DOMESTICATION OF ANIMALS: DETERMINING FACTORS AND CHALLENGES OF BIODIVERSITY AND HUMAN SOCIETY

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Abstract. The domestication of animals has been an essential process in the evolution of humanity, with significant implications for the development of human societies, biodiversity and ecosystems. This phenomenon began about 15000 years ago and was determined by biological, ecological and cultural factors. As certain species have adapted to meet human needs, domestication has led to changes in their behavior and morphology, and species such as dogs, horses, cattle, and pigs have become fundamental to human societies. At the same time, the domestication of animals has generated changes in the structure of ecosystems, contributing to the reduction of biodiversity and the change of natural habitats. Despite the benefits of domestication, this process has also raised significant ecological and ethical challenges. Intensive agriculture, necessary to sustain the growing food needs of the world's population, has had a major impact on natural resources, causing greenhouse gas emissions, deforestation and biodiversity loss. In this context, the sustainable approach to agricultural practices and animal husbandry has become essential to reduce the negative impact on the environment. In parallel, ethical issues related to the treatment of domestic animals are increasingly discussed, especially in the context of factory farms. The living conditions of animals and the need for stricter regulations on their welfare are essential topics to prevent unnecessary suffering. Also, modern monitoring technologies, such as GPS devices and health sensors, have the potential to improve animal management and help reduce stress and improve animal health. Thus, the domestication of animals continues to be a determining factor in the development of human society, but also a subject of major concern in the context of ecological and ethical challenges. Innovative and sustainable approaches in agriculture and animal management are essential to ensure a balanced, environmentally friendly and animal rights future.

Keywords: animals, domestication, factors, impact, perspectives.

Rezumat. Domesticirea animalelor: factori determinanți și provocări ale biodiversității și societății umane. Domesticirea animalelor a reprezentat un proces esențial în evoluția umanității, având implicații semnificative asupra dezvoltării societăților umane, biodiversității și ecosistemelor. Acest fenomen a început acum aproximativ 15000 de ani și a fost determinat de factori biologici, ecologici și culturali. Pe măsură ce anumite specii s-au adaptat pentru a satisface nevoile umane, domesticirea a dus la modificări ale comportamentului și morfologiei acestora, iar specii precum câinii, caii, bovinele și porcii au devenit fundamentale pentru societățile umane. Totodată, domesticirea animalelor a generat schimbări în structura ecosistemelor, contribuind la reducerea biodiversității și la schimbarea habitatelor naturale. În ciuda beneficiilor aduse de domesticire, acest proces a ridicat și provocări ecologice și etice semnificative. Agricultura intensivă, necesară pentru susținerea cerințelor alimentare tot mai mari ale populației mondiale, a avut un impact major asupra resurselor naturale, provocând emisii de gaze cu efect de seră, defrișări și pierderi de biodiversitate. În acest context, abordarea durabilă a practicilor agricole și creșterea animalelor a devenit esențială pentru reducerea impactului negativ asupra mediului. În paralel, problemele etice legate de tratamentul animalelor domestice sunt din ce în ce mai discutate, în special în contextul fermelor industriale. Condițiile de viață ale animalelor și necesitatea unor reglementări mai stricte privind bunăstarea acestora sunt subiecte esențiale pentru prevenirea suferinței inutile. De asemenea, tehnologiile moderne de monitorizare, precum dispozitivele GPS și senzorii de sănătate, au potențialul de a îmbunătăți gestionarea animalelor și de a contribui la reducerea stresului și la îmbunătățirea sănătății acestora. Astfel, domesticirea animalelor continuă să fie un factor determinant în dezvoltarea societății umane, dar și un subiect de preocupare majoră în contextul provocărilor ecologice și etice. Abordările inovative și sustenabile în agricultură și managementul animalelor sunt esențiale pentru a asigura un viitor echilibrat, respectuos cu mediul și cu drepturile animalelor.

Cuvinte cheie: animale, domesticire, factori, impact, perspective.

INTRODUCTION

The domestication of animals is one of the most significant processes in human history, having a profound impact on the evolution of societies and the development of civilization. Through this process, man has been able to turn wildlife species into useful partners, whether for work, food, transportation, or other needs. Domestication is not limited to the individual taming of an animal, but involves genetic and behavioral changes that make a species dependent on human intervention (O'CONNOR, 1997; DIAMOND, 2002).

Domestication involves a long-term evolutionary process, in which artificial selection plays an essential role. This differs from simple taming, which refers to modifying the behavior of a wild animal in a short time, without major genetic changes. While taming can occur at the individual level, domestication affects an entire population, transforming traits such as aggression, social and reproductive behavior (RUSSELL, 2012; LARSON & FULLER, 2014).

ZEDER (2012) defines domestication as an intentional process, in which man takes control of the reproduction, feeding and protection of animals, directing their evolution according to his needs and objectives. In this context, HUȚU (2020) emphasizes that domestication involves not only physical changes, but also behavioral and psychological changes, which allow animals to live in close proximity to humans.

The understanding of domestication has not only historical relevance, but also contemporary relevance. Recent studies of the genome of domestic and wild animals provide insights into how artificial and natural selection have

contributed to major physiological and behavioral changes. Domestication also provides a clear example of co-evolution between humans and biodiversity, highlighting how both sides have been mutually influenced, providing a starting point for understanding the concept of Human-Animal-Environment. This interaction has not only shaped the behaviors and physical traits of animals, but has also fundamentally influenced the social, economic and cultural structures of human communities, thus opening up new perspectives in the study of the symbiotic relationships between humans and nature (PINHEIRO & RODRIGUES, 2021; SANDU, 2021).

Thus, domestication should not be understood only as a simple modification of animals, but as a complex process, which has led to the formation of an interdependent ecosystem, in which the evolution of the human species and that of domestic animals are closely linked. This interdependence continues to play a central role in how we manage biodiversity and natural resources today, and a deep understanding of this process is essential for modern conservation and sustainable development approaches.

The study adopts a multidimensional and qualitative approach, combining the inductive method and the synthetic method to explore in depth the process of animal domestication. This approach is not limited only to the analysis of quantitative data or the application of rigid assumptions, but emphasizes a holistic understanding of the phenomenon, exploring not only the biological, but also the social, cultural and ecological dimension of animal domestication.

The inductive method, which starts from particular observations to reach general conclusions, allows the identification of patterns and trends in animal domestication based on existing studies, while the synthetic method integrates information from various sources and perspectives to create a complete and coherent picture. This synthesis of data from relevant articles and documents contributes to the formation of an overview of the impact that animal domestication has had throughout history on biodiversity and human society.

In this study, the analysis of the literature plays a crucial role, providing solid theoretical foundations and highlighting the evolution of research in the field. Relevant documents, which include both academic research and expert reports or case studies, are examined to understand not only the historical context of animal domestication, but also the determining factors that shaped this process. Among these factors are ecological conditions, the economic needs of human communities, but also the cultural and social interactions that have influenced the selection of domesticated animal species.

The study is also exploratory, aiming to discover new research directions and understand the complexity of this process. By combining theoretical and empirical approaches, a dynamic view of the impact of domestication on biodiversity is proposed, as the selection of animals for domestication has influenced not only the evolution of the respective species, but also the ecosystems of which they are part. Moreover, the study also explores the long-term implications for human society, in terms of economic development, changing lifestyles and human-animal interactions.

Therefore, the objective of this study is not only to analyze the domestication process itself, but also to understand the complex relationships between humans and animals and how they have shaped and continue to influence both the biodiversity of the planet and the economic and social structures of human communities.

Domestication is a long-term evolutionary process, in which artificial selection and controlled reproduction play an essential role in the profound transformations of the evolution of domestic species and in the creation of animal lines with specific traits adapted to the economic, social and cultural requirements of man, while also influencing the evolution of human societies (RUSSELL, 2012; PRICE & BROWN, 2018).

While natural selection favors traits that improve survival and reproduction in a given environment, the domestication process involves artificial selection, where traits are chosen based on human preferences and needs. This essential distinction between natural and artificial selection has allowed the development of specific traits that are essential for the integration of animals into human activities, such as docility, productivity, resistance to disease and adaptability to managed environments. These traits were essential not only for animal welfare, but also for the success of human civilizations.

A significant example of this process of artificial selection is observed in the domestication of horses, which were not only selected for physical abilities such as manpower, but also for their ability to work in harmony with humans. Thus, selection favored more cooperative, less aggressive animals, which could be more easily learned and cared for, strengthening the human-animal relationship and facilitating the development of mutually beneficial collaboration. This evolution has been supported by researchers such as OUTRAM et al., (2009) and VIGNE & HELMER (2007) who have emphasized the importance of behavioral selection in animal domestication.

Similarly, in other animal species, artificial selection has been directed towards improving specific economic characteristics. For example, in cattle, selection has been geared towards increasing milk and meat production, resulting in the development of more productive breeds. In sheep, selection for wool production has led to the development of breeds that have a longer and denser wool, adapted for regular shearing and to meet the needs of the textile industry. These transformations are described in the work of ZEDER, (2006) and LARSON & FULLER, (2014) who explore how domestication was essential for the evolution of certain species and their adaptation to the economic demands of society.

Theories on the beginning of domestication

The domestication of animals is a complex, continuous and deeply rooted process in the history of interactions between humans and the surrounding fauna. Over the past few years, several studies (CHEN et al., 2010; WRIGHT, 2015; HUNTER, 2018; AHMAD et al., 2020) focused on the domestication of animals, and currently, it is possible to establish a timeline for the domestication of several species (Table 1).

Table 1. Main species of domesticated animals, place and estimated period of domestication.

No.	Species	Approximate period domestication	Geographic region
1.	Dog	15000 - 40000 î.Hr.	Eurasia, Middle East
2.	Goat	10000 î.Hr.	Middle East, Anatolia
3.	Sheep	10000 î.Hr.	Middle East, Anatolia
4.	Hen	8000 - 10000 î.Hr.	Southeast Asia
5.	Pig	9000 î.Hr.	Asia and Europe
6.	Cat	9000 î.Hr.	Egypt, Middle East
7.	Cattle	8000 - 10000 î.Hr.	Middle East, Central Asia
8.	Zebu	8000 î.Hr.	India
9.	Lama	6000 î.Hr.	Peru
10.	Donkey	5000 - 6000 î.Hr.	East Africa, Asia
11.	Horse	4000 î.Hr.	Central Asia
12.	Bees	4000 î.Hr.	Multiple seats
13.	Camel	3000 - 4000 î.Hr.	Middle East, North Africa
14.	Silk butterflies	3000 î.Hr.	China
15.	Goose	2500 î.Hr.	Egypt
16.	Yak	2500 î.Hr.	Tibet
17.	The buffalo	2000 - 4000 î.Hr.	Southeast Asia, China
18.	Rabbit	1000 - 2000 î.Hr.	Europe, Central Asia
19.	Duck	1000 î.Hr.	Southeast Asia

This research allows for a detailed understanding of how domestication began and what factors led to the transformation of certain wildlife species into domestic partners. In order to explain this phenomenon, several theories have been proposed, each offering a different perspective on the dynamics of this process.

For example, the theory of "active domestication" (controlled by humans) suggests that prehistoric humans intentionally selected certain species of animals to breed and reproduce, taking an active role in modifying their behavior and characteristics. It is assumed that the first domesticated species were those that exhibited favorable traits such as docility, small size, and tolerance to human closeness, traits that made them more manageable and integrated into people's daily lives (ZEDER, 2006). Thus, the selection was oriented towards creating a stable and efficient partnership between man and animal, in which resources were shared mutually.

On the other hand, the theory of "passive domestication" (self-selection of animals) proposes a more natural approach to the process. This suggests that domestication began spontaneously, as a result of the natural interaction between animals and humans. Animals that benefited from human presence, such as access to readily available food or protection from predators, were more likely to live near human settlements. This gradual adaptation process was described by COPPINGER (2001), who highlighted the fact that animals that were no longer aggressive or that had less evasive behaviors towards humans were favored in this context. In this sense, domestication was seen as a less directed phenomenon, but with a significant influence on animal behavior.

The theory of the "mutualist model" suggests that domestication was a process of co-evolution beneficial to both animals and humans. According to this theory, humans provided food, shelter and protection to animals, while animals contributed various economic resources and services, such as transportation, food (milk, meat) or help in hunting and defense. ZEDER (2006) points out that this type of relationship has been mutually beneficial, reinforcing the interdependence between humans and animals throughout their evolution. In this view, domestication is not only seen as a process of animal control, but as the development of a long-lasting symbiotic relationship, in which both parties had clear and beneficial roles for survival.

The theory of "ecological pressure" suggests that climate change and the decrease in natural resources were driving factors in accelerating the domestication of animals. BERCA (2000) and BĂBEANU (2008) argue that, as natural resources became more difficult to access, human communities had to establish closer relationships with wild animals to ensure survival. This ecological pressure has accelerated the domestication process, with animals becoming not only sources of food and work tools, but also indispensable partners in managing the new challenges brought by climate change.

The theory of "multiple paths" argues that domestication did not occur in a single place or at a single time in history, but was a process that occurred independently in various parts of the world. DNA analyses have shown that some domestic species, such as dogs, evolved simultaneously in several regions, which supports the idea that domestication was not an isolated phenomenon. HUȚU et al. (2020) point out that the genetic diversity of domestic animals shows that, although in different regions of the world animals have evolved in distinct ways, all these processes have been influenced by similar factors, such as the need for food and protection, but also by interaction with humans.

Understanding the various theories about the origin of domestication helps us to better interpret the relationship between humans and animals, highlighting the complexity and adaptability of both parties in an ever-changing environment. Domestication was not a singular or simple process, but one that involved a wide range of biological, ecological, social, and cultural factors, and that continues to have a significant impact on how we interact with the natural world. These theories provide a valuable framework for future research, which will help deepen our knowledge of the interdependence between species and how we evolved with them.

Biological factors that influenced domestication

The domestication of animals was influenced by a combination of biological factors that determined the ability of species to adapt to coexistence with humans. Understanding these factors provides essential insights into how some species have been successfully domesticated, while others have not.

One of the most important factors was high genetic variability. Species with large and diverse wildlife populations have demonstrated a superior ability to respond to artificial selection, allowing specific traits to develop. This genetic diversity has provided a broad basis for the selection of desired traits in captivity (LARSON & FULLER, 2014).

Another key biological factor was the short reproductive cycle and high reproductive capacity in captivity. The accelerated rate of reproduction has allowed humans to observe the effects of selection in a relatively short period of time, turning these species into sustainable and efficient food sources.

Physiological adaptability was also an important criterion. Animals such as sheep and goats have demonstrated remarkable adaptability, being able to thrive in a wide range of environments, including arid ones. These species, capable of digesting a variety of foods and withstanding harsh conditions, have become essential for communities in resource-limited regions (VIGNE & HELMER, 2007).

The social structure and group behavior of some animals played a significant role in the domestication process. Species living in well-organized social groups with defined hierarchies, such as cattle and horses, were easier to integrate. ZEDER, (2006) mentions that natural herd leaders facilitated the acceptance of humans as leaders, reducing the initial resistance to human closeness.

Another major factor that influenced the domestication process was the low level of aggression. Animals that were more tolerant of human presence and less aggressive were more likely to be selected for domestication. Tolerance towards humans has been crucial for reducing risks in the process of handling and maintaining animals.

Finally, the deliberate interaction between man and animal has amplified the influence of these biological factors. Over time, humans have favored and perpetuated the traits that facilitated the integration of animals into human life, gradually transforming them into domesticated species. These factors such as genetic variability, docility, social behavior, adaptability, reduced aggressiveness, and ability to reproduce in captivity were fundamental to the success of domestication.

Ecological factors in animal domestication

The environment was a determining factor, not only in the availability and characteristics of fauna, but also in understanding the conditions that favored their integration into the daily life of human communities.

One of the most significant aspects was the high biodiversity of the regions where the first stages of domestication took place. Areas such as the Horn of Plenty, also known as the Fertile Crescent (Fig. 1), a region with remarkable ecological diversity, have been places conducive to close interaction between humans and wildlife. These areas have provided access to species suitable for domestication, such as sheep, goats, cattle and pigs, thus becoming strategic points for hunting and the development of symbiotic relationships between human communities and wild herbivores. MCCOY (2005), and VIGNE & HELMER (2007a) mentions that the proximity of water sources, such as the Nile Valley or the Yangtze River, was essential, providing not only access to water for animals, but also favorable conditions for the development of sustainable ecosystems, which supported both wildlife and farmers and livestock breeders.

The climate profoundly influenced the domestication process. The temperate and subtropical regions provided ideal conditions for animal husbandry and reproduction, especially for horses and cattle, which thrived in Europe and Central Asia. In arid and semi-arid regions, such as the Arabian Peninsula, people have turned to drought-resistant species, such as camels and goats, species that have been domesticated for transportation and food resources. Climate change, especially the end of the last ice age, has altered the distribution of wildlife, forcing human communities to seek and capitalize on new food sources. The disappearance of megafauna at the end of the Neolithic accentuated the need to domesticate smaller, more adaptable species that would provide constant resources in a changing environment (ZEDER, 2006).

Geographical features also had a significant impact on the domestication process. In isolated regions, such as islands, access to native species suitable for domestication has been limited, and the domestication process has been much slower. On the other hand, in vast and interconnected continents such as Eurasia, domestication has been carried out on a large scale, due to greater biodiversity and extensive access to various species. Connectivity between different regions, supported by trade routes and human migration, facilitated the exchange of domestic species, thus accelerating their spread (VIGNE & HELMER, 2007a).

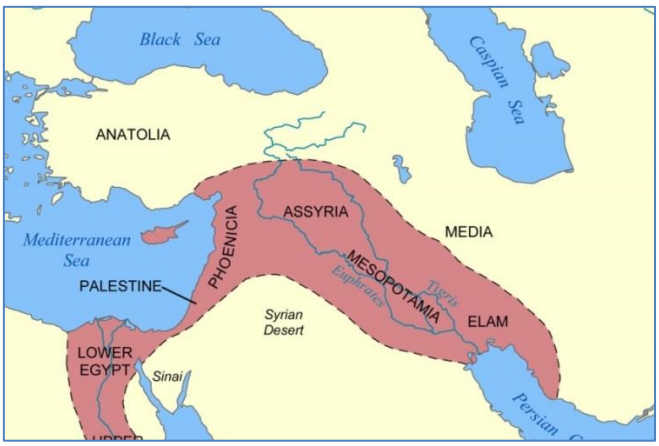

Figure 1. The general area in which the Horn of Abundance is defined.

Cultural and social factors in the domestication of animals

From economic needs and the role of animals in work, to the sacred and spiritual meanings attributed to them, cultural and social factors have been determinant in the domestication process. Economic necessity was a major driver of domestication. Domesticated animals provided a wide range of essential resources, such as meat, milk, skins, and wool. Cows and sheep, for example, provided not only feed, but also raw materials for making clothing and other necessary goods. In this context, the domestication of animals has been closely linked to the economic development of societies, and animals have become a central factor in their sustainability (VIGNE & HELMER, 2007).

In addition, the use of animals for work was another key factor. For example, horses, oxen, and elephants, trained for heavy tasks such as plowing the land or transporting loads, have had a significant impact on the evolution of agriculture and trade. With their help, it was possible to apply more efficient methods of cultivating the land and to transport goods between regions.

In many cultures, dogs were used for hunting, guarding, and even spiritual protection, and the deep bond between humans and dogs favored their domestication. Thus, the interaction between humans and animals became not only an economic one, but also a social one, establishing long-lasting partnerships between species.

The transition from nomadic societies to agricultural societies allowed for a more stable and organized relationship with animals, facilitating the domestication process. Sedentary communities had more resources and time to care for animals, and this led to a more rigorous selection of domesticated species.

Also, in many societies, certain groups or individuals had specialized tasks related to the care and breeding of animals. Shepherds, breeders or even shamans had deep knowledge about the behavior of animals and their needs, and this specialization facilitated the domestication and care of animals in an effective way (BAKER & VAN VUREN, 2004).

The domestication of animals was not limited to their local use, they also became important commodities in trade between tribes and civilizations. Trade routes, such as the Silk Road, transported horses, sheep, and cattle between the eastern and western regions of the ancient world, boosting economic exchanges and increasing inter-cultural relations (DIAMOND, 2002).

In many societies, owning animals such as horses and elephants was a sign of social and economic status, with these animals being symbols of power and wealth, associated with elites, and having both an economic role and one of prestige and social influence. In addition, animals have played a central role in people's cultural life, being integrated into myths, rituals and legends. For example, in Norse mythology, horses were considered messengers of the gods, and in many Asian cultures, the buffalo was a symbol of diligence and hard work, and was often revered. The spiritual connection with these animals contributed to the protection and respect of certain species, especially in regions where religion and spirituality profoundly influenced daily life.

Also, dogs, as the first domesticated partners of humans, were considered faithful companions in hunting and protection, and in Paleolithic sites, dog skeletons found alongside human ones suggest a close and deeply personal relationship. These links have also been reflected in stories, legends and cultural traditions, where domesticated animals have played important roles, reinforcing the symbolic bond between humans and animals.

Cultural and social factors have had a major influence on the domestication of animals, shaping not only species selection, but also the way humans have integrated them into the economic and cultural structures of society. Religious beliefs, social organization and economic needs have profoundly influenced the relationship between humans and animals, transforming them from mere resources into essential partners in the development of civilizations.

Genetic factors

Understanding genetic factors is essential to explain how certain species have been chosen and modified to fulfill specific roles in human societies, creating a complex symbiosis between humans and animals (BAKER & VAN VUREN, 2004).

The genetic variability existing in wild populations constituted an important reservoir of traits that were selected and strengthened by selective breeding. Humans, aware of the desired traits for certain species, began to select individuals with specific behaviors or physical characteristics, such as docile temperament, adaptability to life around humans, and physical traits necessary to perform specific tasks (SPONENBERG, 2009). Thus, the animals were deliberately bred to transmit favorable traits, a process that led, over several generations, to significant genetic modifications. It allowed the development of distinct lines of domesticated animals, each adapted to the specific requirements of humans. For example, in the case of dogs, genetic diversity has allowed the development of distinct breeds, from hunting dogs to companion dogs, each with specific traits for their tasks. In the case of farm animals, such as cows, sheep and pigs, genetic variability has allowed the development of types adapted to both meat and milk or wool production. This genetic diversity has been essential to ensure a broad genetic base from which to choose the best traits (LARSON & FULLER, 2014).

Impact of domestication on human society and ecosystems

Through the complex processes of adaptation and interaction with animal species, man has managed to transform both the natural landscape and the social and economic structure of society. This symbiotic relationship has brought notable benefits, but also significant challenges, with major implications for biodiversity and human health (DIAMOND, 2002).

The domestication of animals provided a constant source of food, which allowed for greater food stability and an increase in population. This was an essential factor in supporting the formation of the first permanent settlements and in the development of a sedentary lifestyle. Agriculture, based on animals, was the key to these changes, and the introduction of working animals reduced dependence on human power, thus favoring the specialization of trades. Crafts, trade, and agriculture became centralized activities around the resources provided by animals, and the use of oxen for plowing freed up human resources which, in turn, contributed to the development of ancient cities, such as those in Mesopotamia.

The domestication of transport animals, such as horses and camels, allowed for the expansion of trade routes and transportation facilities, connecting remote communities. An emblematic example is the establishment of the trans-Saharan trade routes, where camels were essential for transporting goods through the desert regions of North Africa.

The link between animals and cultural identity has been extremely strong throughout history. In many cultures, domesticated animals have become symbols of status, power, and tradition. For example, in Mongolian culture, horses were seen not only as essential elements for everyday survival, but also as a symbol of social status. Moreover, animals have played an important role in various religious ceremonies and cultural traditions. In India, festivals dedicated to cows, such as "Pongal", continue to symbolize gratitude to animals and their importance in everyday life.

Animal husbandry practices have had a considerable impact on natural ecosystems, bringing with them significant changes. In some cases, these changes have led to massive deforestation and soil degradation, especially in intensive agricultural areas. For example, overgrazing in semi-arid regions has contributed to the desertification process in the Sahel.

The introduction of domesticated animals to regions where they did not naturally exist has had a considerable effect on local biodiversity. For example, in Australia, the introduction of sheep and goats has led to the modification of ecosystems, affecting the endemic fauna and flora of the region. Domestication and human expansion have also led to competition for resources and, in many cases, the extinction of some wild species. A notable example is the extinction of megafauna in North America, which was directly affected by hunting and domestication activities.

Domestication also brought fundamental changes to the genetics of the species. Artificial selection has led to a reduction in the genetic diversity of domesticated animals, making them more vulnerable to disease and environmental changes. An example of this is the domestic pig, which exhibits much lower genetic diversity than its wild relatives. Also, the domestication process favored the creation of specialized breeds for production (meat, milk, wool), but this specialization also raised challenges related to sustainability and the ethics of using animals for economic purposes.

The close interaction between humans and domesticated animals has led to the emergence of new risks to human health, through the transmission of zoonotic diseases. Tuberculosis and influenza, for example, are diseases that have been transmitted to humans from domesticated animals such as cattle and poultry. In addition, the consumption of animal products, such as milk and meat, has influenced the evolution of human nutrition, contributing to the development of a greater capacity to digest lactose in modern European populations.

In conclusion, the domestication of animals has had a great impact on the development of human societies, reshaping their social, economic and ecological structure throughout history. The benefits of this process are obvious, but the effects on biodiversity and human health underline the importance of responsible and sustainable management of the relationship between humans and domesticated animals, in order to ensure a balance between development and environmental conservation.

Future prospects of animal domestication and ethical and ecological implications

As technology and science advance, the future prospects of animal domestication are changing, opening up new possibilities but also major challenges. Innovations in biotechnology, such as gene editing and lab-grown meat production, promise to revolutionize the way we interact with animals and the way food production is conducted. At the same time, ecological and ethical challenges, including the impact on biodiversity and animal welfare, are becoming increasingly pressing. These developments require a deep reflection on how the domestication of animals should be managed, so as to find a balance between human needs and respect for the environment and fauna.

Recent discoveries in biotechnology, especially the use of CRISPR technology and other gene editing methods, have the potential to revolutionize the process of animal domestication. These technologies allow the genetic traits of animals to be modified to make them more resistant to disease, more efficient in food production and more adaptable to changing climatic conditions. For example, creating more disease-resistant animal breeds could reduce the need for antibiotics and other chemical treatments, contributing to healthier and more sustainable agriculture.

Another promising area is the production of lab-grown meat, which could represent an innovative solution to meet the dietary requirements of a growing global population without relying on animal slaughter. This could significantly reduce pressure on natural resources, such as farmland and water, and help protect ecosystems. For example, lab-grown beef, already marketed in some markets, could reduce greenhouse gas emissions and water consumption, compared to raising animals conventionally.

Advanced monitoring technologies, such as GPS devices and health sensors, allow for more efficient management of domesticated animals. These technologies can help reduce animal stress and improve animal welfare, providing farmers with tools to detect diseases early and improve living conditions. Thus, the use of these technologies contributes to a more ethical and efficient approach to animal management (SPONENBERG, 2009).

Global population growth and growing food requirements continue to put pressure on natural resources, including water, farmland and food. Intensive meat and dairy production is a significant source of greenhouse gas emissions and contributes to deforestation, especially in tropical regions. Also, the expansion of agricultural land for animal husbandry has led to the loss of natural habitats and a decrease in biodiversity, affecting ecosystems in various corners of the world.

To address these environmental challenges, it is essential to promote sustainable agriculture and adopt more environmentally friendly animal husbandry practices that include reducing food waste and using more efficient methods of managing natural resources. It is also important to create policies that encourage the reduction of the negative impact of agriculture on the environment, in parallel with supporting more sustainable and ecosystem-friendly practices.

One of the most debated topics regarding the domestication of animals is their ethical treatment. Animal living conditions, access to food, health care and handling are fundamental aspects that need to be regulated in order to prevent unnecessary suffering. On factory farms, animals are often kept in extremely cramped conditions, which can lead to physical and psychological suffering. These practices raise fundamental questions about respect for animal rights and people's moral responsibility towards them.

To address these ethical dilemmas, it is essential to promote high standards on the conditions for breeding, transporting and slaughtering animals, and an independent certification and monitoring system could help ensure compliance. Furthermore, it is necessary for all agricultural practices to align with the principles of animal welfare, in order to ensure humane and ethical treatment of animals throughout their lives.

The agricultural sector is also a major contributor to greenhouse gas emissions (24% of total gases), especially in the case of cattle and sheep farming, which produce methane – a greenhouse gas much more powerful than carbon dioxide. In this context, the necessary measures include promoting more efficient agricultural practices, improving animal feed and using technologies to capture and reduce methane emissions.

Animal domestication is at a crossroads, facing the challenges posed by technological advances, climate change and emerging ethical dilemmas. As society evolves, it is essential to strike a balance between human needs and respect for the environment and wildlife. In this era of technological innovations and population growth, animal domestication must be managed with particular attention to sustainability and animal welfare, to ensure a more balanced and healthier future for all inhabitants of the planet.

CONCLUSIONS

1. The domestication of animals was a gradual and multifactorial process, which began about 15000 years ago and had profound implications on human development. Biological, ecological and cultural factors have played a key role in the selection and adaptation of certain species to live alongside humans. Through domestication, certain species have evolved significantly relative to their wild ancestors, and humans have gained greater control over their environment and their food and raw material sources.

2. From an ecological perspective, domestication has changed not only the relationship between humans and animals, but also the structure of ecosystems. Some species of animals have been favored and propagated by artificial selection, while others have become extinct or marginalized. This process has led to the emergence of domestic species that are profoundly different from their wild relatives, such as dogs, horses, cattle, and pigs. In parallel, domestication influenced the behavioral and physical evolution of humans, creating a symbiotic system that contributed to the development of human societies.

3. Throughout history, the domestication of animals has raised various ethical and ecological dilemmas. The treatments applied to domestic animals, their living conditions and the impact on biological diversity are topics of debate in contemporary society. The exploitation of animals for food, work or recreation has also raised concerns about their welfare and environmental protection. These challenges require a reassessment of current practices and the implementation of more sustainable and ethical policies regarding the use and protection of animals.

4. Future research in the field of animal domestication should focus on a deeper understanding of the biological interactions between humans and animals, including genetic and behavioral aspects of domestication. Also, studying the impact of domestication on the diversity of ecosystems and other species is essential. The development of modern technologies and research methods, such as advanced genetic analysis and archaeological studies, will allow for a better understanding of domestication processes and their long-term impact.

5. The domestication of animals remains one of the most significant phenomena in human history. It influenced not only the evolution of animal species, but also the social, economic and cultural development of human civilizations. By having a deeper understanding of the drivers of domestication and their impact on the environment and ethics, we can build a more sustainable and equitable future for humans and animals alike.

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