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Chapter 10

SOUTH EAST ASIAN LIVESTOCK SYSTEMS: WITH SPECIAL REFERENCE TO INDONESIA'S EXPERIENCE AND PERSPECTIVE

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SYNOPSIS

Livestock production systems in Indonesia such as in other South East Asian countries is varied and complex in nature ranging from traditional to modern activities. In Indonesia, except for dairy cattle, pig and introduced poultry breed (layer and broiler), other livestock such as ruminants (buffalo, beef cattle, goats, and sheep) and non-ruminants (local pig, poultry, and horse) are raised by farmers in the more remote regions. Those farming livestock use it as a buffer in the household economy to complement the main livelihood which is rice paddy cultivation. The large ruminant is raised based on the traditional management in which the buffalo and local cattle are fed with rice straw and/or field grass obtained from road side and arable land. There is virtually no supplemental feeding. While the native chicken and duck are raised close to habitations and fed with rice bran and kitchen by-product. Pig husbandry is not so popular due to religion obligation to the "halal" meat product of the majority of Indonesian society. The commercial poultry and dairy are managed by commercial farm enterprises. To improve the productivity of the traditional Indonesia's livestock farming system, it is important to improve the capacity of the livestock keepers by upgrading the extension effort to promote improved crop-animal systems, and better farming practices. The program includes upgrading the farmer's institution, supporting them financially by simplifying the access to financial institution, and doubling the government's role and involvement. For the future, there will be a need to focus on improving the management system of ruminant livestock production to support the economy and guarantee food security of Indonesian farmers in the context of the severe effects wrought by global climate change.

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1. INTRODUCTION

1.1. Livestock Production Systems in Asia

According to Devendra (2000) livestock systems in Asia are of two types:

- systems involving ruminants
- systems without ruminants

These crop-animal systems are found across several agroecological zones (AEZ) in the tropics. In Asia, as a whole, for example, they provide five types of AEZ from the tropical highlands, semi-arid and arid, and subhumid and humid regions. Table 10.1 describes the different types of crop-animal systems in the individual AEZ including the types of crops and animals used in each. Crop-animal systems are especially significant in South-east Asia where annual crops (rice, wheat, maize, pulses and oilseeds) are grown and both ruminants (buffalo, cattle, goats, and sheep) and non-ruminants (pigs, poultry, including ducks) are integrated into these systems. Examples are rice-chicken-fish-vegetables in Indonesia, vegetables-goats-pigs-ducks-fish in Vietnam; oilpalm-ruminants in Malaysia and coconuts-cattle in the Pacific islands. With annual crops, livestock are integrated into a range of cropping systems.

Table 10.1. Agroecological zones and types of mixed farming systems in Asia

Agroecological Zone	Growing period(days)	Crops	Animals	Mixed farming benefits
Rainfed temperate and Tropical highlands	<110	Barley, millet, fruits Mustard, potatoes	Yak, cattle, sheep	Traction, Transport, manure (fuel, soil fertility), reduced risk survival
Rainfed humid and Sub-humid uplands	180-270	Maize, rice, wheat, root crops, plantation crops	Cattle, pigs, chickens	Traction, Transport, income, manure (as fuel, soil fertility), crop residues
Rainfed humid and Sub-humid lowlands	180-300	Maize, rice, wheat, root crops, sugar cane, mung bean	Buffalo, cattle pigs, chickens, ducks	Traction, Transport, income, manure (as fuel, soil fertility), crop residues
Irrigated humid/ subhumid lowlands	180-365	Maize, rice, cassava, sweet potatoes	Buffalo, cattle pigs, chickens, ducks	Traction, Transport, income, manure (as fuel, soil fertility), crop residues
Rainfed arid/semi-arid lowlands (Unirrigated)	60-120	Sorghum, millet, pea, groundnut, cotton	Camels, donkeys, cattle, sheep, goats, chickens	Traction, Transport, income, manure (as fuel, soil fertility), reduced risk, survival
Irrigated arid/semi-arid lowlands	75-180	Millet, groundnut, pigeon pea, cotton	Cattle, pigs, goats, chickens	income, manure (as fuel, soil fertility), reduced risk, survival

Indonesia provides several examples of crop-animal systems such as the so-called *three-strata forage system (TSFS)*. In the drier and low rainfall areas, a useful system has been developed that combines arable cropping and ruminant production in a sustainable crop-animal system. The TSFS is way of producing and conserving the food requirements of cattle and goats, without any degradation of the environment for dryland farming areas such as in eastern Indonesia and south Asia, the systems, combines crop production (maize, groundnut, cassava, pigeon peas etc.) with shrubs and trees to produce fodder/forage for all year round feeding livestock (and humans!).

Major highlights of the system are:

- Increased forage production has enabled higher stocking rates and live weight gains (3.2 animal units equivalent to 375 in the TDFS compared to 2.1 animal unit or 122kg/ha/year in the non TSFS.
- Cattle in the TSFS gained 19% more live weight and reached market weight 13% faster and farmers in the TSFS benefited by a 31% increase in farm income.
- The introduction of forage legumes into the TSFS reduced soil erosion by 57% in the TSFS compared to the non TSFS, together with increased soil fertility.
- The presence of shrubs (browse) and trees for firewood and construction helps. The integration of goats in addition to cattle into the system further increases the income of farmers
- Overall, TSFS is being institutionalized as the concept and technology spreads (Suarna et al., 1990, Paris, 2002),

Another common crop-animal(s) system is the *Crop (rice/vegetable)-duck-fish integration* that is an excellent example of a crop-animal production system that involves water, especially in ponds. The success and rapid expansion in Indonesia of the rice-fish system (and its variants including the inclusion of ducks) is a good example of efficiency in integrated natural resource use to capture economic benefits. Other variations of the integrated approach are to be found throughout the Region (see Chapter by Hahn, this volume).

- Philippines:-buffalo-pigs-chickens-ducks fruit trees-fish
- South China:-rice-maize-pigs-vegetables-sweet potato, dairy cattle
- Thailand:-Rice-fish-pigs-ducks-vegetables
- Vietnam: - Pigs-ducks-vegetables fruit trees-fish-goats

A typical crop-animal system of the type used in parts of Indonesia has multiple components (Figure 10.1).

In the humid tropics of the Indonesian archipelago, livestock farming systems are based on, and affected mostly by, the specific regional agro-ecological and cultural conditions. Actually, most livestock farming conducted by smallholder farmers more than 75% of whom live in the remote area (*perdesaan*). The livestock keeping is complementary to the main agricultural activity -- rice paddy cultivation. So, the livestock productivity is far from maximally productive. This chapter presents an explanation of the livestock production systems and the obstacles and opportunities for their development. Lastly, some strategies are

proposed to assist those facing problems and improve systems of raising livestock in the context of global and climate change.

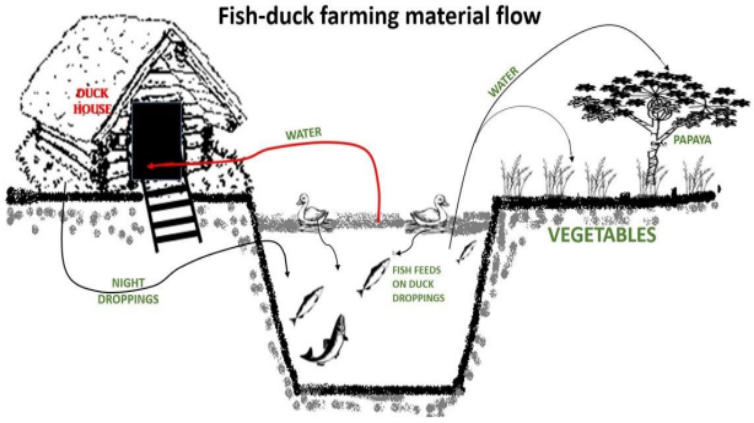

Figure 10.1. The material flow in a duck-fish system with vegetables, trees and rice in very efficient.

2. The Roles of Livestock Farming

In reality, the ruminants such buffalo, cattle, goats, and sheep and non-ruminant animals like chicken, duck, pig, and horse are types of livestock that farmers raise. The number and kind of each breed owned by each raiser depends upon many factors such as the area of land owned, local culture, beliefs, and religion, role of livestock in supporting the economy, and the initial amount of money available to the person who seeks to purchase livestock for the farm (Suhubdy, 2013). Winarto et al., (2000) reported the importance of raising cattle by small holder in Java Island, Indonesia. Cattle raising has a significant role in increasing the family income and ensuring economy security of the farmers.

Figure 10.2. Milking buffalo in Sumbawa Regency (©2005 Suhubdy).

Generally, the roles of farming livestock are (1) to secure the family economy, (2) for traction animals, (3) saving, (4) religion and culture obligations, (5) meat producer, (6) source of green fertilizer, and (7) hobby. Buffalo, cattle, and horse are the livestock could cover all

those functions. While goats, sheep, pig, and poultry (especially native chicken and duck) represent the number 1, 3, and 4 roles and also they well known as "mini bank animals." Dairy cattle is very rarely kept by traditional farmers because of complicated management and high cost. The dairy cow farming in Indonesia is conducted mostly by cooperatives and/or commercial enterprises.

In most of the country, the farmers still use buffalo and cattle even horse for land preparation for rice paddy cultivation. Since mechanization system is introduced by using a tractor as a plowing tool, the use of buffalo, cattle, and horse as draft animals is becoming rare and their function and role of buffalo and cattle has shifted to meat and milk (Figure 10.2) producing livestock (Suhubdy et al., 2017, Suman et al., 2014).

Besides being used as a draft animal, the buffalo provides an interesting and nationally well-known culinary item made from its milk. There are several dishes made of buffalo milk such as "*palopo*" and "*ferment susu*" (cooked coagulated milk mixed with sugar) from Sumbawa Regency (West Nusa Tenggara), "*dadiah*" (fermented milk in bamboo) from West Sumatera, and "*dangke*" (traditional baked cheese) from Enrekang Regency (South Sulawesi) (Suhubdy, 2013a). In addition, many women and men's accessories like jacket, belt, bag, wallet, and shoes are made from buffalo skin and tanned in Yogyakarta. Those are very popular with tourists who visited this city (Said and Hafizah, 2013). Buffalo, are also used as racing animal. A very famous attraction known as "*barapan kebo*" could also be watched regularly at Sumbawa Regency. Because of this race, buffalo are specially bred for size and speed which can increase the price of buffalo and ensure that breeding and selection are given proper attention.

3. Livestock Population and Development

The dynamic of population of livestock in Indonesia are presented in Table 10.2.

It can be seen from Table 10.2 that the livestock population comprises only 0.85% large livestock, 2.11% small livestock, and 97.04% are poultry. The dominant population of Poultry dominates because of the fact that they are 'easy to keep and quick to market'. Large livestock require higher levels of expenditure to acquire and need more input when raising them.

The data also show that population of both ruminant and non-ruminant livestock tended to increase over time. For some large livestock (beef and dairy cattle) their population showed moderate increase at 4.7% and 3.2%, respectively. Growth of buffalo and horse populations during five years showed just a small improvement (0.9% vs 0.5%), respectively. reflecting their diminishing role as draft animals. The rapid increase in beef and dairy cattle may be due to national government policy to become self-sufficient in meat production. Besides the effort to improve the productivity of local breed cattle, the government also imported live animal from overseas such as Australia and other countries that are free from zoonosis diseases (Dirjen PKH, 2016b). Among the small livestock, goats' population showed a small increase of 2,0%. This may be related to increasing the number of slaughtered animals to make the "sate kambing" (meat skewer). For poultry, broiler chicken is very dominant in number because of the advanced industry and modern management applied. According to the above

figures, the large and small livestock may need considerably more attention in both management and improvements in the production system in the future.

Table 10.2. Livestock population in Indonesia (x 000 heads) over a recent 5-year period

No.	Species	Year				
		2012	2013	2014	2015	2016
I	Large livestock	18,468	14,674	16,993	17,716	18,451
1	Beef cattle	15,981	12,686	14,727	15,420	16,093
2	Dairy cattle	612	444	503	519	534
3	Buffalo	1,438	1,110	1,335	1,347	1,386
4	Horse	437	434	428	430	438
II	Small Livestock	39,226	41,025	42,426	43,846	45,788
1	Goat	17,906	18,500	18,640	19,013	19,608
2	Sheep	13,420	14,926	16,092	17,025	18,066
3	Pig	7,900	7,599	7,694	7,808	8,114
III	Poultries	1,686,979	1,818,945	1,917,807	2,021,937	2,109,016
1	Native chicken	274,564	276,777	275,116	285,304	298,673
2	Layer	238,718	146,622	146,660	155,007	162,051
3	Broiler	1,244,402	1,344,191	1,443,349	1,528,329	1,592,669
4	Duck	44,357	43,710	45,268	45,322	47,360
5	Muscovy duck	4,938	7,645	7,414	7,975	8,263

Sources: Dirjen PKH (2016a, National Livestock Service Office).

4. Herbivore (Ruminant) Farming Systems

As mentioned earlier, ruminants play a pivotal role in complementing the agricultural activities of the Indonesian farmers. As ruminant livestock are biologically great converter of roughages or other biomass that cannot directly be used by human being like straw and other agricultural and industrial by-products, and native grassland becoming significant as a source of economic products such as meat, milk, and hide (Church, 1988; Suhubdy, 2016). In the context of Indonesian agriculture, the following are systems applied to raise ruminant livestock.

4.1. Cut-and Carry Based System

Cut-and-carry system is a very dominant applied method of collecting forages and fodders particularly in the area where land for grazing is limited. The farmers cut-and-carry those forages from road side, arable land, bank of river and dike of rice paddy field (Figure 3) to the livestock shelter. They do it at least twice a day, in the morning and afternoon. In small holder farmer observed in Lombok Island, for example, they used a knife called "*arit*" or "*parang*" to cut the native grass or legume trees that are native to the area or planted by the householder in their garden. Species include *Sesbania grandiflora* (*Turi*), *Gliricidia sepium* (*Gamal*), and/or other wild shrub/forb that grows adjacent to their livestock shelter. Collector do not care about quality is but the quantity of the forages collected is all important. The forages so obtained are fed directly to their livestock.

It should be noted that when it comes finishing cattle to slaughter weight that the cut & carry systems of Indonesia generate around 104kg lwt per cow[1] (most of which is from fattening the cull females). This should be seen against the background of trends globally. Beef production per cow ranges from 100-480 kgs globally– weaners are the main part for most systems, with culled adults being the second most important contributor. When it comes to the cost of finishing, the highest cost systems in large scale feedlots continue to occur in Europe (Germany, Austria and the UK) and Asia (China and Indonesia) but the small herder's system in Indonesia continues to cover finishing costs and remain profitable.

Figure 10.3. Cut-and-carry grass fed to cattle in pens (©2011 Suhubdy).

4.2. Rangeland/Pasture Based System

Another important feeding system applied in Indonesia is to use sown pasture in conjunction with native rangeland. This system is widely applied where livestock graze native rangeland in areas such as in Nusa Tenggara islands (NTB, NTT), Sulawesi, and in Papua. Mostly, buffalo, cattle, goats, and horses graze in mixed herds on that native grazing area. No sheep are allowed to graze together with other livestock because sheep are suspected to be a carrier of "*jembrana diseases*" that could kill *bali* cattle (*Bos sondaicus*).

The feeding of large livestock based on this system is especially important to livestock keepers in Sumbawa regency (NTB).This system is traditionally known as "*lar*". This *lar-system* is not only for the communal grazing area but also for other functions such as an arena where farmers meet to discuss the development of their livestock (health, breeding, meeting, calving, and weaning), marketing information, and receive extension messages (Suhubdy, et al., 2018; Darma, et al., 2017; Dilaga et al., 2017).

4.3. Estate-Crop-Livestock Based System

Besides those systems, grazing large livestock from estate enterprises has been applied, in particular, in the huge area of palm oil and cacao estate plantation like those in Sumatera, Kalimatan, and Sulawesi (Fagi, et al., 2009). On those estates, buffalo, bali cattle, and/or

[1]kg live weight (lwt) produced per cow per year.

imported cattle breeds (Angus, Hereford, Brahman cross) are kept in the estate area. They feed them with Palm oil or cacao by-product together with native grass and shrub/fob that grows between the palm oil trees and cacao plants. The livestock does not belong to the ordinary farmer but are owned by the government or by a commercial enterprise who are also interested in raising livestock. This system has double benefit because the livestock provide fertilizer to the plants and the plants provide feed for the livestock. This system, in the future, may need to be extended to increase the output of meat and milk.

More recently, due to the increasing area of land used for corn production, the use of corn straw, corn stover, and corn bran may be other potential system that could be intensively applied in the future for the development of beef and milk production from ruminants.

5. NON-RUMINANT FARMING SYSTEMS

Not all non-ruminant livestock are kept by traditional farmers. For example, the pig husbandry is mostly conducted by people in non-Moslem society areas. Because of the "halal" meat regulation, the pig industry in Indonesia is limited. The discussion in this chapter, will deal only with production from native chicken, duck, and horse.

Native chicken and duck are the "quick money" livestock for the traditional farmers. The farmers raise their chicken and duck adjacent to their house. The keep them in crates that are made of bamboo or other local materials (Figure 10.4). They feed them mostly with by-product of kitchen as well as supplementing them with their own rice bran obtained from rice paddy huller. There is no standard ration provided. In some cases, they also kept cross bred chicken (Arab chicken) for meat production. The farmers may feed them with commercially produced layer or broiler ration. This is not done all the time, but when there is extra money are available.

Figure 10.4. Native chicken reared with traditional free-range management. (http://static.panoramio.com/photos/large/50495711.jpg)

Horses are also raised by the farmers. The horses are kept for transportation to the rice paddy field or moving some goods/produce from garden to the market in the city. During the day, horses graze on the farmers own land or kept in a pen and eat such amount of forages that are available for cut-and-carry from garden, arable land, dike of paddy field, etc. The farmers are concerned about energy of the working horses and these get rice bran as a feed supplement. Horses may have an economic value when they are sold as a race horse or for other recreational purposes, like horse riding or some sports. In the future this option may be needed to be explored further.

6. Climate Change and Livestock Production

Global climate change is one of the great obstacles of livestock production and food security (Suhubdy, 2012; Fuhrer and Gregory, 2014; Sejian, et al., 2015; Malik, et al., 2015). Climate change affects livestock production both direct and indirectly. The Direct effects are due to increases in the environmental temperature and heat loads, causing animal to reduce feed intake, increase heart rate, and have higher rectal temperature. Those effects in the long run will affect productivity. Indirect effect is due to shortage availability of forages or roughages and water caused by limited rain fall and/or much flooding (Suhubdy, 2015). In Indonesia, the productivity of *lar* (native rangelands) reflects the limited amount of rainfall, in particular, from August to September in each year. This period of the year coincides with severe shortages of feed and water limitation often leading to death of animals. This is an important factor that must be overcome in the future if livestock is still to be reared by traditionally management systems. Fodder conservation, greater use of crop residues, and utilization of industrial by-products may be part of a solution.

Concluding Remarks and Management Implications

Traditionally livestock management systems have some advantages in that the start- up costs are relatively low and the outputs are usually sufficient for a subsistence lifestyle but in a modern cash economy the returns are too low and many livestock-based operations are not economically viable. Yet for a significant number of Indonesians in rural areas the advantages of keeping the farmers' lifestyle has lots of appeal. For the farmers with limited resources, they still can keep a few livestock to support their livelihood by rearing the livestock that do not need complicated technology (native chicken and duck and buffalo), doing breeding with traditional ways, and using environmental resources wisely. Against those advantages is the recognition that production of livestock products is not optimal and often uneconomic. Better use of the natural resources and application of technology and science could do a lot to improve output. In future, new livestock production systems based on Indonesian conditions are needed to improve productivity. Capacity building among the farmers and technology transfer will involve doubling the involvement of government and financial institutions, give support for more scientific research to be conducted to identify, prioritize and document the obstacles and related production aspects and find solutions.

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