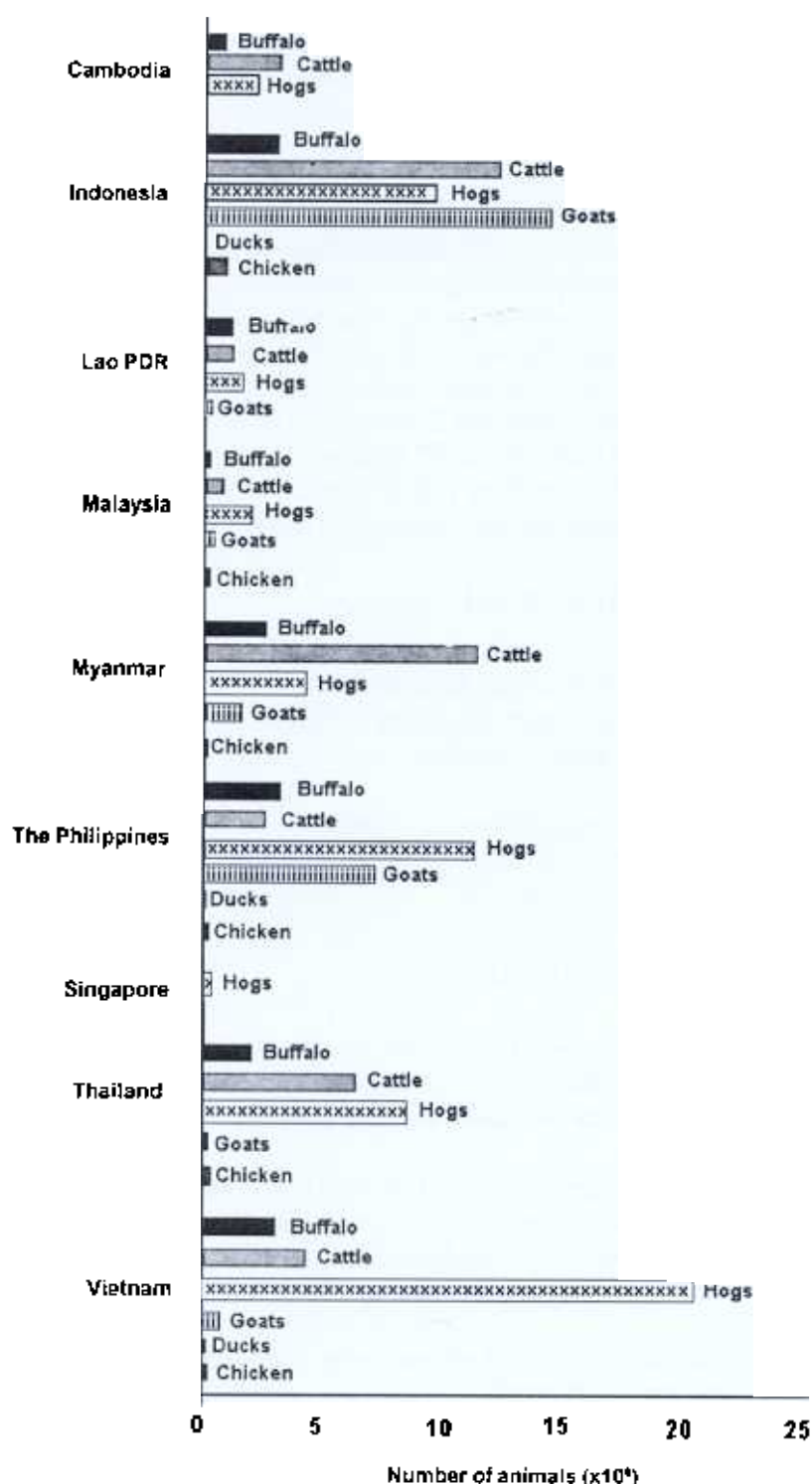


Figure 3. Livestock population in South East Asia, 2001.

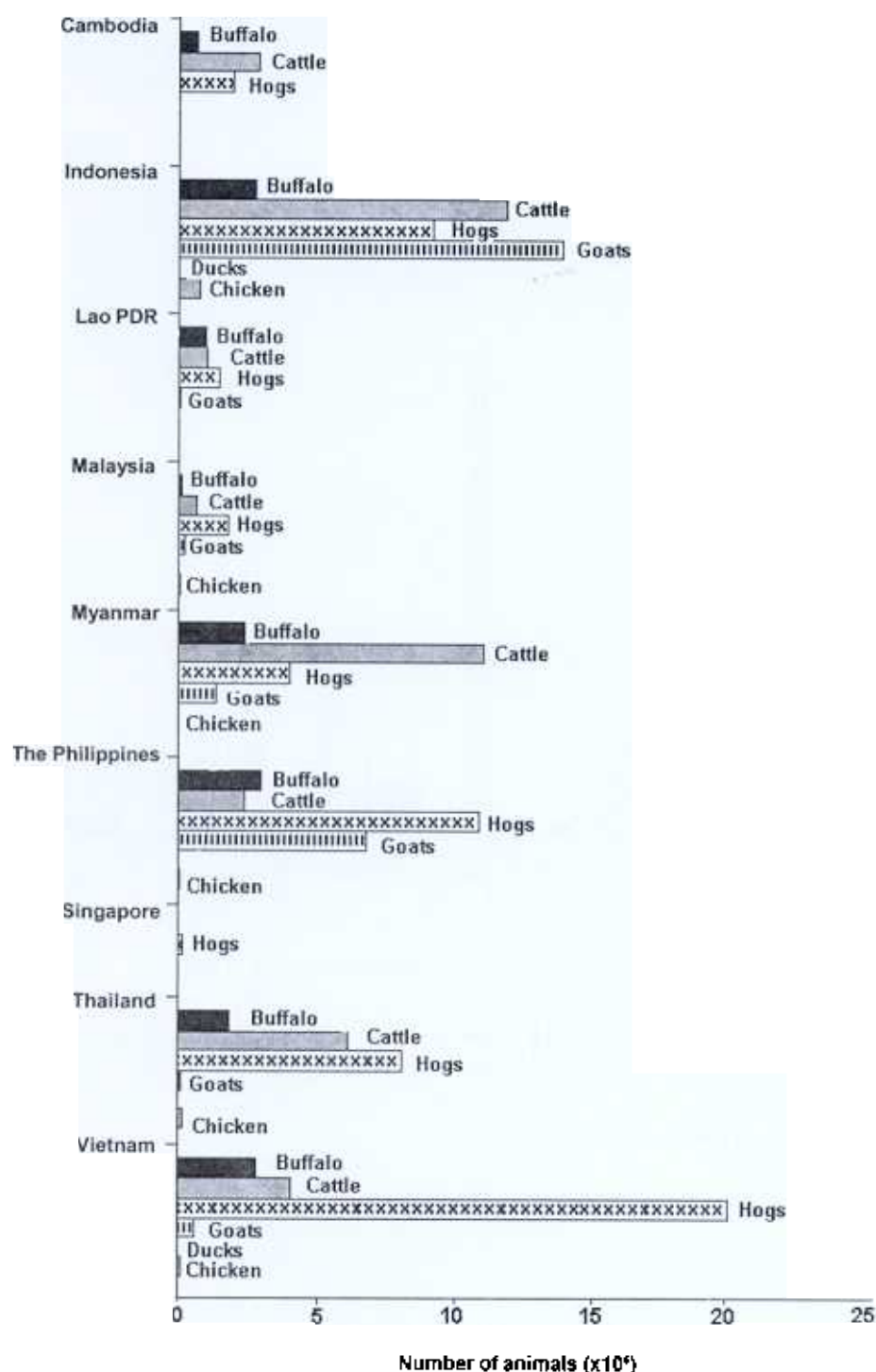


Figure 4. Growth in the animal population in South-East Asia.

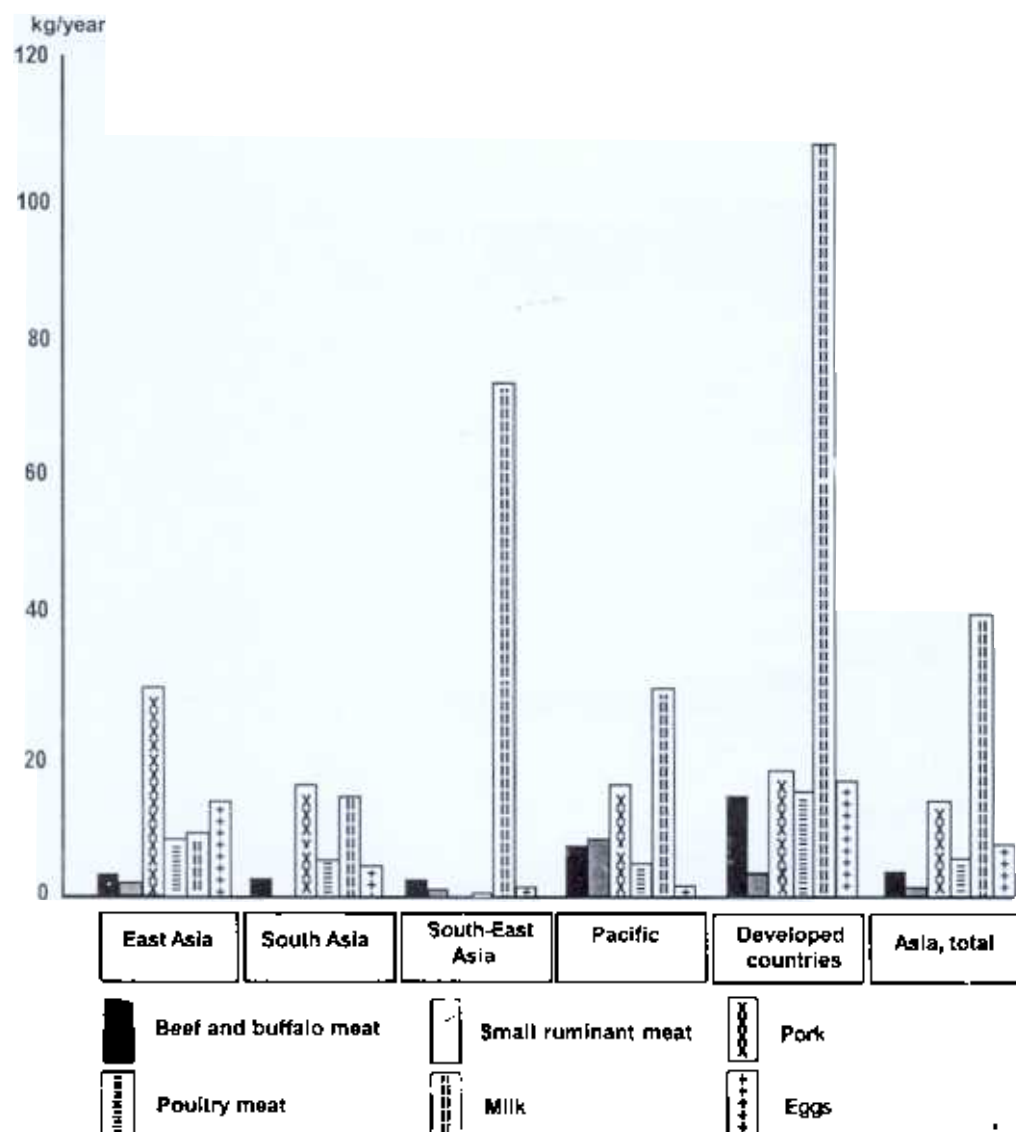


Figure 5. Consumption of animal products per capita, 1995.

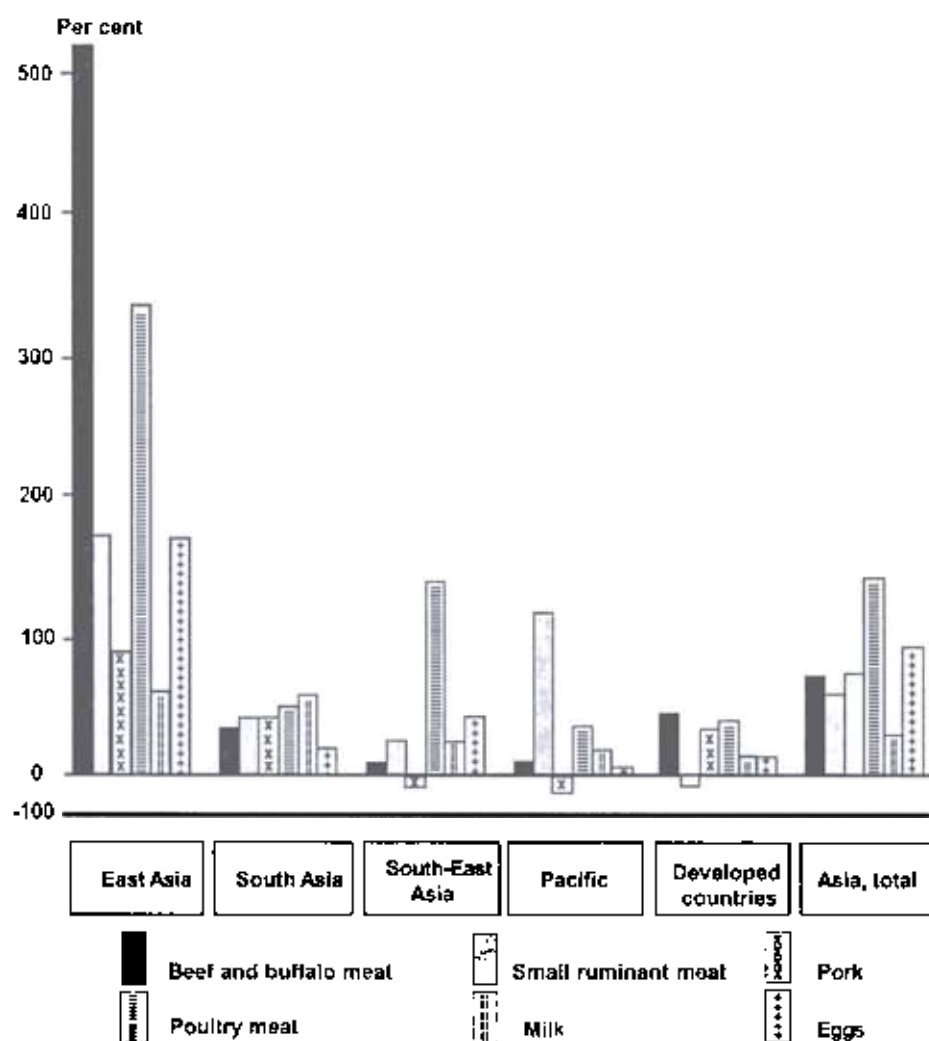


Figure 6. Growth in per capita consumption of animal products, 1985-1995.

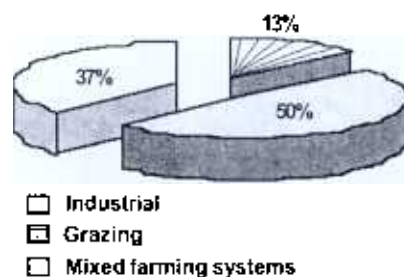


Figure 7. Livestock production by farming system.

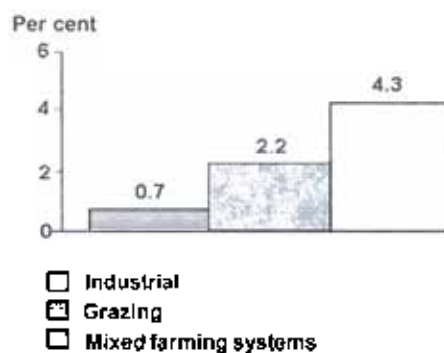


Figure 8. Growth rate of livestock production by farming system.

Table 2. Constraints/problems encountered in livestock production in selected Southeast Asian Ministers of Education Organization (SEAMEO) member countries.

Area	Thailand	Philippines	Lao PDR	Indonesia
Breeding materials	Indigenous breeds predominate for all animal types (with partial exception for pigs)	Large portion of breeding and reproductive herd and flock are very young	Continuous improvement of breeding stock limited; problems lack of quality breeds and technology for breeding base cattle	Low productivity, indigenous breeds; needs breed improvement scheme; improved breeds in temperate regions
Animal feeds	Low utilization of the major feed crops for animals; locally grown crop products (barley, sorghum, rice straw) are not used and imported	Large volumes of animal and fish wastes require treatment before use; animal and fish waste is often recycled	Dependence on imported ingredients; corn and soybean as feed and feed additives (protein and amino)	Feed shortages in dry and rainy season due to limited grazing area
Animal health	Recommended vaccines are not used; and associated with disease and a number of diseases are not reported; poor knowledge of diseases	Inadequate health programs	Unbalanced spread of diseases and diseases based on climate and high cost of biological antibiotics and other medicines (policy & price)	Diseases (haemorrhagic septicemia, foot and mouth disease, hog and fowl cholera, Newcastle disease); no international quarantine station in strategic border areas
Extension	Household production and small plots and management are common; a number of small animals, extensive programs and feed crops are not used; many farmers are not interested in production; many animals are young	Inadequate extension service	Lack of sufficient, well-trained and skilled manpower as well as technical know-how	Socio-economic conditions, farmers to improve production of animals under village conditions
Marketing	No marketing support; lack of credit facilities	Lack of marketing infrastructure, lack of finance	Inefficient marketing system; inadequate credit facilities	No international markets, marketing channels and international trade
Infrastructure support		Lack of infrastructure support; poor grading and standardisation system		

Source: Country papers presented in the Global agenda for livestock research for the South-East Asian region, 10-13 May 1995 and in the conference on Development of livestock research priorities in Asia, 13-15 May 1997.

Table 3. Livestock research priorities in selected Southeast Asian Ministers of Education Organization (SEAMEO) member countries.

Country	Technology and adoption	Management system	Environment	Breeding	Policy and infrastructure support	Animal health	Information technology
Cambodia	Integrated farming systems Fodder tree production for smallholders		Environmental protection and sustainability			Cause of haemorrhagic septicemia outbreak in cattle and buffaloes' animal health	
Indonesia	Identification of superior local genotypes and composite breeds	Livestock production in different agro-ecological zones Methods of setting up priority areas	Environmental protection and sustainability			Animal health and diseases	Training and information exchange
Lao PDR	Forage improvement Genetic improvement Production systems	Livestock production in different agro-ecological zones			Private livestock production for smallholders	Animal health	
~~Malaysia~~	Genetic improvement Production systems		Environmental protection and sustainability			Animal health and diseases Feed resources and nutrition	Training and information exchange
Philippines	Genetic improvement Production systems Technology management Biotechnology	~~Management systems~~			Policy studies	Feed resources and nutrition	
Thailand	Biotechnology				Strengthening national research and development programme		Training and information exchange
Vietnam		Systems analysis			Policy studies	Animal health and diseases Feed resources and nutrition	Training and information exchange

Agro-industrial	Farm-based feeds	Technological inputs	Problems	
1. Subsystems *marketing -postharvest -transport *processing -feedmills -meat products -waste production -product standard *raw material/ inputs -breeding stock -veterinary product Cross-cutting concerns *food safety *research and development *policy (trade and market inefficiencies *sustainability	Feed grains Area for feed grain production	Biotechnology Advanced animal health Genetic improvement Advances in linkages, marketing, feed systems *Knowledge management intensive *Maximised resource use (land, labour, feeds) *Land debased (feed, industrial supply waste)	-Competing crop utilisation for food and feed -Deal with large importation livestock genetic material feeds -susceptible to market fluctuation -poses great environmental risk	
	Crops/cereals	*Basic animal health care (infectious diseases/parasites) *Feeds/concentrates Mixed farming systems	*Most common forms *User intensification opportunities -farm component (residues for roughage) -animal component (fertiliser, animal fibers) *For small and large ruminants	Imported inputs Feed utilisation and efficiency
	Grazing		*Production expansion is through increasing land and stock population *Based on native grassland *With little or no irrigation *Rarely has imported inputs, low caloric output/ha *Needs stronger institutional local empowerment and regulation	*Urbanisation and crop production moving into grazing areas *Limited scope for expansion (Lao, Indonesia, Philippines) *Land degradation *Less competitive diminishing return to labour *Low technology uptake

Land requirement

Figure 9. Agro-industrial concerns within the context of livestock farming systems.

How best these problems can be addressed are the expectations of this conference. What this paper has just provided are added options by which the problems can be approached.

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ASEAN¹ livestock trade and market policies: A regional perspective

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Overview

Planning for the livestock sector calls for two perspectives: one is looking inwards taking into account the dynamic forces confined within the sector itself; and the other looking outward, i.e. the environment which would direct, shape, and influence the very forces within the sector itself.

The first part of this paper presents the policy environment from the regional perspective of the Association of Southeast Asian Nations (ASEAN), highlighting the move towards regional economic integration that affects all sectors. This includes tariff reduction under the Common Effective Preferential Tariff-ASEAN Free Trade Area (CEPT-AFTA), initiatives in the elimination of non-tariff barriers, trade facilitation and cooperative efforts to promote trade. This would serve as part of the big picture in developing plans, including the identification of research areas and exploration of alternative developments strategies for the livestock sector.

The second part of the paper discusses the developments in the ASEAN Ministers of Agriculture and Forestry (AMAF) Technical Working Group on Halal, an ASEAN organisational sub-unit that initiated a regional programme for international trade dedicated to livestock as a component of the food sector.

The general trend since the ratification of the Uruguay Round of Negotiations and formation of the World Trade Organization has been to stimulate trade. This paper will not explore the effect of specific trade policy instruments such as the gradual lowering of tariffs, harmonisation of non-tariff barriers, and the formation of free trade zones. Suffice to say, these are developments that need to be monitored considering their significant trade effects on all sectors, their differential effects on input-producing industries, the livestock sector itself, and other sectors linked to the livestock sector such as the food industries.

The imperative of globalisation has encouraged a regional approach to policies that direct national trade policies. This has led to recent changes in national food and/or livestock policy, moving from a highly insular and protective policy towards market deregulation, reduced government spending, structural reforms and privatisation of services (H.

1. ASEAN stands for the Association of South-East Asian Nations

Steinfeld 1998). The devolution of authority in some countries allows further market deregulation on prices and better market access.

This is in consideration of its socio-political dimension, preponderance in the livelihoods of lower-income segments of the population and the contribution of small and medium enterprises. Hence, full liberalisation in terms of tariff reduction on meat allows for flexibility in ASEAN and would be last for the original six members set at 2010 and 2015, for new members.

This paper's presentation on tariff policy in the ASEAN divides the 10 members into two classes, the ASEAN-6, comprised of the original members of the group, and the CLMV (Cambodia, Laos PDR, Myanmar and Vietnam), composed of new members. The latter is described as transition economies, emerging from centrally-planned economies and are adjusting to the market-oriented global scenario.

National trade policies of member countries reflect differing developmental needs, with the ASEAN-6 leading newer members in their readiness to trade. Relative to first world countries, the livestock industries in the ASEAN are at a more incipient stage of development (USDA 1997).

The move towards regional integration

On December 15, 1997 the ASEAN adapted the so-called Vision 2020. The agreement embodies the desire of members to forge a stronger economic integration. This builds on strides made in cooperative efforts of the past and the commitment to enhance mutual assistance.

The ASEAN would sustain efforts on economic stability, poverty alleviation, trade and investment flows from the opening up of markets and liberalised trade. While committing itself under the influence of market forces, the vision puts emphasis on sustainable and equitable growth. Equity considerations are embodied in the commitment to narrow the gap in the level of development among member countries, ensuring that the multilateral trading system remains fair and open and the ASEAN, achieving global competitiveness.

An outward-looking ASEAN guides its participation in international fora to advance its collective interests, specifically with dialogue partners and other regional organisations. The promotion of a modern and competitive small and medium enterprises (SME) sector in ASEAN is explicitly stated in the vision. This would be relevant to the focus of development efforts in the region's livestock sector. The vision further specifies food security as an important endeavour, wherein ASEAN would be a leading producer.

Rather than backtrack as a result of the economic and financial crisis in 1997, ASEAN accelerated the integration process through a package of bold measures, issued the following year (ASEAN Secretariat 1998). This advances the implementation of AFTA by the year 2002 for ASEAN-6 that would cover products committed to the so-called Inclusion List (IL). These are products subject to tariff reduction at 0-5% by 2002 (Table 1).

Table 1. *Timetable for accelerating the ASEAN Free Trade Area (AFTA).*

Year	Commitment
2000	A minimum of 90% of the six countries' total tariff lines must have tariffs of 0-5%. Individually, each country would commit to achieve a minimum of 85% of the Inclusion List with tariffs of 0-5%.
2001	Each country would achieve a minimum of 90% of the Inclusion List in the 0-5% tariff range.
2002	100% of items in the Inclusion List would have tariffs of 0-5% but with some flexibility.

Source: ASEAN Secretariat (1998)

The first in the series of plans to implement Vision 2020 is the Hanoi Plan of Action (HPA). The plan has a six-year time frame covering 1999 to 2004. Broadly, it defines the collective path ASEAN would take to translate the vision into identifiable socio-economic goals. It is a comprehensive plan that includes macro-economic and financial co-operation, investment, and trade in services. The enhancement of greater economic integration would be achieved through the acceleration of the AFTA, customs harmonisation, standards and conformity assessment and other trade facilitation activities.

The enhancement of food security and competitiveness of ASEAN's food and agricultural products would be supported by the development of technologies to increase productivity, the promotion of intra- and extra-ASEAN trade and greater private sector investment. International issues and problems affecting trade in food and agriculture shall be addressed through joint approaches and enhancement of co-operation.

Trade policies in ASEAN

Tariff reduction

The lowering of tariff peaks and granting of margin of preferences preceded the move towards economic integration. The first substantial steps towards economic integration were made by the ASEAN leaders at their fourth Summit in 1992 held in Singapore. On January 28, 1992, the agreement establishing AFTA was signed that would spur intra-ASEAN trade, strengthen the region's competitive edge and attract foreign investments.

At the Sixth ASEAN Summit in December 1998 held in Hanoi, Vietnam, the completion of the AFTA implementation for the Inclusion List was targeted at 2002. ASEAN6 agreed to deepen as soon as possible, tariff reduction to 0% and accelerate the transfer of products to the Inclusion List.

The new members of ASEAN are given the flexibility in their commitment of products to IL to lower tariffs at 0-5%. This is by 2006 for Vietnam, 2008 for Laos and Myanmar, and 2010 for Cambodia. Currently, ASEAN has met its target on IL with 40,776 out of 44,046 tariff lines or 92.61%. Average tariff rate for the region is at 3.57% (ASEAN

Secretariat 1998). Exempted from the Common Efficient Preferential Tariff (CEPT)-AFTA are commodities in the General Exemption List. These are products that pose danger to animal, plant and/or human life, or by reasons of national security, protection of morals, protection of historic or artistic interests that imports of these products are subject to restrictions and are permanently excluded from CEPT. By 2010 for ASEAN-6 and 2015 for CLMV, ASEAN would fully implement CEPT-AFTA, removing tariffs for all products. This includes products temporarily excluded from the scheme, retaining protective tariff barriers at a definite period prior to the realisation of AFTA. This is called the Temporary Exclusion List (TEL), composed of two important categories: one is the manufactured and processed agricultural products and the other is the unprocessed agricultural products.

The protocol to Amend the Agreement on the CEPT-AFTA was signed in Bangkok on December 15, 1995. The amendment phased in unprocessed agricultural products (UAPs) for inclusion beginning 1997 in seven equal installments. Products transferred should be accompanied by a tariff reduction scheme with the following guidelines: a) after 1998, products transferred should have tariff below 20% then reduced at 0-5% by 2003; b) products transferred in 2003 should have tariffs at 0-5%. This expands the IL to include UAPs.

On September 30, 1999, ASEAN Leaders signed the Protocol On the Special Arrangement for Sensitive and Highly Sensitive Products. These are products protected by member countries from imports. Among others, the Protocol provides the time-frame and flexibility for member countries to phase-in sensitive commodities.

Most live animals are included in the IL. Thailand, Brunei, Singapore and Myanmar reported no sensitive products for livestock and poultry. In Annex 2 of the Protocol, Cambodia listed live poultry including ducks, geese, guinea fowls, poultry cuts, other live animals, meat products, and eggs as sensitive products. Malaysia included certain live animals, meat, eggs and poultry. The Philippines included live swine and poultry, fresh, chilled or frozen meat, and edible offal. Vietnam listed live poultry, ducks, geese, turkey guinea fowls, their meat and edible offal, eggs, sausages, meat of swine and bovine animals.

The same Protocol obliges ASEAN-6 members to phase-in sensitive products not later than January 2003 and shall be completed by January 1, 2010. Vietnam shall phase in sensitive products to the CEPT scheme beginning on January 1, 2004 but not later than January 01, 2006 and shall complete the process by January 1, 2010. Laos PDR begins on 2006 but not later than 2008 and must be complete by 2015, Cambodia begins in 2008 but not later than 2010 and complete the process by 2017. In November 2000, ASEAN Economic Ministers signed the Protocol providing flexibility to countries facing problems on their last tranche of TEL Products. This is also time-bound. By sector, the average tariff rates on live animals in 2002 is 3.57% (Table 2). This covers chapters 01-05 of the Harmonised System of Nomenclature of the World Customs Organization.

Intra-ASEAN trade in live animals (HS Chapter 01) as reported by the ASEAN Secretariat peaked in 1996 amounting to US\$ 273,049,000 and went down to US\$ 135,067,200 in 2000. Restrictive imports on meat products are reflected in lower trade, amounting to US\$ 60,543,000 in 1996 and down to US\$ 54,047,000 in 2000.

Table 2. Average tariff rate on imports of live animals in the ASEAN, 2002

Country	Average Tariff Rate (%)
ASEAN	3.50
Philippines	5.36
Malaysia	1.38
Indonesia	6.35
Thailand	8.41
Vietnam	4.29
Singapore	0.00
Brunei Darussalam	0.00
CLMV	Not available

Source: ASEAN Secretariat (1998).

Domestic consumption of poultry has grown faster than exports. However, barriers to feed stuff imports raise domestic production costs. In Thailand, the growth of the livestock sector resulted in the country becoming a net importer of corn where previously, it was a net exporter (USDA 1997 p. 2). In The Philippines, the implementation of the Agricultural and Fisheries Modernization Act (AFMA) is expected to stimulate growth in livestock and poultry. Recent growth trends in The Philippines are attributable to the reduction of tariff on feeder cattle from 10 to 3% (Medium-Term Development Plan 1999-2004).

Live horses, assess, sheep and goats are under the normal track in the CEPT for ASEAN-6 and tariffs are currently at 0-5%. Live swine, except for The Philippines, are also in the normal track. Imports of live pure bred swine for breeding purposes are imposed a lower tariff of 3% in The Philippines.

For newer members, collectively called CLMV countries, tariffs peak at 10%, but the trade is hindered by non-tariff barriers, mainly foreign exchange restrictions and state trading enterprises. Import tariff for chicks for breeding is at 3% in The Philippines under the 2001 CEPT Package. Import tariff by the ASEAN-6 range from 0-10% for live turkey, ducklings, geese and guinea fowls. The same rate applies for meat of bovine animals and beef. In Brunei, Indonesia and Singapore, imports of meat of fresh, chilled or frozen swine are imposed CEPT rates of 0-5%. The same type of meat in Myanmar and Vietnam is imposed a higher tariff of 10 and 20%, respectively.

Live swine is in the sensitive list of The Philippines and Malaysia, with the former imposing a tariff quota policy at 30% for in-quota imports within the minimum access volume and out quota at 45%. Similarly, Laos and Cambodia included live swine in the sensitive list and are permitted greater flexibility to transfer to the IL, the former at 2015 and the latter in 2017 as the final date of inclusion. In ASEAN-6, only The Philippines included live goats in the sensitive list of the 2001 CEPT Package along with Laos PDR. As a rule, meat is treated as a sensitive product by Malaysia and The Philippines.

Standards and conformity assessment

Non-tariff barriers are also being addressed to realise the vision of regional economic integration. In 1992, the ASEAN Consultative Committee on Standards and Quality (ACCSQ) was established. The fifth ASEAN Summit in Bangkok held in December 1997 mandated greater transparency in standards and conformance and the establishment of Mutual Recognition Arrangements. Some 20 industrial and consumer products widely traded in the ASEAN were identified for standards harmonisation under the auspices of ACCSQ.

In the Senior Officials Meeting of the ASEAN Ministers of Agriculture and Forestry (SOM-AMAF), parallel efforts were made to eliminate technical barriers to trade in agriculture, a painstaking process. This is in support of the Hanoi Plan of Action mandating stronger information networking on standards and technical regulation to meet WTO requirements on the application of sanitary and phytosanitary measures. In line with this, the 19th Meeting of AMAF held on 11–12 September 1997 in Bangkok emphasised the need for having common quality standards conforming to international standards, paving the way for global market access.

The criteria for some livestock have been endorsed. Quality standards for frozen chicken and other selected commodities will be established through dialogues, exchange of information especially in the sharing of R&D and market information. The adoption of the ASEAN Halal Guidelines on Food has been completed. To facilitate trade, AMAF entered into a Protocol on Sanitary and Phytosanitary Measures (SPM) to implement the Agreement on the Facilitation of Goods in Transit. Other endeavours include the formulation of the Criteria for Accreditation Scheme of Livestock and Livestock Product Establishments under the auspices of the ASEAN Working Group on Livestock, and the Protocol for Accreditation of Animal Vaccines and Testing Laboratories.

The protocol for accreditation of animal vaccines has made considerable progress with the endorsement of 38 animal vaccine standards. These standards were published in the Manual of ASEAN Standards for Animal Vaccines. The focus of activities includes further development of the Manual of Rules and Procedure for Registration of Animal Vaccines, ASEAN standards on these vaccines and accreditation of animal vaccine laboratories. The end result of standards conformity assessment would be global competitiveness, better market access, and more predictable and trade-friendly regime owing to the reduction of the complexity involved in technical and procedural requirements.

Customs harmonisation and strengthening

Trade liberalisation under AFTA is complemented by trade facilitation on customs matters. The ASEAN Vision 2020 mandates promotion of customs partnership for world class standards and excellence in efficiency, professionalism, service, and uniformity through harmonised procedures. Since 1995 the ASEAN Directors-General of Customs have met every year and programmed activities based on their plans and programmes embodied on the Customs Vision and the Customs Policy Implementation and Work Program (PIWP).

On March 1, 1997 the ASEAN Finance Ministers signed the Agreement on Customs. The technical elements of the plan of action to realise the ASEAN Customs Vision 2002 include:

- Simplification and harmonisation of procedures for goods in transit and temporary admission
- Automation to harness technology and assist in raising the efficiency of international trade and customs functions and activities
- Benchmarking of performance standards and the promotion of simple, user-friendly cargo processing
- Transparent and uniform application of the rules of origin
- Application of post-entry audits and development of ASEAN guidelines for post-audit system based on best practices
- Application of risk management techniques and check small percentage of consignments.

One important initiative that would facilitate information exchange, research on trade policy and consistency of statistical reports is the implementation of the ASEAN Harmonised Tariff Nomenclature, originally targeted for completion by year 2000 and reset for implementation in 2002. Over 10 thousand tariff lines at the HS-8 digit level have been aligned and shall be endorsed for signing by ASEAN Finance Ministers.

Another is the application of the GATT Valuation by the year 2000. This is to support the objective of the ASEAN Agreement on Customs to simplify and harmonise customs valuation methods. Under this policy, Customs Valuation is based on transaction value and shall not be used for protective purposes or as a barrier to trade. A common interpretation of the GATT Valuation Agreement shall be adopted to ensure consistent and unbiased application.

This involves a shift in paradigm from the traditional view of customs as a revenue source. Coupled with the reduction of tariffs in CEPT-AFTA, the transactions-based valuation system reorients customs towards trade facilitation. While the original and new members have acceded to the Customs Agreement, only five countries are implementing the GATT Valuation Method, i.e. Thailand, Philippines, Malaysia, Singapore and Indonesia (ASEAN Secretariat 1998).

Other developments include the establishment of the Green Lane for ASEAN products and elimination of customs surcharges.

Facilitation of goods in transit

The facilitation of goods in transit, while a customs function, is accorded a separate treatment since regulatory obstacles such as customs checks and documentation, transport regulation for drivers and vehicle specifications would be a daunting non-tariff barrier. Lack of uniformity and multiple requirements would not only slacken time of transport but would raise costs of trading.

During the 29th Ministerial Meeting in Jakarta on July 20-21, 1996, the ASEAN Foreign Ministers decided that efforts had to be undertaken to promote free movement of

goods in ASEAN. This is in keeping with the strides made in enhanced intra-ASEAN trade with the implementation of the CEPT-AFTA.

The Second Informal Summit held in Kuala Lumpur, Malaysia on December 1997 resulted in the exploration of measures to facilitate goods both in transit and interstate, covering land, maritime and air links. In December 1998, the ASEAN Economic Ministers signed the ASEAN Framework Agreement on Facilitation of Goods in Transit. To implement this Agreement, two protocols, one on Types and Quantity of Road Vehicles and the other on Technical Requirements of Vehicles have been finalised while nine protocols are nearing completion. ASEAN has also agreed to work for an integrated customs transit system operating on the principle of 'One seal, one deposit.'

Strengthening of food security and competitiveness of ASEAN's food, agriculture and forestry products

Earlier sections of this paper presented trade policies that affect all sectors. In the HPA, the plan for food is specified under paragraph 2.4 which reads as:

"ASEAN would strive to provide adequate levels of food supply and food accessibility within ASEAN during instances of food shortages to ensure food security and at the same time, enhance the competitiveness of its food, agriculture and forestry sectors through developing appropriate technologies to increase productivity and by promoting intra and extra-ASEAN trade and greater private sector investment in the food, agriculture and forestry sector."

The January 1999-July 2001 Mid-term Review of the Implementation of the HPA on the Food, Agriculture and Forestry sectors reported that cooperation programme and activities progressed under the guidance of the SOM-AMAF and the AMAF. Activities are co-ordinated by sectoral working groups and subsidiary bodies of the SOM-AMAF.

Food security arrangements

The Strategic Plan of Action On ASEAN Cooperation In Food Agriculture and Forestry, 1999-2004 addresses the need for more effective planning of food production and trade within ASEAN. The compilation, management, dissemination of statistical data and information has been assigned to a responsible working unit, i.e. the ASEAN Food Security Board. It is tasked to develop a common framework of analysis, and prepare reports on the analysis and review of food trade policies of ASEAN member countries.

A Regional Food Security Information System for ASEAN shall be established to plan and manage food supplies and utilisation as well as to provide information relevant to decision on investments and/or joint venture in food production in conducive areas. The strengthening of the food marketing system of agricultural cooperatives for enhancing food security is assigned to the ASEAN Sectoral Working Group on Agricultural Co-operatives.

Strategic alliances among agricultural co-operative organisations in ASEAN are being pursued in data and information exchange, beef farming, and co-operative productivity enhancement programme.

Enhancement of international competitiveness

The Sectoral Working Group on Livestock monitors the implementation of CEPT-AFTA. It is also the working unit assigned to develop an accreditation scheme for establishments involved in the production of livestock and livestock products that are widely traded within the ASEAN. Harmonisation of regulations for livestock products utilising biotechnology, and conducting a study to strengthen competitiveness of ASEAN food derived from livestock in international markets are undertaken by separate working group units. The implementation of ASEAN guidelines on halal food is under the aegis of the Working Group on Halal Food.

Enhancement of ASEAN co-operation and joint approaches in international and regional issues

A collective voice would carry more weight and would merit serious consideration in international fora than individual country positions. Consultations within the ASEAN structure, particularly at the level of ASEAN Economic Ministers (AEM) and Senior Economic Officials Meetings (SEOM) are regularly conducted to ensure better co-ordination of positions in dialogues with Australia, US and the EU. On Codex matters, a Task Force had been established to formulate common positions on issues in preparation for the WTO Meeting in Doha, Qatar. The ASEAN Secretariat convened a meeting of an *ad hoc* experts group on WTO issues. The ASEAN formulated a common stand on the WTO Agreement in Agriculture, proposed a broad-based agenda including anti-dumping, market access, giving effect to special and differential treatment (S&D) to developing countries, and more enhanced capability-building initiatives to assist the implementation of WTO Agreements.

Enhancement of private sector involvement

The private sector is given the opportunity for continuous participation in the meetings of appropriate bodies, such as the joint Committee on ASEAN Cooperation and Joint Approaches in Agriculture and Forest Products Promotion Scheme. Under the HPA, ASEAN would establish networking and strategic alliances with the private sector to promote investment and joint venture opportunities in the ASEAN. Thailand had established its website (www.cpd.go.th/accdac) for agricultural co-operatives to be shared with and linked to other countries. Indonesia took the lead and established a breeding and training centre that produces straws of frozen semen for trade exchange with other member countries.

Foster small and medium enterprises

The HPA recognises that small and medium enterprises (SME) constitute the majority and contribute significantly to economic development. The trade aspects of SME cooperation will ensure that there shall be no bias against SMEs in market-oriented policies in the ASEAN and such endeavours should provide a more favourable environment for development.

Emergency measures

Article 6 of the CEPT Agreement allows suspension of preferences if as a result of implementation of the Agreement, surges in imports cause or threaten to cause serious injury to the domestic industry of a member country. This is consistent with Article XIX of GATT 1994.

The foregoing trade policies are by no means, exhaustive. It must be understood that the policies presented form part of the total policy environment external to the livestock sector. Planning for the sector involves identification of critical policies that will chart its future requiring that appropriate issues are addressed and programmes pursued are consistent with challenges and opportunities in the ASEAN.

ASEAN cooperation on halal food

The ASEAN cooperation on halal food is one of the initiatives under the AMAF, through one of its subsidiary bodies, the Ad hoc Working Group on Halal Food Guidelines. The importance of halal food in the region and the enormity of the work to be done has been recognised in the ASEAN that at the SOM of the 22nd AMAF, the Ad-hoc Working Group on Halal Food Guidelines was upgraded to the level of a permanent body and renamed as the ASEAN Working Group on Halal Food.

Halal, which literally means permissible or lawful in the practice of the Muslim faith, is a large chunk of the global food market. It is now estimated at US\$ 150 billion, and consumed by about 1.3 billion people, the majority residing in the Asian countries of Indonesia, Bangladesh, Pakistan, Malaysia and India, as well as Turkey, Iran and Nigeria; and vast regions of the Middle East and North Africa. Almost one in four persons in the world is a halal consumer.

Within the corridors of the ASEAN, halal food presents a vast opportunity for trade in meat, poultry, dairy products and other food products permissible to Muslims. Rising incomes point to increasing consumption of food derived from livestock and poultry, with domestic consumption growing faster than exports. Most member countries are net importers of halal food. This poses a challenge of translating the HPA in the food sector in the area of standards and conformity assessments, food security, and international competitiveness, through joint approaches and co-operative programmes.

The guidelines were developed by the *Ad hoc* Working Group on Halal Food Guidelines, chaired by Brunei Darussalam. The decision to develop the guidelines was made at SOM of 17th Meeting of AMAF, which was held in Singapore on 21-23 August 1995. The Meeting agreed to form an *Ad hoc* Working Group comprising representatives from SOM-AMAF and relevant religious authorities of each ASEAN member country to prepare the guidelines for approval by SOM-AMAF. The *Ad hoc* Working Group finalised the Guidelines on its Third Meeting held in Bangkok on 24-26 November 1997. The proposed Guidelines were then approved by the Special SOM-AMAF, held on 27-29 April 1998 in Phuket, Thailand for consideration and endorsement of the 20th Meeting of AMAF on 17-18 September 1998 in Hanoi.

The halal food guidelines were based on and in line with the following documents:

- 1) The Council of Religious Ministers of Brunei Darussalam, Indonesia, Malaysia and Singapore (MABIMS) Guidelines for Preparation of Food and Drink for Muslims, which was prepared by a Technical Committee formed by MABIMS; and
- 2) Codex General Guidelines for Use of the Term 'Halal', an official document of Codex Alimentarius Commission.

The upgrading of the *Ad hoc* Working Group into the ASEAN Working Group on Halal Food expanded the scope of its work to include overseeing the implementation of the halal food guidelines, through cooperation projects in areas of certification, training, promotion and information exchange in halal food. The first meeting of the working group was held in Manila on 25-27 September 2001, where its terms of reference were presented as follows:

- 1) To conduct periodic reviews of the processing and marketing of Halal Food in the ASEAN region.
- 2) To develop effective methods of exchange of information among ASEAN Member Countries pertaining to Halal Food with the view to facilitating cooperative undertakings in this sector of the economy, as well as the eventual coordination and harmonisation of ASEAN Halal Food sector regulation and policies.
- 3) To identify areas of co-operation among the ASEAN Member Countries as well as with third countries, groups of countries or international agencies, in order to promote the sound development of the sector in the ASEAN region.
- 4) To formulate project proposals for consideration and approval by SOM and AMAF.
- 5) To monitor and evaluate the progress made in the implementation of approved projects and activities.
- 6) To submit to SOM-AMAF periodic reports on its programme of work and on the progress made.
- 7) To maintain close co-operation with other related ASEAN bodies as with related extra-ASEAN national and international organisations and meetings.

In the same meeting it was agreed that the HPA Mid-Term Review January 1999 to July 2001 shall include activities on halal food under Enhancement of the Marketability of ASEAN Food, Agriculture, and Forest Products. This is in recognition of the trade potential of halal food. The Working Group is developing an accreditation scheme for establishments aspiring for involvement in intra-ASEAN trade in halal food. Halal food marketing in conjunction with promoting tourism is yet to be explored, but it has been cited by the incumbent Tourism Secretary of The Philippines.

It is foreseen that the approval and eventual adoption of the accreditation scheme is forthcoming. However, its implementation may be delayed in the absence of an established competent authority for some of the member countries, namely The Philippines and the CLMV.

One initiative towards the harmonisation of conformance standards is the registration and compilation by the Working Group of halal additives being used in the ASEAN. Another is the formulation of guidelines and conditions on the use of the ASEAN halal logo and the mutual recognition of the logo to facilitate trade in the region.

To provide a greater understanding on the halal certification, the Islamic Religious Council of Singapore/Maglis Ugama Islam Singapore had conducted a training on March 2001 with participants from Brunei Darussalam, Cambodia, Indonesia, Malaysia and The Philippines. Singapore also conducted a Training of Trainers for Halal Food Inspectors. Training of Trainers on Halal Food Preparation and Handling was conducted by the Department of Islamic Development in Malaysia. The academe in Malaysia is active in developing new food products conforming to halal standards and processes. Indonesia is the lead country in the training of Halal Food Auditors and tasked to formulate a training module. Proposed new activities include the creation of an ASEAN Halal Food Website and development of an ASEAN Halal Portal for the purpose of harnessing technology in facilitating trade in halal goods and services, and halal certification. Considering that there are several international bodies on halal conformance, a proposal has been received on the establishment of an International Halal Council.

Guidelines on the preparation and handling of halal food

The Guidelines will serve as a practical guide for the food industry in the production and handling of halal food by food processing establishments. These establishments will be allowed to use a common ASEAN Halal Logo on the label of their products as an identification that the products come from ASEAN-accredited food processing plants.

Halal means compliance to sanitary/technical standards and in its broadest meaning does not only cover food. On top of the halal requirement to be 'clean', halal must comply with the Shariah Law.

Definition

Halal Food means food permitted under the Islamic Law and should fulfil the following conditions:

1. does not consist of or contain anything which is considered to be unlawful according to Islamic Law
2. has not been prepared, processed, transported or stored using any appliance or facility that was not free from anything unlawful according to Islamic Law; and
3. has not in the course of preparation, processing, transportation or storage been in direct contact with any food that fails to satisfy 1 and 2 above.
4. Halal food can be prepared, processed or stored in different sections or lines within the same premises where non-halal foods are produced, provided that necessary measures are taken to prevent any contact between halal and non-halal foods.
5. Halal food can be prepared, processed, transported or stored using facilities, which have been previously used for non-halal food provided that proper cleaning procedures, according to Islamic requirements, have been observed.

Criteria for use of the term 'halal'

The term halal may be used for food that are considered lawful. Under the Islamic Law, all sources of food are lawful except the following sources, including their products and derivatives which are considered unlawful:

1. Food of animal origin
 - a) Pigs and boars
 - b) Dogs, snakes and monkeys
 - c) Carnivorous animals with claws and fangs such as lions, tigers, bears and other similar animals
 - d) Birds of prey with claws such as eagles, vultures and other similar birds
 - e) Pests such as rats, centipedes, scorpions and other similar animals
 - f) Animals forbidden to be killed in Islam, i.e. ants, bees and woodpecker birds
 - g) Animals which are considered repulsive generally like lice, flies, maggots and other similar animals
 - h) Mules and domestic donkeys
 - i) All poisonous and hazardous aquatic animals
 - j) Any other animals not slaughtered according to Islamic Law.
 - k) Blood
2. Food of Plant Origin
Intoxicating and hazardous plants except where the toxin or hazard can be eliminated during processing.
3. Drink
 - a) Alcoholic drinks
 - b) All forms of intoxicating and hazardous drinks
4. Food Additives - all food additives derived from Items 1 and 2.

The basic principles of the Islamic laws remain definite and unaltered. However, their interpretation and application may change according to time, place and circumstances. Issues like biotechnology, unconventional sources of ingredients, synthetic materials, and modifications in animal slaughter and meat processing are some of the instances Muslim scholars and halal food regulators are dealing with in order to make sure that the food available to Muslim populations are indeed halal.

Proper slaughtering of animals

There are special requirements for slaughtering the animal:

1. An animal must be of a Halal species
2. It must be slaughtered by an adult, sane Muslim
3. The name of Allah must be pronounced at the time of slaughter
4. Slaughter must be done by cutting the throat in a manner that induces rapid and complete bleeding, resulting in the quickest death.

Islam places great emphasis on gentle and humane treatment of animals, especially before and during slaughter. Animal-derived food ingredients like emulsifiers and enzymes must be made from animals slaughtered by a Muslim to be halal. The requirements of

proper slaughtering and bleeding are applicable to land animals and birds. Fish and other creatures that live in water need not be ritually slaughtered.

Food processing equipment and proper sanitation

There are no restrictions about cooking in Islam, as long as the equipment and utensils are free from prohibited materials and ingredients. In the food industry, if the same equipment is used for halal and non-halal food products, it must be thoroughly cleaned and sanitised before using it for Halal products. Any visual or analytical method to assure proper sanitation may be employed. However, dedicated halal equipment are preferred to guarantee absolute freedom from unacceptable contaminants. Alcohol may not be used in cooking, formulating or processing halal food items.

Proposed ASEAN accreditation scheme

The scheme shall operate under the SOM-AMAF mechanism on two levels, the ASEAN level and the national level, with the working group as overseer. At the national level is a competent authority implementing systems and procedures in the issuance of halal certifications and awarding of the halal logo to the accredited establishment.

Accreditation procedures

Processing plants requesting accreditation shall direct their requests to the competent authority. The competent authority will then assign inspectors/accreditors to determine whether or not the plants meet the criteria for halal establishments. Report of the accreditors will then be evaluated by a committee. The competent authority will then decide to issue the certificate and approve the use of the ASEAN logo, only upon the recommendation of the committee. Laboratory samples will be collected as may be required. However, laboratory test alone cannot justify accreditation.

Records of the visit of the accreditors shall be kept by the competent authority, and all halal production, packaging, handling and storage procedures shall be documented. Regular follow-up shall be maintained to insure compliance to halal procedures. Auditors check practices in the plant and report non-compliance to both the management of the plants and the competent authorities. Auditor's reports shall be discussed in the Accreditation Committee for further action. A review on each plant will be done once a year, although it may be done on a regular basis by the Accreditation Committee, based upon the recommendation of the auditors. They will discuss the review report and the Competent Authority will decide on the action to be taken.

Criteria for accreditation of halal food establishments

In abattoirs, the following shall be observed:

1. Animal – only lawful animals are kept and slaughtered in the premise.

2. Slaughter-man must be knowledgeable and skilful in technique of slaughter, certified and authorised by the Competent Authority on Halal.
 3. Technique of slaughter - the technique is in accordance with the ASEAN General Guidelines on Preparing and Handling Halal Food.
 4. Supervisor - A supervisor is required if two or more slaughtermen are needed anytime. The supervisor identifies and tags non-halal products.
 5. Documents - the slaughterhouse should have halal assurance manuals.
 6. Officer responsible on Halal Programme - the plant appoints in writing an officer, preferably a Muslim, responsible to ensure that halal procedures are met.
 7. Hygiene and sanitation - The abattoir should meet hygienic and sanitary requirements of the Member Country and registered as export abattoir.
- The following shall be observed in the processing plants:
1. Material used - Raw materials such as beef, mutton and chicken shall come from slaughterhouse accredited under this Scheme. If the meat comes from a third country, then the meat should be from sources accredited as halal by at least one of the Member Countries. All other raw materials and ingredients used must be verified by the competent authority.
 2. Halal Assurance System - The plant should have an effective Halal Assurance System in place.
 3. Officer Responsible on Halal - The plant appoints in writing an officer in charge of the halal programme.
 4. Training on Halal - Training on halal should be given at all staff levels.
 5. Compliance to ASEAN Halal Guidelines - The plant should comply with the ASEAN Halal Guidelines on processing, packaging, and storage and accreditors verify its compliance.
 6. Hygiene and Sanitation - The plant should meet the hygiene and sanitary requirements of the Member Country and registered as an export establishment.

The guidelines and the accreditation scheme work in tandem with other conformance measures such as the Hazard Analysis and Critical Control Point (HACCP) and ISO. Success in this endeavour would be the key for ASEAN to compete in the global halal market.

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Linking smallholders to emerging markets for livestock products: Research and development opportunities

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Introduction

The Livestock Revolution presents new and expanding market opportunities for smallholder livestock producers. Delgado et al. (1999) projected that per capita consumption of meat and milk will increase by about 50% from 1993 to 2020, and that developing countries, where at least three-fourths of livestock production come from smallholder/backyard producers, will produce about 60% of all meat products and 53% of all milk products. Inappropriate policies and misallocation of investment resources could, however, skew the distributions of the benefits and opportunities away from the smallholders who would potentially gain the most from this revolution (Lapar et al. 2002.)

The increasing demand for livestock products in South-East Asia presents expanding market opportunities for livestock producers, particularly for smallholders. Although domestic markets have been liberalised and globalisation has further opened up international input and output markets, the terms upon which the poor enter markets are inequitable. Smallholders should be given the opportunity to have access to these markets, and at present, the ability of smallholders to access markets is a pressing development challenge. Although policies and institutions can promote market access, they may also hinder access to markets, if they are inappropriate.

Accessing the market

Market access plays an essential role in assuring better income and welfare for smallholder producers through various channels. By raising incomes, markets increase purchasing power which creates demand for consumer goods, and thus enhances welfare. In addition, by creating demand for production inputs and investment goods, markets promote economic growth. Markets also facilitate the accumulation of assets, provide the opportunity for improved nutrition and balanced diets, and therefore help alleviate poverty.

Although the merits attributable to markets are numerous, there exist various limiting factors. Foremost, market access is restricted by increased transaction costs created by poor

infrastructure (distance of the poor from markets), missing and/or inappropriate institutions, lack of skills and organisation, incomplete market information, the asymmetry of relations between large numbers of smallholder producers and a few buyers, the incidence of livestock diseases, as well as domestic policy distortions. In addition, the domestic policies of the Organization for Economic Cooperation and Development (OECD) act as barriers of entry in international markets. While developing countries have considerably reduced the barriers to agricultural trade in recent years, OECD member countries have made little effort to reduce or eliminate barriers to agricultural and agro-industrial trade. For example OECD farmers remain protected by subsidies amounting to US\$ 300 billion a year (World Bank 2000).

Escalating tariffs are also another means by which OECD countries protect their markets. These measures are making it difficult for developing country farmers to compete in OECD markets. Such adverse trade policies are accelerating the declining trend in world agricultural prices and are therefore limiting the export and growth potential of agriculture in the developing world by dampening incentives to improve agricultural productivity. In addition to the subsidies and tariffs of OECD countries, there are also a range of non-tariff barriers, particularly in regards to veterinary and human health standards for agricultural and especially livestock commodities, classified as sanitary and phyto-sanitary measures. Environmental standards are also poised to be imposed as another set of non-tariff barriers.

Protectionism in developing countries is not the solution either. Developing countries should continue to reform their domestic policies to be competitive in global markets. To achieve this they need to eliminate internal biases against agriculture, increase investment in health, promote improved agricultural technology for smallholder farmers, improve management of land and water resources, improve tenure security, and improve the organisational abilities of small farmers (Ehui 2001.)

Additional measures can be taken to facilitate access to markets for smallholders. Physical access to markets can be made easier by improving infrastructure such as constructing and maintaining roads, improving transportation, storage and information.

Other factors include:

- promoting the creation of institutions that increase the returns from markets and vertical integration (such as co-operatives and contract growing)
- supporting the development of livestock market intermediaries (for example networking livestock input dealers)
- removing policy distortions biased against small producers, such as subsidised credit provided to large producers
- eliminating the distorting policies of the OECD
- reducing risks born by smallholder producers, for instance by enhancing capital and asset building
- reducing disease incidence, and integrating disease reduction programmes with changes that provide an enabling environment for smallholders (such as ensuring access to credit in rural areas, improving regulatory frameworks and the dissemination of information, creating better linkages with high value outputs, and identifying a clearer role for the rural poor in livestock policy formulation)
- enhancing efficiency through improved human capital resources like skills and education and

- generally, by implementing policies and institutions (such as collective action programmes) that facilitate increased returns from market exchange.

ILRI research

The International Livestock Research Institute (ILRI) is engaged in undertaking studies that will contribute to increasing returns from investments in animal agriculture by smallholders, and will generate policies to improve the competitiveness of smallholder dairy systems.

One of the research outputs in this area is the study conducted to assess smallholder participation in Ethiopian dairy markets (Holloway et al. 2000). This research revealed that reducing the travel time to markets, investment in milk groups, as well as increasing asset and knowledge accumulation raises the level of marketable milk surplus. Specifically, owning a minimum of three crossbred cows, owning at least six local cows, reducing the distance to milk collection centres to 55 minutes, improving formal schooling, and increasing the number of extension visits to ten visits was found to affect market entry decisions.

A similar ILRI study conducted in The Philippines revealed that smallholder participation in livestock markets and sales increase with higher levels of animal stock, financial capital resources and lower levels of transaction costs (Lapar et al. 2002). In addition, 'neighbourhood effects' were observed to have an important impact on market participation (Lapar et al. 2001). However, the presence of alternative, more remunerative activities, be it production or employment, can potentially shift preference away from participation in livestock markets.

In conclusion, ILRI studies have revealed that smallholder market participation decisions are influenced by the policy and institutional environment as much as by other factors outside of this purview. Having observed the great potential for growth in production and consumption of livestock products (particularly in developing countries), policy makers will have to target the policy instruments affecting smallholder market participation, keeping in mind that alternative occupation opportunities significantly affect the effectiveness of social and economic prescriptions. Focus should also be given to measures that will ensure long-term smallholder competition in domestic and international markets. ILRI's past and ongoing work along this subject matter has brought to light some policy options that can be easily addressed to increase the participation of smallholders in emerging markets for livestock products. However, more work needs to be done to examine in much detail the important policy issues on smallholder market access.

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Markets, technologies and smallholder dairy: Partnerships for research-based development

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This paper outlines selected activities of the smallholder dairy research and development (R&D) programme of the consortium of the International Livestock Research Institute (ILRI) and its partners. Specific attention is given to activities in and for Asia. Examples are given to illustrate the programme's approach and its focus on poverty alleviation and indigenous marketing systems.

The dairy R&D programme on policies, institutions and technologies carried out by ILRI and its partners sets out to inform the actors developing dairy sub-sectors, and specifically the development of smallholder dairy as a means of poverty alleviation. In this context smallholder dairy includes not only those actual or potential dairy producers with little land and very scarce non-land resources, but also marginalised and landless families who are, or have the potential to be, dairy producers. Important primary clients for the research information and the related development efforts also include market agents and dairy processors, especially those serving the poor, whether producers or consumers. The research on policies, institutions (i.e., the way policies are implemented, or 'the rules of the games') and technologies and the related development activities examine how national dairy systems work and how they can be improved. The research addresses the question: 'Can smallholders, the marginalised and the landless compete?' (Staal 2002) and identifies and tests options in support of smallholder dairy development.

The R&D programme is driven by the so-called 'Dairy (or White) Revolution' (Delgado et al. 1999 and 2001). In response to rising human populations, urbanisation and increased purchasing power, the per capita consumption of dairy products in developing countries has increased over the last twenty years at a much faster rate than in developed countries and the increased demand is projected to continue (Table 1).

The increases are particularly marked in Asia and Africa where they represent important market opportunities for actual or potential smallholder dairy producers and for the employment of dairy market agents and processors. Nevertheless, even at the estimated high rates of increased consumption in 2020, the levels in China and South-East Asia will still only be a half of that in sub-Saharan Africa (SSA), which, in turn, is only approximately a third to a half of the levels of consumption in South Asia. These markedly lower rates of consumption of dairy products in East and South-East Asia reflect the regions' lack of a dairy tradition, in contrast to South Asia (India, for example) where

Table 1. *The Dairy Revolution: the growing demand for dairy products.*

Region	Kg per capita LME			% annual growth 1997 to 2020
	1983	1997	2020 (est.)	
Developed countries	195	194	203	0.4
Developing countries	35	43	61	2.7
Latin America	93	112	127	1.8
South Asia	46	62	78 (104) ¹	3.0 (3.2) ¹
Sub-Saharan Africa	32	30	37	3.3
South-East Asia	10	12	18	2.9
China	3	8	3.5	3.5

1. India

Source: Delgado et al. 1999 and 2001

dairy products have traditionally formed an important part of the diet of the majority. In East and Southeast Asia, therefore, the lack of a tradition both for dairy consumption and for dairy production makes it likely that the impacts of the "Dairy Revolution" on smallholder agriculture in the region and its contribution to poverty alleviation will be much less than in South Asia and Africa.

Against the background of the 'Dairy Revolution', and to ensure that the research of ILRI in collaboration with its partners is in line with the major challenges facing smallholder dairy development, India's National Dairy Development Board (NBBD) and ILRI hosted a South-South Workshop on 'Smallholder Dairy Production and Marketing – Constraints and Opportunities' in March, 2001. The Workshop, which was co-sponsored by the Australian Centre for International Agricultural Research (ACIAR), brought together smallholder dairy R&D specialists from eight Asian and seven sub-Saharan African countries to: identify the major R&D issues for the next 5–10 years; form partnerships to address the issues; identify the most appropriate approaches and methods to apply; and, explore more effective means for maintaining the exchange of information (Rangnekar and Thorpe 2002).

The countries representing the various regions of the South were: West and Central Africa – Cameroon, Ghana and Nigeria; Eastern and Southern Africa – Ethiopia, Kenya, Tanzania and Uganda; South Asia – Bangladesh, India, Nepal, Pakistan and Sri Lanka; and East and South East Asia – China, Thailand and Vietnam.

The sessions of 34 papers and plenary and group discussions, addressed six themes: regional and country overviews; international trade regulations; national dairy policies; market institutions; livestock services; and, the research and extension paradigm. From these papers and the resulting discussion, the workshop participants identified for follow-up four major R&D issues related to the development of smallholder dairying and its competitiveness:

- **South-South information exchange and networking.** The importance of continued cooperation on the sharing of information, experiences and research findings was stressed, with emphasis on networking among the countries of the South. ILRI offered to assist

in establishing a network through exploring opportunities with FAO. Specific areas of interest were: collective-action groups; participatory research and extension; milk marketing research; and policy research.

- **Championing the collective action (co-operative) approach.** NDDB agreed to play the lead role in information dissemination and supporting the development of farmer organisations.
- **Improving the understanding of WTO regulations and their implications for smallholder dairy development.** The Institute of Rural Management (IRMA), Anand, India, and NDDB offered to provide a forum for articulating the issues affecting smallholder dairy development in countries of the South.
- **Improving research and extension systems to serve smallholder dairying.** It was agreed that NDDB and IRMA would collate information from South Asia, while ILRI (subject to funding) would mount a parallel effort in sub-Saharan Africa.

In conclusion therefore, the discussions during the South-South Dairy Workshop and the agreement on major R&D issues demonstrated:

- the commonality of many of the issues related to smallholder dairy production and marketing in the countries of the South
- the richness of the experiences in the South applicable to the improvement of the livelihoods of the landless, the marginalised and smallholders through dairy
- the key role that market-orientation and participatory approaches play in fostering effective efforts in support of dairy development
- the large benefits, actual and potential, for exchanging experiences amongst the countries of the South
- the importance of taking advantage of the new generation of information technologies to ensure more effective exchange of information within the South and
- the willingness and enthusiasm of the participants to work together to plan the agreed actions and to mobilise the resources required for their implementation.

The proceedings of the workshop will be available in three formats: a book (Rangnekar and Thorpe 2002); a multi-layered CD with linkages to resource materials on the workshop themes and on the major R&D issues agreed by the participants; and, through the NDDB (www.nddb.org), ILRI (www.cgiar.org/ilri), ACIAR (www.aciar.gov.au) and related websites.

The conclusion of the South-South workshop participants that many of the issues related to smallholder dairy production and marketing are common to the countries of the South underpins a major on-going activity of ILRI and national, regional and international partners. The consortium of research partners is carrying out a trans-regional project covering sites in Latin America, sub-Saharan Africa and Asia (Figure 1).

The research studies crop-ruminant (principally dairy) livestock systems in order to understand and to predict the dynamics of the systems and to model and quantify the relationships amongst the factors and indicators of change at the farm and household levels. Through the research it is expected to better define demand domains for technologies (e.g. crossbred dairy cattle or planted fodders) and the factors that affect them, such as

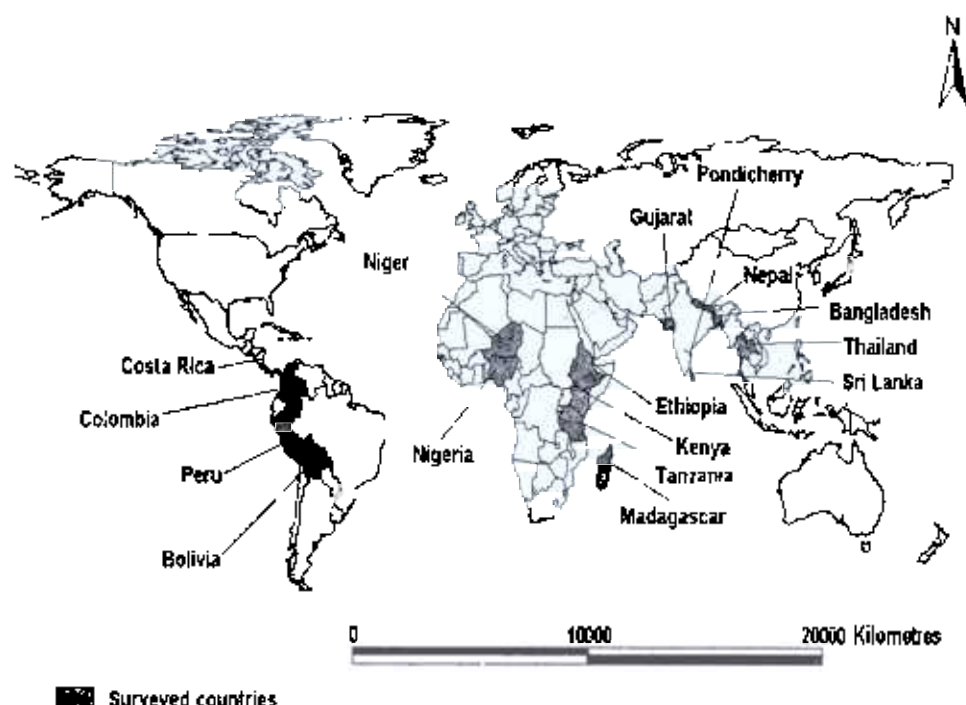


Figure 1. ILRI project sites for its research on crop-ruminant (dairy) livestock systems.

agro-ecology, level of market access, infrastructure (e.g. roads) and farmer resources. The research will inform policy makers, their advisers and planners of intervention possibilities and direct R&D efforts in support of smallholder dairy development.

The research is carried out through analyses at three levels of detail. The first is multi-country village rapid appraisals using a minimum set of indicators of crop-livestock systems. To date 48 appraisals have been carried out in 15 countries, which include Bangladesh, India, Nepal, Sri Lanka and Thailand. The second level of analysis is carried out at the landscape and farm/household level using geographic information systems (GIS) and household resource information derived from surveys carried out in Colombia, Nigeria, Kenya, India and Sri Lanka. And the final, third level of analysis is the detailed bio-economic modelling of producer households and their crop-livestock systems in Nigeria, Kenya, India and Sri Lanka.

As a first step in this process, Staal et al. (2002) have described results from the bio-economic analysis of the Kenya study sites which uses a data set of over 3000 randomly sampled households of which nearly 90% were farms and of those nearly two-thirds raised crops and kept cattle.

By combining the resources of many partners in the South to analyse and better understand the dynamics of crop-dairy systems, the consortium carrying out the trans-regional analyses is expecting to better advise on investment strategies in support of smallholder dairy development through the results of this ongoing research.

Underpinning these trans-regional activities is ILRI's conceptual framework for research to understand dairy systems and to support dairy development (Figure 2; Rey et al. 1993). The first step of the approach is the appraisal of a national dairy sub-sector (or of the dairy systems within a defined milk-shed). The broad-brush analysis critically assesses the policy, organisational and technological components and integration of the dairy sub-sector or milk-shed. By ensuring that the appraisal is carried out in an inter-disciplinary, multi-organisational way, it builds R&D partnerships that aim to transcend pre-conceived ideas of dairy development and to address dairy's potential for alleviating poverty. The 1999 appraisal of the Sri Lanka Dairy Sub-Sector is a good example of the approach (Ibrahim et al. 1999).

With the sub-sector appraisal as the guiding description, subsequent studies analyse the four sub-systems (Figure 2): consumption (showing the demand for milk and processed dairy products); marketing; processing; and production (showing how dairy producers respond to consumer demand for milk). Suggested methodologies for implementing these sub-system characterisations (Mullins et al. 1994; Jabbar et al. 1997; Rey et al. 1999) and recent examples of their application in East and West Africa are available through ILRI (e.g. Agyemang 2001; Staal et al. 2001). The sub-systems characterisations provide the information, the client-orientation and the partnerships required to seek solutions to address constraints and to explore opportunities, whether these are technological, political or organisational, through applying participatory approaches.

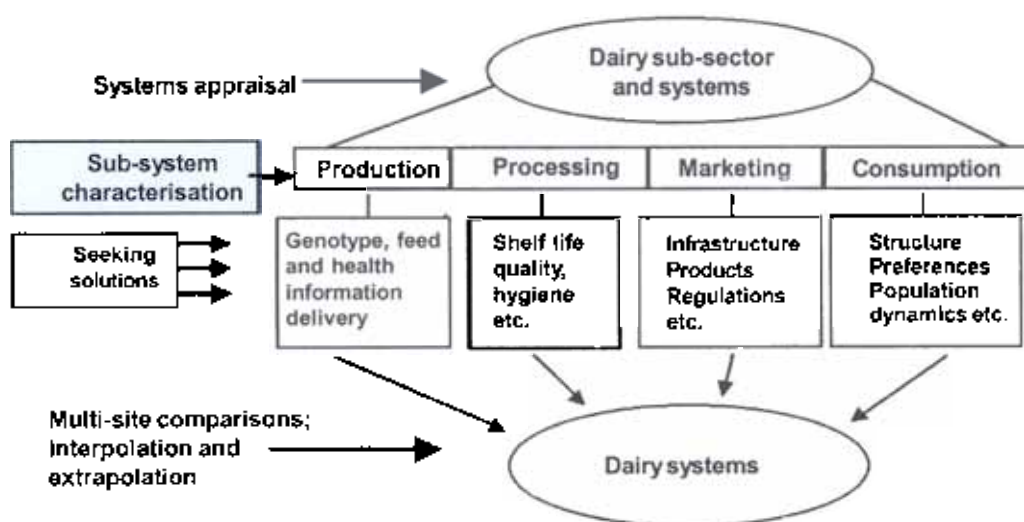


Figure 2. Building research and development (R&D) partnerships to understand dairy systems.

Outcomes of the inter-disciplinary, multi-organisational partnerships and the participatory approach include a better understanding of the market constraints facing actual and potential smallholder dairy producers. In many countries, particularly those with a dairy tradition, indigenous market systems are important. Table 2 shows the important role indigenous

dairy markets and processing play in Kenya, Bangladesh and Ghana where, for each 100 litres of milk handled daily, they provide approximately 2, 6 and 10 people with employment, respectively (Omore et al. 2002). The importance of indigenous markets is illustrated in Figure 3 which shows the estimated milk flows in India, said to be the world's largest producer of marketed milk. Approximately 85% of milk is marketed through indigenous market systems, and the rest through industrialised cold-chain, pasteurised milk marketing systems. In Pakistan and other Asian countries with a dairy tradition, indigenous marketing systems are equally or more important, challenging therefore prevalent mind-sets about the applicability of the industrial financial capital-based dairy development model, and showing the importance of labour-intensive production and marketing for dairy in many developing countries.

Table 2. Benefits from employment, employees per 100 litres of milk handled daily.

Where	Number directly employed	US\$/month	Milk supply	Main product
Kenya (mobile traders)	1.7	67	High	Liquid milk
Bangladesh (sweet makers)	5.6	21	Medium	Traditional sweets
Ghana (snack retailers)	10	21-30	Low	Milk snacks

Source: Omore et al. 2002.

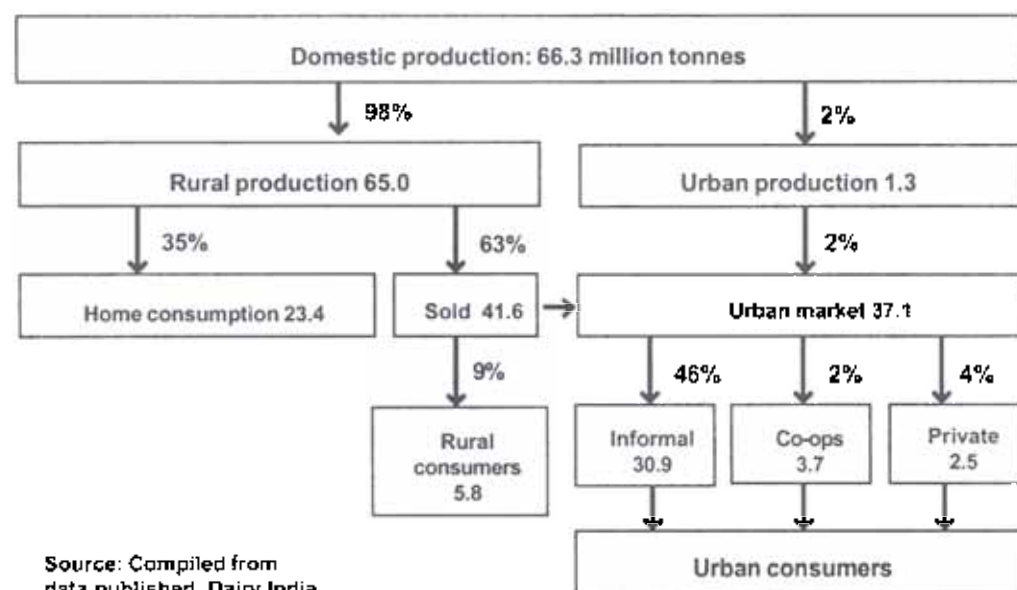


Figure 3. Estimated milk flows in India.

Clearly indicated therefore is the importance of having an objective, factually based understanding of current dairy production and marketing systems at the national and milkshed levels. Essential, for example, is a consideration of current laws and regulations affecting milk marketing and processing and a clear understanding of their manner of implementation (institutions or 'rules of the game') to ensure fair competition amongst small- and large-scale market agents and processors. Recent research by ILRI and its national partners in Kenya (Omore et al. 2001a) and in Ghana and Tanzania (Omore et al. 2001b) has highlighted inherent institutional barriers facing small-scale market agents and processors and the inhibiting effects on smallholder dairy production. In addition to biological studies, research on policies, regulations and institutions is required, in concert with systematic efforts to change mind-sets and 'the rules of the game' (Omore et al. 2001a, 2001b).

This brief review of selected dairy-related activities of ILRI and its partners has outlined the content of the research, its close links to dairy development policy and the methods and approaches used to implement the R&D programme in support of dairy as a means of poverty alleviation.

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Session V

Food safety and quality

Halal and cultural aspects of livestock production and marketing

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Introduction

The increasing awareness of two billion Muslims all over the world on their obligation to consume only halal food creates an excellent potential and lucrative market for food manufacturers and livestock producers. It is estimated that the average global halal food trade is around US\$ 100 billion per year. Fortunately, with the current progress of science and technology in communication, information technology, transportation and food processing, Muslims worldwide have better access to halal food.

The cultural aspect of livestock production and marketing is very wide and subjective. It encompasses many factors including religion, customs and tradition, beliefs and taboo, food habits etc. Cultural food practices vary widely, even within a nation where the people are multiracial and multi-religious. For example, in India cattle is regarded as sacred by the Hindus and they are not reared for food, while in the USA cattle are reared for beef production for human consumption. In other customary scenes in many countries of Asia like Malaysia and Indonesia, meat is served as special meals at weddings and on festive occasions. But to the Muslims, wherever they are, at whatever occasion, it is only halal food that they will choose to eat.

Why and what is halal food?

The lives of Muslims are guided by Islamic or Shariah Law. They are required to consume only halal food and avoid food which are non-halal or *haram* or food which contains *najis*. Halal is a Quranic term which means 'allowed' or 'lawful'. Halal activities are obligatory to every Muslim. *Haram* means 'prohibited' or 'unlawful' and all *haram* activities are forbidden to every Muslim. *Mushbooh* (Syubhah) means 'suspected'. If one does not know the halal or non-halal status of a particular food or drink, such a food or drink is doubtful or '*mushbooh*' and should be avoided. *Najis* are things that are themselves not permissible such as pork and all its derivatives, alcoholic drinks, halal food that is contaminated with things that are not permissible and halal food that comes into direct contact with things that are not permissible.

Halal food shall fulfill the following conditions:

1. Neither does it consist of, nor contain, any part or matter of an animal that a Muslim is prohibited to consume or that has not been slaughtered in accordance with Shariah Law
2. Does not contain anything which is considered to be impure according to Shariah Law
3. Has not been prepared, processed or manufactured using any instrument not free from anything impure according to Shariah Law, and
4. Has not been, in the course of preparation, processing or storage in contact with or in close proximity to any food that fails to satisfy 1, 2 or 3 above or anything that is considered to be impure according to Shariah Law.

Halal food production

The halal food chain begins at the farm level and continues to the abattoir and the factory for processing before they are distributed to the consumers locally or shipped out to foreign markets (Figure 1).

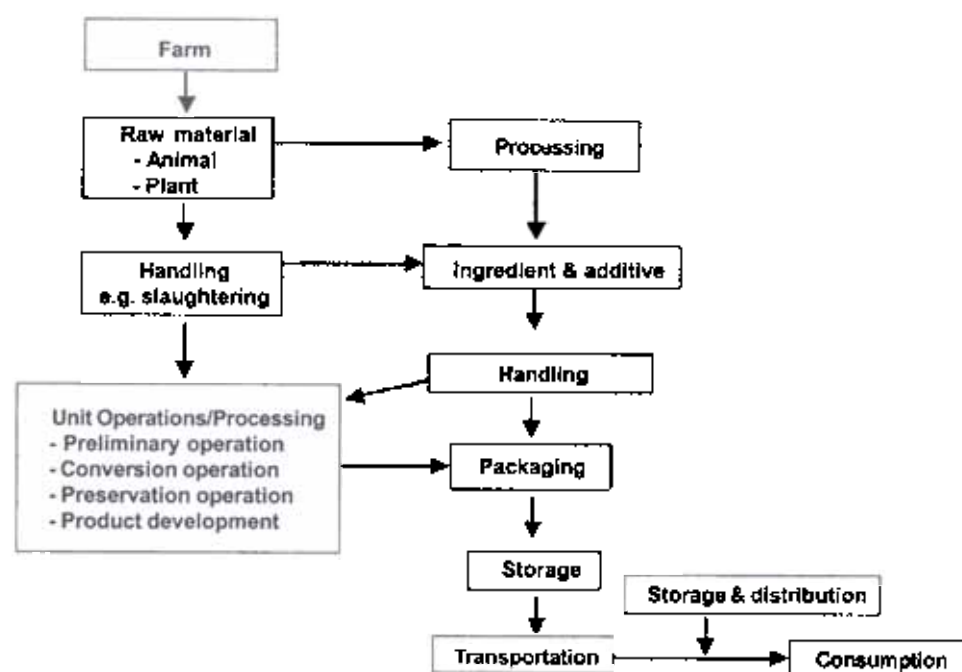


Figure 1. The halal food chain (halal – from farm to plates).

Halal food production activities include sourcing and handling of halal raw materials, unit operations during processing, packaging, storage and transportation of halal products. Since Malaysia imported about 70% of raw materials (animal or plant origin) for the food industry, the government monitors closely on the import to ensure that they are certified

halal by accredited national religious authority recognised by Malaysia. As for raw material handling, be it manual or mechanical, the equipment and utensils used must not be in contact with any *haram* food or materials. All halal establishments should not operate non-halal work to avoid mandatory cleansing.

Abattoir and halal slaughter

The slaughtering of halal animals should be completely separated from non-halal animals according to the following regulations:

1. Slaughtering performed by a Muslim who is conversant with the rules and conditions of slaughter in Islam
2. Animals to be slaughtered are halal as food
3. Animals are alive
4. The slaughter act – the trachea, esophagus, main arteries and veins of the neck region are severed
5. The phrase 'Bismillah' is invoked immediately before slaughtering
6. Slaughtering tools and utensils – dedicated for slaughter of halal animals only and
7. Slaughtering tool must be sharp and should not be lifted off the animal's neck during slaughtering act.

Besides ritualistic processes, halal slaughter at the abattoir emphasises hygiene and sanitation. The objective is to ensure that the meat produced is hygienic and is not hazardous to health, which forms part of the halal requirement. The product shall be processed and packed under strict hygienic conditions in accordance with good manufacturing practices (GMP) and the public health legislations in Malaysia.

All halal meat products that are stored, displayed, sold or served should be categorised, and should be labeled halal and segregated at every stage, so as to prevent them from being mixed or contaminated with things that are non-halal. Halal meat products shall be suitably packaged where its packaging material is halal in nature according to Shariah Law.

Halal food market

The global halal food market stands at about US\$100 billion per year opening a huge market and greater opportunity for halal food business. The current trend in consumer demand for halal food is expected to continue in parallel with the increasing Muslim population all over the world. The current world Muslim population is estimated at 2 billion people and projected to be 2.5 billion in 2005 (growth rate of 6% per year). There are approximately 250 million Muslims in ASEAN countries alone.

In Malaysia, the demand for halal foods comes from the Muslim population of 14 million in 2000. Malaysians spent Malaysian ringgit (RM; US\$ 1 = RM 3.8) 21.7 billion on food in 2000, which is approximately RM 2.2 billion per year (assuming 10% consumption) on processed and manufactured meat-based products. In the same year, Malaysia imported a total of RM 1.848 billion and exported RM 1.004 billion worth of livestock and livestock products. The statistics on import of processed and prepared (non-swine) meat-based prod-

ucts from 1995 to 2000, indicated that Malaysia imported over RM30 million worth of products per year before 1998, and the total import of non-swine products ranged from 60–75% of total import. However, the demand can be underestimated taking into consideration the non-Muslims who also consume halal foods.

Halal certification

Halal food certification refers to examination of processes in its preparation, slaughtering, cleaning, processing, handling, storage, transportation and management practices of halal food. Certification bodies should be able to provide a form of control on halal food production in the exporting country and therefore should be reliable, efficient, trustworthy and acceptable to the industry and the governments of both importing and exporting countries.

A halal certificate or a halal logo labeled on meat products gives assurance to Muslim consumers that a particular product has been thoroughly investigated and found to conform to Shariah Law and suitable for consumption. In the case of countries exporting halal food to Malaysia, halal certificates issued by the competent authorities recognised and endorsed by JAKIM (Department of Islamic Development Malaysia) are acceptable. Recognised certifying bodies are based on the track record, competency and capability to control halal production in the plant. The application process for halal certification is outlined in Figure 2.

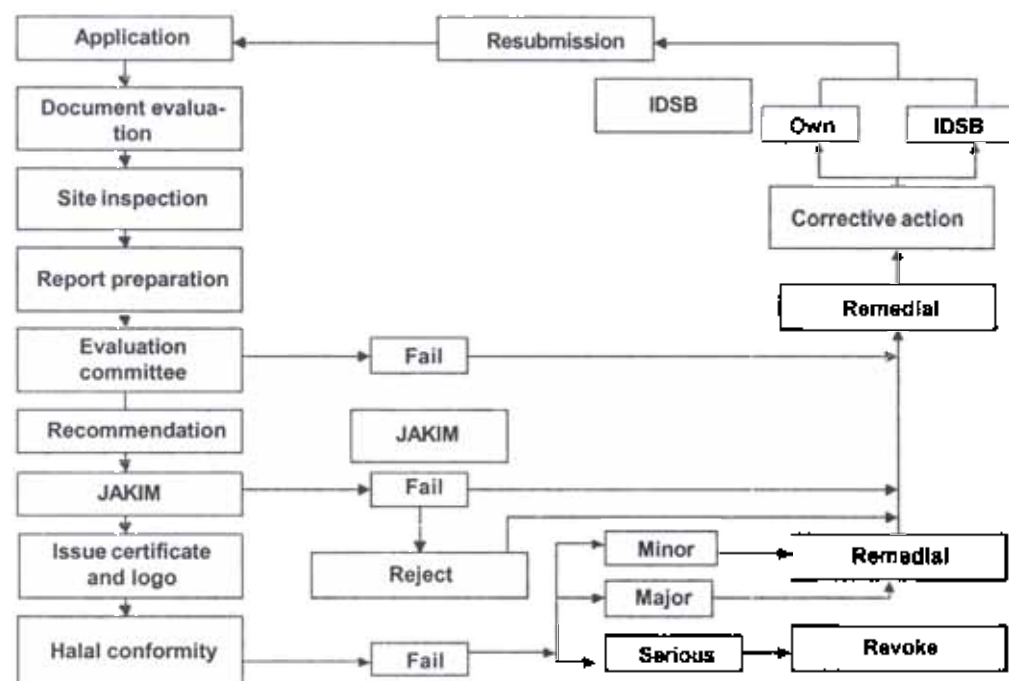


Figure 2. Guidelines in application for halal certification (e.g. IDSB)

In the course of processing an application, risk analysis is conducted on any country wishing to export meat and meat products to Malaysia. This is done through information gathered by means of questionnaires on sanitary, veterinary and public health control. Next, inspection of the meat plant would be arranged. Plant inspection focuses on the slaughtermen, the slaughter technique, the separation between halal from non-halal products throughout the plant and the commitment of the plant management. Upon fulfilling the requirements, an establishment number or the halal certificate is awarded to the plant and the halal logo is required to be labeled on their products.

In response to the need for more halal food, halal certification agencies are found in almost every country in the world which participate in international trade. In Malaysia, the certification agency is Ilham Daya Sdn. Bhd. (IDSB).

National, regional and international initiatives with regard to halal food

The Codex Alimentarius Commission, in short 'Codex', is an inter-governmental body established in 1962 by Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO), to implement the Joint FAO/WHO Food Standards Program. Codex is a collection of internationally adopted food standards presented in a uniform manner. The objectives of Codex are to protect the health of consumers, to ensure fair practices in food trade and to co-ordinate all food standards work.

With the formation of the World Trade Organization (WTO) in 1995, its Sanitary and Phytosanitary System (SPS) and Technical Barriers to Trade (TBT) agreements recognised Codex standards as reference or benchmark on food safety for protecting human health and life, and in resolving trade disputes between member countries. This recognition definitely affects all halal food traded at the international level as exporters and importers who market them are obliged to comply to Codex standards. In this context, there is currently a 'Codex general guidelines for use of the term halal' which was adopted in 1997. This guideline provides basic and general information on how food could be produced and claimed as halal. It is hoped that Codex will develop more halal standards addressed specifically to food additives, methods and analysis and the halal logo.

At the regional level, the Association of South-East Asian Nations (ASEAN) has taken steps to harmonise regulations on halal food trade and in 1999, endorsed the ASEAN halal Logo. Besides the above initiative, ASEAN agreed to eliminate all barriers to trade among its members through the formation of ASEAN Free Trade Area (AFTA) in 1992. AFTA aims to facilitate trade in the region, which definitely will give positive impact and better competition in halal food market.

A proposal to establish an international halal food hub in Malaysia had been raised several years ago. Ideally, the hub should be a one-stop shop or marketing centre for global halal food trade or business consultation. It should be an international forum for harmonising halal standards and regulations in food inspection, certification, logo, methods and analysis, research and development (R&D) and last but not least, the information centre on halal food and networking for interested parties. In promoting national

halal food production, the Department of Standards Malaysia has produced the 'general guidelines on the production, preparation, handling and storage of halal food' in 2000.

Conclusion

Halal food is a sensitive and serious matter to every Muslim. The halal food market estimated at US\$100 billion is lucrative and offers a great opportunity and profit for food manufacturers and livestock producers. The widening effect of WTO and globalisation will erode the national barriers of food entry but definitely will create a competitive global market for better quality halal food products for the more knowledgeable Muslim consumers.

Development of an animal traceability system for the APHCA¹ countries

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In our previous discussions, we have mentioned the loss and cost of animal diseases not only to human life but also to the economies of concerned countries. The threat of diseases to human health and economic losses of disease outbreaks have resulted from foot and mouth disease (FMD), bovine spongiform encephalopathy (BSE), the Nipah virus in Malaysia and other emerging viral diseases, the *Escherichia coli* O:157 in the US, swine fever and rinderpest.

We have also heard about globalisation of trade and industrialisation of food processing and its impact on the increased movement of animals and animal products. We have millions of animals and meat and meat products that are shipped every year. This has resulted in an increased risk of spread of diseases and loss of consumer confidence because consumers perceive that there are insufficient controls in the chain. In order to gain this consumer confidence, it is imperative that there is control and transparency in the production chain from the stable to the table. Traceability is therefore considered one of the bases of any modern food safety system and of the Hazard Analysis and Critical Control Point (HACCP) system. Identification and traceability including movement controls are also an important issue in epidemiological surveillance and in the intervention of Organisation Internationale des Epizooties (OIE) and the Food and Agriculture Organization of the United Nations (FAO) to eradicate diseases. It is also imperative that diseases be traced and animals that get sick and spread diseases be identified for eventual contingency planning.

We have heard about the impact of the World Trade Organization-Sanitary and Phytosanitary Agreement (WTO-SPS) on international trade. WTO-SPS is concerned about the application of food safety and animal and plant health measures in international trade but the underlying objective of WTO-SPS is to ensure that quarantine and health requirements are not used as unjustified health barriers. This is aimed at protecting its own market against imports. While traceability is not specifically cited, it may be a requirement established by the importing country or it can be shown by exporting countries as one of the means to comply with the required quality standards.

1. APHCA stands for Animal Production and Health Commission for Asia. Its member countries are Australia, Bangladesh, Bhutan, India, Indonesia, Iran, Laos PDR, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, The Philippines, Sri Lanka and Thailand.

An identification and traceability system is not only about animal health and trade. In production, it is also a basis for animal performance recording, breeding and genetics. It is also an important part of farm management decisions and livestock statistics that will lead to policy decisions. In developed countries, this is used as a basis for payment of subsidies. Only when countries adhere to an identification and traceability system that subsidies are paid.

All these lead to a call for an integrated approach. We should look at identification and traceability systems as beneficial to all partners. It is beneficial to the production chain and to the veterinary system. It is also an important part of trade.

A study on the trace back systems used in Asia shows that there are only four countries in the region which could be identified as countries that have a system in place (Table 1). The system allows a trace back of animals from the abattoir to the origin.

Table 1. Trace back systems used in Asia (modified from Y. Otaura, B.H. Long and S.J. An).

Country	Marking method	Certificate issued by	Trace back from abattoir
Australia	Ear tags, tail tags	Authorised person	Yes
Japan	Ear tags, micro chips	Authorised vet	Yes
Laos	ID cards	District officer	Yes
Myanmar	-	Township or district officer	Yes
Bhutan	-	District officer	No
Iran			No
Malaysia	Ear tags, tattoos	District officer	No
Nepal	Ear tags, tattoos	District officer	No
Sri Lanka	-	Quarantine station	No
Thailand	Ear tags, hot brand, ID cards	Area vet office	No
		Quarantine station	
		District officer	No
Vietnam	-	District officer	No

Australia and Japan are two developed countries with a trace back system. From the developing countries, we have Laos and Myanmar whose system uses ID cards to follow the animals as they leave the farm from the village to the slaughterhouse. While the other countries do use a marking system for their animals, they report that they do not have a trace back system in place.

Summing up the situation in Asia, we find that most of the countries in Asia do not have a trace back or appropriate identification system in place. On the other hand, countries which have a system in place may be considered as non-systematic. In some the system is campaign-based, e.g. a vaccination campaign using ear tags on the animals. In other countries we have several systems in place which are not compatible. There are three systems: one is a system established by the artificial insemination (AI) service, another by the breeding service, and the third by the vet service. Perhaps, a fourth system is provided by a developed country that gives specific assistance for a development programme. There are also identification systems which are on paper or client-based.

In all these identification systems, there is very limited information or no records at all about births, death, slaughter or movements. Veterinary records are almost nil.

From the Asian scene, I would like to draw on the European experience. Europe is considered as a big regional market that has now become a single market. It has started with Council directive 92/102/EEC which regulates the identification and registration of all animals. It has established two systems to control animal movements in the EU. One is ANIMO (animal movement) and the other is a system that assists the health control of imports of items of veterinarian concern at frontier inspection post from third countries (SHIFT) and that was introduced in 1990 with major shortcomings. In effect these systems do not work because they are stand-alone and have no national or international interface and do not provide for individual animal identification. If somebody buys animals in a market in Germany, the veterinarian issues a cohort certificate which is then sent by fax or email to the frontier post and then to the veterinary office in the recipient region.

The establishment of the above mentioned systems was followed by the Council Regulation 820/97 that also regulated the identification and registration of animals. This was also a failure because in Europe there is a wide variety of national systems – the British system, Irish, German, Dutch, French – where international standards were not always applied and different formats had been used. There was no consideration for international data exchange, i.e. multilingual functionality.

The next project was EUROVET which developed standards but no further progress was made. Europe then decided to wait for the French IDEA project. This project involves about one million animals in six countries and looks at the application of electronic ID devices for identification and traceability. Once this project is completed, there will be a rethinking about the possibility of a standard European system for identification and registration and traceability.

From all these, what are the lessons learned? These may be stated as:

1. Harmonisation of standards and procedures is imperative. It would be ideal if we could use global standards that could allow global trade and global comparison.
2. Integrated approach is necessary in combining production, veterinary health, and processing activities.
3. Asian countries are at the beginning of the process. They have the opportunity to do things right, learning from previous mistakes made by others. This is considered as an appropriate time to start.

Identification and traceability system in the APHCA countries

In the September 2001 meeting of the Animal Production and Health Commission for Asia (APHCA) in the Philippines, the APHCA member countries recognised the need for a harmonised system of animal identification and traceability for the Asian countries and requested FAO to develop country-driven process standards and guidelines for an identification and traceability system.

How did FAO respond to this need of our partner countries? While we approached it from a regional perspective, we feel very strongly that this should be country-driven. Individual countries should take the responsibility of developing the standards and guidelines. We will draw on the experience of the EU experts by learning from their mistakes. Since this is of global importance, we feel that we should get the OIE and the International Committee for Animal Recording (ICAR). ICAR develops standards for animal recording and identification. And from what we have heard today in the presentations, we feel it is important to involve regional bodies like APHCA, the Association of South-East Asian Nations (ASEAN) and other regional organisations.

Our initial plans are to develop an FAO-TCP to develop standards and guidelines, up to the point of slaughter. At the moment, limited funding does not allow us to go beyond that but we feel that if we could develop standards and guidelines up to the point of slaughter, we feel we have done a great step forward.

The first step to do in the project is an inventory and analysis of existing systems in the countries. Then identification codes for animals and holdings for countries, and perhaps animal passports, will be developed. Further, we will have to think about the harmonisation of standards and codes for events, births, deaths, movements, different breeds, diseases, and production parameters.

It would be of key importance that the system has multilingual capability to make it usable by all the countries in the region. In this project, we also have to define all the various procedures, functions, and information flow. There is also a need to determine the modalities and procedures for inter-linked databases using the worldwide web.

How do we implement the project? We have 15 countries in APHCA and we have an enormous number of animals. Our approach will be to start documentation with the active sector – those who are in the commercial, trade, breeding, AI, and other services and linking this to other livestock sectors. I think it is illusory to say that in such a short time, one can cover the entire number of animals in the region.

The type of identification will definitely depend on the type of production and species, the individual level being preferred. Some species will be at the cohort level, homogenous group, and herd level. The main conditions for identification is that it must be unique, temper proof, permanent, not harmful to the animals, and should be easy to apply and read. The key issue is that the animal and the holding or herd should be identified.

The identification methods used likewise depend on the production system. They should not only be acceptable to the livestock owners but the costs should also be considered.

Tattoos, ear notches, ear tags, tail tags, collars (neck, legs), and cold and hot brands may be acceptable in some areas and not in others. Computer technology such as microchips in implants, ear tags and rumen boluses is promising but the costs of these devices are relatively high. Certain groups have looked at DNA analysis but it should be limited to very specific issues.

A major problem would be definitely the attribution and distribution of these identification numbers. How do we give these numbers to the farmers and how do we keep control? This is a particular consideration that should be given to the many smallholders in Asia.

A computer-aided identification system is therefore necessary (Figure 1). In this system, animal movements are recorded and information is moved from one database to another. While there is a question on how to link these databases, there are unlimited possibilities that this system offers. This is the way it could happen in the future but in the end, it would still be the countries involved who, in consultation with one another, would decide what would be the most appropriate system for them.

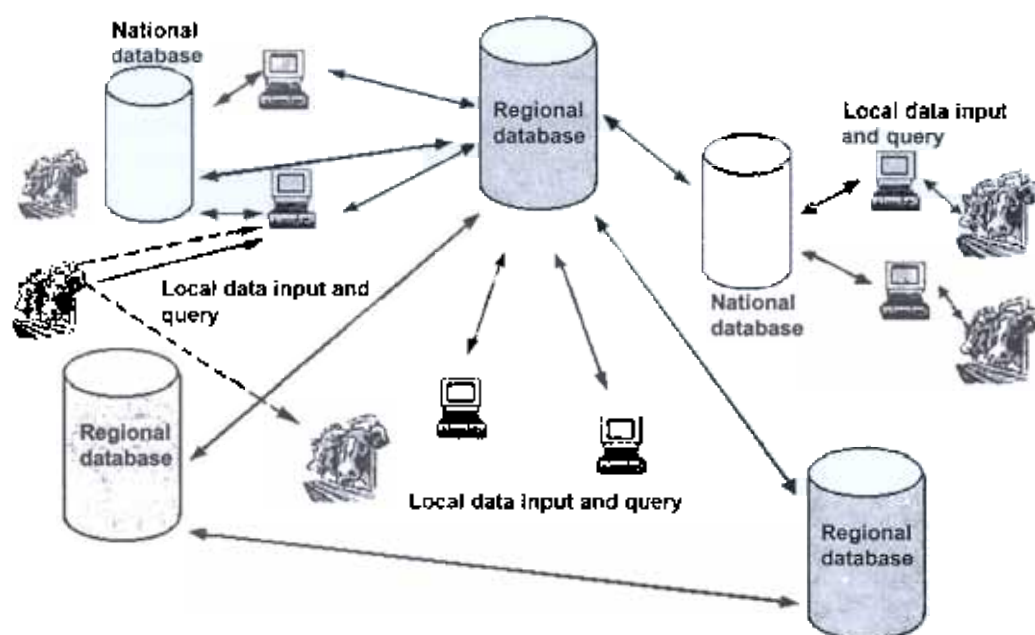


Figure 1. Flow of information in a computer-assisted identification system.

Major problems that would have to be taken into consideration when we talk about this computer-assisted identification system are:

- number of animals in the region
- structure of the livestock sector ranging from small scale to industrial
- information flow, maintenance and integrity of the system
- costs and distribution of tags
- cost for the maintenance of the system (the maintenance cost in UK and the cost of the tag only in New Zealand equals US\$ 10 per cattle/year whereas in Europe it equals 5 Euros).

In conclusion, I would like to stress that traceability will be a non-negotiable part of food safety and in trade of livestock and their products in the future. Traceability and animal identification are important in the control of epizootic and enzootic diseases. Finally, livestock improvement programmes will only function if they are based on sound animal identification systems.

HACCP and meat production in Thailand

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The Hazard Analysis and Critical Control Point (HACCP) System is a system which identifies, evaluates and controls hazards which are significant for food safety. It is a world-recognised, science-based, systematic and preventive approach that addresses biological, chemical and physical hazards through anticipation and prevention, rather than through end-product inspection and testing. HACCP is recommended wherever possible to enhance food safety.

The HACCP system can be applied throughout the food chain from the primary producer to the consumer. It emphasises control of the process in the processing system by utilising operator control and/or continuous monitoring techniques at critical control points to prevent food safety problems. Besides enhancing food safety, other benefits of applying HACCP include more effective use of resources, savings to the food industry and more timely response to food safety problems. In addition, the application of the HACCP system can result in more focused risk management by food control regulatory authorities and can promote international trade by increasing buyer confidence in food safety. HACCP is specific to each specific food. Any HACCP system should be capable of accommodating change, such as advances in equipment design, changes in processing procedures or technological developments.

Thailand is an agricultural country that can produce animals particularly poultry and pigs not only for domestic consumption but also for export. The country exports poultry meat and poultry meat products to many countries in Asia, Europe and Africa. Its export volume in 2001 was about 590 thousand metric tonnes. Thailand ranks in the top five of the world poultry meat exporter. With respect to pork, the export volume of fresh and cooked pork to Asian countries in 2001 was about 12 thousand metric tonnes. The major constraint affecting pork export is the foot and mouth disease, which still exists in Thailand.

The Department of Livestock Development (DLD) is Thailand's regulatory agency responsible for meat production including control and inspection of meat and meat products for export. The role of the DLD in the meat production industry is to promote the production of safe and good quality products for human consumption which is also beneficial in enhancing international trade. As the HACCP approach is internationally recognised as being effective in ensuring the safety and suitability of food for human consumption and international trade, the DLD therefore has introduced HACCP to the Thai meat industry.

In assisting the meat industry to apply HACCP in their processing, the DLD has provided since 1995 an annual national budget for conducting training courses on good manufacturing practices (GMP) and HACCP for DLD officials and personnel of the meat industry. GMPs

are incorporated in the training module, as they are the foundation of the HACCP plan. Inadequate programmes of GMPs may lead to additional critical control points that would have to be identified, monitored and maintained under the HACCP plan.

During 1995–1999, the training courses were conducted several times each year. After this period, trainings were conducted once annually. When the revised version of the Recommended International Code of Practice-General Principles of Food Hygiene which incorporates the HACCP system and guidelines for its application was adopted during the 22nd session of the Codex Alimentarius Commission, held in June 1997, the DLD has recommended that the meat industry follow these guidelines.

At the early stage of developing the HACCP plan, the DLD asked its officials who control and inspect the operations of each plant to give advice to the HACCP team at the plant. During that time the application of the HACCP system in the processing plants was still voluntary. However, in 2000, the DLD required the meat plants who produce products for export to apply the HACCP system in their processing activities. The HACCP plan of these meat plants will be approved by the DLD committee and the DLD officials at the plant will monitor the HACCP implementation in the plant according to the DLD guidelines for monitoring HACCP to assure that the HACCP implementation is effective.

Of the 89 meat plants (slaughterhouses and meat product processing plants) producing products for export, 80% have already implemented HACCP in their processing. The rest must do so by March 2003, the deadline imposed by the DLD. Results of the HACCP application show that *Salmonella* contamination in the poultry slaughterhouses is significantly reduced.

Additionally, the DLD has also introduced HACCP to the animal feed industry to ensure that the feed produced is safe for animals, which assures pre-harvest food safety for human consumption. Since 1999, the DLD has conducted several training courses on GMPs and HACCP for DLD officials and personnel of the animal feed industry. The course content is specific for feed manufacturing.

Meanwhile there are 360 animal feed plants in Thailand (103 feedmills, 64 premix manufacturing plants, 14 supplement feed manufacturing plants and 179 raw materials for feed plants). Five feedmills which also produce feed for export have implemented the HACCP. At this moment, the application of HACCP in the animal feed industry is voluntary except for those that produce for export. The DLD officials responsible for feed quality control will audit the effectiveness of HACCP implementation of animal feed plants.

With respect to animal farms, the DLD employs an accreditation system for farms, particularly those that produce animals slaughtered for export. The criteria for accreditation is based on good farming practices. The accredited farm must have a veterinarian who passes the DLD training course and receives license from the DLD to look after animals. Each year the DLD also provides training courses on good farming practices for farmers. In the near future the DLD will introduce the HACCP system in animal farms.

An effective food safety programme must be based on strong risk analysis principles and on the concept of 'prevention' using the principles of HACCP. The concept of risk analysis and HACCP should be incorporated from the beginning to the end of the food chain – from farm to table. The industry, the government regulators and the consumer must

understand their individual roles in ensuring an effective food safety programme. The responsibility of having a safe food supply depends on everyone —no single individual or group can meet this responsibility alone. Therefore, all segments must work together to identify hazards and assess potential risk, develop science and technology for interventions, and communicate appropriately between industry, government regulators and consumers.

Use of extenders in meat processing

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Introduction

The severe shortage of protein of high biological value in the developing countries and the trend in Europe or the United States to consume less meat and meat products has created a great interest in the possibility to produce protein rich food from plant and other protein sources. Also, considering the limiting factors in world meat production, e.g. availability of adequate feed, the conditions for keeping animals and the environmental factors etc. the use of extenders in meat processing is getting more and more important.

Non-meat components in meat processing

Use of non-meat components in meat processing is very common. In most countries, one can find at the corresponding governmental offices a list of additives tolerated in meat processing. In addition, one can find which of these additives have to be declared on the label attached to the product and which can be used without declaration.

Additives are used for the following reasons:

1. to improve the quality of the emulsion
2. to increase the water holding capacity of meat
3. to develop taste
4. to decrease the loss during cooking
5. to improve the development and maintain the colour of the product, and
6. to decrease production loss.

There are three groups of non-meat additives used in meat processing (Figure 1). In the first group, only one additive, water or ice, is mentioned here. This increases the weight or volume, but has no effect on the nutritive value of the final product. Using water in large quantities in the production of sausages became possible with the use of more sophisticated equipment for processing, like cutter, colloid mills etc. Water is added in many different meat products especially in scalded sausages like Frankfurter, Bologna and others. Its use develops the characteristics of the corresponding product and also increases the quality, like tenderness and juiciness. The percentage of water added varies from 15 to 30%.

The second group of meat extender is composed of crop products. They stabilise the processed product. While they have a relatively high content of carbohydrates, they have a low protein content. These products are flours from wheat, corn, rice or the starch ex-

tracted from these flours or starch from potatoes and cassava. These highly absorb water but they do not have any emulsifying effect. The use of starch is very common in meat processing because it decreases the production costs and increases the amount of water added, which promises a higher income for the producer. These kinds of extenders are mainly used in the different kinds of scalded sausages. The amount added should be between 2 to 5%. A higher percentage creates a hard and dry product and affects the taste.

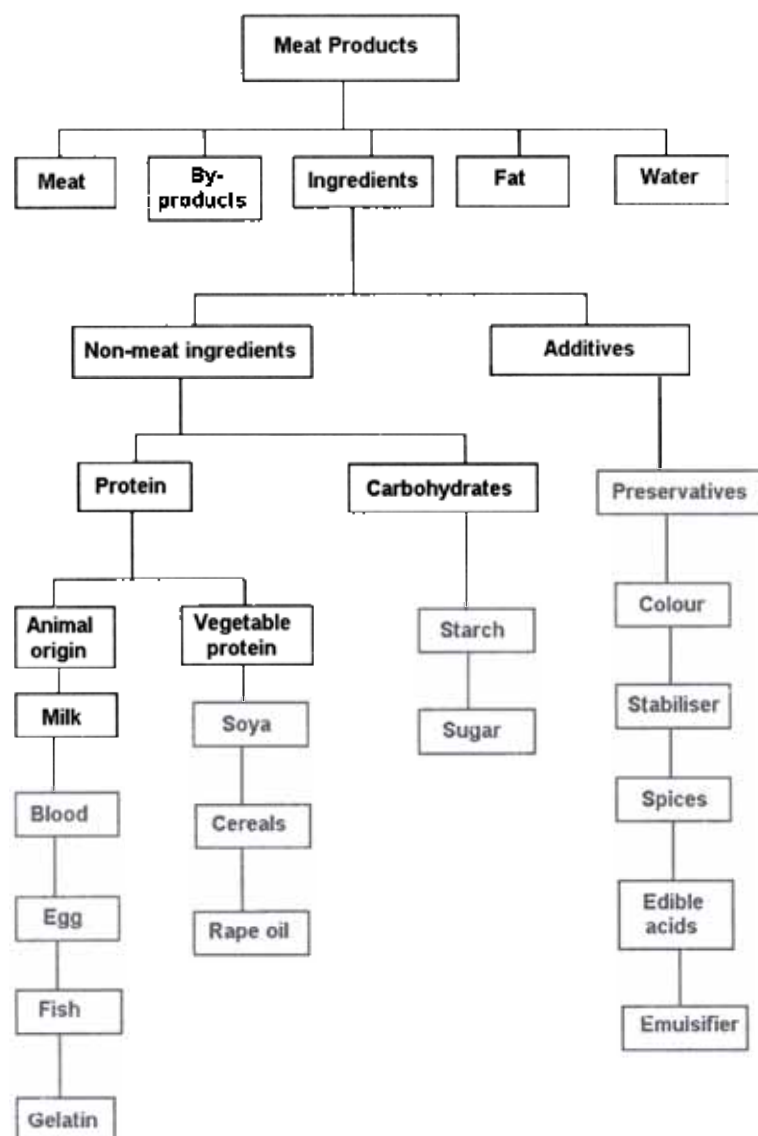


Figure 1. Ingredients used in meat processing.

In the third group are ingredients that come from animal or vegetable sources. They contain high amounts of protein. Among the vegetable proteins which have been exploited in this way are:

1. Soya flour with a protein content of 40–60 %. Its strong smell or taste influences the flavour of the product considerably.
2. Soya concentrate with a protein content of 70% is added more frequently to meat products because it creates only a light variation of taste.
3. The isolated soya protein which is around 90% protein is taste-neutral and has excellent emulsifying abilities in binding water and fat. The use of this soya product is very common in meat and food processing. Sausages like Frankfurter or Mortadella and many other products have been made only with isolated soya.

Soya undergoes a thermoplastic change when used in an extruder. The entire soya, or sometimes defatted soya, is fed into a hollow barrel of an extruder, where a tempered screw forces it under high pressure and temperature, towards a narrow orifice into the exterior. Under this condition, starch component gelatins and proteins partially denature. The prefabricated products combined with other food components, colouring, and flavour can be made up as simulated meat, like meat steaks and other products, which are in the market already.

The extruded soya may have a protein content as high as 30%. A 4% replacement of the meat protein in Frankfurter sausage with that of soya has been found to reduce the cost of the final product by about 30%. Other protein sources are the gluten of wheat, globulins of groundnut, cottonseed, sesame and yeast, and proteins separated from rape.

Non-meat ingredients from animal sources

Besides the non-meat ingredients with vegetable origin, different kinds of proteins also come from animal sources. These are:

1. Lacto products like fresh milk cream, milk powder in its different forms, sodium caseinate and whey powder. These products are used as emulsifier and for water binding.
2. Liquid and dry blood plasma contain about 60–70% protein and due to their very good emulsifying effect, they are used in meat processing. In general 3.5 kg meat could be substituted with 1 kg dried plasma.
3. The entire egg or the white of the egg also is used to replace meat in some products, especially in emulsions and pate.
4. Drinde is a dehydrated meat protein from beef and pork skin and bones. The main abilities are swelling and waterbinding as well as cohesion and fat binding. The protein content depends on the raw material used, and ranges between 80 and 85%.
5. Gelatin from beef and pork bones is mainly used as binding and gelling agent.

In countries like Vietnam, fish is sometimes abundant and this is also used as an alternative to substitute a part of the meat during processing. In recipes of scalded sausages, fish can substitute 10 to 15% of beef or pork meat. Depending on the price of fish, and in times when fish are very cheap, production cost could be reduced up to 15%.

Besides replacing meat in the elaboration of meat products by other ingredients, the use of extenders also has an economic effect. All the above mentioned products are, in most countries, cheaper than meat. The incorporation of extenders makes the products cheaper and therefore more attractive for the consumer. Also it is possible to provide high-quality protein to people with low incomes.

The effect of extenders in lowering the production costs of Frankfurter with different formulations is shown in Table 1.

Table 1. Cost of production and chemical analysis of extenders in Frankfurters.

Item	Content (%)			
	Control	Trial 1	Trial 2	Trial 3
Frankfurter material				
Pork	60	53	50	46
Fat	20	20	20	20
Water/ice	20	23	25.5	29
Skim milk powder			1	1
Starch		1.5	1.5	1.5
Isolated soya		1.5	2	2.5
Total	100	100	100	100
Cost US\$/kg ¹	1.3	1.18	1.05	0.93
Chemical analysis (rounded values)				
Water	52	56	57	58
Protein	21	21	21	21
Fat	24	22	21	20
Others	1	1	1	
Total	100	100	100	100

1. Cost based on prices in Vietnam

Meat processing in Vietnam

In Vietnam, the meat consumption per person per year is around 22 kg with an increasing trend. In addition, each person consumes 14 kg of fish every year.

Like the tradition in other Asian countries, Vietnam processes meat for preparing dishes mostly by cutting it in small pieces for cooking. However, consumption of meat products is not very common. There are only a few traditional meat products in the market like:

1. Pork pile, which is an emulsion out of pork meat and fat and spices. In the original recipe no water or any other ingredients are added.
2. A kind of aspic made out of meat and skin from the pork head.
3. Chinese sausage, a mixture of pork meat and fat and spice and without any other additive. For preparation and maturing, the sausage is dried for a certain period of time at a temperature of 40 to 50°C.

4. Nem, a fermented pork meat, where a high quality lean meat is required.
5. Different kinds of dried beef and pork meat.

Of the meat products mentioned above only pork pile and aspic use non-meat ingredients, mostly starch and flour of cereals. The others do not use extenders because these would considerably change the characteristics of the product.

Therefore for Vietnam and maybe for other Asian countries as well, use of non-meat ingredients with a high protein level in soups, stews and mixed food should be promoted because these dishes are well accepted and widely consumed. Some soya products like tofu are already available.

In general one can say that in Vietnam, the meat extenders mainly used are starch, soya concentrate and flour from different kinds of cereals. These are designed to make the product cheaper and also to increase the income of the producer. The use of meat substitutes in meat products as a protein source is not very common yet.

There are many other materials added to meat and meat products like meat tenderisers, colorants, antioxidants, stabilisers, antiseptic ingredients and so on. Some of these additives are sold both legally and illegally. Others may have negative effects on the consumer. The control of food by the corresponding institutions should be taken more seriously and more frequently.

The western style of different scalded sausages like frankfurter, bologna and other meat products like raw and cooked ham, bacon, salami, hamburgers etc. shows an increasing demand. This is happening especially in the urban areas where people with higher income and a larger number of expatriates are residing. This increasing consumption certainly will continue because quite a number of national and international companies are opening up processing plants in Vietnam. With the availability of these products in the market and the advertisement campaigns of the corresponding companies, the demand and consumption will respond.

With the continuing growth of the world population and its consequent food requirement, use of non-meat ingredients containing high protein in meat processing will be a factor worthy of serious consideration.

Meat commodity diversification and upgrading of meat processing technologies in the Asia-Pacific: A Common Fund for Commodities (CFC) project

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Introduction

Meat is a food commodity readily accepted in high demand in most Asian and Pacific countries. A forecast for global meat consumption in the year 2020 demonstrates the rapidly increasing share of developing countries wherein its share rose from 47% in 1998 to 63% in 2020.

The Asia-Pacific region contributes 61% of the world population, a huge consumer market for meat. The economic growth in the countries of the region over the past two decades resulted in improvement in food consumption patterns, which in turn triggered increased and improved production of livestock products for food.

There are characteristic variations in consumption of livestock products among Asia-Pacific countries. Figures show however, that the average growth rates for meat consumption are much higher than milk. The higher meat intake has contributed to the improvement of dietary patterns of consumers in Asia and the Pacific. Per capita daily calorie intake increased from 2321 to 2534 kcal from the 1970s to the 1990s per the Food And Agriculture Organization of the United Nations (FAO) Food Balance Sheet. The total annual meat consumption in Asia-Pacific was 29 kg per capita by the mid-1990s. This is lower than the world average of 33 kg/head, but it is much higher than those in the Near East and Africa.

Countries in the Asia-Pacific region have experienced staggering increases in meat production with an annual growth rate of 9.2% (1987-97), unparalleled by any other developing region in the world. The current annual meat output from Asia-Pacific is 91 million tonnes, 83 million of which come from developing countries of the region and represents 41% of the global meat production.

Constraints to meat industry development

Despite the encouraging figures, the livestock sector in developing countries of Asia-Pacific as in most other developing regions, is subject to deficiencies, some of which are the following:

- low productive and reproductive performance of animals
- prevalence of livestock diseases and parasites
- high cost of feed and management for improved breeds
- inefficient livestock marketing, resulting in low returns particularly to smallholder farms
- imports of cheap, subsidised meat which are cheaper than local meat that results in losses for local meat producers and a disincentive for local livestock producers
- limited, if any, access to microcredit facilities for small-scale meat processors and equipment producers
- limited number of local, small-scale equipment fabricators
- substantial losses from weight loss and death during transport of animals to slaughter plants, and
- unhygienic methods of processing meat.

The meat sectors of countries of the Asia-Pacific region are in varying stages of development. The least developed countries (LDCs) still use the traditional methods of slaughtering, meat cutting and further processing of meat that are generally unhygienic and sell these in wet markets. There is also a lack of trained personnel in all fields in the meat sector. Waste management facilities for meat plants, like abattoirs are also inadequate and results in environmental problems.

Measures required to deal with identified problems

There is quite a number of interventions that can be instituted to address the problems of the industry. First is the promotion of private entrepreneurship in the meat sector. This can be done through the institution of appropriate government policies and measures that encourage private capital and talent into the industry.

Second is the capacitation of government-controlled bodies and veterinary authorities to enable them to enforce existing sanitary regulations, as entrepreneurs tend to consider sanitation second to their business interest. It will be a welcome development if government authorities will succeed in encouraging private enterprises to upgrade meat plants in the region. Some countries are in the process of addressing this concern. Others will have to do likewise if they are to be competitive in a globalised market regime.

Third is the transfer of expertise and technology which has to be instituted by the meat industry itself with support from international and bilateral technical assistance programmes given the fact that governments have limited capacity to undertake this. In this context, product development and improvement programmes and training of personnel will play a major role.

Lastly, there has to be compliance with environmental standards. This will require the co-operation of both the public and private sectors and the introduction of simple technologies applicable under the conditions of developing countries. Related to this is the importance of complying with the World Trade Organization's (WTO) Sanitary and Phytosanitary Standards (SPS) agreement pertaining to meat products. Importing countries, particularly developed ones in EU, US, Japan etc. are quite strict in the observance of these standards. This is the major constraint faced by developing countries in penetrating these lucrative markets. Likewise, countries particularly in Europe will not import meat products from countries where animal welfare particularly among slaughter animals is not observed.

The project

In its 17th Session in November 1998 at Cape Town, South Africa, the Intergovernmental Group on Meat (IGM) which is the relevant International Commodity Body designated by the Common Fund For Commodities (CFC) decided to sponsor a project on development and promotion of value-added meat products in Asia and Pacific Island countries with CFC for possible co-financing.

A project proposal was forwarded to CFC on April 1999, and in October 2000, the CFC Executive Board approved the proposal for funding, with the new project title, 'Meat commodity diversification and upgrading of meat processing technologies in Asia-Pacific'.

This is a three-year project executed by the FAO-AGAP (Animal Production Services) for technical inputs, and the FAO-RAP (Regional Office for Asia Pacific) for the operational aspects.

The project is located at the Animal Products Development Center (APDC) of the Department of Agriculture in Manila, Philippines. The APDC was established in 1992 through the assistance of the FAO and the United Nations Development Programme (UNDP). APDC's mission is to support the growth of the meat and slaughter by-products industry through training, development and extension of appropriate technology, leading to improved methods of handling, processing, and utilisation of animal products and by-products. It has been operating as a government-owned training and development centre on meat technology in the country, with small- to medium-sized slaughtering for large animals and hogs, cutting, and further processing of meat. Complementing these, are competent research and training staff and training/dormitory facilities.

The project addresses the problem of imbalance between supply and demand of meat products in Asia-Pacific that leads to imports of products from developed countries, to the detriment of local development. The project focuses likewise on dissemination and commercialisation of existing and new technologies taking into account the specific requirements of the different countries in the region. The project also includes production of low-cost and shelf-stable meat products to optimise use of the resources in meat processing and value addition.

Particular efforts will be made under the project to address the specific needs of least developed countries. Satellite centres representing three different characteristics of the meat sector, are proposed to be established in Bangladesh, where restriction of certain meat types due to the socio-cultural situations exists; Myanmar, where utilisation and

production of all types of meat are being undertaken; and Samoa, where meat supply partly depends on imports, which is typical for the South Pacific.

Project costs

The estimated total project cost is US\$ 2,332,679 covering all project components including project management, monitoring and evaluation. The financing of the project is based on the sharing of resources from the stakeholders like CFC, FAO, GTZ/CIM and the governments of The Philippines, Bangladesh and Myanmar. The CFC will provide an estimated support of US\$ 931,095 in the form of grant and loan, while FAO and GTZ/CIM will put up counterpart funds of US\$ 379,000 and US\$ 100,000, respectively. The share of the Government of The Philippines is valued at US\$ 872,584 covering cost of existing infrastructures, facilities and some of the operating expenses that will be involved in project implementation. On the other hand, the governments of Bangladesh and Myanmar will contribute US\$ 15,000 and 20,000, respectively.

Objectives

The project aims to make better use of meat resources in Asia-Pacific and to facilitate and strengthen production, marketing and trade through appropriate means of handling towards value adding of meat and product diversification. Its specific objectives are as follows:

- 1) to modify existing and develop new meat products suitable to Asian/Pacific markets
- 2) to provide technical solutions for small-to medium-sized meat processors in meat equipment and environmental sectors
- 3) to capacitate meat processors in commercialising meat products and processing equipment
- 4) to train meat industry personnel on issues as stated in 1 and 2 above and
- 5) to promote technologies on the meat products and equipment developed.

Outputs

With the above objectives, the outputs to be achieved are the following:

- 1) new product formulations and improved quality of meat products, i.e. low cost for low income population groups and shelf-stable for handling without cold chain
- 2) technically simple, functional and economical abattoir and meat processing equipment for local fabrication and low-input waste treatment facility
- 3) regional meat training and development network composed of a main centre and three satellite centres
- 4) significant number of meat industry personnel trained
- 5) extent of promotional activities conducted to disseminate information and
- 6) different schemes for commercialising the technologies developed.

Project components

The following are the components of the project:

1. Establishment of meat training and development network. A meat training and development network will be established, composed of a Regional Meat Training and Development Centre, which will support three Satellite Centres.

The Regional Meat Training Centre would be the APDC in Valenzuela City, Philippines, where most of the essential facilities for slaughtering and meat processing and other auxiliary facilities required to manage a regional training centre already exist. Moreover, specialised staff reside in the centre and can be tapped to conduct the development work and training. The regional centre will be responsible for training mid-level technical personnel from the satellite centres that will serve as trainers there. The three satellite centres will be organised in three strategically located areas, namely Bangladesh, Myanmar and Samoa. These centres will make use of existing structures with the option of constructing small units, if necessary. These centres will work at developing a limited number of meat products that will cater to the local needs as well as train and advise local meat industry personnel or potential small-scale entrepreneurs in direct support. These trainees will also serve as catalysts for commercialising the products developed in these centres. These centres will also reach out to rural areas through training of village groups, in particular women, in simple meat processing technologies by using meat and locally available food crops for low cost meat-mix products.

2. Meat product development and market research. The meat processing unit of the proposed regional centre at APDC has already developed low-cost meat products through research and development (R&D). Low-cost meat processing technologies could be adapted to address the need of least developed countries for inexpensive yet nutritious food to combat malnutrition. However, because of its limited resources, these products were simply tested by trained panelists and found acceptable. Under the project, these products would be modified if necessary and be subjected to comprehensive market research in order to test their potential for national and regional trade.

Considering the consistently increasing cost of meat and meat products, alternatives to promote value adding to the meat is very much desired to maximise returns from animal products. The proposed range of products that can be developed includes use of the entrails, the use of meat substitute and extender on food crop basis, or the process involved in the development. Products may also include those acceptable to consumers in other Asian and Pacific countries.

Another activity being planned is the identification and testing of meat equipment, machines or fixtures that could be locally fabricated. Meat processing equipment are generally expensive and mostly imported. However, there are local skills in the Philippines that can be tapped to fabricate the equipment needs of small- and medium-scale meat processors at lower cost. This equipment can be exported to the satellite countries. For this purpose, packages of small-scale equipment could be developed at different prices, depending on whether the equipment will be electrical or manual.

3. **Training and capability building in meat processing.** A minimum of five international training courses consisting of participants from Asia and Pacific Island countries, particularly the core staff that will man the three satellite centres, as well as national and regional meat industry personnel and extension workers, will be held during the three-year project period. These training courses cover topics on meat processing, meat hygiene, proper slaughtering, carcass and meat grading, waste management procedures and commercialisation and shall make use of the hands-on training approach. These will be supplemented by short study tours to expose the participants to different country experiences. These training courses will be under the sponsorship of FAO through a technical co-operation project (TCP) and conducted by the regional training staff, the Chief Technical Adviser (CTA), and other experts.

To augment the capability of the regional training centre for manpower training in meat processing and commercialisation, the technical capability of the APDC will be strengthened through a long-term expatriate meat technologist. Furthermore, during the Regional Training Courses, an expatriate expert on meat technology/hygiene will be available.

4. **Technology promotion and commercialisation.** The Network's capability on meat product development, in particular the low cost shelf-stable meat products, the locally fabricated equipment and meat technology and hygiene training in general, are the goods that the project should be able to highlight, promote and market, via various media of communication and delivery systems.

A standby micro-credit facility that can be accessed by project co-operators to finance their initial production and market undertakings shall be established. Micro-credit facilities are small amounts of loan that can be made available to those who would be interested to engage in small-scale village style meat processing. This will cover the costs for acquiring basic tools and will enable those who would wish to go into local equipment fabrication or expand their production but require capital to do so.

An important task of satellite centres is the dissemination of meat processing technologies developed in the centres to the existing local meat industries, to potential local entrepreneurs and to rural communities, in particular rural women. In this respect, the satellite centres will provide technical assistance to the private sector especially the small-scale firms to come up with strategies that will ensure the viable operation of these firms.

Project Benefits

The implementation of the project is expected to lead to a number of benefits. The first and most apparent benefit and contribution of the project is the provision of low-cost quality source of protein for the low-income population groups in both the urban and rural areas. In addition, this population will have access to affordable, nutritious and shelf-stable meat products from hygienically processed meat and will help reduce the incidence of diseases that are derived from unhygienically processed meat.

Another important sector that will benefit substantially from the project is the local meat equipment fabricator. There will be an increase in demand for cheap and locally fabricated but appropriate and efficient equipment. The improvement of the meat processing industry will have a significant spill-over effect that will lead to the development of this sector. Making machines and equipment available at lower cost will eventually result in lower production cost and price of meat products.

The project can help stimulate the livestock industry through an increase in demand for processed meat. In isolated rural areas especially, the farm households have no incentive whatsoever to increase the number of farm animals that they raise in the backyard because they have very little, if any, market possibilities for them. With the introduction of low-cost meat processing methods, it will be possible for local people with limited capital to engage in meat processing using locally raised animals that will cater to the requirements of the local markets. This will provide a market for backyard-raised animals.

Employment generation and the consequent income multiplier effects are very important side effects of the introduction and commercialisation of meat technologies. These are to be expected from the stimulation of domestic economic activities.

Last but not least is the stimulation of interregional trade among the countries in the Asia-Pacific region. The net welfare benefit from the increased trade is expectedly large.

Project implementation

Implementation of the project is expected to commence this year. The FAO contribution to the project, which is in the form of a TCP on regional training in meat processing technologies has already been approved. With this development, the project shall start within the next few months.

Interventions in animal health: Economic analysis of the adoption of herd health risk management programmes in smallholder dairy farms in Central Thailand

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Abstract

This paper examines the adoption of two herd health control programmes designed for dairy smallholders in Central Thailand - for mastitis and for reproductive disease. The impact of adoption on private and social welfare is measured using the Policy Analysis Matrix. For adopters of the mastitis and reproductive health programmes, milk production increased by 173% and 48% respectively. Annual returns per cow were 166% and 154% greater respectively than the control group returns. Disease was significantly reduced on all adopter farms, and highest reductions were seen on adopter farms. It is demonstrated that an increase in social profits should occur owing to social revenues increasing at a greater rate than social costs. The policy implications of this observation are discussed.

Introduction

In less developed countries, public policy commonly supports the production of agricultural products that are produced at socially inefficient levels. This is usually done for reasons of self-sufficiency, food security, or the improvement of rural welfare.

In Thailand, dairy production receives considerable government support. The price of milk is established by government process, importation quotas of milk products are set annually with concomitant import tariffs, processors participating in the government-sponsored school milk programme are required to purchase minimum amounts of locally produced milk, and veterinary and artificial insemination services are heavily subsidised. This heavy public support is deemed justifiable by the Thai Ministry of Agriculture as part of a larger effort to promote the sustainability of agriculture by encouraging diversification of crops other than rice, which is seen as too demanding of the

nation's water supply, and too dependent on environmentally damaging fertiliser and pesticides (Timmer, 1992). This paper examines the change in impact of these policy distortions at the farm and social level following the adoption of basic veterinary herd health programmes in smallholder dairy farms in Central Thailand

By reducing the likelihood of occurrence of economically damaging disease, and by providing tools with which to monitor disease when it does occur, the adoption of herd health programmes at the private farm level is a type of risk management behaviour. This behaviour by the private sector (producers) benefits society (consumers) at the regional or national level when milk production occurs with improved economic efficiency. This paper will illustrate this argument by estimating the private and social benefits before and after the adoption of herd health programmes in smallholder dairy farms.

The Thai dairy industry

The Thai dairy industry has grown rapidly in the last 25 years, driven by annual increases in demand for milk products. In the last 10 years alone per capita consumption of milk products has risen from 2 to 16 litres. Dairying is seen as a valuable cash-generating enterprise that can employ otherwise slack household labour and provides a source of generational investment to rural families. A service sector that has built up around dairying communities, including a national system of dairy co-operatives, functions well to provide inputs and to collect, process, and market dairy products. Government extension support services including low cost artificial insemination and vaccination service and subsidised veterinary care are available in most dairying regions.

The annual milk production of the nation's approximately 25 thousand dairy farms housing 150 thousand dairy cows is 520 thousand metric tonnes (TOAE 1999) which accounts for roughly 35% of domestic demand for dairy products (Figures 1-3). In order to meet the excess demand of more than 850 thousand tonnes of dairy products (domestic consumption plus some regionally exported product), the government allows the importation of predominantly powdered milk at a 5% tariff rate. Should importers exceed the quota allotted, the importation tariff jumps to a dissuasive 232.8%. The government-mandated price paid to dairy farmers is 12.5 Thai baht (ThB, US\$ 1-40 ThB) per litre. This price is adjusted by the processor to compensate for the milk quality and to pay for services offered to the producer by the processor.

The typical Thai dairy herd is characterised as a smallholder herd with ten to twelve milking cows producing an average of 2000-2400 kg of milk per cow per year. Cattle are often but not exclusively housed in a tie-stall arrangement. Feed consists of seasonal roughage including domestic grasses, maize, sugarcane, and by-products. Grain-based supplements are readily available. The dairy animal of choice, once the indigenous Thai cow, is now the more productive Holstein-Friesian (H-F) crossbred cow. While H-F crossbreds have the potential to produce more than four times as much milk, they also require a higher level of management than the indigenous Thai cow. The H-F is less resistant to endemic diseases such as foot and mouth disease, requires higher feed inputs, and is more sensitive to diseases of intensification (for example, mastitis, reproductive

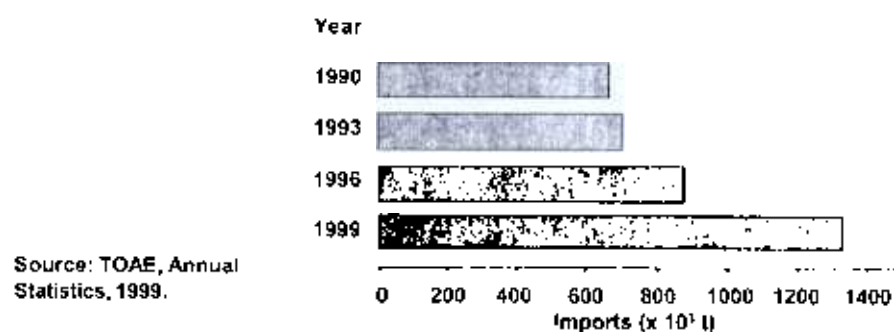


Figure 1. Import of dairy products by Thailand, 1990–1999.

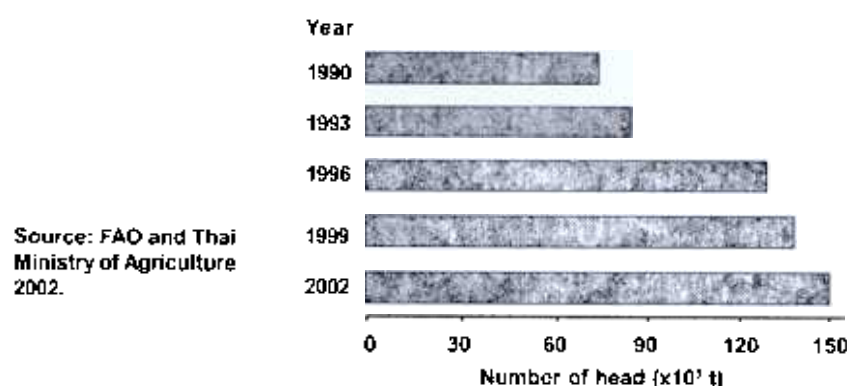


Figure 2. Thai dairy cow population, 1990 – 2002.

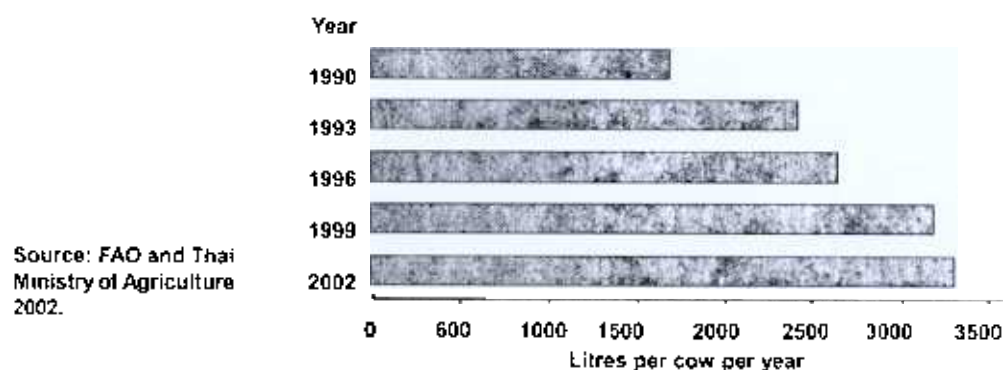


Figure 3. Thai dairy production, 1990 – 2002.

disorders, and lameness). Diseases of intensification are considered primary constraints¹ to the Thai dairy sector, and are now of greater concern than the more traditional diseases of the tropics.

Most dairy farmers in the central province of Ratchaburi, the main dairying area of Thailand, are members of the Nong Pho Dairy Co-operative, which has more than 4000 active dairy farming members and accounts for about 35% of Thailand's domestic milk production. Although they are aware of the major diseases of intensification, there is little use of preventive management techniques, which reduce the risk of cattle contracting diseases of economic importance. Examples of low cost techniques include teat dipping to help prevent mastitis and proper record keeping of reproductive events to identify chronic repeat breeders. It is well established that reduction of the incidence and continuous control of the major diseases of intensification is achievable with the use of some of these inexpensive preventive risk management techniques (Radostits et al. 1994, Andrews 2000).

Identification of an institutional framework and development of a policy to support such herd health programmes should significantly increase milk production in the small-holder sector from its current low level of six to eight litres per cow per day, increasing private (firm level) profitability. However, the economic impact on social profitability is unclear. Currently we are not aware of any estimates of the impact that adoption of such preventive technology has on dairy farms in Thailand.

Objectives of the study

Current dairy policy in Thailand supports the production of dairy products at socially inefficient levels. Thai dairy producers receive a milk price that is set by government legislation, and veterinary and other inputs are heavily subsidised. This study examines the change in the impact of these policy distortions at the farm and social level following the adoption of basic veterinary herd health programmes. Herd health programmes are a production risk management tool of varying sophistication that have become well accepted on dairy farms in developed countries; they are not yet commonly used by smallholder farmers in developing nations.

Data was collected in Ratchaburi province, Central Thailand to investigate the economic impact on private and social welfare of the adoption of basic herd health risk management programmes by smallholder dairy farmers in Central Thailand.

The purpose of the herd health programmes was to prevent diseases of economic importance in Holstein-Friesian crossbred cows following the adoption by producers of basic health management procedures. Foremost in this analysis of the adoption of preventive

From a survey conducted by D. Hall on 100 dairy farms in Central Thailand. Farmers cited the primary constraint facing dairy farming as mastitis. Other major constraints included the limited availability of roughage in peri-urban areas that face increasing industrial development, reproductive disorders, and the environmentally sound management of animal waste.

programmes is estimation of the social welfare impact in relation to current dairy policy. The project is essentially a pilot study of what ideally would include a greater number of dairy farms throughout Thailand, covering a longer trial period, and investigating a larger segment (i.e. the national dairy segment) of the agricultural sector.

This study fills a void in the literature for two main reasons: it evaluates the benefits of the adoption of a production risk management tool as a social benefit, and the research demonstrates the application of Policy Analysis Matrix (PAM) to animal health problems.

Methods and data

In order to analyse the potential impact on current policy effects of herd health programme adoption by the dairy sector of Central Thailand, a policy analysis tool was needed that was flexible to limited availability of data, and clear in presentation to policy makers and economists alike.

The policy analysis matrix (PAM)

The policy analysis matrix developed by Monke and Pearson (1989) is a partial equilibrium framework that allows analysis of policies in terms of their impact on commodity systems, representing the results in a matrix of private and social values (Table 1, Figure 4). Details and applications are described in Monke and Pearson (1989) and in Pearson et al. (1995).

The PAM is primarily useful in evaluating the impact of policy change in a commodity system. Several researchers have used the PAM in various settings: Pearson et al. (1995) examined potential impact of policy change on the Kenyan agricultural sector, Rae (1992) showed that livestock and feed policies in Indonesia worked to provide disincentives to livestock production, and Staal and Shapiro (1994) demonstrated that the Kenyan dairy market remained non-competitive following policy reform.

It should be pointed out that the PAM is essentially a static analysis; it does not lend itself to dynamic assessment of policy impact, such as the estimation of elasticities based on market changes following policy implementation. It is appropriate, however, where the changes are known or have been estimated by a separate procedure.

The PAM approach requires the formation of accounting matrices for revenues, costs, and profits, where profits are defined as the difference between revenues and costs. Revenues represent the value of outputs, and are those revenues generated by the commodity producing enterprise. Costs are defined in two columns as tradable inputs and domestic factors of production (essentially land, labour, and capital). Tradable inputs are those that are available at the international market level; hence, tradable inputs available domestically are considered to be potential exports. Intermediate inputs (for example, fuel, animal feed, and electricity) are disaggregated into their tradable input and domestic factor components. Thus, intermediate costs are separated into four categories: tradable inputs, domestic factors,

Table 1. The policy analysis matrix

Item	Revenues	Costs		Profit
		Tradable inputs	Domestic revenues	
Private prices	A	B	C	D ¹
Social prices	E	F	G	H ²
Transfers	I ³	J ⁴	K ⁵	
	L ⁶			

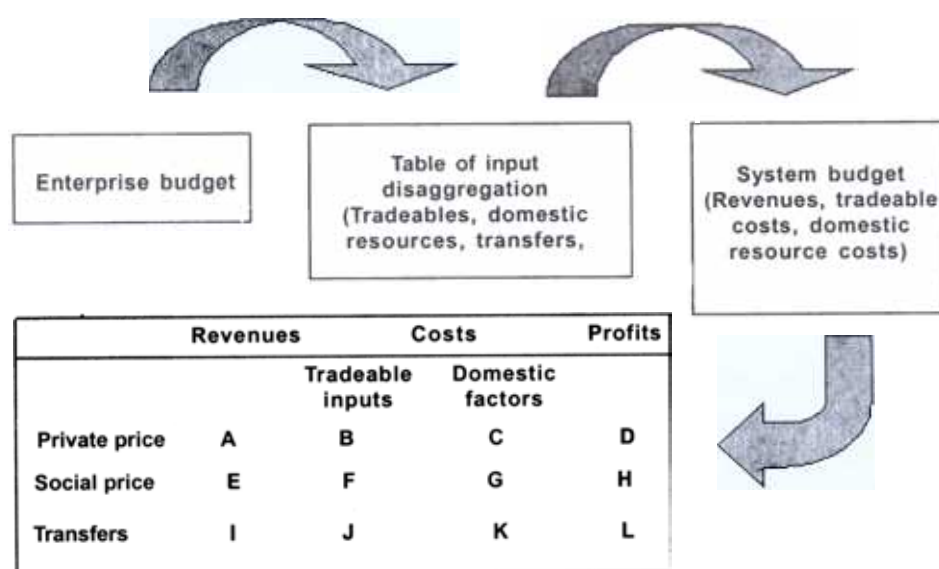
1. Private profits, $D = (A - B - C)$ 2. Social profits, $H = (E - F - G)$ 3. Output transfers, $I = (A - E)$ 4. Input transfers, $J = (B - F)$ 5. Factor transfers, $K = (C - G)$ 6. Net transfers, $L = (D - H) - (I - J - K)$ 

Figure 4. The policy analysis matrix (PAM).

transfers (taxes or subsidies), and non-tradable inputs which are themselves disaggregated into one of the other three categories.

The first row of the PAM contains the calculation of private profitability (D) defined as the private revenues (A) less private costs (B+C). Private profitability represents the competitiveness of the agricultural system (e.g. the farm enterprise at the firm level), given current technologies, observed market input and output costs, and policy transfers. The second row defines social profitability (H) defined as social revenues (E) less social costs (F+G), which represents a measure of comparative advantage or efficiency in the agricultural

commodity system. Social prices (measured at the international market level) reflect valuation of domestic factors.² Positive social profits are indicative of socially efficient use of resources, and negative social profits indicate that the system requires government assistance to survive (i.e. production at social costs that exceed the costs of importing results in inefficiencies).

The final row of the PAM, the transfers, is calculated as the difference between private and social valuations (for example, Output Transfers = $I - [A-E]$). Any vertical divergence must be explained by the effects of distorting policy or the existence of market failures. The net transfer caused by policy and market failures ($I - [D-H]$) is the sum of the separate effects in the factor and product markets.

Farm survey and on-farm trial

All of the animal health data and much of the economic data needed for use in estimating the PAM were not initially available. Farm record keeping is generally poor in Thailand and while some farm level economic data exist in the Office of Agricultural Economics, they are insufficient for enterprise budgeting or profitability estimation at the regional or farm level. These data insufficiencies required that an on-farm survey tool (a structured questionnaire) be designed, as well as an on-farm monitoring and data collection protocol detailing and monitoring the adoption of two structured herd health programmes.

The on-farm survey was conducted in 100 dairy farms (with a total of 795 cows) in Ratchaburi Province from May to September 1998. All farms were members of the regional Nong Pho Dairy Co-Operative and they were selected using a stratified randomised process. The questionnaire collected information on farm management, expenditures and revenues, production, animal health, and extension education. All the questions were asked in Thai by two Thai agricultural technicians who were local to the area. The principal author was present at most of the interviews to monitor the data collection process and to explain the purpose of the study to the Thai farmers.

A portion of the results of the survey is presented in Table 2. The data collected with the questionnaire were used to supplement the data needed in estimating private and social profitabilities of the dairy sector, described in more detail below. All farms in the subsequent on-farm trial of herd health programme adoption were included in the survey.

The on-farm trial was conducted on 44 dairy farms in Ratchaburi Province from November 1998 to December 1999. Farms were selected using a randomised process, from the active membership of the Nong Pho Dairy Co-operative. Potential farms for inclusion in the on-farm adoption trial were visited and their participation in answering a questionnaire was solicited. Farms not willing to participate in the questionnaire were removed from the pool of potential trial farms.

2. Monke and Pearson (1988) use the term price here in the strictest economic sense. That is, there exist output and input prices, as well as private and social prices. When a supplier of feed provides ration to a farmer, the farmer pays some amount that is an input price to the farmer, but an output 'price' to the feed manufacturer. That is, the price of feed viewed from two perspectives. On occasion, social prices will differ from private prices if the resource can be traded at a different value than that at which it is traded internally.

Table 2. Descriptive statistics for 100 smallholder dairy farms in Central Thailand.

Variable	Mean	Standard deviation
Number of cattle on farm	23.57	12.72
Milking cows	9.89	6.67
Dry cows	3.71	2.48
Heifers	4.42	2.64
Calves	5.35	3.98
Milk/ cow/ day (litres)	8.74	6.86
Number of labourers (family)	2.12	0.99
Number of labourers (non-family)	0.25	0.78

Data gathered were used to assess the economic impact of the implementation and adoption of dairy herd health control programmes directed at diseases associated with intensification, specifically mastitis and reproductive disorders. Data collected included quantities and prices of variable inputs, feed usage, herd inventory, milk production, health events such as incidents of disease and veterinary interventions, and reproductive events.

Monthly somatic cell count (SCC) data were collected for a period of eight months, although this number of observations is likely too short to be of much value beyond demonstrating the use of such data in a longer study. Daily milk price and quantity data were also collected for all producers in the survey and farm trial from the Nong Pho Dairy Co-operative, the collection point and processor for virtually all the milk from the trial farms (a small portion of milk not received by the co-operative was accounted for, such as that consumed on the farm or discarded). On-farm data were collected by the farmers themselves with assistance from veterinarians who visited the farms monthly. Herd record books, measuring pails, clipboards, and other recording instruments were distributed at the start of the trial for this purpose.

Three study groups of smallholder farms were randomly selected from the Nong Pho Dairy Co-operative members: 15 farms were selected in a control group that did not receive any special treatment (the control group), 14 farms in a mastitis group that received special mastitis prevention treatment (a rudimentary mastitis herd health control programme focusing on udder sanitation and early detection of disease), and 15 farms in a reproductive disease group that received special reproductive disease prevention treatment (a rudimentary reproductive herd health control programme focusing on heat detection and identification of non-cycling animals). The total number of dairy cattle in the study at any one time was between 800 and 1000. Farms that agreed to participate were not charged for herd health services.

A summary of production statistics for the on-farm adoption trial farms is included in Table 3. Statistically significant difference of means is indicated for pairs of treatment groups. Using a combination of the data described above, a balance sheet was composed for each of the three types of farms in the study (Table 4). The information contained in this balance sheet was needed for the calculations of the PAM analysis.

Table 3. Summary of production statistics for 44 farms in Central Thailand participating in an adoption trial for basic herd health programmes.

Variable	Treatment group					
	Control (n = 15)		Reproductive (n = 15)			
	Mean	St. dev.	Mean		Mean	St. dev.
Number of animals	20.47	6.80	19.4	8.25	24.40	10.18
Milking	9.00	3.64	8.74	5.1	10.69	6.92
Dry	3.07	2.40	2.80	2.75	3.73	1.52
Heifers	3.00	3.02	4.13	3.35	3.60	2.20
Calves	3.40	2.71	4.33	2.89	5.80	3.38
% change in milking cows in 1 year ^{1,2}	-0.83	20.42	-35.96	24.82	-6.13	18.87
Milk/cow/day (litres) - start of trial	6.75	2.49	7.05	3.63	8.67	1.58
Milk/cow/day (litres) - mean ¹	8.30	1.70	10.07	2.12	9.37	2.78
% change in milk/cow in 1 year ^{1,2}	38.61	50.72	173.90	113.92	47.53	46.07
Milk price per litre ¹	10.30	0.25	10.32	0.21	10.38	0.13
% Change in milk price	5.06	2.62	5.53	3.90	7.46	9.29
Mean linear somatic cell count (lnSCC)	6.01	0.10	6.01	0.13	5.74	0.69
% change in lnSCC in 6 months	3.10		-4.12			2.68
Monthly new cases/10 cows of:						
Mastitis	0.69		0.64			0.53
Reproductive disorders	0.14		0.16			0.18
All diseases	1.26		1.65			1.54
Calving to conception interval (days)	156.71	42.41	147.29	51.63	164.70	40.19
% change in interval	139.83	100.55	86.33	73.33	95.95	44.63
Average days open ¹	237.07	41.44	236.96	31.86	274.41	57.00
% change in days open	78.50	62.23	47.36	50.75	57.99	47.87
Average feed costs/litre milk ¹	5.06		4.18			4.23
% change in feed costs/L	45.89		-1.18			28.53
Number of labourers (non-family) ^{1,2}	0.07	0.26	0.71	0.00	0.07	0.26
Number of labourers (family)	2.07	0.88	2.27	1.28	2.46	0.86

¹ Difference between control and mastitis treatment means is significant ($p = 0.05$).

² Difference between mastitis and reproduction treatment means is significant ($p = 0.05$).

³ Prices are quoted in Thai baht (TB). US\$ 1 = 40 TB.

The most interesting observations from the results of the on-farm trial are as follows. First, milk production per farm and per cow increased for all farms (Figure 5) with the use of fewer cows, most particularly for the mastitis programme adopters. As well, the linear somatic cell count (SCC) for value decreased for the mastitis programme adopters (Figure 6) but not the control or reproductive programme adopters, suggesting a reduction in udder health problems for mastitis programme adopters. Average feed costs per litre of milk produced on the farm increased for the control and reproductive programme adopters but decreased slightly for the mastitis programme adopters. Reproductive disease parameters increased considerably, although this was considered an artifact resulting from a lack of reproductive disease identification and reporting prior to the start of the trial, coupled with low impact of the reproductive programme due to low energy diets insufficient for normal reproductive cycling. It is probable that farmers derived significant benefit from the monthly

Table 4. Estimated profit statement for 44 farms in Central Thailand participating in an adaptation trial for basic herd health programmes (values are in Thai Bhat, ThB).

Item	Control	Mastitis	Reproductive
Revenues			
Milk production			
Annual revenue from milk production (ThB)	280,733.01	351,598.07	379,325.54
Co-operative dividends	21,200.00	30,353.00	29,467.00
Sale of calves			
Number of calves sold	1.20	1.50	1.60
Annual revenue from calf sales (ThB)	600.00	750.00	800.00
Sale of mature animals			
Number of heifers/cows sold for other herd	1.70	1.30	0.90
Number of mature animals sold for meat	2.18	2.40	1.90
Annual revenue from mature animals (ThB)	41,980.00	36,500.00	26,700.00
Sale of manure			
Kg sold per annum (estimated)	10,125.00	9830.77	12,021.05
Annual revenue from manure sales (ThB)	6986.25	6783.23	8294.53
Total Revenues	351,499.26	405,984.30	444,587.07
Costs			
Milk transport	8178.33	9635.03	10,959.70
Veterinary and other health costs	7280.00	7997.50	8682.50
Feed costs	133,523.68	114,476.63	105,431.75
Artificial insemination (60 ThB per breeding)	2160.00	2097.23	2564.49
Debt payment (BAAC ¹ , 12.25%)	9253.57	11,114.09	11,130.00
Salaries (non-family labour)	14,433.60	21,578.26	28,945.47
Fuel, utilities, miscellaneous ² (682.6 ThB/cow)	6143.40	5964.87	7293.84
Depreciation of buildings and equipment ² (2119 ThB/cow)	19,071.00	18,516.80	22,642.32
Depreciation of cows ² (3042 ThB/cow)	27,378.00	26,582.40	32,504.93
Taxes (10% of total milk revenues reported)	28,073.30	33,159.81	37,932.55
Total costs	255,495.38	251,122.62	268,087.55
Cost per litre of milk produced ³	9.37	7.82	7.34
Net Profit (Loss)	96,003.88	154,861.68	176,499.42
Returns/annum/litre milk produced	3.52	4.82	4.83
Returns/annum/cow	10,667.10	17,721.85	16,517.85

¹US\$ 1 = 40 ThB

² The Bank for Agriculture and Agricultural Cooperatives (BAAC) is a quasigovernment institution that provides low interest loans to farmers at interest rates of 12.25% per annum.

³ Data were weak for these variables; the same per cow estimates are used for all farms.

⁴ Significantly different between Control and Mastitis and Control and Reproduction treatment groups ($p = 0.05$).

attention of a veterinarian commenting on basic health procedures as well as from the specific details of the adopted programmes.

It is compelling to ask from these observations what happened to farm profits per farm or per cow. Table 4 shows that both adopter farms had lower per litre costs of production and received higher net profits per litre of milk produced than the control (non-adopter) farms; the mastitis adopters received 7.3% higher profits per cow than the reproductive group adopters. These results will be referred to when we examine the profitability estimation of these same farm groups using the PAM analysis approach.

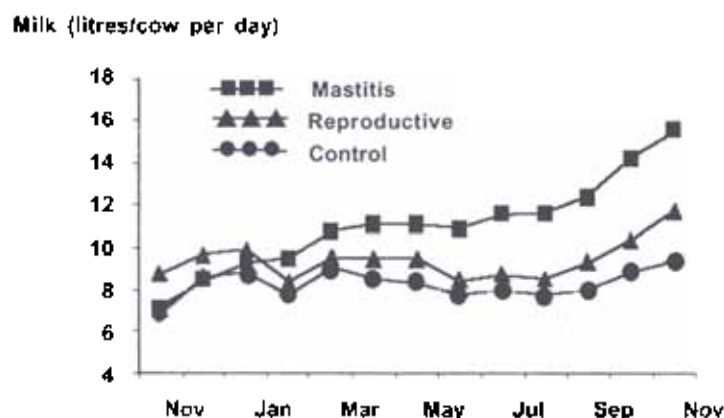


Figure 5. Milk production for three trial farm types following the adoption of animal health control programme.

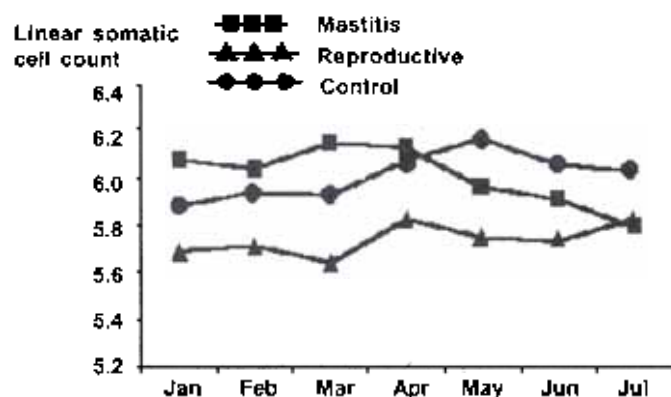


Figure 6. Somatic cell count (SOC) for three trial farm types following the adoption of animal health control programme.

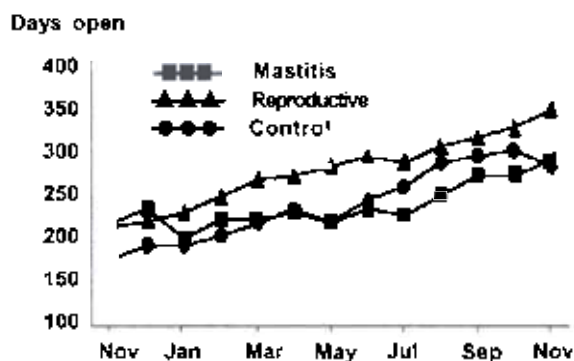


Figure 7. Days open for three trial farm types following the adoption of animal health control programme.

Data preparation and assumptions for constructing the PAM

The data demands of the PAM private profitability estimation are perhaps the least complicated to validate. Market prices and quantities of factor inputs and outputs such as feed and livestock were obtained through records of actual farm purchases and sales, or through observation of relevant regional factor prices (these values are indicated either directly or indirectly in Tables 3 and 4).

The on-farm survey was also used to supplement these prices when records could not validate factor prices (for example, few farmers keep records of revenues from the sale of bovine manure; this was not difficult to estimate knowing the mean number of mature animals and the local price).

Milk price and quantity series were recorded on-farm; these recordings were incomplete for several farms but verification or supplementation of records was possible with the assistance of records from the Nong Pho Dairy Co-operative which uses a weigh in and recording system for all individual members. Quantities were adjusted for milk fed to calves, for personal consumption, or discarded, although for most farms this was not a consideration.

This is all the basic information that is needed in order to estimate the first row of the PAM, which captures farming production, delivery from farm to processor, processing, and marketing characteristics of the smallholder dairy system. Ideally one would like to derive this information from four separate PAMs, one for each of the activities in the chain (farm production, delivery from farm to processor, processing, delivery from processor to wholesale market). Lack of details on each stage did not allow for this precision; instead we focused on details of the farm production stage, implicitly capturing the impact of other stages in their respective factor prices.

In order to complete the first row of the PAM, all private costs were normalised to reflect monthly currency fluctuations, and were disaggregated to their domestic factor and tradable input components. The details of this step are not shown in this paper for the sake of brevity but the process is described well by Monke and Pearson (1989).

Veterinary care costs represent aggregate values (labour, call charges, and drug and other medical supplies) as recorded on farm and at the veterinary clinic. Veterinary care is heavily subsidised since the majority of farm veterinarians not employed by private industry are employed by the Ministry of Agriculture and Co-operatives (exceptions are much of the pork and poultry sectors which rely predominantly on private sector service driven by vertical integration). Thus dairy farmers benefit from substantial subsidisation of veterinary wages, though a small fee is charged of farmers for service; approximately 65% of farm paid costs are for veterinary supplies and pharmaceuticals.

Comparative advantage or efficiency in the agricultural commodity system is estimated by the second row of the PAM, using social valuation of resources. The most obvious sources for valuation of input and output factors traded internationally are world prices – CIF (cost, insurance plus freight) consumer import prices are used for goods or services imported, and FOB (free on board) export prices are used for exportables. As for private prices, social valuation of domestic factors first requires

distinguishing between mobile and fixed factors of production. Calculation of world price equivalents is necessary for domestic tradable inputs and outputs, pricing inputs at their opportunity cost and outputs at their scarcity value or shadow price. The import CIF price is the shadow price where it is the lowest consumer price for an input, measuring scarcity value of the good to the economy; the export FOB price represents the marginal revenue or opportunity cost when it is the highest price obtainable.

As Monke and Pearson (1989) point out, the empirical estimation of social profits is the most difficult portion of the PAM and is not an exact method. The objective here is to measure divergences from efficiency³ prices caused by distortions present in the dairy sector. Indirect subsidies are offered through subsidisation of veterinary salaries already mentioned, and heavy subsidy of breeding services (artificial insemination charges that farmers pay are approximately 7% of actual costs). Farmers also receive farm loans at an interest rate lower than other sectors from the parastatal Bank of Agriculture and Agricultural Co-operatives (BAAC). The BAAC rate is 12.25%; the offered loan rate based on the minimum retail interest rate extended to non-agricultural small businesses in 1998 averaged 20% (Bank of Thailand 1999), and this was used as the social efficiency price of farm capital. While dairy feed costs are not subsidised, it is more expensive to import feed than to purchase it locally. In 1998 the farm price for dairy concentrate ration was 5 ThB/kg., which was less expensive than importing concentrate at 7.9 ThB/kg. using a CIF import price and including all charges to transport the feed to a Nong Pho farm gate. A similar figure was arrived at for feed using CIF imports of grain, making it less expensive privately and socially to manufacture feed domestically; the PAM incorporates this saving in feed imports in considering the input costs. Prices of other inputs of less importance are noted in Tables 3 and 4.

Farm sales of milk generate higher private revenues than would be generated at the social efficiency price. Thai dairy farmers receive direct price protection in the form of a government regulated farm price for milk (12.5 ThB/l), which is effective due to excess domestic demand and the presence of quotas and tariffs placed on powdered milk. Most powdered milk is imported from New Zealand and Australia, at the CIF import price on a reconstituted fluid basis of 7.0 ThB per litre including tariffs, transportation, and other expenses in getting the milk to the Nong Pho Dairy Co-operative. This forms the efficiency price for milk in the Ratchaburi area. On the other hand, cattle sales generated less revenue than they would at international prices, using an FOB Sydney price of 17,500 ThB for a mature heifer and 1,225 ThB for a calf.

Results and discussion

Private profits represent farm revenues less tradable input costs and domestic resource costs, all valued at private prices. Since returns to domestic factors of production are

3. In an ideal world, purely efficient prices exist when the difference between private and social prices is made up solely of acceptable transaction costs (e.g. transportation). In other words, society is not subsidising profit that is directed at the private sector (as they would be in a policy instrument such as a production quota).

considered a cost, zero private profits imply normal profits, or in other words, domestic factors receive prevailing market rates of return. With negative private profits, there are disincentives to enter dairy farming.

The status quo of dairy farming in Central Thailand is represented by the control group with profits of -1,897 ThB per farm. It suggests that there are disincentives to enter the industry, or at least that the private returns to investment of resources are below current market rates (Table 5). As herd health control programmes are adopted, the private profits of the mastitis and the reproductive programme adopter groups suggest that above normal profits are experienced and there are incentives to enter the industry. Mastitis programme adopters with private profits per farm of 48,246 ThB received higher profits per farm than the reproductive group (a difference of 31,057 ThB).

Table 5. The estimated Policy Analysis Matrix for three types of smallholder dairy farms in Central Thailand participating in an adoption trial for basic herd health programmes (baseline scenario; values are in Thai Baht).

Item	Revenues	Costs		Profits
		Tradable inputs	Domestic factors	
Control group				
Private prices	355,379	70,872	286,404	-1,897
Social prices	248,140	189,238	294,846	-235,944
Transfers	107,239	-118,366	-8,442	234,048
Mastitis group				
Private prices	403,948	61,824	293,878	48,246
Social prices	277,241	168,701	305,659	-197,120
Transfers	126,707	-106,877	-11,782	245,365
Reproductive group				
Private prices	415,918	56,382	342,347	17,189
Social prices	298,552	165,520	353,226	-220,194
Transfers	117,366	-109,138	-10,879	237,382

The ordinal ranking of profits of the three groups is consistent with the farm profit statement. Note that private revenues increase with adoption (owing to an increased production of litres of milk per cow per day) and costs of tradable inputs are reduced, primarily from the apparent reduction in marginal costs of feed inputs. The costs of veterinary tradable inputs (non-labour items) actually increased for adopters, but the overall effect is a reduction in tradable input costs. The costs of domestic factors rose with adoption; again, veterinary inputs (labour in this case) rose by a greater amount than feed costs fell. This pattern of changes in costs is consistent with the farm profit statement, although the farm profit statement treats returns to domestic factors of production as farm profits; hence the control group is also profitable using the farm profits statement approach.

Social profits evaluate production at economic prices (opportunity costs for inputs and shadow prices for outputs). Estimation of social profits using the PAM indicate that dairying is not socially profitable for farmers in Central Thailand, or in terms of foreign exchange earning capacity, dairying is not efficient. If one takes into account the increased milk production under adoption, the inefficiencies are reduced when herd health programmes are adopted but the reduction does not have a great impact on overall social efficiency (mastitis programmes reduce inefficiencies by 16.5%, reproductive programmes by 6.6%).

To further investigate the issue of social efficiencies, consider the final row of the PAM, the transfers. The results of changes to revenues and costs at private and social prices following adoption are reflected in transfers, the vertical difference between the revenues and costs in the PAM. Recognising that dairy farmers receive farm fluid milk price protection and input subsidies, it should be clear that as adopters increase private profits they do so at the expense of transfers from the social sector. This explains why transfers of profits increased for adopters (by 174 and 162% for mastitis programme and reproductive programme adopters, respectively); private profits increased at a faster rate than social profits (16 and 7% for mastitis and reproductive adopters, respectively). It would seem that adoption of herd health programmes benefits private producers far more than the social sector, although this is not the case. In order to demonstrate this by clarifying the impact adoption has at prevailing private and social prices and to evaluate the overall comparative effects of the programmes on transfers, standard coefficients have been suggested and are explored in the next section.

PAM coefficients

Four comparative measures of policy are defined and calculated in Table 6. The nominal protection coefficient (NPC) indicates the net effect of distortions or a negative protection on outputs. An NPC > 1 indicates that producers are protected for the product. Since the price of farm outputs is not affected by the herd health programmes, the NPC would not be expected to change significantly, as is the case (a 1.7% increase and a 2.7% decrease for mastitis and reproductive programme adopters, respectively). A similar ratio from the input cost perspective, the nominal protection coefficient of tradable inputs (NPI), measures the ratio of the private cost of tradable inputs to their social cost. Where NPI < 1, producers experience protection or subsidisation for input purchase prices. Herd health programmes have a small impact on NPI (a 2.4 and 9.1% reduction for mastitis and reproductive programme adopters, respectively).

Of greater interest to this study are the effective protection coefficient (EPC) and the domestic resource cost (DRC) ratios. The EPC ratio is a measure of the net effect of distortions or negative protection on outputs and tradable inputs. For an EPC > 1, producers are protected for the value-added produce. Where there was no adoption of herd health programmes, EPC is remarkably high at a level of 4.830,⁴ reflecting the combination of

4. For illustration purposes, the EPC of rice production in the central Thai plains province of Nakornsawan has been estimated by Yao as 0.912, and the DRC as 0.856.

Table 6. Comparative measures of policy derived from the estimated policy analysis matrix for three types of smallholder dairy farms in Central Thailand participating in an adoption trial for basic herd health programmes.

Indicator	Herd health programme group		
	Control	Mastitis	Reproductive
NPC ¹	1.432	1.457	1.393
NPI ²	0.375	0.366	0.341
EPC ³	4.83	3.152	2.703
DRC ⁴	5.006	2.816	2.655

For description of variables in definitions refer to Table 1.

1. NPC = nominal protection coefficient of products = A/E

2. NPI = nominal protection coefficient of tradable inputs = B/F

3. EPC = effective protection coefficient of product = $(A-B)/(E-F)$

4. DRC = domestic resource cost = $G/(E-F)$

output price protection and input subsidisation. For dairy farmers adopting herd health programmes, EPC is reduced considerably (34.7% for mastitis programme adopters and 44.0% for reproduction programme adopters).

Examining the equation for EPC, one can see there are several scenarios under which this could occur; in the case of herd health adoption, the increase in the difference between revenues and tradable inputs at private prices ($A - B$) increased less than the same calculation at social prices ($E - F$). The simpler interpretation of this is that the adoption of herd health programmes effectively reduces the heavy protection accorded to dairy farmers, while still allowing them to improve their private profits. Of course, this also transmits as an improvement in terms of social efficiency.

The DRC indicates comparative advantage measured as the difference between opportunity costs of using domestic resources (G) and the value-added generated by the activity ($E - F$), both measured in terms of world prices. If the production of a good is of social benefit, then one expects the $DRC < 1$, indicating comparative advantage over other outputs using the same inputs. The high DRC of the non-adopters in Table 6 clearly indicates inefficient use of resources; this inefficiency is not removed by adopting herd health programmes but it is greatly reduced (a 43.7 and 47.0% reduction for mastitis and reproduction programme adopters, respectively).

A similar argument for the DRC coefficient can be made as was done for the EPC; opportunity costs increased but less than the increase in value added by adopting herd health programmes. Care must be taken in interpreting this improvement in the DRC coefficient. To say that adoption improved comparative advantage is not quite correct because there has not been a direct comparison of an alternate farm level activity conducted in the same region. For example, it would be incorrect to conclude that Yao's (1997) DRC estimate of 0.856 for rice means that Ratchaburi dairy farmers should begin growing rice. However, it can be said that following adoption the DRC coefficient indicates a socially more efficient usage of the outputs that were used prior to adoption.

Conclusions

Basic herd health risk management programmes to control diseases associated with intensive production are low cost, low input technologies that contribute to increased private profits (Radosnits et al. 1994). Of more concern to this study is the impact that the adoption of herd health control programmes has on the exogenous (policy induced) distortions that benefit Thai dairy farmers.

Results of the PAM and the comparative measures indicate that dairy farmers of Central Thailand have economic incentives to adopt herd health risk management programmes and that, following adoption of such programmes, there is a reduction in the degree of social inefficiency resulting from public policy supporting dairy farming. Following a reduction in the incidence of bovine disease on adopter farms, this study predicts there should be an increase in private profits due to the increase in farm revenues exceeding the increase in veterinary input costs. Similarly, an increase in social profits should occur owing to social revenues increasing at a greater rate than social costs.

Several possible policy scenarios exist to promote adoption of herd health programmes while not reducing social benefits. Perhaps the most obvious is management of the programme by the local dairy co-operative, funded by farmers with a check-off programme, with non-financial backing and promotion from the government. This avoids generating programmes that are demanding of public funds while still promoting the interests of dairy farmers. Another possible scenario is decreasing government support for farm veterinary care, transferring this cost to the private sector; this is a topic of hot debate stemming from the current shortage of farm veterinarians in Thailand and the privatisation of veterinary care that is ongoing in the poultry and swine sectors. A more detailed analysis of potential policy options to promote adoption of herd health programmes, including discussion of veterinary privatisation, imperfect and asymmetric information, and reduction of transaction costs, is needed.

This study has focused on the farm level impact of herd health risk management programmes but has not incorporated the post-farm activities associated with dairy production in Central Thailand in much detail. For a thorough evaluation of efficiency and competitiveness of regional or national production, post-farm costs such as a breakdown of processing plant labour and marketing activities must be included in greater detail (Monke and Pearson 1989). This is particularly the case for measurement of the competitiveness of dairy production as opposed to alternate use of agricultural resources, such as sugarcane production, rice farming, or small ruminant production. A cautionary note is in order: public policy is not always dictated by the most efficient option, as is the case in the government's policy to promote alternate agricultural activities other than rice farming, in which Thailand has considerable international comparative advantage. While dairy products are considerably more costly to produce domestically in Thailand than to import, the decision to continue support for dairy farming is based on diversification of agricultural activities. The implications of this study are that the adoption of herd health risk management programmes by the dairy sector of Central Thailand is a more socially efficient implementation of this policy decision, while increasing the private net benefits to dairy farmers.

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FMD and trade in South-East Asia

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Introduction

The South-East Asia Foot and Mouth Disease Campaign (SEAFMD) aims to minimise the impact of foot-and-mouth disease (FMD) on the livestock industries and trade in the region.

FMD is a serious disease of cloven hooved animals and causes significant impacts on production and is also a major barrier to trade in animal products. The trade effects are more obvious in countries that are free zones for FMD. However, restrictions also apply in areas such as South-East Asia.

Previous presentations have described the roles of the World Trade Organization (WTO) and the Sanitary and Phytosanitary Standards (SPS) in the new order of world trade. The Office International des Epizooties (OIE) has been delegated the responsibility for standards for animal health and trade in animal products and increasingly in food safety issues.

In the markets for products from FMD-susceptible species, there is a high premium for products from FMD-free zones. Other products go to lower-value markets. There is a significant difference in price and that is why many countries have aspired to free zone status for FMD.

The South-East Asian FMD campaign

The South-East Asian FMD Campaign covers eight of the ASEAN countries. These are Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Phillipines, Thailand and Vietnam. The campaign emphasises the need for regional co-ordination. If further progress is to be made, there must be co-ordination between countries, because FMD is a disease that spreads very rapidly.

What is the status of FMD in South-East Asia? Indonesia eradicated the disease in the mid-1980s and was formally recognised by OIE as an FMD-free zone in 1990. Indonesia is working to maintain its status and realise that maintaining its FMD-free zone status requires a significant effort and investment.

The Philippines has been making very good progress. Mindanao in the south is recognised as a disease-free zone and it is hoped that the Visayan Islands will be declared free in May. In Luzon in the north, the disease is still prevalent and there is a very active programme in place. The Philippines' task force approach has been very successful and hopefully, their programme would make significant progress.

East Malaysia has been free of FMD for many years and is developing a case for a free zone status. The southern end of the Malay Peninsula has been relatively free for some time. FMD outbreaks occur particularly along the border zones and the policy is to eradicate them. Elsewhere in South-East Asia FMD is prevalent. The prevalence and the degree of disease control varies between countries. There are also several strains of FMD circulating in these areas and the main ones are types O, A and Asia 1. A key issue for the region is the fact that it also adjoins China, India and Bangladesh and these have been the sources of new strains in recent times.

Controlling animal movements is critical to managing the spread of disease. This requires knowledge of the direction of animal flows and this is strongly influenced by price. If we look at the Philippines, most animal movements are from southern parts to Manila and Luzon island in the north, where there are higher priced markets.

In mainland South-East Asia, we are trying to move the zones to the north. What we find is that the flow of animals is into the high-priced southern markets where the stronger economies are and these include Thailand and Malaysia. These animal movements are both legal and illegal. If we want to control the disease, managing animal movements becomes very important.

The principle that is being applied is to manage these movements with a minimum restriction on trade. The reality is that the South-East Asian countries do not want the disease and want to do something about it. Each of them has movement controls related to FMD that limit movement and restrict trade. One of the major concepts behind this SEAFMD campaign is that in a totally free zone, animal movements are uninhibited and go on without the concerns about movement of FMD.

Yesterday, it was reported that the Malaysian Minister for Agriculture has halted all animal movements into Malaysia and has appointed an expert committee to advise on the movement controls required to minimise disease incursions. This is an example of how FMD can result in significant restrictions on trade in the region.

In the Malaysia-Thailand-Myanmar (MTM) area, there is a proposal to achieve FMD free zone status in the area. The concept for the MTM Peninsular Campaign for FMD Freedom is to define control and buffer zones. In buffer zones (Figure 1) there will be full vaccination of animals and in control zones emphasis is on surveillance and eradication. There will be movement controls in place to limit the spread of the disease. There will be targets and standard procedures to eradicate the disease. The aim of the campaign is to progressively improve zone status and to achieve a disease-free status in four and a half years, according to OIE standards.

Benefits from FMD control

There are benefits to each of these three countries and this is a very good example of mutual benefits derived from countries working together. Thailand and Malaysia have offered support to assist Myanmar in the FMD campaign because this will also benefit them. This will be a good model for countries working together in the region.

The benefits are that Malaysia and Thailand will be able to expand their FMD-free zone status and reduce the costs of eradication. Myanmar and Thailand can export their animals



Figure 1. Malaysia-Thailand-Myanmar buffer zone.

to high-priced markets such as Malaysia, and Thailand will also maintain its disease-free areas. Each of these areas will be able to export and gain higher prices for their animals for being able to trade with FMD-free markets.

A recently released study of the economic impacts of FMD in the Philippines by Dr Brian Perry of the International Livestock Research Institute (ILRI), reported improved production and poverty alleviation as major benefits. He found that among the major beneficiaries were the private sector, and particularly the large commercial producers. The SEAFMD is trying to engage this sector and encourage them to consider it to be good business practice to take action to reduce the risk of disease. As a major beneficiary they should also be making a significant contribution to FMD control and the campaign.

SEAFMD research and development needs

The SEAFMD and MTM Peninsular campaigns both need strong research and development programmes to drive the campaigns. The following section describes the research needs in the region for these campaigns and I hope this might help us in our further discussions.

1. SEAFMD role in research –The SEAFMD campaign has a very small budget and is not a research provider. We help facilitate and we try to encourage other people to do work in FMD. We have, however, funded some small projects and we have good collaboration with the International Livestock Research Institute (ILRI), the Food and Agriculture Organization of the United Nations (FAO), and some of the donor agencies

that have done FMD research in the region like the Australian Centre for International Agricultural Research (ACIAR).

2. Economic analysis – I have previously mentioned the study by ILRI. We need to do further economic analysis on the impacts of FMD, particularly for the MTM initiative. In this way we can start early by having a good understanding of the economic issues.
3. Epidemiological research – This is needed to drive the campaigns. What we are dealing with is a disease that is changing and we know that new strains are evolving in new areas and industries are also changing. However, we have good diagnostic tools and all we need is good epidemiological research to identify where to target our resources, and where we can get the best returns.
4. Monitoring and evaluation – We will need a project to monitor progress with the MTM Campaign and this will have epidemiological and economic elements.
5. Diagnostic tools and vaccines – At the moment, we have inadequate diagnostic tests for FMD and we have difficulty in differentiating vaccinated and unvaccinated animals. There is a need for further work on better diagnostic tests and more targeted vaccination strategies, particularly for new FMD strains. Work on these aspects is going on in other parts of the world, however evaluation and implementation in South-East Asia will be required.
6. Communication research – One of the big challenges is communicating our information to eight countries with different cultures and different languages and to target different sectors.

Session VI

Workshop sessions

Workshop output

Three workshop groups worked in two sessions to answer a series of questions designed to identify opportunities and approaches for livestock research and development to contribute to smallholder well-being. In the first session, four key questions were posed and the schematic in Figure 1 used as a framework for discussion:

1. List the features that characterise households whose livelihoods depend on livestock
2. Which of these features are most likely to lead to change – for better or worse.
3. Describe the possible paths followed by these households – and their positive and negative features.
4. Where are the problems that require research and development by partnerships?

An underlying theme was to capture the dynamic nature of development and not focus on using livestock to stimulate change from a 'poor' to a 'less-poor' condition. Rather the emphasis was on using livestock to stimulate pathways to development using livestock and access to livestock markets as the focal points.

The second workshop session aimed at developing concepts for research and development in the region. To guide the workshop groups, four features were designed to be addressed and identified: the problem, approach to the problem, partnerships, and resources needed. The three groups reported separately, followed by a general discussion.

Workshop session 1

Group 1

Group 1 focused on Indonesia and the Philippines. Akemi Kamakawa (JIRCAS) reported on the group's output.

1. Features that characterise smallholders

- Number of animals
- Species
- Farm size
- Type of farmers
- Access to inputs and markets
- Education and information
- Food consumption
- Dependence on agriculture
- Location
- Family size

2. Pathways

Ruminants and native chickens (with a niche market) were identified as the possible pathways. Currently, there is low production and animal health is poor.

3. Positive and negative outcomes

Current social and political pressures may increase government interventions, that in turn affect credits and markets, information and education and land reform. For land reform, an opinion pointed out that it is a domestic issue which ILRI and FAO should stay away from.

Urbanisation in the rural areas is making young people leave their farms resulting in less rural labour. Other outcomes include on- and off-farm employment, land degradation, shorter fallowing periods, forests becoming depleted, negative balance of soil nutrients, and weed infestation (*Imperata cylindrica*). Another factor is globalisation which weakens competitive position of developing countries.

On the role of the International Livestock Research Institute (ILRI) and the Food and Agriculture Organization of the United Nations (FAO), the Philippine delegate suggested that ILRI and FAO should work on global policy research issues like the World Trade Organization (WTO) and import/export subsidies, opinions for different environments, e.g. chicken leg quarters issue, regulations for export and their effects on small producers.

Technologies are also very important but due to institutional problems, they have not always led to implementation. Research on policy and technology innovation should be priorities. Examples of technology innovations that can be investigated are the food-feed systems, varieties of forage, feed potential of certain rice varieties, and feed storage.

There is also a need for labour efficiency as there is less labour now in the country-side. Technologies on ways to utilise waste from palm oil, cacao, and coffee industries and technologies that require low external inputs need to be found. Cost of deworming also needs to be minimised. Sustainable farming systems that employ good use of nutrients and are labour-saving would need to be determined.

4. Pathways

Factors like credit, information, and marketing all influence the change in different ways – in some, pathways would go to increase livestock production, some would be non-agriculture, some to specialisation e.g. dairy, where some would specialise in just transport of product, or others would go into milking (contracting).

Group 2

David Hall of ILRI reported on the discussions and output of Group 2 which focused on Thailand and Malaysia.

1. Features that characterise smallholders: land and resource base (hectarage, ownership, value); labour, enterprise diversification, credit access, dependency on other sectors and industries (livestock feeds into and out of these other industries and sectors); spatial effects of urbanisation as well as its non-spatial effects that include waste and loss of agricultural land, waste as a particular issue for waste management; species of livestock; level of and access to technology and information; marketing and market access, organisation within and external to the community, at the farm, regional and national level; and formal and informal systems of education.
2. Which features are most likely lead to change? The group reported that credit access, technology, markets and organisation were the most important features.

3. Pathways

- a. Credit access involves collateral and process of credit acquisition is different for smallholders. Land title and ownership are relevant here.
- b. Co-operative development and networking from the private sector which includes community participation.
- c. Liberalisation of credit markets is an important pathway and this does not necessarily come from a nationally directed programme down to the smallholders. This may come from pressure within a community or within a region. Several examples in South-East Asia discussed by the group reflected this issue.
- d. Increase appropriate extension services. Extension MUST meet demand of and be relevant to the livestock sector.
- e. Market access as a pathway involves many issues. Information on prices need to be available as it is very difficult to make decisions without such information. There is a need for a physical market environment that provides ability to access that market. This also includes organisation and the process of bringing buyers and sellers together.
- f. Community-level development of networks is another pathway. In South-East Asia, community-level networks that develop independent of national or regional direction are often the case. In this case, a community-led level of participation in, for instance, mobilisation to improve market channels, can utilise the family and extended family structures, a very important social issue in the region. This leads to the whole issue of developing networks that enhance market access.

4. Research issues

Where are the problems for partnerships? The group decided that there was room for all partners present and those not represented at the meeting. So, no specific roles for specific partners were identified. Research issues identified were the following:

- a. Information and its availability. How is this information made available to smallholders? There are new forms of information and new ways and technologies of acquiring information. Such ways and technologies may not yet be distributed to some people or they may not be appropriate to some regions. What are the appropriate methodologies for bringing all these issues together?
- b. Credit markets. How do we go about liberalising credit markets? We also need to consider the benefits and social costs of doing so. It is a very different situation for smallholders to access a credit market or for a smallholder community to have a liberalised credit scheme than it is for large, private institutions.
- c. In terms of market access, an issue identified was on investments for reducing transaction costs when these costs are considered as a barrier to market access. For example, a dairy producer that lives not far from the urban market but cannot access that market because the road system may be complicated for him in transporting a heavy load.
- d. Meeting sanitary and phytosanitary standards (SPS) measures. How are smallholders affected? How can they be brought in?
- e. Food safety concerns. What is the impact of raising standards on smallholders? Some standards addressed at international level and are required for international

market participation may not be appropriate for domestic markets. They may instead be a barrier that can reduce regional market activity. What are the methodologies and how do we implement some of the standards?

- f. Property rights and linkages to other issues like impact on market access and others.
- g. Organisation. What are the empowering and appropriate policy issues that allow organisations to be effective? How do they come together, make decisions?

Group 3

Group 3 was composed of representatives from Cambodia, Vietnam, Myanmar, and China.

Dr. Than Daing of Myanmar presented the group's output.

1. Features of households that depend on livestock included the following:
 - a. Land. Most important issue is the landless. Most people are labourers who are daily wage earners (about US\$ 0.60 -1.30).
 - b. Access to credit. There is lack of access to credit, a shortage of capital among smallholders.
 - c. Market access. Poor roads, informal and unstable markets, seasonal fluctuation, illegal trade.
 - d. Local policy encourages large-scale companies leading to ethnic marginalisation.
 - e. Species are mostly monogastrics.
 - f. Level of production of native livestock is low and there are also problems of diseases.
 - g. Quality of natural resources.
 - h. Appropriate technologies and information are lacking.
 - i. Access to water is limited.
 - j. Cooperatives have high failure rate but are necessary.
 - k. Lack of education, low literacy, low social status.
2. Pathways
 - a. Cooperatives and local grouping. While there were many co-operatives that failed, these are still considered necessary for farm households to break away from poverty. There is still need for other farmers associations that can provide strategic alliances, for instance, in supply arrangements, that can lead to development of more small and medium enterprises.
 - b. Government policy leads to large-scale enterprise.
 - c. Big companies contract growers.
 - d. In Myanmar, farmers income-generating group sharing of costs reduce risk.
 - e. Shift to other species, e.g. dairy and beef cattle, move to lean pigs or commercial poultry.

Problems felt by smallholders are access to quality feed, capital requirements, diseases, perishable milk, lack of technology and training.

The major constraints are:

 - a. Infrastructure
 - b. lack of information about markets and production technologies

- c. poor delivery of extension services
- d. lack of market structure and middlemen are not always the black sheep they are thought to be
- e. lack of exploitation of local resources in rainfed areas

Research work is needed in the following areas:

- a. animal nutrition (and training on feed formulation)
- b. appropriate genetics for a given environment
- c. farm management
- d. animal health treatment and diagnosis
- e. food quality and post-harvest and transport losses
- f. government policy to enhance environmental sustainability

Discussions

Ethnic marginalisation was a concern raised in some countries. In some countries, ethnic groups get less attention from the government authorities.

Issues raised in the context of research and development can be grouped into three areas: global and international issues that relate to SPS and WTO; sustainable technology development in such areas as waste, sustainable farming, food-feed systems, appropriate genetics; and domestic market and related social issues like organisation, credit access, infrastructure, tenure, property rights, information flow, policies etc. Access to credit is a major problem among smallholders. But research should also look at the mechanisms of savings, especially when the functions of livestock are examined. One such function is that livestock is a form of savings and low productivity may not be that important to a smallholder. In Latin America there are credit schemes where farmers pay back in kind, e.g. offspring. But the experience is that it is always difficult to arrange for pay back in kind since sale of animals is not predictable.

While liberalising markets is a question, a key question is to find ways where smallholders can get access to credit. In the Philippines, commercial banks have a natural bias against lending capital to smallholders because of transaction costs. A United Nations Development Programme (UNDP) project in Bangladesh where microcredit funds are provided wants to channel these funds to other project activities because it believes that credit is a function of the commercial banking sector.

A suggestion was made that research should look more at the informal credit system as shown in the high degree of success of the Grameen Bank credit method in Bangladesh, Thailand and the Philippines. There is a need for research to examine both credit systems that have worked and not worked in the past as a basis for formulating strategies and this is precisely where ILRI can help, especially in developing cross-country comparisons.

There was also a suggestion that in the smallholder system where loans are provided, technical backup should be a necessary feature of the loan programme. This problem was experienced in a Grameen project in Bangladesh where landless women

borrowed money for goat production. However, *Peste des petit ruminants* (PPR) wiped out the goats. There is therefore a need to assure smallholders that risks can be minimised for them.

A question was raised on why this cross-country comparison should be done in South-East Asia and why not in other parts of the world. It was the consensus that the livestock revolution has brought up very clear issues in South-East Asia and that livestock is a pathway out of poverty. Access to credit is key to this and microcredit is a useful tool. In addition, donors would find South-East Asia extremely interesting because of its so many different social, economic and technical backgrounds.

It was also suggested that while there is a lot of biodiversity in South-East Asia, the challenge for ILRI and FAO's role in bringing about better food security in the region is to turn this biodiversity as a living asset into an economic benefit.

Access to market price information enables smallholders to make better decisions and negotiate for favourable prices. As it is the middlemen have better access to market information. There is a need to link the smallholders to market information. It is not only price information that is needed. Smallholders also need information and training on technologies, risk avoidance etc. On the other hand, there was a concern on the poor delivery of extension services as evidenced by unqualified extension personnel who give advice on animal health issues to smallholders.

There is a need to synthesise and digest the information already available in many research institutions. There must be a way of synthesising this information as a basis for sound decision-making and make this available to smallholders, to the business sector and to the policy makers.

A key research issue is getting information to policy makers especially on global policy studies (competitiveness, barriers to trade etc.)

Workshop session 2

In this workshop, seven research and development concepts were developed. The concepts include food-feed systems, animal health, animal genetic resources, impact of raising SPS standards on smallholders in South-East Asia, animal diseases and smallholders, impact of liberalisation on smallholders in South-East Asia, and market access. The following project concepts were presented (Tables 1-7).

Table 1. *Concept 1 - food-feed systems*

Item	Response
Problem What is the problem?	Limited land, low productivity and decline in soil fertility in smallholder rice-based crop-livestock systems in rainfed areas
Approach How will the problem be solved? How will we know that the problem has been solved? What are the objectives?	Characterisation of existing crop-animal systems, identification of constraints and potential solutions Determination of feed requirements of local animals and formulation of year-round feeding strategies using local feeds; assessment of the impact of legumes and dual-purpose crops on quality of crop yields and crop residues; meeting the requirements of the animals and maintaining soil fertility
Partnerships Are partnerships needed? Who will be the partners?	Yes National Agricultural Research Systems (NARS) ¹ in China, Vietnam, Myanmar, Thailand, Indonesia, Philippines, International Livestock Research Institute (ILRI), Food and Agriculture Organization of the United Nations (FAO)
What will each partner contribute?	1) NARS - personnel, research facilities, matching funds, and other local resources 2) ILRI - personnel, methodologies, training 3) ILRI and FAO - backstopping, e.g. networking, liaison with other Consultative Group on International Agricultural Research (CGIAR) centres to obtain crops germplasm
Resources What is needed to solve the problem? Who will provide the resources?	Funding to support NARS to conduct field research Funding for ILRI to assist NARS with methodologies, conduct cross-site data analyses and training. Estimated cost from donors - US\$ 600 thousand to 750 thousand (for a 3-year period). Will vary depending on number of countries effectively involved

¹Yunnan Beef and Pasture Research Centre and Yunnan Agricultural University in China; Institute of Agricultural Sciences of South Vietnam and Goat and Rabbit Research Centre in Vietnam; Livestock Breeding and Veterinary Dept. in Myanmar; Khon Kaen University and Department of Livestock Development in Thailand; Central Research Institute for Animal Sciences (CRIAS), Central Research Institute for Food Crops (CRIFC) and Assessment Institute for Agricultural Technology in Indonesia; and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and the University of the Philippines at Los Baños Institute of Animal Science (UPLB-IAS) in the Philippines.

Table 2. Concept 2 – animal health

Item	Response
Problem	
What is the problem?	Inappropriate diagnosis of animal diseases Non-affordability of prevention and treatment Inadequate disease reporting Inefficient delivery of veterinary services
Approach	
How will the problem be solved?	Diagnosis, assessment of disease situation
How will we know that the problem has been solved?	Vaccine – easily applicable by farmers (e.g. I ₂ Newcastle vaccine)
What are the objectives?	Use of traditional medicine (ethno-veterinary) Integrated community based health management Conduct case studies and research
Partnerships	
Are partnerships needed?	Yes
Who will be the partners?	National Animal Health and Production Investigation Centre (NAHPIC), Cambodia, Livestock Breeding and Veterinary Department (LBVD) Myanmar, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Bureau of Animal Industry (BAI), University of the Philippines at Los Baños College of Veterinary Medicine (UPLB-CVM) Philippines
What will each partner contribute?	Human resources Laboratory facilities
Resources	
What is needed to solve the problem?	Improved facilities, R&D manpower capability building/upgrading
Who will provide the resources?	International donor agency, ILRI/FAO, NARS

Table 3. Concept 3 – Animal genetic resources.

Item	Response
Problem	
What is the problem?	Access to appropriate genetic resources
Approach	
How will the problem be solved?	Document existing genetic resources (characterisation; status; valuation; databases; molecular diversity)
How will we know that the problem has been solved?	Develop tools for conservation and utilisation (decision aids; cost-effective conservation strategies; cost-effective and sustainable breeding programmes)
What are the objectives?	Demonstrate approach via regional/global breed selection, testing and development
Partnerships	
Are partnerships needed?	Yes
Who will be the partners?	NARS of several/many countries, ILRI, FAO
What will each partner contribute?	ILRI, specific NARS partners, Agricultural research institutions (ARI), FAO NARS backstopped by ILRI/FAO
Resources	
What is needed to solve the problem?	Substantial funding to support NARS staff collect data and samples
Who will provide the resources?	Funding to ILRI/FAO to collect data and design decision aid tools and backstop data analyses. Funding to initiate demonstration projects with commitment from NARS or local communities beyond initiation phase. Estimated cost from donors – US\$ 1 to 5 million per species

Table 4. Concept 4 – Impact of raising sanitary and phytosanitary (SPS) standards on smallholders in South-East Asia.

Item	Response
Problem	
What is the problem?	More stringent international SPS standards seem to promote/encourage increased integration/concentration of meat industries in South-East Asia. This tendency further marginalises small-scale livestock producers, forcing them more into informal markets.
Approach	
How will the problem be solved?	Research and Analysis • Case studies on cost of compliance to SPS regulations • Assess (using OGE model) impact on poor smallholders
How will we know that the problem has been solved?	
What are the objectives?	Provide information to regional policy makers with the intent of bringing issue/options to SPS Committee Heighten ASEAN's influence in the SPS (Codex) standard setting process
Partnerships	
Are partnerships needed?	Yes
Who will be the partners?	ILRI, FAO, ASEAN, country-level policymakers, representatives of local meat industries
What will each partner contribute?	
Resources	
What is needed to solve the problem?	Technical/economic expertise using regional institutions and universities
Who will provide the resources?	Funding Co-operation from meat industries in specific case study countries

Table 5. Concept 5 –Animal diseases and smallholders.

Item	Response
Problem	
What is the problem?	Uncontrolled animal movement in Indo-China and endemic animal diseases inhibit trade by South-East Asia leading to lower production and returns to small livestock producers
Approach	
How will the problem be solved?	• Case studies on impact on elimination of FMD on smallholders, including an assessment to measure the impact of animal diseases on productivity • Implementation of traceability standards and guidelines developed by FAO/ILRI/OIE. This would allow movement control and animal traceback
How will we know that the problem has been solved?	Problem solved: free regional trade flows in livestock and meat products
What are the objectives?	Objectives: access to global markets, higher production and returns by smallholders
Partnerships	
What is needed to solve the problem?	Donors, country collaboration
Who will provide the resources?	Expertise in animal health, epidemiology, economic analysis, risk analysis and trade in animal products

Table 6. Concept 6 – Impact of liberalisation on smallholders in South-East Asia.

Item	Response
Problem	
What is the problem?	Trade liberalisation creates opportunities and risk for smallholders in South-East Asia. Market access creates competition in local markets. What policies and instruments can assist smallholders to adjust to and thrive in this changing environment?
Approach	
How will the problem be solved? How will we know that the problem has been solved? What are objectives?	• Competition studies • Regional and country trade models with distributional impact • Identify through distributional models what type of intervention, policy or other, such as access to credit etc., can be implemented • Present results to policy makers in the region with the objective of heightening the visibility of the topic of the impact of the World Trade Organization (WTO) on smallholders • Develop a platform of options in WTO negotiations
Partnerships	
Are partnerships needed? Who will be the partners?	Yes ILRI, FAO, ADB, ACIAR, ASEAN and national universities and institutions
What will each partner contribute?	
Resources	
What is needed to solve the problem? Who will provide the resources?	Partners, political commitment from regional policy makers

Table 7. Concept 7 – Market issues (market access).

Item	Response
Problem	
What is the problem?	Inadequate participation in market activities due to the presence of transaction costs which act as barriers to market access
Approach	
How will the problem be solved?	The problem will be solved by the reduction of identified transaction costs to a level identified by stakeholders as achievable and suitable
How will we know that the problem has been solved?	
What are the objectives?	
Partnerships	
Are partnerships needed?	Yes
Who will be the partners?	Farmers (smallholders), market agents, FAO/ Japan Livestock Technology Association (JLTA) and Japan International Research Centre for Agricultural Sciences (JIRCAS/ ILRI/ NARS/NGOs, policy makers (regional and national), and regulators
What will each partner contribute?	Farmers (smallholders) – knowledge of market access barriers and priority areas Market agents – identification of priority areas FAO/JLTA and JIRCAS/ILRI – backstopping, methodology, and logistical support, capacity building NARS and NGOs – capacity building, institutional framework for the investigation of and distribution of research findings and results, and policy support Policy makers (regional and national) and regulators – policy development, policy implementation, and policy enforcement
Resources	
What is needed to solve the problem?	Appropriate study design that includes input from all stakeholders Human resources Linkages to ongoing work Appropriate and achievable funding
Who will provide the resources?	ADB country loans Bilateral resources Commodity resources (e.g. CFC) Appropriate foundations

Annex

List of participants

LIST of participants

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