

ANIMAL PRODUCTION

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Keywords: animal productions, cattle, chicken, domestic animals, domestication, goat, horse, meat, milk, pig, sheep, wild animals

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Summary

This chapter reviews the history of domestication and the present situation of principal livestock animal species. The history of human culture is largely dependent on the process of domestication of wild animals and their subsequent use. The goat, sheep, cattle and pig were domesticated by 6000 BC, and the horse by 2000 BC in western Asia. Size reduction generally occurred in the early stages of domestication. Then, various types of breeds with different body size, constitution and maturation were differentiated by genetic selection of domestic animals according to human needs for meat, milk, egg, fur and other products. Raw products from domestic animals have been processed into ham, bacon, sausage, cheese, butter, ice cream, wool, clothes, carpets, shoes and various other daily necessities such as musical instruments and tools.

The domestic goat, which principally originated from the bezoar goat in mountainous areas in western Asia, has provided milk, meat and fabric to common people for a very long period. The sheep, domesticated mainly from the Asiatic mouflon, has made a major contribution as an important food resources and a symbol of property in the history of humankind. Various breeds of sheep have been bred as wool, meat and double use types. The pig, domesticated from wild boars, is currently responsible for about 40% of global meat production from livestock animals. Its meat is used for high quality ham and sausage. Cattle were derived from aurochs, of which the last individual survived until 1627 in Poland. The cow is a major source of milk, producing a great amount of milk (normally more than 8000 kg/head/ year). Beef cattle have long served as an important and vital source of meat protein and fat throughout the world, especially in Europe, North and South America. From ecological and nutritional aspects, the low conversion efficiency from grass and cereal to protein in cattle is a big problem. Domestic fowl have been bred as fat chickens, hens for egg production and cockfighting, junglefowl (*Gallus* sp.) in south Asia having contributed to their domestication.

Recently, due to human health factors, the demand for chicken as a meat source has been increasing in developed countries. In those developed countries, the numbers of hens is almost the same as the human population in each country. The horse is the most recently domesticated animal. Its uses have been primarily for riding, labor, military purposes and transportation for humankind. However, in the past and even today, its meat has been a precious food supply for human beings.

1. Introduction: general aspects of domestication of wild animals

The lifestyle of Neanderthal and CroMagnon man consisted of hunting and gathering over a very long period of several hundreds of thousands of years. They led a wayward life, moving in forests, mountains and grassland in search of wild animals to hunt, and seeking seasonal plant resources. Their lifestyles were ultimately controlled by the natural environment, like wild animals. Wild animals are important food resources for humankind. Mammals such as the mammoth, reindeer, deer, aurochs (ancestor of domesticated cattle), wild boars, goat, sheep, horses, and other animals such as various types of birds, reptiles, amphibians, fishes and insects have been hunted by humankind. Skillful cave murals of animals such as aurochs and horses drawn at Altamira in Spain and Lascaux in France show realistically that people in the Paleolithic era had a keen interest in wild animals and significantly understood them. Hunting technology for wild animals was not established until there was a good understanding of the behavior and ecology of wild animals. There were many common features between the induction of wild animals in the direction that they wanted them to run, and the control or management of domestic animals. Domestication may have arisen from such control of a group of wild animals.

The term "domestication" may be most simply defined as "the keeping of wild animals by humans for their own profit". It can also be described as "morphological and physiological changes of animals generated through the process of domestication, these changes being heritable". Artificial selection in the progression of domestication brought about physiological and morphological changes in animals, such as in the body and reproductive system. A drawing of aurochs which seem to be an ancestor of domesticated cattle and also the alteration of body shape in cattle with different usage, are shown in Figure 1. In addition, differences in body structure and function between pig and wild boar are compared in Table 1. The pig has earlier growth and sexual maturation, more frequent reproduction and higher fecundity than the wild boar. As a result of repeated breeding over a long period, each animal developed into many kinds of breeds, e.g. domesticated cattle have various breeds which can be divided into milk cow, beef cattle, and working cattle according to their utilization.

Figure 1. A reconstruction of aurochs.
(from "*Domesticated Animals*", J. Clutton-Brock, *British Museum-Natural History*, 1981)

Table 1. Comparison of the difference in body structure and function between the pig and wild boar.

The udder develops to a remarkable extent in the milk cow, and the hindquarters are particularly well developed. Working cattle which carry heavy loads and pull the plow have well developed forequarters for increased driving force and therefore well-developed head, neck and forelimbs. In general, the main differences between domestic animals and wild animals are shortening of the skull and horns, increase in the pelage color variation, increase of fecundity, and lowering of self-immunity. In the process of domestication from wild animals, a tendency to miniaturization appeared. One of the reasons for this is considered to be the amount of food that could be produced by human activity. For agricultural communities in the Neolithic era, food production was not enough to support the people, and the quantity of leftover food and cereal given to domestic animals would have been limited. Also, sufficient areas of grassland for grazing had not been created. Therefore, larger individual animals which required more feed would have been a disadvantage for people, or they were slaughtered earlier than the smaller individuals, to be served as meat. Moreover, smaller animals were easier for people to handle. Through such factors, miniaturization seemed to progress in the initial stages of domestication.

Although domestication of wild animals was intentionally promoted from a certain stage in the history of humankind, it seems to have been naturally and multilaterally progressed in the initial stage of domestication in which a close relationship between humans and wild animals was maintained. For example, there were many cases where people housed newborn or young animals captured by hunters and these animals lived together with people. The dog established a reliable relationship with humankind as early as 10 000 BC (the late Paleolithic age), mainly as a companion for hunting. It has also been considered that dogs came to be associated with the human community through search of leftover food, even if it was tainted meat. This characteristic as a scavenger was advantageous for human life.

Differentiation to variety began in the dog around 4000 BC, and the main strains of dog were already well established by 1000 BC. The successful hunting of big wild animals could only be accomplished by cooperative work involving more than one family and hunting dogs. Many common features between the social structures of dog and human communities would facilitate their joint life.

Several problems had to be overcome when humans began to feed wild animals in the process of domestication:

- Surplus human food and grassland around the human community were required.
- People had to prevent the domestic animal from escaping.
- People had to protect their domestic animal from attack by wild animals.
- People had to guard against domestic animals stealing human food.
- People had to control the reproduction of domestic animals.
- Various disputes would arise between people over domestic animals.

What was the advantage for humankind in having domestic animals, bearing in mind such problems? The population in the paleolithic era was still very small, and many wild animals seemed to live around the human community. There was therefore little advantages for people in breeding domestic animals just for their meat. Strong

motivation for domestication did not seem to be generated unless there was a situation of insufficient wildlife resources due to growing human population and aridity of the land as a result of climate change (warming). It is said that the population on Earth 6000 years ago was 5 to 10 million. When aridity increased, people gathered around water sources that would not dry up. The social community of the people who gathered and settled down in such way developed gradually, and the number of animals hunted also decreased gradually. The most valid theory of early domestication is that it was done by people who settled down to an agricultural way of life.

The beginning of the non-nomadic society was also the beginning of farming villages and cities. After people began to keep domestic animals they found they had a sustainable food supply, and their life basis was stabilized. The work produced by domestic animals such as cattle and horses, in addition to their usefulness in production of meat and milk, considerably improved farming technology, and so the dependence of people on domestic animals increased. In the areas of four major civilization the harvesting efficiency rose remarkably by combining the planting of wheat and barley with cultivation by cattle, and the basis of human society was stabilized. Moreover, domestic animals were frequently utilized as offerings and symbols to God and as victims in the burial of the governor, while the community enhanced physiolatry in order to band together.

The Mesolithic era from 9000 to 6500 B.C. was transitional in the process of domestication, and all of the present domestic animals, excluding the horse, were being raised as livestock by 5000 BC, in the early Neolithic era. The domestication of ungulates began with goats and sheep (7000 B.C.), followed by pigs and cattle, and finally the horse (3000 BC). The domestication of ungulates seemed to begin in western Asia (now Syria, Jordan, Palestine, Israel, Turkey, Ukraine, Iran, Afghanistan, Turkistan, etc.). A great number of wild species of goat, sheep, pig, cattle and horse, as well as other wild animals such as gazelle and onager, lived in these areas in those days. Farming developed largely in the fertile "crescent moon" zone and areas around there, and agriculture and stock raising were run in the area to the north of the Black Sea and in the steppe zone to the east. Also in China and South-East Asia, domestic animals had been bred for many long years. The introduction of domestic animals to these regions was done through India and Central Asia. In Japan, a country in the Far East, after the process took about five centuries. In this country, work was the primary motivation in utilization of domestic animal, and utilization of milk and eating meat did not spread in Japanese society until the latter half of the nineteenth centuries. The main source of protein in this nation was seafood such as fish and shellfish, and whales were also a vital food resource, served as a daily necessity until recent times.

2. Domestication and modern production—goats

The domestic goat mainly originated from the bezoar goat (*Capra aegagrus aegagrus*) which inhabited mountain area in western Asia. Domestication of the goat was very early, at least 8000 to 7000 B.C. after that of the dog. From remains in Jericho dated to 7000~6000 BC in Jordan, horn samples of goat with a crescent moon type of horn unlike that of the bezoar goat have been excavated. This has been called a turning point in human history, when hunter-gatherers in western Asia began to breed goats instead of

hunting wild cattle, gazelle and onager.

Modern goats thrive in both arid highland and wet lowland, covering a wide range of climatic and topographic environments, in Asia, Europe, and Africa (especially Ethiopia). Goats prefer to eat the buds, leaves and stem of shrubs, while sheep prefer grass. This habit of the goat largely contributed to expansion of arable land by farming people. Unfortunately, however, overgrazing by goats and sheep over a long period, as well as burning and trimming of virgin forests, has been a major reason for expansion of desertification in various regions.

Though the sheep excels the goat in respect of wool, fat, and meat characteristics, the milk production of the goat is higher than that of sheep. Therefore, the use of raw milk, cheese, and butter of the goat was propagated by nomad in wide regions of Europe, Greece, Egypt and Central Asia. From earliest times, the bones and horns were used to make various tools while fat was used as wax and the manure as fertilizer and fuel. Also the skin of the goat was used as material for shoes and carpets. Generally, the goat provides a model for utilization of livestock products, and they have been very important resources in the lives of common people.

The world's domesticated goat can be divided into three types by morphological features.

- Bezoar type-This is a milk type of goat such as Saanen and Toggenburg which are small and native goats bred in Africa and South-East Asia.
- Savanna type-This derives from north-east India. The Syrian goat of the Middle East is an example of this type. It has sagged ears, twisted horns, and black fur. Cashmere and Angora goats, famous for their wool types, are also included in this group. These goats exist as a result of adaptation to rough and dry land with less grass.
- Jamnapari type-Jamnapari in India and Nubian in Africa are included in this type. The distance from the wild ancestor is the biggest in terms of their body form. The constitution is increased, the face protrudes, and the ears are very long.

While the nomad utilizes milk of the goat, in the wet tropical zone the meat is entirely utilized. In Malaysia and Indonesia where many of Muslim live, the habit eating goat's meat, instead of pork, is widespread. It is possible to have a daily milk secretion of 4 to 6kg in a good Saanen goat, in which milk production has been increased by breeding. The Angora goat which originates from Angora district, to the south of the Black Sea, produces white fur with the lustre of silk yarn. This fur is called mohair and it is respected by many people, for its use in production of special fabric. The Tibetan Himalayas is the origin of the Cashmere goat. The whole body of a Cashmere goat except for the head and limbs is covered with long hair, and the soft and silk-like hair which grows under the long hair is used for valuable shawls and fabric. Though the goat has played a very important role in the history of domestication, the devastation of the land has been a frequent and widespread problem, because of their feeding habits. This is why sheep became more popular than goats in warm regions. However, even today the goat is still an important domestic animal in places where grass is scarce and shrubs plentiful, and in places where food and water are insufficient for breeding cattle.

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