Pig systems in Asia and the Pacific: How can research and development enhance benefits to the poor?

Proceedings of a regional workshop held 23–24 November 2006, at Bangkok, Thailand
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Editors:
W Thorpe and Tesfaye Jemaneh
Table of Contents

Foreword

Pig systems, livelihoods and poverty

Current status, emerging issues, and ways forward – A Costales

Paper

Powerpoint presentation

Status and strategies for pig production in North East India – KM Bujarbaruah

Powerpoint presentation

Pig systems in the Philippines and Thailand – N Poapongsakorn

Powerpoint presentation

Vietnam pig systems and R&D contribution to the poor – NN Que

Paper

Powerpoint presentation

Pig systems in Southeast Asia—The case of Cambodia – P Samkol, K Borin and S Sovann

Paper

Powerpoint presentation

Safety scares, changing retailing and pork supply chain development in China: Opportunities and challenges – K Chen

Powerpoint presentation

Issues of pig production in the Small Pacific States – Hans Wagner

Powerpoint presentation

Discussion group outcomes

Facilitating interventions and innovation in production systems and markets

Pig farming systems in Nepal: How can research and development enhance benefits to the poor farmers of Nepal? – DD Joshi

Paper

Powerpoint presentation

Farmer-led research in village pig production in Lao PDR – P Phengsavana and W Stür

Paper

Powerpoint presentation
Farm-based multidisciplinary research to improve pig production efficiency in the Papua Province of Indonesia – C Cargill and S Mahalaya

Paper
Powerpoint presentation

Improving pig performance through breeding and feeding in Vietnam – LV Kinh and LT Hai

Paper
Powerpoint presentation

Technology interventions enhance the productivity of sweet potato–pig systems at the smallholder level – Z Chengyi

Powerpoint presentation

Sweet potato as a feed resource within feeding strategies for improving smallholder animal production systems in Asia – C Leon-Velarde

Powerpoint presentation

Discussion group outcomes

Facilitating innovation in R&D institutions and knowledge management

Information sharing to facilitate innovation in R&D institutions and knowledge management: The experience of the PigTrop website – V Porphyre

Paper
Powerpoint presentation

Experiences in information sharing and the Livestock Working Group in Vietnam – P Gautier

Paper
Powerpoint presentation

Southeast Asia Foot-and-Mouth Disease campaign (SEAFMD) – R Abila

Powerpoint presentation

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

Powerpoint presentation

APAARI: A platform for knowledge sharing in Asia-Pacific – BD Rosario

Paper
Facilitating innovation in R&D institutions and knowledge management – AM Zola
  Paper
  Powerpoint presentation

Information sharing to facilitate innovation in R&D institutions and knowledge management: The global consortium on zoonoses and avian flu – DD Joshi
  Paper
  Powerpoint presentation

Discussion group outcomes

**Plenary discussion of outcomes and possible ways forward**

Annex 1  Workshop program
Annex 2  List of participants
Foreword

In Asia and the Pacific, and particularly in Southeast Asia, pig keeping is important to the livelihoods of millions of poor people. With the demand for pig meat continuing to rise in the region, increases in pig numbers, more trade in live pigs, commercialization and increasing scales of pig production present both opportunities and threats to the livelihoods of the poor. These poor people include poor pig producers, those who work in, or live in association with, pig production, processing and marketing, and poor consumers of pig products. As these changes happen, what is the role of research and of the research and development community in ensuring that the poor benefit? And if researchable issues are addressed and development interventions identified, what are the best ways of ensuring that the answers are applied as quickly and effectively as possible?

To address these questions, a workshop ‘Pig systems in Asia and the Pacific: How can research and development enhance benefits to the poor?’ was held in Bangkok, Thailand, from 23–24 November 2006, co-organized by APHCA (the Animal Production and Health Commission for Asia and the Pacific: http://www.aphca.org), FAO-RAP (the Regional Office for Asia and the Pacific of the Food and Agriculture Organization of the United Nations: http://www.fao.org), and ILRI (the International Livestock Research Institute: http://www.ilri.org).

The workshop was an important milestone in a continuing process to share information among key R&D stakeholders, to promote dialogue on current and emerging issues, to identify important research questions and effective development interventions and to identify and strengthen the links between research and development.

Research results, development interventions and existing processes of sharing information and joint action for pig systems R&D were reviewed by leading experts and practitioners in the region. Drivers of change that affect pig systems and the poor in Asia were identified and discussed and emerging issues and new ways of working in the R&D community were identified. These sources of innovation and change were discussed in the context of development outcomes that directly affect the poor.

As a result, the outcomes of the workshop were:

- Information on R&D priority activities in the region shared and new mechanisms for sharing information identified;
- Effective development interventions and important gaps requiring research identified, and options for R&D projects and resource mobilization developed;
- New relationships created and existing networks for R&D strengthened.
Pig systems, livelihoods and poverty: Current status, emerging issues, and ways forward

A Costales

Livestock Economist, Pro-Poor Livestock Policy Initiative (PPLPI), FAO (Food and Agriculture Organization of the United Nations), Rome, Italy

Introduction

Engagement in livestock production is an important income-generating activity among agricultural households in rural areas in the developing regions of the world. The rapidly increasing demand for livestock products at the global level, particularly due to increasing populations, increasing per capita incomes, and rapid urbanization in developing countries, presents opportunities for the rural poor in these countries to participate in and benefit from such growth. On the other hand, on the supply side of the market, new technologies as well as new organizations in production, processing, procurement and distribution systems have emerged to more efficiently meet not only the larger volumes required but also the increasing demand by consumers for food products quality and safety, and to comply with public rules and regulations governing trade in livestock products. Within this environment, there is no automatic link between engagement in livestock as livelihood source by rural households and the increasing demand for livestock products. Strong market links between livestock producers in the rural areas and the growing markets for livestock products within the economy is a necessary condition for taking advantage of these opportunities for increased incomes by rural livestock keepers.

The global picture

In the majority of the developing countries, livestock-based livelihoods among rural households are not specialized stand-alone economic activities but are closely integrated with other agricultural endeavours within the framework of mixed production systems (e.g. crop–livestock). This general statement, however, recognizes that there are also significant proportions of poor livestock keepers in developing countries that specialize in livestock, such as pastoralists in the arid zones of Africa, Asia and Latin America. The mixed-farm facet of livestock livelihood is significant in that the potential for livelihood improvement can be situated within the development stage of agriculture of individual countries at the macro level, and of farms at the micro level within countries. Pingali (2006) classifies the development of agriculture into three broad stages—‘traditional’, ‘modernizing’, and ‘globalizing’—according to some criteria such as the share of agriculture in GDP, share of labour in agriculture, output mix, importance
of scale economies, and market orientation. In terms of the last criterion, ‘traditional’ farms would be more subsistence-oriented, with occasional opportunistic ventures to local markets. ‘Modernizing’ farms would generally be market-oriented, with links to domestic markets at the local and/or national level. In most developing countries, the ‘globalizing’ farms would constitute only a small proportion of farms in the rural areas. Nevertheless, the integration of the agricultural economies of developing countries to global agricultural trade would have impacts that reverberate in the domestic markets of rural livestock keepers.

The increasing demand for livestock products in developing countries presents an opportunity for increased incomes of households raising livestock or engaged in the trade of the commodity along the various market chains of the livestock sector. However, the increasing demand for product quality and food safety among urban consumers, and the increasing competition from imports as well as from larger-scale and more sophisticated commercial suppliers, present a challenge particularly for smallholder rural livestock keepers to participate in, compete for, and defend their own market share in the growing demand for livestock products.

The extent to which smallholder rural livestock producers and their market chains can participate in and benefit from the growth in the livestock economy depends on the strength of the linkage between the rural farms and the various classes of consumers, intermediated by market chains in both the formal and informal markets (Haggblade et al. 2005). When that link is strong, supported by functional physical and institutional market infrastructure, and accessible to larger-scale and smallholder producers alike, the growth in demand, the technological advances in production, and the growing sophistication in the organization of processing and distribution, would most likely translate to increased incomes of both larger farms and smallholder rural-based producers, meeting such growth and diversity in the demand for livestock products.

When the strength of the linkage between livestock producers and consumers are biased in favour of more progressive farmers (e.g. better access to physical and institutional market infrastructure) at the expense of producers with a weaker political voice and bargaining power, then the impacts of growth in the livestock sector would tend to be inequitable. Growth would likely benefit those with better access to lucrative mainstream markets catering to urban centres, while the rest would be consigned to compete among themselves in the marginal markets where growth in demand may not be as strong. Livestock producers shut out from the growth markets may exit from the livestock sector to find alternative livelihoods.

Finally, when at the country level, rural livestock producers are barely connected to urban markets, growth in demand for livestock products could readily be met with increased imports. With local rural producers disconnected from the mainstream markets, the livestock livelihood of rural households would likely stagnate. When this happens to the entire rural sector at the
country level, with no source of growth stimulation, agricultural productivity will deteriorate, leading to lower real returns and incomes to agricultural labour, and worsening rural poverty. Along this evolution of events, the exit of households from agriculture, the shift to mean jobs in non-agricultural activities, and the migration to urban centres would be seen as ‘escape valves’ out of deeper poverty, rather than a reflection of the growth in demand for non-agricultural labour.

The above considerations argue that improvements in livestock livelihood as a tool for poverty alleviation cannot be seen and treated in isolation. Pure technical interventions to increase livestock productivity at the farm level would not automatically translate to a sustained improvement in household incomes and to a reduction in poverty. While there are real resource costs to such technical interventions, requiring the use of scarce physical, human, and financial resources from the public or/and private sector(s), the intended benefits to poorer rural households may not necessarily be forthcoming.

Livestock sector and pig systems in Southeast Asia and the Pacific

Asia is a major producer of pig meat in the world. Table 1 shows that Asia accounts for the largest share (43%) of global pig output (Groenewold 2004). The next major group comprises the OECD countries (37%). In terms of production systems, close to 80% of pig output in Asia is produced under ‘mixed’ farms (crop–livestock), while the rest are produced in specialized intensive ‘landless’ systems (Table 2).

Table 1. Shares in volume of pig meat output, by region, 2004

<table>
<thead>
<tr>
<th>Region</th>
<th>Output volume (× 10³ t)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>31,368</td>
<td>42.9</td>
</tr>
<tr>
<td>OECD</td>
<td>27,167</td>
<td>37.2</td>
</tr>
<tr>
<td>E. Europe and CIS</td>
<td>10,759</td>
<td>14.7</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>3126</td>
<td>4.3</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>526</td>
<td>0.7</td>
</tr>
<tr>
<td>Other developed</td>
<td>135</td>
<td>0.2</td>
</tr>
<tr>
<td>West Asia and North Africa</td>
<td>38</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73,118</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 2. Distribution of pig output by production system in Asia, 2004

<table>
<thead>
<tr>
<th>Production systems</th>
<th>Percent share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed crop–livestock</td>
<td>78.1</td>
</tr>
<tr>
<td>Landless intensive</td>
<td>21.9</td>
</tr>
<tr>
<td>Land-based extensive</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>


Landless systems would mostly be strategically located in peri-urban areas. This configuration confirms the predominance of livestock livelihoods being integrated within the gamut of agricultural activities of households within the farm. Within Asia, major concentrations of production are located in southern China and Southeast Asia, particularly in Vietnam, Thailand, and the Philippines (Figure 1).


Figure 1. Concentrations of pig production in South China and Southeast Asia.
Agriculture and the livestock sector

The significance of agriculture in the respective economies of the countries in SEA and the Pacific vary in terms of their relative contribution in GDP. In macroeconomic sectoral accounting, the primary or agricultural sector includes economic activities in crops, livestock, fisheries and forestry. The secondary and tertiary sectors refer to industry and services, respectively. Table 3 shows that agriculture is relatively more important in the lesser developed economies of Myanmar, Lao PDR, Cambodia, Timor Leste and PNG (between 30 and 50% share in GDP) than the rest of the countries. For all countries in the Southeast Asian region, the relative significance of agriculture in the economy exhibited a declining trend between 1990 and 2005. The reverse, however, was occurring in the Pacific countries of Papua New Guinea and Timor Leste-Leste.

Table 3. Share (percent) of agriculture in total GDP, 1990–2005

<table>
<thead>
<tr>
<th>Country</th>
<th>1990</th>
<th>2000</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myanmar</td>
<td>57.3</td>
<td>57.2</td>
<td>50.6</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>61.2</td>
<td>52.6</td>
<td>47.0</td>
</tr>
<tr>
<td>Cambodia</td>
<td>55.6</td>
<td>37.9</td>
<td>32.9</td>
</tr>
<tr>
<td>Vietnam</td>
<td>38.7</td>
<td>24.5</td>
<td>20.9</td>
</tr>
<tr>
<td>Philippines</td>
<td>21.9</td>
<td>15.8</td>
<td>14.4</td>
</tr>
<tr>
<td>Indonesia</td>
<td>19.4</td>
<td>15.6</td>
<td>13.4</td>
</tr>
<tr>
<td>Thailand</td>
<td>12.5</td>
<td>9.0</td>
<td>9.9</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>29.8</td>
<td>25.8</td>
<td>31.6</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>29.0</td>
<td>30.8</td>
<td>33.1</td>
</tr>
</tbody>
</table>


The share of the livestock sector in the agricultural economy also varied among countries. Livestock has a relatively greater contribution in the agricultural GDP of the Philippines, Cambodia, Thailand, and Timor Leste (20–25% share) as compared to the rest (Figure 2).

Except for Thailand, the share of livestock in agricultural GDP improved from 1990 to 2005. What this indicates is that even as the contribution of agriculture as a whole in GDP was declining within agriculture, the role of livestock was becoming more and more important as a contributor in the agricultural economy. This indicates that the livestock sector was posting a more rapid growth than the other sectors of agriculture combined. Thus, in SEA and The Pacific, a strong source of growth among rural households for income generation and poverty reduction is the livestock sector.
Meat consumption patterns and trade

Per capita meat consumption shows quite variations among countries in SEA and Timor Leste (from 10 kg to 48 kg per capita). Table 4 shows that in general, higher per capita consumption (>25 kg) is associated with the countries with more developed economies and with higher per capita incomes (Malaysia, Thailand, The Philippines, Vietnam) as compared to the rest. In all countries, however, the increase in per capita consumption between 1990 and 2002 reflects the growing demand for meat products.

Table 4. Growth in per capita meat supply (consumption), 1990–2002, in kg

<table>
<thead>
<tr>
<th>Country</th>
<th>1990</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>38.1</td>
<td>48.0</td>
</tr>
<tr>
<td>Philippines</td>
<td>17.9</td>
<td>29.6</td>
</tr>
<tr>
<td>Vietnam</td>
<td>15.7</td>
<td>28.2</td>
</tr>
<tr>
<td>Thailand</td>
<td>22.8</td>
<td>27.0</td>
</tr>
<tr>
<td>Cambodia</td>
<td>12.3</td>
<td>14.8</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>11.2</td>
<td>15.5</td>
</tr>
<tr>
<td>Indonesia</td>
<td>8.0</td>
<td>9.6</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>17.6</td>
<td>21.7</td>
</tr>
</tbody>
</table>

The relative importance of pig meat as compared to other sources of meat again shows wide variations among countries in the region. Figure 3 shows that pig meat is the dominant source (>50% of meat consumption) in Vietnam, The Philippines, Cambodia, and Timor Leste. On the other hand, poultry is the most popular meat source for Malaysia, Indonesia, and Thailand. The lesser significance of pig meat in Malaysia and Indonesia could be traced to cultural and religious traditions influencing tastes and preferences of the general population.

Figure 3. The relative importance of pig meat and other meat types, various countries, 2002 (in percent of total meat consumption).

Figure 4 reveals that in terms of absolute quantities, the popularity of pig meat consumption is maintained in Vietnam, The Philippines and Timor Leste (>10 kg/cap), although Thailand is rapidly approaching the 10-kg mark. Indonesia, and to a lesser extent, Malaysia, continue to be countries where pig meat consumption is relatively not favoured. In all the countries in the region except Indonesia and Malaysia, per capita consumption of pig meat exhibited a significant increase between 1990 and 2002, with the largest absolute and relative improvements taking place in Vietnam, where large strides in economic growth had been taking place.

The differences in consumption patterns show that for a number of countries, pig meat is significant and occupies the largest component of meat consumption, and in these countries, the increase in meat consumption levels have been relatively rapid. However, it is also the case that for some countries, other meat types carry greater importance, as seen in the dominantly Islamic countries of Indonesia and Malaysia, where even per capita consumption of pig meat is declining.
Net trade position in pig meat

The net trade position in pig meat also shows contrasting performance among the countries in the region. Table 5 shows that Thailand and Vietnam have emerged as the leading net exporters of pig meat, with even Indonesia showing positive value. On the other hand, Timor Leste, Malaysia, and The Philippines are shown to be net importers, with imports gradually increasing their role as source of domestic supply of pig meat. The net exports position of Thailand and Vietnam points to the challenges for exporters in these countries to maintain and defend current export markets and niches, as well as to break new export markets as food safety standards continue to be tightened especially in markets of developed countries. For net importing countries, the influx of imports present the challenge to domestic producers to compete in supplying domestic consumers, particularly in the large urban centres, with pig meat that are comparable with imported products, not only in terms of price, but also in terms of product quality, food safety, and product packaging. It becomes evident that competition at the farm level is influenced by competitiveness also along the entire chain that lead to domestic consumers. For countries such as Indonesia, Lao PDR and Cambodia, focusing on domestic markets and internal competition among producers would be the more pressing issues.
Table 5. Net exports position in pig meat trade, 1992–2002, as percentage of total domestic supply

<table>
<thead>
<tr>
<th>Country</th>
<th>1992</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>0.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>-0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Laos</td>
<td>0.0</td>
<td>-0.01</td>
</tr>
<tr>
<td>Cambodia</td>
<td>0.0</td>
<td>-0.02</td>
</tr>
<tr>
<td>Philippines</td>
<td>-0.1</td>
<td>-2.5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-2.7</td>
<td>-4.2</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>-7.0</td>
<td>-10.4</td>
</tr>
</tbody>
</table>


Production response to increased regional demand for pig meat

The production response of the pig sector in countries in SEA and selected Pacific countries to increasing pig meat demand in the region does not show a corresponding uniform rapid increase in output. Observing the trends in the output index covering the years 1990–2004, countries could be grouped into ‘high growth’ and ‘slow growth’ countries. Figure 5 shows that for ‘high growth’ countries, output increase by 2004 was by 75 to 175% of their 1990 levels. These included the countries of Vietnam, Myanmar, Cambodia, The Philippines, Thailand, and Papua New Guinea. For the ‘slow growth’ countries, Figure 6 shows that output increased only 4 to 51% over the same period. These countries were Indonesia, Lao PDR, and Timor Leste. Slow growth in Indonesia may be attributed to weak domestic demand due to cultural reasons, where per capita consumption of pig meat has in fact been on the decline, but even then, the positive net exports position of Indonesia, although still relatively small, indicate that growth in demand may be located outside the country, but local production may be facing constraints to respond to these potentials. On the other hand, slow growth in Lao PDR and Timor Leste does not point to slow growth in domestic demand but may indicate barriers impeding a more rapid domestic production response. For Timor Leste in particular, rather than domestic production picking up, imports of pig meat have become an increasingly significant source of domestic supply. In general, there needs to be a deeper investigation on the lack of positive response in production in these countries.

Even for the apparently ‘high growth’ countries, there needs to be a deeper investigation of which types of production systems were responding more rapidly to growth in demand in the domestic as well as international markets. This is important in establishing whether or not there are links between growth in the sector and poverty reduction among the households that dominantly engage in the activity. Where there are such links, it is important to establish the dynamics of how these links work.

**Figure 5.** Trends in growth of pig meat production in ‘fast growth’ countries, 1990–2004.


**Figure 6.** Trends in growth of pig meat production in ‘slow growth’ countries, 1990–2004.
Agriculture and poverty linkages

Among the SEA and selected Pacific countries, Table 6 shows that there are wide differences in the overall incidence of poverty (using the respective national poverty thresholds), with Malaysia and Thailand having the lowest poverty rates. What is generally true, with the exception of Myanmar, is that rural poverty incidence is significantly higher than in urban areas. For more than half of the countries, the proportion of households living below the poverty threshold was between 35 and 46%.

Table 6. Comparative rural and urban poverty incidence by country, in percent

<table>
<thead>
<tr>
<th>Country</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippines (1999)</td>
<td>41.4</td>
<td>15.0</td>
</tr>
<tr>
<td>Lao PDR (2002)</td>
<td>41.0</td>
<td>26.9</td>
</tr>
<tr>
<td>Cambodia (1997)</td>
<td>40.1</td>
<td>18.2</td>
</tr>
<tr>
<td>Vietnam (1997)</td>
<td>35.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Myanmar (2000)</td>
<td>22.4</td>
<td>23.9</td>
</tr>
<tr>
<td>Thailand (2002)</td>
<td>12.6</td>
<td>4.0</td>
</tr>
<tr>
<td>Malaysia (1999)</td>
<td>12.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Timor-Leste (2001)</td>
<td>46.0</td>
<td>26.0</td>
</tr>
<tr>
<td>PN Guinea (1996)</td>
<td>41.3</td>
<td>16.1</td>
</tr>
</tbody>
</table>


Rural households, in general, depend on agriculture, directly or indirectly, for their livelihood. For more than half of the countries represented, between 57 and 82% of the total labour force were employed in the agricultural sector (Table 7).

Table 7. Proportion of labour force employed in agriculture by country, in percent

<table>
<thead>
<tr>
<th>DMC</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lao PDR (2003)</td>
<td>82</td>
</tr>
<tr>
<td>PN Guinea (2005)</td>
<td>72</td>
</tr>
<tr>
<td>Myanmar (1997)</td>
<td>63</td>
</tr>
<tr>
<td>Vietnam (2005)</td>
<td>57</td>
</tr>
<tr>
<td>Cambodia (2004)</td>
<td>60</td>
</tr>
<tr>
<td>Indonesia (2005)</td>
<td>44</td>
</tr>
<tr>
<td>Thailand (2005)</td>
<td>43</td>
</tr>
<tr>
<td>Philippines (2000)</td>
<td>37</td>
</tr>
<tr>
<td>Timor-Leste</td>
<td>…</td>
</tr>
</tbody>
</table>


The above figures indicate that for intervention to reduce poverty in these countries, measures must be undertaken in the locations where the poor are found (predominantly in the rural
areas), and must have a positive impact on the economic activities in which the poor are already engaged (predominantly in agriculture). Furthermore, within agriculture, the interventions must focus on the economic activities and subsectors that have potential for growth and increased incomes for households engaged in them, directly or indirectly. These would be the agricultural products experiencing significant growth in demand in domestic markets, particularly in the major centres of demand—the urban areas. Such products would generally involve those with relatively higher income elasticity, such as meat and milk, as well as higher-value crops (e.g. fruits and vegetables). The existence of strong consumption or/and production linkages in the economic activities of the rural poor where intervention is targeted would increase the likelihood that interventions made at the production and marketing chain levels bring about sustained increases in incomes of rural households, thereby making headways in rural poverty reduction.

While the initial target markets may be the large urban centres, the significance of smaller towns should not be overlooked, as the consumption linkages created by sectoral growth at the farm and at the rural–to–urban market chain levels can create additional sources of demand growth closer to the production centres. In addition, while agricultural products with higher income elasticity would be obvious targets for income generation among rural households, one should not forget that for poorer households both in the rural and urban areas, the access to (availability and affordability) basic food staples is a necessary ingredient to poverty alleviation. Improving the productivity and markets of the basic staples sector should not be ignored. Thus, in considering pro-poor intervention strategies involving livestock-based livelihood of households in the rural areas, one always has to return to the basic framework that livestock is an integrated aspect of the agricultural livelihood of rural households rather than a singular specialized activity of pure ‘livestock producers’.

Dynamics of pro-poor livestock sector development and poverty reduction: The case of Vietnam

Location of the poor

Information on the distribution of poverty across geographic areas in a particular country is a powerful tool in locating poverty alleviation interventions. In the case of Vietnam, poverty maps generated from such information reveal that poverty incidence is most acute in the Northern Mountain Regions as well as in the Central Highlands, which generally could be described as the more remote rural areas (Figure 7a). On the other hand, poverty density maps show that a greater number of poor households are located in the same areas where there are high population concentrations, meaning in and close to the large urban centres,
but more particularly so in the north than the south (Figure 7b). Both maps indicate the two aspects of poverty among households—the static and the dynamic aspects. Poverty incidence remains acute in areas with little economic activity and opportunity (remote rural areas), and poor households move and gravitate to where economic opportunities exist for them to earn their livelihood, most likely where economic activities are occurring, in or close to large population centres. Evidently, for the poor in the rural areas, their livelihoods are closely linked to agricultural production activities. For the poor in and around the cities, livelihoods will be more varied, including activities along the market chains that link rural production areas to major consumption centres. For the poor in these locations, which may not be engaged in livestock or more general agricultural production activities, an important element of poverty alleviation intervention is the improvement in their real incomes and purchasing power through lower consumer prices of basic staples as well as livestock products.

Source: VLSS (2002).

Figure 7a. Geographic distribution of poverty incidence in Vietnam, 2002.
Pig production among rural households

How relevant is the economic activity of pig production among rural households in Vietnam? Figure 8 shows that in four of the seven major geographic regions in the country, more than 60% of all rural households engage in pig production. Most of these regions are in the north and central parts of Vietnam. These are the same regions where rural poverty incidence is among the highest. In these same regions, income from livestock provides a significant contribution to total household income, particularly in the northern regions where the contribution of livestock reaches not less than 20% of household income. Figure 9 reveals that of the total livestock income, in most of the regions, income from pigs constitutes greater than half. In Figure 10, the grouping of households into income quintiles also reveals that there are differences in the relative significance of income from pigs for households in the north and central regions, in contrast to the households in the southern regions of Vietnam. First is that income from pigs in general has greater significance to households in the north than in the south. Second, for households in the north and central regions, income from pigs holds greater significance for households belonging to the lower income quintiles (poorer) than for those in the higher income quintiles.
Figure 8. Regional distribution of ownership of pigs by rural households in Vietnam, 1998.


Figure 9. Share of livestock in total income and distribution according to livestock sources, 2001.

In contrast, in the southern regions, income from pigs has greater significance for households belonging to the upper income quintiles (richer). The differences in the patterns of relative significance of incomes from pigs among income groups, in the north and in the south, point to the potentially different distributional impacts of a singularly-directed intervention that promotes growth in the pig subsector. Furthermore, as there are differences in access to markets and services among pig production systems (e.g. household-based smallholder farms versus large commercial farms), it matters which production and marketing systems are supported by a single-directed pig sector promotion intervention in anticipating the pattern of distributional impacts of such sectoral intervention.

Typologies of rural households and integration of pig production and other livestock in livelihoods

In dealing with the variety of sources of income of rural households in Vietnam, one could classify households as ‘agricultural’ (where >50% of total income are derived from agricultural activities) or ‘diversifying’ (where their income from agriculture is less than 50% of total income). Table 8 shows that the majority of rural households remains ‘agricultural’ (56%), but that the proportion of ‘diversifying’ households is already quite significant. Agricultural households can further be classified as to the extent of market orientation (or the degree of dependence of household income on home production). ‘Subsistence’-oriented (>75% home produced), ‘semi-commercial’ (25–75% home produced), or ‘commercial’-oriented...
(<25% home produced). It is important to note that the greater majority (close to 60%) of agricultural households are those that are already integrated in markets but not yet intensively commercialized. This has an important bearing on the direction of interventions that are aimed at reducing poverty among rural households in Vietnam. For diversifying households, they could also be classified according to significance of home production into ‘semi-market oriented’ (>25 % home produced) and ‘market oriented’ (<25% home produced).

Table 8. Distribution of rural households by livelihood categories and market orientation

<table>
<thead>
<tr>
<th>Category</th>
<th>Market orientation</th>
<th>Percent of HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>Subsistence (&gt;75% home produced)</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Semi-commercial (25–75% marketed)</td>
<td>33.0</td>
</tr>
<tr>
<td></td>
<td>Commercial (&gt;75% marketed)</td>
<td>16.5</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>55.6</td>
</tr>
<tr>
<td>Diversifying</td>
<td>Semi-market (&gt;25% home produced)</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>Market-oriented (&lt;25% home produced)</td>
<td>34.8</td>
</tr>
<tr>
<td></td>
<td>Sub-total</td>
<td>44.3</td>
</tr>
</tbody>
</table>

Source: Maltsoglou et al. (2005).

Figure 11 reveals that within both categories of households (agricultural and diversifying), the groups with higher market orientation had higher mean household incomes. The most market-oriented households had mean incomes that were more than double the incomes of less market-oriented households. Thus, among rural households in Vietnam, the level of household incomes has more to do with their strength of linkage to markets rather than on their being ‘agricultural’ or being ‘diversifying’ households.

Figure 12 shows that in rural Vietnam, income from livestock has greater significance among ‘agricultural’ households (ranging between 20 to 25% of total income) than among ‘diversifying’ households. This validates the status of livestock livelihood as integrated into whole agricultural livelihood of the rural household, rather than as a singular specialized livelihood of livestock households.

The degree of market orientation has a more telling impact on livestock income among agricultural households than for diversifying households. For all household types, income from pigs dominates as contributor to livestock income. Figure 13 shows that, particularly among agricultural households, the greater the market orientation, the higher the mean income from pigs. Subsistence-oriented households depend more on pigs and chicken as a source of livestock income. As agricultural households become more commercialized, income from livestock also becomes more diversified to include income from cattle and fowls other than chicken.
Figure 11. Comparative household income levels by HH category and market orientation.

Figure 12. Share of livestock in total income by HH category and market orientation.
From the configuration of rural households, it can be asserted that the impact of livestock sector interventions would largely fall on agricultural rather than diversifying households. Within the category of agricultural households, as the largest proportion belong to the group of ‘semi-commercial’ households (59%), the type of intervention in the livestock sector that would have the widest coverage would be one that would have the impact of improving the terms of exchange of those already extensively participating in markets, and moving them to a more gainful intensive engagement. A more intensive engagement is exemplified by the 30% ‘commercially oriented’ farm households that were earning more than twice as much income as their ‘semi-commercial’ counterparts. Policy and institutional interventions that address, as broadly as possible, the market barriers to pig production and trade that ‘semi-commercial’ farm households face, which would have the impact of improving their terms of trade, would most likely also benefit the already quite ‘commercially-oriented’ group. This should not necessarily pose a distributional problem.
as the wider the coverage of the positive impacts, the wider the direct income improvement effects, the more extensive also the secondary income effects, and the stronger would be the poverty reduction impacts. For subsistence-oriented agricultural households, improving the terms of trade would have impact only on their incomes arising from their small proportion of marketed output. Alternative measures of direct poverty alleviation that would address the capacities and limitations of these households would be more suitable measures than pure market improvements.

Directions for intervention in the livestock sector for poverty reduction in Vietnam

When the objective of poverty reduction is an explicit dimension of policy, intervention in the livestock sector must be viewed within the whole agricultural livelihood configuration of rural households in Vietnam, not as an isolated sectoral intervention. As shown in Table 9, a significant piece of information is that more than 60% of household income comes from marketed agriculture. The market linkage is essential, as seen in the differences in total mean income levels of ‘commercial-oriented’ agricultural households and ‘subsistence-oriented’ and ‘semi-commercial’ households (Figure 11), and more particularly the significant difference in the levels of livestock income between the ‘commercial’ and ‘semi-commercial’ households on the one hand, and the ‘subsistence-oriented’ households on the other (Figure 12). The importance of market linkage is even more evident in pig production as among the three agriculture household types, between 94 to 99% of the value of all pig produced is derived from sold output (VLSS 2002).

Table 9. Sources of income of rural households in Vietnam, 2002

<table>
<thead>
<tr>
<th>Income source</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketed agriculture</td>
<td>62</td>
</tr>
<tr>
<td>Self-employment</td>
<td>18</td>
</tr>
<tr>
<td>Wages</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: VLSS (2002).

For agricultural households, the income from marketed agriculture depends on a complex of market supply chains extending from the farm-gate to urban households, and even to foreign households as in the case of pig production in Vietnam. Increasing marketed income from livestock is not just a matter of increasing pig holdings or improving their
physical productivity. These additional livestock holdings must earn positive net returns from market engagement (i.e. not traded at a loss). The income-generating capacity of household investments in livestock depends to a large extent on the terms of trade that farmers get in their linkage with markets. PPLPI research on these linkages indicates that the terms of participation are still far from achieving their potential to help the rural poor (Roland-Holst et al. 2006). Understanding these complex linkages require investigation into the nature of barriers at work that worsen these terms of market participation, and their impacts along the market supply chains.

Micro-economic fundamentals assert that broadly the terms of market participation of rural producers can be improved by measures that impact on either the revenue or cost side (or both) of the balance sheet of these market participants. The revenue side could be improved either by an increase in the volume of marketed output or an increase in the farm-gate value (price) per unit of output. On the cost side, the terms of participation are improved when measures undertaken lead to a reduction in the cost per unit of output marketed. The income improvement and poverty reduction impacts of interventions that improve the terms of trade of market participants is magnified when the positive impacts filter through to market participants at various stages along the market supply chains.

Pro-poor impacts of livestock policy change

The configuration of engagement in livestock of various types of households has a bearing on the distributional impact of policy change in the livestock sector. The previous section revealed that income from livestock has a relatively larger significance to incomes of lower income households in general, and among lower income agriculture-dependent households in the rural areas in particular. In addition, the level of market engagement of agricultural households has a direct bearing on the level of their livestock incomes. Taking into consideration their respective current levels of market engagement, as well as the inter-sectoral linkages of the livestock subsector, simulation experiments on the distributional impact of a generic livestock promotion policy change that improves livestock productivity growth by seven (7) percent annually, show that in general, poorer households would realize greater relative income improvements than would wealthier households (Roland-Holst et al. 2006). The spread of relative changes in household incomes across households is shown on Figure 14. Thus, interventions in the livestock sector, as they work through the market chains, that improve the livelihood of rural households at the farm and along these chains, will have direct impacts in poverty reduction in Vietnam.
Conclusion

The demand for livestock products has exhibited a fairly rapid growth in Southeast Asia and The Pacific. For pig meat in particular, demand has shown strong growth, except in the predominantly Muslim countries of Malaysia and Indonesia. At the macro level, the pig sector in the countries of Southeast Asia and The Pacific have exhibited different responses to growth in demand, with the majority exhibiting rapid growth in output and a few showing slow growth or stagnation.

In general, the sectoral response to increasing demand for livestock products depends on the strength of market linkage between rural producers and the mainstream urban markets for these products, and even with external markets where these are present.

Livelihood from livestock is a significant component of total household income, particularly for the lower income households, as exemplified by the case of Vietnam. Most agricultural households are linked to markets for their produce, and derive the larger part of their household income from such market engagement, although at varying intensities, with the degree of
market linkage positively related to the level of income from livestock, as well as to total household income, particularly for rural agricultural households.

Pure technical interventions to increase livestock holdings or physical productivity at the farm level may not automatically result in improved incomes of the rural households with livestock. Livestock keepers must be able to gain positive net returns from marketing their additional livestock; otherwise losses incurred due to market engagement would increase their indebtedness. Strengthening the market linkages in a way that improves their terms of trade for the livestock products of rural agricultural households has significant potential for improving the incomes of rural households with livestock livelihood, and in reducing poverty.

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Pig Systems, Livelihoods and Poverty: Current Status, Emerging Issues, and Ways Forward

Achilles Costales

FAO PPLPI

Regional Workshop
APHCA - FAO-RAP - ILRI
“Pig systems in Asia and the Pacific: How can R&D enhance benefits to the Poor?”
Bangkok, Thailand
23-24 November 2006

Outline

1. The Global Picture
   • ‘Drivers’ of Change
   • Main pig production regions
   • Dominant production systems
2. Regional Profile: Southeast Asia and the Pacific
   • Macro indicators
   • The pig sector
   • Poverty dimensions
3. Country-level Perspectives in Livestock Development-Poverty Reduction Linkages: e.g., Vietnam
   • Spatial dimensions
   • Household typologies
   • Potential impacts of policy interventions
PIG PRODUCTION IN THE WORLD

Interlocking ‘Drivers’ of Change

• Growing and changing demand for livestock products in Developing Countries
• New technologies in production and processing
• National and international market liberalization and integration

Question:

How will developing countries in SE Asia and the Pacific respond?
Stages of Development in Agriculture (Livestock)

<table>
<thead>
<tr>
<th>Traditional Agriculture</th>
<th>Modernizing Agriculture</th>
<th>Globalizing Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of agriculture in GDP</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Share of labour in agriculture</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Market orientation</td>
<td>Subsistence</td>
<td>National / Domestic</td>
</tr>
<tr>
<td>Output mix</td>
<td>Food staples</td>
<td>Food staples + export crops</td>
</tr>
<tr>
<td>Scale economies</td>
<td>Not important</td>
<td>Not important</td>
</tr>
</tbody>
</table>

Source: Pingali, 2005

Alternative Responses to Drivers of Change

1. Positive pathway
   - Large farms → Formal supply chain → Urban consumers
   - Small farms → Informal supply chain → Rural consumers

2. Stagnation / involution
   - Small subsistence farms

3. Inequitable pathway
   - Large farms → Formal supply chain → Urban consumers
   - Small farms → Informal supply chain → Rural consumers
   - Small farms → out of business

Source: Pingali, 2005
Global Concentrations in Pig Production

Source: FAO, 2006

Distribution of world pigmeat output, 2004

 Shares (5)

OECD 37%
E. Europe & CIS 15%
Other Developed 0.2%
Asia 43%
WANA 0.1%
S-S Africa 0.7%
LAC 4%

Source: Groenewold, 2004
Production Systems: Endowments & Constraints

- Mixed Systems still the predominant mode in developing country regions
  - integrated in crop production
- Intensive systems in OECD Countries
  - They also exist in Asia, to a lesser degree
- Predominance of systems of production reveal already broad resource constraints, as well as resource endowments that are readily usable, to which farmers have access.
Southeast Asia & the Pacific: Trends and Perspectives

- Agriculture in the overall economy
- Relative importance of Livestock
- Urbanization
- Production, consumption, and trade
- Poverty dimensions

Agriculture in the economy, 1990-2005

% of GDP

Source: ADB, 2006
Relative importance of Livestock in Agricultural economy, 1990-2005

% of Agriculture GDP

Source: FAOSTAT, 2006

Urbanization, 2000-2004

% of total population

Source: ADB, 2006
Macro trends

• The share of Agriculture to GDP is declining over time in most countries
• That the contribution of Livestock to agriculture GDP is increasing reveals the growth potentials of Livestock as income generator
• Urbanization is generally increasing in all countries, although at different speeds
  • This has implications on growth of DEMAND for livestock products and on CHARACTER of that demand in the respective countries.

Pig Production in the Livestock Sector
Regional Concentrations of Pig Production

- Major concentrations: Southern China, Vietnam, Philippines, Thailand
- Minor concentrations
  - Pockets of production regions within countries

Differential Growth in Pig Production, 1990-2004

High-growth countries

Slow-growth countries

Source: FAOSTAT, 2006
Regional Position in Pig Production

- SE Asia is a major pig producing region in Asia (outside China)
  - The Pacific is still a minor, but emerging region
- Most of the countries in the region have been experiencing relatively rapid growth in pig production.

Questions:
- Why has rapid growth happened in high-growth countries?
  - Is this growth equitable?
  - Or is it of the inequitable kind?
- What have been preventing Lao PDR, Indonesia and Timor-Leste from exhibiting more rapid growth?
  - Is the lack of growth an indication of tendencies toward ‘involution’?

Consumption Patterns and Trade
**Total Meat per Capita Supply (Consumption), 1990-2002**

- Growing meat consumption in all countries
- Lower per capita consumption in lower-income countries

Source: FAOSTAT, 2006

**Pigmeat per capita supply (consumption), 1990 - 2002**

- Growing pigmeat consumption in almost all countries
  - Exception of Malaysia and Indonesia

Source: FAOSTAT, 2006
Share of pigmeat in total meat consumption, 2002

Source: FAOSTAT, 2006

Net exports in proportion to total pigmeat supply, 1990-2003

% of domestic supply

Source: FAOSTAT, 2006
Consumption Patterns

- Per capita consumption of pigmeat is rising in the region
  - At different speeds
- Pigmeat is more important in some countries, but less in others
  - Malaysia, Thailand and Indonesia - larger demand for poultry meat
- What markets are targeted?
  - Thailand and Vietnam - the export market introduces other rules in the production and marketing of output to compete
  - Net importing countries - local producers have to compete with imports, in delivery efficiency and quality, in the same markets supplied

Agriculture and Poverty Linkages
Rural Poverty is still prevalent…

Poverty incidence (%)

Sources: ADB, (2006)

Dependence on Agriculture for Employment, 1990-2000s

% employed in agriculture

Source: ADB, 2006
Locus of Poverty Reduction Interventions

- …must be located on where the poor are (rural areas and communities)
- …must begin with the economic activities that rural households are already engaged in (agriculture)
  - For home consumption
  - For the market
- …must focus on economic activities that have potentials for growth and income generation (Livestock, HVCs…)
  - Direct production impacts
  - Strong consumption and/or production linkages (processing, services)

The Dynamics of Sectoral Development and Poverty Reduction

The dynamics happen at the country level

Example: Vietnam
- Availability of information: a focus country of PPLPI
- May offer insights of approach for other countries
Where are the poor located?

- Spatial distribution of poverty incidence
  - Highest in the Northern Mountain Regions & Central Highlands
  - More remote rural areas

Where are the Concentrations of Poor HHs?

- Poor HHs density
- Population density
Location of Poor Households

- Poverty is prevalent in more remote rural areas
- Households in search of better livelihood locate themselves where the employment opportunities are (converging in population centers)
  - They may be found along market chains, performing various production activities and services (linkages)
- There are also poor households in urban centers who would benefit from the access to affordable livestock products
- Lower real prices of meat could expand demand linkages

Prevalence of Pig Production among Rural HHs

<table>
<thead>
<tr>
<th>Region</th>
<th>% of HHs in region</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Mountains</td>
<td>80</td>
</tr>
<tr>
<td>R. R. Delta</td>
<td>70</td>
</tr>
<tr>
<td>N. C. Coast</td>
<td>60</td>
</tr>
<tr>
<td>S. C. Coast</td>
<td>50</td>
</tr>
<tr>
<td>C. Highlands</td>
<td>40</td>
</tr>
<tr>
<td>Southeast</td>
<td>30</td>
</tr>
<tr>
<td>M. R. Delta</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: VLSS 1998
Importance of livestock and pig incomes

- Greater significance of livestock income in the northern regions (>22%)
- Dominance of income from pigs
  - Geographic variation in importance

Significance of Income from Pigs for the Poor
Significance of Pig income...

• By income group
  • Income from pigs is of greater relative importance among poorer households (first three income quintiles)

• By geographic distribution
  • Income from pigs is of greater relative importance in the North and Central regions than in the South

Reversal of tendencies:
• For certain provinces in the South, pig incomes become more significant as household incomes increase!
  • Implies intensification, scaling up, specialization, and commercialization

Livestock Incomes at the Household Level

• Typology of Rural Households
• Livelihoods
Typology of Rural Households

% of sample HH

- Subsistence
- Semi-commercial
- Commercial
- Semi-diversified
- Diversified

Commercializing Agricultural HHs
Diversifying HHs

Relative importance of income from agriculture

% of total income

- Subsistence
- Semi-commercial
- Commercial
- Semi-diversified
- Diversified

Commercializing Agrit HH
Diversifying HH

- Dependence on agricultural income is still very high even among ‘commercial’ households
Differences in HH income levels

- Commercializing Agri-HHs:
  - Market engagement provides a big boost to incomes
    - But most of rural HHs are in the Semi-commercial group!
- Diversifying HHs:
  - HHs with better capacity to diversify out of farm activities have significant advantage

Question:
- What capacities to build?

Importance of livestock income

- Dependence on income from livestock is more significant among agri-based HHs
Income from livestock, by source

Magnitude of livestock incomes

- Income from livestock is significantly boosted by greater market engagement
- Income from pigs is dominant for all HH types
Do interventions in livestock sector matter of rural households?

Impact on HH incomes
Impacts on poverty alleviation

Sources of Rural Incomes in Vietnam

- Marked Agriculture: 62%
- Self-employment: 18%
- Wages: 9%
- Other: 11%

Source: 2002 VLSS
Smallholders in the food supply chain

Known: the majority of rural income arises from marketed food products.
- Livestock’s contribution to this income depends on complex market supply chains extending from the farm gate to urban households (and even foreign HHs).
- PPLPI research on these linkages:
  - Indications that the terms of this market participation are far from achieving their potential to help the rural poor.

Questions:
- Which particular barriers are at work in worsening the terms of market participation by smallholders?
- What are their impacts along the supply chain?

Microeconomic fundamentals

- Three ways to improve the balance sheets of farmers:

<table>
<thead>
<tr>
<th>Revenue side</th>
<th>Cost side</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increase output</td>
<td>3. Reduce Cost</td>
</tr>
<tr>
<td>2. Increase value (price)</td>
<td></td>
</tr>
</tbody>
</table>
Responses to Policy Changes

Two generic kinds of scenarios:

• Policies targeted to improve livestock production
• Policies to improve market access
  • E.g., Vietnam accession to WTO

Policy change: livestock promotion (generic)

All Livestock: Simulated 7% annual productivity growth 2005-2015

Source: Roland-Holst, Otte & Kazybayeva, 2006
A Living from Livestock
Pro-Poor Livestock Policy Initiative

Livestock Development and Poverty Reduction

- Trade liberalization, by itself, does not generate large impacts on poverty reduction among rural HHs.
- The potential of livestock to improve livelihoods of the rural poor depends on a complex of economic behavior and linkages.
- Participation in livestock production does not automatically lead to income generation & poverty reduction (alternative pathways of growth).
  - The challenge: to convert livestock dependence into a sustained source of income growth.
- Policy and institutional change:
  - Improving the terms for smallholder participation in food (e.g., livestock) markets appears to offer the best means of meeting this challenge.

Changes in poverty incidence, 2004-2010

% change

Source: Roland-Holst and Kazibayeva, 2004
Thank You!
Status and strategies for pig production in North East India

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NE India: A Glance
NE Region

Comprised of: 8 states
Area: 26.12 mn. hectre accounting 8.3% of India.
   Out of this, 77%-hills and senile plateau
Net cultivated area: 12%
Total population: 39.08 million
Climate: Subtropical to alpine
Rainfall: 2000 mm (Av)
Common Features: Ecosystem diversity, Poor accessibility, ethnicity and Rich Biodiversity.
Primary sector for economy: Agriculture contributing upto 45% of the total economy.

Demography and food habits

<table>
<thead>
<tr>
<th>Population</th>
<th>39 million</th>
</tr>
</thead>
</table>

- 40% of the people below poverty line.
- 80% of the population is tribal.
- Rice along with meat is staple food
- 100% of tribal population meat eater.
- Total tribal population – 13.8 million
Livestock population in millions (2003)

<table>
<thead>
<tr>
<th>Region</th>
<th>Cattle</th>
<th>Buffalo</th>
<th>Goat</th>
<th>Sheep</th>
<th>Poultry</th>
<th>Pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE states</td>
<td>11.48</td>
<td>0.91</td>
<td>4.36</td>
<td>0.23</td>
<td>36.46</td>
<td>3.82</td>
</tr>
<tr>
<td>All India</td>
<td>185.18</td>
<td>97.92</td>
<td>124.36</td>
<td>61.47</td>
<td>489.01</td>
<td>13.52</td>
</tr>
</tbody>
</table>

28 % of Country’s population

Meat production and requirement (million tones per year)

Deficit = 49.7 %
Animal protein availability

- Tribal 100% meat eaters
- Per capita 5.6 kg meat
- Per capita 77 g milk
- Per capita 33 eggs
- 23.25 million livestock
- 36 million poultry

Pig production scenario

A. Present status

Pig population (in million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total of NE region</th>
<th>1982</th>
<th>1992</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>1.41</td>
<td>1.41</td>
<td>3.15</td>
<td>3.82</td>
</tr>
<tr>
<td>1992</td>
<td>3.15</td>
<td>3.15</td>
<td>3.82</td>
<td>3.82</td>
</tr>
<tr>
<td>2003</td>
<td>3.82</td>
<td>3.82</td>
<td>3.82</td>
<td>3.82</td>
</tr>
</tbody>
</table>

Decadal growth rate

<table>
<thead>
<tr>
<th>Period</th>
<th>NE</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982-92</td>
<td>123%</td>
<td>26%</td>
</tr>
<tr>
<td>1992-02</td>
<td>21%</td>
<td>5.79%</td>
</tr>
</tbody>
</table>

Number of pigs available/100 persons

- India = 4
- NE Region = 18
B. Growth of pig in comparison to other livestock in India

B1. Growth of pig in comparison to other livestock in NE India
C. Rearing practices in NE

• Housing System

• Landless and marginal farmers

• Small farmers

• Housing System (Contd.)

• Medium farmers

• Commercial farmers
D. Types of pig reared in NE

- Hampshire
- Indigenous
- HS X I (87.5%)
- LWY
- Duroc
- Landrace

E. Feeding Practices

- Scavenging
- Scavenging + Evening ration
- Semi commercial
<table>
<thead>
<tr>
<th>Type of farmers</th>
<th>Feeding practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi scavenging (Landless)</td>
<td>Broken rice+ leaves+ other wastes</td>
</tr>
<tr>
<td>Small</td>
<td>Bran + broken rice + waste vegetables</td>
</tr>
<tr>
<td>Medium</td>
<td>Maize + rice polish + leafy vegetables + kitchen/hotel waste</td>
</tr>
</tbody>
</table>

**Traditional feeding cycle**

1. **Collection of plants**
2. **Cutting into pieces**
3. **Cooking as gruel**
4. **Feeding of pigs**
F. Health measures

**Vaccination**

- Swine fever – Not as per practice
  - Required doses not available
  - No Storage facility – Potency loss
- FMD – Only when disease occurs
- HS – Not practiced

Disease reporting – Extremely delayed
Parasitic measures – Non existent

Common diseases/conditions:
- Skin infection
- GI Parasitism
- Swine erysepelas
- Swine fever
G. Slaughtering and Processing

Processing – Almost Nil in the region

H. Transporting and marketing
### I. Performance under this system

<table>
<thead>
<tr>
<th>Traits</th>
<th>Genetic groups of pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Khasi Local</td>
</tr>
<tr>
<td>Litter size at birth</td>
<td>5.50 ± 0.49</td>
</tr>
<tr>
<td>Litter size at weaning</td>
<td>3.05 ± 0.51</td>
</tr>
<tr>
<td>Individual wt. At birth (kg)</td>
<td>0.485 ± 0.23</td>
</tr>
<tr>
<td>Individual weight at weaning (kg)</td>
<td>4.97 ± 0.21</td>
</tr>
<tr>
<td>Weight at 180 days (kg)</td>
<td>11.35 ± 2.23</td>
</tr>
<tr>
<td>Age at first farrowing (days)</td>
<td>367.47 ± 8.32</td>
</tr>
<tr>
<td>Interfarrowing interval (days)</td>
<td>194.52 ± 9.47</td>
</tr>
</tbody>
</table>

### J. Output from this system

- **Slaughter age** – 16 to 18 months
- **Slaughter weight** – 39 to 90 kg
- **Average pork Production/pig** – 31 to 72 kg
- **Present pork availability** – 48,000 MT (From the two systems)
- **Pork Requirement** – 58,000 MT
- **Deficiency** – 20.83 %
### K. Production economics at research farm

<table>
<thead>
<tr>
<th>Traits</th>
<th>Genetic groups of pigs (4-6 months age group)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Khasi Local (KL)</td>
</tr>
<tr>
<td>Feed Conversion efficiency</td>
<td>1: 6.5</td>
</tr>
<tr>
<td>Feed cost per kg body wt gain (Rs.)</td>
<td>58.50</td>
</tr>
<tr>
<td>(Rs 9/kg of feed)</td>
<td></td>
</tr>
<tr>
<td>Labour cost/pig/day at the ratio of 1:60</td>
<td>1.00</td>
</tr>
<tr>
<td>(Rs)</td>
<td></td>
</tr>
<tr>
<td>Veterinary medicine/pig/day (Rs)</td>
<td>0.15</td>
</tr>
<tr>
<td>Expenditure per pig per day (Rs.)</td>
<td>5.65</td>
</tr>
<tr>
<td>Cost of production of 1 kg live weight</td>
<td>73.45</td>
</tr>
<tr>
<td>(Rs,)</td>
<td></td>
</tr>
<tr>
<td>Return through pork with 85 % dressing</td>
<td>85.00-73.45=11.55</td>
</tr>
<tr>
<td>percentage at selling price of Rs.100/kg</td>
<td></td>
</tr>
</tbody>
</table>

### L. Shall this system suffice??

- **Local practice** – No
- **Improved practice** – Yes

*(Economics as shown)*
M. What then should be the shift?

- Unorganized to organized farming
- Small scale household to semi commercial production system
- Non adequate to adequate service delivery involving private partners with R & D back up
- HACCP measures in pork production
- Mass multiplication of improved pig both as sole and integrated component of farming

N. Role of Research organizations

- To produce pig varieties that will give a litter size of 8-10 at weaning from the present average of 4.5

Through

- Genetics
- Nutrition
- Physiology
- Reproduction
- Production management
- Health protection
- Product processing and value addition
O. What role they are presently playing in NE

**Pig Genetics**
- Evaluation, genetic cataloguing, *in situ* conservation and utilization of some of the strains through cross breeding producing 87.5% cross bred

**Pig nutrition**
- Developed ration with 40% boiled sweet potato for cross bred grower pigs
- Developed ration with under utilized crops like Job’s tears (*Coix lachryma-Jobi*) and buck wheat (*Fagopyrum esculentum Moench*) for weaner and grower pigs
Physiology and reproduction

- Standardized the protocols for boar semen collection, preservation and use
- Standardized the practice of early weaning at 21 days
- Synchronized the estrus in gilts/sows through fertivet/progesterone vaginal pessaries

Health cover

- Developed parasitic disease diagnostic kit
- Standardized the protocol for molecular diagnosis of important pig diseases using RT-PCR
- Working on developing soil-weather-disease relationship

Detection of swine fever virus by PCR (E2) gene

480 bp
Production management

- Developed pig housing systems for hilly and heavy rain fall areas
- Controlled piglet mortality during winter through guard rail/heat lamp or controlled breeding
- Use of galactogogue for increased milk production
- Heat detection procedures

Pig in farming system

- In an effort to multiply improved pig at farmers field, pig-crop-fish-hedge row-MPT-vermiculture system of integrated farming has been propagated with input-output ratio of 1:1.45
P. What pig farmers need?

• Improved pig variety and source of procurement
• Semi-balanced to balanced but cheaper feed options
• Vaccine and sero diagnostic services
• Knowledge up scaling program
• Market linkage
• IT based information delivery system

Q. Future research need

Pig genetics

• Improved variety development while conserving indigenous line
• Identification of superior genes/QTLs from wild pig and redeploy them in a new set up through cloning and transfer
• Development of miniature/broiler type of pig variety utilizing pigmy hog
• Development of microsatellite markers to aid in selection
• Lethal gene characterization to seek solution for problems like rhinitis
Pig nutrition

- Partnership research with crop scientists for QPM, soybean and ground nut
- Development of feed blocks for disaster period
- Processing of feed to check loss and increase feed conversion efficiency
- Technical and economic feasibility assessment of probiotics in pig feed
- Improving trace mineral status
- Development of pig ration with tea and other wastes

Pig physiology

- Environment X genetic interactions information collection based on weather/climate parameters
- Physiological trait micro-manipulation for lean meat production
- Research on physiology of lactation/increased milk production to support enhanced pig numbers
- Physiological traits-production correlation assessment
Pig reproduction

- Standardization of protocols for pig semen cryopreservation
- Standardization of dose, time, method etc, for AI in pigs
- Development of early pregnancy diagnostic kits
- Development of estrus synchronization protocols for AI

Production management

- Design and development of housing systems based on local materials for different client groups including development of odourless pigsty
- Increasing the number of farrowing/pig/year through early weaning system
- Market intelligence and production planning
- Sanitary and phytosanitary regulations
Health aspects

- Region wise mapping of pig disease including their impact on production
- Capacity building of the institutions for nucleic acid based disease diagnosis
- Microbial quality assessment in pork and pork products (Zoonotic angle)
- Development of pig health calendar based on disease-weather-season relationship and their management schedule

Health aspects (Contd.)

- Development of adequate quarantine measures to check any danger from pig fauna related piracy
- Validation of ITKs used for control/treatment of pig diseases
- Bio-extracts preparation from herbs/shrubs/weeds both as growth promoters and control of some diseases
Pork product technology

- Assessment of indigenous methods of pork processing like smoked pork vis-a-vis product soundness
- Standardization of pig slaughter age/weight as per type and development of carcass grading method based on Indian standards to codify procedures for value addition, packaging etc,
- Promoting slaughter house by product based industries particularly where concentration of pig slaughter is high

R. R & D for emerging areas

- Organic pork production
- Pig dung based organic compost preparation to support organic agriculture
- Pig based models for Intensive Integrated Farming Systems
- Back stopping of up scaled technology for poverty reduction and employment generation
- Development of transgenic pig
- Skill up gradation of stakeholders to promote PPP so as to prepare them to face the challenges of globalization of pork trade
S. Future development need

• Establishment of nucleus pig breeding farms, one in each capital city, at state Government level to ensure germplasm availability (in the line of state seed corporation)
• Establishment of pig villages-one in each district (in the line of certified seed grower)
• Initiation of mission mode program on pig production and health (in the line of technology mission on horticulture/oil seeds)
• To put in place a sound extension mechanism linking KVKs and ATMA
Pig Systems: Current Status, Emerging Issues and Ways Forward

Nipon Poapongsakorn
Dean, Faculty of Economics
Thammasat University

A presentation at the FAO Regional Workshop on Pig Systems in Asia and Pacific: how can R&D enhance benefits to the poor? Organized by FAO Regional Office for Asia and the Pacific, Amari Watergate Hotel, 23-24 November 2006

Pig Systems: Current Status, Emerging Issues and Ways Forward

1. Objectives
   - What is the current status of pig production and trade in Thailand and Philippines?
   - What are the strength and weakness of the small holders?
   - What are the major technological development that has benefited the small holders in the last 25 years?
   - What are the challenges for small holders?
2. Current status: some salient characteristics

-(1) There has been a trend towards larger commercial farm pig

Distribution of swine farm by scale of operation

-(1) Toward larger farm (cont.): It’s estimated that 77% of standing pigs in Philippines come from with less than 20 heads. The share is declining slowly.

-(2) Yet our studies show that the small holders are more efficient in the weaning activities while the fattening farms have higher share.
-(3) Share of contract farming in pig farms is small in both Philippines and Thailand

- Independent farms still dominate, accounting for more than 72% in Thailand and 90% in Philippines.
- Two types of contract farming in Thailand: wage contracts are more popular than the price-guaranteed (forward price) contracts.

-(4) Pig production in both countries is mainly for the domestic market which has become slightly larger. In Thailand, the income elasticity is smaller than one, and population has increased at the slow rate.
(4) Pig production (cont.) In Philippines, there is increasing trade deficits after the Uruguay Round Agreement on market access.

![Volume of imports and exports of pigmeat, Philippines, 1989-2003](chart1.png)

(4) Pig production (cont.): Thailand has a very small net export, but exports of live pigs have picked up sharply since 2000, thanks to Laos and Cambodia.

![Number of swine export, 1989-2005](chart2.png)
Export for swine and products, 2001 and 2004-05

<table>
<thead>
<tr>
<th>Items</th>
<th>2001</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swin (head)</td>
<td>12,246</td>
<td>45,465</td>
<td>82,649</td>
</tr>
<tr>
<td>- Pigle (head)</td>
<td>1,230</td>
<td>20,506</td>
<td>31,275</td>
</tr>
<tr>
<td>- Fattenning (head)</td>
<td>10,556</td>
<td>24,820</td>
<td>51,160</td>
</tr>
<tr>
<td>Por (kg.)</td>
<td>8,748,556</td>
<td>5,519,726</td>
<td>5,784,939</td>
</tr>
<tr>
<td>Other (kg.)</td>
<td>2,942,979</td>
<td>4,353,073</td>
<td>6,033,173</td>
</tr>
</tbody>
</table>

Note: Main destinations of live pigs are Laos and Cambodia. Pork is exported to Hongkong.
Source: Department of Livestock

- (5) Though the environmental problems have become increasingly serious, the market for pig manure has become very active in Thailand because of the farmers’ increasing demand. Organic farming and cassava production are major users of manure.

For the Philippines, pig manure use as fertilizer is not prevalent, except for some commercial farms observed in Mindanao (Bukidnon province) where pig manure is used in fruit orchards close to the commercial pig farm of the owner.
• Reasons for scaling-up of pig farms
  – High performance breeds, feed technology, farm management, cost of pollution abatement, capital investment in evaporative housing.

• Small and medium-scale farms are more efficient in piglet activities because they are care intensive

Efficiency

• The highest technical efficient farms are
  – Piglets: medium low scale
  – Fattening: medium low and large scale
• Small holders have better FCR.

<table>
<thead>
<tr>
<th>Class</th>
<th>FCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (1-100)</td>
<td>1.76</td>
</tr>
<tr>
<td>Medium low (101-500)</td>
<td>1.91</td>
</tr>
<tr>
<td>Medium high (501-1,000)</td>
<td>1.92</td>
</tr>
<tr>
<td>Large (&gt;1,000)</td>
<td>2.41</td>
</tr>
</tbody>
</table>

• Small holders tend to have higher gross margin (price of swine – feed price).

<table>
<thead>
<tr>
<th>Class</th>
<th>Piglets</th>
<th>Fattening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>56.7</td>
<td>30.3</td>
</tr>
<tr>
<td>Medium low</td>
<td>43.7</td>
<td>25.5</td>
</tr>
<tr>
<td>Medium high</td>
<td>46.0</td>
<td>24.1</td>
</tr>
<tr>
<td>Large</td>
<td>48.5</td>
<td>22.6</td>
</tr>
<tr>
<td>Independent</td>
<td>50.5</td>
<td>24.3</td>
</tr>
<tr>
<td>Contract (price)</td>
<td>55.8</td>
<td>28.2</td>
</tr>
</tbody>
</table>
Transaction costs: Input prices paid by small farms are lower.

- Using family labor help increase profit
- Small holders can market their products in the local markets and thus enjoy higher profit margin because they do not have to transport their pigs to the market in the city.
3. What are the past and current technological development that have benefited small holders?

3.1 Five important technological developments

- Thailand
  - (1) Commercial breeds replaced native breeds in 1962. It was American landrace with low quality carcass and highly disease resistant
  - (2) Twenty years ago, the European pure breeds were imported. It has high performance growth, high quality carcass but also higher morbidity
  - (3) The major technological change that has resulted in a widespread growth of commercial farms (including smallholders) is the nutritional improvement in 1982.

- Also true in Philippines—popularity of landrace and large white.
  - All commercial farms use either pure breeds of crosses (Landrace, Large White, Duroc, Pietrain… being the more well known)
  - For market-oriented smallholders, their stocks will be ‘uncontroled crosses’ of these races, but true genetic characteristics are undetermined.
  - The native ‘black’ pigs would be relegated to small farms in more remote rural areas
(4) Artificial insemination also drastically reduced the cost of growing boars in the 1970’s. This has benefited the small as well as large farms in Thailand.

What’s about Philippines?

- Artificial insemination is more the realm of large commercial farms which want to have greater control of the genetic characteristics of pigs raised.
  - For smallholders, the natural ‘boar’ service is still popular, where the boars may be raised by other households or producers, and are mated with sows of interested parties.
  - Philippines.

(5) Usage of cassava feeds is the most important factor for the survival of small holders in Thailand because (1) its use reduces the mortality and morbidity rates (an unintended desirable consequences of small level of cyanide in Thai cassava and bacterial; (2) it is the low cost feed

- Cassava has not taken off as feed material in the Philippines. Cassava technology with high yields also has not taken off, where spread of technology has been concentrated in poorer regions of Eastern Visayas, where R&D activity was being undertaken by a regional university (formerly Visayas College of Agriculture – VISCA) in Eastern Visayas.

- Commercially oriented producers depend heavily on the mixed feed companies, with their standard ingredients mixes (domestic or imported maize / imported feed wheat; imported soya bean meal, other protein sources)

- For remoter rural areas, sweet potato vines, banana trunks, gabi leaves, farm residues, rice bran, would be cooked for feeding the backyard pigs.
### Standard of cassava chips and pellets produced in Thailand

<table>
<thead>
<tr>
<th>Products</th>
<th>Cassava chips</th>
<th>Cassava pellets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>Prime</td>
<td>Regular</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Crude fiber (%)</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Ash/Sand (%)</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/1-2</td>
<td>5/3</td>
</tr>
<tr>
<td>Starch (%)</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>65</td>
</tr>
</tbody>
</table>

### ME Contents of Cassava Chips with Different Levels of Crude Fiber in Pigs and Chickens Diets.

<table>
<thead>
<tr>
<th>Types of Cassava chips</th>
<th>CF (%)</th>
<th>Pigs</th>
<th>Broilers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20 kg</td>
<td>60 kg</td>
</tr>
<tr>
<td>Cassava starch</td>
<td>0</td>
<td>3,741</td>
<td>3,756</td>
</tr>
<tr>
<td>Peel – off</td>
<td>2.3</td>
<td>3,540</td>
<td>3,574</td>
</tr>
<tr>
<td>Prime quality</td>
<td>3.9</td>
<td>3,356</td>
<td>3,385</td>
</tr>
<tr>
<td>Regular quality</td>
<td>5.2</td>
<td>3,189</td>
<td>3,291</td>
</tr>
</tbody>
</table>

Source: Punsurin et. al. (2002) and Lokaewmanee et. al. (2002)
### Chemical Composition of Basal Feed Ingredients

<table>
<thead>
<tr>
<th></th>
<th>Cassava</th>
<th>Corn</th>
<th>Rice</th>
<th>Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>11.8</td>
</tr>
<tr>
<td>ME (Kcal/kg)</td>
<td>3360</td>
<td>3300</td>
<td>3569</td>
<td>3140</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.50</td>
<td>0.90</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Fiber (%)</td>
<td>4.0</td>
<td>2.50</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>0.09</td>
<td>0.25</td>
<td>0.27</td>
<td>0.23</td>
</tr>
<tr>
<td>Met+cys (%)</td>
<td>0.06</td>
<td>0.39</td>
<td>0.32</td>
<td>0.27</td>
</tr>
</tbody>
</table>

### Nutritional Comparison of Basal Feed Ingredients

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Rice</th>
<th>Cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>8</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>ME (kcal/kg)</td>
<td>3300</td>
<td>3596</td>
<td>3360</td>
</tr>
<tr>
<td>Starch Digest.</td>
<td>Slow</td>
<td>Moderate</td>
<td>Fast</td>
</tr>
<tr>
<td>Mycotoxins cont.</td>
<td>High</td>
<td>Low</td>
<td>Low/Non</td>
</tr>
<tr>
<td>Effect to Health</td>
<td>Poor</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td>Medication uses</td>
<td>High</td>
<td>Fair</td>
<td>Low/Non</td>
</tr>
<tr>
<td>Mortality rate</td>
<td>High</td>
<td>Fair</td>
<td>Low</td>
</tr>
<tr>
<td>Price (Baht/kg)</td>
<td>5.8</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
Specific Properties of Cassava

1. Containing soft-starch (mainly amylopectin) which is mostly digested in the upper part of the intestine.
2. Contamination of natural bacteria especially lactic acid bacteria (Lactobacillus spp.) and yeast.
3. More acidic pH (4-6)
4. Low to no contamination of mycotoxins.
5. Containing of low and non-toxic level of HCN.

Effects of Cassava in Animal Nutrition

1. Higher digestibility of starch and dry matter.
2. Higher population of non-pathogenic bacteria and yeast, more acidic pH / lower population of pathogenic bacteria in the digestive tract.
3. Higher percentage of butyric acid in SCF produced from cecum. Butyric acid is nutrient for intestinal mucosal cells.
4. Higher proliferation of intestinal mucosal cells /improvement of nutrient absorption and diseases protection.
Effects of Cassava in Animal Nutrition

5. Increase of blood lymphocytes, a cellular immunity system in the animal, and improve diseases resistant.

6. Increase activity of glutathione peroxidase, an antioxidant in the animal body to eliminate free radical and improve immunity of the animals.


8. Reduction of medication used in the feeds and reduction of animal mortality.

9. Providing a similar performance and carcass quality of pig and poultry to those on corn diet.

10. Reduction of pig production cost / Production of antibiotic-free pork.
Recommended Inclusion Levels of Cassava in Animal Rations.

<table>
<thead>
<tr>
<th>Animal Rations</th>
<th>Max. inclusion level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs (weaning, growing-finishing, breeding)</td>
<td>40-60</td>
</tr>
<tr>
<td>Broilers</td>
<td>25-30</td>
</tr>
<tr>
<td>Hen layers</td>
<td>40-45</td>
</tr>
<tr>
<td>Duck (meat and laying ducks)</td>
<td>40-45</td>
</tr>
<tr>
<td>Beef and dairy cattle</td>
<td>40-45</td>
</tr>
<tr>
<td>Aquaculture</td>
<td>30-35</td>
</tr>
</tbody>
</table>

Cassava has also been successfully used as a corn substitute in rabbits, horses and elephant feeds.

Utilization of Cassava in Starter, Grower, Finisher and Breeder Pig Diets

Nakhon Laung Farm

109 Mo 9 Donkhoi, Kampaengsaen, Nakhon Pathom
Tel. 034-282411
Ms. Pisamai and Ms. Pantipa Prayotetaweekit
The Farm Owners

The Farm Background

1. The farm has been established for more than 20 years by their father.

2. Presently, the farm has 300 sows with farrow to finish operation.

3. The farm has employed cassava as basal feed ingredient in the pig diets for more than 8 years (since 1977).
4. Levels of cassava in the pig diets

- Creep feed: 5% in diet
- Weaner 1, 2: 10, 20% in diet
- Starter (25-40 kg): Major basal feed
- Grower (40-70 kg): Major basal feed
- Finisher (70-Mkt): Major basal feed
- Gestation: Major basal feed
- Lactation: Broken rice:Cassava=1:1

---

### Pig Feed Formulae of the Farm

<table>
<thead>
<tr>
<th></th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava / Broken Rice</td>
<td>328/150</td>
<td>432/0</td>
<td>404/0</td>
</tr>
<tr>
<td>TSR/RB /WB</td>
<td>0/60/40</td>
<td>50/90/50</td>
<td>100/90/50</td>
</tr>
<tr>
<td>SBM/EFFSB/FM</td>
<td>175/150/45</td>
<td>208/100/30</td>
<td>205/75/28</td>
</tr>
<tr>
<td>MCP/DCP</td>
<td>9.5/0</td>
<td>0/12</td>
<td>0/5.5</td>
</tr>
<tr>
<td>Limestone/Oil</td>
<td>11.5/17</td>
<td>3.5/7</td>
<td>8/9</td>
</tr>
<tr>
<td>Salt/Premixs</td>
<td>3.5/5</td>
<td>3.5/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Lys./Met./Thr.</td>
<td>0.5/1.1/0.15</td>
<td>0.6/1.4/0.25</td>
<td>0.45/1.45/0.5</td>
</tr>
</tbody>
</table>

TSR=Tapioca starch residue, RB=Rice bran, WB=Wheat bran
Pig Feed Formulae of the Farm

<table>
<thead>
<tr>
<th></th>
<th>Starter</th>
<th>Grower</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>19.2</td>
<td>17.7</td>
<td>16.5</td>
</tr>
<tr>
<td>ME (kcal/kg)</td>
<td>3275</td>
<td>3150</td>
<td>3075</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.2</td>
<td>1.10</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Results of Cassava Diets in the Farm

1. Cassava diet have provided a similar reproductive performance of the breeder pigs to broken rice diet but have much less incidence of MMA.

2. Cassava diets never have problems of mycotoxins toxicity and breeder pigs have shown a normal number of mummify fetus.

3. Cassava diets are bulky and help to increase digestive tract capacity of gestating sows and stimulate more feed intake during lactation.

4. Reduction of constipation during gestation and providing ease of farrowing.

5. Growing-finishing pigs on cassava diets had better performance, more growth uniformity, better health, lower mortality, less medication required than those on corn diet.

6. Carcass quality and meat quality of pigs on cassava diets is considerable quite good and is acceptable by the butchers and consumers.
Results of Cassava Diets in the Farm

9. Antibiotics except those for respiratory disease control were withdrawn in every diets without any problems or loss of performances of animals.

10. The farm has an attempt to switch to corn diet for 3 times during the shortage and high price of cassava but severe problems of mycotoxins toxicity and lower digestibility of the feed was occurred when compared to the cassava diets although a good care has paid for purchasing and milling of corn. The farm has definite decision to go on with cassava.

Conclusion of The Utilization of Cassava Under Commercial Pig Farm Application

1. Cassava can be used as the major basal feed ingredient in diet of weaning, growing-finishing and breeding pigs without any deterioration of performances.

2. A benefit of animal health improvement that provide the lower mortality rate, the minimum to no antibiotics required in the animal production system as well as the reduction of animal production cost has consistently reported by the farmers.
3. Although cassava price was high these years (2004-2005) and cassava diets are a little more expensive than corn diets but farmers still employing cassava diets due to the advantages and the definite reduction of animal production cost at the bottom line.

4. Cassava roots production can be very much expanded by the yield improvement especially by using pig wastes as soil and foliar fertilizer.

Conclusion of The Utilization of Cassava Under Commercial Pig Farm Application

3.2 Why does the feed technology explain the survival of small holders?
- The high performance European breeds have the biological limitation factor against the large scale farms
- Farm size with 150 – 500 sows are optimum in term of disease control, and high fertility
- Role of the Center for Research and Development of Feed, Kasetsart University in researching and providing extension services of the new feed formula to the small holders
- Role of the drug companies and university professors in provision of training and extension services. While most professors are advisors to the large commercial farms, some professors still prefer to work with small farmers, thanks to their devotion for the poor.
As a consequence, Thai small holders have chance to experiment with new ideas they’ve learned from the training programs.

One Thai professor argues that Philippines’s technological development is at least 10-15 years behind Thailand because of lack of such training programs.

- For the Philippines, there was no known systematic programs in agricultural universities (national or regional) to give a thrust to such trainings. If there were some, they were own short term initiatives of faculties during their own terms – not sustained and long-term strategic programmes.
- Technology programmes were more biased toward crops, the earlier ones on staples (rice and maize), and the later ones on high-value crops.
- There are also a few training centers for hog production technology, but again, these were not full programmes with the national scientific community in the national universities participating to integrate their own programmes.

4. Strength and weakness of small holders

Weakness: a large number of small holders went out of business

Thailand:
- Cost of labor: Because of smaller family size and the young rural people’s preference for non-farm jobs and higher education, Thai farms need to depend heavily on hired labor which has become more expensive. In addition, the farm work is undesirable.
- Cost of pollution abatement is scale-biased. Water scarcity is also important in Thailand.
- The increasing demand for safe food will not benefit the small holders so long as entry barriers against modern slaughterhouses remain.
- Some technological factor is scale-biased, e.g., evaporative housing.
- But there’s a minimum optimum scale for the small holders to survive, i.e., 150-500 sows per farm.
Philippines:
- Dependence on continued protective trade policy on maize, which could be circumvented to a certain extent by large commercial producers (who could band to import lower-tariff feed wheat)
- Dependence on unidentified mixes of genetic material for stock, which bring uncertainty of quality of meat produced (cannot command price premia)

Strength
Thailand
- Biological limitation of the high performance breeds favor the small and medium-scale farms
- Low fixed cost from open-system housing
- Small holders are more competitive in weaning (which is care intensive).
- But if they want to fatten pigs, they must adopt the full circle or fully integrated system with at least 40-50 sows; otherwise the operation won’t be cost effective.

Philippines:
- Their non-costing/undervaluation of unpaid family labor, in common situations of the lack of alternative employment opportunities in the non-farm sector, in a regime where there are legislated minimum wages for agricultural labor (although lower minimum rates than non-agricultural labor because family labor is a quasi-fixed factor)
5. Challenges
- Prioritization of areas of research, training & demonstration and extension for small holders, e.g., feed improvements, environmental abatement methods, etc.
- Public expenditure constraints in research, training and extension services for small holders & relatively low incentive for the researchers and trainers
- The attitude and policy of the decision makers are biased towards other populist policies, e.g., one-million cows project
- How to encourage small holders to form the effective cooperatives which can provide the necessary public goods for the group? How can they compete with large commercial farms?
- Data availability: how to design a proper sampling methods to measure the impact of R&D&E on the profitability of small holders?
Vietnam pig systems and R&D contribution to the poor

NN Que

Vice Director of Center for Agricultural Policy (CAP), Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD) B3, 128 alley, Thuy Khue str., Hanoi, Vietnam

Introduction of the Vietnam livestock sector

In recent years, the national economy of Vietnam has grown considerably. The annual GDP had achieved a comparatively high and stable growth, at 7.68%, during the period of 1991–2001 (GSO). The agricultural sector, which accounts for 70% of the national labour force and is considered the backbone of the economy, has also grown strongly (4.26% per year). Animal husbandry sector has noticeably developed; for instance, livestock industry since 1986 has grown at an average rate of 5.7% per year, higher than crop and agricultural service sector (GSO).

The government reported that the value of Vietnam’s livestock production in 2005 occupied 25% of the total value of Vietnam’s agricultural production (MARD). The government expects the country will raise the proportion of livestock to 30% by 2010 and 35% by 2015. The value of Vietnam’s total livestock in 2005 grew by 11.6% while the total agricultural sector increased only by 3.2% (see Table 1). This was significantly higher than in 2004 because of increased pig and beef production and stabilization of the poultry number after the drop of 2004. In 2005, total meat production (live weight) increased by 12.3%, of which pork increased by 13.7%, beef by 18.7%, buffalo by 4%, and poultry meat by 1.7%. Poultry egg production increased by 1% compared with the year before.

Table 1. Vietnam’s livestock sector annual growth rate (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total agricultural sector</th>
<th>Crop production</th>
<th>Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>5.4</td>
<td>5.2</td>
<td>6.7</td>
</tr>
<tr>
<td>2001</td>
<td>2.6</td>
<td>2.3</td>
<td>4.2</td>
</tr>
<tr>
<td>2002</td>
<td>6.2</td>
<td>5.5</td>
<td>9.9</td>
</tr>
<tr>
<td>2003</td>
<td>4.2</td>
<td>3.2</td>
<td>8.2</td>
</tr>
<tr>
<td>2004</td>
<td>4.2</td>
<td>4.7</td>
<td>2.3</td>
</tr>
<tr>
<td>2005</td>
<td>3.2</td>
<td>1.3</td>
<td>11.6</td>
</tr>
</tbody>
</table>

Source: General Statistics Office (GSO).
Pig production system in Vietnam

Figure 1 shows the annual growth of the production of pigs and other livestock since 1986. In 2005 pig production increased at the particularly rapid rate of 13.7% due to the impact of the avian influenza outbreak that led to less competition from poultry production. A smaller increase of 6% is forecast for 2006 and 2007 with the recovery of the poultry sector. An upsurge of Foot-and-Mouth Disease is also lowering pig meat prices and dampening growth. Vietnam’s pig production is comprised mostly of backyard/household operations. At present, about 85–90% of pigs are raised in backyard/household operations while the rest come from commercial farms. (In Vietnam, farms are considered commercial if they have 20 sows). As commercial farms are more efficient, only 75–80% of total pork production was from backyard/household operations, while 20–25% came from commercial farms. The Vietnam government plans to increase commercial pig production to 30–35% by 2010.

Vietnam’s 2006 animal meat production is expected to reach 3.4 thousand tonnes (TMT) live weight, about 7% higher than 2005’s production (see table 2). Currently, pork still plays by far the dominant role at 81% of total livestock production. The share of poultry meat is about 11.5% and all other kinds of meat including beef, buffalo, and goat meat occupy only 7.5%. In terms of relative proportion of different meats in livestock production, no big changes are expected in the next two years.
Table 2. Vietnam—Key livestock components (2004–07)

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006 (est.)</th>
<th>2007 (est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig population (× 10³)</td>
<td>26,144</td>
<td>27,435</td>
<td>28,369</td>
<td>29,059</td>
</tr>
<tr>
<td>Cattle population (× 10³)</td>
<td>4908</td>
<td>5541</td>
<td>5870</td>
<td>6160</td>
</tr>
<tr>
<td>Dairy population (× 10³)</td>
<td>95.794</td>
<td>104.12</td>
<td>126.9</td>
<td>145.9</td>
</tr>
<tr>
<td>Buffalo population (× 10³)</td>
<td>2870</td>
<td>2922</td>
<td>2951</td>
<td>2981</td>
</tr>
<tr>
<td>Poultry population (× 10³)</td>
<td>218,200</td>
<td>219,911</td>
<td>228,500</td>
<td>240,000</td>
</tr>
<tr>
<td>Goats and sheep (× 10³)</td>
<td>1023</td>
<td>1314.2</td>
<td>1492</td>
<td>1641</td>
</tr>
<tr>
<td>Total meat production (tmt) (live weight)</td>
<td>2513.07</td>
<td>2821.8</td>
<td>3420.9</td>
<td>3754.8</td>
</tr>
<tr>
<td>Share of pork meat/ total meat (%)</td>
<td>80</td>
<td>81</td>
<td>71.5</td>
<td>69.7</td>
</tr>
<tr>
<td>Share of poultry meat (%)</td>
<td>12.6</td>
<td>11.4</td>
<td>21.9</td>
<td>23.8</td>
</tr>
<tr>
<td>Share of beef meat (%)</td>
<td>4.8</td>
<td>5</td>
<td>4.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Share of buffalo meat (%)</td>
<td>2.3</td>
<td>2.1</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Share of other meat (%)</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Source: USDA.

Pig meat consumption in Vietnam

Vietnam has nearly 80 million people, of which 70% live in rural areas. With that population, Vietnam is a large market for animal products. The consumption of those products such as meat, egg and milk has risen dramatically in recent years.

Recently, animal husbandry has made great steps forward, with an average growth rate of 6.7% per year during 1995–2005 years (GSO). At present, Vietnam produces over 2 million tonnes of meat, of which over 70% is pork. Over 90% of the pork and 60% of chicken meat supplied by farmers are consumed in the market.

According to the General Statistics Office of Vietnam, Vietnam’s GDP for 2005 grew at the remarkable rate of 8.4%, led by gains in construction, tourism and telecommunications. GDP growth in 2006 is predicted at 8% according to the Asian Development Bank (ADB). The country’s economic development has had a strong influence on consumer spending. According to GSO, consumer spending and retail sales in Vietnam rose by 21% in 2005. As a result, Vietnam’s per capita meat consumption is increasing as well (see Table 3).

Table 3. Vietnam’s per capita meat consumption (2004–2007) (kg/head per year)

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006 est.</th>
<th>2007 est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita meat consumption (in lw*)</td>
<td>30.64</td>
<td>33.95</td>
<td>35.99</td>
<td>38.16</td>
</tr>
<tr>
<td>Pork (in cwe**)</td>
<td>17.17</td>
<td>19.27</td>
<td>20.35</td>
<td>21.50</td>
</tr>
<tr>
<td>Poultry meat (in cwe)</td>
<td>2.66</td>
<td>2.67</td>
<td>2.91</td>
<td>3.16</td>
</tr>
<tr>
<td>Beef (in cwe)</td>
<td>0.73</td>
<td>0.85</td>
<td>0.90</td>
<td>0.96</td>
</tr>
<tr>
<td>Buffalo meat (in cwe)</td>
<td>0.30</td>
<td>0.31</td>
<td>0.32</td>
<td>0.33</td>
</tr>
<tr>
<td>Other meat (in cwe)</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*lw: live weight  **cwe: carcass weight equivalent.
Source: MARD
According to the 2002 Vietnam Household Living Standard Survey (VHLSS), most Vietnam households consumed meat products such as pork, beef, carabeef (buffalo meat), chicken meat and fish/shrimp. With the development of pig production, over 98% of households consumed pork while this number for beef and carabeef were only 40 and 7%, respectively. The low percentage of household consuming carabeef reflects undeveloped trend of buffalo production.

Table 4. Percentage of household consuming meat by type of products

<table>
<thead>
<tr>
<th>Type of meat</th>
<th>Percentage of household consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork</td>
<td>98.45</td>
</tr>
<tr>
<td>Beef</td>
<td>40.23</td>
</tr>
<tr>
<td>Carabeef</td>
<td>7.12</td>
</tr>
<tr>
<td>Chicken meat</td>
<td>80.94</td>
</tr>
<tr>
<td>Fish/shrimp</td>
<td>97.23</td>
</tr>
</tbody>
</table>

Source: Tran Cong Thang, calculated from the 2002 VHLSS.

Current per capita consumption in Vietnam is well below other countries like Taiwan (41.4 carcass meat equivalent kg/year), Hong Kong (53 kg), China (38 kg) or European Union (45 kg) (Figure 2). The difference between Vietnam and other countries shows the potential market for domestic sales is still high. Thus, focusing on the domestic market over the next few years is still a good strategy for producers. Vietnam does not have high comparative advantage in meat exports.

Source: FAOStat.

Figure 2. Meat consumption in Vietnam and other countries (kg of carcass per year).
Trade for pig industry

Vietnam needs to import breeding stock as it continues to boost its swine production. The country has in recent years imported breeding pigs and semen from USA, Canada, Thailand, Korea and Belgium. According to US trade data, in the period of 2000–2004, USA exported 1374 live pigs to Vietnam with a value of USD 708 thousand. However, since the beginning of 2005 Vietnam has not imported any live pigs from USA. Breeding farms currently feel that the cost of US breeding pigs is too high and have looked to other sources.

Figure 3. Pork exports from Vietnam, 1990–2004 (× 10³ t).

In Vietnam, almost all pork production is for local consumption. Only 1–2% of total pork production was exported. The main pork export from Vietnam is suckling pigs. In the past, these have been sold to several nearby countries, but disease concerns have recently restricted exports only to the biggest market, Hong Kong (see Figure 4). The government hopes to become a major exporter of pork, but strong and growing domestic demand and the health restrictions of other countries make this very unlikely any time soon. Vietnam also imports pork, but volumes are very small, much less than 1% of consumption. Almost all is processed meat. With WTO accession, tariff rates will drop but Vietnam is still expected to supply most of its pork demand domestically.
How R&D enhance benefit for the poor pig households

R&D contribution to the poor

Vietnam now has seven institutes supporting the livestock and veterinary sector in which the National Institute for Animal Husbandry, the National Institute for Veterinary Research and the Institute of Agricultural Science of South Vietnam are the main organizations (Table 5). There are a number of breeding centres or branches in research institutes.

Table 5. MARD main research institutes in livestock sector

<table>
<thead>
<tr>
<th>Institute</th>
<th>Acronym</th>
<th>Animal husbandry veterinary science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bee Research and Development Centre</td>
<td>BRDC</td>
<td>X</td>
</tr>
<tr>
<td>Institute of Agricultural Science of South Vietnam</td>
<td>IAS</td>
<td>X</td>
</tr>
<tr>
<td>National Centre for Inspection of Drugs and Bio-products</td>
<td>NCIDB</td>
<td>X</td>
</tr>
<tr>
<td>National Institute for Animal Husbandry</td>
<td>NIAH</td>
<td>X</td>
</tr>
<tr>
<td>National Institute for Veterinary Research</td>
<td>NIVR</td>
<td>X</td>
</tr>
<tr>
<td>Vietnam Agricultural Science Institute</td>
<td>VASI</td>
<td>X</td>
</tr>
<tr>
<td>Institute of Policy and Strategy for Agriculture and Rural</td>
<td>IPSARD</td>
<td>X</td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Apart from that, Vietnam has been supported in making development policies by international organizations such as World Bank, ADB, SIDA, CIDA and GTZ. Besides, the extension system in Vietnam is in charge of transferring appropriate technologies to households. This system consists of the National Agriculture Extension Centre (NAEC) of MARD at the central level, and Provincial and District extension centres.
In past years, R&D in Vietnam has been contributing to the development of agricultural sector in Vietnam in general and particularly in livestock sector. However, generally R&D is still weak and inefficient, especially in supporting poor households. Hereby, some major issues in R&D can be clarified in more detail.

Under-funding and weak capacity of the research system

Government investment in agricultural research has increased significantly in recent years but this is still not enough for research activities. Total public expenditure for agricultural research was only 1.7% of public expenditures in agriculture and .08% of agricultural GDP (Table 6). In comparison to agricultural GDP, China spends four times as much as Vietnam and Thailand 14 times as much. By most standards, the amounts in Vietnam are very low and cannot sustain an effective research program to develop modern agriculture. More than half of agricultural research expenditures are used to cover salaries, and current expenditures on research equipment and machinery. As a result of resource constraints, research organizations engage themselves in commercial activities. Moreover, the limited funding results often in poor laboratories, equipment, and few on-farm trials.

Table 6. Asian governments spending on agricultural research

<table>
<thead>
<tr>
<th>Country</th>
<th>Share of agricultural GDP (%)</th>
<th>Share of total government spending (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>0.25</td>
<td>0.66</td>
</tr>
<tr>
<td>China</td>
<td>0.43</td>
<td>0.54</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.27</td>
<td>0.29</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1.06</td>
<td>0.57</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.40</td>
<td>1.10</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.17</td>
<td>0.19</td>
</tr>
<tr>
<td>Average for Asia</td>
<td>0.58</td>
<td>0.51</td>
</tr>
</tbody>
</table>


In the case of the livestock sector, total funding for livestock research from the central budget is about 14% of total funding. The share of total funding committed to livestock increased slightly from 11% in 1993 to slightly over 15% in 1999. However, the majority of the total budget is for salaries. For example, in 1999, the total budget for livestock and veterinary research was about VND 12 billion (USD 857 thousand) of which salaries were 50%, leaving only about USD 430 thousand for actual research activities. In terms of GDP contribution by the livestock sector, the total state budget for research was less than 1% (ACI 2004).

Weak collaboration between the research system and extension

The transfer of appropriate technologies in the agricultural sector is carried out by various institutions, namely: the National Agriculture Extension Centre (NAEC) of MARD at the central
level, with Provincial and District extension centre playing the principal roles. Front-line extension is undertaken by non-government workers at the commune level. At present, the extension system is an establishment with three levels, from the central level (NAEC in MARD headquarters) to the level of District. Apart from Government extension services at central and local levels, there are many organizations and institutions, including NGOs, that perform extension work, but with weak co-ordination and support from Government.

Outputs of the research activities are often the results obtained from experiments and/or pilots on a small scale. Extending them to large-scale production faces several difficulties: institutes often do not have enough human resources and finance to undertake this activity, and the extension networks at the grassroots level (particularly from district level downward) are still in the phase of development. The systems of research and extension have difficulties in linking together, for many reasons including different channels of funding and reporting responsibility.

Limited extension services for poor livestock households

Over the past decade, Vietnam has registered some important achievements as regards the transfer of technologies to the client farming community notably through its extension programs and projects to diffuse hybrid rice and maize, change cropping patterns to avoid or attenuate natural calamities, promote beef cattle and pigs with higher percentages of lean meat, and dairy cows with more milk, and to diffuse new production technologies in industrial crops, fruits and vegetables etc. However, these have been achieved despite the technology transfer system in Vietnam which is facing many difficulties and challenges. These challenges are:

- Low public investment in technology transfer and poor infrastructure of the technology-transfer institutions;
- Lack of coordination and co-operation among the many technology-transfer institutions, and between these institutions and the banks responsible for loans to people;
- Lack of experience with the participatory approach;
- High levels of poverty in many farm households, meaning that they do not have enough money to adopt the new technology—questioning the suitability of these technologies to their livelihood systems;
- Low levels of education of recipient farmer trainees, and difficulties in communication between extension agent/trainers and trainees due to language differences, especially in mountainous and remote areas;
- Low numbers and insufficiently qualified grass-roots extension agents, negatively affecting the efficiency and effectiveness of technology transfer;
- Lack in Vietnam of a proper curriculum and facilities for educating and training technology transfer staff at any level, including the university level.
Due to those difficulties, extension activities cannot reach a large number or types of producers. Thus, only small livestock producers can receive extension services. Overall, only 28% of producers received extension services from government and non-government organizations (Table 7). Besides, most livestock farmers receiving extension service are large ones. The number of small producers getting extension support is much limited (Table 8).

Table 7. Percentage of producers utilizing extension services by region

<table>
<thead>
<tr>
<th>Region</th>
<th>Producers utilizing extension services (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River Delta</td>
<td>22.02</td>
</tr>
<tr>
<td>North East</td>
<td>18.48</td>
</tr>
<tr>
<td>North West</td>
<td>35.46</td>
</tr>
<tr>
<td>North Central Coast</td>
<td>50.71</td>
</tr>
<tr>
<td>South Central Coast</td>
<td>27.41</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>19.88</td>
</tr>
<tr>
<td>North East South</td>
<td>31.68</td>
</tr>
<tr>
<td>Mekong River Delta</td>
<td>30.90</td>
</tr>
<tr>
<td>Average</td>
<td>28.42</td>
</tr>
</tbody>
</table>


Table 8. Number of visits per year of extension agencies to different farm categories

<table>
<thead>
<tr>
<th>Regions</th>
<th>Small farms</th>
<th>Large farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River Delta</td>
<td>0.20</td>
<td>1.05</td>
</tr>
<tr>
<td>North East</td>
<td>0.71</td>
<td>1.01</td>
</tr>
<tr>
<td>North West</td>
<td>0.86</td>
<td>0.75</td>
</tr>
<tr>
<td>North Central Coast</td>
<td>0.27</td>
<td>0.07</td>
</tr>
<tr>
<td>South Central Coast</td>
<td>0.59</td>
<td>0.98</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>1.66</td>
<td>1.20</td>
</tr>
<tr>
<td>North East South</td>
<td>0.00</td>
<td>2.66</td>
</tr>
<tr>
<td>Mekong River Delta</td>
<td>10.25</td>
<td>2.32</td>
</tr>
</tbody>
</table>


Adoption of improved breeding by poor farmers is limited

As mentioned above, Vietnam has seen an increase in the offtake rate of pigs. However, the adoption of exotic/crossed breeds by producers has been slow for a number of reasons. These include the unsuitability of many exotic breeds for smallholder raising, difficulties of access by smallholders to appropriate genetics and inefficiencies in the breed programs of the breeding centre system. Only commercial, large-scale producers have adopted significant numbers of pigs of exotic breeds; only 9% of small farms and 56% of large farms keep exotic pigs. Small farms still rely heavily on local breeds, or crossbreeds of low genetic quality. Adoption of crossbred pigs has been relatively widespread, with around 58% of small farmers and 25% of large farmers having at least one crossbred pig in their herd. However, many of these crossbred
pigs, especially those on small farms, are likely to be of very low genetic quality, and have performance levels that are not significantly greater than those of local animals.

How can R&D enhance the benefit for poor livestock households?

Ways through which poor livestock households could benefit more from R&D include:

1. Focusing on making breeding programs and supplying improved stock more accessible to farmers;
2. Increasing funding for the extension system in which the poor should be prioritized;
3. Implementing a comprehensive assessment of poor farmers’ needs and constraints both in terms of livestock production and the markets for livestock products;
4. Extending farmer group models to enhance access to markets by poor livestock producers.

References

ACI (Agrifood Consulting International) and Uniquest Pty Ltd. 2004. TA 4194-VIE Agriculture Science and Technology.


MARD (Ministry of Agriculture and Rural Development). Data compiled by the Planning Department, Ministry of Agriculture and Rural Development, Hanoi, Vietnam.


Vietnam Pig System and R&D contribution
By Nguyen Ngoc Que

23–24 November 2006

Content

1. Introduction
2. Livestock production in Vietnam
3. Livestock consumption in Vietnam
4. Livestock Trade in Vietnam
5. R&D contribution in pig system
1. Introduction

- Livestock industry developed considerably; annual average growth rate was 5.27% over 20 years since 1986;
- In last 10 years, livestock sector made up 17-25% of total agricultural product value; it’s expected 30% by 2010, and 35% by 2015;
- Pig population is increasing considerably and pork accounts for 81% of total meat production (live weight) in 2005;
- Livestock products generally consumed domestically;
- Livestock product export - mostly Pork

2. Livestock production in Vietnam

The sector production annual growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Total agr. sector</th>
<th>Crop production</th>
<th>Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>5.4</td>
<td>5.2</td>
<td>6.7</td>
</tr>
<tr>
<td>2001</td>
<td>2.6</td>
<td>2.3</td>
<td>4.2</td>
</tr>
<tr>
<td>2002</td>
<td>6.2</td>
<td>5.5</td>
<td>9.9</td>
</tr>
<tr>
<td>2003</td>
<td>4.2</td>
<td>3.2</td>
<td>8.2</td>
</tr>
<tr>
<td>2004</td>
<td>4.2</td>
<td>4.7</td>
<td>2.3</td>
</tr>
<tr>
<td>2005</td>
<td>3.2</td>
<td>1.3</td>
<td>11.6</td>
</tr>
</tbody>
</table>

Source: General Statistic Office (GSO)

Annual average growth rate of 2000-05: Agr. 4.1, Crops 3.5 & Livestock 7.2%
2. Livestock production in Vietnam (cont.)

Annual average growth rate (by head)

Source: GSO

for 2003-05: Buffalo 1.5%, Cattle 12.3%, Pig 5% & Poultry -7%

---

2. Livestock production in Vietnam (cont.)

Animal Population (Unit: mill. heads)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig</td>
<td>26.1</td>
<td>27.4</td>
<td>28.4</td>
<td>29.1</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>4.9</td>
<td>5.5</td>
<td>5.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>0.958</td>
<td>0.104</td>
<td>0.127</td>
<td>0.146</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.87</td>
<td>2.92</td>
<td>2.95</td>
<td>2.98</td>
</tr>
<tr>
<td>Poultry</td>
<td>218.2</td>
<td>219.9</td>
<td>228.5</td>
<td>240.0</td>
</tr>
<tr>
<td>Goats &amp; sheep</td>
<td>1.0</td>
<td>1.3</td>
<td>1.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Source: USDA
2. Livestock production in Vietnam (cont.)

Meat Production

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006 est.</th>
<th>2007 est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total meat, mill.ton</td>
<td>2.513</td>
<td>2.822</td>
<td>3.421</td>
<td>3.755</td>
</tr>
<tr>
<td>Share, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pork</td>
<td>80.1</td>
<td>81.1</td>
<td>71.5</td>
<td>69.7</td>
</tr>
<tr>
<td>Poultry</td>
<td>12.6</td>
<td>11.4</td>
<td>21.9</td>
<td>23.8</td>
</tr>
<tr>
<td>Beef</td>
<td>4.8</td>
<td>5.0</td>
<td>4.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.3</td>
<td>2.1</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Others</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Source: USDA

3. Meat consumption in Vietnam

- Over 90% of the pork and 60% of chicken meat supplied by farmers are consumed in markets;
- Most of Vietnamese household consume meat products, especially pork with over 98% of households consumed. However, a lot of households consumed self-produced meats. And this share is quite large in rural area especially in north uplands;
3. Meat consumption in Vietnam (cont.)

### Per capita consumption

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006 est.</th>
<th>2007 est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total meat (kg/yr)</td>
<td>20.9</td>
<td>23.1</td>
<td>24.5</td>
<td>26.0</td>
</tr>
<tr>
<td>Share, %</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Pork</td>
<td>82.2</td>
<td>83.3</td>
<td>83.0</td>
<td>82.7</td>
</tr>
<tr>
<td>Poultry meat</td>
<td>12.7</td>
<td>11.5</td>
<td>11.9</td>
<td>12.1</td>
</tr>
<tr>
<td>Beef</td>
<td>3.5</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Buffalo meat</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Other meat</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Source: MARD

---

3. Meat consumption in Vietnam (cont.)

### % of HHs consuming meat by type of the product

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork</td>
<td>98.45</td>
</tr>
<tr>
<td>Beef</td>
<td>40.23</td>
</tr>
<tr>
<td>Carabeef</td>
<td>7.12</td>
</tr>
<tr>
<td>Chicken meat</td>
<td>80.94</td>
</tr>
<tr>
<td>Fish/shrimp</td>
<td>97.23</td>
</tr>
</tbody>
</table>

Source: IPSARD calculation based on VHLESS2002
3. Meat consumption in Vietnam (cont.)

Meat consumption in Vietnam and other countries
(kg/person/year)

![Graph showing meat consumption in Vietnam and other countries](image)

Source: FAO
(VN potential of home consumption is still very high)

4. Trade for Vietnam’s Pig industry

- In recent years, most of meat export from VN is pork
- Pork production in VN is mainly for home demand. Only 1–2% of total pork production was for export.
- Countries imported livestock products are: Russia, Hong Kong, China, Malaysia, Laos, Japan...
- VN hopes to become a major pork exporter. However, the strong and growing domestic demand and other countries health restrictions make this very unlikely.
4. Trade for Vietnam's main livestock industry (cont.)

Pork export of Vietnam, 1990-2004 (000 tons)

Source: Tran Cong Thang, ICARD

4. Trade for Vietnam’s Pig industry (cont.)

Countries that import pork from Vietnam (%)

Source: Custom Office.
5. R&D contribution

- Main institutes involved in livestock sector in Vietnam are National Institute for Animal Husbandry (NIAH), National Institute for Veterinary Research (NIVR); Institute of Agricultural Science of South Vietnam (IAS);
- NGOs support for livestock sector include: World Bank, ADB, SIDA, CIDA, GTZ...
- New technology comes to farmers mainly by extension system;
- Expenditure for R&D has been increased on agriculture, particularly livestock sector, however, still limited.

<table>
<thead>
<tr>
<th>Country</th>
<th>Share of Agricultural GDP (%)</th>
<th>Share of total Govt. spending (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>0.25</td>
<td>0.66</td>
</tr>
<tr>
<td>China</td>
<td>0.43</td>
<td>0.54</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.27</td>
<td>0.29</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1.06</td>
<td>0.57</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.40</td>
<td>1.10</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>0.17</td>
<td>0.19</td>
</tr>
<tr>
<td>Asia Average</td>
<td>0.58</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Source: FAO/UNDP (2001); ADB (2001) Agricultural Sector Program Study

The R&D system in VN is under-funded and weak capacity.
5. R&D contribution (cont.)

Investment for research on livestock sector

- Total funding for livestock research institutes from central budget is about 14%. The share of total funding to livestock has increased slightly over the years, 11% in 1993, 15% in 1999.
- However, majority of total budget is for salary cost.
- The total state budget for the livestock research was less than 1% of its contribution to GDP.

5. R&D contribution (cont.)

Achievement & constrains

- Major achievements in transferring new technologies to poor farming community are promotion of beef cattle production, introduction of new pig variety of higher lean meat and dairy cows with more milk production.
- Slow adoption of exotic/crossed breeds by small producers due to nutrition requirements, difficulties of access to appropriate genetics and inefficiencies in breed development in breeding center system.
- Commercial producers have largely adopted exotic breeds. Small farms still rely heavily on local breeds, or crossbreeds of low genetic quality.
- Weak linkage between research and extension systems. Moreover, extension system could not covered wider range of producers.
- Only 28% of producers received extension services from government and non-government organizations.
5. R&D contribution (cont.)

Achievement & constrains

- Exotic pigs is largely adopted by large farms (9% of small farms & 56% large farms keep exotic pigs);
- Adoption of crossbred pigs has been relatively widespread, 58% of small farmers and 25% of large farmers having at least 1 crossbred pig in their herd;
- However, many of crossbred pigs, especially on small farms are likely to be of very low genetic quality, and have productive performance levels that are not significantly greater than those of local animals;

Suggestions:

- More research work on pig breeding that can help pig producers to adopt easily;
- Call for more funding to strengthen and expand extension service; priority of extension programs for the poor.
- More research studies needed on poor farmer’s need or conditions for pig production and consumption in rural areas;
- Increasing the formation of farmer groups to enhance market powers of poor livestock producers
Thank you for your attention!
Pig systems in Southeast Asia—The case of Cambodia

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P.O. Box 2423, Phnom Penh 3, Cambodia
2. Heifer Project International–Cambodia

Abstract

In Cambodia, livestock contributed about 7.6% of the GDP in 2002, and the total value of animal production was about USD 385 million. The improvement of the Cambodian economy (GDP was USD 313 in 2006) and the population growth (13.4 million in 2006) will lead to higher demand for meat. In spite of this opportunity, low agricultural productivity, caused by poor opportunities for using improved technologies, poor marketing infrastructure and declining access to common property resources such as forests and fisheries, are major causes of food insecurity and malnutrition. Typically poor families have cattle and chicken and very few pigs due to high cost of feeds. Research at the Centre for Livestock and Agriculture Development (CelAgri) has shown the potential to use local feed resources based on rice by-products and protein-rich vegetative resources that can be produced on-farm. However, due to lack of financial and institutional support, these messages have reached only a few communities. When poverty alleviation is the goal, the need is for simplified information and training packages that take into account the knowledge, and socio-economic and cultural features of this target group. Such packages should emphasize the use of visualized materials such as videos produced in CD-ROMs, manuals, posters, flip charts and leaflets, which facilitate uptake by village-level extension staff, and leaders of farmer groups.

Introduction

Cambodia, Laos, Myanmar and Vietnam are the poorest countries in Southeast Asia and the majority of the populations depend on agriculture for their food, income and subsistence. In all four countries, growing inequalities can be seen between the rural and urban populations (Ngo Van Man and Luu Trong Hieu 2005).

Depending on the country and scale of production, pigs are important for farmers as a major source of family income, as a sideline for raising funds for particular purposes (tuition for children, cultural and festivity events or paying a debt), or as a ‘savings bank’ (Steinfeld 1998). Devendra (1993) indicated that in Southeast Asia, pigs can play three important functions: (1) diversification of resources and reduction of socio-economic risks, (2) promotion of linkages
between systems and resource components (land, water, crops and animals), and (3) generation of value-added products (e.g. utilization of fibrous crop residues to produce meat and also use of manure).

A survey conducted in the 8 communities of Phnom Kravanh district, Pursat province, showed that each family owned on average $2.9 \pm 0.14$ cattle, $0.87 \pm 0.106$ pigs and $7.3 \pm 0.72$ adult chicken (CelAgrid 2006a). In Cambodia, livestock contributed about 7.6% of the GDP in 2002, and the total value of animal production was about USD 385 million (FAO 2005). The improvement of the Cambodian economy (GDP was USD 313 in 2006) and the population growth (13.4 million in 2006) will lead to higher demand for meat.

An analysis by the World Food Programme in Cambodia suggested that low agricultural productivity, caused by poor opportunities for using improved technologies, poor marketing infrastructure and declining access to common property resources such as forests and fisheries are major causes of food insecurity and malnutrition. Other causes of rural poverty include: (i) high transportation costs impeding efficient marketing and distribution of outputs; (ii) poor basic infrastructure, including the transportation network; (iii) inadequate or lack of access to affordable credit and high level of indebtedness; and (iv) lack of tenure and land title for many poor households. Farmers keep their animals in traditional scavenging systems as a means of risk management rather than in systems more orientated toward increased production and income. As well as large ruminants (cattle and buffalo), mainly used for draught purposes, there is a considerable contribution from pigs and poultry to farmers’ livelihoods and food security. The majority of farmers raise local breeds, including pigs, chicken and ducks, although small- and medium-scale commercial farms close to the cities and towns keep exotic or improved breeds in order to meet the increasing demand for meat and eggs of the fast growing and increasingly affluent urban populations.

Pig and other livestock production

The animal production systems are mainly extensive. Tethering of animals in the field or close to the homestead is practiced widely to collect dung for crop cultivation. Pigs and poultry are fed mainly with kitchen wastes and rice bran, and occasionally limited amounts of purchased concentrates are given. There is little or no investment in housing. Pigs are slaughtered at 10–12 months of age at weights of about 60–70 kg.

The management of smallholder systems and the resultant levels of production are often suboptimal. Smallholders are generally ‘price takers’ not ‘price makers’. In a baseline survey conducted by CelAgrid (2006a), pig keeping was not very attractive due to high cost of feeding. The fluctuation of price per unit live weight was another reason to discourage farmers to keep pigs as other source of income.
Disease control in the region is a difficult issue, both at the national scale (for countries with long land borders with their neighbours) and at a local level (smallholders have poor understanding of diseases, have limited funds, and poor access to drugs and other veterinary services). Transport of infected animals and smuggling are often the causes of failures in disease control (Sovann and San 2002). Management of wastes from pig production is generally poor and natural resource management is a very serious problem in peri-urban areas and in countries with limited land mass. Extension services generally need improvement.

Within the livestock subsector, pig production has shown a significant increase during the last 4 years (Table 1). The increase in production is mainly due to the growth of medium-scale farms around cities to satisfy the demand for meat of the increasing population in the cities.

Table 1. Livestock population in Cambodia (2000–2004)

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>2,992,640</td>
<td>2,868,827</td>
<td>2,924,457</td>
<td>2,985,416</td>
<td>3,035,400</td>
<td>9.14</td>
</tr>
<tr>
<td>Buffalo</td>
<td>693,631</td>
<td>626,016</td>
<td>625,912</td>
<td>660,493</td>
<td>680,500</td>
<td>-0.02</td>
</tr>
<tr>
<td>Pig</td>
<td>1,933,930</td>
<td>2,114,524</td>
<td>2,105,435</td>
<td>2,304,248</td>
<td>2,484,250</td>
<td>11.9</td>
</tr>
<tr>
<td>Poultry</td>
<td>15,249,201</td>
<td>15,248,447</td>
<td>16,677,864</td>
<td>16,013,713</td>
<td>16,033,700</td>
<td>0.05</td>
</tr>
</tbody>
</table>


Pig-based farming systems

Crop–animal systems have played an important role in the mixed, small-farm households. Livestock convert plant materials of low nutritive value to high quality products such as meat and milk and return nutrients to the soil in the form of manure. This synergistic interaction between livestock and crops improves the sustainability of the farming system and maintains or improves soil fertility.

In Southeast Asia, particularly Cambodia, farmers commonly keep a few large and small animals such as cattle, buffalo, pigs and chickens because they are part of the tradition and culture. Livestock plays an important role in the farming systems and in general farmers understand the importance of having animals as the entry point to improve farm productivity. However, in many cases, limited resources, including land area and shortage of capital to purchase, in particular, large ruminants (cattle and buffaloes), prevent them from developing integrated farming systems (Khieu Borin 2005).

In the case of Cambodia, it was observed that farmers keep more pigs after harvesting rice due to the availability of rice by-products such as broken rice and rice bran and farmers also have resources to buy piglets (Khieu Borin 2006 personal observation).
Beside manure from large livestock, pig manure is also a source of fertilizer for the crops. Thorne and Tanner (2002) reported that farmers claimed that plant growth responses are greater with manure-based compost than with fresh manure or inorganic fertilizers. Therefore appropriate management of the animals within the farming system is important in order to maximize the use of manure for crops, and in return to optimize the utilization of crop residues as animal feed, thus resulting in an efficient ‘food–feed system’.

**Feed resources for pig production**

Rice bran is the most common ingredient for pig diets in Cambodia. In fact, the raising of pigs may be viewed partly as a means of adding value to rice bran or just to save daily income when rice bran is purchased. Rice bran being of medium energy and protein content is in itself a reasonable feed for pigs, and it may be estimated that rice bran accounts for up to 50% of the feed for pigs in Cambodia. Farmers buy the rice bran from the rice miller, who owns the bran as part payment for the milling process. The majority of rice grown in Cambodia is processed in local ‘village’ mills. The miller usually takes the by-products of milling—cracked and fine cracked grain, bran and husk as payment for the service of milling. The rice bran available from village mills is generally of poor quality due the high content of husk. The rice bran from larger mills with modern machinery is of better quality with 12–13% of crude protein while from village mills the protein is only 8–10%. In the market, different qualities of bran can be bought as generally these are classified as first, second and third grade. Third grade has significant amounts of husk. Husk has a high content of fibre, which pigs cannot digest, and therefore bran with high levels of husk are poorer quality feeds.

<table>
<thead>
<tr>
<th>Items</th>
<th>Riel/kg fresh weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice bran–grade 1</td>
<td>750–800</td>
</tr>
<tr>
<td>Rice bran–grade 2</td>
<td>500–600</td>
</tr>
<tr>
<td>Rice bran–grade 3</td>
<td>350–450</td>
</tr>
<tr>
<td>Broken rice</td>
<td>800–900</td>
</tr>
<tr>
<td>Rice full grain</td>
<td>1200–1500</td>
</tr>
</tbody>
</table>

Rice grain has also been used for pigs. It is cooked with other vegetables from nearby households or with water plants collected from lakes and ponds. Typical vegetables are water spinach, sweetpotato leaves, amaraths, water lily, taro and banana stems. The type and quantity of feed vary on a seasonal or area basis, and on the labour requirements to collect the feed. It has been observed that the number of pigs per family increases when they make rice wine. Sometime the production of rice wine may not be profitable but is justified in order to get the brewery residue for their pigs. The quality and quantity of feeds given to pigs is invariably not sufficient for them to reach their productive potential. Given the price of feeds and the risk of sickness
or death, farmers are often not willing to invest in pigs, even if they were available. However, significant improvement could be made in pig nutrition by better use of locally available feeds, and targeting protein rich feeds to young pigs, as part of overall better management of young pigs to reduce their mortality.

At present, pig production in Cambodia is limited by the availability of the feed resources. The scavenger food resource base limits the number of small stock that can exist in a village under free-range conditions and is a function of husbandry practices and the nutritional value of what is available. Studies indicate that a household may produce in the vicinity of 200–500 kg of dry matter (0.5–1.4 kg daily) of waste food materials per annum. The rest must therefore come from the environment around the house or the village. Productivity under this situation is low. Age to first mating-slaughter live weight is delayed; females may produce a single litter per annum and only 2–3 litters per lifetime due to delayed onset of oestrous post-weaning. Local breeds of pigs perform better than exotic breeds under these conditions.

Moore (1976) reported high potential yields of foliage when cassava was managed as a semi-perennial crop with repeated harvesting at 2–3 month intervals. When provided with appropriate nutrient inputs and management practices, cassava managed for foliage production could be one of the potential tropical crops for producing protein (Khieu Borin and Frankow-Lindberg 2005). Cassava leaves have been reported as having a good array of amino acids, as compared to soybean meal, but with a deficiency in sulphur-containing amino acids (Eggum 1970; Phuc et al. 2000). Trials conducted with farmers in several locations indicated that a mixture of water spinach and cassava resulted in daily weight gain of 250 to 350 g, using broken rice and rice bran as energy sources (CelAgrid 2006b; Khieu Borin et al. 2005).

Commonly, commercial pig farms use cereal grains with either soybean meal or fish meal or combinations of the two as the feed base. The price of these conventional feed resources is now rising rapidly as they are increasingly employed as feedstock for production of fuel (Preston 2006).

Smallholder pig producers

The definition of a smallholder pig farm varies amongst countries. For instance, in Philippines and Vietnam, a small farm has less than 20 pigs, while small farms in Cambodia and Laos have less than 5 pigs (FAO 2005). Smallholder farmers are mainly located in rural areas. Because of their numbers and generally low standard of living, smallholders are an important focus for poverty alleviation and development programs sponsored by Governments donor agencies (Jones 2002). These small-scale pig farms provide an increasing supply of pigs to the local markets and to Phnom Penh. The marketing chain in the open market system is short, both for input supplies and the finished product.
The economic failure of small-scale pig production is often due to high mortality of young piglets. Farmers commonly buy piglets from middlemen at the time of the rice harvest. Such piglets are generally not adapted to the smallholder environment and often cannot survive on poor quality diets. Mortality is also caused by stress during the transportation.

A 20 kg improved breed piglet currently costs approximately 85 thousand riel. After 6 months, the 100 kg ‘improved’ pig sells at the farm gate at about 4 thousand riel per kg live weight. Crossbreed pigs may have a farm-gate price of only around 3 thousand riel per kg. The price incentive for farmers to raise improved breeds and apply better husbandry should adequately justify the investment in new technologies. Khieu Borin et al. (1996) emphasized that the strategy for long-term and sustainable development is to establish the reproduction system in the villages, so that the piglets are better adapted to the native environment and local feed conditions.

Large-scale pig producers

Large-scale pig farms account for 15 to 20% of the total regional pig population (Northoff 2006). The share of commercial pig production within total pig production differs between countries. At this moment, there are only a few commercial pig farms in Cambodia, mainly located near Phnom Penh (Yu Tong and CP companies). They supply almost all the grandparent stock, breeding sows, and piglets to medium scale producers particularly around Phnom Penh and other larger cities. These farms are very well-equipped, well-managed and have a high productivity. Only exotic breeds are kept in this system and the breeds are mostly Yorkshire, Landrace and Duroc (Khieu Borin 2006, personal communication).

In the Philippines, Thailand and Vietnam, intensive pig farms rely on imported germplasm, technology and feed. Vietnam is establishing a disease-free zone about 30 km from Ho Chi Minh City for export purposes. Beside, having their own commercial production facilities, companies such as the CP group have also made contracts with farmers, whereby the company provides all the inputs and technical support, while the farmer adds housing facilities and labour. The increase in the number of these contracts will most likely result in the domination of the meat market by giant companies. Under the current scenario, millions of smallholder households will lose their market share and subsequently become employees of these large firms (Lapar et al. 2003). As an example, the recent dumping of finished pigs from Vietnam into Cambodia has significantly affected the livelihoods of both medium- and small-scale farmers in Cambodia.

Around Phnom Penh and other cities in Cambodia, a medium size pig farm may have 10–50 pigs with a mix of production categories such as sows, piglets and fatteners (Khieu Borin 2006, unpublished data). Producers in this system in many cases own rice mills or brew rice wine.
Demand for pig meat

Countries in Southeast Asia are developing rapidly, with increases of 4 to 8% in income, 2 to 3% in population, 4 to 6% in urbanization and between 4 and 8% in meat consumption. In comparison to the 31% of the world meat production by developing countries in 1980, they are expected to produce 60% of the world meat production in 2020. Of this 60%, 13% will be produced in Southeast Asia alone. In this region, pork production is the most important meat source accounting for approximately 58% of total meat output.

In a study of preferences (scale of 1 to 10) for different types of meat (CelAgrid and ILRI 2006, unpublished data), consumers in the Phnom Penh area gave scores of 9.01 for pig meat and 8.92 for fish, while Takeo consumers scored 8.96 and 8.74 for pig meat and fish, respectively. Although, local breed pigs usually have lower productivity than improved and cross breeds, consumers in both places gave higher scores for pig meat from local breeds than from exotics and crosses. The reasons of giving a higher score for meat from local breeds were because of the people’s perception that local breeds are produced by villagers without hormones or antibiotics.

Research and development priorities

If this issue is not addressed, the differences between commercial and smallholder producers will increase because the commercial sector has, and will increasingly have, superior resources and access to the national and the world knowledge/information base on pig production technology and marketing.

So far little has been done to improve small scale pig production in Cambodia. Some NGOs have provided piglets to communities but not much has been done to improve the production process. The recently established ‘Cambodian Australian Agricultural Extension Project’ is in the process of developing messages that should provide solutions to the small scale pig keepers. During the last 5 years, the Centre for Livestock and Agriculture Development (CelAgrid) has carried out a series of research studies relating to the improvement of management and development of feeds from local resources. However, due to lack of financial support, there has been little transfer of these messages to the communities.

Extension workers find it is easier to talk to commercial farmers, who are usually educated, while poor farmers are in most cases illiterate. For the latter, it is difficult to introduce innovations due to socio-economic and cultural barriers. In addition, most extension workers, while well prepared from the technical viewpoint, have not been trained to deliver effective extension messages to farmers with poor resources.
Possible solutions

It can be assumed that farmers who have decided to ‘make a business out of pig production’ will of their own volition acquire access to information on improved and appropriate technologies. However when poverty alleviation is the goal, the need is for simplified information and training packages that take into account the knowledge, and socio-economic and cultural features of this target group. Such packages should emphasize the use of visualized materials such as videos produced in CD-ROMs, manuals, posters, flip charts and leaflets. These messages can target, for example, village-level extension staff, and leaders of farmer groups. Some desirable characteristics for these information/training packages are that they:

- Produce extension materials which will enhance pig production at the small and medium scale
- Provide producers with information that will improve their capacity to:
  - manage their enterprises more efficiently and profitably
  - make more efficient use of locally available feed resources
- Supply credible information that is sufficiently accurate for the main task at hand
- Provide performance parameters so that farmers can compare productivity with their peers. (This will involve increasing the emphasis on record-keeping.)
- Make available marketing information.

Delivery of information and training may need to take into account the following observations and points.

- Communication is a two-way process. Advisers/trainers may well have as much to learn from smallholder producers about operational, tactical and social aspects of pig production as they have knowledge and understanding to impart;
- Effective communication can occur through a diversity of routes (e.g. formal training courses, word-of-mouth, and actually seeing new technologies in practice on other farms);
- Provision of information and training entirely from government resources can be extremely expensive, so financial or in-kind contributions from participants should be a prerequisite, and support from commercial groups, donors, and NGOs should be sought;
- Information on costs, prices, and their trends is as important, if not more important, than technical information on the various aspects of production.

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CelAgrid. 2006b. Ensiled cassava leaves and fresh water spinach as protein sources for fattening pigs on farms in Takeo, Cambodia. Report of on farm trial to CIAT.

Devendra C. 1993. Sustainable animal production from small farm systems in Southeast Asia. FAO (Food and Agriculture Organization of the United Nations), Rome, Italy.


Khieu Borin, Than Soeun, Preston TR and Kenji Sato. 1996. The role of the sugar palm tree (Borassus flabellifer) in livestock based farming systems in Cambodia. National seminar on sustainable livestock production on local feed resources, held at University of Agriculture and Forestry, Ho Chi Minh City, from September 10–14, 1996.


Background

- Population: 13.4 million, 85% of which are farmers, and women constitute > 50%
- Rice is main crop
- Livestock:
  - Pig
  - Cattle and Buffalo
  - Poultry

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** Heifer Project International - Cambodia
Livestock production in Cambodia

(Source: MAFF, 2004)

Pigs are important for farmers

Steinfeld (1998)
- Major source of family income
- Sideline for raising funds for particular purposes
- Saving bank

Devendra (1993) in SE Asia pigs can play
- Diversification of resources and reduction of socio-economic risks
- Promotion of linkages between systems and resource components (land, water, crops and animals)
- Generation of value-added products
Low livestock productivity

- Farmers keep animals in traditional scavenging systems as means of risk management rather than in systems more orientated toward increased production and incomes.
- Majority of people raise local breeds (pigs, chickens and ducks) although small and medium scale commercial farms close to cities and towns keep exotic or improved breeds to meet demand of urban populations.

Pig-based farming systems

- Crop-animal systems play important role in mixed, small-farm households archiving ‘food-feed system’
- Livestock convert plant materials of low nutritive value to high quality products such as meat and milk and return nutrients to soil in form of manure.
- In Cambodia: farmers keep more pigs after harvesting rice due to availability of rice by-products and farmers have resources to buy piglets.
Feed resources for pigs production

- Rice bran is most common ingredient for pig diets
- Rice grain cooked with vegetables collected nearby households or water plants from lakes and ponds
Feed resources for pigs production

At present pig production is limited by availability of feed resources

- Scavenger food resource limits number of stock that exist under free-range conditions
- Function of husbandry practices and nutritional value depends on what is available
- Commonly commercial farms use (cereal grains, soybean meal, fish meal) become more expensive which rural farmers hard to afford

Small scale pig producers

- Small pig farm varies amongst countries
  - Philippines and Vietnam: less than 20 pigs
  - Cambodia and Laos: less than 5 pigs
- Productivity at small-scale farms is often far below potential levels (breed, disease, supply of feed and management)
- Monitoring of diseases is difficult task
- Economic failure of small-scale pig production is high mortality of young piglets
  - Bought from middlemen of unknown sources
  - Not adapt or cannot survive with very poor quality diets
  - Nutritional stress and stress during transportation
Large scale pig producers

- Accounts for 15-20% of total regional pig population
- Exotic breeds (mostly Yorkshire, Landrace and Durock)
- Rely on imported genetic, technology and feeds
- Compete with people for food and lead to increase grains for human and animals
Contracted farmers: company provides all inputs and technical support, farmer adds housing facilities and labor.

Increase of these contracts will most likely result in domination of meat market by giant companies.

Under this scenario, millions of smallholder producers will lose their market share and become employees of these large firms.

As an example, price of live pig decreases about 23% by recent dumping of finishing pigs from Vietnam into Cambodia which significantly affect both medium and small-scale farmers in Cambodia.
Demand for pig meat

- Pork production is most important source to provide meat accounts for 58% of total meat output
- 31% of world meat produced by developing countries in 1980, and will produce 60% in 2020
- Of this 60%, 13.2% will produce in SE Asia
- Pig meat, cow meat, chicken, duck, seafood and fish found to be most common food for Cambodian households
- Consumers in Cambodia give highest ratings for pig meat then fish and higher for pig meat from local breed than other
R & D priority

- Information systems and technology transfer
- Policy development
- Environmental management
- Health and food safety
- Feeding and breeding

Information Systems and Technology Transfer

- Provide resources in competitive basis for research
- Produce extension materials which will enhance pig production at small and medium scales
- Provide information that will improve their capacity to manage their enterprises more efficiently and profitably
- Supply credible information that is sufficiently accurate for main task at hand
- Provide performance parameters so that farmers can compare productivity with their peers
- Make available marketing information
**Policy Development**

- Encourage smallholders to organize into cooperatives and buying groups so that their inputs are cheaper and more accessible, and market power and market access are enhanced.
- Encourage large-scale commercial producers to develop niches in production chain for smallholders.
- Support education, training, and technology transfer programs for smallholders.

**Environmental management**

- Biogas technology seems to be beyond financial and management resources of many smallholders, although it has important role to play in semi-commercial and commercial production systems.
- Any changes would need to be seen to add value to crop/livestock system.
- Disposal of solid effluent using worms has apparently been practiced successfully in Cuba, with final product being worms and nutrient-rich organic matter.
- Pelleting solid manure for use in horticulture or crop production may warrant for further attention.
Health and Food safety

- Regional cooperation OIE and FAO in quarantine inspection and disease surveillance and management
- Other related activities by individual countries should continue (e.g. disease diagnosis, vaccination programs, training and extension, and supply of veterinary products)
- Implementation of programs based on existing knowledge which emphasis on activities such as registration and inspection of slaughterhouses and training in food hygiene for meat handlers and processors

Feeding and Breeding

- Provide simple tools for smallholder farmers or their advisers that are simple to use and understanding with basic science behind and on past research and experience in region
- Encourage smallholder farmers to be more aware of, and responsive to, market signals on carcass quality
- Seek opportunities for closer integration of feed and breed aspects of their production systems with those of commercial-industrial producers
Thank you for your attention!
Safety Scares, Changing Retailing, and Pork Supply Chain Development in China: Opportunities and Challenges

Kevin Z. Chen, Ph.D, Professor, The Institute of Rural Development and the School of Business, Zhejiang University and Manager, Beijing Program Office, China Canada Agriculture Development Program

Dinghuan Hu, Ph.D, Professor, Agricultural Economics Research Institute, Chinese Academy of Agricultural Science

Two Key Drivers

- Changing retail markets
- Food safety scares
Major Food Retailing Trends in China

- Overall Growth of the Modern Self-Service Stores Continues
- Growth of Hypermarkets and Convenience Stores is Particularly Fast
- Consumers Still Prefer Traditional Markets When Shop for Fresh Food despite Rapid Chain Store Growth
- Supermarkets have started to spread from richer and up middle class to middle and poor consumer segments and from large to medium cities/town.
- There has been increased penetration of foreign food retailers
- There has been increased consolidation in the retail sector
- There has been increased availability of range of foods at market
Food Safety Scares (Pork)

- Illegal feed additives – Clenbutero
- Residues - Antibiotics
- Animal disease – Streptococcus and Foot and Mouth Disease
- “Water-injected” pork
- Underground Slaughtering
- Unlicensed Meat Processors

The Proportion of Sample Pork that Clenbutero Is Tested Positive

[Graph showing the proportion of sample pork tested positive for Clenbutero from 2001 to 2003]
**Clenbutero Pork in Shanghai**

- Pork with Clenbutero were found to be sold in several wet markets in Shanghai, September, 2006
- Resulted in 336 persons being poisoned
- Since 1998, one person dead and 1,700 sick due to “Clenbutero” pork

**New Business Practices on Sourcing Food Products**

- Increasing use of supply contracts
- Numerous and costly criteria for supplier accreditation
- Towards regional and global sourcing networks
- Tough contract negotiations and enforcement
Impacts on the Organization, Institution, and Market Participants

- Increasing Exit of Traditional Retailers
- Emergence of Food Distribution Centres/Companies and Bypassing Pressure on Traditional Wholesaler
- Rationalizing Domestic Food Processing Industry
- Gravitation toward Large Producers

Beginning to Affect the Way Food Is Produced

- To keep pace with the demands, farms will have to adjust by specializing in a particular commodity, consolidating fragmented land holdings to achieve scale economies, and forging stronger links with processors and retailers.
- Closer relationships between firms at different stages of production and marketing are emerging as larger commercialized farm operations grow produce and animals under contract for processors, retailers, or exporters.
Supply Chain Development as a New Strategy

- In response to these drivers, a new type of organisation and management in agri-food system has been emerged
- At the same time, emergence of bio-modal structure of retail markets

Pork as a Case: China Hog and Pork Industries

- Pork is the dominant meat in Chinese diet
- China is the largest pork production (4.86 mmt, 2005) as well as consumption (4.89 mmt) – accounts for more than 50% of the world total
- China is a net pork exporter (400 v.s. 70 mt, 2005)
- There was 108 million pig farms and farmers in 2003 but 95% of them raises less than 9 pigs
- The top five pig producing provinces are Sichuan (10%), Henan (9%), Hunan (9%), Shangdong (7%) and Hebei (7%)
- Less than 10% of pork are further processed
- Two largest hog and pork processors are Shineway (turnover $US 2 billion, 2005) and Yurun (1 billion)
**Meat Production in China**

The graph shows the production of pork, beef, and mutton in China from 1996 to 2005. The production of pork has remained relatively stable, while beef and mutton have shown a steady increase.

**Size Distribution of Pig Farms in China, 2003**

<table>
<thead>
<tr>
<th>The Number of Animals</th>
<th>The Number of Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–9 heads</td>
<td>101,963,901 (95%)</td>
</tr>
<tr>
<td>10–49</td>
<td>4,815,474</td>
</tr>
<tr>
<td>50–99</td>
<td>851,429</td>
</tr>
<tr>
<td>100–499</td>
<td>249,016</td>
</tr>
<tr>
<td>500–2999</td>
<td>33,844</td>
</tr>
<tr>
<td>3000–9999</td>
<td>3,388</td>
</tr>
<tr>
<td>10000–49999</td>
<td>911</td>
</tr>
<tr>
<td>50000 and above</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>107,917,993</td>
</tr>
</tbody>
</table>
## Three Types of Pork Supply Chains in Sichuan

<table>
<thead>
<tr>
<th>Chain</th>
<th>Features</th>
<th>1985</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Backyard Farms to Local Markets</td>
<td>3-4 family members, 2-5 pigs</td>
<td>95%</td>
<td>70% (14 million)</td>
</tr>
<tr>
<td></td>
<td>Fed with limited feed and leftovers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local hybrids, 150 days to reach 80kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh meat sold at local markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From Specialized Households to Out of Province Markets</td>
<td>Family-based, 50-1,000 pigs</td>
<td>3%</td>
<td>25% (300,000)</td>
</tr>
<tr>
<td></td>
<td>Commercial feeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mixed breeds, 120 days to reach 80kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh or frozen meat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From Large Commercial Farms to Export Markets</td>
<td>Different ownerships, 5,000 or above pigs</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>DLY breeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh or frozen meat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Backyard to Wet Market
Large Commercial Farms to Exports and Supermarkets

Pork Supply Chain in Sichuan (IFC 2005)
**Sichuan Supply Chain: Assessment**

- Breeding - local hybrid (88%), DLY (10%), and local (2%).
- Fattening – dominated by fragmented smallholders
- Primary processing – fragmented (460 mmt)
- Secondary processing – small (170 mmt)
- Markets – local (360 mmt), other provinces (80 mmt), and export (16 mmt).

**Sichuan Pork Chain: Limiting Factors**

- Lack of coordination (both industrial and institutional)
- Low adoption of good breeds
- Poor feeding practices
- Difficulty in sourcing pigs from fragmented smallholders
- Inadequate cold chain
- Difficulties in animal disease prevention and control
- Meat safety scares
- Volatile market
Sichuan Pork Chain: Recommendations

• Rationalize the pig raising sector
• Integrate smallholders
• Special fund to promote the improved breeds
• Credit to small holders
• Pig insurance policy
• Effective extension targeted on small holders
• Cold chain and logistics development

Integrating Small Farmers into Supply Chains

• Private companies + Farmers
• Quasi government companies + Farmers
• NGOs + Farmers
• Wholesalers + Farmers
• Farmer Associations + Farmers
• Co-operatives + Farmers
• Large farmers + Small farmers
• Brokers/Transporters + Farmers
• Other combinations
Some of Observed Public Initiatives
- China

- Office of Agro-Industrialization to promote co-ordinated system
- “Dragon Head Enterprise” Policy Framework
- Quasi-government distribution centre, Zhejiang Provincial Department of Agriculture
- Various food safety initiatives aiming at improving farmers’ access to modern retail and service outlets
- Many small chains are setting up under joint efforts of extension technical departments, farmers/organization, and private companies
- Promotion of formation of farmers’ organizations and cooperatives
- Subsidized livestock insurance policy

Sichuan Pork Supply Chain Pilot Funded CIDA

- Project inputs: 
  - Participating extension approach (PEPS)
  - Breeds improvement and breeding technologies
  - Farmers cooperatives & management
  - Quality assurance and safety of slaughter house
  - Good Agriculture Practice (GAP)
  - Trace-ability
  - Agribusiness training

- Project inputs: 
  - Meat classification training
  - Agribusiness Training
  - GMP/HACCP
  - Food inspection

- Government
  - MOFCOM
  - AGRQ
  - MOA
  - MOH
  - MOF

- Project inputs: 
  - Ag administration and management
  - Training
  - WTO/SPS training

- Project inputs: 
  - Market access barrier analysis
  - Technical assistance

- Small Hog Farmers
- Slaughter Houses & Processors
- Markets

- Project inputs: 
  - Farmers cooperatives/Farm Producers Association
  - National food safety strategy/Slaughter Protocols
  - Extension and training
  - Cold Chain

- Project inputs: 
  - Market access contracting
  - Market access
  - Market access regulation
  - Agribusiness training
  - GMP/HACCP
  - Food inspection

- Project inputs: 
  - Policy research
  - Policy research
  - Market system
  - Research
**Activities & Impact**

- Agriculture Technical Extension Reform (ongoing)
  - incentive and appraisal mechanism and extension approaches.
  - Agriculture → Animal husbandry

- Farmers Cooperatives / Farm Producers Association (ongoing)
  - “Farmer Cooperative Law”
  - Training Manual and Materials

- Cold Chain

---

**Activities & Impact**

- Food safety & lab network
  - quality control and lab management
  - antibiotics testing

- Meat classification & inspection training

- Quality assurance system at slaughter houses
Activities & Impact

- Hog development strategy and 11th five-year-plan
- The first pig farmers field school in China
- Disease prevention and control house at village level
- Pig insurance

Challenges Ahead

- Incentive based mechanism to award good practices of stakeholders in the chain
- How to create the environment of fair competition in the market?
Issues of pig production in the Small Pacific States

Hans-Gerhard Wagner
Senior Animal Production and Health Officer

Pacific Islands
Small islands developing states

- Face common constraints:
  - smallness,
  - remoteness,
  - geographic dispersion,
  - vulnerability to natural hazards (cyclones),
  - peculiar population structure and mobility
- Strong traditions (a party without a pig is not a party). Fiji US$ 1 000 per pig for ceremonial purposes
- 40 % of total value of livestock production (SPC 2001)
- Fishing rights, Remittance and grants important factor of the economy

<table>
<thead>
<tr>
<th></th>
<th>Inhabitants 1000</th>
<th>Pigs 1996 1000</th>
<th>Pigs 2005 1000</th>
<th>Pig meat production 1000</th>
<th>Pigs/inh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook Islands</td>
<td>20</td>
<td>16.50</td>
<td>32.00</td>
<td>0.55</td>
<td>1.60</td>
</tr>
<tr>
<td>Fijii Islands</td>
<td>823</td>
<td>115.00</td>
<td>140.00</td>
<td>3.94</td>
<td>0.17</td>
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<td>84</td>
<td>27.60</td>
<td>12.40</td>
<td>0.88</td>
<td>0.15</td>
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<tr>
<td>Marshall islands</td>
<td>60</td>
<td>13.00</td>
<td>15.00</td>
<td></td>
<td></td>
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<td>Micronesia Fed. St.</td>
<td>108</td>
<td>40.00</td>
<td>32.00</td>
<td>0.87</td>
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<td>Nauru</td>
<td>13</td>
<td>3.00</td>
<td>2.80</td>
<td>0.07</td>
<td>0.22</td>
</tr>
<tr>
<td>Niue</td>
<td>2</td>
<td>1.50</td>
<td>2.00</td>
<td>0.06</td>
<td>1.00</td>
</tr>
<tr>
<td>Palau</td>
<td>20</td>
<td>0.80</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>4 920</td>
<td>1033.00</td>
<td>1750.00</td>
<td>66.00</td>
<td>0.36</td>
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<tr>
<td>Samoa</td>
<td>159</td>
<td>179.00</td>
<td>201.00</td>
<td>3.80</td>
<td>1.26</td>
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<tr>
<td>Solomon Islands</td>
<td>463</td>
<td>55.00</td>
<td>53.00</td>
<td>2.32</td>
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<td>13.50</td>
<td>0.09</td>
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<td>Vanuatu</td>
<td>202</td>
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<td>62.00</td>
<td>2.81</td>
<td>0.31</td>
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<tr>
<td></td>
<td>6 857</td>
<td>1637.4</td>
<td>2396.70</td>
<td>82.89</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Statistics for the Pacific Islands
### Special Programme for Food Security

- Italian funded
- SSC with experts from Philippines and China
- Technical areas
  - Water
  - Crops
  - Livestock (pigs and poultry)

### Communalities

<table>
<thead>
<tr>
<th>Country</th>
<th>Geographic Type</th>
<th>Farming System</th>
<th>Livestock / Poultry</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papua New Guinea</td>
<td>Highlands with good forest covers, and few atolls</td>
<td>Mixed species planting system (root crops)</td>
<td>Cattle, Buffalo, sheep, goat, swine, poultry</td>
<td>Technology in breeding, access to credit, marketing, particularly the smallholder.</td>
</tr>
<tr>
<td>Solomon Island</td>
<td>High islands and few atolls</td>
<td>Mixed planting (root crops)</td>
<td>Cattle, swine, chicken, goat</td>
<td>Lack of breeders, technology, animal nutrition, waste management, post production technologies</td>
</tr>
<tr>
<td>Kiribati</td>
<td>Predominantly atolls</td>
<td>Coconut based</td>
<td>Swine and poultry</td>
<td>Lack of quality breeders, feeding resources, Improved management practices</td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>Atolls</td>
<td>Coconut based</td>
<td>Swine and poultry</td>
<td>Lack of quality breeders, feeding resources, Improved management practices</td>
</tr>
<tr>
<td>Nauru</td>
<td>Raised corals island</td>
<td>Mixed crops (root crops)</td>
<td>Swine and poultry</td>
<td>Lack of quality breeders, feeding resources, Improved management practices</td>
</tr>
<tr>
<td>Palau</td>
<td>High island and atolls</td>
<td>Multi storey agro forestry</td>
<td>Swine, Poultry such egg types and ducks, goat, cattle</td>
<td>Lack of extension personnel, lack technology, breeders, and breeding programs.</td>
</tr>
<tr>
<td>Tokelau</td>
<td>Atolls</td>
<td>Coconut based</td>
<td>Swine and poultry</td>
<td>Lack of quality breeders, feeding resources, Improved mg.</td>
</tr>
</tbody>
</table>
Communalities

• Small holders subsistence farmers
  – Low input
    • Local feed resources inadequate and unbalanced
dependency on imported feed (irregular)
    • Low level of management – scavenging
    • Nuisance,
    • No veterinary service
  – Low productivity
    • No reproductive management
    • In-breeding due to small and closed populations
  – Poor waste management – odor, diseases
  – No slaughter facility, meat hygiene, formal market

Feeds available in Marshall Islands (similar in other countries)

<table>
<thead>
<tr>
<th>Whole coconut</th>
<th>Local fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut scrapings</td>
<td>Fish wastes:</td>
</tr>
<tr>
<td>Copra cake</td>
<td>Tuna jaw, head &amp; tail</td>
</tr>
<tr>
<td>Breadfruit</td>
<td>Fish gills and innards</td>
</tr>
<tr>
<td>Banana leaves/stem</td>
<td>Kitchen scraps</td>
</tr>
<tr>
<td>Banana fruit peelings</td>
<td></td>
</tr>
<tr>
<td>Taro</td>
<td></td>
</tr>
<tr>
<td>Sweet potato vines</td>
<td></td>
</tr>
</tbody>
</table>
Traditional feeding in Marshall Islands

- Scavenging + coconut
- Sliced coconut + taro
- Whole coconut + kitchen scraps
- Whole coconut + kitchen scraps + greens
- Sliced coconut + breadfruit + kitchen scraps + greens

Marshall islands

- Overall demand for pig and pork - there are about 60,000 inhabitants. Assuming average consumption 10 kg per head - 600,000 kg requirement. Carcass weigh 30 kg an annual requirement of 20,000 pigs. Assuming 12 piglets per sow per year would require 1700 sows.
- What is the feed resource in the country. How many pigs can realistically be fed using local feed resources.
- If feed has to be imported is local production economically competitive with imported frozen meat? Would people pay the higher price?
- Since feed is a limiting factor is it not advisable to focus more on multiplication of the smaller/traditional/local pigs than to focus on the improved white/European breeds and leave the latter to a few bigger ones? Where do we find these adapted resources
- To 'improve' local pigs - a simple on farm recording could be done: note matings, farrowing dates, piglets born, piglets weaned and slaughter pigs sold (weight and date).
Niue

- Inhabitants 2 000 – 2 000 pigs
- 8 hair cutting ceremonies
  - 425 pigs slaughtered
  - 24 kg dressing weight – 11 840 kg
  - 5.1 kg/p/year
- 12 hair cutting ceremonies
  - 636 pigs slaughtered
  - 17 760 kg – 8.5 kg/p/year

Saville Manuelli 2002

Problems affecting pig production in the Pacific Islands region (SPC 2001)

<table>
<thead>
<tr>
<th>Problem to be addressed</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving nutrition</td>
<td>1</td>
</tr>
<tr>
<td>Improving animal health</td>
<td>2</td>
</tr>
<tr>
<td>Improving genetics</td>
<td>3</td>
</tr>
<tr>
<td>Extension services and technology transfer</td>
<td>4</td>
</tr>
<tr>
<td>Housing and environment</td>
<td>5</td>
</tr>
<tr>
<td>Fertility</td>
<td>6</td>
</tr>
<tr>
<td>Product development and quality</td>
<td>7</td>
</tr>
</tbody>
</table>
Summary of the issues

- Important for food security and diversification of the diet
- Culture
  - No clear individual country assessments:
    - What is available
    - What are the requirements and what is realistically possible
    - Acceptability of the proposed changes
  - Trade-off between cultural requirements and development requirements
  - Policies do exist but are not implemented
- Very flexible system – ideal for poverty alleviation
- Small holder subsistance farmers need help – bigger once are more knowledgeable,

Summary of issues

- Feeding
  - Local feed resources availability in quantity and quality and accessability
  - Mobilizing (distribution) local resources
  - Formulation of rations
- Housing and management (scavenging pigs are a nuisance)
- Genetics – reproduction – genetic resource;
  - No records at least basic ones
  - Inbreeding, availability of boars
  - Is bigger beautiful?
  - AI – which breeds
- Economics versus tradition and culture
- Slaughter – products development - market
- Polution (Fidjii Hotel 25%, village waste 40%, pigs 35%)
- Practical training and demonstration
Some of the problems will solve themselves.......  

Thank you
Discussion group outcomes

In this session, *Pig systems, livelihoods and poverty—Current status, emerging issues and ways forward*, the three systems-based discussion groups: (i) Subsistence level/producing for the local market; (ii) Smallholders producing for the market; and, (iii) Industrial commercial orientation, were asked to address:

- Systems typology — common elements in different countries/regions
- Drivers of change — is the system changing, what makes it change, what limits change

The summary outcomes of the three discussion groups were:

I Subsistence/producing for the local market

Typology

It was concluded that the common elements are:

- local market focus
- using existing resources, e.g. feed, breeds, labour
- pig production forms part of a diversified low-risk livelihoods system

The group identified the component characteristics as:

- **Disease**
  - High loss of animals to disease
- **Feed**
  - Farmer time/labour required to source or gather feed
  - Slow animal growth (approximately 110g/day)
  - Adaptability, particularly to fibre-rich diet
  - Scavenging system and poor quality feed
  - Feed resources are key, especially when different breeds are introduced
  - Pigs are being used to recycle sources from within the system
- **Markets**
  - Market access limited to buyers in immediate locale
  - Market imperfections, e.g. intermediaries capture much of the profit that would otherwise accrue to farmers (high transaction cost)
  - Low sale price of animals in most cases
  - Degree of isolation: lack of exposure of local markets/smallholders to other markets/production systems
  - Somewhat buffered from the impact of globalization on local market prices and supply (buyers may prefer fresh local products and low use of concentrates reduced impact of high feed prices)
• Breed
  • Mostly indigenous breeds are used by the poor
  • Preference for some attributes of local breeds (disease resistance, ability to survive on poor feed quality, cultural aspects including colour preference)
  • Taste—local breed may be preferred (if the consumer can afford it)
  • As pig farming becomes more business/market oriented, local crosses may be preferred in order to improve carcass quality

• Livelihood function
  • Market vs. non-market values as part of the definition of smallholder system—pigs as a finance and insurance asset
  • Part of a diversified low-risk livelihoods-oriented production system
  • Contributes to food security, although usually through sale rather than direct consumption
  • Gender—women and children involved

Drivers of change
The group agreed that the system is changing and that the changes include:

• Movement towards a more business-oriented model but difficulties to adopt new techniques (e.g. in NE India)
• Differences in the speed of change, largely dependent on remoteness (e.g. in Vietnam)
• Where feed resources can be developed there is a move towards increased intensification (e.g. in Laos)
• Change from scavenging to penned systems, depending on feed sources
• Urbanized demand also tends to be met from semi-intensive production units rather than subsistence ones (e.g. in Laos)
• Increased market linkages in remote areas; also the risk of disease epidemics and animal-to-human disease transmission (e.g. in Laos) result in new regulations
• Changing diets (e.g. fast food consumption): urbanization has increased demand for food but it also involves migration of entire families who continue to carry out their traditional production but with, e.g. hotel wastes (e.g. in Nepal)
• Government policy explicitly promoting commercialized systems (e.g. in Bhutan)

In answer to the question ‘What is limiting change?’ the group identified:

• Labour availability in mixed farming systems is limited (scavenging preferred)
• Not every farmer has the objectives or resources to intensify
• Poor access and communication (market linkages)
• Farmer capacity needs to be developed to permit and support change
• Government services: there is a lack of supply and/or inadequate delivery of services, e.g. veterinary and extension services. Basic training is needed
• Lack of government development programs to deliver and manage for exotic breeds
• Credit: little priority for agriculture by government or priority given to other livestock species. Credit system does not work well for those without collateral, although there are some self-help groups
• Intensification satisfactory as long as risk can be managed; lack of insurance in the context of high mortality, especially with introduced breeds
• Niche markets and taste preferences (local breeds) but slow growth. However, there is also the misconception that local breeds cannot grow quickly even with adequate feed
• Feed resource base inadequately developed and low feed conversion ratio by local breeds
• Standardization at the subsistence level is difficult

Based on their discussion the group identified four key issues related to developing subsistence systems:

• How can the existing production system be improved without increasing risk (low risk from a livelihood perspective because diversified, despite being high risk from the point of view of disease challenge)
• Delivery and training in the use of inputs is key to improvements (with other breeds)
• Group/community initiatives can be successful (but often only carried out with improved breeds)
• Need to find alternative employment opportunities for displaced local producers

II Smallholders producing for the market

Typology

The group identified this system by:

Characteristics

• Ownership: family-based
• Purpose: primary source of income generation (as distinguished from subsistence production)
• Labor mainly household, occasional hired labor
• Housing: mainly confined
• Pig numbers: range 1–10 sows or 1–100 fatteners per year
• Product: live pigs mostly, some produce products (including processed) that supply the meat chain
• Market is local, occasionally contracted, sometimes niche markets (e.g. organic, attributes for traditional cuisine)
• Can meet demand for attributes that cannot be met by industrial producers
• Independent producers; in some cases can be in cooperatives that may be contracted in some countries

Inputs

• Feed: combination of local and formulate/concentrate feed; generally rely more on on-farm produced feeds; greater mixing of feed on-farm; supplementation with formulated feed. Sows can handle more roughage than young stock
• Genetics: mainly crossbreeds, but whole spectrum ranging from pure local to pure exotics  
• Health: limited health inputs; auto-medication, use of local paravets/local government vet service, technicians from feed/vet supply companies; variable level of control; bio-security not a major concern; reactive not proactive attitude to vaccination  
• Access to capital/credit: variable, ranging from traditional banks, companies (feed), traders, cooperatives, micro-credit NGOs

Drivers of change

a What are the factors facilitating change?

• Mobility of the system, quite dynamic; entrepreneurial response of individual  
• Increase in demand (local, regional, global) for pork in terms of quantity (largely), but increasingly more about specific attributes, quality  
• Opportunity cost of labor that creates incentives for greater economies of scale  
• Availability of genetics  
• Collapse of alternative agriculture  
• Government policies (e.g. Laos, Vietnam (tax incentives for up-scaling))  
• Commercial sector interventions, e.g. contract farming (CP)

b What are the factors limiting change?

• Government policies  
  • Pollution control, implementation, regulation  
  • Animal health control threatens market access  
  • Feed subsidies distort feed markets in favor of industrial producers  
  • Lack of feed quality control (e.g. feed quality variability that creates production risk, drives producers away from formulated feeds); differential incentives  
• Availability of inputs  
  • Lack of structure, mechanisms to deliver inputs, e.g. improved genetics  
  • Sourcing of feeds (and information about it) that could provide regular, consistent supply to allow transformation from subsistence to use of more external feed inputs  
• Lack of R&D in the sector  
• Delivery of outputs to market—lack of infrastructure and organization, e.g. organizing farmers into cooperatives is one way to address this  
• Health inputs and disease control at farmer, national, regional level  
• Finance/credit—a major constraint as identified by farmers in decisions to upscale  
• Market volatility/limitations  
• Unregulated transboundary trade (e.g. Vietnam, Laos, Cambodia)—creating cheap competition for locally-produced pig meat.

III Industrial commercial orientation

Typology – common elements of these systems in different countries/regions

• Large scale: generally hundreds, often thousands of pigs in one unit
• Intensive systems close to urban centres
• Using advanced pig genetics; balanced, cereal-based feeding; strict disease control and biosafety
• Contracted production with efficient market chain: often service delivery by integrated companies
• Global and regional input and output markets

Drivers of change

• Consumer demand for consistent supply of high quality meat
• Biosafety
• Economies of scale in production
• Efficient input and output market chains
• Policy thrusts promoting industrial systems often aiming for export of high quality pork
• Investments (government, private and FDI) and WTO

a What are the factors facilitating change?

• Government policies favouring adoption of industrial production for domestic and export markets, often due to biosafety concerns
• Availability of government loans and other subsidies
• Expansion of retail chains, e.g. in SW China
• Access to new capital and availability of feeds, e.g. in Cambodia
• Production contracts
• Access to export markets
• Capacity to manage wastes or a lack of environmental controls

b What are the factors limiting change?

• Food safety scares and volatility of markets, e.g. in SW China
• Small size of market, e.g. Pacific Island States
• Continued small size of modern chilled pork market, e.g. Vietnam
• Economics vs. tradition and culture, e.g. tribal communities
• Low cost of labour
• Lack of collective organization of small producers and therefore lack of bargaining power
• Lack of access to technologies
• Lack of reliable, competitively-priced feeds

Research questions related to poverty reduction

• Equity impacts on smallholders—displacement?
• Employment effects of scaling up—including impacts along the chains?
• What are the differential employment absorption capacities of industrial vs. smallholder farms per unit of output?
Pig farming systems in Nepal: How can research and development enhance benefits to the poor farmers of Nepal?

DD Joshi

Executive Chairman, National Zoonoses and Food Hygiene Research Centre (NZFHRC), Katmandú, Nepal

Introduction

Nepal is an agrarian country where 82% of the people depend on agricultural activities. In 2004, the Ministry of Agriculture and Cooperatives (MoAC) has estimated agricultural contribution to be 39% to the national GDP, whereas livestock sector contributions have been estimated to be 16%. Around 31% of the agricultural GDP is being rendered by the livestock sector only, of which 53% is derived from the hills, 38% from the terai, and 9% from the mountains (CBS 2001–02).

Importation of exotic breeds of pigs (Yorkshire, Landrace, Hampshire, Duroc, and Pakhribas black) to Nepal began in 1957. The exotic breed population of pigs constitutes 42% of the country’s total pig population. Among the indigenous breeds, the black coloured Chwanche in hills; the rusty brown coloured Hurrah in Terai; and the rusty brown to black coloured Bampudke or Sanu Bandel constitute the remaining 58%. About 53% of total pig population is concentrated in the eastern region of Nepal (Kayastha 2006). Pig meat contributes about 7% of the total country’s meat production. Although two farrowings per year with 8–12 piglets per farrowing are reported, it is estimated that there is 15% piglet mortality up to weaning.

Very poor, mostly landless, small farmers practice traditional pig farming in a scavenging system in unhygienic conditions. It is recommended to provide skills training on better husbandry practices to the pig farmers in order to produce better quality meat at low cost in hygienic conditions.

Pig population in Nepal

Although pigs are widely distributed in all the eco-regions of the country, the population is the highest (53%) in the mid-hills and the lowest in the high-hills (Table 1). This suggests that people of the mid-hill region prefer to eat pork more than the people of other regions.
Table 1. Pig population by eco-zone

<table>
<thead>
<tr>
<th>Eco-zone</th>
<th>Population</th>
<th>% of population</th>
<th>Meat production (t)</th>
<th>% of meat production</th>
</tr>
</thead>
<tbody>
<tr>
<td>High hill</td>
<td>102,893</td>
<td>11.0</td>
<td>1,255</td>
<td>8.16</td>
</tr>
<tr>
<td>Mid hill</td>
<td>492,598</td>
<td>52.68</td>
<td>8,449</td>
<td>54.90</td>
</tr>
<tr>
<td>Terai</td>
<td>339,584</td>
<td>36.32</td>
<td>5,685</td>
<td>36.94</td>
</tr>
<tr>
<td>Total</td>
<td>935,075</td>
<td>100.00</td>
<td>15,389</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: DLS (2002).

In addition, the pig population is highly concentrated in the eastern development region of Nepal, which accounts for 53% of the total population of the country. The lowest (5%) proportion of the pig population is found in Far-western Development Region (Table 2).

Table 2. Pig population by development region

<table>
<thead>
<tr>
<th>Dev. Region</th>
<th>Pig Population</th>
<th>% of Pig Population</th>
<th>Pork production (t)</th>
<th>% of pork production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>495,230</td>
<td>52.96</td>
<td>7,556</td>
<td>49.10</td>
</tr>
<tr>
<td>Central</td>
<td>157,371</td>
<td>16.83</td>
<td>3,413</td>
<td>22.18</td>
</tr>
<tr>
<td>Western</td>
<td>108,449</td>
<td>11.60</td>
<td>1,879</td>
<td>12.21</td>
</tr>
<tr>
<td>Mid-western</td>
<td>126,172</td>
<td>13.49</td>
<td>1,934</td>
<td>12.57</td>
</tr>
<tr>
<td>Far-western</td>
<td>47,853</td>
<td>5.12</td>
<td>607</td>
<td>3.94</td>
</tr>
<tr>
<td>Total</td>
<td>935,075</td>
<td>100.00</td>
<td>15,389</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: DLS (2002).

People of certain ethnic groups such as Rai, Limbu etc. prefer to keep more pigs, especially black ones, for festivals and ceremonial purposes. Moreover, these ethnic groups are concentrated in the Eastern Development Region, so the pig population is the highest in this region where almost half of the total pork production in the country takes place.

Pig farming system in Nepal

Pig farming has been accepted socially and culturally by certain ethnic groups only. However, its trend is changing gradually due to urbanization. The farm size is usually smaller, but it is coming up in the form of commercial farms. In comparison to other livestock, crop cycle of pig farming is shorter. Generally, two farrowings per sow per year can be obtained with the harvest of 8–12 piglets in a single farrowing with 15% piglet mortality during weaning period.

Particularly in rural area, pig farming is based on agricultural by-products and kitchen wastes. Depending upon the type of feed supplement, the feed conversion ratio is 1:3 to 1:4. Nowadays, pig meat is becoming popular and the production volume in 2004 was estimated at 15,389 tonnes (t). Nowadays, piglets are being exported to Sikkim, Darjeeling, Meghalaya, Bhutan etc. It has been estimated at 9,873 piglets exported in a year only from the eastern region of the country (DLS 2001).
Local pig breeds of Nepal

The identified indigenous breeds (*Sus domesticus*) are Chwanche, Hurrah and Bampudke. Amongst these breeds, Chwanche are usually found in the hills and are black in colour. Hurrah pigs are distributed in Terai region and are rust brown in colour. Bampudke, also known as Sanu Bandel, is a wild species, which is known to be the smallest of all hogs in the world. They are rusty brown to black in colour and an adult weighs between 20 to 25 kg (Table 3). The indigenous pig breeds are good in terms of disease resistance and reproductive characters such as litter size and farrowing intervals. However, they have lower body weights as compared to the improved breeds.

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Adult weight (kg)</th>
<th>Litter size at birth (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chwanche</td>
<td>35</td>
<td>6–8</td>
</tr>
<tr>
<td>Hurrah</td>
<td>46</td>
<td>5–8</td>
</tr>
<tr>
<td>Bampudke</td>
<td>25</td>
<td>6–8</td>
</tr>
<tr>
<td>Pakhrivas black</td>
<td>100–150</td>
<td>10</td>
</tr>
<tr>
<td>Landrace</td>
<td>330–400</td>
<td>10</td>
</tr>
<tr>
<td>Hampshire</td>
<td>250–300</td>
<td>8</td>
</tr>
<tr>
<td>Yorkshire</td>
<td>300–450</td>
<td>10</td>
</tr>
<tr>
<td>Duroc</td>
<td>300–380</td>
<td>10</td>
</tr>
</tbody>
</table>


Pig breeding system

Pure breeding or cross breeding system is being followed only in case of exotic breeds such as, Hampshire, Landrace, Yorkshire, and Duroc. Crossbreeding and cross-crossing among these breeds is being practiced for commercial pork production. However, pure breeding of these breeds to maintain the parent stock is being encouraged.

Feeding system

Pig producers will have to continue using a combined program of scavenging with little supplementation of wheat and rice bran particularly during finishing period. In addition, some good quality fodders can also be provided especially on farms, which produce legumes as part of the pasture program. The advantage of complementary forage feeding is that it can counteract certain deficiency symptoms that arise due to improper balance of certain minerals and vitamins.
Pig and pork marketing systems

In Nepal, marketing channels of live pig and pork is shown in Figure 1. There is no fixed system for marketing; however, there is a regular live animal and pork haat bazaar system developed in different municipalities and a few highway roadside bazaars to which farmers bring their live animals for sale to local traders. The traders then sell the pigs to the major traders and either they export to adjoining districts, including Kathmandu of Nepal, or to Bhutan and India or they sell to the butchers who slaughter the pigs and sell the meat at retail meat shops. There are only a few cold stores in the country because consumers prefer fresh pork to frozen.

Figure 1. Marketing channels of live pig and pork in Nepal.
How can research and development enhance benefits to the poor farmers of Nepal?

There are several types of research and development pig programs that could be implemented in Nepal through the Department of Livestock Services (DLS), Nepal Agriculture Research Council (NARC), National Zoonoses and Food Hygiene Research Centre (NZFHRC) and other INGO and NGO. Possible R&D programs are:

- Poverty alleviation program by introducing new pig farming systems
- Income generation program
- Women development program in pig farming
- Unprivileged community development program for different ethnic pig farming group
- Pig group formation @10 farmers per group
- Piglet distribution @ 20 female and 2 male piglets per group
- Drenching and vaccination program for pig disease surveillance and control
- Insurance fund and credit integrated
- Training and extension programs for pig farmers either in group or in community
- Formulation and development of policies and standards for poverty alleviation of pig farmers
- Establishment of pig slaughterhouse and pig meat markets to improve hygienic and sanitary conditions
- Resource matching between commercial farms, NARC, government farms and pig farmers
- Training programs to the pig farmers for modern technology transfer
- Establishment of breeder pig farms (currently involved in Jhapa, Morang, Sunsari, Makwanpur, Syanja, Kaski, Udayapur, Tanahun, Dang and Kailali)
- Establishment and promotion of commercial farms in different districts (currently 30 farms involved)
- Implementation of growth axis program
- Maintenance of breeding stock in government farms
- Supply of breeding stock to the breeder farmers
- Distribution of piglets to the farmers through the breeder farms.

Parasites of pigs and their zoonotic importance

Pigs are final or intermediate hosts of many parasite species, the incidence and effects of which depend upon the management system. Thus it is more common to record higher incidence and pathogenic effects of parasites on the animals reared under the scavenging system than under the intensive or semi-intensive system. Among the different parasite species, the intermediate form cestode parasite *Taenia solium* is of zoonotic importance and of major concern for public health. The important parasites of pigs are presented in Table 4.
Table 4. Some important parasite species of pigs

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Cestodes</th>
<th>Trematodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris</td>
<td>Cysticercus</td>
<td>Fasciola</td>
</tr>
<tr>
<td>Hyostrongylus</td>
<td>Echinococcus</td>
<td>Opistorchis</td>
</tr>
<tr>
<td>Globocephalus</td>
<td></td>
<td>Gastrodiscus</td>
</tr>
<tr>
<td>Oesophagostomum</td>
<td></td>
<td>Schistosoma</td>
</tr>
<tr>
<td>Trichinella</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichostrongylus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongyloides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metastrongylus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stephanurus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Infection of *T. solium* has received increased significance in recent years because the cystic form of the parasite, the ‘cysticerci’, lodged in the brain has been found to be the major cause of neurocysticercosis causing acquired epilepsy in the human beings (Joshi 2006).

The socio-economic condition of pig farmers is very poor. They are ignorant about health and hygiene. In Terai districts, 80% farmers keep pigs in the open field. Traditionally free-range feeding of pig is quite common all over Nepal. The unhygienic disposal of the waste makes the problem worse. The main sources of income of the farmers are agriculture crop farming and/or animal farming. Every household has 2–3 pigs. It was found that all the farmers rear a small number of black local breed pigs, the maximum number not being more than eight. It has been observed in general that most of the pig farmers (73%) reared pigs in the scavenging (extensive) system. Most of the families of the pig rearing communities do not have latrines. They use open field for defaecating, which contaminates soil and nearby water streams. This contamination contributes greatly to the parasitic infestation of both pigs and humans. Most of the pigs are kept inside the house at night and are fed on kitchen wastes and excreta. This is the important factor that is co-related with the high prevalence of parasitic infestations like Taeniasis and bacterial infections in pigs and humans. Only 27% farmers reared pigs under intensive system i.e. 27% of the farmers had pigsties, where they reared and fed pigs. But these sties were also found to be very unsanitary. As for the consumption of pork, 68.19% of the respondents consumed cooked pork, 4.34% of them consumed boiled pork while 8.34% of the people consumed raw pork (Sharma et al. 2006). No modern slaughterhouse has been constructed and no meat inspection is practiced so far in Kathmandu valley (Sharma et al. 2006).

Sale and price of fresh pork meat products in Kathmandu Valley

Although pork accounts for only 2.1% of the total meat consumed in the valley (TLDP 2002), the meat production and distribution in the valley amounted to a total of 1568 t in the year
2003–04 (Figure 2). Bhaktapur district did contribute 23, Lalitpur district 588 and Kathmandu district 957 t to this total (APSD 2004).

![District-wise pork production in the valley.](image)

Although processed meat has a lot of advantages over fresh meat in terms of hygiene, people still prefer fresh meat, perhaps due to lack of knowledge.

Wild boars fetch the highest price in the pig market in Kathmandu valley. Their price ranges from Indian Rupee (INR)\(^1\) 240 to 300 a kilo. But Hurrah crosses are also sold at its rate in various places in the valley. Black pigs follow these wild boars as regards the price. They are sold at the rate of INR 150 to 160 a kilo. The prices of white pigs are the cheapest. Their meat sells for INR 130 to 140 a kilo. However the rates for different viscera and some parts of the pig are similar; they are listed as follows (Rana et al. 2006):

- Lard: INR 30–60 per kg
- Intestine: INR 30–60 per kg
- Heart: INR 30 per kg
- Lungs: INR 25 per kg
- Legs: INR 100 per kg

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1. Indian Rupee (INR). In October 2008, USD 1 = INR 47.08.
Conclusion

Pig raising is still in the developing stage in Nepal. However, gradual improvement in the acceptance of pork by all the communities is being observed showing a positive indication in the development of pig farming. The indigenous pig in Nepal is a scrub animal and small-sized that produces small number of litters, is a slow grower and has pork of low quality. So, they do not grow quickly because they are generally reared as scavengers. However, commercial pig production in some of the districts is developing very fast. The pig growers need regular supply of piglets of good genetic quality. They need training on low-cost production technology, modern husbandry practices together with knowledge on zoonotic diseases in order to produce good quality pork from healthy pigs, which can fetch better price. Emphasis should be given to a production program in specific selected areas in order to develop a growth axis and farmers should be trained in production technology and market-oriented production systems. Marketing mechanisms at the local level need to be established, strengthened and linked to the marketing channels and the production program integrated with slaughterhouses to utilize slaughterhouse wastes better. Technologies for low-cost production should be developed in order to produce pork economically and government pig farms should be strengthened as resource centres for supplying breeding animals to the breeder farms.

Acknowledgements

I am grateful to Dr William Thorpe, Regional Representative for Asia of International Livestock Research Institute, and Dr Hans Wagner, Senior Animal Production and Health Officer, FAO/Regional Office for Asia and the Pacific for their financial and technical support. I would also like to thank pig farmers of Nepal, the Livestock Officer of the Department of Livestock Services (DLS), Nepal Agriculture Research Council (NARC) and staff of NZFHRC for their kind support during the study.

References


Pig Farming Systems in Nepal: How Can Research and Development Enhance benefits to the Poor Farmers of Nepal?

Dr. Durga Datt Joshi  
*Executive Chairman, NZFHRC*

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**Background of Nepal**

- Nepal is an agrarian country where 82% of the people depend on agricultural activities.
- In 2004 the Ministry of Agriculture and Cooperatives (MoAC) has estimated agriculture contribution to be 38.81% to the national GDP whereas livestock sector contributions have been estimated to be 16%.
- Around 31% of the agricultural GDP is being rendered by the livestock sector only.
Pig Breeds of Nepal:

- The exotic breeds population of pigs constitute 42% of country's total pig population.
- Among the indigenous breeds, the black coloured Chwanche in hills; the rusty brown coloured Hurrah in Terai; and the rusty brown to black coloured Bampudke or Sanu Bandel which constitute the remaining 58% of the total population.

Chwanche

Black coloured, located in hills
**Hurrah**
Rusty brown, located in Terai

**Landrace**
Originated - Denmark
Long and droopy ears
Origin: England  
Erect ears

Yorkshire

Origin: England  
White belt-like color around the girth

Hampshire
Developed at PAC
Cross between Tamworth, Saddleback and Fayuen

Pakhribas Black

Cross breed between local and landrace.
Cross breed between Chinese landrace and local breed

Cross breed between Yorkshire and local breed
Dharane Kalo Banggur

American Landrace
Cwanche pig breed in Western Nepal

Harrah terai pigs breed
## Pig Population in Nepal

### Table 1: Pig population by eco-zone

<table>
<thead>
<tr>
<th>Eco-zone</th>
<th>Population</th>
<th>% of Population</th>
<th>Meat production (mt)</th>
<th>% of meat production</th>
</tr>
</thead>
<tbody>
<tr>
<td>High hill</td>
<td>102,893</td>
<td>11.0</td>
<td>1,255</td>
<td>8.16</td>
</tr>
<tr>
<td>Mid hill</td>
<td>492,598</td>
<td>52.68</td>
<td>8,449</td>
<td>54.90</td>
</tr>
<tr>
<td>Terai</td>
<td>339,584</td>
<td>36.32</td>
<td>5,685</td>
<td>36.94</td>
</tr>
<tr>
<td>Total</td>
<td>935,075</td>
<td>100.00</td>
<td>15,389</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*Source: Department of Livestock Services Report 2005*
### Table 2: Pig population by development region

<table>
<thead>
<tr>
<th>Dev. Region</th>
<th>Pig Population</th>
<th>% of Pig Population</th>
<th>Pork production (mt)</th>
<th>% of pork production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>495,230</td>
<td>52.96</td>
<td>7,556</td>
<td>49.10</td>
</tr>
<tr>
<td>Central</td>
<td>157,371</td>
<td>16.83</td>
<td>3,413</td>
<td>22.18</td>
</tr>
<tr>
<td>Western</td>
<td>108,449</td>
<td>11.60</td>
<td>1,879</td>
<td>12.21</td>
</tr>
<tr>
<td>Mid-western</td>
<td>126,172</td>
<td>13.49</td>
<td>1,934</td>
<td>12.57</td>
</tr>
<tr>
<td>Far-western</td>
<td>47,853</td>
<td>5.12</td>
<td>607</td>
<td>3.94</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>935,075</strong></td>
<td><strong>100</strong></td>
<td><strong>15,389</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Source: Department of Livestock Services Report 2005*
Pig Farming System in Nepal

- Pig farming has been accepted socially and culturally by certain ethnic groups only.
- Pig farming is based on agricultural by-products and kitchen wastes.
- Pig meat is becoming popular and the production volume has been estimated at 15,389 metric tons in the year 2004.
- Nowadays, piglets are being exported to Sikkim, Darjeeling, Meghalaya, Bhutan, etc. It has been estimated at 9,873 piglets exported in a year only from the eastern region of the country (ERDLS, 2061).

Local Pig Breeds of Nepal

Table 3: Production performances of indigenous and commercial breeds

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Adult weight (kg)</th>
<th>Litter size at birth (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chwanche</td>
<td>35</td>
<td>6-8</td>
</tr>
<tr>
<td>Hurrah</td>
<td>46</td>
<td>5-8</td>
</tr>
<tr>
<td>Bampudke</td>
<td>25</td>
<td>6-8</td>
</tr>
<tr>
<td>Pakhribas black</td>
<td>100-150</td>
<td>10</td>
</tr>
<tr>
<td>Landrace</td>
<td>330-400</td>
<td>10</td>
</tr>
<tr>
<td>Hampshire</td>
<td>250-300</td>
<td>8</td>
</tr>
<tr>
<td>Yorkshire</td>
<td>300-450</td>
<td>10</td>
</tr>
<tr>
<td>Duroc</td>
<td>300-380</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Annual Report, ABD (1997)
Pig Breeding System

- Pure breeding or cross breeding system is being followed only in case of exotic breeds such as, Hampshire, Landrace, Yorkshire, and Duroc.
- Crossbreeding and criss-crossing among these breeds is being practiced for commercial pork production.

Pig Feeding System

- Pig producers will have to continue using a combined programme of scavenging with little supplementation of wheat and rice bran particularly, during finishing period.
- In addition, some good quality fodders can also be provided especially on farms, which produce legumes as a part of the pasture programme.
How Can Research and Development Enhance benefits to the Poor Farmers of Nepal

There are several types of research and development pig programs to be implemented in Nepal through Department of Livestock Services (DLS), Nepal Agriculture Research Council (NARC), National Zoonoses and Food Hygiene Research Centre (NZFHRRC) and other INGO and NGO. R&D programmes could be-

- Poverty alleviation programme by introducing new pig farming systems
- Income generation programme
- Women development programme in pig farming
- Unprivileged community development programme for different ethnic pig farming group
- Pig group formation @10 farmers per group
How Can Research and Development…. Cont.

- Piglet distribution @ 20 female and 2 male piglets per group
- Drenching and vaccination programme for pig disease surveillance and control
- Insurance fund and credit integrated
- Training and extension programmes for pig farmers either in group or in community
- **Formulation and** development of policies and standards for poverty alleviation of pig farmers
- Establishment of pig slaughterhouse and pig meat markets better hygienic and sanitary condition
- Resources matching between commercial farms, NARC, government farms and pig farmers

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How Can Research and Development…. Cont.

- Training programmes to the pig farmers for modern technology transfer
- Establishment of breeder pig farms (currently involved in Jhapa, Morang, Sunsari, Makwanpur, Syanja, Kaski, Udayapur, Tanahun, Dang and Kailali)
- Establishment and promotion of commercial farms in different districts (currently 30 farms involved)
- **Implementation of growth axis programme**
- Maintenance of breeding stock in government farms
- Supply of breeding stock to the breeder farmers
- Distribution of piglets to the farmers through the breeder farms.
### Parasites of Pigs and their Zoonotic Importance

#### Table 4: Some important parasite species of pigs.

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Cestodes</th>
<th>Trematodes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ascaris</em></td>
<td><em>Cysticercus</em></td>
<td><em>Fasciola</em></td>
</tr>
<tr>
<td><em>Hyostrongylus</em></td>
<td><em>Echinococcus</em></td>
<td><em>Opisthorchis</em></td>
</tr>
<tr>
<td><em>Globocephalus</em></td>
<td></td>
<td><em>Gastrodiscus</em></td>
</tr>
<tr>
<td><em>Oesophagostomum</em></td>
<td></td>
<td><em>Schistosoma</em></td>
</tr>
<tr>
<td><em>Trichinella</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Trichostrongylus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Strongyloides</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Metastrongylus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stephanurus</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Infection of *T. solium* has received increased significance to be the major cause of neurocysticercosis causing acquired epilepsy in the human beings (Joshi 2006).

The socio-economic condition of pig farmers is very poor.

80% farmers keep pigs in the open field. Most of the families of the pig rearing communities do not have latrines.

They use open field for defaecating.

Free range feeding of pig is quite common all over Nepal traditionally.
Sale and Price of Fresh Pork Meat Produces in Kathmandu Valley

Pork meat consumption accounts for 2.1% of the total meat consumed in the valley (TLDP 2002)

Graph 1: District-wise Pork Meat Production in the Valley

Price of Pork Meat and Viscera in the Valley

- **Pork Meat**: Rs. 110-120 per kg
- **Lard**: Rs 30-60 per kg
- **Intestine**: Rs 30-60 per kg
- **Heart**: Rs 30 per kg
- **Lungs**: Rs 25 per kg
- **Legs**: Rs 100 per kg

*Source: Rana et al., 2006.*
Conclusion

- Pig raising is still in the developing stage in Nepal.
- However, gradual improvement in the acceptance of pork by all the communities is being observed showing a positive indication in the development of pig farming.
- Pig farmers need training on low cost production technology, modern husbandry practices together with knowledge on zoonotic diseases in order to produce good quality pork from healthy pigs.

Conclusion

- Marketing mechanism at the local level needs to be established, strengthened and linked to the marketing channels.
- Integrate production program with slaughterhouses to utilize slaughterhouse wastes better.
- Develop technology on low cost production in order to produce pork economically.
- Strengthen government pig farms as a resource center for supplying breeding animals to the breeder farms.
- Research and Development enhance benefits to the poor pig farmers of Nepal.
Acknowledgement

I would like to thank to:
- Pig farmers of Nepal
- Livestock Officer of DLS
- Staffs of NZFHRC.

Thank You Namaste
Farmer-led research in village pig production in Lao PDR

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2. International Center for Tropical Agriculture (CIAT)
P.O. Box 783, Vientiane, Lao PDR

Abstract

Pigs are a very important component of smallholder farm households in the uplands of Lao PDR. About 60–80% of households in upland areas raise pigs and smallholder pig production accounts for more than 80% of the total pig population in the country. Pigs are commonly kept in three production systems: Free scavenging (seasonally or year-round), confined in enclosures and penning. The main constraints in pig production are disease epidemics and low animal productivity due to lack of feed, both quality and quantity.

Farmers are always looking for ways to improve their crop and livestock production systems. Recently, an opportunity for improving feed supply for pigs was identified by farmers in northern Laos. The legume *Stylosanthes guianensis* CIAT 184 (Stylo) had been introduced as a feed for ruminants but farmers also evaluated its use as a feed for pigs. They found that stylo was liked by pigs. They used stylo to replace naturally-occurring green feeds which took a long time to collect from fallow fields and forest margins. Women had been spending, on average, 3 hours per day collecting and cooking feed for pigs. With stylo, this time was reduced to 90 minutes per day, a saving of 1.5 hours per day. As farmers started to feed more stylo, they found that their pigs grew much better, increasing the average daily weight gain from approximately 100 to 200g. This better growth halved the time needed to grow pigs to marketable weight. These benefits prompted other farmers in surrounding villages also to grow and use stylo as feed for their pigs.

Creating an environment in which farmers were able to freely evaluate and adapt forage technologies to their own situation was a critical element in the evolution of this innovation. Participatory approaches were employed to ensure that farmers were involved actively in every stage of technology development. This generated unexpected outcomes such as the feeding of forage legumes to pigs, and it opened new research opportunities.

Animal productivity improved with better feeding, making pig production a more profitable farm enterprise. This stimulated farmers to make other improvements in their pig production systems and to look at pig production as an income-generating opportunity. Interest in stylo for
pigs occurred once participating farmers started to get, and report, the large benefits of feeding stylo. Impact was clearly the most important driver of adoption of this simple technology.

Smallholder pig systems

Pig is one of the most important animals for smallholders in the uplands of Lao PDR. In remote upland areas, particularly in areas where shifting cultivation is practiced, households face a high risk of crop failure or low rice yields, resulting in too little food for their households. Pigs are part of the household insurance system, and can be sold when cash is needed for buying rice and other food, for paying school fees or if a household member is sick and needs medical attention. In 2005, the pig population in Laos was approximately 1,820,000 pigs (FAO 2005) and more than 80% of these were raised by smallholders (Thorne 2005). Per capita pig density is highest (>0.3 pigs per person) in the northern provinces (Stür et al. 2002) and is particularly high among some ethnic minority groups, such as the Hmong and Khmu people (Thorne 2005). In most households and villages, pig raising is the responsibility of women.

There are many ways of classify pig production systems. A recent survey by a joint team of researchers from the National Agriculture and Forestry Research Institute (NAFRI) and the International Center for Tropical Agriculture (CIAT) on pig production in the northern Laos suggested three main pig production systems:

- Seasonal or year-round free range scavenging. This is practiced only in relatively remote upland areas and mainly for sow-piglet production. Pigs scavenge for feed either during the day, and kept in enclosures at night time, or are left to roam free all the time. In this system, small amounts of supplementary feed, such as left-over human food, cassava, maize and rice bran, are often provided.
- Year-round or seasonal confinement in an enclosure. Pigs are kept in enclosures either all year, or only during the crop growing season; in the latter case, pigs are free to scavenge during the dry season after crops have been harvested. This system is practiced in semi-intensive upland cropping areas.
- Penning. Fattening pigs are kept in pens for the whole fattening cycle. Farmers usually buy weaned pigs, weighing around 14–15 kg, and raise them until they reach a market weight of 60–70 kg.

Many farmers and villages in northern Laos have specialized in either raising sows to produce piglets for sale, or growing and fattening pigs for slaughter (Phengsavanh and Stür 2006). Piglet production is practiced mainly by farmers in the more remote upland areas (often Hmong and Khmu ethnic groups) who sell these piglets to farmers in other villages for fattening. Often, villages located in lowland areas concentrate on fattening pigs, utilizing rice bran, which is a by-product of paddy rice production, as the main feed.
The main constraints of village pig production are disease epidemics, high piglet mortality, poor growth rates and high labour demand (Stür et al. 2002). Disease epidemics cause huge losses for smallholders, and in some areas up to 90% of pigs in a village die in a single outbreak of classical swine fever. The high labour demand and the poor growth rates are related to feeding. Many women spend up to three hours a day collecting and preparing feed for pigs.

Using stylo for feeding pigs—A farmer innovation

Over a ten-year period, the Forages for Smallholders Project and its successor the Forage and Livestock Systems Project, both funded by AusAID, introduced a range of broadly adapted forage varieties to farmers in the uplands of Lao PDR, with the aim of assisting farmers to overcome feed shortages in ruminant production. While working with these forages, farmers learnt that the legume ‘Stylosanthes guianensis CIAT 184’ can be fed not only to ruminants but also to pigs. A survey by Phengsavanh (unpublished), during which farmers were interviewed and asked about the impact of growing and using stylo for pigs, showed that the main impacts of using stylo were improved animal growth rates and the saving of time for collecting and preparing feed.

Labour is a very limited resource for upland farmers, particularly in areas where upland rice is produced in shifting cultivation systems. In these systems, weed invasion is a big problem, and farmers have to spend a lot of time weeding. Labour requirements for weeding one hectare of upland rice have been estimated at 140–190 person days per ha for one crop (Horne 1998). Reducing labour requirements for pig production frees up labour, which is then available for other activities.

Reducing labour requirements was an excellent entry point for working with pig farmers in upland areas of Laos. If farmers had plenty of stylo 184, the time needed to feed pigs could be reduced from more than 3 hours to 1.5 hours (Table 1). Farmers feeding only rice bran and stylo were able to reduce the time needed for feeding to 40 minutes a day, as they no longer needed to cook feed. Even farmers with small areas of stylo saved almost one hour per day.

The improved growth rates of the pigs fed stylo 184 is significant, as daily weight gain increased from 107 grams per day in traditional feeding system to 207 grams per day for pigs being supplemented with stylo 184 (Table 2). The low productivity in the traditional feeding system may be explained by (i) overall lack of feed, (ii) diets that are high in energy but deficient in protein, and (iii) seasonal availability of pig feeds, such as maize, rice bran and cassava, resulting in poorly balanced diets (e.g. farmers feeding mainly cassava root which is severely protein deficient and so affects pig growth). Also, naturally-occurring green feeds, which are a source of protein and minerals for pigs in traditional diets, are not available year-round, and
when they are, the high labour requirement for collecting them may result in the collection of insufficient quantities.

**Table 1. Time needed to feed village pigs before and after adoption of stylo**

<table>
<thead>
<tr>
<th>Items</th>
<th>Before</th>
<th>Now (with stylo)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time spent (min)</td>
<td>Small stylo area (not enough to feed daily)</td>
</tr>
<tr>
<td>Collecting feed</td>
<td>125 W/M*</td>
<td>55</td>
</tr>
<tr>
<td>Cook</td>
<td>50 W</td>
<td>50</td>
</tr>
<tr>
<td>Feeding</td>
<td>20 W</td>
<td>20</td>
</tr>
<tr>
<td>Collecting stylo</td>
<td>– –</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>195 145</td>
<td>90</td>
</tr>
</tbody>
</table>

*W = women, M = men.


**Table 2. Productivity of growing pigs supplemented with traditional green feeds or stylo**

<table>
<thead>
<tr>
<th></th>
<th>Traditional green feeds (no stylo)</th>
<th>Supplemented with fresh stylo</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of production cycle, months</td>
<td>18.0</td>
<td>8.7</td>
<td>0.95</td>
</tr>
<tr>
<td>Initial weight, kg</td>
<td>14.0</td>
<td>15.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Final weight, kg</td>
<td>65.3</td>
<td>65.1</td>
<td>3.2</td>
</tr>
<tr>
<td>Calculated ADG, g/day</td>
<td>107</td>
<td>207</td>
<td>12.2</td>
</tr>
</tbody>
</table>


**Drivers of system change**

There are many factors that either encourage or allow farmers to change the way they raise and manage pigs. These include disease epidemics, scarcity of local feed resources, damage to food crops by free-range pigs and market demand for leaner meat.

**Disease epidemics**

In remote areas in Laos, where agricultural production systems are extensive, many villages use free-range scavenging pig production systems to raise pigs. Traditionally, feed availability was high in these remote areas and the risk of introduction of disease epidemics low. Contact with other villages was limited and livestock production systems were ‘disease-free, closed systems’ where no or very few animals were added to the village pig population from external sources. However, as soon as villages in these remote areas became more accessible, the risk of accidental introduction of diseases to the villages by visitors (e.g. meat and livestock traders; pigs purchased from markets etc.) increased and, once they were introduced, diseases such
as classical swine fever spread rapidly through the free-roaming pig population. When this happened, many if not all, pigs in these villages died.

This new production risk forces farmers and villages to find ways to reduce disease risk. One of the first strategies is a change from free-range to confined production systems. This increases the level of management (e.g. farmers see their animals several times a day) and also means that farmers have to provide all of the nutritional needs of pigs.

Scarcity of local feed resources

Local feed resources, especially the natural green leaves and herbs needed to supplement basal feeds (such as rice bran, maize and cassava) used to be abundant. These have become scarcer through overuse. Farmers (predominantly the women) have to spend several hours a day collecting sufficient material for their pigs. Time is a very valuable commodity on smallholder farms and having to spend a lot of time feeding pigs makes pig production a less attractive livelihood activity with poor returns to labour. On the other hand, households have little choice but to continue to raise pigs, as these are needed as part of the family reserves. The introduction of stylo has reduced the time needed to feed pigs significantly, thus making pig production a more attractive farm activity.

Feeding stylo also resulted in significant improvements in pig productivity (probably because farmers fed their pigs more green material so the pigs received more feed, particularly more protein and minerals). The improvement in pig productivity meant that pig production became much more attractive and farmers started to improve other parts of the production system (e.g. housing and more confinement). Farmers also started to have more animals at any one time and, because of higher daily gains, were able to turn off animals faster and fatten more animals per year.

These improvements happen because the right entry point was identified. In this case, the entry point was the inordinate amount of labour needed for collecting natural green feeds, which was overcome with the introduction of the forage legume.

Damage to food crops by free-range pigs

In the areas where crop production has become more intensive (and more profitable than pig production), the amount of crop damage caused by free-range scavenging pigs has become a village issue. Building pig-proof fences is expensive, both in terms of materials and in terms of labour needed to build and maintain these fences. As the number of conflicts increased, the village committee (or district government) saw no alternative but to issue a regulation banning
free scavenging, either during the crop growing period or for the whole year. This has forced many households to start confining pigs in enclosures and pens.

Market demand for leaner meat

The main pig breeds raised in Laos are high fat, black, swaybacked Asian breeds. Pig fat is the main fat used for cooking in remote areas and the local pigs provide plenty of fat for this purpose. Clearly, local breeds have many positive attributes such as being hardy and able to survive on relatively poor feed resources. However, meat yield of local pigs is low. With demand for lean meat growing in urban areas, exotic breeds that produce more meat and less fat are becoming popular among farmers located near urban centres. These tend to be farmers who keep pigs in relatively intensive production systems in pens (no free-range scavenging). At this stage, crosses are mainly between exotic pig breeds such as ‘large white × duroc’ rather than ‘local × exotic breed’ crosses. Farmers producing these exotic breeds report higher feed conversion rates than for local breeds, which may be explained by the lower nutrient requirement for producing meat as compared with producing fat.

Conclusion

The introduction of stylo was conducted in a participatory way that encouraged farmers to experiment with forages and the feeding of forages to livestock. This resulted in farmers using stylo for pigs which had not been anticipated by the researchers involved. Thus, the participatory approach that encouraged farmer innovations was a key ingredient in this story.

The entry point for system’s change was the enormous labour demand for feeding pigs in the traditional management system. Planting stylo freed up labour but soon farmers also noticed better growth of pigs resulting in much higher returns to labour from pig production. The new feed resource enabled farmers to change the way they managed their pigs, with some farmers moving towards more intensively managed production systems designed to produce regular income.

Adoption of stylo for pigs by neighbouring villages began only once the participating farmers started to experience and report significant benefits from the feeding of stylo. This could only occur once farmers had production size stylo plots (100–200 m² per pig) as smaller areas provided less or only intermittent benefits.

Improved feeding quickly led to demand by farmers for other pig production system improvements such as improved housing, de-worming and vaccination. Working closely with farmers has opened new research opportunities such as the search for other forage legumes as a protein source for smallholder pig production.
Acknowledgements

We would like to acknowledge financial support from AusAID, which funded both the regional Forages for Smallholders Project (FSP) and its successor the Forage and Livestock Systems Project (FLSP) in Lao PDR. We would also like to thank ACIAR which currently funds the ‘Forage legumes for supplementing village pigs in Lao PDR’ project, a project that has grown out of the farmer innovation of feeding stylo to pigs. This project examines the reasons for the significant growth response to stylo supplementation and explores the potential other forage legumes as pigs feeds.

References


Horne P. 1998. Securing the livelihoods of farmers in upland areas of Lao PDR: The role of livestock and opportunities for forage development. ACIAR Proceedings No. 87. ACIAR (Australian Centre for International Agricultural Research), Canberra, Australia.


Farmer-led research in pig production in Lao PDR

Phonepaseuth Phengsavanh (NAFRI / CIAT)

Smallholder Pig Production
Background

Importance of pigs to smallholders:
- Pig sales account for more than 50% of cash income in many poor upland households.

Pig population:
- 1.8 million with 83% being raised by smallholders in upland and highland areas.
- Commercial pig production (17% of pigs raised) is located near major urban markets.

Source: Livestock Sector Review, 2002
BREEDS AND ISSUES

Main native breeds:
- Moo chid, Moo laat, Moo dam, Moo Nonghaet (Laosoung).
- Mature weight ranges from 60-120 kg.

Main issues:
- Loss of animals through diseases
- Low productivity and slow growth, limitation of feeds in both quantity and quality.
- High labour requirements for collecting natural feeds

MAIN PRODUCTION SYSTEMS

Scavenging  Confined in enclosure  Penned
Purpose of raising pigs

**Piglet production**

**Fattening**

Main feeds used on upland farms

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<td>Rice bran</td>
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<tr>
<td>Leaves &amp; herbs</td>
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</tbody>
</table>
### Nutritive value of main feeds

<table>
<thead>
<tr>
<th>Feed</th>
<th>As a source of Energy</th>
<th>As a source of Protein &amp; Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice bran</td>
<td>✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Broken rice</td>
<td>✓ ✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cassava root</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>✓ ✓ ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Leaves &amp; herbs</td>
<td>✓</td>
<td>✓ ✓ ✓</td>
</tr>
</tbody>
</table>

### Feeds limiting productivity

<table>
<thead>
<tr>
<th>Lowland</th>
<th>• Rice bran</th>
<th>• Low in energy and protein</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Leaves &amp; herbs</td>
<td></td>
</tr>
<tr>
<td>Upland</td>
<td>• Cassava, maize</td>
<td>• Very low in protein</td>
</tr>
<tr>
<td></td>
<td>• Rice bran</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Leaves &amp; herbs</td>
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</tr>
</tbody>
</table>

- Pigs tend to be under-fed as farmers raise more pigs than they can easily feed.
- “It is better to keep many pigs as I may have to sell some pigs for unforeseen expenses.”
Farmers’ innovation of using Stylo as a source of leaves

Farmer innovation...

- Stylo 184 was introduced as a broadly adapted forage legume for feeding to ruminants in a participatory research project.
- Farmers preferred grasses as feed for ruminants and tried to feed Stylo to pigs (and poultry).
- They observed that pigs liked to eat Stylo. Stylo made a very easily available source of leaves for pigs (collecting natural leaves took a long time) and they later found that pigs grew better with Stylo than natural leaves & herbs.
### Impact of Stylo supplementation on labour

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>Now</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Time (min)</td>
<td>Who does work?</td>
</tr>
<tr>
<td>Collecting feed</td>
<td>125</td>
<td>W/M</td>
</tr>
<tr>
<td>Cooking</td>
<td>50</td>
<td>W</td>
</tr>
<tr>
<td>Feeding</td>
<td>20</td>
<td>W</td>
</tr>
<tr>
<td>Collecting Stylo</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>195</td>
<td>-</td>
</tr>
</tbody>
</table>

### Impact of Stylo supplementation on growing pigs

<table>
<thead>
<tr>
<th></th>
<th>Feed</th>
<th>SE</th>
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<tbody>
<tr>
<td></td>
<td>Traditional</td>
<td>With Stylo</td>
</tr>
<tr>
<td>Cycle length (months)</td>
<td>18.0</td>
<td>8.7</td>
</tr>
<tr>
<td>Initial weight (kg)</td>
<td>14.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Final weight (kg)</td>
<td>65.3</td>
<td>65.1</td>
</tr>
<tr>
<td>ADG (g/day)</td>
<td>95</td>
<td>191</td>
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</tbody>
</table>
## Stylo helps to fill a gap in feed availability

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<th>1</th>
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<td>Rice bran</td>
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<tr>
<td>Vegetables</td>
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<td>Stylo 184</td>
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- Increased number of piglets sold
  - Higher survival rate
- Increased number of pigs fattened
  - More fattening cycles
  - More pigs raised per cycle
1. The entry point for change was a production constraint: Not enough labour to collect leaves & herbs.

2. Once this constraint was solved, farmers looked for ways of making use of the new feed resource (more intensive production system - more confinement of pigs so they could provide better management).
Improving feed quality and intake...

- Farmers observed that the intake of fresh Stylo was limited to about 10% of total feed intake.
- They started to process Stylo into leaf hay and leaf meal as pigs can eat 20-30% of their daily intake as Stylo leaf meal.
- By having Stylo leaf meal, farmers are able to keep it for feeding pigs in dry season.

Housing, other management issues and animal health...

As farmers move along the path from subsistence to market-orientation, they start to value pig production as a farm enterprise and are willing to invest more into pig production systems including:

- Better housing
- Water supply
- Animal health issue (deworming, vaccination program and fund)
- Village quarantine systems
- More productive animals (change from local to exotic breeds)
Conclusions

- Offering technologies that address farmers’ immediate problems are a good entry point that lead to other pig production improvements.
- Need to encourage adaptation and innovation by farmers and offer technologies that result in significant benefits to farmers.
- This requires farmer-oriented participatory approach to research and extension, with committed, informed, and confident follow-up.
Conclusions...

In working with farmers to adapt new technologies for their traditional pig management systems, several new opportunities for improvements have emerged such as production systems improvements (housing, management issues, deworming and vaccination).

Working closely with farmers has identified new research needs such as the use of forage legumes as a protein source for smallholder pig production.

What are we doing now...

**Project:** L4PP (ACIAR funded project)

**Duration:** May 2006 – December 2008

**Implementing agencies:** NAFRI and CIAT

**R & D Objectives:**
1. Determine the nutritional factors responsible for the growth response to Stylo supplementation and identify additional legume options.

   2. Scale out the use of Stylo as supplementary feed for village pigs, investigate factors affecting adoption of legumes for pigs, and develop guidelines for scaling out of legumes supplementation.
Thank you!!!
Farm-based multidisciplinary research to improve pig production efficiency in the Papua Province of Indonesia

C Cargill\(^1\) and S Mahalaya\(^2\)

1. South Australian Research and Development Institute, Roseworthy Campus, University of Adelaide, Roseworthy SA 5371, Australia
2. International Potato Center, ASEAP Office, Bogor, Indonesia

Introduction

Pigs and sweetpotatoes are an integral part of the culture among many Papuan tribes, and sweetpotato (SP) is the main food for both people and pigs. Although pork is a significant protein source for people, it is also a widely traded commodity. Hence pigs offer a good opportunity for income generation as cash incomes become more important for education and survival.

The initial aim of the project described in this paper was to document the existing human–sweetpotato–pig production system in order to understand the major constraints. This was achieved through the conduct and analysis of a socio-economic diagnostic survey, which provided data on social and economic issues affecting residents of the Baliem Valley in Papua. In addition there was a disease and productivity survey of pigs in selected villages (Mahalaya et al. 2005). The major factors contributing to poor pig production were identified as poor growth and low fertility. Growing pigs took over 2 to 3 years to reach maturity and sows farrowed once every 1.5 to 2 years. Factors contributing to the low productivity included diets low in nutrients, irregular feeding of pigs, suboptimal husbandry and housing, poor management systems and parasitism (Putra et al. 2004; Damriyasa et al. 2005a, b).

In order to address the deficiencies, the following research aims were developed using a participatory approach that included farmers and several Indonesian institutes and organizations:

- to improve SP production for ensuring a stable feed supply with emphasis on selection of:
  - dual-purpose varieties (suitable as human and animal food) and forage feed varieties
  - drought- and frost-resistant varieties for pig feed.
- to enhance productivity and efficiency of pig growth through nutritional improvements using appropriate technology and disease management based on various levels of confinement acceptable to the local farmers in Papua.
• to improve the efficiency of indigenous, integrated, pig-raising systems in Papua:
  • by improving the management and nutrition of sows and boars;
  • by improving the management and nutrition of growing pigs;
  • through the development of a confinement based foraging system for pigs;
  • through developing training programmes for Government scientists and extension officers, project staff, farmers (Train the Trainer), and developing farmer groups (farmer–to–farmer extension).

While significant improvements in SP productivity were achieved through the development of new SP clones, which have been registered for release across Indonesia, this paper describes the methodology used to modify SP-based pig production in the Baliem Valley to increase productivity and economic growth for participating farmers.

Methodology, results and discussion

Initially three villages were selected and one sili or household from each village invited to become associated with the project. A sili includes the head of the household, his wife or wives and several related males and females including grandparents and children. Meetings were held with each household and the aims of the project discussed. The major constraints identified by the survey were reported and checked against the household’s own experience and opinions. Based on these discussions, three major research themes were developed. These included the nutrition of growing pigs, the management and husbandry of growing pigs and the management, husbandry and nutrition for sows and boars.

As the project continued, other nine households from other nine villages were recruited over the next two years. Three households conducted nutrition experiments aimed at developing improved diets for growing pigs, three conducted experiments aimed at improving sow fertility and productivity and six conducted experiments aimed at developing a modified husbandry system that would increase growth rate, reduce the risk of zoonotic diseases and reduce the impact of parasites on growing pigs.

Difficulties in recruiting households were experienced during the first year and many farmers approached decided not to participate. The major drawback was that the project was not offering direct payment to participants. Rather the financial incentives were payment for labour, assistance in developing infrastructure, such as buildings and fences, and purchase of feed ingredients, equipment and pigs. However, once positive results were achieved by feeding pigs modified diets, and farmers were invited to see the outcome, they began volunteering to become part of the project and many had to be refused because of limited funding.

The original project team was drawn from the International Potato Centre, the South Australian Research and Development Institute’s Pig and Poultry Production Institute (Adelaide, Australia),

65
the Research Institute for Livestock (Bogor Indonesia), and the Jayawijaya Livestock Office (Wamena, Papua, Indonesia), with a local Dani Project Co-ordinator. As the project developed, the team was joined by scientists from the Papua Assessment Institute for Agricultural Technology and two more local project staff members were appointed. The team included a pig production specialist, an animal nutritionist, two veterinarians, a fish production scientist, a sociologist, several extensionists, a forester and the Dani team members and farmers.

All research was conducted ‘on-farm’ and farmers were included in all stages of planning, assessment and reporting of results. Farmers were paid for their time and labour provided they followed protocols that were agreed to by all parties prior to the commencement of an experiment. All experimental sites were visited regularly 2 to 3 times each week by Dani project staff and 6 times each year by the Indonesian project manager. Farmers were invited to participate in the regular project team meetings, which were held 3 times/year during each visit by the project leader, as well as to the project review workshop held annually. At these meetings, farmers were encouraged to assist in the presentation of both the experimental methods and results, and to answer relevant questions about the procedures and techniques used that were raised by other farmers.

In the final years of the project, a bus was hired during the project review workshop so that farmers could visit each village where experiments were being undertaken to help them understand the rationale for the experiments and observe the outcomes. This was necessary as only one research activity theme was undertaken at each site. The host farmer and the Dani Project Co-ordinator described the conduct of the experiment at each site and answered questions from other farmers, supported by team members.

The methodology, results and discussion for each of the research themes described are recorded in separate sections (A, B, C, and D).

All experiments were conducted in villages using facilities built for the purpose. Experiments were repeated at least 3 times at different locations in order to compensate for the small group sizes and to validate the outcomes achieved.

A. Enhancing productivity and efficiency of pig growth by nutritional improvement

The participatory approach described above was used to design experiments that would assess and validate a series of SP-based diets, comparing them with traditional diets used by a majority of farmers. The initial diagnostic survey had shown that the majority of farmers fed a combination of uncooked SP roots and vines to pigs either once or twice daily.
**Developing the baseline:** As part of the initial diagnostic survey, and to determine growth rates and mortalities for pigs fed traditional diets, 6 pigs in each of 5 villages were tagged and weighed monthly for 4 months. Three pigs in each village were treated monthly with Doramectin to remove internal parasites. The mean growth rates for untreated pigs was 18.7 g/day compared with 48.7 g/day for parasite-free pigs but more importantly 40% of non-treated pigs died during the 4 month period.

**Value of cooking and ensilaging sweetpotato:** Prior to project interventions, feeding was often irregular and pigs were generally fed raw SP roots and vines, which contain so-called anti-nutritional factors that limit growth. Under experimental conditions, pigs were fed approximately 10% of their body weight on a daily basis and medicated at regular intervals to eliminate parasites. Pigs were weighed monthly and feed intake adjusted accordingly.

When pigs were fed uncooked SP roots and vines (60% SP vines + 40% SP roots) at experimental levels, growth rates were 3 times as fast as pigs fed traditional diets of uncooked roots and vines suggesting that regularly feeding of sufficient quantities of material would increase production significantly. By contrast, pigs fed the cooked diets (Wamena #1 diet – see below) grew almost 40% faster again. However, one of the major costs in providing cooked diets flagged by farmers was purchasing or obtaining firewood. Using firewood is also unsustainable without a renewable source of timber so it was agreed to transfer a simple technology for ensilaging SP roots and vines from Vietnam.

While older and larger pigs fed cooked roots and vines supplemented with ensilaged SP roots and vines (Wamena #2 diet) grew at similar rates to pigs fed Wamena #1 diet, smaller pigs (<15kg) fed the same diets tended to grow more slowly. In the latter case, pigs fed the silage material grew approximately 14% slower than small pigs fed only cooked diets. Based on these data it was agreed to recommend that pigs be fed only cooked material until they reach 15 to 20 kg liveweight when they can be changed onto diets containing ensilaged material.

To further reduce the use of firewood, farmers asked if they could reduce the number of days material was cooked. As a result, pigs fed a diet containing ensilaged material, where SP roots and vines were cooked 4 days/week (Wamena #3 diet), grew at similar rates to pigs fed Wamena #2 diet. These data suggested that daily cooking is not necessary thus reducing the usage of firewood.

Several farmers, who were taken to other parts of Indonesia to observe pig production, were keen to use feed ingredients commonly used in those areas when they returned to Wamena. As a result pigs were fed diets containing fish (Wamena #6), tofu waste (Wamena #7) and rice bran (Wamena #8). As expected pigs fed diets supplemented with fish offal as a source of animal protein grew significantly faster than pigs fed diets supplemented with either tofu waste or rice
bran. In fact, growth rates in pigs supplemented with fish offal were approximately 10 times greater than growth rates recorded for pigs in the initial village survey, confirming the value of using fish products to supplement diets of village pigs. Healthy pigs fed these diets could be expected to grow around 300 g/day. This created much interest among the participating farmers as they could see what was possible. However, it was agreed that while fish production and supply could be improved in the Baliem Valley, the availability of corn, tofu waste and rice bran was limited and it could not be imported economically.

The final diet that was developed (Wamena #9 diet) resulted from a discussion with team members and farmers on other possible sources of animal protein available in the Baliem Valley. The most promising suggestion proved to be the golden snail, which is prolific, fast growing and plentiful in the Baliem Valley. Subsequent experiments proved that they are not only safe but a valuable source of protein for pigs. Growing pigs fed diets containing snails (Wamena #9 diet) grew 20% faster than pigs fed Wamena #2 diet. This outcome demonstrated the value of using regular team meetings with participating farmers as a source of ideas based on local knowledge.

List of animal diets developed to date:

Wamena #1 diet: 56% cooked SP vines + 33% cooked SP roots + 11% cooked banana trunk + 0.5% salt.

Wamena #2 diet: 33% cooked SP vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines\(^1\) + 11% cooked banana trunk.

Wamena #3 diet: 33% raw\(^2\) SP vines + 22% raw SP roots + 34% ensilaged SP tubers and vines (see footnote 1 below) + 11% raw banana trunk.

Wamena #4 diet: 33% sun-dried raw SP vines + 22% sun-dried raw SP roots + 34% ensilaged SP tubers and vines (see footnote 1 below) + 11% raw banana trunk.

Wamena #5 diet: 20% raw SP roots + 9.9% raw SP vines + 60% corn + 10% grass (*Puerasía cephaloides*) + 0.1% salt.

Wamena #6 diet: 50% cooked SP roots + 30% cooked SP vines + 20% cooked fish internal organs (gill etc.).

Wamena #7 diet: 50% cooked SP roots + 30% cooked SP vines + 20% tofu waste.

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1. The ensilaged material contained 85 kg SP roots + 15 kg SP vines + 0.5 kg salt and was fermented for 14 days.
2. SP roots and vines cooked for only four days.
Wamena #8 diet: 40% cooked SP roots + 30% cooked SP vines + 10% ensilaged SP tubers and vines (see footnote 1 above) + 20% rice bran.

Wamena #9 diet: Wamena #2 + 1kg boiled snails (ad lib).

The most sustainable diets include Wamena #1, #2, #3, and #6.

Various combinations of ensilaged material are also being tested. These include:

Silage A: 85% SP roots + 15% SP vines + 0.5 kg salt fermented for 14 days.

Silage B: 85% SP roots + 15% grass (Puerasia cephaloides) + 0.5% salt fermented for 14 days.

Silage C: 85% SP roots + 15% tree leaves (Erythrina variegate) + 0.5% salt fermented for 14 days.

B. Developing management and husbandry systems based on confining pigs and supplementing diets with high protein forage pasture

Although Dani farmers had used traditional lalekens (fenced areas for confining pigs) previously, these had largely disappeared over the last few decades. While they had only been used as a means of confining pigs, after discussions with farmers and Dani Project Team members, it was decided to reintroduce them in a modified management system that would enable farmers to supplement pig diets with high protein pasture, as well as reduce the pig’s access to toxic plants and human and dog faeces. A number of species of grasses growing in the Baliem Valley were analysed and based on the results, three locally grown species, Sundaleka (Puerasia cephaloides; 17% crude protein), Wurikaka Baru (Centrosema sp; 15% crude protein) and Jirikpuruk (Calopogonium sp; 11% protein) were selected for further investigation. Similarly a number of tree species whose leaves could be used as a source of protein were also analysed. The two selected for further investigation were Dadap (Erythrina variegate; 29% crude protein) and Gamal (Gliricidia sepium). The trees also had the advantage that they could be used for ‘live fences’ around the lalekens and as a source of firewood. Experiments were designed to assess and validate the nutritional improvements to be gained by supplementing pig diets with access to high protein pastures and the foliage from fodder trees used as fences.

A further modification was the incorporation of special ‘dunging areas’ into the laleken management system to improve the control of internal parasites. Farmers had told us that native pigs seldom dung inside their pen when housed overnight, and that the majority of defecation occurs when they are first released each morning. By covering the ‘dunging area’ with rocks, or a raised slatted platform to separate pigs from their faeces, exposure to parasite
eggs contained in the faeces could be further reduced and reinfection delayed. Experiments were designed to test this hypothesis and assess the potential of dunging areas for improved parasite control.

Finally, the time required for pastures to regenerate following foraging, as well as the most productive rotational program, also had to be assessed and validated. After observations made over a 2-year period, during both wet and dry periods, it was decided to move pigs from one pasture to the next, when 50% of the foliage had been eaten. This proved a more reliable strategy than relying on stocking rates (pigs/m²).

Assessing the value of supplementing SP based diets with foraging high protein pasture

After 5 months, pigs given access to pasture had grown 80% faster than those with no access to pasture. However, both groups had significant infestations of parasites (*Hyostrongylus* sp) by the end of the third month and all pigs had to be retreated with Doramectin. Although pigs with access to pasture still had low Hyostronylge egg counts at the end of the experiment, they still grew significantly faster than pigs without access to pasture (P<0.05). Despite the fact that parasitism developed in both groups of pigs, the data recorded confirmed the value of giving growing pigs access to high protein pasture grass on a daily basis.

Assessing the value of dunging areas in reducing parasite infections

Pigs treated pre-experiment with Doramectin grew significantly faster than untreated pigs and remained relatively free of parasites for 3 months, when significant faecal parasite egg counts were again recorded. The data confirmed the value of treating pigs to remove parasites, as well as validating the use of dunging areas as a means of reducing parasite burdens in growing pigs (Syahputra et al. 2007).

C Improving efficiency of pig production through improved sow management and nutrition

Data collected in the initial diagnostic survey indicated that sows farrowed approximately once every 18 months and that litter size was small.

Assessing the value of boar contact post-weaning on sow productivity

One of our key observations was that sows in many of the villages in the Baliem valley have no or little contact with boars. When questioned, there was a reluctance on the part of farmers to keep entire males as, although they grow faster than castrated males, they have less fat on the carcase. As boar contact is considered important in stimulating sow fertility, an experiment was designed to demonstrate to farmers the importance of keeping boars in villages for contact with
sows. Two sites for housing weaned sows were built, one (site 1) consisted of one small pig house with 2 pens, both connected to separate lalekens for daytime foraging and the other (site 2) situated 50 metres away behind a high mound contained only one pen connected to a single laleken. A boar was housed permanently at site 1 but not at site 2. Every alternate sow that was weaned in the village was housed in the pen adjacent to the boar at site 1 and moved in with the boar for 24 hours when she displayed signs of oestrus. Sows that did not display signs of oestrus again over the next 30 days were returned to their owner. Sows that displayed signs of oestrus again were returned to the boar for remating. Sows that failed to conceive on the second mating, or sows that had not shown signs of oestrus after 50 days, were also returned to the farmer. Every other sow that was weaned in the village was housed at site 2 (without boar contact) until they displayed signs of oestrus. Once signs of oestrus were displayed, the sow was moved across to site one and housed with the boar until she had been mated. She was then returned to site 2 for 30 days and the same procedures were then followed as for site 1.

The data collected confirmed the importance of boar contact in bringing sows into oestrous following weaning and also indicate that productivity is further increased by larger litter size (Putra et al. 2004b). Ninety percent of sows given boar contact continuously following weaning were mated within 10 days of arrival at the site, compared with only 40% of sows with no boar contact. Sows that were given boar contact pre-mating also farrowed 82% more live piglets at the next farrowing.

The economic advantage of using boar to stimulate sows post weaning in a village farming system would seem quite significant. Even if a boar costs over USD 1000, an increase of 83% in pig sales at an estimated USD 100–400/pig will more than offset the cost. As a result of these demonstrations undertaken in three villages, the farmers have invited their neighbours to make use of the boar resulting in increased sow productivity within each village.

**Summary and conclusion**

While the major aim of the project was to characterise the existing human–SP–pig production system using socio-economic and technical diagnostic surveys, significant improvements were made in the efficiency of pig production using a multidisciplinary and participatory approach to research.

Based on the analysis of the diagnostic surveys, the major factors contributing to poor pig production were identified as poor growth, with pigs taking 2 to 3 years to reach maturity, and low fertility, with sows producing one litter every 1.5 to 2 years. Factors contributing to the low productivity included diets low in nutrients, irregular feeding of pigs, suboptimal husbandry and housing, poor management systems and parasitism.
All research was conducted ‘on-farm’ and farmers were included in all stages of planning, assessment and reporting of results. They were paid for their time and labour, provided they followed protocols that were agreed to before each experiment commenced, and invited to participate in regular project team meetings over the life of the project. These meetings were used to introduce and receive new ideas, and review progress and reasons for failure.

Twelve households were recruited over the life of the project to participate in experiments relating to pig production. Three households conducted nutrition experiments aimed at developing improved diets for growing pigs, three conducted experiments aimed at improving sow fertility and productivity and six conducted experiments aimed at developing a modified husbandry system that would increase growth rate, reduce the risk of zoonotic diseases and reduce the impact of parasites on growing pigs.

Initial difficulties in recruiting households were overcome when farmers were able to observe outcomes such as significant improvements in the growth rate of pigs fed modified diets and after 12 months when more farmers were volunteering and becoming interested in the project than could be recruited. The major financial incentives for farmers were payment for their labour, assistance in developing infrastructure, and purchase of feed ingredients, equipment and pigs.

The multidisciplinary project team was drawn from a number of institutes and organizations from within Indonesia and Australia, and included a pig production specialist, an animal nutritionist, two veterinarians, a fish production scientist, a sociologist, several extensionists, a forester and the Dani team members and farmers.

The major outcomes from the project have been the registration of seven new SP clones with higher protein and energy content for pigs and humans, together with nine diets based on SP roots and vines. These were assessed in a series of experiments conducted in facilities built in selected villages. The basic diet (56% cooked SP vines, 33% cooked SP roots, 11% cooked banana trunk and 0.5% salt) was supplemented with a range of other materials including ensilaged SP roots and vines, corn, fish offal, tofu waste, rice bran and golden snails. The ensilaged material contained 85% SP roots, 15% SP vines or 15% pasture grass, and 0.5% salt and was fermented for 14 days. Pigs fed twice daily with these diets grew from $145 \pm 63.3$ g/day to $296 \pm 146.9$ g/day, approximately 4 to 10 times faster than the baseline growth rates initially recorded.

A modified pig management and husbandry system, based on small paddocks (lalekens) sown with high protein forage pasture, reduces the human and pig health risks identified in the disease survey, and increase protein intake of pigs. Pigs were housed overnight, and given access to forage pasture in confined areas during the day. The pigs were moved to new pasture
when 50% of the foliage in a laleken had been eaten. Pigs were held in a special ‘dunging area’ for 30 minutes each morning, prior to moving to the laleken, to reduce contamination of pastures with parasite eggs. Pigs managed in this system grew significantly faster than housed pigs and remained relatively free of parasites for 3 months. Pigs treated for parasites and given access to pasture also grew 80% faster (P<0.05) than pigs treated for parasites and fed the same diet without access to pasture.

A lack of uncastrated male pigs was identified as a major cause of the low sow productivity and providing sows with boar contact following weaning increased the number of sows mated within 7 days from 40 to 90% and increased litter size by 80%. Previously farmers had been reluctant to keep uncastrated boars as they preferred the fatter carcase of castrates.

Based on the modified SP-based diets and the modified husbandry and housing system developed, the efficiency of pig production in the selected villages was improved significantly.

Acknowledgements

We gratefully acknowledge the generous financial support of the Australian Centre for International Agricultural Research (ACIAR). We also acknowledge the support of Dr John Copland (Program Manager), ACIAR, Dr Fernando Ezeta (Regional Representative CIP–ESEAP) and Professor Simon Maddocks (Chief Scientist SARDI Livestock Systems). We also sincerely thank Dr Keith Fuglie (Leader, Impact Enhancement Division–CIP) for his encouragement and advice and his contributions to the project. Finally we acknowledge the generous support and contributions of our colleagues Luther Kossay, Dai Peters, A Triono Syahputra, Yatiya Pahebol (International Potato Center), I Made Putra (Jayawijaya Livestock Office), Pius Ketaren (Balai Penelitian Ternak (Balitnak) and Albert Soplanit (Balai Pengkajian Teknologi Pertanian Papua (BPTP) as well as the farmers in the Baliem Valley, without whose generosity, understanding and commitment this project could not have been completed.

References


Farm-based multidisciplinary research in Papua Province Indonesia

Colin Cargill – SARDI
Sukendra Mahalaya, Dai Peters – CIP Bogor
Luther Kossay, A. Triono Syahputra, Yatiya Pahebol – CIP Wamena
Research Institute for Legumes and Tuber Crops, Malang (Balitkabi)
I Made Putra – Livestock Department, Papua Province
Albert Soplanit – Papua Assessment Institute for Agric Technology
Pius Ketaren – Research Institute for Livestock, Bogor
Other Participating Institutes and Organisation

- Veterinary Research Laboratory, Bogor (Balitvet)
- Veterinary School, University of Udayana (UNUD) Bali.
- Disease Investigation Centre, Denpasar Bali

List of disciplines

- Social science - cultural and social assessment and analysis
- Sweet potato breeding and cultivation
- Pig production, nutrition, husbandry, health and housing
- Pasture cultivation and management
- Tree cultivation and management
- Economics and impact assessment
Introduction

- Project commenced in 2000
- Initial aim of the project
  - to study and characterize the existing human-sweetpotato-pig production system within the overall household economy;
  - Identify and understand the major constraints.

Australian Centre for International Agricultural Research (ACIAR)
Introduction

The major research aims (1):
- to improve sweetpotato production to ensure a stable feed supply with emphasis on selection of:
  » dual-purpose varieties (suitable as human and animal food) and forage feed varieties;
  » drought and frost resistant varieties for pig feed.

The major research aims (2):
- to enhance productivity and efficiency of pig growth by:
  » improve nutrition - using appropriate technology
  » improve management and housing of sows and boars;
  » improve the management and housing of growing pigs;
Introduction

The major research aims (3)

- to capacity build by:
  » develop training programmes for
    - Government Scientists (JLO, BPTP, KIPPK)
    - Project staff
    - Farmers (Train the Trainer), and developing farmer groups (farmer-to-farmer extension).

Process

- Completion of a socio-economic diagnostic survey
  - provided data on social and economic issues affecting farmers
  - analysis was used to identify problems and limitations

- Disease & production survey to identify restraints

- Data used to design participatory action research aimed at improving the efficiency of both sweetpotato and pig production;
Research Methodology

- All experiments were conducted in villages
  - using facilities built for the purpose

- All experiments repeated at least 3 times at different locations

- Used a participatory approach to design experiments
  - invited Dani villages to participate in project
  - farmers included in planning process
  - paid farmers for their time and labour
    - to follow agreed procedures
  - regular visits by Dani project staff (2/3 times/week)
  - regular visits by project team (3 - 6 times/year)
  - farmers participated in all project team meetings
  - farmers & project staff presented results to other farmers
    (allowed farmers to question each other and us)
  - different farmers involved in different experiments
  - annual visits by farmers and project team to all sites
Enhancing productivity and efficiency of pig growth by nutritional improvement

- Initial diagnostic survey
  - Majority of farmers fed pigs once or twice daily (often not regular)
  - Diet: combination of uncooked SP roots and vines sometimes supplemented with vegetables

- Research Plan –
  - Determine baseline production (traditional management and diet)
  - Design and develop modified diets
  - Compare growth rates for modified diets with traditional diets
    » Source of pigs – village farmers
    » Length of feeding trials – 3 to 5 months

Baseline growth rate

<table>
<thead>
<tr>
<th></th>
<th>Untreated pigs</th>
<th>Treated pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean growth rate ± SD (g/day)</td>
<td>18.7 ± 12.3</td>
<td>48.2 ± 13.1</td>
</tr>
<tr>
<td>Range (g/day)</td>
<td>-9.0 to 36.0</td>
<td>15.0 to 66.0</td>
</tr>
<tr>
<td>Death rate (%)</td>
<td>40%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Results
Major nutritional problems

- Lack of discipline (pigs not fed every day)
- Pigs underfed
- Diets solely sweet potato vines and roots
  - anti-trypsinases in SP roots
  - low protein in roots (lysine and methionine)
  - low in minerals
  - too bulky???

The effect of cooking SP roots and vines on growth rate

<table>
<thead>
<tr>
<th>Diet</th>
<th>Mean growth rate ± SD (g/day)</th>
<th>Range (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet A - cooked</td>
<td>278.3 ± 76.2</td>
<td>156 to 324</td>
</tr>
<tr>
<td>60% vines + 40% roots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet B – uncooked</td>
<td>153.4 ± 36.4</td>
<td>112 to 197</td>
</tr>
<tr>
<td>60% vines + 40% roots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet C – uncooked</td>
<td>189.0 ± 34.8</td>
<td>145 to 232</td>
</tr>
<tr>
<td>56% vines + 33% roots + 11% banana trunks + 0.2% salt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
85% SP roots + 15% SP vines + 0.5 kg salt fermented for 14 days

Heavier (older?) pigs respond better

**Results**

<table>
<thead>
<tr>
<th>DIET</th>
<th>56% vines + 33% roots + 11% banana trunk + 0.5% salt</th>
<th>33% vines + 22% roots + 11% banana trunk + 34% ensilaged roots &amp; vines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate</td>
<td>Small pigs (&lt;15 kg)</td>
<td>Large pigs (&gt;15kg)</td>
</tr>
<tr>
<td>Mean growth rate ± SD (g/day)</td>
<td>168 ± 69,8</td>
<td>178 ± 36,7</td>
</tr>
<tr>
<td>Range (g/day)</td>
<td>73 to 213</td>
<td>127 to 233</td>
</tr>
</tbody>
</table>

Heavier (older?) pigs respond better
Feeding ensilaged SP roots and vines and cooked SP roots and vines

The response of growing pigs to ensilaged material

Improving Protein Intake

- **Three Base Diets**

  - **Wamena #1 diet**: 56% cooked SP vines + 33% cooked SP roots + 11% cooked banana trunk + 0.5% salt
  - **Wamena #2 diet**: 33% cooked SP vines + 22% cooked SP roots + 34% ensilaged SP tubers and vines + 11% cooked banana trunk
  - **Wamena #3 diet**: 33% raw SP vines + 22% raw SP roots + 34% ensilaged SP tubers and vines + 11% raw banana trunk

NOTE: fed raw 3 days/week and cooked 4 days/week
Improving protein intake

- **Other diets tested**
  - **Wamena #4 diet**: 33% sun-dried raw SP-vines + 22% sun-dried raw SP roots + 34% ensilaged SP-tubers and vines + 11% raw banana trunk
  - **Wamena #5 diet**: 20% raw SP roots + 9.9% raw SP vines + 60% corn + 10% sundeleka grass + 0.1% salt
  - **Wamena #6 diet**: 50% cooked SP roots + 30% cooked SP-vines + 20% cooked fish internal organs (gill etc)
  - **Wamena #7 diet**: 50% cooked SP roots + 30% cooked SP-vines + 20% tofu waste
  - **Wamena #8 diet**: 40% cooked SP roots + 30% cooked SP-vines + 10% ensilaged SP tubers and vines* + 20% rice bran
  - **Wamena #9 diet**: Wamena #2 + 1kg boiled snails

- **Diets**
  - Various combinations of ensilaged material also tested.
    - **Silage A**: 85% SP roots + 15% SP vines + 0.5 kg salt fermented for 14 days
    - **Silage B**: 85% SP roots + 15% pasture (*Puerasia cephaloides*) + 0.5% salt fermented for 14 days
    - **Silage C**: 85% SP roots + 15% leaves (*Erythrina variegate*) + 0.5% salt fermented for 14 days

*Note: *Puerasia cephaloides* – 17% crude protein
*Erythrina variegate* – 29% crude protein
Supplementing diets with snails

![Graph showing comparison between Group A (Snail) and Group B (Without Snail) over different periods.](image)

**Traditional system**

- Pigs confined at night in houses
- Pigs share dunging area with dogs and children
- Pigs wander over large areas of uncropped scrubland during the day
Assessing the major health problems limiting pig production

Methodology

- Disease survey
  » Pigs from 9 villages examined clinically, weighed, examined post-mortem
  » Blood samples collected and tested for range bacterial, viral and protozoan diseases
  » Faecal samples and large intestinal contents collected and analysed for parasite eggs

Major health problems

- Internal parasites - including
  » Strongyle type (100% samples)
  » Trichuris suis (56%)
  » Metastongylus (56%)
  » Ascaris suum (33%)

- Toxic plants
  » Pyrrolizidine alkaloids (Crotalaria spp)

- Zoonotic diseases
  » Trichinella sp - 5 (13%) antibody positive (not detected in muscle)
  » Toxoplasma gondii - 7 (18%) pigs positive for antibodies
  » Taenia solium ⇒ Cysticercosis (pork measles)
Developing management and husbandry systems based on confining pigs

- **Rationale for confining pigs**
  - Reduce access to toxic plants
  - Access to high protein forage plants in diets
  - Increased parasite control by
    - incorporating dunging areas
    - rotational foraging
  - Reduced access to human and dog faeces
  - Use fodder trees as “live fences”
    - provides extra protein source
    - firewood

**Resources and management**

- Lalekens (small fenced areas) used historically
- 3 high protein pasture species identified
  - *Pueraria cephaloides* (17% crude protein)
  - *Centrosema sp.* (15% crude protein)
  - *Calopogonium sp.* (11% protein)
- 2 fodder trees identified
  - *Erythrina variegata* (29% crude protein)
  - *Gliricidia sepium* (15% crude protein)
- Pigs moved (rotated) to fresh pasture when 50% foliage eaten
8 laleken rotation system

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
<td>Column 4</td>
</tr>
<tr>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
<td>Column 4</td>
</tr>
<tr>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
<td>Column 4</td>
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<tr>
<td>Column 1</td>
<td>Column 2</td>
<td>Column 3</td>
<td>Column 4</td>
</tr>
</tbody>
</table>

---

![Forest scene](image.png)
Assessing the value of supplementing SP based diets with foraging high protein pasture

Results

<table>
<thead>
<tr>
<th></th>
<th>Daily access to pasture</th>
<th>No access to pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean growth rate ± SD (g/day)</td>
<td>166 ± 41</td>
<td>92 ± 23</td>
</tr>
<tr>
<td>Range (g/day)</td>
<td>107 to 201</td>
<td>47 to 107</td>
</tr>
</tbody>
</table>
**Dunging areas** - Special place for pigs to dung and urinate when they come out of their house in the morning. Limits pig’s access to parasite eggs.

- Ground covered with stones
  - Stops pigs digging up the soil
  - Sun will kill eggs
  - Rain will wash the parasite eggs between the stones

**Dunging area**

Slatted platform outside the house made of wood (~30 cm above the ground)

- Pieces of wood are about 2.5 to 3.5 cm wide
- Gap 1.5 to 2 cm between each piece of wood
- Dung falls through the gaps (or pushed through) and collected under the platform for composting.
Assessing the value of dunging areas in reducing parasite infections

- Growth rate and mortality data

<table>
<thead>
<tr>
<th></th>
<th>Experiment 1</th>
<th>Experiment 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group A</td>
<td>Group B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean growth rate ± SD (g/day)</td>
<td>133 ± 62.2</td>
<td>47 ± 45.5</td>
</tr>
<tr>
<td>Range (g/day)</td>
<td>118 to 166</td>
<td>-17 to 100</td>
</tr>
<tr>
<td>Deaths</td>
<td>1/6 (17%)</td>
<td>3/6 (50%)</td>
</tr>
</tbody>
</table>

Faecal parasite egg counts

<table>
<thead>
<tr>
<th>Month</th>
<th>Trichuris</th>
<th>Hyostronglyes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group A</td>
<td>Group B</td>
</tr>
<tr>
<td>March*</td>
<td>240</td>
<td>333</td>
</tr>
<tr>
<td>April</td>
<td>20</td>
<td>876</td>
</tr>
<tr>
<td>May</td>
<td>0</td>
<td>167</td>
</tr>
<tr>
<td>June</td>
<td>0</td>
<td>120</td>
</tr>
<tr>
<td>July</td>
<td>67</td>
<td>253</td>
</tr>
<tr>
<td>Sept</td>
<td>0</td>
<td>125</td>
</tr>
</tbody>
</table>

* All pigs in Group A injected with Dectomax (1ml/33kg)
Requirements for Housing

- Free from drafts – especially important for younger pigs
- Increased ventilation when it is warm outside – allow air movement to cool the pig and remove ammonia gas
- Reduced ventilation when it is cold outside – to maintain warmth inside the house
- A wet area for eating and drinking and a dry area (with dry grass) for sleeping.
- Enough floor space for the number of pigs
- Enough volume for the number of pigs
- Clean water supply
- Enough feeder space
Housing
How to explain temperature requirements to a man who never hears a weather forecast?
Improving efficiency of pig production through improved sow management and nutrition

- Initial diagnostic survey plus validation survey
  - sows in many of the villages have no or little contact with boars
  - farmers reluctant to keep entire males
  - growth faster but not as fat as castrated males
  - sows farrowed once / 18 months
  - litter size was small (2 – 4 pigs weaned)

Assessing the value of boar contact post-weaning on sow productivity

- Rationale
  - Boar contact considered important in stimulating sow fertility post weaning

- Experimental design
  - Two sites for housing weaned sows
    - Site 1
      » small pig house with 2 pens + 2 lalekens for daytime foraging
      » boar housed permanently at site 1
    - Site 2
      » small house with 1 pen connected + 1 laleken
      » no boar at site 2
      » site 2 was 50 metres away behind a high mound
Assessing the value of boar contact post-weaning on sow productivity

- Results: Number of days between arrival and mating

<table>
<thead>
<tr>
<th></th>
<th>Site 1 (boar)</th>
<th>Site 2 (no boar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>7,3 ± 8,78</td>
<td>18,2 ± 17,7*</td>
</tr>
<tr>
<td>Range</td>
<td>1 to 31</td>
<td>4 to 22*</td>
</tr>
<tr>
<td>% sows mated within 10 days</td>
<td>90%</td>
<td>40%</td>
</tr>
</tbody>
</table>

* 2 sows did not mate

- Results: pigs born / sow at next farrowing

<table>
<thead>
<tr>
<th></th>
<th>Site 1 (boar)</th>
<th>Site 2 (no boar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs born/sow</td>
<td>5,1 ± 2,08</td>
<td>2,8 ± 2,25</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>2 to 8</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>
The Future

Thankyou for listening
Improving pig performance through breeding and feeding in Vietnam

LV Kinh and LT Hai

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121 Nguyen Binh Khiem, District 1, Hochiminh City, Vietnam

Introduction

Pig production is very important in the livestock sector of Southeast Asia and Vietnam in particular. For thousands of years, pig production has been closely associated with small-scale farmers as a way to utilize household by-products and as a form of saving money. Pig production contributes a large amount of the total income of small-scale farmers and to reducing poverty. The demand for pig meat is rising day by day, which leads to increases in pig numbers and the trade in live pigs, commercialization and increasing scales of pig production, resulting in both opportunities and threats to the livelihoods of the poor. Consequently, small-scale pig producers are encouraged to adopt modern pig keeping methods to improve both the quality and the quantity of pig product (meat) to satisfy the demand of the market. Without these changes, small-scale producers are unlikely to compete with large producers, both domestic and international, and, as a result, they will become poorer. With these changes happening as Vietnam’s economy integrates into the world market, the role of research and development becomes more important. Through research and development projects, small-scale poor pig producers can access advanced technologies that enable them to fulfil the demand of the market and consequently, increase income.

The ACIAR (Australian Centre for International Agricultural Research) project ‘Pig Breeding and Feeding in Australia and Vietnam’ was evaluated as one of the successful research and development projects targeting enhancing benefits to the poor in Vietnam. The project aimed to enhance pig production, especially amongst small-scale producers, through programs improving breeding and feeding. Improved pig breeds, which were imported from Australia, were evaluated for adaptation to Vietnamese conditions. Raising and feeding procedures were also developed for high-yield pig breeds. Development programs were carried out through establishing artificial insemination centres in several local areas, providing trained staffs as well as training courses and technical leaflets to pig producers. The project achieved high efficiency both in terms of the return over invested capital, social impact on promoting pig production and increased incomes of the poor pig keepers.
The Vietnam experience from ACIAR project 9423

In 1995, the project proposal ‘Pig Breeding and Feeding in Australia and Vietnam’ was finalized and approved for implementation in Vietnam with the participation of the Institute of Agricultural Science of South Vietnam (IAS) and the Animal Research Institute of the Department of Primary Industry–Queensland (ARI). The project was funded by ACIAR and coded ACIAR-9423. The project was implemented from 1995 to the end of 2000 and its co-leaders were Dr Cam McPhee from ARI-Queensland and Ass/Prof Le Thanh Hai, Former Vice Director of IAS.

The project collaborated with the Animal Husbandry Research Institute of Hanoi, the University of Agriculture and Forestry of Ho Chi Minh City, the Department of Agricultural Extension of the Ministry of Agriculture and Rural Development of Vietnam and other extension centres. Since ACIAR highly appreciated the project’s outcomes in the first phase, it funded a second phase of the project.

Role of pig in Vietnam

Vietnam is an agricultural country with more than 70% of the population living in the agricultural sector which comprises mainly small-scale farmers, who have been heavily dependent on rice and pig production for thousands of years. Pigs play a vital role in the livestock industry, are the major source of animal protein for the population, and are highly competitive with other livestock species. Pig production in Vietnam comprises 81% of the total meat consumption while chicken meat and beef are only 11.5 and 7.5%, respectively. According to the 2005 statistics (Table 1), the pig population of Vietnam was nearly 27.5 million, approximately 14% being sows and 86% fatteners. The average growth rate in pig numbers over the last six years was about 6%.

Table 1. Livestock number in Vietnam 2000–2005 (million)

<table>
<thead>
<tr>
<th>Livestock type</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>Annual growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry</td>
<td>196.1</td>
<td>218.1</td>
<td>233.3</td>
<td>254.6</td>
<td>218.2</td>
<td>219.9</td>
<td>2.02</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>4.128</td>
<td>3.900</td>
<td>4.063</td>
<td>4.394</td>
<td>4.908</td>
<td>5.541</td>
<td>5.7</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.897</td>
<td>2.808</td>
<td>2.815</td>
<td>2.835</td>
<td>2.870</td>
<td>2.922</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Source: Data obtained from the General Statistical Organization (2005).

Pig production plays an important role in improving the incomes of small-scale farmers and it is the key element for reducing poverty of the rural poor. The pig industry is the major source of income for many farmers and it is estimated that smallholder pig producers derive about 75% of their total income from pigs, medium farms 90% and large farms 95%. Pig keeping also
brings about considerable employment in the countryside, especially for women. Moreover, it is an excellent way of adding value to, and disposing of, other agricultural by-products by using them as feed components. Thus, pig production plays an extremely important role in raising living standards and contributing to the rural and national economy.

**Defined problem addressed by the project**

Currently, there are four broad types of holdings producing pigs. Smallholder systems are dominant and account for approximately 80% of the national pig population (Table 2). Within the smallholder systems, most farmers raise only one or two fattening pigs. Limited professional knowledge and capital are usually associated with this type of pig holders. The farmers usually purchase a few piglets at a time, as required, in the market or from their neighbours.

### Table 2. Pig production holdings in Vietnam, classified by scale of production

<table>
<thead>
<tr>
<th>Holding type</th>
<th>Herd size</th>
<th>% of national herd (1999)*</th>
<th>% of national herd (2006)**</th>
<th>Breeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholders or backyard</td>
<td>1–10 pigs</td>
<td>80</td>
<td>64</td>
<td>North: mostly local</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>South: mostly cross with exotic</td>
</tr>
<tr>
<td>Small-medium</td>
<td>5–20 sows or 30–100 fattening</td>
<td>10</td>
<td>20</td>
<td>Cross and exotic</td>
</tr>
<tr>
<td>Medium</td>
<td>20–500 sows or 100–4000 fattening</td>
<td>5</td>
<td>10</td>
<td>Exotic</td>
</tr>
<tr>
<td>Large</td>
<td>&gt;500 sows or &gt;4000 fattening</td>
<td>5</td>
<td>6</td>
<td>Exotic</td>
</tr>
</tbody>
</table>

Sources: * La Van Kinh, Le Thanh Hai, Do Van Quang and Nguyen Van Duc (2002); ** La Van Kinh (2006).

Most of the pigs raised on smallholder farms are local breeds with high fat and low lean meat percentages, although crossbreeds are more significant in the south (Table 2). The larger-scale farms, on the other hand, keep either crosses between local and exotic breeds or exotic pigs. In 2000, only about 15% of the country’s pigs showed evidence of infusion of exotic genetic material as evidenced by lean meat percentages above 50%. Adoption of improved pig breeds is quite slow. A recent survey found that, while 75% of pig producers had one or more crossbred pigs in the herd, only 20% had one or more exotic pigs, and only 18% had exotic pig at adoption rates of 100% (La Van Kinh 2006). These are the reasons why pig performances are low compared with those of developed countries.

The larger farms may keep either a mixture of sows and fattening pigs or specialized in fattening pigs only. Hygiene and veterinary practices of this holding type are of higher standard than other holding types with lower labour costs. Medium- and large-scale farmers are generally willing to apply new technologies and to practice better overall management, with the result that they have substantially higher incomes than smallholders.
Carcass characteristics are important traits in assessing the quality of the breeding stock in different geographical zones (Table 3). Among five regions, only in the Southeast area were pigs of good quality as shown by the high slaughter weights, long carcasses, good dressing-out percentages, and low backfat thickness. By contrast, pig breeds in the other regions are mainly crosses between local (Thuoc Nhieu, Ba Xuyen, Mong cai…) and exotic breeds (50–75% exotic blood). Farmers in this region keep pigs as a form of savings, thus, the fattening period is prolonged and consequently, slaughter weights and backfat thickness are high. Generally, backfat thickness of pigs in various areas of Vietnam is quite high and, as a result, lean meat component is low and of low quality.

Table 3. Carcass traits of pigs in some agro-ecological zones

<table>
<thead>
<tr>
<th>Agro-ecological zones</th>
<th>n</th>
<th>Slaughter weight (kg)</th>
<th>Dressing percentage (%)</th>
<th>Carcass length (cm)</th>
<th>Backfat thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River Delta</td>
<td>70</td>
<td>82.1</td>
<td>69.8</td>
<td>70.0</td>
<td>32.3</td>
</tr>
<tr>
<td>North Central Coast</td>
<td>33</td>
<td>83.3</td>
<td>70.5</td>
<td>68.5</td>
<td>36.3</td>
</tr>
<tr>
<td>South Central Coast</td>
<td>78</td>
<td>79.1</td>
<td>72.4</td>
<td>70.6</td>
<td>33.4</td>
</tr>
<tr>
<td>Southeast Vietnam</td>
<td>79</td>
<td>86.8</td>
<td>71.7</td>
<td>79.9</td>
<td>21.4</td>
</tr>
<tr>
<td>Mekong River Delta</td>
<td>369</td>
<td>94.6</td>
<td>73.7</td>
<td>68.1</td>
<td>38.0</td>
</tr>
</tbody>
</table>

Source: La Van Kinh et al. (2002).

In summary, the defined problem for the project was low pig production due to more than 80% of total pig population keeping in small-scale producers. Productivity in this area is very low both in terms of quantity and quality due to breeds of low productivity and poor nutrition and raising method. Improvement of breeds and breeding scheme as well as nutrition and feeding strategies for small-scale pig holders are the keys to improving pig productivity and the incomes of the poor.

Project activities

Activities of the project included both genetics and nutrition for pigs as well as training programs for the pig holders. The activities were divided into four major subprograms: genetic development, feed evaluation, nutrient requirements and pig production technology transfer, which includes international training courses and communication of results.

- Genetics development subprogram included the following activities:
  - Ranking of genotypes: A comparison between Australian breeds (Large White and Duroc) and Vietnamese counterparts was undertaken. The results showed that the Australian stocks maintained their advantage over the Vietnamese Yorkshire in growth rate and carcass lean meat under Vietnamese conditions.
  - Design of a selection procedure: A procedure was developed to select pig genotypes suited to the requirement of Australia and Vietnam with low level
Monitor selection response: The heritabilities of growth rate, and fat depth and the correlation between two traits were estimated. Application of selection procedure: Selection was then applied to boars from Australian stock for introduction into the Vietnamese herd through artificial insemination to widen genetic diversity. PIGBLUP software was also introduced to estimate breeding values for growth rate, fat and litter size.

- Doing breeding between Australian and Vietnamese pigs.
- Feedstuff evaluation subprogram included the following activities:
  - Feedstuffs and pig production survey: Pig production systems of small, medium and large scale were surveyed for production system, feed availability and current ration used for pigs, qualifications of pig holders and others. Feed mills were also studied.
  - In vitro feed evaluation: Various feed ingredients were collected by types, varieties, locations and processing methods and basic analysis carried out in Vietnam with cross checking in Australia. Chemical composition of these samples was reported.
  - In vivo feed evaluation: Energy and nutrient digestibilities of common feed ingredients used for pigs were determined by in vivo studies.
  - LCD evaluation: Chemical analysis and digestible energy data on feed were incorporated into the Feedmania diet formulation package. A large number of diets for various pig classes were formulated using the biochemical information.
- Nutrient requirements subprogram included the following activity:
  - Lysine and energy requirements for lean growth performance were determined in pigs from weaning to 20 kg live weight and pigs from 20 to 100 kg live weight.
- Pig production technology transfer subprogram included the following activities:
  - Training on pig breeding and genetics
  - Training on nutrition for pigs

Project performance and impact

Major project results

Project performance on improvement of Vietnamese pigs by introducing Australian Yorkshire and Duroc pigs

Australian Yorkshire and Duroc pigs were imported and raised at Binh Thang Research and Training Center, Institute of Agricultural Science of South Vietnam in order to study their adaptability under the production conditions of Vietnam and their genetic merit to improve the performance of Vietnamese pigs. Four generations of pigs produced from 33 imported pigs were raised in Binh Thang centre from October 1995 to December 2000. Adaptability to the production conditions of Vietnam of purebred pigs born to or sired by the 33 imported pigs was evaluated by the reproductive performances of sows and the semen quality of the boars. The semen quality of purebred boars in four generations was acceptable with VAC varying from 34 to 50 billion of sperm cells per ejaculation. This means that 1375 offspring of these imported Australian pigs have been supplied to breeding farms, artificial insemination centres and commercial farms in 18 provinces from North to South of Vietnam from 1999 to December 2000.
In Vietnam, experiments were carried out at pig breeding farms such as Binh Thang Research and Training Center, Ho Chi Minh City, Phu Son pig farm, Dong Nai province, Thanh To state farm as well as Hai Phong and Cau Dien pig breeding farm in Ha Noi. Offspring boars sired by Australian Yorkshire and Duroc pigs and semen were used to breed sows raised at these farms and in Cao Lanh district – Dong Thap province, Go Cong Dong district – Tien Giang province, Dong Nai province and Binh Thuan province in order to assess their breeding ability in performance improvement. Offspring sired by Australian Yorkshire and Duroc boars or semen of these boars had better growth rate, feed conversion rate and backfat at P2 than those of control pigs (offspring sired by Vietnamese exotic boars).

Over 500 young males have been performance tested at Binh Thang Research and Training Center. All male offspring of imported Australian Yorkshire pigs had better growth performance than Yorkshire from Binh Thang Center. Growth performances of crossbred pigs between Australian and Vietnamese pigs were higher than the average of the two. It indicated that Australian pigs have a very good genetic merit and would contribute a lot to the genetic improvement for Vietnamese pigs (Table 4).

Table 4. Performance testing at Binh Thang Center

<table>
<thead>
<tr>
<th>Traits</th>
<th>Yorkshire Vietnam</th>
<th>Australia</th>
<th>Duroc Vietnam</th>
<th>Australia</th>
<th>Crossing AY–VY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight, kg</td>
<td>19.1</td>
<td>20.6</td>
<td>–</td>
<td>20.3</td>
<td>22.2</td>
</tr>
<tr>
<td>Final weight, kg</td>
<td>91.2</td>
<td>99.1</td>
<td>–</td>
<td>100.0</td>
<td>96.3</td>
</tr>
<tr>
<td>Average daily gain, g/day</td>
<td>601</td>
<td>655</td>
<td>–</td>
<td>669</td>
<td>625</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>3.25</td>
<td>2.95</td>
<td>–</td>
<td>2.88</td>
<td>3.05</td>
</tr>
<tr>
<td>Backfat thickness (P2) at 180 days of age, mm</td>
<td>14.6</td>
<td>12.0</td>
<td>–</td>
<td>11.4</td>
<td>12.3</td>
</tr>
</tbody>
</table>

*AY–VY*: Australian Yorkshire × Vietnamese Yorkshire.
Source: Le Thanh Hai et al. (2002).

The number of piglets born alive of Australian Duroc sows, 11.1 per litter, was more than from Yorkshire sows and crossbred Australian and Vietnamese Yorkshire sows (Table 5), but the number of weaned piglets from Australian Duroc sows was the lowest. Vietnamese Yorkshire sows had more piglets born and more born alive than Australian Yorkshire sows, but fewer piglets weaned than Australian Yorkshire sows. Litter weight at 21 days of age of Australian sows was better than that of Vietnamese ones (Table 5).

Local sows bred with Australian boars had better reproductive performance than local sows bred with local boars. The conception rate of sows bred with Australian boars varied from 80 to 90% compared to 73 to 84% in sows bred with local boars. The number born and number born alive of local sows bred with Yorkshire boars being offspring of imported Australian pigs were almost the same or higher than those of local sows bred with local boars (Table 6).
Table 5. Reproductive performance of Australian and Vietnamese sows raised at Binh Thang

<table>
<thead>
<tr>
<th>Traits</th>
<th>Yorkshire</th>
<th>Duroc</th>
<th>Cross</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vietnam</td>
<td>Australia*</td>
<td>Vietnam</td>
</tr>
<tr>
<td>Number born (pig)</td>
<td>10.5</td>
<td>10.2</td>
<td>– 11.1</td>
</tr>
<tr>
<td>Number born alive (pig)</td>
<td>10.0</td>
<td>9.4</td>
<td>– 9.8</td>
</tr>
<tr>
<td>Number weaned (pig)</td>
<td>9.0</td>
<td>9.3</td>
<td>– 8.4</td>
</tr>
<tr>
<td>Birth weight, kg/piglet</td>
<td>1.32</td>
<td>1.48</td>
<td>– 1.53</td>
</tr>
<tr>
<td>Litter weight 21 days of age (kg)</td>
<td>5.1</td>
<td>5.3</td>
<td>– 5.6</td>
</tr>
</tbody>
</table>

* Australian sows being offspring of imported Australian pigs. ** AY–VY: Australian Yorkshire x Vietnamese Yorkshire.
Source: Le Thanh Hai et al. (2002).

Table 6. Reproductive performance of local sows bred with local boars and Yorkshire boars being offspring of imported Australian Yorkshire in some provinces

<table>
<thead>
<tr>
<th>Provinces</th>
<th>Dong Thap</th>
<th>Tien Giang</th>
<th>Dong Nai</th>
<th>Binh Phuoc</th>
<th>Binh Thuan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>Local</td>
<td>AY* Local</td>
<td>AY* Local</td>
<td>Local</td>
<td>AY* Local</td>
</tr>
<tr>
<td>Conception rate (%)</td>
<td>73.0</td>
<td>80.0</td>
<td>80.0</td>
<td>90.0</td>
<td>–</td>
</tr>
<tr>
<td>Number born (pig)</td>
<td>10.3</td>
<td>10.2</td>
<td>8.6</td>
<td>10.07</td>
<td>–</td>
</tr>
<tr>
<td>Noborn alive (pig)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>10.53</td>
<td>11.03</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.4</td>
<td>1.5</td>
<td>1.02</td>
<td>1.30</td>
<td>–</td>
</tr>
<tr>
<td>Survival rate to weaning (%)</td>
<td>94.0</td>
<td>96.2</td>
<td>88.4</td>
<td>89.9</td>
<td>94.2</td>
</tr>
</tbody>
</table>

* AY: Australian Yorkshire boars/Yorkshire boars being offspring of imported Australian pigs.
Source: Le Thanh Hai et al. (2002).

Three hundred and ten pure and crossbred pigs were fattened at Binh Thang Center and Phu Son pig farm. Offspring of Australian Yorkshire and Duroc pigs had better performance on average daily gain, feed conversion ratio and backfat thickness at P2 than those Vietnamese control pigs. The increase of average daily gain varied from 0.8 to 13.0%. The decrease of feed conversion ratio varied from 1.9 to 13.6%. The improvement of backfat thickness varied from 4.9 to 34.7% (Table 7).

Table 7. Average daily gain, feed conversion rate and backfat of Yorkshire and Duroc pigs raised at pig breeding farms

<table>
<thead>
<tr>
<th></th>
<th>Binh Thang Center</th>
<th>Thanh To pig breeding farm</th>
<th>Cau Dien pig breeding farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yorkshire</td>
<td>Duroc</td>
<td>Yorkshire</td>
</tr>
<tr>
<td></td>
<td>VN Aus</td>
<td>VN Aus</td>
<td>VN Aus</td>
</tr>
<tr>
<td>Initial weight, kg</td>
<td>29.73 29.94</td>
<td>29.74 29.53</td>
<td>40.82 41.42</td>
</tr>
<tr>
<td>Marketing weight, kg</td>
<td>83.50 84.19</td>
<td>81.40 83.84</td>
<td>92.57 99.92</td>
</tr>
<tr>
<td>Average daily gain</td>
<td>597 602</td>
<td>574 603</td>
<td>575 650</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>3.30 3.12</td>
<td>3.35 3.15</td>
<td>3.59 3.16</td>
</tr>
<tr>
<td>Backfat thickness (P2)</td>
<td>12.8 11.39</td>
<td>13.00 9.86</td>
<td>16.3 12.1</td>
</tr>
</tbody>
</table>

Source: Le Thanh Hai et al. (2002).
Based on the results of performance testing for reproductive traits, growth rate and backfat thickness, we can conclude that the genetic merit of imported Australian Yorkshire and Duroc pigs is very good, especially on growth traits and backfat thickness. Performances of crossbred pigs between Australian and Vietnam pigs reach the average of the Australian and Vietnamese pigs.

### Project performance on nutrition and feeding of pigs

Approximately 350 samples were collected by various types, varieties, locations and processing methods for *in vitro* evaluation. Samples included various kinds of fresh roots, fruits and vegetable, energy rich sources (corn, broken rice, rice bran, and cassava), vegetative protein rich sources (soybean and soybean meal, green bean, peanut meal, copra meal and sesame meal) animal protein rich sources (fishmeal and seafood processing residues). Samples were analysed for dry matter, crude protein, ether extracts, crude fibre, ADF, NDF, total ash, calcium, phosphorus, salt, starch and GE. Amino acid compositions of samples were also analysed. Chemical compositions and amino acid profile of wide range of samples are good references for formulating suitable diets for pigs.

Nutrient requirement (energy, protein and amino acids: lysine, methionine, cystine and threonine) studies were conducted in piglets, growing and finishing pigs of local, exotic and cross breeds. The results of nutrient requirement studies were showed in Tables 8 and 9. Together with the nutritive value of feedstuffs (obtained from *in vitro* analysis of chemical composition and amino acid profile) and the results from *in vivo* studies determining digestible energy for pigs, these are the primary data for formulating diets for pigs.

**Table 8. Nutrient requirements of weaned piglets**

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Piglet &lt; 7 kg</th>
<th>Piglet 7–15 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME (Kcal/kg)</td>
<td>3300</td>
<td>3300</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>22.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.65</td>
<td>1.35</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.45</td>
<td>0.36</td>
</tr>
<tr>
<td>Met + Cys (%)</td>
<td>0.94</td>
<td>0.77</td>
</tr>
<tr>
<td>Threonine (%)</td>
<td>1.04</td>
<td>0.85</td>
</tr>
<tr>
<td>Tryptophan (%)</td>
<td>0.33</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Table 9. Nutrient requirements of growing/finishing pigs

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Growing pig 15–30 kg</th>
<th>Growing pig 30–60 kg</th>
<th>Growing pig 60–100 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME (Kcal/kg)</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>18</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.1</td>
<td>0.9</td>
<td>0.75</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.3</td>
<td>0.2</td>
<td>0.20</td>
</tr>
<tr>
<td>Met + Cys (%)</td>
<td>0.63</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td>Threonine (%)</td>
<td>0.69</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>Tryptophan (%)</td>
<td>0.22</td>
<td>0.15</td>
<td>0.14</td>
</tr>
</tbody>
</table>


Impact of the project

Direct impact of the project

Tisdell and Wilson (2001) in the assessment of the ACIAR Research Project AS2/1994/023, ‘Breeding and feeding pigs in Australia and Vietnam’ (supported by ACIAR from July 1995 to the end of 2000) concluded that the project had yielded an extraordinarily high rate of economic return on the funds invested. According to these authors, the best estimate benefit–cost ratio for investment in this project is at least 159:1 with a corresponding internal rate of return of 900% and a net present value of Australia dollar (AUD)1 496 million. This is a total value, not an annual value. To give context to the number AUD 496 million, in 2000, 1.3 million tonnes of pig meat, worth AUD 2,323 million, was consumed in Vietnam in that year alone. The returns to the project are still significant even when the net present value up to, and including, 2001 is considered. While the breeding and the feeding components of the project had highly favourable levels of economic return, the relative economic returns for the genetic component are considerably higher than the nutrition component.

The project has enabled better quality (less fatty) pork to be produced, has resulted in more favourable feed-conversion ratios in pig husbandry and has reduced the number of sows needed to produce a given annual stock of pigs for slaughter. This is mostly a result of genetic improvements in the Vietnamese pig herd made possible by the importation of Australian Yorkshire pigs (also known as Australian Large Whites) from Queensland. These pigs have several genetic advantages in the tropical climate of Vietnam. However, nutrition research has also added to these benefits. As a result of changes in the lysine/energy content of complete pig meal for fattening and finishing pigs, it has become possible to produce leaner pork more cost effectively in Vietnam. The new feed formula is being adopted by Vietnamese-owned millers of complete pig feed, and benefits should flow to Vietnamese pig farmers. In addition, in the near future, results from the nutrition research component of this project should enable Vietnamese-

1. AUD (Australia dollar). In October 2008, USD 1 = AUD 1.25.
owned mills to produce feed for weaned pigs for the first time. To date, this production has been exclusive to foreign-owned mills.

The extremely high net benefits from the project result from the following factors. First, the genetic material transferred as a part of the research package, namely from Australian Yorkshire pigs of the herd of the Queensland Department of Primary Industries (QDPI), was most appropriate to Vietnamese tropical conditions and was capable of adding both to the quantity and quality of pig production in Vietnam. Second, the transfer of this genetic material was not on a commercial basis but essentially was an aid item. Third, the considerable costs involved in developing the pig herd of QDPI (now sold to private interests in Australia) was not assigned as a cost of this project. They were treated as a sunk cost because they had been incurred before the ACIAR project. Fourth, there was an extremely short lag or gestation period before the flow of benefits or results from this subcomponent in Vietnam. Benefits could be obtained almost immediately. Fifth, effective mechanisms were quickly put into place to help diffuse the superior genes.

Indirect impact of the project

Nearing the end of the project and with the support (equipment purchasing and staff training) of the Australian Agency for International Development (AusAID), five artificial insemination centres were established in five provinces across the country (Thai Binh, Thanh Hoa, Quang Ngai, Binh Thuan and Dong Thap). The objectives of these five AI centres were to multiply the effectiveness of the ACIAR project; four of the centres have been developed very well and they remain as long-term assets for Vietnam.

One of the most impressive impacts was to stimulate the Vietnam pig breeding project. When we recognized the effectiveness of the new breed, a proposal was sent to the national Government for a local project to improve pig breeding. With the agreement of the Agriculture Minister, in 2002 we imported 10 thousand GGP pigs from Australia. These pigs have performed well and have been distributed to many places in the country.

Problems of pig systems in Vietnam need to be solved

a. Although the Vietnam Government has encouraged farmers to adopt new pig breeds with high lean meat, it is mainly medium- and large-scale farms that have adopted the breeds effectively. For the small-scale pig householders, especially in remote areas, the local breed still predominates and the quality of the pig breed still needs to improve. As a result pig production there still has low productivity (low reproductive performance and low growth rate). The low lean meat percentage of local breeds reduces the value of pig meat in the market. One of the possible strategies is to organize small-scale pig producers
into cooperative groups around good quality boars or an AI station and introduce some high-yielding sows and train all the members in the breeding and feeding of pigs. The members would exchange information and experiences and help each other in applying the technologies for producing high productivity pigs.

b. Rations for pigs kept by small-scale producers are usually unbalanced resulting in lower feed efficiency and, hence, increased input costs. These problems need to be overcome in order to improve pig production and to increase the incomes of the poor. Since fatteners that grow slowly need more time to reach market weight, they need more feed for maintenance, occupy the pig shed longer and consequently reduce the efficiency of using the shed, reduce the number of pig produced in a unit of pig shed or invested capital. Studying how to use local feed resources effectively and training the farmers on how to feed their pigs would be a good solution.

c. In areas where there is a high concentration of pig rearing, environmental pollution can be extremely critical. It causes bad odour, polluted surface and underground water that badly affect human (public) health. The need to eliminate or at least to reduce environmental pollution is very urgent.

References


IMPROVEMENT OF PIG PERFORMANCE THROUGH BREEDING AND FEEDING IN VIETNAM

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I. INTRODUCTION

• Pig production is very important sector in animal production of the SEA regions and VN, ↑ total income of the small farmers and reduces poverty.
• The demand for pig meat raising ⇒ increasing in pig numbers ⇒ brings about both opportunities and threats to the poor ⇒ should improve both quality and quantity of pig product. If not, they become poorer.
• Through research and development projects, small scale poor pig producers can reach advanced technology ⇒ fulfill the demand of the market and consequently, increase income.
• The ACIAR project 9423 of “Pig Breeding and Feeding in Australia and Vietnam” is evaluated as one of the successful research and development targeting in enhancing benefits to the poor in VN.

• Improved pig breeds from Australia were evaluated for adaptation in Vietnamese condition, establishing artificial insemination centers in several local areas, providing trained staffs and technical leaflets to pig producers.

• The project brings about extremely high efficiency both in term of the return over invested capital and social impact on promoting pig production and income of the poor pig keepers.

II. THE VIETNAM EXPERIENCE FROM ACIAR PROJECT 9423 IMPACT

• The project “Pig Breeding and Feeding in Australia and Vietnam” was from 1995 to the end of 2000, co-leading by Dr. Cam McPhee from ARI-Queensland and Ass/Prof. Le Thanh Hai – Former vice Director of IAS.

• The project has collaborated with the Animal Husbandry Research Institute – Hanoi, the University of Agriculture and Forestry of Ho Chi Minh city, Department of Agricultural Extension of the Ministry of Agriculture and Rural Development of Vietnam and other extension centers of province.
### 1. ROLE OF PIG IN VIETNAM

#### Table 1. Livestock number in Vietnam 2000-2005 (million)

<table>
<thead>
<tr>
<th>Livestock type</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>Annual growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry</td>
<td>196.1</td>
<td>218.1</td>
<td>233.3</td>
<td>254.6</td>
<td>218.2</td>
<td>219.9</td>
<td>2.02</td>
</tr>
<tr>
<td>Cattle</td>
<td>4.128</td>
<td>3.9</td>
<td>4.063</td>
<td>4.394</td>
<td>4.908</td>
<td>5.541</td>
<td>5.7</td>
</tr>
<tr>
<td>Buffalo</td>
<td>2.897</td>
<td>2.808</td>
<td>2.815</td>
<td>2.835</td>
<td>2.87</td>
<td>2.922</td>
<td>0.14</td>
</tr>
</tbody>
</table>

*Source: Data obtained from the General Statistical Organization (2005)*

#### Table 2. THE ROLE OF PIG PRODUCTION IN VIETNAM

(meat consumption per capita Kg/year/person)

Derek Quirke et al. 2003

<table>
<thead>
<tr>
<th>Year</th>
<th>Total meat</th>
<th>Pork</th>
<th>% Pork</th>
<th>Beef</th>
<th>Poultry</th>
<th>Seafood</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>11.48</td>
<td>8.42</td>
<td>73.3</td>
<td>0.8</td>
<td>2.26</td>
<td>6.75</td>
</tr>
<tr>
<td>2001</td>
<td>19.68</td>
<td>14.63</td>
<td>74.3</td>
<td>0.83</td>
<td>4.22</td>
<td>10.52</td>
</tr>
<tr>
<td>2005</td>
<td>27.1</td>
<td>20.3</td>
<td>74.9</td>
<td>1.3</td>
<td>5.5</td>
<td>28.7</td>
</tr>
<tr>
<td>2010</td>
<td>30.7</td>
<td>22.6</td>
<td>73.6</td>
<td>1.5</td>
<td>6.6</td>
<td>36.7</td>
</tr>
<tr>
<td>2020</td>
<td>40.5</td>
<td>29.6</td>
<td>73</td>
<td>1.9</td>
<td>8.7</td>
<td>62.8</td>
</tr>
</tbody>
</table>

*Derek Quirke et al. 2003*
## 2. The Defined Problem of Project

### Table 3. Pig production holdings in VN, classified by scale of production

<table>
<thead>
<tr>
<th>Holding type</th>
<th>Herd size</th>
<th>% of national herd (1999)*</th>
<th>% of national herd (2006)**</th>
<th>Breeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small holders or backyard</td>
<td>1-10 pigs</td>
<td>80</td>
<td>64</td>
<td>North: mostly local South: mostly cross with exotic</td>
</tr>
<tr>
<td>Small-medium</td>
<td>5–20 sows or 30–100 fattening</td>
<td>10</td>
<td>20</td>
<td>Cross and exotic</td>
</tr>
<tr>
<td>Medium</td>
<td>20–500 sows or 100–4000 fattening</td>
<td>5</td>
<td>10</td>
<td>Exotic</td>
</tr>
<tr>
<td>Large</td>
<td>&gt;500 sows or &gt;4000 fattening</td>
<td>5</td>
<td>6</td>
<td>Exotic</td>
</tr>
</tbody>
</table>

Source: *La Van Kinh, Le Thanh Hai, Do Van Quang and Nguyen Van Duc (2002)*; **La Van Kinh 2006

### Table 4. Carcass traits of pigs in some agro-ecological zones

<table>
<thead>
<tr>
<th>Agro-ecological zones</th>
<th>n</th>
<th>Slaughter weight (kg)</th>
<th>Dressing percentage (%)</th>
<th>Carcass Length (cm)</th>
<th>Backfat thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River Delta</td>
<td>70</td>
<td>82.1</td>
<td>69.8</td>
<td>70</td>
<td>32.3</td>
</tr>
<tr>
<td>North Central Coast</td>
<td>33</td>
<td>83.3</td>
<td>70.5</td>
<td>68.5</td>
<td>36.3</td>
</tr>
<tr>
<td>South Central Coast</td>
<td>78</td>
<td>79.1</td>
<td>72.4</td>
<td>70.6</td>
<td>33.4</td>
</tr>
<tr>
<td>Southeast Region</td>
<td>79</td>
<td>86.8</td>
<td>71.7</td>
<td>79.9</td>
<td>21.4</td>
</tr>
<tr>
<td>Mekong River Delta</td>
<td>369</td>
<td>94.6</td>
<td>73.7</td>
<td>68.1</td>
<td>38</td>
</tr>
</tbody>
</table>

Source: *La Van Kinh, Le Thanh Hai, Do Van Quang and Nguyen Van Duc (2002)*
CONTEXT OF PROJECT

➢ Australia and Vietnam had interest in ↑ pork yields, ↓ production costs via improved nutrition of pigs and genetic progress.
➢ Vietnamese pig meat was low quality (fattiness) ⇒ wanted to reduce the fattiness of pork (table 3).

Table 5: Number of pigs slaughtered and weight of pork produced per number of the pig stock by Australia and Vietnam, 1994 and 2000.

<table>
<thead>
<tr>
<th></th>
<th>1994</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs slaughtered in relation to the stock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>1.87</td>
<td>2.03</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.99</td>
<td>1.00</td>
</tr>
<tr>
<td>Kgs of pork produced per number of the pig population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>121</td>
<td>137.5</td>
</tr>
<tr>
<td>Vietnam</td>
<td>61.4</td>
<td>67.3</td>
</tr>
</tbody>
</table>

Source: Estimated from FAO Livestock Statistics obtained www.fao.org
3. PROJECT ACTIVITIES

1. Genetics development sub-program included the following activities
   * Ranking of genotypes
   * Design of a selection procedure
   * Doing breeding between Australian and Vietnamese pig.

2. Feedstuff evaluation sub-program included the following activities
   * Feedstuffs and pig production survey
   * In vitro feed evaluation
   * In vivo feed evaluation
   * LCD evaluation

3. Nutrient requirements sub-program included the following activity
   Lysine and energy requirements for lean growth performance

4. Pig production technology transfer sub-program included the following activity
   * Training on pig breeding and genetics
   * Training on nutrition for pigs

4. Project performance and impact

4.1 Major project results

a) Project performance on improvement of Vietnamese pigs by introducing Australian Yorkshire and Duroc pigs

Table 6. Performance testing at Binh Thang Center

<table>
<thead>
<tr>
<th>Traits</th>
<th>Yorkshire Vietnam</th>
<th>Australia</th>
<th>Duroc Vietnam</th>
<th>Australia</th>
<th>AY-VY* Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight, kg</td>
<td>19.1</td>
<td>20.6</td>
<td>-</td>
<td>20.3</td>
<td>22.2</td>
</tr>
<tr>
<td>Final weight, kg</td>
<td>91.2</td>
<td>99.1</td>
<td>-</td>
<td>100</td>
<td>96.3</td>
</tr>
<tr>
<td>Average daily gain, g/day</td>
<td>601</td>
<td>655</td>
<td>-</td>
<td>669</td>
<td>625</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>3.25</td>
<td>2.95</td>
<td>-</td>
<td>2.88</td>
<td>3.05</td>
</tr>
<tr>
<td>Backfat thickness (P2) at 180 days of age, mm</td>
<td>14.6</td>
<td>12</td>
<td>-</td>
<td>11.4</td>
<td>12.3</td>
</tr>
</tbody>
</table>

AY-VY: Australian Yorkshire x Vietnamese Yorkshire
Table 7. Reproductive performance of Australian and Vietnamese sows raised at Binh Thang

<table>
<thead>
<tr>
<th>Traits</th>
<th>Yorkshire</th>
<th>Duroc</th>
<th>Cross</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vietnam</td>
<td>Australia*</td>
<td>Vietnam</td>
</tr>
<tr>
<td>Number born (pig)</td>
<td>10.5</td>
<td>10.2</td>
<td>-</td>
</tr>
<tr>
<td>Number born alive (pig)</td>
<td>10</td>
<td>9.4</td>
<td>-</td>
</tr>
<tr>
<td>Number weaned (pig)</td>
<td>9</td>
<td>9.3</td>
<td>-</td>
</tr>
<tr>
<td>Birth weight, kg/piglet</td>
<td>1.32</td>
<td>1.48</td>
<td>-</td>
</tr>
<tr>
<td>Litter weight 21 days of age (kg)</td>
<td>5.1</td>
<td>5.3</td>
<td>-</td>
</tr>
</tbody>
</table>

* Australian sows being offspring of imported Aus pigs. ** AY-VY: Australian Yorkshire x Vietnamese Yorkshire
Table 8. Reproductive performance of local sows bred with local boars and Yorkshire boars being offspring of imported Australian Yorkshire in some provinces

<table>
<thead>
<tr>
<th>Items</th>
<th>Dong Thap</th>
<th>Tien Giang</th>
<th>Dong Nat</th>
<th>Binh Phuoc</th>
<th>Binh Thuan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception rate (%)</td>
<td>73</td>
<td>80</td>
<td>80</td>
<td>90</td>
<td>84</td>
</tr>
<tr>
<td>Number born (pig)</td>
<td>10.3</td>
<td>10.2</td>
<td>8.6</td>
<td>10.0</td>
<td>8.2</td>
</tr>
<tr>
<td>No born alive (pig)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.53</td>
<td>11</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.4</td>
<td>1.5</td>
<td>1.02</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Survival rate to weaning (%)</td>
<td>94</td>
<td>96.2</td>
<td>88.4</td>
<td>89.9</td>
<td>93.1</td>
</tr>
</tbody>
</table>

*AY: Australian Yorkshire boars/Yorkshire boars being offspring of imported Australian pigs*
### Table 9. Average daily gain, feed conversion rate and backfat of Yorkshire and Duroc pigs raised at pig breeding farms

<table>
<thead>
<tr>
<th></th>
<th>Binh Thang Center</th>
<th>Thanh To pig breeding farm</th>
<th>Cau Dien pig breeding farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yorkshire</td>
<td>Duroc</td>
<td>Yorkshire</td>
</tr>
<tr>
<td>Initial weight, kg</td>
<td>29.73</td>
<td>29.9</td>
<td>29.7</td>
</tr>
<tr>
<td>Marketing weight, kg</td>
<td>83.5</td>
<td>84.2</td>
<td>81.4</td>
</tr>
<tr>
<td>Average daily gain</td>
<td>597</td>
<td>602</td>
<td>574</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td>3.3</td>
<td>3.12</td>
<td>3.35</td>
</tr>
<tr>
<td>Backfat thickness (P2)</td>
<td>12.8</td>
<td>11.4</td>
<td>13</td>
</tr>
</tbody>
</table>

---

### THE CONTENT AND RESULT OF PROJECT

#### FEEDING SECTION

#### INVITRO FEED EVALUATION

- 350 samples many kinds of feed ingredients used popularly in Vietnam ⇒ proximate analysis, amino acid.

- All this data was combined with the data of 500 samples from national nutrition project ⇒ book: “Chemical composition and nutritive value of some feedstuffs in Vietnam”.

- This database has been used by many feedmills, pig farms and farmers ⇒ decreased diets cost and save 5-10% feeding cost.
THE CONTENT AND RESULT OF PROJECT

FEEDING SECTION

INVIVO FEED EVALUATION

- Determined the energy and nutrients digestibility of swine feed ingredients: corn, broken rice, cassava flour, fish meal 60%, rice bran…… and some typical pig diets.

- This digestibility information is needed when formulating diets for pig.
THE CONTENT AND RESULT OF PROJECT

FEEDING SECTION

Operation to put canulla
Collecting digesta

IN VIVO TEST
THE CONTENT AND RESULT OF PROJECT

**FEEDING SECTION**

<table>
<thead>
<tr>
<th>DETERMINE NUTRIENT REQUIREMENTS FOR WEANING PIGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ The optimum nutrient levels for piglets: 15 MJDE/kg, 1.0g lys; 0.40g Meth; 0.57g Meth+Cys; 0.63g Thre and 0.18 g Tryp/MJDE.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DETERMINE NUTRIENT REQUIREMENTS FOR FATTENING PIGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ The lysine/energy ratios for York and York x Thuoc nhieu pigs: 0.65/55 and 0.55/0.45g/MJDE, respectively.</td>
</tr>
<tr>
<td>✓ The most suitable energy levels of York and York x Thuoc nhieu pigs: 14-13 and 13-12MJDE/kg.</td>
</tr>
</tbody>
</table>
Experiment of determining nutrient requirements for **weaning pigs**

Experiment of determining nutrient requirements for **fattening pigs**
### Table 9. Nutrient requirement of weaned piglets

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Piglet &lt; 7 kg</th>
<th>Piglet 7-15 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exotic</td>
<td>Crossbreed</td>
</tr>
<tr>
<td>ME (Kcal/kg)</td>
<td>3300</td>
<td>3300</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>22.5</td>
<td>20</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.65</td>
<td>1.35</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.45</td>
<td>0.36</td>
</tr>
<tr>
<td>Met + Cys (%)</td>
<td>0.94</td>
<td>0.77</td>
</tr>
<tr>
<td>Threonine (%)</td>
<td>1.04</td>
<td>0.85</td>
</tr>
<tr>
<td>Tryptophan (%)</td>
<td>0.33</td>
<td>0.27</td>
</tr>
</tbody>
</table>

### Table 10. Nutrient requirement of growing/finishing pigs

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Growing pig 15-30 kg</th>
<th>Growing pig 30-60 kg</th>
<th>Growing pig 60-100 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exotic</td>
<td>Crossbreed</td>
<td>Exotic</td>
</tr>
<tr>
<td>ME (Kcal/kg)</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>18</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Lysine (%)</td>
<td>1.1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.3</td>
<td>0.2</td>
<td>0.24</td>
</tr>
<tr>
<td>Met + Cys (%)</td>
<td>0.63</td>
<td>0.43</td>
<td>0.51</td>
</tr>
<tr>
<td>Threonine (%)</td>
<td>0.69</td>
<td>0.47</td>
<td>0.57</td>
</tr>
<tr>
<td>Tryptophan (%)</td>
<td>0.22</td>
<td>0.15</td>
<td>0.18</td>
</tr>
</tbody>
</table>
4.2. Impact of the project

a). Direct impact of the project

- The project had yielded an extraordinarily high rate of economic return on the funds invested and the best estimate benefit-cost ratio for investment in this project is at least 159:1 with a corresponding internal rate of return of 900% and a net present value of A$496 million (Tisdell and Wilson, 2001).
- The project has enabled better quality pork, has resulted in more favourable feed-conversion ratios in pig husbandry and has reduced the number of sows needed to produce a given annual stock of pigs for slaughter.
- The extremely high net benefits from the project result from the following factors.
  - The genetic material was most appropriate to Vietnamese tropical conditions and was capable of adding both to the quantity and quality of pig production in Vietnam.
  - The transfer of this genetic material was not on a commercial basis but essentially was an aid item.
  - The considerable costs was not assigned as a cost of this project.
  - There was an extremely short lag or gestation period before the flow of benefits or results from this subcomponent in Vietnam.
  - Effective mechanisms were quickly put into place to help diffuse the superior genes.

b). Indirect impact of the project

MULTIPLYING THE BENEFITS OF THE AUSTRALIAN PIG GENE

- To multiply the improved Aus pig genes, ACIAR and AUSAID ⇒ 5 AI centers in Vie, including equipment, the facilities and 10 boars.
- Four of the five centers have been very successful, one center supplies 3000 Aus semen doses to the farmers.
THE IMPACT OF THE PROJECT ON PIG PRODUCTION IN VIETNAM

Transfer technology: The Binh Thuan AI center

Visit The lab in the Binh Thuan AI center by Prof. Hai and Australian officer
**Indirect impact of the project**

- One of the most impressive impact is to combine with VN pig breeding project. We had imported 100 hundreds GGP pigs from Australia in 2002. These pigs have been working well and have gone to many places in VN.

**THE IMPACT OF THE PROJECT ON PIG PRODUCTION IN VIETNAM**

**MULTIPLYING THE BENEFITS OF THE AUSTRALIAN PIG GENE**

- 1999-2000, IAS has transferred the good boars (from **Aus**, Denmark, **Vie**) and semen to 9 provinces ⇒ Total pigs: 900 tested boars, 850 gilt and 8000-10000 semen doses.
THE IMPACT OF THE PROJECT ON PIG PRODUCTION IN VIETNAM
MULTIPLYING THE BENEFITS OF THE AUSTRALIAN PIG GENE

The Australian Yorshire boar at the Binh Thang center

The Australian Duroc boar at the Binh Thang center
THE IMPACT OF THE PROJECT ON PIG PRODUCTION IN VIETNAM

HELPING THE FEED INDUSTRY

- Transfer result of ACIAR project to the following feedmills (1999-2002):
  1. Vina (Dong nai pro.)
  2. Thanh Binh (Dong nai pro.)
  3. Vitaga (Dong nai pro.)
  4. Lai thieu (Binh duong pro.)
  5. Thanh loi (Binh duong pro.)
  6. Vifaco (Binh duong pro.)
  7. Dai hung (Ho chi minh city)
  8. Binh dinh (Binh dinh pro.)
  9. Con voi (Ha noi)

- These feedmills have been produced more than 1500 000 tons of feed yearly.

- These feedmills’s feed ⇒ lower price in comparison to the foreign feedmills ⇒ Vietnam farmers receive benefits from this competition.
Fish meal - feed variation

CHAI BO FISH

<table>
<thead>
<tr>
<th>Nutrient composition</th>
<th>Unit (as feed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>g/kg</td>
</tr>
<tr>
<td>CP: 46.72</td>
<td>Lysine: 20.46</td>
</tr>
<tr>
<td>EE: 4.36</td>
<td>Meth: 5.67</td>
</tr>
<tr>
<td>Salt: 2.10</td>
<td>Meth+Cys: 8.67</td>
</tr>
<tr>
<td>Ca: 4.96</td>
<td>Thre: 14.56</td>
</tr>
<tr>
<td>P: 0.84</td>
<td>Tryp: 10.31</td>
</tr>
</tbody>
</table>
### COM FISH

<table>
<thead>
<tr>
<th>Nutrient composition</th>
<th>Unit (as feed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>CP: 68.38</td>
<td>Lysine: 47.86</td>
</tr>
<tr>
<td>EE: 3.04</td>
<td>Meth: 16.86</td>
</tr>
<tr>
<td>Salt: 2.37</td>
<td>Meth+Cys: 23.02</td>
</tr>
<tr>
<td>Ca: 3.53</td>
<td>Thre: 29.01</td>
</tr>
<tr>
<td>P: 2.67</td>
<td>Tryp: 24.61</td>
</tr>
</tbody>
</table>

### LIET FISH

<table>
<thead>
<tr>
<th>Nutrient composition</th>
<th>Unit (as feed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>CP: 63.48</td>
<td>Lysine: 39.60</td>
</tr>
<tr>
<td>EE: 6.04</td>
<td>Meth: 15.30</td>
</tr>
<tr>
<td>Salt: 1.21</td>
<td>Meth+Cys: 21.20</td>
</tr>
<tr>
<td>Ca: 3.90</td>
<td>Thre: 22.60</td>
</tr>
<tr>
<td>P: 3.32</td>
<td>Tryp: –</td>
</tr>
</tbody>
</table>
### Nutrient composition

**BO FISH**

<table>
<thead>
<tr>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP: 63.12</td>
<td>Lysine: 35.12</td>
</tr>
<tr>
<td>BE: 8.02</td>
<td>Meth: 12.70</td>
</tr>
<tr>
<td>Salt: 2.16</td>
<td>Meth+Cys: 17.76</td>
</tr>
<tr>
<td>Ca: 4.16</td>
<td>Thre: 23.05</td>
</tr>
<tr>
<td>P: 2.50</td>
<td>Tryp: 18.53</td>
</tr>
</tbody>
</table>

**BAC-MA FISH**

<table>
<thead>
<tr>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP: 55.74</td>
<td>Lysine: 31.80</td>
</tr>
<tr>
<td>BE: 4.81</td>
<td>Meth: 9.13</td>
</tr>
<tr>
<td>Salt: 5.37</td>
<td>Meth+Cys: 13.25</td>
</tr>
<tr>
<td>Ca: 3.92</td>
<td>Thre: 19.26</td>
</tr>
<tr>
<td>P: 2.07</td>
<td>Tryp: 15.07</td>
</tr>
</tbody>
</table>
### MISCELLANEOUS FISH

**Nutrient composition**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit (as feed)</th>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP:</td>
<td></td>
<td>45.36</td>
<td></td>
</tr>
<tr>
<td>EE:</td>
<td></td>
<td>7.21</td>
<td></td>
</tr>
<tr>
<td>Salt:</td>
<td></td>
<td>10.19</td>
<td></td>
</tr>
<tr>
<td>Ca:</td>
<td></td>
<td>5.15</td>
<td></td>
</tr>
<tr>
<td>P:</td>
<td></td>
<td>2.14</td>
<td></td>
</tr>
<tr>
<td>Lys:</td>
<td></td>
<td>28.15</td>
<td></td>
</tr>
<tr>
<td>Meth:</td>
<td></td>
<td>9.06</td>
<td></td>
</tr>
<tr>
<td>Meth+ Cys</td>
<td></td>
<td>12.72</td>
<td></td>
</tr>
<tr>
<td>Thre:</td>
<td></td>
<td>17.11</td>
<td></td>
</tr>
<tr>
<td>Tryp:</td>
<td></td>
<td>13.61</td>
<td></td>
</tr>
</tbody>
</table>

### YELLOW MAIZE

**Nutrient composition**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Unit (as feed)</th>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP:</td>
<td></td>
<td>9.22</td>
<td></td>
</tr>
<tr>
<td>EE:</td>
<td></td>
<td>4.07</td>
<td></td>
</tr>
<tr>
<td>CF:</td>
<td></td>
<td></td>
<td>4.79</td>
</tr>
<tr>
<td>Ca:</td>
<td></td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>P:</td>
<td></td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Lysine:</td>
<td></td>
<td>2.44</td>
<td></td>
</tr>
<tr>
<td>Meth:</td>
<td></td>
<td>2.41</td>
<td></td>
</tr>
<tr>
<td>Meth+ Cys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thre:</td>
<td></td>
<td>3.16</td>
<td></td>
</tr>
<tr>
<td>Tryp:</td>
<td></td>
<td>3.16</td>
<td></td>
</tr>
</tbody>
</table>
## WHITE GLUTINOUS MAIZE

### Nutrient composition

<table>
<thead>
<tr>
<th>Unit (as feed)</th>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP: 9.79</td>
<td>Lysine: 2.46</td>
<td></td>
</tr>
<tr>
<td>BE: 4.94</td>
<td>Meth: 1.59</td>
<td></td>
</tr>
<tr>
<td>CF: -</td>
<td>Meth+ Cys: 3.13</td>
<td></td>
</tr>
<tr>
<td>Ca: 0.14</td>
<td>Thre: 2.99</td>
<td></td>
</tr>
<tr>
<td>P: 0.37</td>
<td>Tryp: 3.44</td>
<td></td>
</tr>
</tbody>
</table>

## CASSAVA CHIP

### Nutrient composition

<table>
<thead>
<tr>
<th>Unit (as feed)</th>
<th>%</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP: 1.63</td>
<td>Lysine: 0.41</td>
<td></td>
</tr>
<tr>
<td>BE: 0.48</td>
<td>Meth: 0.14</td>
<td></td>
</tr>
<tr>
<td>CF: -</td>
<td>Meth+ Cys: 0.25</td>
<td></td>
</tr>
<tr>
<td>Ca: 0.06</td>
<td>Thre: 0.29</td>
<td></td>
</tr>
<tr>
<td>P: 0.02</td>
<td>Tryp: 0.19</td>
<td></td>
</tr>
</tbody>
</table>
BROKEN RICE

<table>
<thead>
<tr>
<th>Nutrient composition</th>
<th>Unit (as feed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>CP: 9.07</td>
<td>Lysine: 2.95</td>
</tr>
<tr>
<td>EE: 1.09</td>
<td>Meth: 2.53</td>
</tr>
<tr>
<td>CF: 0.03</td>
<td>Meth+Cys: 4.92</td>
</tr>
<tr>
<td>Ca: 0.08</td>
<td>Thre: 3.00</td>
</tr>
<tr>
<td>P: 0.15</td>
<td>Tryp: 3.91</td>
</tr>
</tbody>
</table>

THE PROBLEM OF PIG SYSTEMS IN VIETNAM NEED TO BE SOLVED

- **PIG BREED** is the best way to increase quality of pork

- **LOCAL FEED RESOURCES AND FEEDING REGIME** is one of the best way to reduce production cost and increase income of the poor farmer
The local breed are still predominant. The quality of pig breed still need to improve. The pig production there still has low productivity, low reproductive performance, low growth rate. Low lean meat rate of local breeds reduce value of pig meat in the market.

**Local Pigs**

**Mong Cai Breed**
Local Pigs

Ba Xuyen Breed

Local Pigs

Thuoc Nhieu Breed
Local Pigs

Phu Khanh Breed

Local Pigs

Binh Thuan Co Breed  Ninh Thuan Co Breed
Crosbred Pigs

- Yorkshire x Mong Cai
- Pietrain x Mong Cai
- Ba Xuyen x Yorkshire
- Yorkshire x Thuoc Nhieu
- Yorkshire x Phu Khanh
- Mong Cai x Co

Yorkshire x Mong Cai
Crosbred Pigs

Mong Cai x Co

Crosbred Pigs

Pietrain x Mong Cai (Black)
and Yorkshire x Mong Cai (White)
Crosbred Pigs
Yorkshire x Phu Khanh

Crosbred Pigs
Ba Xuyen x Yorkshire
Crosbred Pigs

Yorkshire x Thuoc Nhieu

LOCAL FEED RESOURCES AND FEEDING REGIME NEED TO STUDY

LOCAL FEED RESOURCES have not been used efficiently – it should be one of the best way to reduce production cost and increase income of the poor farmer

RATIONS for pigs kept in small scale holders are usually IMBALANCED that makes lower feed efficiency and hence, increase input costs
Too narrow shedding

Too narrow shedding
Malnutrition - Too thin

Malnutrition - Too thin
Malnutrition – Too thin

Malnutrition – Too thin
Imbalanced diet—Too fat
Exotic sow fed with a high fiber diet, low nutrient density

Low quality–high fiber feed

Mycotoxin groundnut cake
III. THE PROBLEM OF PIG SYSTEMS IN VIETNAM NEED TO BE SOLVED

The environmental pollution is extremely critical ⇒ The need to get away or at least to reduce environmental pollution is very urgent.
Technology Interventions enhance the productivity of Sweet Potato-Pig Systems at the Smallholder Level (Institution-farmer cooperation in Sichuan)

Zou Chengyi

Feed Institute of Sichuan Animal Science Academy, China

General Introduction
- Sichuan province is located in Southwest China
- 485 thousand km²
- Population 87.5 millions
- The arable land per capita is only 0.045 ha
- The largest pig producer in China (89 million pigs marketed in 2005)
- Pigs are mainly produced by smallholder crop-animal systems (>80%)
- Sweet potato is one of the main components of the cropping system
- Pigs contribute a larger share of the family income

In January 2002, ILRI and its partners in South East Asia started the project entitled "Improving Crop-Livestock Production Systems in Rainfed Areas of South East Asia" funded by ADB

The ultimate goal was to reduce poverty of smallholder farmers in rainfed areas of South East Asia through using participatory approaches to spread the application of appropriate technologies by farmers to enhance the productivity of crop-livestock systems
✅ Sichuan joined the project in March 2002

✅ To work on the effective utilization of sweet potato tubers and vines as feeds for pigs

Materials and Methods
Identification of the benchmark sites

- 225 farmers from two counties were interviewed
- Identified Zitong County as BMS
- Renhe township was selected, and Tian Le was chosen as the focal village
Consolidation of local networks

- The main partner: Sichuan Animal Science Academy (SASA)
- Advisory committee: Provincial Science and Technology Department, Provincial Animal Husbandry and Food Bureau, Institute of Agricultural Economics of the Chinese Academy of Agricultural Sciences, ILRI Beijing Representative, Sichuan Academy of Agricultural Sciences
- Network members: County and Township level governmental institutions, Village Committees and farmer groups
- All village committee leaders were trained as trainers

Assessment of farmer needs and preferences

- Participatory rural appraisal techniques and questionnaire were applied to identify problems and opportunities in the sweet potato-pig systems practised by smallholder farmers in the benchmark site
Identification of the technology options

- Improved sweet potato varieties
- Sweet potato silage preparation
- Increase feed efficiency of sweet potato-based pig feeding systems
- Upgrading local pig genotypes
- Disease control
- Improved housing

On-farm researches

- Evaluation of sweet potato varieties
- **Chuan-34** (higher starch)
- **Chuan-383** (higher yield)
- **Chuan-788** (higher S &Y)
Ensiling SP roots

Ensiling SP vines
Supplementation of SP-based diets

Two interventions (using concentrates or premix)

Training of extension staff and farmers

- Trainings offered by the ILRI mainly focused on approaches for participatory R&D
- The trainers were basically SASA staff
- Apart from the lectures, many materials were printed and disseminated
Results
Characterization in BMS

- Altitude 558 m, rainfed uplands
- Rainfall 800 mm, dry season over 8 months long
- Farmers are very poor, per capita income less than US$120, and over 80% of total income contributed by livestock, of which pigs play a very important role
- Farm size 0.28 ha and household size 3.2 persons
- Sweet potato, 70-80% are used as pig feed
Problems identified in SP system

- Inadequacy of fertilisation
- Lack of improved varieties
- Post-harvest losses
- Lack of knowledge on other uses
- Inadequate planting methods

Problems identified in Pig production

- Poor housing facilities
- Inadequate year-round feeding systems
- Lack of knowledge on supplementation
- Diseases (diarrhoea and parasites)
- Low productive genotypes
- Reach market-weight very late
Evaluation of sweet potato varieties

Yields of SP vines and roots: the improved vs the native

<table>
<thead>
<tr>
<th>Variety</th>
<th>SP Vine (kg/m²)</th>
<th>Impro. (%)</th>
<th>SP Roots (kg/m²)</th>
<th>Impro. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuan-788</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>7.82</td>
<td>+11.9</td>
<td>1.14</td>
<td>+22.6</td>
</tr>
<tr>
<td>Chuan-383</td>
<td>6.99</td>
<td>+7.1</td>
<td>1.02</td>
<td>+12.0</td>
</tr>
<tr>
<td>Native</td>
<td>7.05</td>
<td>-8.0</td>
<td>0.91</td>
<td>-19.0</td>
</tr>
<tr>
<td>Chuan-34</td>
<td>6.58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>5.13</td>
<td></td>
<td>1.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.58</td>
<td></td>
<td>1.37</td>
<td></td>
</tr>
</tbody>
</table>

Nutrients value of SP-roots in different varieties (%)

<table>
<thead>
<tr>
<th>Varieties</th>
<th>DM</th>
<th>CP</th>
<th>Ash</th>
<th>Ca</th>
<th>P</th>
<th>EE</th>
<th>CF</th>
<th>Starch</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Imp. (%)</td>
</tr>
<tr>
<td>Chuan-788</td>
<td>23.28</td>
<td>2.24</td>
<td>1.22</td>
<td>0.50</td>
<td>0.25</td>
<td>0.14</td>
<td>0.55</td>
<td>19.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+14.69</td>
</tr>
<tr>
<td>Chuan-383</td>
<td>28.28</td>
<td>2.12</td>
<td>1.16</td>
<td>0.50</td>
<td>0.14</td>
<td>0.15</td>
<td>0.57</td>
<td>24.28</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>+45.56</td>
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<tr>
<td>Chuan-34</td>
<td>17.84</td>
<td>1.20</td>
<td>0.86</td>
<td>0.35</td>
<td>0.19</td>
<td>0.14</td>
<td>0.44</td>
<td>15.20</td>
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<tr>
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<td></td>
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<td></td>
<td>-8.87</td>
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<tr>
<td>Local</td>
<td>19.96</td>
<td>1.55</td>
<td>0.95</td>
<td>0.28</td>
<td>0.19</td>
<td>0.18</td>
<td>0.60</td>
<td>16.68</td>
</tr>
</tbody>
</table>

DM-Dry matter  CP-crude protein  Ash-Crude ash  Ca-calcium
P-phosphorus EE-ether extract CF-crude fiber
Silage preparation

- Vines: 6% of maize meal as an additive
- Roots: 0.5% salt and 13% rapeseed meal as additives
- All were safe and easily available on smallholder farms

Supplementation of SP-based diet for piglets

- Average Daily Gain (ADG g)
- Control
- Concentrate (+62.2%)
Supplementation of SP-based diet for piglets

Supplementation of SP-based diet for growing pigs
Supplementation of SP-based diet for growing pigs

- FCR (Feed consumed / Weight gain)
  - Control
  - Concentrate (+29.2%)
  - Premix (+33.7%)

Economic analysis for the supplementation trials with piglets and growing pigs' diets (21 Days)

<table>
<thead>
<tr>
<th></th>
<th>LWG (kg)</th>
<th>Price per kg BW (Yuan)</th>
<th>Feed consumed (kg)</th>
<th>Price per kg feed (Yuan)</th>
<th>Economic benefit (Yuan)</th>
<th>Improvement (Yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piglets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>28.0</td>
<td>6</td>
<td>90</td>
<td>0.95</td>
<td>82.5</td>
<td></td>
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<tr>
<td>Concentrate</td>
<td>45.5</td>
<td>6</td>
<td>101</td>
<td>1.314</td>
<td>140.29</td>
<td>+57.79</td>
</tr>
<tr>
<td>Growing pigs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>46.0</td>
<td>6</td>
<td>223.5</td>
<td>0.95</td>
<td>63.68</td>
<td></td>
</tr>
<tr>
<td>Concentrate</td>
<td>65.5</td>
<td>6</td>
<td>225.15</td>
<td>1.314</td>
<td>97.15</td>
<td>+33.47</td>
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<tr>
<td>Premix</td>
<td>69.5</td>
<td>6</td>
<td>223.65</td>
<td>1.232</td>
<td>141.46</td>
<td>+77.78</td>
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</table>
Estimated length of a pig cycle from weaning to market weight under farmers conditions versus using concentrate

<table>
<thead>
<tr>
<th>Growth Phase</th>
<th>10-20kg</th>
<th>20-40kg</th>
<th>40-60kg</th>
<th>60-100kg</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>ADG (g)</td>
<td>days</td>
<td>ADG (g)</td>
<td>days</td>
<td>ADG (g)</td>
</tr>
<tr>
<td>Control</td>
<td>250</td>
<td>40</td>
<td>350</td>
<td>57</td>
<td>450</td>
</tr>
<tr>
<td>Concentrate</td>
<td>400</td>
<td>25</td>
<td>500</td>
<td>40</td>
<td>600</td>
</tr>
</tbody>
</table>

Implementation of technology options on-farm

- Chuan-383 popular
- Silage additives: 6% maize for vines, and 13% rapeseed meal and 0.5% salt for roots
- Silages represent 20%-30% in pig diet
- Premix to pigs: 80, 100 and 150 g/day; concentrate: 100 – 200 g/day; formulation
- F1 animals (Yorkshire x Native) for fattening
- Diarrhoea prevention; parasites control
- Improved housing facilities
Scaling up experience and farmers’ Day

Assessing impacts

---PLOT LEVEL

Use of improved sweet potato variety

- New variety resulted in at least 25% increment in roots yield
- More than 80% of the farmers recognized the new variety contains a higher content of starch
- Increased area planted to new SP (0.4 to 2.0 mu/farm)
Assessing impacts

---PLOT LEVEL

Conservation of SP vines and roots as silage

- 93.8% farmers in BMS and 54.55 farmers in expansion sites started preparing sweet potato silages in 2003, continued applying the same practice in the future
- 100% farmers in BMS, 63.64% farmers in expansion sites gained the knowledge of silage making
- No Cooking: saving time and fuel (tree branches)

Assessing impacts

---PLOT LEVEL

Improved year-round feeding system for pigs

- Supplements-SP-based diets increased the efficiency of feeds, which resulted in better average daily gains (ADG) and the reduction of about 1.5 to 2 months for pigs to reach market weight
- Pigs fattened per year increased
Assessing impacts

---HOUSEHOLD LEVEL

- Increased income from pig production
- Livelihood changed

New pig house(%)
Bought or built new house (%)

Bought new furniture (%)
Good education for their children (%)
Summary

To use participatory approaches to spread the application of appropriate technologies by farmers to enhance the productivity of sweet potato-pig production systems is the key of poor farmers' family income increment and farmers’ livelihoods change.
Technology interventions and practicable adoption at the smallholder level of sweet potato-pig systems not only helped to alleviate poverty, but also brought new ideas to the researchers and extension stuff and this approach of collaborative research will be scaled up in the future.

Acknowledgement

- ILRI
- ADB
- CIP
- CAAS
- Other Institutions and Scientists
- Poor Farmers
- .....
Thank you very much!
Pig systems in Asia and the Pacific:
how can R&D enhance benefits to the poor?

Sweet potato as a feed resource within feeding strategies for improving smallholder animal production systems in Asia

- Sweet potato crop-management
- System analysis and simulation modeling: Bio-economic scenarios
- Organized producers; market oriented

Carlos U. Leon-Velarde, PhD
Natural Resource Management Division - CIP
Issues and facts

- Animal numbers and outputs need to be improved rapidly in Asia, as well as in Africa and LAC, to respond to the increased demand of livestock products.

- Smallholder livestock producers could benefit of these opportunities, by implementing technology options for increasing feed availability and efficiency in the use of locally available feed resources (pastures, crop residues, agro-industrial by-products and non-conventional feed resources), along with policies that favour their competitiveness.

- Adequate feed budgeting trying to synchronise the availability of local feed resources (preferably those produced on-farm) with nutrient requirements of animals throughout the year is a key approach for improving the efficiency of current feeding strategies in smallholder farming systems.

- The introduction of improved forage species (grasses, and herbaceous and woody legumes), the use of dual-purpose crops, like sweet potato, the treatment of fibrous crop residues and strategic supplementation using locally available resources, are also options for insuring enhanced livestock productivity.
Systems analysis in sweetpotato systems: models and simulation; NRM Division/CIP
Agricultural Systems

● Physical components
● Relationship between components
● Input
● Products

Bio-economic scenarios
Simulation-models
to assess year-round feeding strategies
Market oriented
SILAGE
Peru

CHIPS
Tarlac, Philippines

FERMENTED
Viet Nan
Papua Indonesia
China
Agricultural systems; Crop–livestock

Income = Area \times \text{Production/unit of land} \times (\text{Price} - \text{production cost})

\[
\begin{align*}
\$ &= \text{ha} \times \text{head/ha} \times \text{kg/head} \times \$/\text{kg} \\
\$ &= \text{ha} \times \text{plants/ha} \times \text{kg/plant} \times \$/\text{kg}
\end{align*}
\]
Sweetpotato Vines (silage) Roots -20% Vines +roots

Planting defoliation Harvest

Vines (silage) Roots -20% Vines +roots

Vines (silage) Roots -20% Vines +roots

Maize + vines (silage)

Fresh corn = home/market $
Vines fresh, t/ha

<table>
<thead>
<tr>
<th>Clones</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLAPA (Forrajero)</td>
<td>Dual purpose Vines, some roots</td>
</tr>
<tr>
<td>ARBUNAP 74</td>
<td>Dual purpose Vines &amp; Roots</td>
</tr>
<tr>
<td>SPV55 (Toquecita)</td>
<td>Vines with cut at 75 days (2 cut)</td>
</tr>
</tbody>
</table>

18 clones dual purposes evaluated

Piura, Peru
A. Confinement + Fish meal
B. Grazing + Fish meal
C. Grazing + 1/3 Fish meal
Protein 14–17 %

Concentrate 35–38 %
Types of mechanisms for technical assistance and financing

- Nucleus of producers
- Micro enterprise (Cheese)
- Association of producers
- Micro enterprise (Oca, cheese)
- Private enterprise (Quinoa,)

Market
Simulation Models: CIP-NRM

- **LIFE – SIM**
  Dairy, Beef, Buffalo, Swine, and Goat

- **TOOLS**
  Response Surface, Stability and adaptability, Risk analysis

- **CAMELIDOS South America:**
  Production, Alpaca genetics
Steps in the models development

- Objective
- Analysis
- Synthesis
- Verification
- Validations
- Sensitivity
- Inference
- Algorithm
- Equations
- Programming
- New Areas of research
Swine Model

Interface graphics of the models

Animal

Weather

Process

Feeding

Costs

Results
Definition of objectives

Analysis of the system

Synthesis of the system

Verification

Validation

Analysis de sensibility

Experimentation

Documentation

What happen if...?
Analysis of scenarios

Scheme of factors, levels and conditions used in a composite design central rotatable

<table>
<thead>
<tr>
<th>Factors</th>
<th>Treatments code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2  -1  0  +1  +2</td>
</tr>
</tbody>
</table>

-2  -1  0  +1  +2

Potential growth rate
Stock rate (animal/m²)
Feeding strategy
Herd management

Gross income, $
$/ kg

Scenarios

Stock rate
0.7  0.9  1.1  1.3
Growth rate
5.9  6.9  7.9
The model

The swine model uses all the variables that we discussed.
Discussion group outcomes

In this session, *Facilitating interventions and innovation in production systems and marketing*, the three systems-based discussion groups: (i) Subsistence level/producing for the local market; (ii) Smallholders producing for the market; and, (iii) Industrial commercial orientation, were asked to address:

- What are major constraints to production and marketing? Think about potential livelihood benefits from pig systems
- Research or development lessons that have worked and have not worked well (successes AND failures) – and WHY; what are generic issues as opposed to location specific ones?

The summary outcomes of the three discussion groups were:

### I Subsistence/producing for the local market

**Constraints to production** for subsistence and to supply local markets were identified by the group within factors related to markets, labour and management where the latter had genetic, health and feed components.

**Markets**

- Intermediaries making a large profit compared to the farmer who is a price taker (e.g. intermediary may underestimate weight of animal). But intermediaries do play a useful role. So how to improve position of the farmer? Also sometimes the intermediary is making only a small margin.
- Truly subsistence system not interested in expansion (e.g. Vietnam – Son La)—need to understand what are farmer needs, their interests and the entry points for interventions
- Marketing—importance of meat quality and taste. For example, in Laos scavenging and non-commercial fed animals preferred
- Often poor road infrastructure limits market access (e.g. NE India).

**Labour**

- Labour trade-off with returns to different household/farm activities; household labour dedicated to those activities which are most competitive.
- Time/labour constraints (including for obtaining feed)—need labour-saving interventions to achieve increased productivity, e.g. silage production (see Papua paper) reduced daily tasks by concentrating community work within a certain period.

**Management**

- High piglet mortality
- Inadequate farm management (including regular feeding discipline) and knowledge,
e.g. transition from scavenging to a confined system, poor understanding of the returns to adequate feeding

- Challenges of change to market orientation, i.e. sell regularly rather than when money is needed, which reduces bargaining power
- Cyclical changes in price, e.g. many farmers are obliged to sell at the same time—lean season, which results in low sale prices
- Lack of training requires needs assessment: what is the market demand, what can you supply, which is the best breed for your system, is it available?

Genetics

- Using inappropriate genotypes: ‘superior’ often means crossbred but this ‘superiority’ may not be demonstrated in practice
- Poor breeding management: need for good boar selection, do not sell the best animals, within breed selection can be very effective.

Health

- Vulnerable to disease introduction to farms and absence of preventative and curative interventions. Lack of government support—should determine what is the appropriate intervention and ensure that it is affordable
- Home slaughter can create public health hazards
- If formal health regulations become too onerous then pushes farmer into informality.

Feed

- Inadequate feed supply resulting in underfeeding and malnutrition
- Attempt to keep more pigs than is sustainable (quantity vs. quality)
- Cyclical availability of feed resources tends to limit the flexibility of the farmer to sell at the best time, afford veterinary interventions etc.

Research or development lessons and generic issues were summarized as:

- The importance of integrated and multidisciplinary approaches
- Assist farmers through participatory approach to determining their needs: identification of entry points—farmer not researcher determined; schemes at community level then designed, pigs distributed
- Economic aspects useful for promoting change (market vs. non-market values); demonstration of cost-effectiveness of specific interventions (e.g. health, housing, waste management)
- Research successful (as presented in this workshop) but development aspects weaker—although some positive examples. How to ensure Up and Out-scaling? Engage early on with development partners; ensure good communication (spread the word)
- Close links needed between research and development, and vice-versa. Improved
interaction between different (government, donor, NGO etc.) institutions. Integration of all stakeholders (including service providers)

- Post-project sustainability: visibility of the project logo is an indicator, when this disappears at end of project it often heralds end of intervention success. Key issue—ownership by local institutions even when ‘logo’ disappears. Need for champions within the community to ensure long-term viability.

II Smallholders producing for the market

**Constraints to production** for smallholders producing for the market were identified at the systems and farm levels.

**Systems level**

- Institutional and policy constraints:
  - Along the supply chain there are many actors; organization vs. individual?
  - Why is there no rapid scaling up of those technologies that have shown remarkable results on farm?
  - Is it the lack of appropriate government policies to support the scaling up process?
  - Cambodia example: lack of policies and dominance by a single large scale feed miller/integrator (CP)
  - Need to get away from European systems model; in Asia there are available local resources that can be used effectively by smallholders
  - Inadequate sources of local breeds and insufficient investment in their conservation
  - Time may come when Asia becomes highly dependent on imported genetics; danger of being monopolized by large commercial firms.

- Market organization
  - Smallholders are not well organized; lack of collective action

- Lack of market information
  - Laos: still relatively low demand
  - Price volatility arising from volatility of market supply vs. demand
  - Barriers to access to land
  - Environment pollution
  - Cultural and social constraints.

**Farm level**

- Farmers lacking in skills and knowledge
- Shortage of labour
- Breeding and genetics
  - Inadequate sources of piglets (gilts)
  - Why is there no breeding program for local breeds? Happening in pockets but not at large scale
• Use of adapted crosses seems to have overtaken local breeds although not enough information about the performance of local breeds
• Relationship between breed and feed: need more scientific evidence.
• Poor disease control
• Inadequate feeding
  • How to use agricultural by-products appropriately
  • Moving from ad hoc to more structured routine feeding, so constraint is more variable
• Need to understand better the economics of feeding under smallholder conditions, also accessibility on a continuous basis and acceptability
• Seems to be barrier to use of certain feed technologies when up-scaling: some effective with very small farms but may not be effective when the farm increases herd size.

Research or development lessons and generic issues were summarized as:

• Where R&D has been successful, three factors were usually present:
  • Supportive policy environment
  • Technical inputs (with manpower capable of providing these)
  • Appropriate organizational structure/support
• Pig sector projects should be integrated into the overall social and economic environment
• Lack of public internalization of costs, e.g. Government of Thailand will be more likely to allow a large commercial to build its own units with its own experts rather than provide extension services to a larger number of smaller scale farmers
• Need appropriate diagnostics to realize opportunities and target project objectives to addressing the issue
• People rather than pigs; recognition of what is socially beneficial in terms of employment generation
• The case of Vietnam shows that advocacy requires good support from scientific evidence
• Successful pig systems development depends upon the availability of local innovations (and local leaders to provide the technical knowledge) and facilitation of up-scaling to a larger area through local organizations taking account of, e.g. cultural and social implications
• Successful cooperatives (or interest groups or community groups)—facilitated by good policy environment
• Collective action can facilitate the move from a low level operation (small herd) to a relatively larger, higher risk in operations
• Innovations/technologies are available; the problem is how to effectively put them into practice in a way that farmers will readily adopt.
III Industrial commercial orientation

Constraints to production when the orientation is industrial commercial were summarized by the group as:

- Processors cannot get consistent supply of quality hogs as inputs to processing
  - Depends on breeding-nutrition systems
- Contract farming has not successfully addressed the consistency constraint
- Difficulty to have exclusive control of breeding and feed technology
- Industrial systems, when there is no effective regulation, may also evade bio-safety standards
- Weaknesses in grading standards (varying levels among countries)
- Relevance of transferring the integrated systems of the West
  - Existence of dual markets for consumers: wet and supermarkets
  - Although supermarkets are growing very fast in meat sector (Thailand and China)
  - Limited capacity of modern slaughterhouses
- Volatility in the market (hog cycle; boom-and-bust)
  - More volatile with uncontrolled activities of independent smallholders and medium-sized producers
- Growing demand for organic products (pork)
  - Industrial systems not built to respond to them (no hormones etc.).

Research or development lessons and generic issues were summarized as:

- Importance of quality control and disease control
- Pollution abatement
  - Successes in China and Thailand
  - Favoured industrial systems; no public R&D and technology for smallholders
- R&D on demand side
- R&D mostly on production
- Very limited on coping with changes in demand, impacts of expansion of supermarkets
- R&D on impact of public policy on the dynamics of the pig sector and poverty alleviation
- Public–Private R&D with adequate and continuing funding
  - E.g. Cassava foundation in Thailand on pig nutrition.
Information sharing to facilitate innovation in R&D institutions and knowledge management: The experience of the PigTrop website

V Porphyre

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Key words: Multilingual web portal, network, pig science, World Wide Web resources

Rationale

The PigTrop website has been a unique and collaborative information centre about pig science in the tropics since April 2003. It is run by the French Agricultural Research Centre for International Development (CIRAD) and gathers contributions from researchers and from numerous international scientific institutions, which are considered as partners. It is designed to meet the need for a one-stop website giving information on pig systems in the tropics, to communicate on R&D activities and to create an informal and collaborative network in Asia but also to serve Africa and South America. Its activities mainly focus on education and access to information for researchers, students, professionals and development agencies. A new version, PigTrop 2.0, is under construction to improve the usefulness of this web platform and to better meet the demand of southern country partners.

In 2001, a first note was discussed about the interest for an information platform for networking about pig production amongst French research institutes; this national initiative was rapidly considered as too limited in terms of institutions and perspectives. A second more cost-effective proposal was initiated in 2003 with a strong commitment to create a collective platform to broadcast information of partners’ works. The initial aim was to identify and make visible the CIRAD activities on this specific production and communicate about achievements and ongoing research but rapidly it was considered essential to enlarge the contributors to voluntary participants from the research and development sector in northern and southern regions, with a strong respect for author names, institutions’ logo and funding source. Few papers or comprehensive information were freely available on the web focusing on southern countries with their specific constraints and characteristics; however, isolated data or papers existed on numerous websites (FAO, universities, LRRD etc.); several commercial (not free) websites were targeted at specifically northern producers or vets to cater for their specific needs and interests (international price, northern diseases, ...) and with a low level of interest for southern producers.
Materials and methods

Our main materials (reprint of published papers, projects fact-sheets, announcements of seminars or new releases of books, manuals or PDF documents) are mainly sent by authors or partners. Voluntary participation is the strong base of the selection. Everything serious is thus published in PigTrop without charges and with free access. Nevertheless, the information is under the responsibility of the authors. The website is hosted on the CIRAD server in its Montpellier headquarters, while the funding is at the moment assumed by CIRAD and the webmastering work is done by a limited number of persons. The communication amongst the network’s partners is enhanced to reinforce linkage and partnerships, e.g. with a monthly newsletter addressed at this time to 1400 subscribers in all continents.

Results

The benefits of the site are measured through the connection logs analysed regularly on our server. The 2006 statistics show that the website is consulted by more than 20 thousand visitors per month. Considering the current count (700 visits/day), targeting southern visitors and tropical issues are confirmed as relevant.

Perspectives

Our challenge for 2007 is to develop the next generation of the website by using an open-source web content management system facilitating the navigation and the accessibility of the information. A positive improvement would also be targeted by questioning the global

92
organization, contents and the complementary add-ins to fit the needs of visitors and strengthen the network capacities for the research and development sector; an essential Spanish version would also be planned to improve our audience of Spanish-speaking partners. For the moment, the site is freely hosted on the CIRAD server in Montpellier (France) but financial partnerships would be necessary to strengthen the portal and developed additional information programs like e-forum or specific NTI projects. Discussions are ongoing with various other networks to be associated, e.g. the ASF network and the GWESA network in Africa.

Conclusion

The last three years of experience highlighted the validity of the policy of the PigTrop team to complement the other international networks and initiatives as an essential scientific and technical information centre on pig science in the tropics. Numerous visitors and partners have appreciated the common interest to participate in and associate with PigTrop work on pig production in the tropics. We hope that the second generation of the PigTrop website will fully satisfy all the demands of professionals and visitors interested in tropical pig R&D.

Reference

Facilitating Innovation in R&D Institutions and Knowledge Management

Information Sharing: PigTrop

Regional Workshop
Co-organized by APHCA, FAO-RAP and ILRI

Bill Thorpe
Regional Representative, Asia
International Livestock Research Institute

What was the rationale for PigTrop?

• To meet the need for a one-stop website giving information on pig systems in the tropics and links to related sites
  o Communicate on R&D activities
  o Create an informal network in Asia but also in Africa & South America
• Challenge for 2007: be associated as a "collaborative“ website by FAO on pig production
Why only the tropics?

- Lack of comprehensive source of information from the tropics; major emphasis in literature is the “north”

How are the benefits of the site measured?

- Automatic counter
- Currently PigTrop receives 500 “hits” per day

How is info' selected for inclusion in the site?

- Mainly sent by authors or partners. Voluntary participation. Everything serious is published without charges and with free access.

How will the site continue to be funded?

- Hosted on the CIRAD server at its Montpellier HQ
- Funding currently by CIRAD
- Our proposals for how to fund in future?
Experiences in information sharing and the Livestock Working Group in Vietnam

P Gautier

Coordinator for Livestock/Animal Health in Southeast Asia, AVSF, 67, To Ngoc Van, Hanoi, Viet Nam

The Vietnam Livestock Working Group was set up in 2001 by few foreign experts working in livestock/veterinary development projects, including AVSF. The main justification was to avoid duplication between initiatives, to share experiences and to facilitate collaboration between projects.

During the first three years, the group met informally and acquired more members. In 2004, the first Livestock Working Group conference was organized in Hanoi, and it was decided to set up a website (www.livestockworkinggroup.org). During 2004 and 2005, one major activity for the LWG was to share information on avian influenza and regular updates on the disease situation were sent to members, donors etc. In 2005, the LWG members were consulted for their inputs in a review of the dairy sector in Vietnam conducted by AVSF and ACI on behalf of FAO. In 2006, a few meetings were organized again for LWG members to provide inputs to World Bank’s teams working on avian influenza. At the end of 2006, AVSF received the support from the International Cooperation Department of the Ministry of Agriculture and Rural Development to gather information on international cooperation in the livestock/animal health sector. This allowed a partial update of the information posted on the website.

Although many potential activities were not started or not maintained, a number of tasks have been maintained and the LWG was able to provide on a regular basis in 2006 the services listed below:

• Posting reports, training materials etc. on website
• Answering questions from ‘newcomers’ and direct them to relevant LWG members
• Provide updated information on projects
• Regular interaction with the World Bank, keen to continue consultation with LWG
• An email list of > 50 organizations/projects

Some of the key advantages or outcomes of the LWG have been:

• independent
• website in Vietnamese language
• wide range of stakeholders: NGO, research institutes, universities, private sector, bilateral projects, international organizations, donors etc.
• a ‘memory’ (versus short-life of projects), key for learning lessons
• basis for literature search
• policy dialogue
• avoid duplication
• share resources and foster collaborations
• option to create subgroups (on process for dairy)
• advertise projects and strengthen local capacities on international cooperation
• improve linkages between local experiences and national/regional policies/strategies.
«Experiences in information sharing & the Livestock Working Group in Vietnam»

Patrice Gautier
D.V.M.
Coordinator for Livestock and Animal Health in South East Asia

Agronomes & Vétérinaires sans frontières (AVSF)
“Agronomists and Veterinarians without borders”

p.gautier@avsf.org
www.avsf.org & www.livestockworkinggroup.org

Steps (1)

✓ 2001:
  • Set up by < 5 foreigners in Vietnam, including AVSF. Willingness to avoid duplication, to share experiences, to facilitate collaboration between projects, etc.

✓ 2001 – 2002 – 2003:
  • Informal meetings & growth of the group

✓ 2004:
  • First LWG Conference in Hanoi organized by Belgium Project (with AVSF, ACI & ACIAR)
  • Set up by AVSF & ACI of the www.livestockworkinggroup.org website

✓ 2004 - 2005:
  • Updates on HPAI situation by email

✓ 2005:
  • Consultation on dairy (with FAO PPLPI)
Steps (2)

- 2006:
  - Consultation on HPAI (with WB)

- 4Q06:
  - Update of project information (with Ministry of Agri & RD)

- Permanent:
  - Posting reports, training materials, etc. on web site
  - Answering questions from “new comers” & direct them to relevant LWG members
  - Provide updated information on projects
  - WB (who estimated the LWG to be the most effective WG in Vietnam) keen to continue consultation with LWG
  - An email list of > 50 organizations/projects

Key advantages

1. Independent
2. Web site in Vietnamese language
3. Wide range of stakeholders: NGO, Research Institutes, Universities, Private Sector, bilateral projects, International Organizations, Donors, etc.
4. A “memory” (versus short-life of projects), key for learning lessons
5. Literature search
6. Policy dialogue
7. Avoid duplication
8. Share resources & foster collaborations
9. Option to create sub-groups (on process for Dairy)
10. Advertise projects & strengthen local capacities on international cooperation (e.g. southern China in Nov 06)
11. Option to duplicate in other countries
12. Improve linkages between local experiences and national / regional policies / strategies.
### Constraints

1. Everyone talks about coordination but who does it?  
   => Time constraint and/or real commitment?
2. No dedicated funding yet (currently AVSF uses funds provided by France)
3. Keep it independent
4. The “madness” of Avian Flu !!!
5. Etc.

### Suggestions for the future (1)

- **2006:**
  - Web site (costs to be shared by AVSF projects if no other way)
    - Finalize collection and posting of project information sheets with MARD ICD
    - Re-design web site
    - Add more documents
    - Update the email list
  - Organize workshops (with MARD ICD):
    - PIG: AVSF, FAO PPLPI, ILRI, CIAT, CIP, ACI, ACIAR, CIRAD, Hohenheim, Private Sector, etc.
    - HPAI / Vet Services: AVSF projects funded by WB & USAID
    - Etc.
  - Organize an “administration” meeting with key members
Suggestions for the future (1)

✓ Proposal to be submitted for fund raising:

✓ Organize an electronic library (AVSF)
  ✓ Recruit a library specialist

✓ Upgrade libraries of some Vietnamese institutions (Universities and Institutes)
  ✓ Upgrade capacities of library people
  ✓ Send them paper copies of the electronic library

✓ Any other suggestions?

The LWG is like an animal disease reporting system:

• To receive information, AVSF needs to feed information back to members.

• To feed back, AVSF needs to receive information from members.
AVSF is looking for a 300,000 USD credit fund to support 6,000 small-scale pig & poultry farmers in North Vietnam, Cambodia & Lao PDR
Contact: p.gautier@avsf.org
Southeast Asia Foot and Mouth Disease Campaign (SEAFMD)

Dr. Ronello C. Abila
Regional Coordinator

OIE SEAFMD Campaign

World Organization for Animal Health (OIE)
Southeast Asia Foot and Mouth Disease (SEAFMD) Campaign
OIE SEAFMD Campaign

- 1994 - OIE Sub-Commission for FMD Control in Southeast Asia
- 1995 - 1st Meeting
- 1997 - OIE Regional Coordinating Unit (RCU) for SEAFMD was established in Bangkok

OIE SEAFMD Campaign

- **Goal**
  - to increase food security and alleviate poverty amongst the rural small holder producers of livestock.
- **Purpose**
  - to increase the productivity and economic output of the livestock sector by controlling and eradicating FMD.
- **Objective**
  - to add value to the regional control program through SEAFMDC by employing a series of integrated and harmonised approaches to disease control
OIE SEAFMD Campaign

- Phase I (1997 to 2000)
  - Funding from Switzerland, Australia, OIE Tokyo, with support from Thailand and member countries (in Kind)
- Laying the groundwork
  - Regional concept of disease control
  - Identify national Coordinators
  - Develop Regional Plan

OIE SEAFMD Campaign

- Phase II (2001 to 2005)
  - Funding mainly from Australia, with support from OIE Tokyo and in kind contribution from Thailand and member countries
- Institutionalized regional cooperation
- Identify pilot areas for zoning
- Engagement of private sector
OIE SEAFMD Campaign

- Phase III (2005 to 2008)
  - Funding mainly from Australia, New Zealand, France with support from OIE Tokyo and in kind contribution from Thailand and member countries
- Transition to ASEAN
- Progressive zoning
- Strengthen network

Regional Workshop on Pig Systems in Asia and the Pacific
Bangkok, Thailand, 23-24 November 2006
Achievements

- Institutionalized Regional Coordination
- Better exchange of information
- Better understanding of FMD in the region
- Better understanding of animal movement and risk factors
- Progressive Zoning

Institutionalized Regional Coordination

- Annual Meeting of the OIE SEAFMD Sub-commission
- Bi-annual meeting FMD national Coordinators
- MTM Tri-State Commission meeting
- Working Groups for Upper and Lower Mekong
- Workshops and training seminars
Better exchange of information

Better understanding of FMD in SE Asia
Animal movement and FMD outbreaks

Cattle movement
Pig Movement

2005

SEAFMD Campaign

OIE FMD Free Zone
FMD Infected Zone

1997
SEAFMD Campaign
- OIE FMD Free Zone
- FMD Infected Areas

SEAFMD Progressive Zoning
- OIE recognized FMD – free zones
- Upper Mekong Zone
- Lower Mekong Zone
- MTM
Transition to ASEAN

- OIE/ASEAN Midterm Evaluation in 2003 recommended:
  - To extend phase II from November 2004 to December 2005 to serve as transition period for final handover to ASEAN
  - To appoint an ASEAN National as Regional Coordinator

- 12th ASWGL (Singapore, May 2004) endorsed to SOM-AMAF the mechanics on the establishment of ASEAN Animal Health Trust Fund (AAHTF)

- Purpose of Fund
  - Collect and administer funds from a range of sources for funding the regional coordination of FMD control and eradication
  - Support the implementation of a regionalized disease control and eradication programs for economically important animal diseases that have been identified by ASWGL - Avian Influenza and Classical Swine Fever.
Transition to ASEAN

- 26th AMAF approved the mechanics on the establishment of AAHTF (Yangon, Myanmar, October 2004)
- 27th AMAF approved the quantum and timelines for the each member country contributions to AAHTF (Tagaytay, Philippines, September 2005)
- 28th AMAF signed the official Memorandum of Agreement on the establishment of AAHTF (Singapore, November 2006)
Strategic Directions

- Strengthen and expand regional cooperation
  - Politically strengthened cooperation through ASEAN mechanism
  - Expand to include greater involvement of PR China through the ASEAN+3, and other neighboring countries

- Strengthen international cooperation
  - Increased cooperation between international organizations, donors and other institutions through their participation in the OIE FMD Sub-Commission and Steering Committee.
  - Active role of SEAFMD in the FAO/OIE GF-TADs Campaign
Strategic Directions

• Fulfill the requirements for progressive zoning
  o Implementation of more on-the-ground activities like sero-surveillance, public awareness, standardized regulations and procedures to manage animal movement
  o Continue the MTM, Upper Mekong and Lower Mekong Zoning, and explore new areas for zoning

Strategic Directions

• Develop the capacity of veterinary services
  o Utilize SEAFMD to strengthen the capacity of veterinary services to meet OIE standards
  o Employ the techniques developed by SEAFMD to combat other trans-boundary animal diseases like HPAI and CSF
  o Develop skills of national coordinators to become disease control managers
Strategic Directions

- Institutionalize Private sector participation
  - Strengthen the PSCC mechanism to harness more private sector involvement in the SEAFMD Campaign
  - Cooperation between government and private sector to comply with SPS standards for trade of livestock and livestock products

- Institutionalize epidemiology and laboratory network
  - Identify and train focal person
  - Harmonize procedures for FMD surveillance and diagnosis in accordance with OIE standards
  - The network shall collaborate with other institutions and scientists to conduct researches
Southeast Asia FMD Campaign

Thank You!

www.seafmd-rcu.oie.int
Animal Production and Health Commission for Asia and the Pacific (APHCA)  
1976–2006

APHCA - why

• Collective self help and mutual assistance among FAO member countries through Technical Cooperation among Developing Countries (TCDC).
  o mutual exchange of experiences and expertise between countries with common problems
  o development approaches most appropriate for the region
  o introduction of programmes and policies for disease eradication and animal production.
  o Now 16 countries
APHCA - why

- Response to emerging diseases (FMD, HS, Rinderpest, NIPAH, HPAI)
- Similarity of livestock production issues
- Not so many Regional fora and entities
  - Travel restrictions
  - Interaction between DGs of livestock and CVOs
  - Informal relaxed atmosphere
  - Forum of discussion
  - Information distribution
- National currency fund to allow mutual support
- Semen and vaccine banks for solidarity support
- Training and communication

APHCA Mission Statement

- Promote livestock development in general and national and international research and action with respect to animal health and husbandry problems in the Region;
- Build up regional and national livestock programmes based on collective self-reliance and mutual assistance within the region;
- Promote livestock production as industry and as part of the farming system on the basis of self-reliance at the farm level;
- To raise the level of nutrition and standard of living of small farmers and rural communities through the optimal exploitation of potential resources for livestock development.
APHCA set-up

- Chair and vice-chair
- Annual Session
- Executive committee (6 countries)
- Secretary – Senior APH-Officer in RAP provided by FAO-RP
- Annual contributions by countries (US 84 000) continuous Trust Funds

APHCA priority areas

- Defined by countries in annual Session:
  - Control of transboundary animal diseases
  - Small scale dairy and meat production and processing
  - Food and feed safety
  - Livestock industrialization, poverty reduction, environment
  - Training WTO-SPS, BSE and VPH
- TCDC activities
Activities for 2007

1. Animal identification, traceability and movement control
2. Design for hygienic basic medium and medium scale abattoirs
3. Improved market access and smallholder dairy farmer participation for sustainable dairy development
4. Assistance Fund to Respond to Disease Emergencies (other than HPAI)
5. Food Safety Workshop (pending on findings of consultant)
6. Establishment and Maintenance of APHCA FMD Vaccine/Antigen Bank
7. Risk Based Surveillance Workshop
8. Joint APHCA / OIE Activity on BSE/TSEs (prion diseases)
9. Joint APHCA/OIE activities on BSE and WTO-SPS agreement
10. Creating a APHCA/APAARI/ILRI Resource of Livestock Knowledge in Asia

Interaction with international organizations

- Informal interaction on a case by case basis:
  - Joint training activities (OIE, ILRI, SEAFMD, National Laboratories)
  - SAARC, ASEAN Sectoral WG
  - Joint workshops
  - Joint publications
  - Participation in annual Sessions as observers
Publications

• Asia Livestock
• Internet  [www.aphca.org](http://www.aphca.org)
• Publications examples:
  o The Yak
  o Nipah Virus
  o Training manuals
  o Asia Livestock industries

• Hard copies are still very important

30th Anniversary 2006
Thank you
APAARI: A platform for knowledge sharing in Asia-Pacific

BD Rosario

APAARI, Maliwan Mansion, 39 Phra Atit Rd, Bangkok 10200, Thailand

Introduction

The Asia-Pacific Association of Agricultural Research Institutions (APAARI) was established in 1990, and has emerged as a self-sustaining, proactive and dynamic regional forum that fosters closer linkages among its 38 members (NARS, CG centres, international and regional institutions) as well as with other stakeholders such as FAO, GFAR, and several NGOs in the Asia-Pacific region. APAARI’s activities as per its mission and objectives are based on its strategies for implementing Vision 2025. It has further refined its priorities at national, subregional and regional level, and diversified its activities considerably to meet the emerging needs of NARS.

As a member-driven, not-for-profit, neutral platform, APAARI has played the role of a trust-builder among NARS and has enhanced partnership and cooperation for agricultural research for development in the region. It has been associated with many agricultural research-for-development (AR4D) networks and consortia and it has strived to strengthen and sustain their operations through some modest support for coordination. Among the regional fora under the umbrella of GFAR, APAARI is acknowledged to have trail-blazed in the areas of ICT/ICM and biotechnology. Further, its new initiatives on Asia-Pacific Agricultural Research Information System (APARIS) and Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB) have contributed significantly in accelerating the pace of ICT/ICM activities and promoting the application of agricultural biotechnology.

APAARI has kept track of recent developments in agricultural sciences vis-à-vis changed agricultural scenario, and has regularly organized meetings, consultations, workshops, and high level policy dialogues on important and emerging issues. It has further strengthened inter-NARS and CGIAR centres collaboration and has developed stronger partnerships with the private sector in the field of agricultural biotechnology.

Information and knowledge sharing initiatives

In line with APAARI’s objective to promote the exchange of scientific knowledge and information, APAARI has brought out diverse publications in different forms: print, CD and
on the web (www.apaari.org). To date, it has published 25 success stories on different areas/disciplines for technology dissemination among NARS, namely: crops (11: cereals, horticulture and industrial crops), pest management (2), fisheries (4), livestock (2), farming system (2), effective institutional linkages/partnership (1), agro-tourism (1), and commercialization of Bt corn in the Philippines—status report (see Table 1). The Asia-Pacific NARS and institutions have strengthened linkages with other stakeholders, adopted a more participatory approach to R&D to include not only the formal R&D institutions but other civil society groups such as the NGOs, the rural producers/farmers association and the business/private sector. Together they have developed better approaches, tools, methodologies and technologies more attuned to their particular needs. Their ‘success stories’ and ‘best practices’ in promoting local innovation deserve more attention than they previously received. APAARI will endeavour to publish and widely disseminate them in print, electronically and through other appropriate media such as video. These case studies can be used to raise awareness, gain and sustain support of policy/decision-makers and donors regarding agricultural research-for-development. It can be used to sensitize NARS leaders and managers and other stakeholders on partnership building for effective agricultural innovation capacities. It can also be shared by GFAR with its other regional and subregional groupings.

Table 1. Success stories published by APAARI (1994–2005)

<table>
<thead>
<tr>
<th>Publication title</th>
<th>Year</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby corn production in Thailand</td>
<td>1994</td>
<td>Chamnan Chutkaew and RS Paroda</td>
</tr>
<tr>
<td>Tilapia farming in the Philippines</td>
<td>1994</td>
<td>Rafael D Guerrero III</td>
</tr>
<tr>
<td>Hybrid rice in China</td>
<td>1994</td>
<td>Lou Xizhi and CX Mao</td>
</tr>
<tr>
<td>Dairying in India</td>
<td>1994</td>
<td>RP Aneja</td>
</tr>
<tr>
<td>Hybrid cotton in India</td>
<td>1995</td>
<td>AK Basu and RS Paroda</td>
</tr>
<tr>
<td>Palm oil industry in Malaysia</td>
<td>1995</td>
<td>YB Basiron</td>
</tr>
<tr>
<td>Transformation in Korean farming: A success story of effective linkages</td>
<td>1996</td>
<td>Chae Yun Cho</td>
</tr>
<tr>
<td>Cotton production in Pakistan</td>
<td>1996</td>
<td>Badaruddin Soomro and Parvez Khaliq</td>
</tr>
<tr>
<td>Orchids in Thailand</td>
<td>1997</td>
<td>Kanchit Thammasiri</td>
</tr>
<tr>
<td>Wheat production in Iran</td>
<td>1997</td>
<td>Abbas Keshavarz and MJ Mirhadi</td>
</tr>
<tr>
<td>Agro-tourism in Australia</td>
<td>1997</td>
<td>Tom Connors</td>
</tr>
<tr>
<td>Direct seeded rice in Malaysia</td>
<td>1998</td>
<td>Cheong Ah Wah</td>
</tr>
<tr>
<td>Groundnut in China</td>
<td>1998</td>
<td>Duan Shufen, Hu Wenguang and Sui Qingwei</td>
</tr>
</tbody>
</table>
APAARI’s six-monthly newsletter and proceedings of expert consultations are regularly published to enhance NARS knowledge on diverse emerging issues. Other publications relate to regional directories, special status reports such as on regional agricultural research systems, on ICT/ICM, and on plant genetic resources. All these have further catalysed NARS in strengthening their ARD programs.

Asia-Pacific Agricultural Research Information Systems (APARIS)

APAARI organized an expert consultation in 2000 to promote the use of new information and communication technologies (ICT) for better information and communication management (ICM) in agricultural research-for-development (AR4D) in the region. The participants were agricultural information professionals from member NARS, ACIAR, FAO, CABI, AIT and other stakeholder organizations. The expert consultation recommended that APAARI develop a decentralized system for efficient information and knowledge sharing among the region’s national agricultural research systems (NARS) and other ARD stakeholders. Since then APAARI, with financial support from ACIAR, has been developing and maintaining the Asia-Pacific Agricultural Research Information System (APARIS).
Over the last five years APARIS has evolved from a simple APAARI website (www.apaari.org) to a knowledge-sharing mechanism with active involvement of various APAARI members and AR4D stakeholders. However, issues related to priority use of ICT (e.g. scientific and technical information, research data management, research management, extension and outreach) and capacity building for weaker NARS remain big challenges for APARIS. Hence, APARIS shall focus on three broad themes: advocacy, capacity development and integration of information resources.

ARD networks associated with APAARI

Worldwide, research partnerships are well recognized and accepted to address issues of common concern. Based on shared vision, partnerships have been established involving scientists, and/or institutions in the form of either research networks or consortia, which are useful in accelerating technology generation, assessment and refinement. In the Asia-Pacific region, APAARI has always strived to foster research partnerships among institutions and other stakeholders in the region. To date, the AR4D networks associated with APAARI are mainly on crops, none on livestock (Table 2). There is growing interest though in livestock (as part of the farming system recognized by the CLAN network). Most existing networks have been facilitated by the CGIAR centres. Many are still very active and have made good progress while a few have faced financial difficulties. Moreover, two regional programs under APAARI have been implemented, namely (1) the Asia-Pacific Agricultural Information Systems (APARIS) established in 2000 and (2) the Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB) established in 2003.

Recently however, more and more inter-regional collaboration on priority areas were encouraged by GFAR, one of which is linking farmers to markets (LFM), a global partnership program collectively designed by its partners and which has recently been approved by the GFAR Steering Committee. The challenges of proliferation, sustainability and accountability are glaring realities we faced as we move ahead with these ARD networks and consortia.
<table>
<thead>
<tr>
<th>Network</th>
<th>Year</th>
<th>Facilitation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals and Legumes Asian Network (CLAN)</td>
<td>2002 as CLAN; 2018 as Asian Grains Legumes Network</td>
<td>ICRISAT, ICARDA and AVRDC; coordination unit at ICRISAT</td>
<td>Active; expanded commodity scope to include lentil and mungbean; 13 member countries: Bangladesh, China, India, Iran, Indonesia, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, Vietnam and Yemen; since 2003 APAARI provides USD 10 thousand</td>
</tr>
<tr>
<td>Council for Partnership on Rice Research in Asia (CORRA)</td>
<td>1996</td>
<td>IRRI</td>
<td>Active; 15 countries represented, namely, Bangladesh, Cambodia, China, India, Indonesia, Japan, Korea, Laos, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam</td>
</tr>
<tr>
<td>Plant Genetic Resources Network (PGR)</td>
<td>1991</td>
<td>IPGRI</td>
<td>Active; successfully operating in four subregions (South Asia, SE Asia, East Asia, and Pacific)</td>
</tr>
<tr>
<td>Rice–Wheat Consortium</td>
<td>1994</td>
<td>CIMMYT, India</td>
<td>Considered a prime case study of successful NARS-led consortia, with support from IARCs and donors; an eco-regional initiative of the CGIAR involving the NARS of South Asia, namely, Bangladesh, Nepal, India, and Pakistan, the IARCs and Advanced Research Organizations; major resource conservation technologies developed for rice–wheat areas include Leaf Colour Chart (LCC) to ascertain optimum N-use, zero till machine, and reduced till systems</td>
</tr>
<tr>
<td>Banana Asia –Pacific Network (BAPNET)</td>
<td>1998</td>
<td>PCARRD–IPGRI</td>
<td>NARS-led and NARS-based; Active; good progress</td>
</tr>
<tr>
<td>Tropical Asian Maize Network (TAMNET)</td>
<td>1993</td>
<td>CIMMYT/FAO initially; transferred to APSA in 1994</td>
<td>Functioning quite satisfactorily until 2000: Inactive due to funding constraint</td>
</tr>
<tr>
<td>Underutilized Tropical Fruits Asia Network (UTFANET)</td>
<td>1995</td>
<td>ICUC/PCARRD originally; IWMI recently</td>
<td>Active; 13 member countries: Bangladesh, India, Indonesia, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand, and Vietnam; ICUC and PCARRD provided funds for research on jackfruit, pummelo, and mangosteen</td>
</tr>
<tr>
<td>Group on Fisheries and Aquatic Research (GoFAR)</td>
<td>2000</td>
<td>World Fish Center</td>
<td>Faced with funding constraint</td>
</tr>
<tr>
<td>Inter-regional Network on Cotton (INCANA)</td>
<td>2002</td>
<td>AARINENA, APAARI, CACAARI, AREO, ICARDA</td>
<td>Active; APAARI provided USD 5000 for meetings, 2003</td>
</tr>
</tbody>
</table>
APAARI regional priorities redefined (2007–17)

APAARI provides a platform for regional priority setting based on the needs identified by the different stakeholders in the Asia-Pacific region. During the last decade, APAARI has done its best to bring together all stakeholders to collectively decide on regional research priorities, its strategic plan, the networks it is associated with, and some new initiatives such as on ICT/ICM and biotechnology. While it has taken time to bring in NGOs and FOs, they are now more actively engaged and involved in the process.

In 2001, subregional priority setting exercises were conducted by APAARI member institutions. The synthesized regional priorities have helped shape global perspectives and priorities of the CGIAR system to maximize its contribution to the Millennium Development Goals (MDGs). Two regional programs have been initiated and supported by APAARI and other donors, namely, the Asia-Pacific Consortium for Agricultural Biotechnology (APCoAB) and the Asia-Pacific Regional Information System (APARIS) mentioned above. A new initiative in post-harvest and linking farmers to market (LFM) is being facilitated by the Global Forum on Agricultural Research under the Global Partnership Programme (GPP-LFM).

In 2004 and 2005, APAARI conducted research needs assessment for the three subregions, taking into consideration new developments in science and challenges posed by globalization. One of the major challenges the Asia-Pacific region faces is the on-going shift from a focus on increased production to meet national food security targets, to increased farm productivity that factors in environmental concerns and profitability. Since the majority of the producers in the region are small-scale farmers, moving them beyond the subsistence level to market-oriented and environmentally sound production systems will not be easy. This therefore constitutes a major paradigm shift for ARD. In South and West Asia for instance, new research areas deserving additional emphasis include agro-enterprise development (focus on legumes, post-harvest technology for value adding products), and policy and institutional reforms with special emphasis on strategies to encourage higher investments in infrastructure, and enabling policies on marketing, credit and commodity pricing. In the Pacific, serious gaps have been identified in important research areas such as value adding and post-harvest management, markets and marketing. In Southeast Asia (SEA), the main priority areas include (1) food safety and security, specifically agriculture and fisheries product quality, value adding of products for competitiveness, productivity and profitability, export/import competitiveness, policy researches related to food safety, market changes, biotechnology and other emerging issues; and (2) farmers/fisher folks capability enhancement including value-chain analysis and improve market access, entrepreneurial development of farmers and fisher folks, provision of access to credit, and intra/inter-household production access. There is growing recognition that research must transform subsistence farming into agro-entrepreneurship.
With support from GFAR, the Regional Synthesis of Research Needs in Asia-Pacific was conducted on 18–19 August 2006 in Bangkok. It brought together key stakeholders in the three subregions, namely, the NARS, CGIAR centres, NGOs, farmers’ and private sector organizations, donor representatives, regional and international organizations, and the youth sector. The workshop synthesized regional research needs and identified regional priorities in the short and medium term, and suggested anticipatory researches, and the roles of APAARI and GFAR. To the extent possible, the workshop addressed concerns for inter-sector imbalance (crops, livestock, fisheries), harmonization with priorities of the CGIAR and GFAR, and building new partnership based on complementation and subsidiarity principles. It identified six regional research themes: Natural resource management, genetic resources and biotechnology, enterprise improvement, post-harvest and value addition, policy and institutions, and capacity building. Anticipatory research in the areas of climate change, risk management and biofuels were recommended. A number of follow-up actions by different stakeholders were generated.

APAARI and GFAR are expected to continue to play the role of honest brokers and facilitators in the areas of information and knowledge sharing, capacity building, partnership and networking, resource mobilization and policy advocacy. A new role in monitoring and evaluation of these collaborative activities was suggested. NARS leaders are expected to address the priorities and recommendations from this synthesis workshop and donors will hopefully be more supportive of AR4D.

Conclusion

APAARI through its strategies/priorities and action plan has focused on promoting NARS efficiency through collaboration and networking (facilitating/promoting crop and regional networks) with diverse stakeholders, promoting and disseminating technologies and ‘best practices’, enhancing NARS human resource capacity, advocating policy relevant initiatives and fostering a culture of knowledge sharing.

Based on its strategic plan, APAARI envisages promoting other priority areas such as linking farmers to markets, natural resource management and livestock knowledge resource network. Its growing membership and diversification among its partners provides collective knowledge-base to address poverty reduction and food security, thereby contributing to better livelihoods/welfare of the poor farmers consistent with the Millennium Development Goals (MDGs).
Facilitation of innovation in R&D institutions and knowledge management

AM Zola

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Consultants and information sharing

Individual consultants and consulting companies have a high demand for access to research and development expertise in the course of preparing bidding documents for proposals; during project implementation and preparing project reports; and, when formulating projects for consideration by donors and client governments. Larger consulting firms are often able to mobilize internal institutional sources of knowledge, including:

- Human resources, namely the personal experience of the specialists, documents, electronic (CDs and internet);
- Local external sources of knowledge, namely university professors, researchers, research institutes; and,
- Exchanges both within and among consulting teams working in the field.

However, smaller firms, those with fewer permanent professional staff and fewer teams in the field, are obligated to either create and maintain a collection of documents and books for use by specialists engaged to prepare proposals and implement projects; or, seek access to ‘free’ sources of information from international institutes, organizations, and agencies.

Image of the research community among consultants and non-government organizations

Consultants and NGOs tend to see the research community as a free source of information for development practitioners. Researchers and experts affiliated with international institutes, organizations, and agencies are valuable sources of contacts, information and field data. They are seen as a ‘brain bank’ of committed technical experts, who are available for consultation and guidance as required by the task at hand. Generally, they are found to be highly responsive and accessible.
Need for new mechanisms for sharing information and knowledge on livestock

Several factors mandate the development of new mechanisms for sharing information and knowledge on livestock, specifically:

- In many developing countries, livestock is a ‘gold mine’ for farmers. This is true particularly in least developed countries that are adjacent to or close by rapidly developing countries or middle income economies. Livestock is seen as an important tool for poverty alleviation and increasingly as an alternative agricultural development model. Examples of such countries include Lao PDR, the province of Aceh in Indonesia, and Afghanistan. Therefore, livestock improvement and development projects are critical to the creation of wealth from this asset of the poor.

- At the same time, livestock are susceptible to an ever-growing and diverse range of communicable diseases that are occurring more frequently and spreading more quickly in the context of globalization and regional trade liberalization. Such diseases include SARS, avian influenza, BSE, Foot-and-Mouth-Disease, salmonellosis (poultry, cattle and swine), among others.

- Added to these two factors is the increased demand for meat protein in countries with rapid economic growth and rising incomes, particularly those with growing middle classes, specifically China, Vietnam, and Thailand.

At the same time, there is a significant growth in consumer demand for natural, organic, and free range products, particularly meat derived from livestock that has not been exposed to hormones and antibiotics.

As a result, there is a significant and even urgent need for the development of new mechanisms for sharing information and knowledge on livestock.

Possible mechanisms for sharing information and knowledge on livestock

Several mechanisms offer the potential to be used for sharing information and knowledge on livestock:

- Specific to NGOs, a registry of NGOs could be established, drawing from the existing roster of NGOs maintained by the United Nations. NGOs registered with the UN and consulting companies registered in developing countries (the Thai Ministry of Finance maintains a list of registered Thai consulting firms, for example) could be provided with free electronic access to reports and information on a subscription basis.

- Similarly, NGOs and consultants from developing countries could access information and technical advice through a focal point or a clearing house, allowing them to contact one or more technical specialists or experts. Such access could be free for a limited period, with a nominal charge for exceeding a stipulated number of hours.
- Large and small consulting firms from any country could pay for subscriptions to reports prepared by experts from ILRI, for example. Reports that were more than say 3–4 years old would be available free to download from the agency’s website.
- Similarly, large and small consulting firms could be given access to a network of experts whose services and advice are available for a fee. The FAO or another coordinating agency could fix rates that would give access to livestock specialists for a limited number of hours per topic. Proceeds would be made available to the participating institute.
- Livestock research institutes could organize global on-line conferences open to all, on specific topics. Internet-based telephone services like Skype and Google could be utilized.
- In addition, livestock research agencies could make selected experts available free on-line through the internet, for a fixed time period, with experts making themselves available to all concerned and interested parties.
- Similar to the ‘Thorn Tree’ operated by the Lonely Planet guides, a question and answer website could be established with open access for all interested parties.
- Finally, research organizations and agencies could establish internet-based ‘chat rooms’ wherein discussions on specific technical topics could be scheduled. Participants would sign up to join the discussion in advance, including sending in their questions so that appropriate experts could be available to discuss them.
Facilitation Innovation in R&D Institutions & Knowledge Management

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President, MIDAS Agronomics Co. Ltd.
& Chief Technical Officer
Doi Tung Centre for Social Entrepreneurship
Mae Fah Luang Foundation under Royal Patronage

Consultants & Information Sharing

How do consulting companies access R&D expertise?

• **Internal** institutional sources of knowledge:
  – human resources / personal experience of the specialists, documents, electronic (CDs & Internet)

• **Local external** sources of knowledge:
  – university professors, researchers, research institutes

• **Exchanges** within the consulting teams
Consultants & Information Sharing

How do consultants share information?

• **Sharing of documents**, data, reports; electronic & hard copies
• Informal discussions
• **Tapping each other’s networks**, both domestic & international
• **Team meetings**: brain-storming sessions, focus groups, multi-disciplinary discussions

How do consultants & NGOs view the research community?

• Researchers
• Experts
• **Valuable sources of contacts, information, & data**
• Dedicated & committed technical experts
• **Free source of information for development practitioners**
Is there need for new mechanisms for sharing information & knowledge on livestock?

• Assumptions:
  – In many countries, livestock is a “GOLD MINE” for farmers; key tool for poverty alleviation; e.g. Laos, Aceh, Afghanistan
  – Multiplicity of communicable livestock diseases are occurring more frequently & spreading more quickly in the context of globalization & regional trade liberalization: SARS, avian influenza, BSE, foot & mouth disease, salmonellosis (poultry, cattle & swine), etc.
  – Increased demand for meat protein in countries with rapid economic growth & rising incomes / growing middle classes (e.g., China, Viet Nam, Thailand)
  – Significant growth in consumer demand for natural / organic / free range products: no use of hormones

• Result: Increased importance of livestock as an alternative agricultural development model

Possible mechanisms for sharing information & knowledge on livestock

• Registration of NGOs; use UN roster
  – Providing electronic access to reports & information – free
  – Access to a focal point / clearing house to contact one or more technical specialists / experts; free for a limited number of hours

• Subscriptions for consulting companies
  – Providing electronic access to reports & information; some are free; some for a fee; Le monde newspaper example
  – Access to a network of experts whose services & advice are available for a fee; fixed rates; limited number of hours per topic; proceeds are made available to the host institute
Possible mechanisms for sharing information & knowledge on livestock

• On-line conferences open to all
  – Fixed time period when experts will make themselves available to all concerned & interested parties
  – Q & A; written questions & written responses
  – Chat room discussions

• Paid subscriptions for consulting firms & free subscriptions for registered NGOs
  – Fixed number of technical papers available annually

The End

Thank you
Information sharing to facilitate innovation in R&D institutions and knowledge management: The global consortium on zoonoses and avian flu

*DD Joshi*

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**Background information about zoonotic diseases and their transmission factors**

To understand the epidemiology of zoonoses, that is the diseases transmitted from animals to humans, requires the integration of knowledge about human, animal and ecosystem health. Professionals from these diverse disciplines must work together to address the complex aspects at the intersection of health and the environment (Figure 1).

![Figure 1. Epidemic process and evolution of zoonoses.](image)

**Epidemiological and environmental factors associated with man/animals**

Zoonotic diseases with their reservoirs in domestic and wild animals impose a heavy burden on human health, especially among rural people. The complex epidemiological disease cycle between animals and humans remain largely unclear and risk factors associated with acquiring zoonotic infections are not fully understood. Moreover the prevalence and socio-economic consequences of zoonotic diseases in many developing countries have worsened in recent years due to changes in farm and livestock management and land-use practices leading to ecological developments without public health controls being put in place. In Asia the rapid changes in consumer habits and in the fast-growing food industries have not been matched...
by improved services for the surveillance and control of diseases, such that zoonoses like brucellosis and hydatidosis have assumed increasing economic significance. As a consequence of urbanization, travel tourism and trade, zoonoses associated mostly with domestic and commensal animals in urbanized areas, such as rabies, hydatidosis and taeniasis, and ‘newly emerging’ zoonoses have become threats to the health and well-being of humans and to the growth of animal populations.

The usual modes of transmission of zoonotic infection to human beings are by: (i) contact, whether direct or indirect (like food and mouth disease, anthrax, brucellosis, staphylococcosis; (ii) inhalation (tuberculosis, Q-fever, lassa fever etc.); (iii) ingestion (salmonellosis, shigellosis, sarcosporidiosis); (iv) vectors such as arthropods or other invertebrates that transmit the infection mechanically or biologically (murine typhus, human plague, Japanese encephalitis, visceral leishmaniasis etc); and (v) inoculation (leptospirosis, brucellosis, Q-fever etc.). Our ability to control zoonoses is affected by an inadequate knowledge of reservoir hosts, reluctance (and some legal problems) to destroy domestic animals when they constitute reservoirs, and the lack of economically feasible methods for their control.

Factors at the level of the community have to be understood: Poor rural communities, who are a neglected sector of our populations; males and children are more affected, and a strong association with occupational exposure is evident; general demography and educational status of the community, including occupations; beliefs and practices about the diseases (this can include considerable surprises); social and community infrastructural aspects of the population, including occupations and services; subclinical infection carriers, acute cases, and chronic cases; general comprehension about health and diseases, prevention and control, and the use of any health facilities need to be understood. When resettlement schemes, migrant workers or nomadic populations are involved, then it is important to examine three basic levels: point of origin, route, and final destination, as well as duration of movements and frequency.

Economic factors include: Sources of income in the community and employment patterns; ownership of land and other assets; nomadic populations and sources of income/survival and productivity; agricultural patterns in the community, including schemes for mechanization and commercial enterprises; colonization and resettlement schemes, forestation and forest clearance activities, irrigation schemes and other development projects in the area; local political and economic structure; location and distribution of houses and their design; domestic animals, livestock and other animals distribution and practices; individual treatment costs; loss of time at school/work/home at different levels of disability/morbidity; associated losses in income/revenue and savings and investment opportunities; hospitalization costs; costs of preventive care and associated with animal reservoirs and their control of elimination and for disease control in the community.
The case of avian influenza

The zoonosis, avian influenza (AI or bird flu), has generated much recent concern (Joshi 2006b). Since 1959 there have been more than 25 HPAI (highly pathogenic) virulent viruses isolated from poultry, ducks and turkeys (Alexander 2001; Joshi 2006a). Risk factors for recent disease outbreaks in animals should be identified not only for HPAI but also for equine influenza (EI) and swine influenza (SI). All countries should put in place surveillance systems based on the guidelines given by OIE/FAO/WHO (OIE 1994, 1999 and 2000; Chillaud 2001). The transmission cycle of the influenza virus is shown in Figure 2. AI is a deadly disease prevalent in poultry (including ducks) of Asian countries, which poses the risk of a pandemic that can cause far greater loss of human beings than Severe Acute Respiratory Syndrome (SARS). The AI virus may persist in the environment (including poultry sheds) for many years and poultry can act as reservoirs and are capable of excreting large quantities of the viruses into the environment without showing clinical symptoms (Fujita 2004). As the direct effect on the poultry populations of Asia, the threat of the virus mutating into a form that could spread as a global epidemic or pandemic in birds and in humans, has had major impacts on tourism and trade.

Global consortia and international recommendations

The guidelines addressing AI developed by WHO, FAO and OIE for occupational human health and safety state that:

- Contaminated and potentially contaminated materials, including animal carcasses, should be properly disposed of within 24 hours of the destruction of the susceptible animals;
• Disposal should be done in a manner that does not allow the avian influenza agent to spread, has little or no effect on the environment, and conserves meat or animal protein if logistically supportable from a biosecurity viewpoint;
• All premises on which animals are euthanised and disposed of should be required to be cleaned and disinfected;
• Biosecurity procedures to prevent the spread of avian influenza should be implemented within 24 hours of the identification of the first presumptive positive premises;
• Development of common educational materials for biosecurity and public health should be completed and shared with the region for translation and distribution across the region as this would be essential for biosecurity and containment;
• Veterinary Task Force in charge of preparing emergency control, contingency, and response plans should include, among others, representatives from other agencies and individuals responsible for the public health sector for consultation by these authorities;
• Preventing infection in individuals at higher risk of exposure (veterinarians, cullers, laboratory workers, health care workers etc.) should involve provision of personnel protective equipment (PPE), vaccines and antivirals, training, technical guidance, and advisories;
• Potentially exposed, known infected, or diseased poultry which are culled, should never enter the human or animal food chain, and must be properly disposed of eggs produced under systems of potential or known exposure should likewise not enter food chains;
• Samples of animal origin should be sent to the national reference veterinary laboratory for preliminary or primary diagnosis with further dispatch to reference laboratories;
• Reference laboratories of OIE, FAO, and WHO are recommended to share timely results of their analysis with other laboratories, the world community and most certainly the authorities of the country of origin;
• Veterinary laboratories should conduct diagnostic procedures according to the OIE Manual of Standards for Diagnostic Tests and Vaccines’;
• Make the development of a simple, robust, and reliable diagnostic test for use in the field and at the patient’s place a high priority;
• Continue to monitor H5N1 virus strains, in humans and avian species, to determine changing patterns of resistance to antiviral drugs;
• In countries experiencing continuing outbreaks in poultry, conduct studies to identify the factors driving continued transmission of the virus, and plan interventions accordingly;
• Standardize antigen content in poultry vaccines and insist on rigorous quality control worldwide in line with OIE standards;
• Continue to recognize, for surveillance and research on pathogenesis, the potential role of pigs (or other species) as intermediate hosts in the generation of pandemic viruses;
• Enhance international collaboration in the surveillance of wild birds and in the sharing of data from such surveillance efforts;
• Improve understanding of migratory routes for wild waterfowl and strengthen collaborative interactions with ornithologists.

Conclusion

Given the complexity of the epidemiology of existing and emerging zoonoses and the threat of zoonoses to the health of humans and animals and to national economies, it is clear that regional and global consortia are critical to our efforts to limit the impacts of these diseases and to their control. Inter-disciplinary expertise is essential to facilitate innovation and, ultimately, to ensure the effective management of knowledge in local and regional R&D institutions that lead to timely interventions against these major threats. Whether the threat to the health of humans and animals is from AI or from another zoonosis in which, for example, pigs act as hosts, it is vital that there are Research and Development (R&D) programs on livestock systems in the Asia and Pacific region in which disease surveillance and research on pathogenesis are key components. Clearly the potential role of livestock species (including pigs) as intermediate hosts in the generation of pandemic viruses and other zoonoses will remain for many years a major issue to be addressed by the region’s livestock R&D community.

Acknowledgement

I thank Ms Meena Dahal for her excellent support in preparation of this paper.

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Global Consortium: Zoonoses and Avian Flu

Dr. Durga Datt Joshi
Executive Chairman, NZFHRC

Ecosystem, Environment and Zoonotic Disease Transmission
### Epidemiological Factors Associated with Man-Animals

- Zoonotic diseases have had a tremendous impact on the evolution of man, especially on those cultures and societies that have domesticated and bred animals for food production.
- Zoonotic diseases with their reservoir in domestic and wild animals, have imposed and are still imposing a very heavy burden, especially among the vast number of people living and working in rural areas.
- The complex epidemiological disease cycle interrelationship(s) between the animal and human remain largely unclear. The risk factors of acquiring the infections are not completely identified.

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### Epidemiological Factors…….(Cont.)

- With respect to the prevalence and socio-economic consequences of zoonotic diseases in Nepal the conditions have actually deteriorated in recent years which is due to:
  - Farm management, changing land-use patterns, and animal industries have led to ecological developments without appropriate controls of their respective public health hazards.
  - Changing consumer habits rapidly developing food industries by inadequate services of diseases surveillance and control.
Epidemiological Factors……(Cont.)

• Asian developing countries have expanded and/or expanding their dairy, meat and other animal industries zoonoses such as brucellosis and hydatidosis have assumed increasing economic significance.

• Zoonoses associated mostly with domestic and commensal animals in urbanized areas, such as rabies, hydatidosis, taeniasis and “newly emerging” zoonoses have become an increased hazard to the growth of the animal population and to the health and well-being of the human population as a consequence of urbanization, travel tourism and trade.

Environmental Factors

• Environmental factors have played an important role, and the environment itself has suffered, through the alternation of ecological conditions and ecosystem health as a result of more zoonotic diseases.

• Zoonoses cause heavy losses of high-quality protein food (milk, meat, eggs, fish, etc.) which seems to be increasingly scarce among those populations who mostly need them, particularly children.

• The Usual modes of transmission of zoonotic infection to human beings are by:
### Environmental Factors...(Cont.)

- **Contact** – Anthrax, Brucellosis.
- **Inhalation** – Tuberculosis, Q-fever, Lassa Fever, etc.
- **Investigation** – Salmonellosis, Shigellosis, Sarcosporidiosis.
- **Vectors** – Murine Typhus, Human Plague, Japanese encephalitis, visceral leishmaniasis etc.
- **Inoculation** – Leptospirosis, brucellosis, Q-fever etc.

### Factors associated with community:

- Poor rural communities who are a largely neglected sector of our populations.
- General demography and educational status of the community, including occupations.
- Perception of the community on sources and modes of acquisition of infection and their attitude stewards such modes.
- Beliefs and practices about the diseases (this can include considerable surprises).
Perception of the most important zoonotic diseases – FAO-L-members survey, 2005

(200 answers)
Comparison of the perception of the most important zoonotic diseases
FAO-L-member survey, 2002 and 2005

Avian Influenza (Bird Flu)

- Causative Agent: RNA viruses, genus *Influenzavirus* (Type A and B), family Orthomyxoviridae; type C is in a separate, unnamed genus.

- Syndrome: Human: An acute respiratory disease. Signs of types A and B typically include fever, chills, headache and muscular aches, malaise, pharygitis, and cough. Gastrointestinal signs, such as nausea, vomiting, and diarrhea, occur more in children than in adults.
Avian Influenza…...(Cont.)

- Bird flu is also called Avian Influenza. It is caused by an RNA genome group of virus.
- It has three recognized types A, B and C. From the epidemiological point of view, there are two antigens involved in the infection: one hemagglutinating (H) antigen and the other Neuraminidase (N) antigen.
- Their subtypes are from H1 to H12 and N1 to N9 antigen recognized so far (WHO, 1980).
H5N1 Bird Flu Outbreaks in Asia, 2005.

Avian Influenza......(Cont.)

- **Confirmatory tests:** Virus isolation from throat or nasal washings early in the illness. Serologic tests (HI, CF, SN) of paired sera.
- **Occurrence:** Worldwide, usually in epidemics or pandemics, with high morbidity and generally low mortality, and sporadic cases.
- **Transmission:** Mainly by inhalation of aerosols and by direct contact with droplets. Among birds, also by the fecal-oral route.
- **Control and Prevention**
- **Local/Community:** vaccination campaigns can help reduce the magnitude of epidemics.
Avian Influenza......(Cont.)

- During the year 1997, there was an outbreak of H5N1 in birds in Honk Kong and 6 people died and 18 were cured. In 2003, same subtype virus H5N1 occurred in birds and 83 people got this flu and a person died (WHO/FAO/OIE 1984).
- During the year 1997/1998 to 2003, outbreaks were recorded in South Korea, Vietnam, Japan, Netherlands and Honk Kong. Many infected birds died while others were killed and sacrificed.

Highly Pathogenic Avian Influenza (HPAI) Isolates from Poultry since 1959 Outbreaks in Different Countries

- A/chicken/Scotland/59 (H5N1)
- A/turkey/England/63 (H7N3)
- A/turkey/Ontario/7732/66 (H5N9)
- A/chicken/Victoria/76 (H7N7)
- A/chicken/Germany/79 (H7N7)
- A/turkey/England/199/79 (H7N7)
- A/chicken/Pennsylvania/1370/83 (H5N2)
- A/turkey/Ireland/1378/83 (H5N8)
- A/chicken/Victoria/85 (H7N7)
Highly Pathogenic Avian Influenza (HPAI)...

- A/turkey/England/50-92/91 (H5N1)
- A/chicken/Victoria/1/92 (H7N3)
- A/chicken/Queensland/667-6/94 (H7N3)
- A/chicken/Mexico/8623-607/94 (H5N2)
- A/chicken/Pakistan/447/94 (H7N3)
- A/chicken/NSW/97 (H7N4)
- A/chicken/Hong Kong/97 (H5N1)
- A/chicken/Italy/330/97 (H5N2)
- A/turkey/Italy/99 (H7N1)

Source: Dennis J. Alexander, 2001 and Joshi 2005

Highly Pathogenic Avian Influenza (HPAI)...

- A/chicken/Hong Kong/2000 (H5N1)
- A/chicken/Thailand/2001 (H5N1)
- A/duck/Vietnam/2002 (H5N1)
- A/chicken/China/2003 (H5N1)
- A/chicken/Vietnam/2004 (H5N1)
- A/chicken/Thailand, Vietnam, Laos, Cambodia, China/2005 (H5N1)

Source: Dennis J. Alexander, 2001 and Joshi 2005
Host Range of Influenza Virus

- Host range of influenza viruses by HA-NA combinations and by species include: (Slemons, 2002)
  - Humans: H1N1, H2N2, H3N2, (H5N1, H9N2)
  - Swine: H1N1, N3N2, H1N2, (H9N2, H4N6, H1N7)
  - Equine: H3N2, (H7N7)
  - Avian: All 15HA and all 9NA subtypes in most combinations (135 potential HA-NA combination) H5N1-HPA1)
Spread of Bird Flu Virus in Birds and Human.

Pig Density and Avian Influenza Outbreaks in Asia, 2004 FAO
Recommendation as per WHO/FAO/OIE guidelines

- Contaminated and potentially contaminated materials, including animal carcasses, should be properly disposed.
- Disposal should be done in a manner that does not allow the avian influenza agent to spread.
- All premises on which animals are euthanized and disposed.
- Biosecurity procedures to prevent the spread of avian influenza should be implemented.
- Development of common educational materials for biosecurity and public health should be completed and shared.

Recommendation ……. (Cont.)

- Potentially exposed, known infected, or diseased poultry which are culled, should never enter the human or animal food chain, and must be properly disposed.
- Samples of animal origin should be sent to the national reference veterinary laboratory.
- Reference laboratories of OIE, FAO, and WHO, are recommended to share timely results of their analysis with other laboratories.
- Veterinary laboratories should conduct diagnostic procedures according to the OIE Manual.
Recommendation …… (Cont.)

- Continue to monitor H5N1 virus strains, in humans and avian species.
- Standardize antigen content in poultry vaccines.
- Continue to recognize, for the purposes of surveillance and research on pathogenesis.
- Enhance international collaboration in the surveillance of wild birds.

Conclusion

- Developing vaccines against potential pandemic influenza viruses is an urgent need for a vaccination and control of human infection with influenza A (H5N1) and A (H9N2) viruses.
- It is necessary to have Research and Development (R&D) on pig farming systems in Asia and the Pacific to recognize for the purposes of surveillance and research on pathogenesis, the potential role of pigs as intermediate hosts in the generation of pandemic viruses.
- The FAO/OIE also stated that regional collaboration in Avian Influenza surveillance in domestic animals and wildlife, reporting and control is crucial.
I would like to acknowledge the following persons for their support:

- Dr. William Thorpe, Regional Representative, Asia, International Livestock Research Institute.
- Dr. Hans Wagner, Senior Animal Production and Health Officer, FAO/Regional Office for Asia and the Pacific.
- Dr. Nawarat Chalermpao, Project Assistant FAO/RAP Bangkok.
- Ms. Meena Dahal, Computer Analyst, NZFHRC.
Discussion group outcomes

To conclude the session, *Facilitating innovation in R&D institutions and knowledge management*, groups of three participants were asked to answer (through writing their ideas on cards) the questions:

- What do you see as a major communication—knowledge sharing gap?
- What do you consider to be an opportunity to address the gap?

Contributions were grouped into two broad categories:

- *Communication among R&D stakeholders* can be promoted through:
  - Evaluating potential interventions in terms of livelihood outcomes, rather than just in technical (pig production) terms
  - Researchers talking to all stakeholders along the value chain, especially farmers, to hear the ‘voices from the farmers’
  - Understanding the needs of clients (farmers, butchers etc. depending on where we work along the value change) and recognizing how to define the best entry point
  - Understanding market demand and providing feedback to producers and other stakeholders
  - Undertaking R&D to generate interventions that will facilitate value-addition to give higher incomes to the poor
  - Undertaking R&D to identify smallholder-friendly technology development in an environment where most is developed for commercial sector
  - Identifying and prioritizing problems of poor farmers and undertaking R&D to produce technologies that are scale-neutral and can be adopted as public goods: an example is abatement of environmental pollution
  - Undertaking R&D to understand constraints to adoption and identify practical solutions to facilitate widespread adoption of technologies that have shown to be viable on farm: an example is the utilization of agricultural by-products as feed
  - Monitoring of animal, inputs and sales performance to enable informed decisions on economics, management and breeding
  - Investing in R&D that does not increase risk for smallholder producers or the poor; but increases sustainability of the pig production systems in the long run
  - Researchers learning how to interact and engage in dialogue with policymakers and government planners
  - Ensuring that all national pig industry stakeholders can get together in an annual meeting; with a few national representatives for regional meetings
  - Exchanging ideas among all stakeholders (private sector, farmers organizations, researchers, CSOs other development practitioners, policymakers)
  - Supporting a regular regional or international forum focusing on smallholder pig production
  - Recognizing the need for building capacity to find and use the information available on the internet.
The smallholder/client focus of extension system and delivery methods can be enhanced by:

- Encouraging extension services to interact more with researchers; and researchers need to respond to the needs of particular locations
- Assessing objectively the role of local breeds in development and the genetic conservation and improvement of indigenous breeds
- Developing a suitable certification method for local service providers throughout the value chain
- Making an inventory of available extension materials for smallholders (on feed, health, management, breeding) and, if necessary, develop material to be available in English on the web that can be translated locally
- Defining the availability of communal resources for sustainable and equitable land use in subsistence systems
- Creating industry levies to support activities for smallholder pig system development
- Innovating with funding mechanisms, for example, a subsidy from large-scale producers to support small producers; and oblige big producers to pay for environmental costs.
Plenary discussion of outcomes and possible ways forward

The closing plenary discussion first addressed how well the workshop had achieved the expected outcome:

- Existing R&D networks strengthened and new relationships created

It was agreed that while participation at the workshop had strengthened existing linkages and opened the possibility of new relationships, it was important that efforts should continue to put in place stronger formal mechanisms and to develop informal networks. Examples were: (i) linking APhCA and APAARI; (ii) promoting pig production and marketing for poverty alleviation at national and regional fora, including commercial events like the VivAsia Pig & Poultry biannual Expo; (iii) identifying ways of more effectively engaging key development actors, policy-makers and the private sector; (iv) using the workshop mailing list to continue exchanging information amongst the participants and their colleagues; and, (v) developing communities of practice (CoPs) on specific topics, e.g. improving farm-produced feed.

The discussion had a large degree of overlap with that about the second expected outcome from the workshop:

- Information on R&D activities in the region shared and new mechanisms for sharing information identified

Participants appreciated the range and depth of the information presented in the various papers and acknowledged the key roles that regional bodies like APhCA and APAARI can play, the potential of National Livestock Working Groups and their pig systems subgroups and the excellent service provided by PigTrop: http://pigtrop.cirad.fr/en

During the discussion of the third expected outcome:

- Effective development interventions and important gaps requiring research identified

the participants emphasized the need for an integrated approach and highlighted the importance of developing effective interventions to:

  - improve on-farm feed resources (citing the examples from Laos and Papua) and the processing of locally available feeds
  - test through action research alternative models for delivering breeding services and vaccines and to create disease-free zones.

Amongst the research issues that should be addressed were listed:

- Understanding processes for effective R&D cycles and collective action
- Characterization of indigenous breeds
- Barriers to market access for small-scale producers, including Codex standards
- Updating demand scenarios for pig meat and pork products
• Nutrient flows and environmental impacts of large- and small-scale units, including the disposal of waste from production units and slaughter houses
• Efficiency of use, and the pricing of, water
• Reducing risks of zoonoses from pig production
• Pig welfare (for which reference should be made to OIE).

The discussion of these and related R&D issues then focused on the priorities to be addressed by the group in order to deliver the workshop’s fourth and final outcome:

• Options for R&D projects and resource mobilization identified

The outcome of the debate was the identification of six topics (each with potential funding agencies) for which it was agreed that concept notes would be drafted:

• Factors influencing commercialization of small-scale pig production (CFC; ADB)
• Natural resource management, and especially water management, related to pig systems (CPW&F; WB)
• Conservation and utilization of indigenous pig breeds in sustainable systems (build on outcomes of the undertaken discussions)
• Capacity-building for genetic improvement applied to pig systems (regional TCP)
• Understanding linkages for effective R&D cycles (APAARI with IFAP; ACIAR)
• Evaluation of project processes for lesson-learning (AusAid/ACIAR)

For topics 1-3, ILRI was identified as the lead organization, David Steane agreed to lead topic 4, and APAARI with IFAP would lead topic 5 and the Australians topic 6.

It was concluded that the workshop had provided an effective forum for reviewing the status of pig systems R&D in the context of enhancing benefits from pig production and marketing for the poor. And, moreover, there were clear priorities for the participants and their colleagues to address.
Annex 1  Workshop program

Opening:
W Thorpe, ILRI

Session 1. Pig systems, livelihoods and poverty: Current status, emerging issues and ways forward
Chairman/facilitator: Steve Staal, ILRI

1.1 Papers and plenary discussion
Overview
NE India: Traditional and commercializing systems KM Bujarbaruah
Philippines and Thailand: Sector differentiation, environment and export trade N Poapongsakorn
Vietnam: A spectrum of commercialization NN Que
Myanmar, Laos and Cambodia: Transition from subsistence POK Samkol
SW China: Responding to market demand K Chen
Lessons from the Pacific H-G Wagner

1.2 Discussion groups to identify major R&D issues

1.3 Plenary presentation of group outcomes

Session 2. Facilitating interventions and innovation in production systems and markets
Chairman/facilitator: Werner Stür, CIAT

2.1 Papers and plenary discussion
Pig systems in Nepal: How can R&D enhance benefits to the poor farmers of Nepal DD Joshi
Farmer-led research in Laos P Phengsavanh
Farm-based multidisciplinary research in Papua Colin Cargill
Improving performance through breeding La Van Kinh
Institution–farmer cooperation in Sichuan Zhou Chengyi

2.2 Discussion groups to identify important lessons and possible ways forward

2.3 Plenary presentation of group outcomes
Session 3. Facilitating innovation in R&D institutions and knowledge management

Chairman/facilitator: Doug Gray, ILRI

3.1 Papers and plenary discussion
   Information sharing: PigTrop
   National dialogue and synthesis: Vietnam Livestock Working Group
   Regional cooperation: ASEAN and SEAFMD
   International dialogue and synthesis: APHCA
   International dialogue and synthesis: APAARI
   Regional cooperation: NGOs, GMS
   Global consortium: Zoonoses and avian flu

W Thorpe
P Gautier
R Abila
H Wagner
BD Rosario
T Zola
DD Joshi

3.2 Discussion groups to identify important lessons

3.3 Plenary presentation of group outcomes

Session 4. Plenary discussion of outcomes and possible ways forward

Chairman/facilitator: Shirley Tarawali, ILRI
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