The Advancement of Livestock Production with Special Reference to Feed Resources Development in the Tropics — Current Situation and Future Prospects —

Masao Sasaki*

Abstract

The paper reviews the global and regional (Asian) trends of livestock production and future prospects of livestock development activities with particular emphasis on feed resources for ruminants. Of the estimated world feed consumption of 4 billion tons (barley equivalent) in recent years, roughage accounts for 75-80%. Almost 650 million tons of coarse grains and wheat, i.e. nearly half of the world output of cereals (excluding paddy rice) have been consumed as animal feed each year. Although grain feeding has been traditional for non-ruminant livestock, in the recent beef and milk production systems, a larger amount of concentrate feedstuffs tends to be consumed. In Asian developing countries, grains are seldom fed to cattle and buffaloes. FAO strategies to increase the availability of ruminant feed resources involve among others: 1) Better Utilization of Natural Pasture Lands, 2) Forests as a Source of Animal Feed, 3) Use of Urea-treated Straw, 4) Use of Urea-Molasses Blocks, 5) Utilization of Agro-industrial Waste/By-products and 6) Exploitation of Non-conventional Feeds.

Introduction

Livestock farming in the tropics is an integral part of the economy of the country and contributes to the well-being of the people in the region. Livestock are generators of food, draught power, manure and other useful animal products/by-products and serve, particularly in case of large ruminants, as an important asset to stabilize the living of millions of rural farmers. Cattle and buffaloes and to some extent, small ruminants, support and sustain agricultural operations in the tropical regions. They also consume large quantities of agricultural and industrial by-products/wastes and convert these otherwise useless materials into valuable products for human population.

The characteristic features of livestock production in the tropics as compared to those in the temperate zone, consist of a predominance of small-scale units and low productivity per animal. There are many reasons for this low productivity i.e. low genetic potential of local animals, poor husbandry management, poor animal health care, etc. In addition, various problems relating to feed and feeding practices definitely account for the low productivity of livestock in most countries of the tropics. This paper deals with recent trends of livestock production, the present status of available feed, better utilization of feed resources and improved feeding systems for ruminants in the context of small scale livestock farming in the Asian tropical countries.

*FAO Regional Office for Asia and the Pacific, Phra Atit Road, Bangkok 10200, Thailand.

Recent trends of livestock production and feed availability

1 Livestock resources and product output

Table 1 summarizes the recent trends in the increase of the number of animals in 6 livestock species (FAO, 1990). The average population growth rates per year for each species are rather low in both the Asia-Pacific region and the World except for chicken. The growth rates for the population of ruminant species (cattle, buffaloes, sheep and goats) are 1% for all the species in the Asia-Pacific region and less than 1% for the world population of cattle and sheep. In the Asia-Pacific region the number of livestock has increased in all the 6 species at higher rates than those for the world average.

Table 1 Animal resources in Asia and the Pacific

Species	Population (million head)		As of total world population (%)		Average annual growth rate (%), 1979-89	
	1979	1989	1979	1989	Asia-Pacific	World
Cattle	360	404	30	32	1.3	0.6
Buffalo	117	135	96	96	1.4	1.4
Pig	360	424	47	50	1.6	1.0
Sheep	416	466	38	40	1.0	0.8
Goat	224	271	49	52	1.5	1.3
Chicken	1,904	3,897	28	37	7.9	4.5

Source : FAO, 1990.

Despite the low population growth of ruminant animals, the Asia-Pacific region performed well during the 1979-89 period in terms of annual growth rates for the output of major livestock products (meat 5.4% and milk 4.5%, Tables 2 and 3).

During the same decade (1979-89), the total ruminant meat (beef, buffalo meat, mutton and goat meat) production increased at the average annual growth rate of 1.6% (world), −0.1% (Asia-Pacific, developed) and 6.5% (Asia-Pacific, developing), respectively. Total milk (milk from cattle, buffaloes, goats and sheep) output during 1979-89 showed on average annual growth rate of 1.7% (world), 1.9% (Asia-Pacific, developed) and 5.4% (Asia-Pacific, developing). These figures illustrate that in spite of the comparatively low growth of ruminant production at a global level and also in 3 Asian developed countries (particularly Australia), a satisfactory performance was observed in the Asian developing countries as a whole.

Table 2 Meat production by species in Asia and the Pacific

Species	Production (million tons)		As of total world production (%)		Average annual growth rate (%), 1979-89	
	1979	1989	1979	1989	Asia-Pacific	World
Cattle	4.5	5.0	9	10	2.2	1.4
Buffalo	0.7	1.3	81	86	6.3	5.6
Pig	14.1	26.7	25	40	6.6	3.0
Sheep	1.8	2.3	32	36	2.2	1.5
Goat	0.8	1.3	45	56	4.5	3.1
Chicken	4.6	7.7	16	20	5.3	4.1
Total meat	27.1	45.2	22	27	5.4	2.7

Source : FAO, 1990.

Table 3 Milk production by species in Asia and the Pacific

Species	Production (million tons)		As of total world production (%)		Average annual growth rate (%), 1979-89	
	1979	1989	1979	1989	Asia-Pacific	World
Cattle	38.6	58.0	9	12	4.4	1.5
Buffalo	24.8	38.2	94	96	4.7	4.5
Goat	1.9	2.8	28	34	4.2	3.0
Sheep	1.1	1.4	16	16	2.1	1.8
Total milk	66.6	100.4	14	19	4.5	1.7

Source : FAO, 1990.

2 Feed resource availability

The world total consumption of animal feed in recent years has been estimated at around 4 billion tons (barley equivalent). Major ingredients for compound feed (coarse grains, milling by-products, oil meals, pulses, root crops, etc.) accounted for 20-25% of the total requirement of animal feed (energy basis) or almost half of the world output of cereals (excluding rice paddy), while roughages (crop residues, fodder, grasses, etc.) covered the rest of the world feed resources. Although roughages are still the far predominant feed, they have been losing ground to concentrates in the last decade, particularly in many developing countries (Table 4).

Table 4 Estimates of world feed utilization

(Million tons)

	Countries				World	
	Developing		Industrialized			
	1986 (m. t.)	Growth rate 1981-86 (%)	1986 (m. t.)	Growth rate 1981-86 (%)	1986 (m. t.)	Growth rate 1981-86 (%)
Concentrates	260	3.7	640	1.8	900	2.3
Roughages	1,850	1.3	995	0.6	2,845	1.0
Total feed	2,110	1.0	1,635	1.0	3,745	1.0

Note : Grain equivalent
Source : FAO.

The relatively rapid increase in the consumption of concentrate feed in developing countries is a clear reflection of a shift in the composition of the livestock population and their product output, i.e. a larger number of monogastric animals and their products (pork, poultry meat and eggs). However, even for ruminants, the requirement for concentrate feed is expected to increase gradually in some developing countries since intensive-type of operations such as feedlot system is being increasingly adopted for milk and beef production and also since the role of large ruminants as draught animals is rapidly decreasing. It has been a common practice in most tropical countries not to use concentrate feed for draught animals.

Cereals are used in addition to direct human consumption, as a) feed, b) seed and c) miscellaneous purposes (industrial use, etc.). In Table 5, the end use of cereals is shown in

13 developing and 3 developed (Australia, Japan and New Zealand) countries. In the Asian developing countries as a whole, the rations were relatively high in the Republic of Korea (31%), Malaysia (30%), DPR Korea (29%), while such countries as Bangladesh, India, Nepal and Pakistan allocated less than 1% of cereals to animal feed. The use of cereals as ingredients of compound feed is thus, still limited in many Asian developing countries. In this regard, policy makers and planners should recognize the general upward trend of the end use of grains as animal feed to cope with further expansion of intensive-type livestock operations including those for large ruminants.

Table 5 End uses of cereals

(1,000 tons)

Country	Supply	Feed	(%)	Seed	(%)	Rest	(%)
Developing Countries							
1 Bangladesh	21,417	3	(-)	711		1,615	
2 Burma (Myanmar)	11,343	713	(6.3)	316		1,055	
3 China	315,772	42,978	(13.6)	9,713		19,903	
4 DPR, Korea	9,628	2,760	(28.7)	132		1,359	
5 India	143,457	1,402	(1.0)	9,084		7,379	
6 Indonesia	35,637	1,645	(4.6)	372		2,584	
7 Malaysia	3,863	1,166	(30.2)	15		159	
8 Nepal	3,824	13	(0.3)	122		448	
9 Pakistan	16,988	89	(0.5)	699		543	
10 Philippines	11,649	646	(5.5)	158		1,009	
11 Rep. of Korea	14,138	4,384	(30.8)	50		1,348	
12 Sri Lanka	3,060	58	(1.9)	75		135	
13 Thailand	12,806	1,860	(14.5)	504		1,489	
Total	603,582	57,717	(9.6)	21,951	(3.6)	39,026	(6.5)
Developed Countries							
14 Australia	6,966	3,204	(46.0)	1,216		807	
15 Japan	37,819	17,747	(46.9)	118		2,534	
16 New Zealand	1,019	416	(40.8)	58		223	
Total	45,804	21,367	(46.6)	1,392	(3.0)	3,564	(7.8)

Crop residues, fodder trees, industrial by-products/waste materials are available in large quantities in most tropical countries. The use of these feedstuffs, mainly for ruminants, has however, not been fully exploited by local farmers due to improper feeding practices and the lack of dissemination of new technologies. Better utilization of these abundant feed resources through adaptation of new technology and development of practical feeding systems applicable to actual farmers' conditions, is the key to secure enough feed for the future expansion of ruminant livestock production in most tropical countries of the region.

Better utilization of available feed resources

The following topics concerning a better utilization of available feed resources for ruminants are outlined in this section:

1 Urea-treated straw
2 Urea-molasses block
3 By-pass proteins

4 Sugarcane products and by-products
5 Palm kernel cake
6 Trees and shrubs as fodder resources
7 Biotechnology for enhancing feed value of roughages

1 Urea-treated straw

A large amount of research results has been accumulated on alkaline treatment of straw to improve this most abundant crop residue in Asia. The actual adoption by farmers, however, has not yet reached the desirable level and thus, large quantities of straw are still being wasted. To enable the application of the new technology by rural and subsistence farmers, the following conditions should be met:

1) Must be practically applicable at farm level.
2) Should produce visible results in a short time.
3) Does not require high initial investment and
4) Should be safe for use at the village level.

Most successful examples have included urea-treatment for lactating cows. In the urea-treatment of straw, urea is dissolved in water at 4-5% level, poured over the straw and mixed thoroughly. Each kg of straw requires one litre of urea solution. The soaked straw is then kept under air-tight conditions (covered with a plastic sheet) for at least 7-10 days before being used as feed.

The application of this technique to draught animals tends to be less popular due to the lack of immediate visible benefit.

2 Urea-molasses block

When straw and other fibrous crop residues are the main feed constituents, supplementation with urea-molasses blocks has been effective as an alternative to the urea-treatment, on the performance of large ruminants. To improve the nutritive value of crop residues, it is necessary to supplement the diet with an adequate level of required nutrients (soluble nitrogen, soluble CHO, minerals, etc.) for the rumen microflora to multiply and convert fibrous residues into microbial constituents and volatile fatty acid (VFA).

A large-scale application of urea-block has been undertaken in India under the initiative of the National Dairy Development Board (NDDB) by Anand.

Composition and preparation of urea-molasses block (NDDB)

The following is one the typical formulas of, and the procedure to manufacture the urea-molasses block.

Composition	
Molasses	45%
Urea	15%
Mineral mixture	15%
Salt	8%
Calcite powder	4%
Bentonite	3%
Cotton seed meal	10%
	100%

A Japanese group also developed a new formula for blocks as described below (Hamada, 1989). The manufacturing process includes the gelatinization of propylene glycol and thus, enables to avoid the heating step required to solidify the block.

Molasses-propylene-urea block	
Molasses (cane)	45%
Propylene glycol	9%
Urea	9%
Alfalfa meal	3%
Seaweed	3%
Corn starch	3%
NaCl+NaSO=MgCl+MgO	9%
Trace minerals+Vitamins	1%
Ca (OH)	7%
HPO	11%
	100%

3 By-pass proteins

By-pass proteins are defined as feed proteins which pass intact from the rumen into the intestinal tract (Leng, 1989). In the rumen, most proteins are degraded by microbial enzymes for the production of VFA, CO_2 CH_4 and ammonia. Under standard conditions, this is a wasteful process because high quality proteins are broken down up to ammonia in the rumen and are less effectively used for microbe synthesis than digestible carbohydrates. The protein which by-passes the rumen and reaches the lower digestive tract will be digested by intestinal enzymes and absorbed as amino acid into the animal body as in the case of monogastric animals.

Dietary proteins may escape rumen fermentation and reach the small intestine under the following conditions:

1) Protein meals which are highly insoluble (by heat treatment, etc.).
2) Protein meals which have high tannin contents.
3) Protein meals which move quickly into the small intestine (i.e. in a finely ground form).

Supplementation of crop-residue-based diet with a by-pass protein improves the P : E ratio (more available protein synthesized per energy produced), resulting in improved efficiency of feed utilization for milk production or growth. A larger number of studies should be carried out to apply this innovative concept of by-pass proteins to farmers' conditions.

4 Sugarcane products and by-products

Sugarcane is considered to be one of the most efficient collectors of solar energy, storing it in the biomass form of fiber and soluble sugar. Whole fresh sugarcane can be used as a good quality fodder crop throughout the year to meet the requirement, particularly, in the dry season and in case of feed shortage. The sugarcane industry which is an important sector in many countries of the tropics, produces 3 major products/by-products as feed resources i.e. sugarcane tops, bagasses and molasses.

5 Palm kernel cake

Palm kernel cake (PKC), a by-product from the oil palm industry has become an important feed resource in Southeast Asia, in particular, in Malaysia. The oil palm industry is expanding and oil palm production in Malaysia alone is expected to reach a value of 6-7 million tons in 1991 and thus as many as 700,000 tons of PKC could be available as animal feed (FAO, 1989).

Nutritive value of PKC

PKC is a good feed resource for the supply of protein to cattle and buffaloes. The protein value of PKC was found to be slightly higher than that of copra cake but lower than that of groundnut meal. The digestibility of PKC which was estimated using local cattle was 70%

for crude protein and 87% for nitrogen-free extract (carbohydrate), indicating that PKC is a good source of both protein and energy for ruminants.

In Malaysia, PKC is commonly used as feedlot fattening ration for cattle. PKC is also used for dairy cattle since the cost of PKC feed is much lower than that of the conventional ration. PKC can account for 60-70% of the beef and dairy cattle feed, provided farmers use PKC in conjunction with cheap, locally available energy by-products such as sago waste, cassava waste or molasses together with an ample amount of mineral (particularly calcium) supplement. The following are some of the constraints on the utilization of PKC:

1) Poor palatability
2) Variation in product quality
3) Copper toxicity
4) Rancidity

6 Trees and shrubs as fodder sources

The importance of trees and shrubs in forest and fallow lands as providers of fodder has been much underestimated in the region. In the arid and semi-arid tropical areas and mountainous/hilly lands, fodder from trees and shrubs plays a major role in ruminant feeding. Although the productivity of browse (leaves and pods) in such lands seems to be very low (100-1,000kg of edible dry matter per ha annually) as compared to cultivated fodder/pasture lands, the contribution of such lands to animal production is highly significant due to the vast areas involved.

Community forestry program to support livestock production

Forest lands in the past have tended to be considered as sites restricted to wood production and their role as a source of fodder had been completely ignored in the region. Since the raising of large ruminants is an integral part of the socio-economic pattern of rural life in most Asian countries, community forestry programs should be designed so that the production of fodder trees, shrubs and grasses is a part of the objectives for forest land use. One of the recommendations adopted by the recent FAO Expert Consultation on "Agro-silviculture in relation to Livestock Production" is as follows (FAO, 1991):

"As policy guidelines and strategies for maximum use of forest land, it is recommended that at the central level, the national coordinating committee be established which comprises representatives from forestry, livestock and other rural development agencies to coordinate the integrated (maximum) use of forest lands. At the local level, the statutory user group be organized to plan the use of and manage their own community forest lands".

7 Biotechnology for enhancing the feed value of roughages

There is a high potential for the application of biotechnology to improve the utilization of fibrous crop residues and other by-products by ruminants. Dalmacio (1989) and Ho *et al.* (1989) have reviewed the progress in the development of research activities on this subject in this region. The possible areas where more research is required, are: 1) Microbial treatment of lignin-rich low quality roughages, 2) Manipulation of rumen environment and 3) Production of single cell proteins using by-products as fermentation substrate.

References

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Discussion

Pradhan, K. (India) : The technology for improving the feeding value of straws by urea-ammonia treatment has been perfected but is not applied at the village level. What are the FAO strategies to transfer this technology at the farm level?

Answer : FAO is supporting many national governments to organize training courses at the farm level and to solve problems with the actual users, namely the farmers. Some of the strategies are as follows : 1. To secure a stable supply of urea at reasonable price (at the initial stage subsidies my be required); 2. To carry out economic studies (milk price versus feed cost) to justify the use of urea-treated straw and to give to the farmers some incentives to apply this technique and; 3. Problems of transport of straw - straw treatment can be best applied at individual farmers' backyard (large scale urea treatment and subsequent distribution to needy farmers tend to fail due to transportation problems).