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Review Article

Livestock Production Systems and Trends in Livestock Industry in Iran

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ABSTRACT

The paper reports the livestock importance and trends in livestock industry in Iran. The report covers different production systems for sheep and goats, cattle and poultry and the status of feed resources and feed industry. The paper reports the problems dealing with the present small ruminant production systems and explains how can overcome present nutritional problems of poor ranges. The report also explains the changes from traditional and local to industrial and modern production systems and shows how productivity of the systems can be improved.

Key Words: Livestock production; Iran; Productivity; Pastures; Rangelands

INTRODUCTION

The global food production must increase greatly to meet rapidly growing demands. Some 95% of the population growth is occurred in developing regions, where food deficits are already severe and alternative employment opportunities and economic growth are limited. However, demand for food will be affected also by the ability of consumers to purchase food, the changing dietary patterns and urbanization. It is also obvious that for most developing countries, economic growth will only occur if agriculture and related industries are improved. The developing countries faces tremendous challenges in the next quarter century, including feeding and improving population diets, increasing employment, protecting and enhancing natural resources and ensuring security.

The livestock sector in Asia is under pressure to adapt and expand (Steinfeld, 1998). The adaptation involves mainly a shift in livestock species and functions, with the greatest change being the increase in the number of monogastrics (pig & poultry). There is a general trend towards expansion with the formation of product-specific, which threatens the breakdown of traditional pastoral systems and mixed farming elsewhere. The use of animals for draught power and the non-food functions of livestock are generally declining. Thus, there is a trend from multipurpose to single-purpose animals. Livestock production is growing faster in the moister parts and is moving closer to more densely populated regions. Technological changes are creating modern and capital-intensive production chains for poultry meat, pork, eggs and dairy products, leaving the traditional and labor-intensive sector to smallholder farms. The contribution of livestock to the economy have been largely underestimated in the past and although it is clear that the relative importance of the livestock will decrease, nevertheless livestock provide for a wide range of human needs (Hoffmann, 1999). The major challenge now is to increase the livestock productivity and the quality of products and provide access to markets so as to assist in maintaining food security and relieving poverty, while protecting the environment and human health.

In Asia, the majority of livestock is still kept by small holders; the livestock are fed on crop residues and are opportunistic feeders grazing and scavenging on common- and wastelands. In most cases, therefore, this does not involve the producer in any expenditure. In contrast to the small-scale farmers, commercial production is generally intensive and mainly based on the use of imported feeds. In many cases livestock are an integral part of the system of sustainable mixed farming. This system enables farmers to make maximum use of outputs such as crop residues and animal manure, which are often considered to be of low value but can represent a significant proportion of the value of keeping livestock. Sere and Steinfeld (1998) had defined eleven categories of livestock production systems in Asia, mainly on the basis of (a) agro-ecological zones (b) mixed or solely livestock and (c) landless (intensive). This classification system was further simplified to three system types: pastoral, mixed farming and peri-urban/landless (alternative names are extensive, mixed & industrial). Increasing demand for livestock products, together with changes in international trade, is placing pressure on Asia's livestock sector both to adapt and expand. There is an increasing tendency to greater selectivity as to parts of the

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animal used for food and therefore, there is a trend from multi-purpose to single-purpose animals, with the production of animal protein the overriding objective. Another trend is the growing importance of monogastrics as economic converters of concentrated feed. Livestock production is moving closer to urban settlements and is growing faster in the moister parts of the region. The growth potential for extensive grazing and roughage production is limited. Industrial production of pigs and poultry is increasing relative to the reduction in production from grazing and mixed farming systems.

The growth in demand for livestock products suggests that there will be a consequent rise in demand for animal feed, not only of cereals but of other feeds and particularly proteins. The development, transfer and adaptation of technologies will focus on improving the efficiency of feed utilization and increasing animal productivity. Feed requires land for production and this continues to be the limiting factor to the sector's expansion even if countries resort to feed imports. Data on feed production and consumption are much harder to assemble and FAO does not have comprehensive data on these important commodities. A wide range of different figures (up to 4 billion tons) have been reported for the world annual production and use of animal feed. The largest proportion of feed is used by small farmers in developing regions. Some 800 to 1000 million tons of feed are milled or manufactured feeds.

The Iranian perspective. The total population of Iran is about 70.500 million. The population is young with about 50% aged less than 20 years old. The population growth rate was 3.2% in 1988 but fell down to 1.3% in 2006, respectively. The urban population and villagers account for 68.4 and 31.4% of the total population, respectively while nomads comprise the remaining 0.2%. The male: female ratio is 103 men to 100 women.

A wide spectrum of environmental conditions exist, from the areas of higher rainfall around the Caspian sea, high elevations in the north and west and the subtropical climates in the south, to the drier steppe and desert areas in the central region. Temperatures vary greatly, ranging from –30^{o}C in certain parts of the northwest, to +55^{o}C in the desert areas and the Persian Gulf region.

Agriculture is a major economic sector in Iran, with great potential for development and as such, is seen as a key strategic policy area. It contributes more than 25% of GDP and one-third of total employment. It also contributes substantial export earnings i.e., one-third of total non-oil exports.

Iran's population can be considered largely free from food insecurity. The food balanced sheet showed an increased in net energy supplies from 2800 to 3160 cal per capita per day. The quantity of per capita protein went up from 73 to 80 g per day. In spite of such progress in terms of energy and protein availability, un-balanced diets and micronutrients deficit remain serious problems (Table I). About 90% of the population food requirements are covered by domestic production and domestic supplies cover 95% of agro-industry needs.

Agricultural policies over the last two decades have sought to strengthen agricultural activity in order to achieve higher levels of food production and more diversified sources of foreign exchange thus reducing vulnerability to oil price fluctuations. The government has actively supported the rural sector and agricultural production. Two key aspects of this strategy have been ensuring guaranteed prices to the producers for selected crops and products; and a strong effort towards rural development benefiting thousands of villages.

Livestock production. Livestock is an important national resource in Iran. More than half of the rural population depends at least in part on livestock for their livelihood. Livestock plays a key role in the lives of the rural poor, generating employment and often providing about 80% of their cash income. On average, 31.8% of the gross value of agricultural production is attributed to livestock production, which provides the main source of income and an important component of the average diet. The most common species of farm animals are sheep, goats, cattle, buffalo and camels. Production of milk, red meat, poultry meat and eggs has increased during the last decade by 7.19, 3.14, 7.92 and 5.37% annually, respectively (Table II). Guaranteed and remunerative producer-prices for major commodities have been the essential policy tool behind such performances. Milk production has grown as a result of improved yields and expanding herd size. Livestock by-products such as hides, intestines, hair and related products constitute also part of the country's exports.

Sheep and goats. Small Ruminants (sheep & goats) constitute the major basis of livestock production (Table III). Sheep and goats produce about 53% of the red meat. Due to geographical topography and mountains and plain area, various breeds of sheep and goats in different parts of the country are existed (Kamalzadeh & Shabani, 2007). There are about 28 known sheep and goats' breeds, which are reared by the villagers and nomadic tribes. Apart from the Zel breed, which is reared near the Caspian Sea; all other indigenous sheep breeds are of a fat-tailed type. In general, sheep are mainly bred for meat, milk and wool production, with the exception of the pelt breed of Karakul. There is a large variation in mature size between and within breeds. Due to different production systems, the plans for improving the level of management and production through breeding, nutrition and veterinary practices could be highly variable. Flocks of small ruminants are mainly managed under two different systems, namely, village and migratory (nomadic). In both systems the animals are mostly kept on natural grasslands and farmlands with a little supplementary feeding (Kamalzadeh, 2005). Intensive systems of production are employed in a few cases.

In the nomadic system, the flocks migrate annually from the lowland winter ranges to the higher mountains grazing area in the summer. However, the nomadic

population is decreasing and they settle down in different parts of the country, but still this type of production system has an important role in livestock production sector. Traditionally, hand feeding has not been common among the nomadic tribes and the periodic drought periods caused high mortality and low productivity of the animals. In this harsh situation and through natural selection, only animals, which are well adapted to the environmental conditions, can survive. Therefore, breeding programs such as selection for fast growth rate, higher productivity and bigger size etc., which are common in intensive production system are not suitable for such a system. In fact, for such production systems the breeding plans should be for traits that natural selection is in favor of them.

In the village system, the flocks are allowed on the natural communal grazing pastures, or irrigated farm lands, or even mountain ranges. The vegetation ranges provide part of the annual fodder requirements throughout the year. The majority of the sheep and goats (about 70 & 60%, respectively) are being reared in this type of production system. Based on the availability of the feed resources, there are large differences in various parts of the country. In some parts of the country there are suitable rangelands, harvested forages, grasses and agricultural by products throughout the year, which could provide enough feed. In the villages, supplementary feeding is practiced throughout the year, especially in the winter. In the village system, planning programs for improving productivity of the animals are promising. In this system, suitable breeding, feeding and management programs and new technologies and also range management are practiced through cooperatives and individual producers. Fattening feedlot units, where sheep and cows are intensively fed for a period, could also be included in the category of supplementary feeding. In this respect, the commercially prepared pellets and concentrate mixtures are of special importance.

In general, stocking rate on the natural ranges is not controlled and depends on the seasonal rainfall and conditions of the pastures. Overgrazing, drought and lack of protection during many years have decreased the grazing capacity of the ranges. In most parts of the year, the grazing animals are on a very low plane of nutrition. The problems dealing with the present sheep and goats' production systems can be formulated as follow:

- Low-quality grasses.
- Insufficient rain, little ratoon crops available due to low temperature in the autumn and winter and un-suitable raining intervals.
- Insufficient and inadequately balanced nutrients for early growth.
- Live-weight loss due to periodic restriction as a result of seasonal variation.
- Low extent and efficiency of rumen microbial protein synthesis and negligible rumen by-pass protein due to low-quality available forages.
- Less favorable protein to fat ratio in the carcass due to feeding high energy and low protein concentrates in fattening farms.
- Lack of appropriate feeding strategies during periods with insufficient feed availability.

The effect of low-quality forages is accentuated by seasonal variation. The degree of seasonal variation varies with the climatic conditions. In most part of the country the growing season starts in March and till June, forage (mainly grasses) is available. Parts of the pastures in the lowlands are preserved for next autumn, when the nomads move from highlands to lowlands. In the course of June/July the dry season starts lasting till September/October. In the dry season, feed largely consists of grasses of which the fiber contents are high and protein content low. In the summer, the stubble is used for maintenance of the sheep and goats flocks. In the course of autumn and winter, the nomads may use the preserved pastures of the lowlands, which have a moderate quality or supplementary feeding is practiced. The composition of the ration mainly consists of a straw base diet, supplemented by barley. At the beginning of the green season, the grasses contain on average 9-11% crude protein (CP), while the digestibility is about 60-65%. These values decrease rapidly during the dry season. During a prolonged period of the year the protein content is only 4-5% and the digestibility between 45 and 50% (Kamalzadeh, 2005).

The present system of nutritional management, which largely depends on natural vegetation, is un-satisfactory. On the one side, there is a sizeable gap between the actual and potential productivity of small ruminants. On the other side, lack of suitable feeding strategies resulted in inefficient use of the available feed resources. However the completely intensive system may give higher output, but it needs a large amount of high quality concentrate mixtures. Partly intensive systems are practice in some agro-industrial farms, which cultivate different crops and can produce suitable feed for animals. Small ruminants are grazed in lands after harvesting the crops and there are ample roughages to feed them. In these systems, it is possible to rear large-size and high productive breeds of sheep and goats and apply the new techniques of breeding, nutrition and production.

In order to overcome present nutritional problems of poor ranges, small ruminants should be taken off the ranges as much as possible to reduce the grazing pressure on the vegetation and to allow regeneration of the range species. So, as to be able to take the small ruminants from the ranges, it is suggested that the present extensive system of production should be gradually changed to a more productive semi-intensive system.

Recently, more attention is paid to increase the available amount of concentrates, to overcome the nutritional problems of poor ranges. Any increase in the number of grazing animals is prevented. Since 2003, a 10-years national plan was launched, which aimed at reducing the number of grazing animals and make a balance between rangelands productivity and carrying capacity of the ranges.

Table I. Distribution of different nutrients for Iranian households compare to their optimum requirements

	Requirements (%)				
Nutrients	**< 80**	**80-90**	**90-110**	**110-120**	**>120**
Energy	11	9	25	12	43
Protein	8	7	19	11	55
Calcium	30	10	18	8	34
Vitamin A	46	5	10	5	34
Riboflavin	70	9	11	3	7

Table II. Livestock production, 2002-2009 (1000 ton)

Products	**2002**	**2004**	**2006**	**2009 (Expected)**	**Annual growth (%)**
Milk	5877	6720	7749	9556	7.19
Red meat	741.6	874.9	838.1	922	3.14
Poultry meat	941.5	1171	1360	1605	7.92
Eggs	547.03	645	676	789	5.37

Table III. Livestock numbers in Iran, 2002-2009 (1000 head)

Year/Species	**2002**	**2004**	**2006**	**2009 (Expected)**	**Annual growth (%)**
Sheep:	51701	52115	52271	52114	0.11
Goats:	25551	25756	25833	25756	0.11
Cattle (PE)[1] :	683	753	830	961	5
Cattle (CB)[2] :	2425	2839	3438	4373	8.79
Cattle (LB)[3] :	4337	4039	3624	2915	-5.5
Buffalo:	383	402	424	459	2.62
Camel:	147	150	152	154	0.67
Other:	1727	1727	1571	1724	0.11

([1]) PE = Pure Exotics, [2]) Cross-breeds, [3]) Local Breeds

More attention is paid to the contribution of fibrous crop residues and agricultural by-products as main basal feed resources. With suitable feeding strategies, the output per each unit of feed intake will increase and the conversion of feed to live weight gain can decrease. In a longer term, this will lead to a reduction in the present number of animals without affecting the total productivity of the system.

Cattle. At present, there are three categories of cattle breeds: pure exotic, crossbred of native and exotics and pure native breeds. The number of native cows is about 3.5 million heads and reared in most of villages under a traditional system. It is estimated that the herd size for each family is about 4 to 5 cattle. The cows are allowed on the natural communal grazing lands, or irrigated farm lands. Part of the annual fodder requirements are provided by vegetation lands throughout the year. In this type of rearing system no genetic selection practiced. Therefore, the mean body weight and level of production do not vary in different generations. The birth weight of calves is about 15 to 20 kg and the mature live weight of male and female cows is about 370 and 275 kg, respectively. The average of milk yield in about 150 to 160 days of lactation period is between 600 to 900 kg with a fat content of about 4%. They are generally, well adapted to the available native feed resources, management and environmental factors. However, the local breeds are suitable for extensive production system and their body size, growth rate and productivity are in accordance with the present level of management. Fattening of young calves is not common and usually the animals are slaughtered, as they are old.

Since 55 years ago, some exotic cattle breeds such as Holstein, Brown Swiss, Jersey, Guernsey and Red Danish were imported. However, at present, the Holstein is the most popular and dominating breed and a few dairy farms are rearing Brown Swiss and Jersey breeds. The population of pure exotic dairy cattle is about 850,000 and the crossbreds of native and exotics are 3,500,000 heads. The infrastructure necessary for genetic improvement of these cattle, such as pedigree registration, recording the traits and artificial insemination has been organized since 45 years ago. The animal breeding centre in near Tehran (Karaj) is in charge of dairy herd's milk recording, data analysis, breeding value estimation for the dairy cows, embryo transferring and semen collection from proven sires, freezing semen and distribution to the farms. Since last 25 years, the productivity of the most of the industrial dairy herds has been improved to an acceptable level. The average daily milk production is about 29 kg per cow. These herds which are members of the milk-recording program use semen of proven sires through artificial insemination and or embryo transfer techniques.

Crossing the native breeds with the high producing exotic cattle improves the production level of crossbreds. The milk yield of F1 cows in one lactation period is about 2600 Kg. The number of crossbred cattle has been increasing rapidly during the last 10 years. Parts of the crossbred cattle, which are reared in small farms, usually graze in pastures in spring and early summer. During late summer and early autumn are in harvested lands and in late autumn and winter they are in stable and are fed with roughage and some barley and wheat bran.

The most common feedstuffs, which are used in the commercial dairy farms are alfalfa, clover, maize silage, wheat and barley straws and the concentrates mainly contain barely, maize, wheat bran, sugar beet pulp, cottonseed meal, soybean meal, molasses, fat and mineral supplements. In these farms, the animals are fed indoor and grazing in rangelands or farmlands is not common. Many of these dairy farms do not have enough land to produce feed and have to purchase all or part of their required feedstuffs from the market. Therefore, they are highly influenced by feed price changes in different seasons and years. The prices of feedstuffs are highest in the autumn and winter. The prices of hays are dependent on the price of barely and when there is a shortage in the supply of barley, the prices of roughage increase. Since, the human populations are increasing in and around of the cities, the dairy and feedlot farms, which are in suburban areas of the towns are being forced to move. Therefore, the government has managed a project, through which the land and other basic facilities necessary for production are prepared and farms in the cities and urban areas are moved to the areas out of the cities. The

government has also some new projects to establish new laboratories for feed analysis and evaluation, recording systems, cattle and buffalo semen and embryo production.

Poultry. Traditionally, native breeds of poultry were reared in villages under extensive and mixed systems. The poultry marketed by the villagers and there was not organized commercial marketing and distribution. About 55 years ago, exotic breeds imported to the country. The imported poultry introduced the New-Castle disease. At that time vaccination of the native poultry was not common and they were not immune to the disease. The virus infected the local breeds and caused very high mortality. Since then the poultry farms have been established and day old broiler chicks were imported. Poultry production developed from a simple farm operation to a complex vertical operation of related industries and enterprises, including grain production for animal feeds, feed mills and slaughterhouses and processing plants, food chain stores and wholesale enterprises.

In the last three decades, large amounts of capital have been invested in this sector. At present, there is a pure broiler line farm and many farms for rearing grand parents (GP), parent stock (PS), broilers and layers. There are about 15 GP farms, which can supply the required PS flocks. The pure broiler line farm is established well now and has the capacity to supply high quality GP flocks for the local market and export. Meanwhile, different European breeding companies are also in the market and present their products such as GP and PS.

In 1982 the population of native chickens was estimated to be about 16 million. A project for increasing the number of native poultry breeds was started in 1983. In this project, various native breeds were reared in 14 poultry center in different parts of the country and the vaccinated pullets distributed to the villagers. The project caused, the number of native poultry increased, which was about 52 million pieces in year 2006. One important assumption for the native poultry sector is that, they do not rely on formulated feed, which the most ingredients of which are imported from abroad.

The poultry industry is private and some services are provided through the cooperatives. Few poultry farms are under government management and according to the government policy for supporting privatization, these farms are planned to be sold to the cooperatives and private sectors.

Feed resources. Feed is the most important limiting factor for maintenance and development of animal production. This is mostly because of (a) water shortage and (b) the competition of agricultural products for human foods with animal feeds. Due to climatic conditions, sustainable agriculture and food production depends on efficient use of water. The water resources are limited and the average annual rainfall in the country is about 250 mm and varies from an average 1,120 mm in the Caspian region, to an average 46 mm in the central region. Of the total area of 164.8 million ha, natural rangelands accounts for 90 million ha. About 15% of the rangelands are considered to be rich, 65% fair to poor and the remaining 20% as very poor or un-economic. Of 18 million ha of arable and permanently cropped land, 8 million ha and including fallow land, are under irrigation. Fallow land comprises about one-third of the cultivated land in any year. The remaining is planted with a wide variety of crops, mainly wheat, barley, paddy, cotton, oilseeds, maize, potatoes, onions, pulses, sugar beet, sugarcane and fodder crops including alfalfa and clover.

Table IV. Major resources of poultry feeds in 2007(ton)

Feed	Domestic	Import	Total
Maize	2,800,000	1,602,000	4,402,000
Soya meal	185,000	1,543,000	1,728,000
Fish meal	64,000	66,000	130,000
0thers	464,000	-	464,000
Total	3,513,000	3,211,000	6,724,000

Table V. Major resources of ruminants feeds in 2007 (Million ton)

Feed	Required	Consumed	Difference
Pastures	12.7 (allowed)	17.0	+ 4.3 (low quality)
Straw	9.0	14.0	+ 5 (low quality)
Forages	15.6	13.1	- 2.5 (high quality)
Other resources	22.5	19.4	- 3.1 (high quality)
Total	59.8	63.5	+3.7 (low quality)

The price of agricultural products is an important factor for the farmers to decide for cultivation of crops. Since the last two decades the policy of the government has been to supply the grains for human food and there has been good support for cultivation of wheat and rice. In order to boost wheat production, since 1980, the government launched a comprehensive national wheat program, which included guaranteed purchase prices, input subsidies and research and extension services, as well as consumer's subsidies on flour and bread. Indirect government support was also provided through subsidized prices for energy, transport and machinery services and credit. Guaranteed purchase and higher prices encourage the farmers to shift from roughage to other crops. This situation affects the prices of the available feeds and cause higher livestock production costs.

About 47% of the required feed ingredients for the poultry sector are imported from abroad (Table IV). It is estimated that in the year 2007, about 60 million tons of feeds used by the various ruminant species (Table V). Four major categories of feed resources were defined.

1- Pastures and rangelands vegetation comprised about 27% (17 million tons) of the feed. Whereas base on the data of the department of Forestry and Rangelands, total production of the rangeland forages is about 21.4 million tons, of that only 12.7 million tons (about 60%) should be cut or use for grazing. This shows that in practice, the animals consume 4.3 (17 – 12.7 = 4.3) million tons of pastures and rangeland vegetation above than the allowable level (12.7 million tons). This means that, on the one side, the carrying capacity of the rangelands can not meet animal's requirements. On the other side, with low quality

available forages of the pastures, the animals can not fully exploit their growth and production potentials.

2- Straws comprise about 22% (14 million tons) of the feed. The total straw production is about 17 million tons. In fact, for suitable production, the quantity of required straw should be only 9 million tons. But, with insufficiently good quality forage available, in practice, the animals consume about 14 million tons straw.

3- Forages comprise about 20.6% (13.1 million tons) of the available feed. Whereas, for a suitable production, about 15.6 million tons of good quality forages are needed.

4- Concentrates, by-products of the industrial plants and other feedstuffs (such as wheat bran and middling, sugar beet pulp, oilseed meals, barley, etc.) are about 30.5% (19.4 million tons) of the available feed. Small quantity of the oilseed meals is imported. Whereas, the required amount of concentrate and by-products feeds is about 22.5 million tons.

The above figures show that the composition of the available feed dose not meet the nutrient requirements for optimum production.

Feed industry. The Iranian feed industry is about 45 years old. Manufactured feeds for poultry are the greatest proportion of tonnage. Next is cattle and followed by sheep and fish feeds; the pork industry is not existed. The actual industry's feed production is about 2.6 million tons, which represents 50% of the existed capacity. Manufactured feed exports are not high. Some of the feed-mill plants have modern computerized system and the latest equipments for analytical procedures and they employ the latest manufacturing technology. The quality standards of the feeds of these plants are high and up to international levels. Raw ingredients for manufactured feed are not adequately available in Iran (Table IV).

CONCLUSION

There is a need for low cost and simple technologies for livestock and product processing. The development, transfer and adaptation of technologies should focus on improving the efficiency of feed utilization and increasing animal productivity. Protection of the environment is critically important. True cost of production, including environmental cost must be factored into the cost of production.

Feed ingredients should be obtained and preserved in a stable condition so as to prevent hazardous effects to contamination or deterioration. Feeds should be in good condition and meet generally accepted quality standards. Good Manufacturing Practices will seek to minimize chemical and biological contaminations in feeds and prevent them from entering the food chain. Livestock products must be produced from disease-free animals and under hygienic conditions.

Livestock productivity must rapidly increase to help the growing population's demands without depleting the natural resource base. Biotechnology is regarded as a means to meet both objectives through addressing the production constraints of small-scale or resource-poor farmers, who contribute more than 70% of the food produced. Information gathering and sharing is vitally important. Meaningful data collection leading us to understand what is happening and also understanding what might happen, putting us all in a better position to predict the future.

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