



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Pig Production in Cambodia, Laos, Philippines, and Vietnam: A Review

T.T.T. Huynh

Ministry of Agricultural and Rural Development, Vietnam

Email: thuy.huynh@vnn.vn

A.J.A. Aarnink

Wageningen University, The Netherlands

Email: andre.aarnink@wur.nl

Adam Drucker

Charles Darwin University, Australia

Email: adam.drucker@cdu.edu.au

M.W.A. Verstegen

Wageningen University, The Netherlands

Email: Martin.Verstegen@wur.nl

ABSTRACT

In the last two decades, Asia has become the world's fastest economically growing area. Countries in Southeast Asia are growing at an increasing rate. For instance, the average annual income is increasing from 4% to 8%, population from 2% to 3%, urbanization from 4% to 6%, and meat consumption from 4% to 8%. In this region, pork is the most important source of meat, accounting for approximately 58% of total meat output. However, pig production in the region is small in scale with more than 70% being smallholders. Regional and national goals to reach the international market threaten traditional pig production due to its perceived low standard of output. Alongside, natural resources are under high pressure from heavy pollution emanating from pig production. Industrialization has caused the migration of the pig population from rural areas to the outskirts of big cities like Manila, Ho Chi Minh, and Siemriep, or Phnom Penh. Industrialization has also resulted in air, soil, and water pollution in these cities. In addition, the region shares a huge area of the South China Sea and by intensive pig keeping, surplus nutrients and minerals flow into that sea.

This paper aims to: 1) provide an overview of the current pig production situation in certain selected ASEAN countries, namely Cambodia, Laos, Philippines, and Vietnam; 2) analyze how these changes may occur over the coming years and how it will affect the livelihoods of different types of pig farmers (large, medium, small); 3) identify some of the constraints that will need to be overcome (e.g., environmental impact, disease challenge, breed loss, effect of globalization, marginalization of small farmers, climate change issues); and 4) to pinpoint certain guidelines for drawing up a regional strategy on pig production.

INTRODUCTION

Alongside economic growth, animal production is increasing rapidly in Asia. Compared with their 31% share of the world meat production in 1980, developing countries will produce 60% by 2020 (Delgado et al. 1999). Of this projected 60%, 13.2% will be produced in Southeast Asia alone. Depending on the country and the scale of production, pigs are important for farmers as a major source of family income or as a 'savings bank' (Steinfeld 1998). In the studied areas, pig production shares 2.0% to 2.8% of the total value of national GDP (Jones 2002; FAO AGAL 2005a).

However, the increase in production has brought forth a host of social, economic and environmental concerns. Specifically, these concerns relate to such areas as nutrition, animal health, animal productivity/genetic make-up, extension services, provision of finance to small-scale producers, and marketing. In addition, countries in the region aim to expand pig production and start exporting their pigs and pig products (MARD News 2006); this means that there will be a dramatic increase in the pig population and the attendant effects of such development in the near future. Given the future of pig production and its accompanying problems, developing countries—in particular, the subjects of our study—need to focus on the impact of such development not only on the livelihood of small-scale pig holders but also on the environment. The effects of pig production on both economic growth as well as environmental sustainability should be seriously considered in drawing up regional and national plans.

PIG PRODUCTION: ITS ROLE IN ECONOMIC GROWTH AND AS A DEVELOPMENT PATHWAY

The countries we selected for study, namely, Cambodia, Laos, Philippines, and Vietnam share similarities in terms of the characteristics of pig production and its role as a development pathway in their respective economies (Cameron 2000). In this section and the next, we discuss these features, focusing on the similarities among the subjects of our study, as well as the peculiar characteristics for each country (please see the Annex for more background information on each country as well as details on the respective status of the industry). We start below with the role of pig production in the economy.

Demand for Pork

Before 1999, pork consumption in the region was very erratic (Riethmuller et al. 2002). However, except for Laos which registered a decline of 8%, pork consumption from 1999 to the present has increased per year at 0.1% in Cambodia, and 0.7% in Vietnam (Table 1 and Figure 1). The increase in pork consumption has led to an increase in the pig population of Laos (by 4.5%), and Vietnam (by 4.6%) (Food Agricultural Organization [FAO] 2006). The increase in pig heads in the areas studied is partly traceable to the low slaughter weight which averages around 60 kg (MARD 2006) (See Figure 2).

Table 1. Pork consumption in proportion to total meat produced in some countries in Asia.

	2000, %	2001, %	2002, %	2003, %	2004, %
Laos	37.7	39.2	38.0	38.0	32.4
Thailand	26.0	28.9	28.2	29.6	36.8
Cambodia	53.3	53.3	53.6	53.6	53.0
Taiwan	55.6	57.8	57.0	56.3	56.6
Philippines	53.8	53.9	58.4	58.8	58.3
China	64.0	65.9	65.6	65.5	65.9
Viet Nam	70.9	71.5	72.0	72.2	71.5

Sources: FAO GLIPHA (2006); Riethmuller et al. (2002).

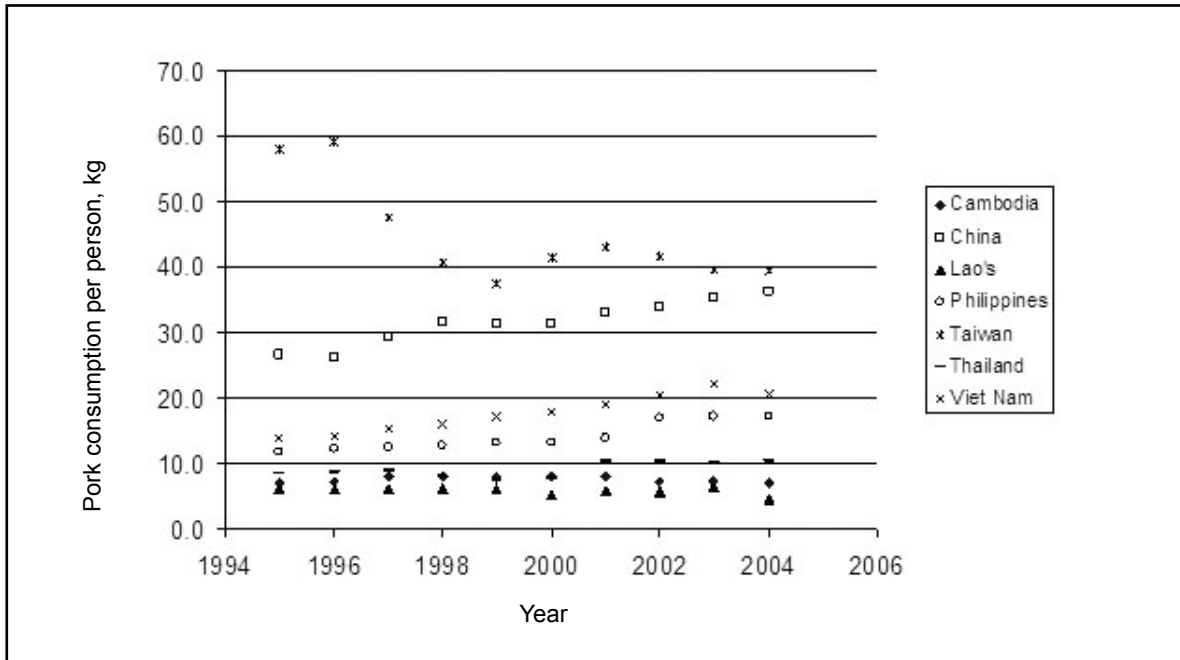


Fig. 1. Pork consumption per person in selected Asian countries.*

* Expressed in kg pork per person per year.

Source: FAO STAT,(2006).

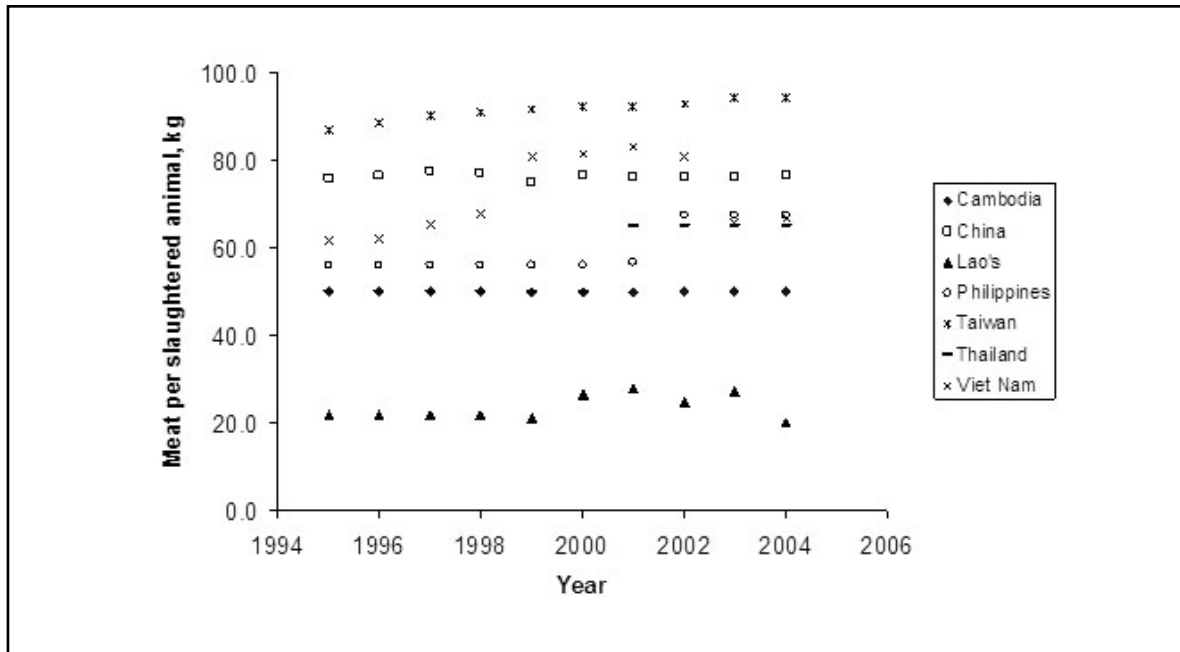


Fig. 2. Meat yield per slaughtered pig in selected Asian countries.

Source: FAO STAT (2006).

Productivity

In the areas studied, small-scale pig farms proliferate, constituting an average of 80% of the total, and their productivity is often far below potential levels (Figures 3 and 4). There is an increased dependency on imports of feed ingredients, veterinary supplies, and exotic genetic material in most countries. These imports are associated with the acceleration of commercialization (Delgado et al. 1999; Cameron 2000). In the peri-urban and inside the big cities of countries like the Philippines and Vietnam, the pig farms are becoming advanced commercial operations (Northoff 2006). The speed and the extent of commercialization, however, vary between countries.

Share of Pig Production in the National Income

The share of pig production in the total value of agricultural gross domestic product (GDP) ranges between 40% and 55%. This translates to around 2.0% to 2.8% of the total value of national GDP (Jones 2002; FAO AGAL 2005a). The shares of livestock production in the total and agricultural

GDP have been increasing by an average of 9.8% annually in the last decade (Table 2).

Research and Development Services for Pig Production

Among the four countries, the Philippines and Vietnam have relatively more advanced research and development programs for pig production (Table 3). In fact, the available services and development programs in the two countries play an important role in the improvement of pig production.

Role of Pig Production to Individuals and the Country as a Whole

Depending on the country and scale of production, farmers recognize the importance of swine as a major source of family income, as a supplementary source of funds for particular purposes (e.g., to finance the children's schooling, to use during the celebration of cultural events, or to pay off a debt), or as a 'savings bank' (Steinfeld 1998) (Table 4). Devendra (1993) added that in Southeast Asia, pig production can play three

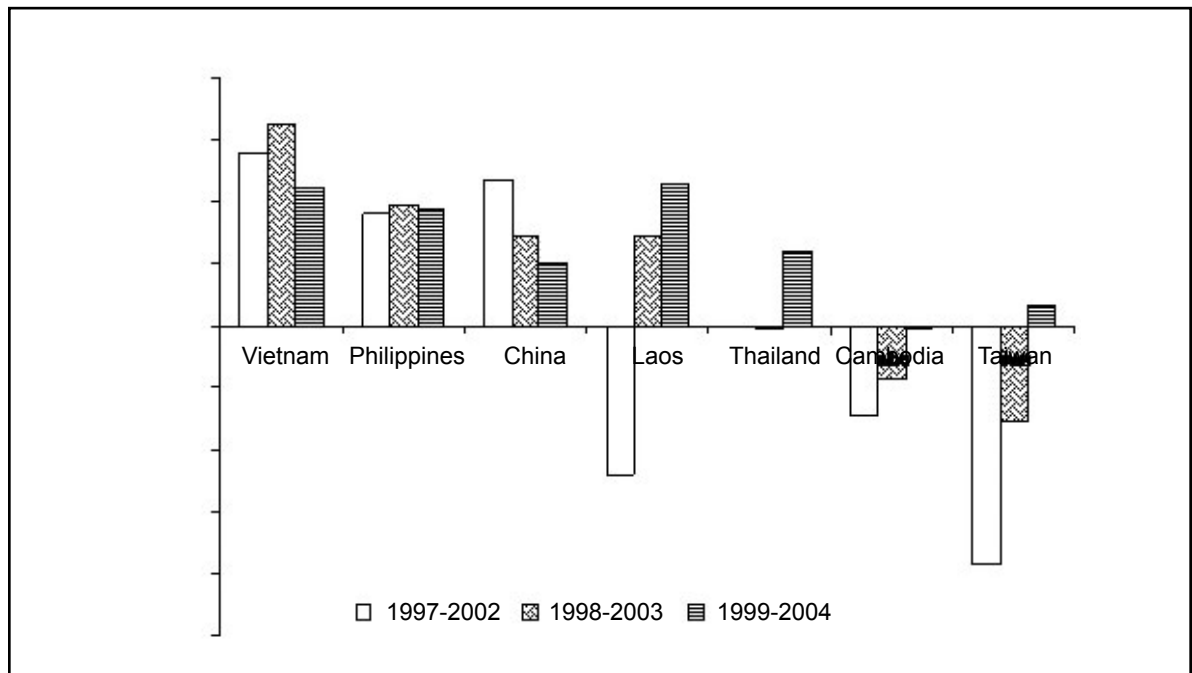


Fig. 3. Pig production growth rate in selected Asian countries in three periods.
Source: FAO GLIPHA (2006).

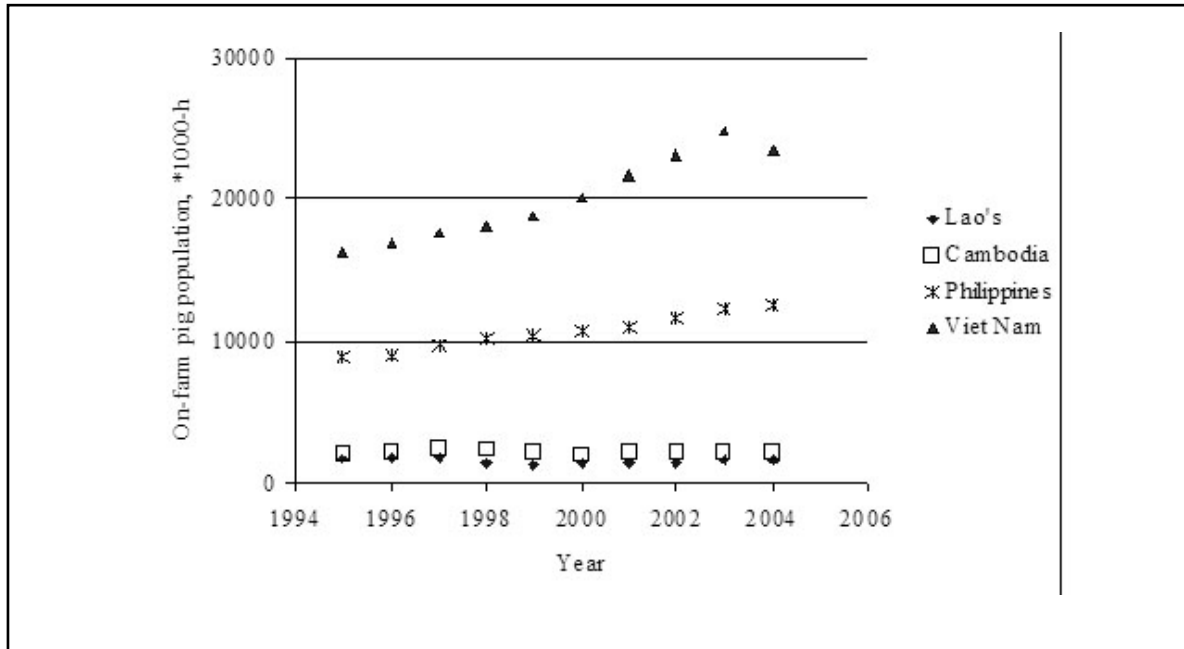


Fig. 4. On-farm pig population in four Southeast Asian countries.

Source: FAO STAT (2006).

Table 2. Total gross domestic product (GDP), agricultural GDP, and livestock GDP as a proportion of agricultural GDP.

Countries studied area	Total GDP average annual growth rate ¹		Agricultural GDP average annual growth rate ²		Livestock GDP, in the proportion of agricultural GDP, %
	1982 - 1992	1992 - 2002	1982 - 1992	1992 - 2002	1992 - 2002
Cambodia	-	-	-	-	20.9
Lao PDR	-	6.3	-	4.9	14.3
Philippines	1	3.8	0.9	2.3	
Viet Nam	-	7.5	-	4.1	4.1

(-) No data.

Source: FAO (2006).

Table 3. Status of R&D and services for pig production in the Philippines and Vietnam.

Scale	Research & Development	Source of stock	Health care	Veterinary products	Feed
Philippines					
Small (<20 heads)	Universities, DOST-PCARRD ¹ , DA ² , Foreign agencies	Among smallholders; government AI ⁴ , commercial farm	Government services	Commercial veterinary drugs	Kitchen refuse, crop by-products, commercial feed
Commercial (>20 heads)	Universities, DA, LGUs, Foreign agencies, private drug and feed companies	Self, imported	Private consultants	Imported drugs	Commercial feed
Vietnam					
Small	Research Institutes Universities	93% local, and 7% state farm, AI	District, Village, National	Domestic, locally produced products	80% crop by-products and 20% commercial feed
Medium	Research Institutes Universities	74% local, AI 26% state farm, AI	District, National	Domestic, imported products	Feed mills using crop by-products 80% and 20% commercial feed
Large	Imported know-how Self-application	Self - supplied	Self - practiced	Imported products	Feed mills using crop by-products and commercial feed

¹ DOST = Department of Science and Technology; PCARRD = Philippine Council for Agriculture, Forestry and Natural Resources Research and Development;

² DA = Department of Agriculture; 3 LGUs = Local Government Units; 4 AI = Artificial Insemination.

Sources: Le and Nguyen (1997); La et al. (2002); Lemke et al. (2002); Villar et al. (2002).

Table 4. Current and estimated agricultural population within the study areas.

	Cambodia	Laos	Philippines	Vietnam
Proportion of agricultural population to total (projected to 2010)	74	83	36	67
Estimation of projected change in agricultural population (2000-2010)	17.6	8.9	2.1	36.8

Source: FAO-STAT (2006).

important functions, namely: (1) the diversification of resources and the reduction of socioeconomic risks, (2) the promotion of linkages between systems and resource components (land, water, crops, and animals), and (3) the generation of value-added products (e.g., the recycling of fibrous crop residues to produce meat, and the use of manure).

STRUCTURE OF THE INDUSTRY

This section presents a description of the hog-raising industry's size and structure. The discussion includes a definition of the different scales of production (large/medium/small) in the four countries studied.

Large-Scale Production

Large-scale pig farms account for 15% to 20% of the total regional pig population (La et al. 2002; Northoff 2006). This commercial sector, however, produces most of the slaughter pigs for the commercial market (Jones 2002; Costales et al. 2006; Steinfeld et al. 2006). The share of commercial pig production within total pig production differs among countries. In the Philippines, large-scale farms hold 14.7% of the total breeding stock (Costales et al. 2006). Currently, there are only few commercial pig farms in Cambodia, mainly located near Phnom Penh (e.g., Yu Tong and CP companies). They supply almost all the grandparent stock, breeding sows, and piglets. These farms are well-equipped, well-managed, and have a high productivity level. Only exotic breeds—mostly Yorkshire and Landrace—are kept in this system (Borin 2006).

On the other hand, Vietnam has state-owned commercial farms as well as privately owned commercial farms. Alongside, these are joint ventures and private large-scale commercial companies involved in breeding herds, fattening, feed supply, slaughter, and processing (Jones 2002; Drucker et al. 2006). This system develops very fast in the peri-urban areas of big cities due to the sharp increase in demand for pork meat in the richer areas (FAO Livestock Policy Brief 2004; Costales 2006). For instance, in Cu Chi, HCMC, Vietnam a newly inaugurated pig-breeding farm, covering around 25 ha, accommodates a herd of 18,000 pigs. The farm is expected to supply 32,000 suckling pigs and 1,500t of pork annually for the domestic market (MARD News 2006). The breeding farm construction is part of the local efforts to first, relocate polluting establishments to rural areas and away from densely human-populated quarters of the city, and second, to modernize technology in livestock breeding.

The majority of commercial pig farms in the Philippines are located in two major regions: Central Luzon and Southern Tagalog. These regions comprise about 66% of the total national commercial pig population (Bureau of Agricultural Statistics [BAS] 2006). Compared to its level in 2001, the average pig holding size per farm in Central Luzon and Southern Tagalog have more than doubled. Clearly, the trend has resulted in the displacement of small-scale pig farmers who could have had a pathway out of poverty (Costales et al. 2006). Large-scale pig farms integrated with commercial feed mills are now being established by foreign investors in the free port zone, which means that there is indirect import of pork into the

country with zero or minimal tariff costs (Villar et al. 2002).

In the region, intensive pig industries rely on imported genetics, technology, and feed. In addition, intensive pig industries often compete with people for food. In addition, there is concern about the rising costs of feed components, leading to efforts to seek feed substitutes and to liberalize the importation of pig feeds. Some operators allegedly escape duties on feeds by importing duty-free grains for human consumption (Ramsay et al. 1999). Besides standing as an independent sector, the commercial pig industry sometimes also arranges a contract with small farmers to grow and fatten pigs (Lapar et al. 2003). The company provides all the inputs and other technical support, while the farmers supply labor and the housing facilities. The increase in the number of this type of contracts will most likely result in the domination of the meat market by giant companies. Under the current scenario, millions of smallholder households will stand to lose their market share and subsequently become employees of these large firms (Cameron 2000; Lapar et al. 2003).

Medium-Scale Pig Production

These farms produce 15% of total pig production. Normally they house between 10 to 500 fatteners and/or 5 to 100 sows, depending on the country (Table 5). Some farms only produce weaners, others only fatteners, while some have both. Some farms also house a husking mill, or

a small feed-mixing facility (Villar et al. 2002; Steinfeld et al. 2006). Pigs are kept in pens, are given commercial feed, and vaccinations and bio-security measures are applied with extreme caution. Between the different countries in the region, there are diversities in types and scales of production.

Around Phnom Penh and other cities, a medium pig farm keeps 10-50 pigs and they can be a mix of production categories such as sows, piglets, and fatteners (Borin 2006). In many cases, operators of this system usually also own rice mills or brew rice wine. The pigs raised here are usually crossbreeds and exotic breeds. Feed used in this system can be home-made concentrates or commercial feed. However, because of price competition, only very efficient farms can survive at this scale of production in the long term.

Small-Scale Swine Raising

The definition of this category varies among countries. For instance, in the Philippines and Vietnam, a small farm has less than 20 pigs, while small farms in Cambodia and Laos have less than five pigs (Jones 2002; La et al. 2002; FAO AGAL 2005c).

Nearly 70% of all pigs in the four countries are raised in small-scale farms. Small farms have been defined as household units that make most of the management decisions, and control most of the farm labor supply and, normally, much of the capital as well (Steinfeld 1998). Small farms have very low resources of labor and capital. Often they

Table 5. Brief classification of pig production system in Vietnam.

Scale	Herd size (head)	Trend	Proportion to total herd (%)	Breeds
Small	1 – 2 sows 1 – 20 fatteners	Slightly increase	80	Northern VN: mostly local (Mong Cai, Ban) South VN: mostly crossed with exotic
Medium	5 – 500 sows 20 – 4,000 fatteners	Rapid growth	15	Cross bred and exotic
Large	> 500 sows > 4,000 fatteners	Slightly increase	5	Exotic

Source: Le and Nguyen (1997); La et al. (2002).

are not able to derive a regular and adequate supply of food or an acceptable income and standard of living (FAO–UNESCO 2002). It is significant to point out here that the region presents a vast scene of small farms, with large populations of small farmers owning a few pig heads, using low inputs, and producing low outputs (Devendra 1993).

In the upland areas, which account for more than three quarters of Viet Nam's land area, pigs serve many more purposes. However, many farmers did not always acknowledge some of the other reasons for raising pigs (J. Peters 2001; D. Peters et al. 2005). This might be because these other reasons are not the main reasons why they might have taken up this activity. For instance, pigs are used as a source of manure for cropping, as a source of pork for protein consumption, and hog-raising can be considered as a custom as well (Lemke et al. 2002).

In Cambodia, the free-range small-scale subsistence pig production has remained as the main source of meat supply for local consumption (Borin 2006). Generally, two to four pigs are fattened during a period of 8–12 months to reach the marketable weight. More pigs are raised after the rice harvest season due to the availability of rice by-products such as broken rice and rice bran. The inadequate feeding, in terms of both quantity as well as quality, results in the poor growth rate of pigs. In this system, the breeds found are the local ones such as Kandol, Domrei, Hainam, and Kampot, as well as crossbreeds of several types, depending on the available breeds accessed by the hog raisers. Pig production contributes only a small part to the overall income of the family.

In Laos, small-scale pig production systems may be categorized into four types, namely: free-range scavenging, semi-intensive (confined within a large area), intensive (confined to a pig pen), and integrated pig and fish farming (Hoffmann 1999b).

In the Philippines, small-scale pig raisers, with less than ten slaughter hogs, keep pigs as a 'savings bank', or for very specific purposes such as tuition fees, food for special occasions, emergency needs and travel, or as a secondary source of income (Villar et al. 2002). They still use mixed breeds and buy their stocks from wherever they can. Often the low price is the criterion for

selecting the stocks (Villar et al. 2002). The use of 'boars-for-hire' within the community is a common practice. This group of smallholders is not likely to survive market competition because they earn the lowest profits per unit of output and are the least efficient at generating profits from a given set of resources, relative to the rest of the small-scale producers. However, there is also an emerging class of smallholders, particularly in Central Luzon and Southern Tagalog, who raise pigs not just on 'hobby farms' but as a full-time occupation.

Integrated System

The integrated system is very important in the region (Ramsay et al. 1999; La et al. 2002; Peters et al. 2005). Integrated production systems involve the combination of one or more types of animal species with crops and fish. The output from one sub-system (e.g., manure) becomes the input to the other sub-systems (e.g., as feed for fish, or as fertilizer for vegetables). An example of this is the VAC model (Vuon, Ao and Chuong: Gardening, Pond, Livestock) in Vietnam as shown in Figure 5; here, farmers operating small farms sell manure to plantations for fertilizing and improving the soil quality (Riethmuller et al. 2002). A survey of the main characteristics of this system in Laos shows that 60 pigs produce enough manure for one hectare of fishpond, which, if stocked with around 40,000 fish, can produce up to 4,000 kg of fish per year. If pig manure is insufficient, ducks can be used to add more manure to the ponds. Water hyacinth can be used to harvest nutrients from the fish pond and it can be used as feed for the pigs (Hoffmann 1999b). Outputs from the integrated systems can be used in many different ways, to wit:

- The system can be a source of food for direct consumption by the farmer's family.
- The other products can be used as input for the production of other output; sometimes, one type of input can deliver two different outputs, e.g., manure can first be used to generate biogas, while the residue can be used as fertilizer. In this way, they are able to double the value of what is otherwise a waste product.
- Some by-products can be used to produce income, e.g., the selling of fresh manure.

CONSTRAINTS OF PIG PRODUCTION

Several factors have been reported to limit pig production. These constraints may be found in the areas of nutrition, animal health, animal productivity/genetic make-up, extension services, provision of finance to small-scale producers, and marketing.

Nutrition

The provision of adequate nutrition for livestock is a major problem in the region. Feed accounts for almost 70% of the production cost. Some smallholders overcome the prohibitive costs of feeds by adding supplements to feed concentrates. Using cross exotic breeds, and feeding the animals with a mixture of commercial feed and local cheap available by-products are also usual practices (Hoffmann 1999b). Among the more common additives used are: cassava leaves (*Manihot esculenta*), sweet potatoes (*Ipomoea batatas*), water hyacinth (*Eichhornia crassipes*), water spinach (*Ipomoea reptans*), Kangkong (water glorybind), banana tree, soya bean, cotton seed, coconut oil, fish meal, rice meal, and sea shells (Kunavongkrit and Heard 2000). At farms where only concentrates are fed, pigs grow faster, but this is a rare occurrence because of the high price of concentrates. In addition, according to the Animal Husbandry Institute of Vietnam, the total amount of feed produced in the country could meet only half of the demand for animal feed (MARD 2006). In 2005, the cost of importing raw materials for making animal feed reached approximately \$500 million, making the price of animal feed in Vietnam 20–25% higher than the world's average price and 10–20% higher than that of other countries in the region (NIAH 2006). In addition, there are several constraints for an efficient use of feed resources:

- Production is scattered and the quality of feedstuffs is often low. There are also problems related to seasonality, and processing and storage facilities.
- Handling and collection costs are high.
- The costs are non-competitive and output prices are low.

- Processing is difficult and, in any case, problematic. In tree leaves and leguminous forage supplements, some deleterious components (anti-nutritional factors and toxins) need to be removed to reduce the effects on animals.
- There is a lack of managerial and technical skills to utilize the feeds in situ.
- There are barely institutional and support services with the participation of farmers.

Low Inputs

The low level of inputs is due to a lack of capital (Riethmuller et al. 2002). Access to feeds and breeding stocks of known quality, and access to veterinary services are critical transaction cost barriers to smaller-sized producers (Costales et al. 2006). Labor is generally not considered as a scarce resource in the small farm situation since unpaid family labor is widely available. However, in some countries like Vietnam and the Philippines where the young rural population migrate to big cities for a better living, family labor for pig production has grown scarce (Ramsay et al. 1999).

For Vietnamese smallholders, pig production can produce gross margins of VND467,000 per sow per year for weaner production, VND16,000 for grower production, and VND23,000 per pig for finished pig production (US\$1 = approximately VND15,000) (McLeod et al. 2004). In the Philippines, the average farm profit per kg live weight for small-scale pig producers can range from PHP10 to PHP14 per kg or PHP800 to PHP1,200 per head of slaughter hog (US\$1 = PHP50) (Costales et al. 2006).

Climatic Factors

The region falls within the equatorial climate zone, stretching from 5° to 23° latitude north of the equator. This region is characterized by a constantly high temperature and high humidity. Rainfall is substantial, averaging 2000–3000mm a year (Serres 1992). The combination of high humidity and high temperature has unfavorable effects on animal housing and environmental protection, thereby constituting a complication for pig raising.

Swine Diseases

Failure to monitor infectious diseases is a major limiting factor for pig production in the region. A wide range of diseases in pigs have been reported (Table 6). Since more than 70 % of pig producers are smallholders, a major problem that prevails is the low level of knowledge and understanding among livestock producers regarding the benefits of disease control. Although commercial pig raisers are aware of the benefits of disease control, they are not as knowledgeable about the requirements for a cooperative national disease monitoring program (Cameron 2000).

Medium and small-scale pig farmers generally have the traditional farrow-to-finish systems, often with very close mixing of age groups. Replacement stock often comes from a variety of sources and of unknown health status with no adequate quarantine before entry. Hygiene application is usually very poor or does not exist with respect to the contact between farm workers and pigs outside their farms, or between outsiders and pigs housed within the farms. Effluent disposal is usually into large ponds near the farms, and these ponds are prone to overflow during the wet season into the local

rivers and waterways (Catelo 2001; FAO Livestock Policy Brief 2004; Northoff 2006). Given all these conditions, therefore, it is not surprising that these herds are infected with a multitude of bacterial, viral and parasitic pathogens, many of which are zoonotic diseases (Catelo et al. 2001). In small-scale hog-raising, disease control is normally done through vaccination. The use of high levels of combinations of antibiotics and anti-bacterial agents without adequate supervision or veterinary advice is very common.

Animal Productivity / Genetic Make-up

In small-scale pig production, animals are fed a low-quality diet and are not protected from diseases. In these conditions, genetic traits for survival may be much more important than those for production (Drucker et al. 2006). Improvements in production traits only become important once certain conditions in health and nutrition are met and certain production levels reached. The small scale of pig keeping is a major obstruction for the development of any promising practical and feasible breeding programs.

Table 6. Important pig diseases currently endemic in Southeast Asia.

Diseases and pathogen	Transmissible	Diseases and pathogen	Transmissible
Enzootic Pneumonia	Zoonose	Epidemic Diarrhea	
Pasteurellosis		Transmissible gastroenteritis	
Porcine Pleuropneumonia		Round Worm	
Bordetella		Oesophagostomiasis	
Atrophic Rhinitis		Leptospirosis	Zoonose
Porcine Respiratory		Brucellosis	Zoonose
Coronavirus			
Swine influenza	Zoonose	Parvovirus	
Glassers Disease		Porcine Reproductive	
		and Respiratory Syndrome	
Streptococcus meningitis	Zoonose	Erysipelas	
Lungworm		Tuberculosis	Zoonose
Colibacillosis	Zoonose	Exudative Epidermitis	
Oedema Disease		Mange	
Salmonellosis	Zoonose	Encephalomyocarditis	Zoonose
Rotavirus		Nipah Encephalitis	Zoonose
Coccidiosis		Foot and Mouth Disease	
Swine Dysentery		Swine Vesicular Disease	Zoonose
Spirochaetal diarrhoea	Zoonose	Pseudorabies	
Proliferative Enteropathy		Classical Swine Fever	
		Japanese Encephalitis	Zoonose

Source: Cameron (2000).

Extension Service

Compared to only 21% of extension service provided by state extension workers, commercial suppliers are able to give farmers short, quick solutions to specific problems (Perkins 2002; Vu 2003). A survey in the Red River Delta in Viet Nam has shown that last year, only 28% of the surveyed livestock smallholders received extension service (Vu 2003). The said study attributes this to the existence of either a shallow reach of extension network or an access problem. Extension information providers visited large wealthy farms more often than small poor farms. Finding a way to plug good information into the burgeoning commercial smallholder sector, as well as into the traditional extension agencies, has a potential high impact value (Perkins 2002).

Effects of Pig Production on the Environment

Because the aim of intensive industries is usually to improve profit margins, environment-friendly and sustainable practices generally receive little interest (Northoff 2006). Figures 6 and 7 illustrate the current situation of gas and nutrient pollution in countries around the South China Sea. In addition, waste treatment costs account for 4% to

19 % of the total costs in pig production. These costs hold back the implementation of potential waste treatment plans (Dietz and Hoogervorst 1991).

In the Philippines, 80% of the backyard and commercial farms deposit their waste products in nearby creeks and rivers (Catelo 2001). Approximately 6,900 t of manure is produced each year from the swine population in Majayjay. This

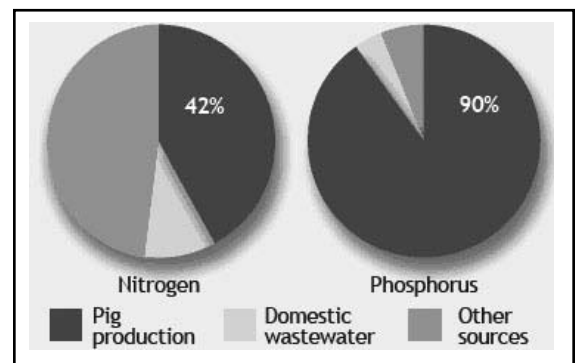


Fig. 7. Contribution of pig production in Vietnam, Thailand, and China to the pollution of South China Sea

Adapted from FAO-LEAD (2006).

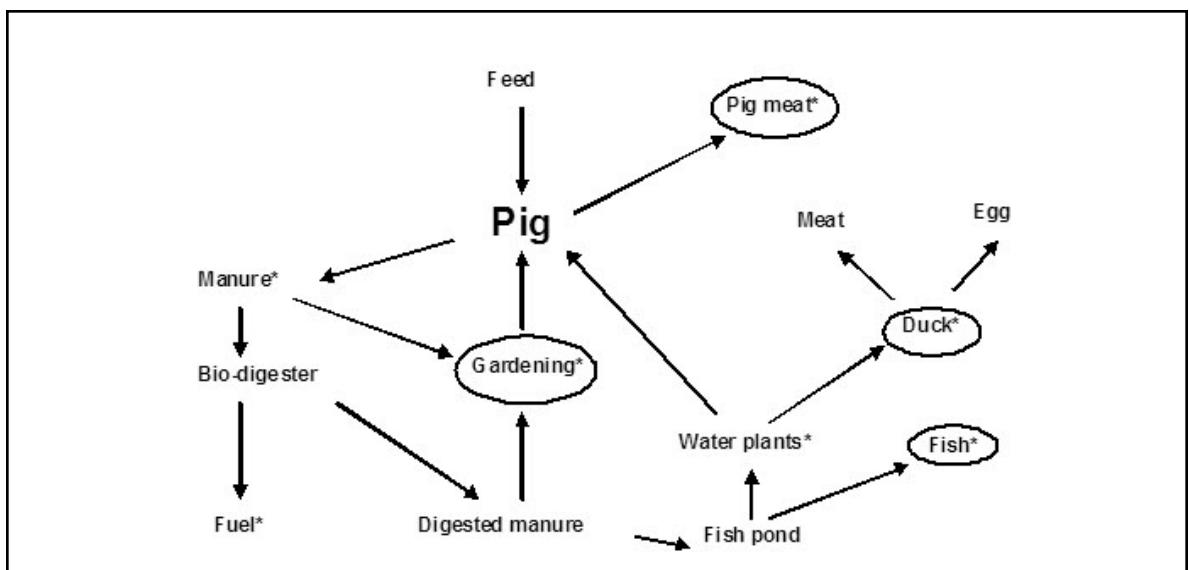


Fig. 6. Integrated pig-fish-duck-vegetable system*

* Above is a sample of the VAC system in Vietnam wherein outputs can be used directly or indirectly.
Source: Ramsay, Andrews et al. (1999).

province alone flushes 5,520 t manure to the river and creeks annually (Catelo 2001).

These circumstances necessitate policy, institutional, and technical interventions to avoid environmental deterioration—a consequence that is contrary to the development challenges of poverty alleviation, increased food production and enhanced livelihood for poor people on small piggery farms (Devendra 1993; Cameron 2000; Catelo 2001; Costales et al. 2006).

Table 7 shows the results of an investigation into the effects of odor from piggery facilities on the farmer himself and on inhabitants who live near pig farms (from 5 to 10 meters) in Majayjay, Philippines (Catelo 2001).

Breeds

Of the pig breeds existing today, 70% are in developing countries where the risk of loss is highest (Rege and Gibson 2003). The case of Vietnam is a good example. To date, of the 14 Vietnamese breeds: Ba Xuyen, Thuoc Nhie, Quang Tri, Ban and H'mong are in vulnerable state; I and Lang Hong are in critical state; and Phu Khanh, Co and Son Vi face extinction (Lemke et al. 2005).

Currently, some of those native breeds can be found in some conservation programs. The long-term sustainability of those programs is questionable, as they are based on very small animal numbers and depend heavily on government subsidies (Drucker et al. 2006). Genetic diversity supports the livestock's adaptation ability. Vietnamese breeds have particular distribution areas and represent a large natural gene pool. There are findings showing their genetic peculiarities and distinctiveness compared to European pig breeds (Jones 2002).

Marketing

The marketing system for pigs includes four components, namely, traders, wholesalers, slaughterers (or workers in the processing plant), and the retailers (Lapar et al. 2003; Knipps 2004). Village pig keepers sell their pigs either to traders, slaughterers, or directly to consumers (Knipps 2004). Smallholders in Laos and Vietnam usually sell their pigs in other villages or provinces and have to obtain a load of paperwork, e.g., license, and health quarantine certificates. Certain factors such as the restricted movement due to disease control, the high transportation fare, the inaccessible market

Table 7. Effects of odor from pig production in Majayjay, Philippines, according to smallholders and commercial pig raisers.

Inquiry	Pig keeper			Nearby inhabitant		
	Smallholder (%)	Commercial (%)	Total (%)	Smallholder (%)	Commercial (%)	Total (%)
Affected by odor						
yes	32	29	30	73	71	72
no	68	71	70	27	29	28
when the odor is strongest						
early morning	15	17	16	56	43	50
early afternoon	7	5	6	31	57	43
early evening	5	10	7	27	21	24
Effects of odor*						
loss of appetite	5	4	4	2	2	2
nausea	4	7	5	5	3	5
headaches	2	3	2	1	1	1
sinusitis	7	5	6	7	6	7
difficulty in breathing	3	2	3	4	5	4
eye irritation	7	6	7	6	7	6
odor sticks to clothes	1	1	1	3	4	3

* 1 would mean the most common answer; 2 would mean the second common answer and so on.

Source: Adapted from Catelo (2001).

information, and the absence of refrigerated lorry serve as restraints that prevent remote smallholders from getting a fair market price for their pigs. The region in general has no organized market or auctioning system for smallholders who want to sell pigs or pig products. Pig farmers are often price takers but not price makers (Lapar et al. 2003). Insufficient marketing outlets, and limited market information, coupled with the lack of guaranteed prices, are major deterrents for small farmers (Sovann and San 2002).

However, smallholders who are perceived to employ backward technology by virtue of their being labeled as 'backyard' producers are actually quite competitive, i.e., they can manage to be as efficient as the larger farms in earning profits from pig production. They are in fact, market-oriented and grow an average of at least 20-200 slaughter hogs per year. Despite this, however, the smaller-scale producers bear more greatly the adverse impact of the transaction costs related to pig production and marketing than do larger producers (Costales et al. 2006).

Urbanization

Urbanization involves the migration of people from rural areas to cities and the urban periphery. One consequence of this trend is that many small farms are being abandoned because of a combination of inadequate labor supply, aging small-scale farmers, and the younger generation pursuing non-agricultural vocations in the cities (Steinfeld 1998; United Nations Development Program [UNDP] 2006). The causes of urbanization are many and are linked to poverty, low income, and increased hardship and vulnerability (Ramsay et al., 1999). Since this is an increasing trend, farming activities must be restructured in a manner that would offer better prospects, and higher income and living standard, to prevent an exodus from rural areas to the cities.

Future Strategy for Pig Production Set by Regional Governments

Being the leading country in pig production among the countries studied, Vietnam's goal to export pork after joining the World Trade Organization (WTO) is worth mentioning. This is

because the plan of Vietnam can strongly influence the regional strategy to develop this livestock industry. The national plan sets an annual export target of 40,000–50,000t of pork. McLeod et al. (2004) discussed the following options in order to reach the target, namely : (1) the reduction of production costs to compete better in existing markets; (2) the diversification of products, e.g., into processed meat, to add value per kg shipped; and (3) the diversification of markets for the current products. Furthermore, some likely requirements and potential impacts are described in Table 8.

The future challenges facing pig production in the region appear to be more closely identified with issues concerning the environment, efficient economical, and social sustainability. Strategies must therefore address not only how to increase the economic contribution of this livestock industry in the future, but also how to enable it to make a parallel ecological and socioeconomic impact (Devendra 1993).

Additionally, the development of pig production in the countries studied has been recently favored by the following changes in regional and international trade (Devendra 1993; Delgado et al. 1999; Hoffmann 1999a):

- The formation of free trade zones such as the ASEAN Free Trade Area (AFTA) within 15 years. Member countries are committed to reducing tariffs for all commodities to between 0% and 5% within 15 years.
- The development of infrastructure, such as roads, ports, cold chains, etc., and market information that greatly facilitate the exchange of products and information both within countries and across borders.

Because government policies strongly influence the development of pig production, these requirements are important (Costales et al. 2006):

- The public or industry funding of research, intellectual property rights, and the government supply of modern inputs and veterinary service;
- Price, trade and industrial policies such as the protection of infant industries, export-led growth strategies, anti-trust legislation, controls on foreign direct investment, controls

Table 8. Possible requirements and consequences of expanding export market for pig meat.

Targets	Requirements	Impact on small holders
Entrance to WTO	Disease monitoring, control, and eradication (require active and transparent disease information exchanges). Quality of pigs must meet international standards.	Available and active village veterinary service. Better interaction with regional organization on animal disease monitoring. Maintain traditional activity but still raise income at the best level as products meet the demands at high standards.
International standards	Certification of veterinary service. Certification of exporting slaughterhouses. Traceability of pigs entering the export chain. Inspection certification of production premises. Strict quarantine during disease outbreaks and stricter routine movement controls.	Demand a higher interaction between smallholders and respective enterprises. Smallholders find high costs for inspection. Finisher producers would sell to domestic market. Piglet producers face severe loss of income for restriction of their market to selling-on for fattening. Immediate effect – disruption of trade, lost income for producers, traders, feed suppliers. Possible development of grey markets. Vulnerable smallholders go out of business. Long term – lower disease levels, increased income for all producers.
Market diversification. Individual importer TBT regulations for processing facilities and finished pigs	Leaner carcass (lean content currently 28%, requirement in some markets 40%). Heavier carcass (currently 29 kg per frozen half carcass, requirement usually 40+kg). Facilities can process at least 200 t/month (currently many process less than 150 t/month).	Need to produce exotics and crosses – less fertile and more prone to disease than local breeds, harder to obtain from local sources, higher input costs. Closure of small export slaughterhouses reducing access of small traders band together to supply larger batches on a consistent basis.

Source: Adapted from McLeod et al. (2004).

on animal health and food safety, and price supports on livestock meat or on inputs of production; and

- Licensing policies, which restrict locations where certain amounts of pollution may be discharged, clean water and air legislation, regulation on disposal of animal by-products, and improvements of markets for animal by-products.

MARD (Vietnam) has suggested some key points to attain sustainable development in agriculture. These recommendations are:

- 1) Financial support should be directly infused to the program;
- 2) Farmers know best what measures should be applied to their own business;

- 3) In order to apply the know-how which fit with the wish of farmers, highly motivated and experienced extension workers are needed; and
- 4) New ideas should be implanted into a group of nucleus farmers, who will, in turn, pass on their acquired knowledge to the rest of the community.

In an effort to address failures in previous research and development programs, John Perkins (1999) wrote a discussion paper about the concerns of future researches for the sustainable development of pig production in Southeast Asia, and he gave the following suggestions:

- Do not invest further in the 'traditional' research areas of pig husbandry (e.g. feeds, breeds, reproduction, health etc.);
- Recognize that farmers treat the pig enterprise as a business, how small that business may be; and
- Recognize that effective business management is the farmer's main concern about the pig enterprise.

CONCLUSION

Southeast Asian countries are economically growing at remarkably rapid speed. Within the region, particularly in the countries selected for this study, pig production is a very valuable and significant component of the world food program. Moreover, countries in the region have revealed plans to commence exporting pigs and pig products. This means that the pig population in the region will increase dramatically in the coming decade. Commercial scale piggeries are increasingly becoming the controlling and high-ranking operators in the markets. The performance models they achieve are becoming the measure for national growth. Alongside these large-scale operators are medium and small-scale pig farmers who tend to choose a modern approach involving some combination of high performance exotic breeds (or crosses) and confined housing, plus highly concentrated feed. Industrialization caused the migration of the center of pig population from rural areas to the outskirts of big cities resulting to severe air, soil and water pollution.

Additionally, it has been suggested that, in some countries, government policies and interventions might in reality have only a minor influence on the development of the pig industry. Although a huge range of well-researched data and results are already available within the public reach, there are very few sources of useful, objective advice available to smallholder pig producers. Given those high pressures, smallholder systems that account for 80% of hog raisers and contribute from 20% to 60% of pork production may be finally forced out of traditional pig production. Observably, small-scale pig farmers in the countries studied need support to maintain their livelihoods and to develop steadily.

In conclusion, the sustainable development of pig production might require a new form of intensive and complex farming systems on the existing small-scale farms, e.g., pig farming associations, and crop-animal integrated farms. Farmers should be involved in all stages of any research and development program. Given their experiences and willingness to improve their own business endeavors, they should be consulted by the experts in any study or plans they intend to make. Transformation of know-how from scientists to farmers should be conducted at a grassroots level at which the perceptions of a group of nucleus farmers should be elicited before such new applications are taught to the whole community. Finally, the system, once established, has to be monitored to maintain its sustainability.

REFERENCES

- Bureau of Agricultural Statistics (BAS), Philippines. 2006.
- Borin, K. 2006. [On the current situation of pig production in Cambodia]. Personal communication.
- Cameron, R.D.A. 2000. "A Review of the Industrialisation of Pig Production Worldwide with Particular Reference to the Asian Region". Animal Health and Area-wide Integration. FAO, Brisbane, Australia.
- Catelo, M.A.O., M.A. Dorado, and E. Agbisit, Jr. 2001.. "Backyard and Commercial Piggeries in the Philippines: Environmental Consequences and Pollution Control Options". EEPSEA Research Report No. 2001-RR6. Ottawa, Canada: International Development Research Centre. <http://www.p2pays.org/ref/13/12938.pdf>.

- Costales, A., C. Delgado, M.A. Catelo, M.L. Lapar, M. Tiongco, S. Ehui, A.Z. Bautista. 2006. "Scale and Access Issues Affecting Smallholder Hog Producers in an Expanding Peri-Urban Market: Southern Luzon, Philippines". pp. 171 [Note: Pls include the larger work where this document appears and the complete range of pages]. Washington, D.C., U.S.A.: International Food Policy Research Institute; Nairobi, Kenya: International Livestock Research Institute; Laguna, Philippines: University of the Philippines Los Baños-College of Economics and Management.
- Delgado C., M. Rosegrant, H. Steinfeld, S. Ehui, C. Courbois. 1999. "The Growing Place of Livestock Products in World Food in The Twenty-First Century". Livestock to 2020: The Next Food Revolution. International Food Policy Research Institute (IFPRI), and International Livestock Research Institute, FAO.
- Devendra, C. (ed.). 1993. Sustainable Animal Production from Small Farm Systems in South-East Asia. Rome: Food and Agriculture Organization of the United Nations.
- Dietz, F.J., and N.J.P. Hoogervorst. 1991. "Towards a Sustainable and Efficient Use of Manure in Agriculture: The Dutch Case". *Environmental and Resource Economics*, 1: 313-332.
- Do, K.T. 2006. Livestock Production in Vietnam From 1990 to 2005. <http://www.mard.gov.vn/>.
- Drucker, A., E. Bergeron, U. Lemke, L. Thuy, and A. Zārate. 2006. "Identification and Quantification of Subsidies Relevant to the Production of Local and Imported Pig Breeds in Vietnam". *Tropical Animal Health and Production*, 38: 305-322.
- Food and Agriculture Organization (FAO). 2004. Cambodia Country Profile.. <http://www.fao.org/es/ess/yearbook/vol1-2/pdf/Cambodia.pdf>
- _____. 2004. "Pollution from Industrialized Livestock Production". Livestock Policy Brief (2004). <http://www.fao.org/ag/AGAinfo/resources/documents/pol-briefs/02/EN/AGA02EN08.pdf>
- _____. 2006. "Agriculture: Livestock: Regional Role". <http://www.fao.org/world/regional/rap/agriculturelivestockregional.asp>
- FAO AGAL. 2005a. "Cambodia, Livestock Information, Sector Analysis, and Policy Branch". <http://www.fao.org/ag/againfo/resources/en/publications/sectorbriefs/lslbKHM.pdf>
- _____. 2005b. "Laos, Livestock Information, Sector Analysis, and Policy Branch". <http://www.fao.org/ag/againfo/resources/en/publications/sectorbriefs/lslbLAO.pdf>
- _____. 2005c. "Vietnam: Livestock Information, Sector Analysis, and Policy Branch". <http://www.fao.org/ag/againfo/resources/en/publications/sectorbriefs/lslbVNM.pdf>
- FAO GLIPHA. 2004. "Pigs, Density land area (head/sqkm)". (<http://www.fao.org/ag/aga/glipha/index.jsp>)
- FAO STAT. 2006. "Live Animals, Pig". <http://faostat.fao.org/faostat/servlet/XteServlet3?Areas=%3E412&Items=1034&Elements=11&Years=2005&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Production.Livestock.Stocks&language=EN>
- FAO-LEAD. 2006. "Protecting the Environment from the Impact of the Growing Industrialization of Livestock Production in East Asia (South China Sea)". In LEAD Approach to Addressing Land, Water and Air Pollution by Industrial Livestock Production". LEAD, Virtual Center. FAO@2006.
- FAO-UNESCO. 2002. Education for Rural Development in Asia: Experiences and Policy Lessons. Bangkok, Thailand. <http://www.fao.org/sd/2002/KN1201en.htm>:
- Hoffmann, D. 1999a. Asian Livestock to the Year 2000 and Beyond. <http://www.aphca.org/publications/files/1999-25/normal.pdf>.
- Hoffmann, D. 1999b. A Manual on Improved Rural Pig Production. RAP Publication 1999/25. <http://www.aphca.org/publications/files/laosEu/Pig%20Eng%20-%20ebook.pdf>.
- ICARD. 2006. "Report on Pork in the Second Quarter of 2003". <http://210.245.60.189/en/stories/tintienganh/BCTA/PorkReportII.asp>.
- Jones, R. 2002. "Priorities for Pig Research in Southeast Asia and the Pacific to 2010". In [Note: Pls insert here the title of the bigger document from which this article is excerpted] pp. 5 - 13. Canberra: Australian Centre for International Agricultural Research. <http://www.aciar.gov.au/web.nsf/doc/ACIA-5ND732>
- Knipps, V. 2004. "Cambodia, Lao PDR, Thailand, Vietnam: Review of the Livestock Sector in the Mekong Countries".. Livestock Information, Sector Analysis and Policy Branch. AGAL, FAO. <http://www.fao.org/ag/againfo/resources/en/publications/sectorreports/lsmekong.pdf>
- Kunavongkrit, A., and T.W. Heard. 2000. "Pig Reproduction in South East Asia". *Animal Reproduction Science*,

- 60–61: 527–533.
- La V.K., Le T.H., Do V.Q., and Nguyen V.D. 2002. "Pig Production in Viet Nam". In *Priorities for Pig Research in Southeast Asia and the Pacific to 2010*, pp. 57 - 70. Canberra: Australian Centre for International Agricultural Research. <http://www.aciar.gov.au/web.nsf/doc/ACIA-5ND732>
- Lapar, M.L., T.B. Vu, S. Ehui. 2003. "Identifying Barriers to Entry to Livestock Input and Output Markets in South-East Asia: The Case of Vietnam". Socio-economics and Policy Research Working Paper 56. Nairobi, Kenya: International Livestock Research Institute.
- Le T.H. and Nguyen N.H. 1997. "Outlines of Pig Production in Vietnam". *Pig News and Information*, pp. 91–94.
- Lemke, U., Huyen L.T.T, R. Rößler, L.T. Thuy, and A.V. Zárate. 2005. "Impact of the Use of Exotic Compared to Local Pig Breeds on Socio-economic Development and Biodiversity in Vietnam". Paper presented at the Conference on International Agricultural Research for Development, held 11-13 October 2005 in Stuttgart-Hohenheim. <http://www.tropentag.de/2005/abstracts/full/251.pdf>
- Lemke, U., L.T. Thuy, A.V. Zárate, B. Kaufmann, and Vang N.D. 2002. "Characterisation of Smallholder Pig Production Systems in Mountainous Areas of North Vietnam". Paper presented at the Deutscher Tropentag 2002 Conference on International Agricultural Research for Development, held 9-11 October 2002 in Witzenhausen.
- MARD. 2006. *Agriculture and Rural Development Plan 2004; and Development Vision 2004 - 2005*. <http://210.245.60.189/en/newsletter/2003/DevelopmentVision2004-2005.asp>. In. (AgroViet)
- MARD, Department of Livestock Production. 2006a. "Pig Herd to be Developed". <http://210.245.60.189/loadasp/tn/en/tn-spec-nodate-detail.asp?tn=tn&id=305175>
- _____. 2006b. "Pork Production Expected to Reach 3.2 million tonnes by 2010". <http://210.245.60.189/loadasp/tn/en/tn-spec-nodate-detail.asp?tn=tn&id=305247>
- MARD News. 2006. "Hi-tech Livestock Breeding Farm Starts Operation". <http://www.mard.gov.vn/>.
- McLeod, A., N. Taylor, Lan L.T.K., Thuy N.T., Dung D.H., Minh P.Q. 2004. "The Potential Impact of Vietnam's Entry to the WTO on the Livelihoods of Smallholder Pig Producers and Small Pig Traders". In E.Owen, T. Smith, M.A. Steele, S. Anderson, A.J. Duncan, M. Herrero, C.K. Reynolds, J.I. Richards, and J.C. Kuvira, eds. [Note to Berns: Pls check; does the preceding list consist of editors or authors?] *Responding to the Livestock Revolution, the Role of Globalisation and Implications for Poverty Alleviation*, Vol. 33. Nottingham: Nottingham University Press.
- Northoff, E. 2006. "Industrial Livestock Production Near Cities Often Damages the Environment". In *FAO Newsroom*. Rome. <http://www.fao.org/newsroom/en/news/2006/1000219/index.html>
- Perkins, J. 2002. "What Should I Do? Research for People, not Pigs". *Priorities for Pig Research in Southeast Asia and the Pacific to 2010*, pp. 14–22. Canberra: Australian Centre for International Agricultural Research. <http://www.aciar.gov.au/web.nsf/doc/ACIA-5ND732>
- Peters, D., Tinh N.T., Hoan M.T., Yen N.T., Thach P.N., and K. Fuglie. 2005. "Rural Income Generation through Improving Crop-Based Pig Production Systems in Vietnam: Diagnostics, Interventions, and Dissemination". *Agriculture and Human Values*, 22: 73-85.
- Peters, J. 2001. "Transforming the 'Model' Approach to Upland Rural Development in Vietnam". *Agriculture and Human Values*, 18: 403-412.
- Ramsay, G., L. Andrews, and D. Hoffmann. 1999. *Poverty Alleviation and Food Security in Asia: The Role of Livestock*. Bangkok, Thailand: FAO. UNDP/FAO RAS/95/01T.
- Rege, J.E.O., and J.P. Gibson. 2003. "Animal Genetic Resources and Economic Development: Issues in Relation to Economic Valuation". *Ecological Economics*, 45: 319–330.
- Riethmuller P., D. Hoffmann, and N. Chalermphao. 2002. "Some Issues Associated with the Livestock Industries of the Asia-Pacific Region". Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific (APHCA))
- Serres, H. 1992. *Manual of Pig Production in The Tropics*. Cedex, France: CAB International.
- Sovann, S., and S. San. 2002. "Pig Production in Cambodia". In *Priorities for Pig Research in Southeast Asia and the Pacific to 2010*, pp. 22-28. Australian Centre for International Agricultural Research. <http://www.aciar.gov.au/web.nsf/doc/ACIA-5ND732>: Canberra)
- Steinfeld, H. 1998. "Livestock Production in the Asia and Pacific Region - Current Status, Issues and Trends". In B.S. Hursey, ed., *World Animal Review*, 90:1. Rome: FAO, Animal Production and Health Division.
- Steinfeld, H., A. Costales, J. Rushton, B. Scherf, T. Bennett, and D. Hall. 2006. *The Livestock Report 2006*, edited

- by A. McLeod, 85pp. Rome: FAO, Animal Production and Health Division.
- Truong, T.D. 2002. [On overview of pig farming in Viet Nam.] Via personal communication.
- United Nations Development Program (UNDP). 2006. "Structural Change and Economic Growth: Economic Growth in Developing Countries is about Changing the Structure of Production". <http://www.un.org/esa/policy/wess/wess2006files/chap2.pdf>.
- UNDP-Laos. 2001. "Advance Rural Development - National Human Development Report Laos 2001". <http://www.undplao.org/Report/NHDR%20final.pdf>.
- UNDP-Cambodia. 2006. "Finding Solutions". Annual Report 2005, p. 44. http://www.un.org.kh/undp/resources/publications/annual_2005_en.pdf.
- Villar, E.C., M.O. Maleon, and D.T. Facundo. 2002. "The Swine Industry in the Philippines: A Focus on Smallholders". In *Priorities for Pig Research in Southeast Asia and the Pacific to 2010*, pp. 48–57. Canberra: Australian Centre for International Agricultural Research. <http://www.aciar.gov.au/web.nsf/doc/ACIA-5ND732>
- Vu T. 2003. "Making Livestock Policies Better Serve the Interests of Vietnam's Poor". FAO (AGAL) - PPLPI Working paper No. 5. Institute of International Studies, University of California, Berkeley. <http://www.fao.org/ag/againfo/projects/en/pplpi/docarc/wp5.pdf>

ANNEX 1 Characteristics of pig production in each country

Cambodia

General information. Cambodia has a total land area of about 181,040 km² and is bordered by Vietnam, Laos, Thailand, and the Gulf of Thailand. The climate is sub-tropical monsoonal with distinct wet and dry seasons. The total population is estimated to be about 13.8 million (UNDP-Cambodia 2006). With an annual growth rate of about 2.8%, the population is predicted to double by 2024. The rural population represents 85% of the total (UNDP-Cambodia 2006). Agriculture dominates the Cambodian economy, contributing 35.6% of GDP in 2002 and employing 69% of the workforce. Livestock contribution to total GDP is approximately 7.6%. The livestock sector is dominated by smallholders. However, the small households have turned in a very low level of production largely due to the low input, poor understanding of nutritional requirements, difficulties with the supply of ingredients, and lack of knowledge in animal husbandry (Sovann and San 2002).

Pig production. Cambodia has started importing live pigs and pork in the amount of US\$502,000 since 2002 (Table A1). Pork is the main protein source for consumers, with an average increase of 5.7% per year from 1990 to 2000 (FAO 2004). Among the four countries, Cambodia's national income from pork production is growing the fastest at 14.1% (Devendra 1993). The average slaughter weight of pigs is 50 kg (FAO 2004). The national sensor of the pig population shows a negative relationship to pork consumption. The reason for this is that hundreds of thousands of fatteners have been illegally imported into Cambodia annually from either the coastal border with Thailand or through Nek Leung, a province along the border adjacent to Viet Nam (Sovann and San 2002). Less than 1% of pig producers operate on a commercial level; these commercial farms are continuously increasing in production size (FAO AGAL 2005a). Foot-and-mouth disease, classical swine fever, and swine vesicular diseases constantly occur in the whole country.

Table A1. Brief view on export capacity and import demands of live pigs in the region.

Exports (Head)	2001	2002	2003	2004
Cambodia	0	0	0	0
Philippines	0	0	0	0
Vietnam	0	0	0	0
Import (Head)				
Cambodia	426	1,621	12,774	
Laos	1,800	2,021	2,627	30,343
Philippines	1,771	1,366	216	1,800
Vietnam		388	498	279

Sources: FAO AGAL (2005a and 2005b); FAO STAT (2006)

Environmental depletion. The central basin, occupied by the Tonle Sap (Great Lake) depression, is the point of confluence of water that subsequently flows into the Mekong, one of the largest rivers in Asia, which is suffering from water pollution that is caused, among others, by livestock activities. Indeed, around Phnom Penh, the density of pigs per square kilometer is approximately 66,1 heads, together with Takeo, with 54,0 heads per square kilometer. These are the two most dense pig areas in Cambodia (FAO GLIPHA 2004).

Laos

General information. Lao PDR is a land-locked, heavily forested, and mountainous country. Most of the population of around 6 million practice subsistence agriculture. It is estimated that 90% of the Laos population live in the rural area (UNDP-Laos 2001). Livestock production contributes 14.3% to total GDP (FAO AGAL 2005b).

Pig production. This livestock industry is significantly important in remote highland areas where people, mostly belonging to the dominant ethno-linguistic grouping, keep their traditional, extensive and low-input way of swine raising (UNDP-Laos 2001). Commercial pig systems are mainly located near the capital of Laos (Vientiane), typically housed in a small cottage-style structure and with a few employees (FAO AGAL 2005b). Meat consumption is increasing, mainly for beef at 7.7% per year, followed by pork at 2.9% per year (FAO

AGAL 2005b). Inefficient output—20 to 26 kg meat per pig head, according to data from FAO (2006)—has led to a negative balance between pork consumption and production. Since 2002, Laos has been importing pigs amounting to \$321,000 annually; this has caused a negative net trade.

Pig diseases. Besides very low slaughter-weight pigs, infectious diseases such as foot-and-mouth disease and classical swine fever are present chronically in the national pig herd. The national development plans emphasize the following strategies, to wit: 1) to increase livestock production and its productivity as a means of national poverty eradication; 2) to strengthen veterinary service by training 12,000 village veterinary workers for the same number of villages; 3) to reach, by the year 2020, a meat production per capita of 60 kg (ten-fold the figure of 2005) and to export meat products worth \$50 million.

The Philippines

General information. The Philippines is one of the world's largest archipelagos with more than 7,100 islands. It extends 1900 km north to south and 1100 km east to west. The land is mostly mountainous with coastal lowlands. About 38% of the workforce is engaged in agriculture. Among all sectors in Philippine agriculture, livestock exhibited the fastest growth, posting an average yearly growth of 4.6% in real terms between 1990 and 2003. The livestock sector steadily increased its share of gross value added (GVA) in agriculture from 18% in 1990 to 24% by 2003.

Pig production. Pig production is the main activity in livestock and it accounts for about 58 % of total meat output, growing at an annual rate of 5.5% (Costales et al., 2006). As of January 2006, there were 13 million on-farm pigs, of which only 25% were reared on commercial enterprises, and the remaining were raised in backyard production (defined as less than 20 heads per household) (BAS 2006). By 2006 about 75% of pig inventories were still classified as raised in 'backyard' farms (BAS 2006). Small-scale holders have developed in the last 15 years. At the current stage, the system is dependently integrated into the commercial feed sector. A remarkable transformation from small to medium scale holder results in an average of 80 finishers per farm. Integration of breeding, high-quality feed formulation, farrow-to-finish operations, and HACCP-compatible slaughtering and processing of branded products are being applied by these companies. If viewed in terms of their ability to apply these same strategies, the smallholder swine raisers are likely to be disadvantaged (Devendra 1993; Steinfeld 1998). Thus, an important policy question for the government is whether it can assist / protect smallholder swine raisers either directly or indirectly against trade globalization (Cateño 2001).

Vietnam

General information. The terrain of Vietnam varies from mountainous to coastal delta. Measured by employment, Vietnam is an agricultural society, with around 67% of the labor force working in agriculture (FAO AGAL 2005c). Vietnam accounts for the second largest of all on-farm pigs in Far East Asia (after China, which holds 84% of all on-farm pigs) (FAO STAT 2006).

Pig production. According to the Livestock Department of MARD (2006), the pig population expects to grow by 3.9% per annum by 2010, to reach a total of 32.8 million animals (Table A2). Almost 80% of pig production is still in the hands of smallholders, but medium and commercial pig producers are growing fast (FAO AGAL 2005c). Vietnamese consumers prefer fresh meat. This gives an advantage to internal pork producers over pork importers. In addition, suckling pigs from local breeds, e.g., the Mong Cai, I, are a competitive export product of Vietnam (Truong 2002). Although Vietnam imports the most prolific pig breeds, e.g., Landrace, Yorkshire, Pietrain and Duroc, the growth rate is still low, averaging 600gr/day (La et al., 2002; Husbandry Department, MARD 2006). National plans aim to cut down small-scale farms from 75% to 60% and to

Table A2. Plan of MARD on Viet Nam's pig production from 2006 to 2010.

Production index	Unit	2006	2010
Pig	Head/year	28,000,000	33,000,000
Pork	Ton/year	2,500,000	3,200,000

Source: Do (2006).

promote industrial-scale enterprises (MARD 2006). Since pork production fulfills domestic demand (100,9%; FAO GLIPHA (2004)), Viet Nam aims to export pork. However, their pork is priced 30 to 40% higher than the prevailing price in the region. Most of the materials are imported and subjected to high tariff. Some quarters have pointed to the lack of logic in being able to ship out US\$2 billion of rice but having to import more than 50% of animal feed annually (ICARD 2006). According to the national plan, the quality (efficiency and output per pig) of the national herd will be improved by importing pure exotic breeds and promoting crossbreeds, with the ratio of imported sows expected to rise from the current 9.6% to 19.2% by 2010 (MARD 2006). At the farm level, the artificial insemination service currently provides 3 million doses of sperm which covers only 20% of the demand (a total of 2000 boars are housed at 300 stations in the whole country). This service will be reinforced by 2010. Additionally, the Vietnamese government aims to strengthen the livestock disease monitoring system—currently very weak—to meet the requirements of international markets.