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**Trends in the Thai Livestock Industry, Animal
Health Implications and Thailand's
Development: An Introduction**

by

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'The overall goal of this project is to develop and evaluate the necessary tools to provide decision-makers with reliable animal health information which is placed in context and analysed appropriately in both Thailand and Australia. This goal will be achieved by improving laboratory diagnostic procedures; undertaking research to obtain cost-effective population referenced data; integrating data sets using modern information management technology, namely a Geographical Information System (GIS); and providing a framework for the economic evaluation of the impact of animal diseases and their control.

A number of important diseases will be targeted in the project to test the systems being developed. In Thailand, the focus will be on smallholder livestock systems. In Australia, research will be directed at the northern beef industry as animal health information for this sector of livestock production is presently scarce.'

For more information on *Research Papers and Reports Animal Health Economics* write to Professor Clem Tisdell (c.tisdell@economics.uq.edu.au) or Dr Steve Harrison, (s.harrison@uq.edu.au) Department of Economics, University of Queensland, Brisbane, Australia, 4072.

Trends in the Thai Livestock Industry, Animal Health Implications and Thailand's Development: an Introduction

ABSTRACT

The Thai livestock industry has experienced significant change over the last two decades in its cattle/buffalo, pigs and poultry sectors. Increasing human population and income levels, political and technological change in Thailand have meant changes in the traditional roles of livestock within the Thai village economy and have caused a heightened demand amongst Thai consumers for livestock products such as meat and milk. These changing socio-economic conditions in Thailand have seen the poultry sector achieve internationally competitive status, and more recently expanding commercial development of the cattle and pork industries. Technological advances in Thailand however have resulted in substantial decline in buffalo numbers as draught power has become increasingly mechanised. In order for Thailand's livestock sector to meet growing domestic and international demand, it is essential that issues such as disease control in livestock are successfully addressed.

Keywords: Animal health programs, economic development of livestock industry, Thailand

JEL Codes: O13, Q11, Q16

Trends in the Thai Livestock Industry, Animal Health Implications and Thailand's Development: an Introduction

1. Introduction

The Thailand livestock industry has undergone significant change over the last two decades. The buffalo, cattle, pig and poultry industries have all experienced a transitional stage in recent times that has mirrored the dramatic economic development of Thailand and the South-East Asian region in general. Changing economic, demographic and political conditions have impacted on the traditional structure of the livestock industry in Thailand. This paper provides an introductory overview of Thailand's livestock industry its development, performance and the role and significance of animal health programs in this process. Follow up papers will provide more details on bovines (buffalo and cattle), swine and poultry in Thailand.

2. Traditional Characteristics of the Thai Livestock Sector

Traditionally the livestock sector in Thailand, as in most of South-East Asia, has been a subsidiary to the subsistence economy with buffaloes and cattle mainly used for draught purposes and pigs and poultry for village consumption. The traditional agricultural societies of the South-East Asian region were predominantly crop-growing societies and only a small livestock component existed to support this crop production.

Limited availability of pastoral land in the region meant that while these crop-growing societies evolved with a heavy reliance on draught animals (especially buffalo), there was a limited dependence on grazing livestock to provide meat or milk. The composition of livestock in the region was therefore influenced by its geographical characteristics. It has been suggested by Crotty (1980) that being cut off from the great rangelands of the world by India on the west and China on the north meant the region traditionally had more buffalo than cattle – maintaining these largely on crop by-products, on grazing under tree crops, or on waste areas. Consequently he claims that milk was essentially an unwanted and economically unimportant product for the South-East Asians as the limited pastoral resources available to

them were used mainly to produce draught power, with meat as a by-product. The traditional Thai breeds of swamp buffalo and local cattle used on the farms for draught and transport purposes were not dairy breeds and produced little milk.

2.1 Integration of Livestock into Farming Systems in Thailand

Despite the orientation of Thai agriculture to crop rather than livestock production, integration of livestock into the whole village production system is an essential feature of Thailand's agricultural sector. Traditionally livestock production is not considered as a distinctive enterprise of the farming system, rather it is an integral part of crop production. Farmers in villages raise cattle and buffaloes for land preparation, manure production and long-term savings. Native chicken and swine are raised in backyards for home consumption as well as for household savings. In many ways, the stability of the small farm system and the small farmers' livelihood depends on the complementary role of livestock and cropping, that is on a mixed farming system.

A large portion of Thailand's livestock and poultry are in the hands of small-holders within villages. On average it has been estimated that a Thai farm family raises approximately 1.2 buffalo, 1.0 head of cattle, 0.8 pigs, 17.1 chickens and 3.2 head of other poultry (Khajarem and Khajareern, 1989, pp. 25). As noted, they are generally raised by farmers to complement and assist in the production of crops and generate additional income. However, while the contribution of additional cash income by livestock to the small farm household has always been essential, (see Thummabood and Morathop, 1992) traditionally this contribution has been low when compared to that of crops. It has been estimated that only around 1/5 of agricultural cash income received by villages is contributed by livestock compared to around 4/5 by crops (Khajareern and Khajareern, 1989). Furthermore the productivity of village livestock is low when traditional raising systems are used.

2.2 Housing and Maintenance of Village Livestock

Buffalo and cattle are generally kept within the village. They are often held under the house at night and grazed on the paddy fields during the day in the dry season. In the wet season, grazing takes place along roadsides, on the edge of cultivated plots or bovines are tethered on allocated land plots (with supplementary feed consisting of cut-and-carry grasses and rice straw). Working animals generally work for 130 days of the year and for the rest of the time exist idly to consume farm weeds, crop residues and act as farm capital (Panayotou, 1985).

Maintenance and condition of such animals is often influenced by the prevailing weather. Fluctuating climatic conditions (i.e. level of rainfall) can significantly influence the consistency and quality of feed supplies for Thai livestock – a perennial problem in rural Thailand.

Pigs and poultry are usually kept under the house at night and let scavenge around the house during the day. Supplementary feeds consisting of farm by-products such as broken rice bran, kitchen wastes or paddy rice are offered in the morning and the evening. Pigs utilise farm by-products and wastes thus generating a supplementary cash income for farmers while instant petty cash needs and food requirements (meat and eggs) are met by chickens and other poultry such as ducks (Panayotou, 1985).

2.3 Endemic Diseases of Livestock

Given the traditional importance of livestock for draught power, fertiliser, meat and supplementary income, the inherent presence of infectious disease in the region has proven to be a long-term problem for livestock owners in Thailand. Endemic diseases in the region such as Foot and Mouth, Newcastle and Aujeszky's disease can cause serious losses in stock numbers, production efficiency and time. Table 1 gives an indication of the impact of endemic disease on national stock numbers over the last decade (according to official records). These probably significantly understate such deaths because of incomplete recording. In recent years, deaths of cattle and pigs from such diseases are much greater than for buffalo.

Table 1 Death of buffaloes, cattle and swine from epidemic diseases in Thailand 1983-1992 according to official statistics

YEARS	BUFFALO	CATTLE	SWINE
1983	36	18	40
1984	6	75	1609
1985	134	139	288
1986	34	9	-
1987	10	4	-
1988	3	1	-
1989	-	15	-
1990	35	44	1231
1991	8	151	119
1992	1	57	57

Source: Thailand's Department of Livestock (cited in O.A.E., 1992, p.107).

This recurrent risk of disease has consistently posed a serious economic threat at both village and national level in Thailand. The traditional role of small farm livestock for the Thai farmer is a varied one and economically the farmer relies heavily on the health of his/her stock. The traditional role of livestock in such village communities has been prioritised by McDowal and Hilderbrand (cited in Crotty, 1980) as follows:

1. Reduction of risks from cropping
2. Accumulation of farm capital
3. Rendering of self-produced farm resources eg. draught power, fertiliser and fuel
4. Satisfying cultural needs
5. Ensuring status or prestige
6. Provision of food (meat, eggs)
7. Generation of supplementary income

The nature of these traditional roles however is changing with the rapid development of the

Thai economy and the changing nature of demand for agricultural products. The position of the livestock sector as a sub-sector of agriculture within the national economy is undergoing change and pressure to reform from its traditional roles as the economic development of the country progresses.

3. Agriculture in Thai Economic Development

Over sixty years ago, Thai agriculture was organised under a feudal system for growing rice as the staple food of the economy. After Thailand changed from absolute monarchy to democracy (establishing a constitutional monarchy in 1932) agriculture was opened to trade and the pre-development stage of the agricultural sector in Thailand began (Office of Agricultural Economics (O.A.E), 1992, p. 1).

Around the 1960s the Thai economy driven by the agricultural sector began to experience dramatic structural change. Partly responsible for this was the development of a series of 5-year national economic and social development plans commencing in 1961 and developed by the National Economic and Social Development Board. Thailand is currently in the stages of its Seventh Plan. It was from the First Five year Plan developed between 1961–1966 that the agricultural sector began to diversify its production into economic crops such as livestock, fruit crops and fisheries (aquaculture) (O.A.E., 1992).

Since this time, six national development plans have been implemented with strong priority given to agriculture – particularly the Seventh Plan which focuses on decentralisation and targeting of agro-industry and food processing (Rural Industries Research and Development Corporation (RIRDC), 1993). Over the period of these development programs the contribution of the agricultural sector to Thailand's GDP increased from 23,111 million baht in 1961 to 284,489 million in 1991 (O.A.E., 1992) due in part to the considerable land expansion (land clearing) programs undertaken during this period. Table 2 gives an outline of the contribution of the major agricultural sectors to Thailand's GDP over time.

Table 2: Gross domestic product at current prices

National Plans 1-6	Gross Domestic Product (GDP)	GDP IN AGRICULTURE					
		Total	Crops	Livestock	Fisheries	Forestry	Other
1950	22549	10196 (45.2)	7454 (33.1)	1048 (4.6)	186 (0.8)	1508 (6.7)	Na
Plan 1 1961	58970	23111 (39.2)	17160 (29.1)	3001 (5.1)	1039 (1.8)	1911 (3.2)	Na
Plan 2 1967	108224	35143 (32.5)	25304 (23.3)	4421 (4.1)	2748 (2.5)	2670 (2.5)	Na
Plan 3 1972	170076	43130 (25.4)	26787 (15.8)	4467 (2.6)	3533 (2.1)	2608 (1.53)	5735
Plan 4 1977	403529	99970 (24.8)	62943 (15.6)	10561 (2.6)	7859 (1.96)	6054 (1.50)	12553
Plan 5 1982	820002	156839 (19.1)	100065 (12.2)	13999 (1.7)	10984 (1.3)	8654 (1.1)	23137
Plan 6 1987	1253147	205592 (16.4)	122809 (9.8)	22448 (1.8)	19835 (1.6)	9757 (0.8)	30743
1988	1506977	250384	160179	24623	21655	8944	34983
1989	1775978	266379	167521	28582	21252	7482	41542
1990	2051208	258904 (12.6)	149647 (7.3)	32384 (1.6)	24451 (1.19)	6489 (0.3)	45993
1991	2289258	284489 (12.4)	164127 (7.2)	34359 (1.5)	27415 (1.2)	6579 (0.29)	52009

Source: Office of the National Economic and Social Development Board (cited in O.A.E., 1992, p. 4).

- Note:
1. Figures in Parenthesis are Percentages of GDP
 2. National Plan= National Economic and Social Plan
 3. The first years of the National Plans are 1961, 1967, 1972, 1977, 1982, 1987
 4. Thailand is currently in its Seventh Plan

While the absolute value of agricultural GDP has increased, the share of total GDP accounted for by agriculture has declined 16% in the thirty years since 1961. As can be seen from Table 3 agriculture has shown a declining growth rate.

Table 3: Growth rate (%) targets in Thai agriculture for Plans 1-7

Average Growth rate in Agriculture (%)	Plan 1 1961-66	Plan 2 1967-71	Plan 3 1972-76	Plan 4 1977-81	Plan 5 1982-86	Plan 6 1987-91	Plan 7 1992-96
Target	3	4	5	5	4	2	3
Actual	7	4	4	4	3	2.5*

Source: Office of the National Economic and Social Development Board (cited in O.A.E., 1992, p. 6).

* Estimated by Office of Agricultural Economics

Within the agricultural sector, the crop sub-sector accounts for about three quarters of the total agricultural value added and the livestock sub-sector in turn accounts for about half of the remainder. Both these shares have been approximately constant since 1960. Other

industries such as the fisheries sub-sector gained ground rapidly until around 1980 (rising from less than 4% in the early 1960s to 10% in the late 1970's) while the share of the forestry sector has declined since 1960 (Warr, 1993).

4. Socio-economic Change in Thailand: the Background

Changes in the economic, political and demographic characteristics of Thailand have had a strong impact on the traditional nature of Thailand's agriculture and livestock industries over the last few decades. Relevant developments have included Thailand's rapid economic and population growth and the associated consequences of this on the demand for livestock products such as meat and milk. Such developments have resulted in increased commercialisation of the livestock industry, increased irrigation and technological expansion and the associated decline in buffalo stocks. A further important factor has been the halt in land clearing schemes undertaken or permitted by the Thai government. This has resulted in increasing grazing pressure on existing pasture lands.

While agriculture was the leading sector in the Thai economy during its crucial two decades of growth in the 1960s and 1970s, this position has since been taken over by manufacturing. This restructuring is indicative of the dramatic changes in the Thai economy over the last two decades and these have impacted directly on the nature and structure of its livestock industries and agriculture in general.

4.1 Thailand's Economy in Transition

Rising income levels and standards of living in developing countries have important implications for the changing nature of food consumption and productivity in these countries. The combined economic conditions of rising income levels – particularly from lower to medium income groups (Harrison and Tisdell, 1995) and a booming tourism sector generally mean both a heightened demand for income elastic goods such as meat and milk (in relation to developing countries) and the gradual westernisation of tastes and technology. This has been the situation in Thailand particularly over the last two decades.

The rapid development of the Thailand economy has been remarkable. The Thai economy has emerged from a country of zero economic growth after the immediate years of World War 2 into one of the most successful economies of the Asian Pacific region. Table 4 gives an indication of the exceptional and unprecedented growth rates experienced by the Thai

economy in recent years. These growth figures make Thailand one of the fastest growing economies in the world over this period (Sheehan, 1993).

Table 4: GDP growth rates (%) for Thailand 1980-1993

GROSS DOMESTIC PRODUCT FOR THAILAND									
1980	1985	1986	1987	1988	1989	1990	1991	1992	1993
%	%	%	%	%	%	%	%	%	%
5.8	4.0	4.6	6.3	10.9	13.2	10.0	7.9	7.6	7.8

Source: Based on Sheehan, 1993, p. 55.

Table 5: Sources of per capita income in Thailand 1961-1990: Agricultural and Non-agricultural

National Plans 1-6	AGRICULTURAL SECTOR	NON-AGRICULTURAL SECTOR	RATIO OF AG TO NON-AG SECTOR
Plan 1 1961	1002	6212	1: 6.19
Plan 2 1967	1373	9148	1: 6.66
Plan 3 1972	1797	10905	1: 6.07
Plan 4 1977	3674	20629	1: 5.61
Plan 5 1982	5743	38357	1: 6.68
Plan 6 1987	5938	52869	1: 8.90
1988	7158	62085	1: 8.67
1989	7540	73093	1: 9.69
1990	7137	85343	1: 11.96

Source: Office of the National Economic and Social Development Board (cited in O.A.E., 1992, p. 40).

Thailand's rapid growth rates have resulted from its utilisation of an abundance of natural resources including fertile agricultural land, minerals including natural gas, oil and tin marine resources and tourism resources (Warr, 1993). While wages and salaries have increased substantially in recent years, labour costs are still relatively low and hence competitive, but becoming less so.¹ As can be seen in Table 5, per capita income levels have increased with

the general growth of the economy. Table 5 indicates the gradual decline in the proportion of agriculture's contribution to per capita income in Thailand. Associated with this is an increase in regional inequality of income between rural and urban regions.

4.2 Population

There has been significant demographic change in Thailand in recent times. This population growth, combined with the per capita growth in income levels, has facilitated the increase in the demand for livestock products such as meat and milk. In mid-1990 Thailand's population was 55.8 million and in the 1980s increased at an average annual rate of 1.8%. Between 1961 and 1991, Thailand's population more than doubled. Life expectancy at birth has increased by about nine years since 1965. Much of this can be attributed to significantly improved medical conditions in poorer regions where preventative medicine has reduced mortality from disease and raised population growth rates. Table 6 provides statistics on Thailand's population and workforce levels broken down in relation to agriculture.

Table 6: Labour force and total population (millions), Thailand, 1961-1991

National Plans 1-6	Thailand's Labour Force Population			Thailand's Total Population	
	Total	Agricultural	Non-Agricultural	Whole Kingdom	Agricultural
Plan 11961	14.18	11.65	2.53	27.13	19.99
Plan 21967	15.91	12.77	3.14	32.98	21.90
Plan 31972	20.42	14.58	5.84	39.29	28.46
Plan 41977	24.43	16.05	8.38	43.87	30.29
Plan 51982	28.39	17.84	10.55	50	32.86
Plan 61987	31.01	18.85	12.15	54.44	34.62
1988	31.45	19.04	12.41	54.96*	34.98
1989	31.88*	19.22*	12.65*	55.89*	35.33*
1990	32.30*	19.40*	12.89*	56.30*	35.66*
1991	32.65*	19.49*	13.16*	57.37*	35.85*

Source: Office of the National Economic and Social Development Board (cited in O.A.E., 1992, p. 30).

Note: 1. Economically active populations are in the 15-64 years of age

2. *Estimates

Although compared to its South-East Asian neighbours, Thailand has traditionally been very

rural, it has now witnessed a growing urbanisation and an associated decline in the agricultural workforce. By 1990, the urban population was 23%, a rise of 10% since 1965 with a corresponding decline in the agricultural workforce from 82% to 70% of the total workforce in the same period (Warr, 1993).

The composition of Thailand's population is also changing with a high proportion of younger Thais living and migrating to urban areas such as Bangkok. The number of youth under 20 years of age in Bangkok comprises 50% of the city's population. This has important consequences for the commercial demand of such products as meat and milk as youth are more susceptible to western influences than the traditional lifestyle of older Thais. Marketing research suggests they are more responsive to the growing commercial demand for commodities such as beef and milk (Khoo et.al., 1992).

The heightened demand for the less traditional foods such as meat and milk is a consequence of the increased income and population levels of Thailand over the last couple of decades. Furthermore, population increase resulted in greater demand for Thailand's staple food rice and this, with the introduction of high yielding varieties of rice, has led to rapid expansion of the area of land irrigated in Thailand (see Table 7). Because of increased irrigation, the incidence of multiple cropping has increased which in itself has important implications for the traditional nature of the livestock industries, especially cattle and buffalo stocks.

Table 7: Area of land (Rai) under small scale irrigation, Thailand, during the National Plans IV-VI

National Plan 1977 - 1990	Thailand :Whole Kingdom
Plan 4 1977	0.310 MI rai
Plan 5 1982	3.413 MI rai
Plan 6 1987	5.986 MI rai
1988	6.330 MI rai
1989	6.714 MI rai
1990	7.044 MI rai

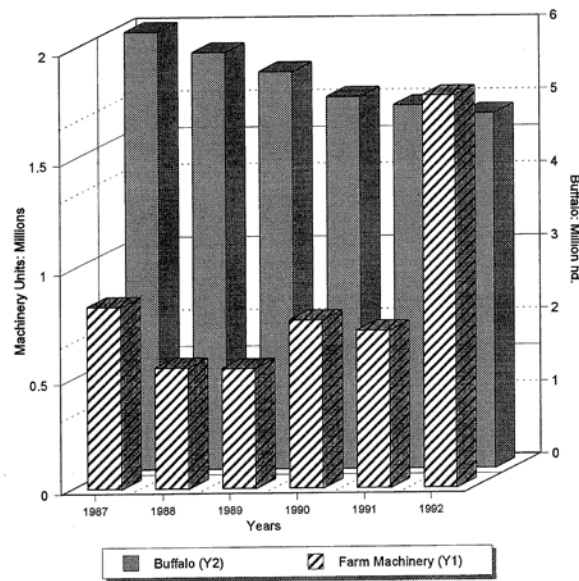
Source: Office of Agricultural Economics, 1992, p. 19.

4.3 Irrigation

Irrigation is a capital intensive means of increasing agricultural output and generally requires heavy investment. Extending the rice growing area by irrigation virtually necessitates double cropping. Rice double cropping is seen as necessary to justify the heavy capital expenditure on irrigation and requires a dramatic change in the region's traditional rice growing methods. This has significant implications for the cattle and buffalo industries as the regions draught animals are a less efficient source of draught power under double cropping than under traditional single cropping conditions. There is substantially more land to plough over more limited time periods.

Furthermore with the double cropped land under rice for most of the year, draught animals are confined to the region's poor quality natural grassland for most of the year; Pressure to switch to mechanical power sources that can be used more intensively in season for ploughing and cultivating and that are not dependant on reduced grazing resources are therefore greater in the region as a result of double cropping than elsewhere. The rate of adoption and import of farm machinery and tractorisation in Thailand provides evidence of this process. Figure 1 indicates the growth in imports of farm machinery from around 800 thousand machines in 1987 to 1.7 million in 1992 (with farm tractor imports increasing from 4000 in 1987, to a peak of 18000 in 1990 and levelling to 9500 tractors in 1992). Recent village surveys in Northern Thailand by ACIAR (1994) indicated a very high use of small tractors (81%) for the ploughing of rice fields by Thai villagers.

Figure 1: Number of buffalo vs farm machinery imports in Thailand, 1987-1992



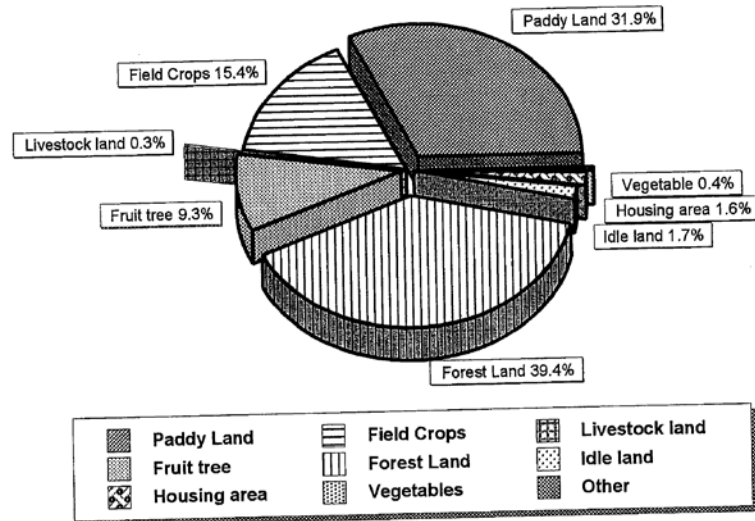
Source: Thailand Department of Livestock (cited in Office of Agricultural Economics, 1993).

Higher income levels associated with the dramatic growth of the economy has facilitated this capital-intensive approach to production and the adoption of farm mechanisation over traditional approaches. Such methods served to further reduce available pasture lands for grazing animals.

4.4 Land Expansion

Thailand has a total area of about 320.7 million rai of which about 65% is used in agriculture. Figure 2 represents the current composition of agricultural land utilisation in Thailand. Pasture land represents an insignificant proportion relative to that of paddy and crop lands. While the growth of the Thai economy is a consequence of the dramatic expansion of productive agriculture into lands previously unused for agriculture, the proportion of pasture land (as well as its productivity and quality) has in fact decreased in recent years from 481,000 rai in 1987, to 394,819 rai in 1992 (O.A.E., 1992, p. 2). Furthermore, factors such as Thailand's rapid rate of urbanisation and expansion of its industrial zones has meant existing agricultural land is increasingly shifting to non-farm use. With an official end to land clearing and an increasing demand for livestock products, there is a growing need for land reform and more intensified commercial industries to meet demand given limited pasture availability.

Figure 2: Agricultural and land utilisation in Thailand (%): 1991

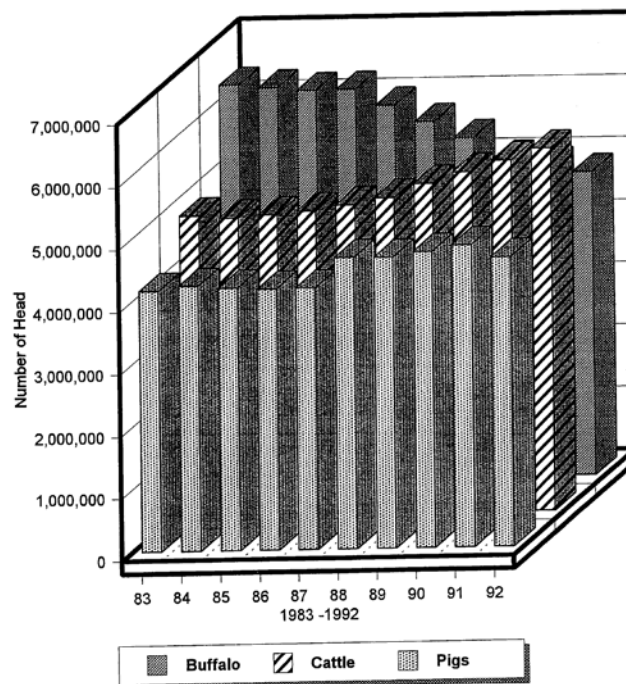


Source: Based on Office of Agricultural Economics (1993)

5. Impact of Thailand's Socio-economic Change on its Livestock Sector

Thailand's expanding economy, its rising population, mechanisation of its crop farming and the increasing presence of large commercial livestock enterprises have all significantly impacted on the traditional role of livestock in village economies and the national economy in Thailand. A steady decline in the total number of Thailand's buffalo stock from around 6.5 million in 1983 to 4.8 million in 1992 (see Figure 3) has occurred as the demand for draught animals has decreased. While the associated growth in income and population levels mentioned above has meant a heightened demand for meat, the demand for draught animals (predominantly buffalo and to a lesser extent cattle) has declined. In the post-war period animal drawn ploughs have been progressively replaced by tractors. More recently from about 1970 and coinciding with the introduction of double cropping, paddy lands began to be ploughed by two wheeled and four wheeled power tillers (Warr, 1993).

Figure 3: Official statistics on reported number of buffalo, cattle and pigs: Thailand 1983-1992



Source: Based on Office of Agricultural Economics, 1993

However, increased demand for products such as meat and milk has sustained and produced an increase in the number of beef and dairy cattle in recent years – raising total cattle stocks beyond those of buffalo from 4.8 million in 1983 to 5.8 million in 1992. Therefore it has only been recently that the high income elasticity of demand for beef has begun to make a significant impact on domestic beef production. In respect to dairy cattle production, the dramatic growth of domestic dairy farming has partly been a product of the strong promotion by the government and the private sector.

Changes in the Thai diet have had a significant impact on the demand for poultry products in particular. Poultry production has become a highly successful component of the Thai livestock production. Introduction of modern breeding programs and production methods (applied in the United States) for poultry has been facilitated by large agribusinesses (e.g. the Charoen Pokphand group) which first pioneered contract farming methods in Thailand in the early 1970s. These early innovations and a long period of low feed prices and (until very recently) labour costs, were responsible for the real decline in poultry prices. This process has increased the importance of poultry products in Thai diets at the expense of traditional fish. Present consumption of poultry stands at about 6.6 kg per capita per year (Warr, 1993, p. 87).

Consumption of pork stands at 4.7 kg per capita per year. It is conventionally recognised that its role in the Thai diet could have been much larger had it not been for restrictive policies affecting the slaughtering industry, policies which have also adversely affected beef consumption. Despite these restrictions however it is now claimed that more than 80% of hogs are grown by commercial growers compared with less than 20% in 1977, indicating that pork production could potentially follow the same path in commercial development as Thai poultry (Sheehan, 1993).

5.1 Control of Animal Diseases in Thailand

A further consequence of this rapid increase in the domestic demand for livestock products as well as increasing export of livestock products by Thailand, has been the growing importance placed on the development of effective and efficient disease control programs for livestock. Table 8 gives an indication of the extensive application of vaccination programs from a national perspective despite the marginal reduction in vaccination levels in 1992 compared to vaccination levels of the previous year.

[TABLE 8 MISSING]

With a growing trend in the rearing of livestock to meet not only domestic but growing export demand as well, there has developed a growing demand for effective disease control programs and hygiene regulations to meet international trading requirements. With the stringent requirements of sanitary regulations governing global trade in livestock products, control strategies such as disease-free zones (regional eradication) for export has developed as a viable alternative to national immunisation through vaccination. In recent times there has been a growing interest in determining the economic viability of various control strategies that endeavour not only to validate the significant investment into such programs but help determine the most efficient and effective program to identify, diagnose and treat the disease given the existing resources.

6. Concluding Comments

In the last few decades, Thailand has undergone significant socio-economic change - substantially rising incomes, a growing population, increased urbanisation and a change in the structure of its economy with a decline in the agricultural sector relative to other sectors

such as manufacturing and tertiary sectors. Technological change in agriculture has resulted in reduced demand for draught animals and this is reflected particularly in declining numbers of buffalo. However, cattle numbers have risen as demand for beef and dairy products have grown. Pig numbers have remained relatively stable but the proportion of pigs supplied by commercial piggeries relative to those supplied by villages appears to have risen. Poultry production has expanded rapidly mostly as a result of commercial production rather than increased village supplies, and Thailand has been able to establish substantial exports of frozen broiler meat. Within Thailand, per capita consumption of poultry meat and red meat has risen mainly at the expense of per capita fish consumption which was (and still is) very high by world standards.

Commercial livestock producers usually aim to maximise profits from their business operations and are motivated by profit considerations to control diseases amongst their livestock. Both commercial poultry and pig producers in Thailand seem to be vigilant in their attempts to prevent or control disease of their livestock. As for the growing Thai dairy industry, it consists of relatively small-sized herds but nevertheless since dairying is a specialized commercial undertaking, there should be a strong economic incentive amongst dairy farmers to control or prevent disease in their dairy cattle. As for the supply of beef in Thailand, the main source by far still seems to be from villagers. Supply comes from work cattle beyond their useful working life and from local breeds of cattle kept specifically for meat. To the extent that real prices of beef have risen with rising demand for beef in Thailand, villagers should have a growing economic incentive to maintain the health of any of their cattle used for beef. Because draught cattle can also be used for beef this may have prevented a decline in draught cattle numbers in Thailand despite the increased availability of mechanical substitutes for draught power.

Note that draught cattle are not as a rule used for ploughing (buffalo are usually preferred for this) but are mainly employed by Thai villagers to draw carts. These may be used to carry produce or to bring cut-and-carry fodder. Whereas buffaloes are being replaced by tractors (often of the small two-wheeled type), utility trucks are replacing draught-cattle in some of their uses. Buffaloes are also used for meat consumption and this may have moderated a decline in their numbers.

The economic development of Thailand has had major consequences for its agricultural sector and particularly for the nature of its livestock sub-sector. In most cases, it has become

more profitable to protect livestock against animal diseases and of greater social importance as market exchange systems involving livestock have become more extended spatially in Thailand. In addition, Thailand itself has become more involved in the export of meat and maintenance of animal health is important for gaining access to export markets and retaining these. Its main exports are poultry meat and to a lesser extent pork. While it has some beef exports to nearby countries such as Malaysia, Thailand has become a sizeable net importer of beef. It is also a substantial net importer of dairy products.

Thailand's dairy herds have increased rapidly and its other cattle numbers (mainly for beef) have also shown an upward trend. It seems likely that Thailand will become an increasing net importer of beef because there is little scope for it to increase cattle numbers via grazing. One of the main avenues for Thailand to increase its domestic beef supply is by improved husbandry of its cattle and by increased lot-feeding of cattle. Both developments have implications for the health of livestock and are likely to make it more important from an economic viewpoint to reduce the presence of disease in livestock.

7. Notes

1. In 1994, F.A.O. predictions stated that increased labour costs for Thailand poultry production could result in decreased sales and erode its competitiveness in Japan, its major market (Anon, 1994a).

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