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ANIMAL PRODUCTION SYSTEMS IN EGYPT: THEIR ROLES, CLASSIFICATION, DESCRIPTION AND POTENTIAL CONTRIBUTION TO DEVELOPMENT

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SUMMARY

This paper focuses on aspects related to the development of the livestock production sector in Egypt, with emphasis on animal production systems. Based on official statistics, published articles, observations and experiences, the authors classified and described the animal production systems in different agro-ecological conditions involving different socio-economic groups. Two inter-linked criteria were used to classify the animal production systems: a) degree of capital intensification, (intensive, semi-intensive or extensive); b) the economic objective of the holders. This may be either of a subsistence, semi-subsistence, semi-commercial or entirely commercial nature.

This paper demonstrates the role and place of the livestock sector and its contribution to the national economy, as well as the development of external trade in milk and dairy products in the past 10 years. The potential for dairy sector improvement is discussed and it is concluded that rapid population growth along with social and economic changes will increase the demand for animal products.

The vision recognises that as intensification evolves, the predominantly traditional systems will change into systems that are more heavily dependent on external inputs and improved technology. This paper is strongly recommending that the traditional mixed farming systems which represent over 70% of the livestock sector are studied in detail, to enable developing farm models that can help the decision-makers at farm level to maintain high productivity.

Keywords: Production systems, classification, mixed farming

INTRODUCTION

Historically, Egypt is known as one of the oldest agricultural civilisations. During the last 200 years, the economy has diversified and the importance of other, non-agricultural sectors, increased. However, agriculture remains an important sector of the Egyptian economy, employing 4.7 million workers, with an annual growth rate of about 0.8% and generating 20% of its Gross National Product (GNP). The annual growth rate for the Gross Domestic Production (GDP) is 3.7% in year 1997/98. The country is self-sufficient in fruits and vegetables, but produces only 30% of its requirements in wheat and 66% in maize. Production increase, through the combined effect of area expansion and yield increase, can not keep up with population growth, so that Egypt will continue to depend on imports for a considerable proportion of its food supplies. Consumer prices for bread are subsidised, but for meat, milk, vegetables and other food commodities, they are determined in the free market.

The total cultivated area during 1997/1998 was 7.9 million feddans (6.3 irrigated and around 1.5 rain-fed; a feddan is 4200 m^2) including the newly reclaimed land, while the harvested area was 14.2 million feddans. The agricultural sector is aiming at increasing output by 4.1% per year. The government began to implement many agricultural national projects in the field of land reclamation and cultivation aiming at increasing the cultivable area during the next twenty five years by nearly 3.4 million feddans of which 2.3 million feddans in the southern valley and north Sinai.

Average farm size is very small, two to three feddan, but, under irrigation, each year at least two crops, a winter crop and a summer crop, can be harvested. In the basin of the Nile River and its delta, about seven million feddan of land are available for irrigated agriculture. In addition, around 1.5 million feddan of former desert land has in recent decades been brought under irrigation.

Although in the winter season a large proportion of the land is cultivated with the forage crop berseem *(Trifolium alexandrinum)*, in economic terms, animal production is less important than arable farming. This is mainly due to the generally medium to low level of production (average estimated milk production per lactation in 1998 ranged from 1946 to 2540 litres; for cross breed, 1511 to 2190 for buffaloes and 950 to 1228 for local breed) of the 3 million cattle and 3 million buffaloes held on small

farms. Thus far, agricultural extension and development have mainly focused on cereals and cash crops, leaving the cattle and buffalo without major technological innovations. Modern dairy farming exists, but comprises only about 100,000 dairy cows. As a result, the country is to a substantial extent dependent on imports for the supply of meat and milk .

The aim of this review is to describe and classify the existing animal production systems, their relative importance and the potential for dairy development.

The place of livestock

Historically, the most significant role of livestock has been in support of arable farming, in both physical and socio-economic aspects.

Animal manure played a crucial role in soil fertility management, by restoring part of the nutrients that crops removed.

Additional nitrogen was supplied through fixation by the berseem.

Until only a few decades ago, animals provided almost all draft power.

Through their role as a capital asset (Bosman *et al.*, 1997; Slingerland *et al.*, 1998), livestock significantly contributed to the economic stability of farm enterprises, serving as 'living banks', providing financial reserves for periods of economic stress and a buffer against sometimes non-remunerative crop prices. Animals thus provide a flexible source of cash, enabling farmers to purchase inputs and meet other urgent needs.

Furthermore, they provide a means to profitably use farm labour during periods when it is not needed for cultivating or harvesting crops (Savadogo, 2000).

Agriculture is the dominant sector in the economy, where today 53 percent of the population lives in rural areas. Output of livestock commodities meat, milk, eggs, wool and skins accounted for 25 percent of agricultural domestic production.

Livestock population development over the period 1976-1997 is indicated in Table 1. Cattle and buffaloes comprise over 70% of the total population, expressed in animal units (AU). The buffaloes (35.5%), and 26.4% of the cattle are considered dairy animals, making the dairy sector the main animal production activity. The size of the population, the area for forage cultivation, and the availability of new technology suggests that there should be an enormous potential for development.

Table 1. Development of livestock* population (, 000) in Egypt during 1976-1997

Year	Cattle	Buffaloes	Sheep	Goats	Camels	Non-ruminants
1976	2,079	2,226	1,878	1,349	101	1,528
1978	2,587	2,542	2,554	1,440	93	1,685
1980	2,423	2,009	2,488	2,409	126	1,719
1984	2,782	2,531	2,479	2,387	146	2,239
1989	2,722	2,864	3,481	2,000	n.a[b].	n.a[b].
1991	2,719	3,165	3,148	2,442	147	1,587
1995	2,996	3,018	4,220	3,131	131	1,354
1997	3,118	3,096	4,260	3,187	136	1,475
AU**[a]	3,117	3,095	852	478	284	885
AU%	35.8	35.5	9.8	5.5	3.3	10.1

Source: Central Department of Agricultural Statistics, Ministry of Agriculture and Land Reclamation, Cairo, bi-annual series volumes from 1976 to 1997.

* Excluding poultry, ** Animal Unit (AU) calculated as 1, 1.2, 0.2, 0.15, 1 and 0.6 for cattle, buffaloes, sheep, goat, camels and non-ruminant animals, respectively.

[a] referring to 1997 , [b] not available

Historically, the most significant role of livestock has been in support of arable farming, in both physical and socio-economic aspects. Animal manure played a crucial role in soil fertility management, by restoring part of the nutrients that crops removed. Additional nitrogen was supplied through fixation by the berseem. Until only a few decades ago, animals provided almost all draft power. Through their role as a capital asset (Bosman *et al.*, 1997; Slingerland *et al.*, 1998), livestock significantly contributed to the economic stability of farm enterprises, serving as 'living banks', providing financial reserves for periods of economic stress and a buffer against sometimes non-remunerative crop prices. Animals thus provide a flexible source of cash, enabling farmers to purchase inputs and meet other urgent needs.

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External trade in milk and dairy products

Currently, as over the last 10 years (Table 2), Egypt imports dairy products to a value of about 500,000,000 ŁE annually (1ŁE = 0.34 US$), representing 43% of its total requirements (1996), mainly in the form of milk powder (various fat percentages), butter oil and various types of cheese. Imports to that extent, may be expected to lead to low domestic prices and disincentives to local production, especially when export of dairy products is stimulated by subsidies from the exporting countries (de Jong, 1996).

Table 2. Value (000, ŁE)[a] of external trade in milk and dairy products*

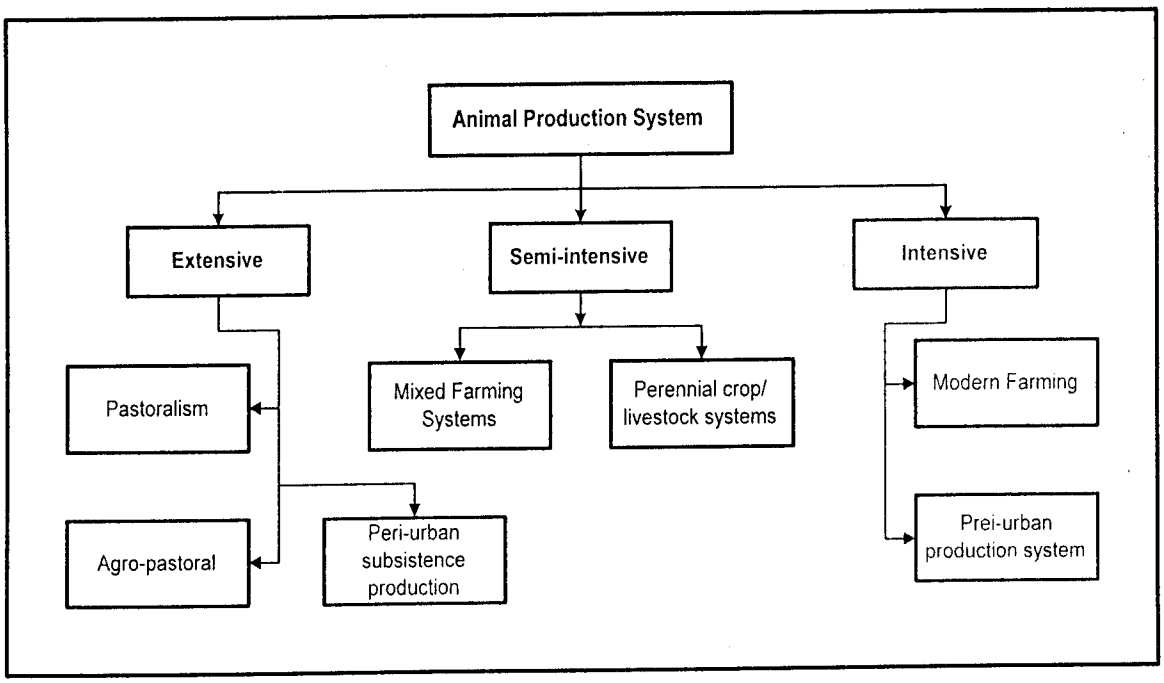
Year	Imports	Exports	Export :import ratio
1990	551,649	5,968	0.01
1991	405,739	16,248	0.04
1992	524,948	15,230	0.03
1993	503,239	15,684	0.03
1994	509,404	19,898	0.04
1995	573,767	9,144	0.02
1996	659,821	14,711	0.02
1997	505,560	15,053	0.03
1998	505,569	12,116	0.02

Source: Central Agency for Public Mobilisation and Statistics (CAPMAS) database, September 1999., [a] 1 ŁE = 0.341 U$

* CIF (cost, insurance and freight) for imports, FOB (free on board) for export.

Classification of animal production systems

Figure 1. Schematic representation of the classification of animal production systems



Classification criteria

From the many classifications of animal production systems proposed, in this paper a slightly modified version of the system described by Jahnke (1982) has been used (Figure 1, Table 3). This classification system meets two requirements: a) the degree of intensification in terms of capital investment (intensive, semi-intensive or extensive), and b) the economic objective of the livestock owner (subsistence, semi-subsistence, semi-commercial or entirely commercial).

Table 3. Number of animals and animal units (, 000) in the classified systems*

	Pastoral	Agro-pastoral	Mixed	Integrated	Peri-urban	Modern
Baladi cattle	3	60	1603	550	78	---
Exotic	---	---	---	---	---	100
Crossbreeds	4	31	533	148	8	---
Buffaloes	3	20	2141	782	149	---
Goats	495	83	1526	981	103	---
Sheep	758	63	2424	902	113	---
Camels	72	967	212	24	7	---
Donkeys	24	16	1036	339	62	---
Animal Units						
Number	315	134	8637	1925	265	120
%	3	1	76	17	2	1

* Modified from Central Department of Agricultural Statistics, Ministry of Agriculture and Land Reclamation, Cairo, bi-annual series volumes from 1976 to 1997.

The boundary between a semi-subsistence and semi-commercial system is set to 50% sale of total production. The classification remains rather arbitrary though, as no accurate statistical data are available on sales of Egyptian farmers. Most commercial producers specialise, focusing on cattle, while subsistence, semi-subsistence and semi-commercial producers may utilise several types of domestic livestock, depending upon their economic-cultural system and environmental conditions. The dominant animals in the pastoral system are sheep and goats, while camel is the dominant animal in the agro-pastoral system. In terms of animal units, 76% of the total population is included in mixed farming systems, followed by integrated farming (17%). The other systems play only a minor role.

Extensive systems

Subsistence

The primary purpose of subsistence-oriented production is to meet family needs. It involves little or no commercial exchanges.

Pastoralism

Pastoralism is of marginal importance in Egypt, comprising about 3% of the total animal population. Pastoralists are concentrated in the northern part of Egypt (near the Egyptian-Libyan borders) and in the Sinai Peninsula, though small numbers of pastoralist families are scattered throughout the drier areas. Pastoralists keep camels, donkeys, sheep and goats. Their breeds can survive under arid and semi-arid conditions, produce some milk, even if poorly fed, and are very fertile (reproductive) under improved feeding conditions. In fact, most of the pastoral breeds are more suitable for meat production.

Most pastoral animals graze in groups, belonging to one holder or one family, moving quickly over the pastures. They often browse during the dry season and graze low quality herbage when available. They may walk considerable distances during the day, usually drinking only once and, if water is scarce they may not be allowed to drink for 2 to 3 days. At night, the animals are kept in camps as one group or sub-divided in several groups each provided with its own enclosure.

The grazing land is a communal resource while livestock are owned individually or by family units. Usually, water resources are also communally owned, though in a few areas they belong to individuals or families. The number of livestock owned by the family is therefore not regulated by the carrying capacity of the grazing land, but by the managerial skills of the family unit.

Social and economic traditions that encourage and assist families to maximise herd size have been retained, despite overstocking, not only to ensure adequate food and income but also family survival in times of disaster.

Agro-pastoral systems

Agro-pastoralists are sedentary farmers that cultivate food crops (mainly barley) both for subsistence and for sale. These systems typically occur where extensive rainfed cropping is possible, i.e. in Egypt in some locations along the Mediterranean coast. This system prefers indigenous cattle that are already utilized by pastoralists in their regions. At present, their cattle are triple-purpose animals (meat, milk, and work). The owners herd their animals, camels, indigenous cattle breeds, sheep and goats, on communal land near their permanent cropping areas, on the fallow during the winter season and throughout the area during the summer season after the crops have been harvested. Indeed, in these places some farmers keep permanent plots under irrigation (using fossil water resources) to be used for crop production and to graze livestock.

The major technical objectives of this management are to maintain and if possible to reduce annual fluctuations in cattle numbers and seasonal fluctuations in live weight, maximize reproductive performance and minimize mortality. All these managerial practices tend to intensify production as a result of increases in herd size and thus increased stocking rates. Men usually herd mature cattle, while women and/or children tend calves and sick animals.

Peri-urban subsistence production

Many urban families keep a few chickens, and/or two to three sheep or goats for occasional home consumption. Little or no investments are made in their feeding or health care. The animals scavenge for a large part of their required feed, but are supplemented with available household and kitchen waste. Performance is therefore poor and mortality is high.

Subsistence production is seasonal: dependent on variations in the household budget, occasions in the religious calendar and more irregularly, events to celebrate, such as a wedding.

Semi-intensive systems

The main characteristic of these semi-intensive systems is the use of 'intermediate levels' of external inputs along with the following features:

- Holdings of relatively small size.
- A mixture of subsistence, semi-subsistence and cash economies, though pure subsistence economies have almost disappeared.
- Milk production as the main objective for livestock keeping, though also draught power continues to play a role.
- Meat from sheep and goats plays a minor role compared to cattle.
- Beef is only a 'by-product' originating from old and culled milk cows.
- Emphasis is on the use of agricultural and industrial by-products as feed, rather than on grazing.

Mixed farming

The mixed crop-livestock system is the most important cattle production system, representing over 70% of all cattle in 1997, together with large numbers of buffaloes and some sheep and goats.

It is the predominant system in the Nile basin. Arable farming, of both food and cash crops is the main agricultural activity. Farm size is usually small (1-5 feddan) with high cropping intensity. Livestock serve arable farming through utilisation of crop residues, partly for the recycling of nutrients to maintain soil fertility and providing additional income in the form of milk and/or meat (Savadogo, 2000). Within this system, buffaloes are kept for milk production and cattle are bred for dual purpose, to gain body weight and produce milk during their lifetime, being slaughtered when too old. In some situations, cows are expected to provide draught power, if mechanisation is not available.

The dominant animals are buffaloes, baladi cattle and crossbreed cattle that are locally available. In areas such as Damietta (northern district of El-Delta), where milk production is promoted by governmental and/or foreign aid projects, and AI (artificial insemination) or genetically improved bulls were used for almost 20 years, crossbreeds are primarily used in addition to the buffaloes. However, attempts are also being made by governmental and/or non-governmental organisation to establish pure breed and high-grade herds of European breeds through imports and AI programs.

The majority of the farmers milk their cattle twice a day – in the morning (calves are allowed to suckle before milking) before they leave home where they are kept at night, and in the evening upon return from the shades where they are tethered during daytime. These shades often are located at the edges of crop fields, if cut and carry systems are applied, restricted grazing systems can also be found when shortage of labour exists.

Feed quality strongly varies with season, with the best feed available in winter (fresh berseem). In summer, on the contrary, animals are mainly dependent on straw-based rations, supplemented with small quantities of grown forage, mainly in the form of densely sown maize, used for fresh feeding at an

age of 2 months (called darawa). The management of feed supply is fully adapted to this 'regular' pattern in feed availability. The animals respond to the variation in feed supply by adjusting milk production and fertility.

Results of surveys have indicated that about 63 percent of the calving occurred during the colder season (El-Sheikh, 1987; Tabana, 1998). Mostageer *et al.* (1981) carried out a study on two groups of approximately 200 females each, located in the same estate farm, fed berseem in winter and darawa in summer. Average milk yield was higher and the lactation period longer in females calving during the colder season than in those calving in the hot season: 1309 versus 1147 kg and 233 versus 200 days. This agrees with the findings reported by Tabana in 1998 (with significantly higher levels of milk production) on the basis of an on-farm monitoring program over a period of 4 years.

The variation in feed availability between seasons was more pronounced in the past than at present. In particular before construction of the Aswan High Dam, seasonal flooding of the Nile occurred. The local breeds appear to be used to these variations, and tolerate seasonal deficiencies in nutrition. However, long calving intervals, delivery preferably in winter and relatively low milk production was a normal performance pattern. This inherited pattern of poor reproductive and productive performance continues to limit productivity on traditional farmer holdings. As a result, especially among the smallholders, in winter seasons there may be a surplus of milk to sale or home processing, while in the summer a precarious balance has to be established between the calves' intake and the off-take for humans.

The major problem to achieve significant development in the dairy sector is the small size of the holdings, that is the result of the inheritance system, along with the pressure of population on limited land resources. Thus, intensification of agriculture such as the production of fruit and vegetables is widely practised to increase cash income for the small farmer.

Similarly, milk production could be a very suitable activity to generate regular cash income for small farmers, if collection, processing and distribution could be properly organised. Before modern dairying techniques can be applied, systems of semi-intensive and intensive herd management need to be adopted for regular, non-seasonal production. An optimum feeding regime of concentrate rations and cultivated green fodder is necessary throughout the year, and proper housing would also be beneficial. Special managerial arrangements will have to be made to meet the technical demands of intensive buffalo farming.

For meat production, three types of fattening activities are practised, separately or in sequence:

a) From birth to weaning. This type of veal production starts with a special calf-rearing program. Initial birth weights are around 35-38 kg for buffaloes and 25-28 kg for baladi cattle. Farmers are aiming to reach 100-120 kg within a period of 90 to 100 days. Calves are fed initially about 50% of the milk produced by their mothers, i.e. two teats until 45 days, then three teats until the 75th day, followed by the full udder till the end of the fattening period. In addition, high quality concentrates (mainly wheat bran, cotton seed cake and ground maize) are used to feed the calves at a daily rate of 2% of their body weight. Green forage and good quality hay are fed in very restricted quantities, if used at all.
b) From weaning age to eight months. This starts from weaned calves, in a range of 100-120 kg body weight to reach 250-260 kg within 6 months post-weaning. The feeding systems strongly vary among areas, depending on the type of concentrate feedstuff available and season. Berseem (clover) is the main fodder offered during winter and darawa (growing maize) in summer. In some areas, where maize silage is promoted such as Shanshor, Monofia governorate, maize silage along with home manufactured or purchased concentrates are commonly used for growing animals, either with berseem in winter or between the summer and winter seasons, whenever green forages are not available.
c) From eight to twelve months. This stage of fattening is oriented by market demand. When price of meat is high due to special occasions such as Aed El-Adha, farmers tend to increase the use of good quality concentrates to maximise the growth rate of the animals and decrease the use of green forages. The opposite occurs when the demand for meat is low, farmers tend to increase the fattening period by using less concentrate and more forages. The final weight is normally over 400 kg.

Perennial crop-livestock integrated systems

An example of this system is the sugar cane-livestock system, prevalent in several districts in Upper Egypt. Sugar cane provides three feed by-products: green tops, molasses and bagasse, that are all three commonly used in Egypt. Sugar cane tops are used as fresh forage, and still rarely, as silage. Molasses are supplemented by urea as source of non-protein nitrogen (NPN), minerals and vitamins and are distributed to farmers at some locations, but unfortunately not yet in the cane growing areas. The

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