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RED DEER FARMING: BREEDING PRACTICE, TRENDS AND POTENTIAL IN POLAND – A REVIEW*

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Abstract

Red deer farming has started to play a greater role in modern agriculture and today is an interesting alternative for pig or cattle breeders. With regard to the low effort and high efficiency of maintenance, it may be expected that keeping these animals in fenced enclosures will be more popular over time. This trend is warranted by the fact that the demand on two main deer products: venison and antlers, is constantly rising, due to the quality of deer meat and prices of antler hunting trophies. Several countries of the world have already realized the scale of advantages to be derived from deer farming and today are world leaders in this area. Despite this expansion, the market still remains opened for deer products. Poland is a country with the climatic conditions, vast plain areas and varied vegetation that are fully sufficient to undertake large-scale deer farming, and to become a European leader. Therefore the aim of this review is to detail deer farming within the Polish framework and environmental conditions, and to illustrate its potential in sustainable modern agriculture and the economy.

Key words: *Cervus elaphus*, sustainable farming, venison, velvet, antler

History and current deer farming practice

The beginnings of cervid breeding dates back to ancient times. The first attempts at deer domestication were undertaken in China where, for cultural reasons, these animals were identified with the God of Longevity. In other cultures this animal was considered more ordinary, as a valuable source of meat and leather. In Europe the first efforts to keep it enclosed belonged to the Romans, for whom the red deer played the role of a food supply, apart from any aspect of decoration and social status (Dmuchowski and Krzywiński, 1997). In the Middle Ages in England, to ensure the food

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supply, hundreds of red deer farms were organized in the royal hunting preserves or constituted the private reserves of the rich (Griffin, 2007). Rapid development of large-scale farming and the beginning of actual red deer breeding began in New Zealand and Scotland in the 1970s (Blaxter et al., 1974; Yerex, 1979). Since then, attempts at targeted selection to obtain animals with the most valuable features have been constantly undertaken. Between the different aspects of animal farming, understanding the mechanisms that control the reproduction may contribute to the increase in farming profitability. For instance, the knowledge about mating seasonality allows the farmer to respond to the changing nutritional requirements of the animals, resulting from the need to store the energetic reserves. Moreover, proper use of crossbreeding enables expanding the valuable subspecies on a larger scale, to preserve unique genotypes or to mate remarkably important breeds or varieties. The creation of the hybrid of European red deer (*Cervus elaphus elaphus*) with wapiti (*Cervus canadensis*), which is currently the basic variety of red deer bred in New Zealand, was an example of how to obtain the larger, faster growing and leaner animals than the purebred counterparts, using the clever reproduction managing (Brown, 1992; Garde et al., 2006). Today, thanks to the desire to improve the genotypes in order to obtain better meatiness or antler size in the animals, the majority of breeds originate from the English line with additions from other European breeds: Hungarian, Romanian, Yugoslavian, German and Dutch. In shaping the traits of farmed red deer, the addition of a native Polish bloodline may turn out to be beneficial. This line was developed about 30 years ago in an experimental station of the Polish Academy of Sciences in Kosewo Górne from the wild animals originating from the natural habitat. These animals usually had a robust and muscular body: hinds weighing about 140 kg and stags more than 300 kg (Karpowicz, 2012). Introducing this bloodline to crossbreeding may therefore turn out to be beneficial for farm venison production, ensuring the higher meat yields. The same rule is applied in cattle breeding, in which highly specialized meat breeds are introduced to increase the effectiveness of meat production in the farms.

Deer farming might be an attractive enterprise, as a much lower workload and investments are needed than breeding other common species, and with guaranteed benefits if conducted properly. In comparison to cattle or pig farming, there is no necessity to build a cowshed or a pigsty. To obtain high milk (in cows) or meat (in cows and pigs) yields, usually it is recommended to administer food supplements or special fodders, which generates costs. Milking process also requires special machinery and the operating staff. In turn deer can be kept on the pasture throughout the year and pasture feed is in general sufficient to ensure the relatively high meat yields and antler growth. There are a few main rules and aspects, which help to keep the deer farming effective. Firstly, to ensure the proper amount of nutrients in the spring/summer period, pasture grazing (at a pinch enriched with salt blocks) is sufficient and no supplements are necessary. In autumn/winter season the basic ingredient of fodder is an easily storable silage, with the addition of nutritive feed like grains or cheap fodder vegetables (beet, carrot, cabbage), depending on what is currently in surplus on the market. As is emphasized by both researchers and farmers, in fodder selection it is enough to consider the seasonal changes in metabolic activity of the

animals and no specialized, commercial feeds or machinery are necessary to prepare and apply the feed. The spring/summer period is the time of intensive antler growth in males, foetus development and lactation in females and fattening in calves. Altogether these factors impose a large energetic demand. Conversely, the shortening of the day length affects a decreased appetite and a preparation for winter, during which possibly the smallest energetic expenses are indicated (Rhind et al., 1998). The second crucial criterion to be met is the maintenance of the proper number of animals within the casements, which depends on the quality of the soil and availability of food. Even in the poorest pastures located in the hot south of Spain, it is possible to maintain 1–2 individuals per hectare (Landete-Castillejos et al., 2010). The metabolizable energy (ME) demand differs according to the season, sex and stage of life, but the highest demands are observed in adult stags (from 0.63 MJ ME/$kg^{0.75}$/day in summer to 0.85 MJ ME/$kg^{0.75}$/day in winter) and in pregnant hinds (from 0.6 MJ ME/$kg^{0.75}$/day in the middle of the pregnancy period to 0.8 MJ ME/$kg^{0.75}$/day before parturition) (Fennessy et al., 1981; Asher et al., 2005). It has to be emphasized that in Poland, red deer have more gentle climate conditions and a more diverse diet due to the different period of plant vegetation than in the south of Europe (Bogdaszewska and Bogdaszewski, 2012). Despite the lower mean temperatures in comparison to some Spanish regions, in Poland there are no extreme heats and droughts and winters are not severe, so there is no radical factor that would limit the length of vegetation period and number of plant species able to adjust to the climate conditions (Pettorelli et al., 2005). Therefore in Poland it is possible to maintain at least 3–4 animals per hectare of poor pasture, and even 7–10 individuals in pastures of the highest quality, as is defined by the Minister of Agriculture and Rural Development directives and farming practices. According to the Polish system of pasture classification, the best pastures can ensure about 51400 MJ ME per hectare and the poor about 17100 MJ ME per hectare (Jamroz, 2013). If these criteria are passed, in most farms a contingent of 2–4 people is enough to manage a herd of even 1000 individuals (breeder's personal communication). By these aspects showing the low effort of deer farming and considering that the venison reaches higher prices in the market in comparison to the other types of meat (venison 8–25 €/kg, beef 5–15 €/kg, pork 4–8 €/kg), deer farming may be an interesting venture and we may suppose that the percentage of farmers interested in red deer farming will rise.

Current breeding conditions and trends in Poland and worldwide

A particularly intensive period of red deer farm development took place in Poland after 2001, when deer farming obtained the status of a livestock and slaughter animal production. According to the data of the Polish Deer Breeders Association, there were 60 farms registered in 2004, maintaining altogether 900 individuals. Two years later the amount of farms had reached 160, and the number of livestock exceeded 2000 individuals. With the increasing number of farms, the growth rate of the enclosed red deer population was evaluated at 100% in 2005–2010 (Borys et al., 2012). Recently, in the middle of 2014, unofficial data detailed hundreds of farms with about 9000 animals. Thus the livestock of farmed deer in Poland is rising, which may suggest a growth of interest in this species by both agricultural producers and consumers.

Due to the fact that red deer breeding is a relatively young trend in Poland, opinions about the main direction of production are divided between the venison production and reproduction farming. Nevertheless, according to some authors, meat production seems to be the first main direction of red deer breeding (Simińska et al., 2011; Borys et al., 2012). In this type of farming a harem-structure is maintained within the herd and the calving ratio generally equals 1:1. The most promising females are used for herd reconstruction and the other animals are slaughtered (Karpowicz, 2012). In recent years an upward tendency has been observed in the prices of livestock. It indirectly demonstrates the progressive changes in consumer interests, who search for light, health-friendly and naturally produced food products (Hoffman and Wiklund, 2006; Ignaczewski, 2011). On the other hand, over the last few years the share of deer venison in total meat production in Poland was low and reached only 0.3–0.4%, about 12–14 thousand tonnes per year (Ruda et al., 2011). In favor of meat breeding is the fact that it is usually conducted in accordance with the principles of sustainable ecological agriculture: a) animal development is not stimulated with fattening fodders or feed additives like enzymes, pigments etc., and proceeds naturally, b) *ad libitum* grazing, without fattening or high caloric fodders, c) none or strongly limited soil fertilizing, d) contact with pharmaceuticals is usually reduced to deworming, administered twice a year (Borys et al., 2012; Karpowicz, 2012). All the foregoing advantages make deer venison a really attractive product for the modern and aware consumer. Apart from these, the facts allow us to believe that despite the present trade loss to the more popular types of meat like beef or pork, deer venison may become a serious alternative in the future (Simińska et al., 2011). This supposition is the more probable that today, apart from the still not intensified farm venison production in Poland, our country is already one of the biggest European producers. Moreover, the studies on the quality of meat from national and foreign markets are becoming more popular and expected by the consumers, illustrating the interest in this type of meat (Dziedzic et al., 2003; Bertolini et al., 2005; Daszkiewicz et al., 2013).

The second main direction of red deer breeding is stag farming focused on obtaining the antlers, which in Poland are treated mainly as hunting trophies or as a substrate to produce decors and ornaments. In this case farms are oriented on producing stags with large, symmetric and attractive-looking antlers. The animals are either sold for introduction to hunting areas to obtain trophies or the antlers are cut in the farm and sold for decors production. Farms specialized in this production pay special attention to proper diet in the period of antler formation, for instance, the fodder should contain about 16% protein and ensure correct proportions of macro- and microelements to the animals (Estevez et al., 2009). The proper development of antlers depends especially on the right content of calcium, phosphorus and magnesium (Landete-Castillejos et al., 2012 b). As reported by the Committee on Nutrient Requirements of Small Ruminants (2007), antler growth also increases the ME demand for about 0.1 MJ/kg$^{0.75}$/day. The first two macroelements mentioned above, as a calcium phosphate, are transferred from bones to the growing antlers, while magnesium is responsible for stabilization of the calcium in developing antler tissue. Also the role of potassium and zinc cannot be omitted – any deficiency results in excessive

porosity of the antler and thereby in its decreased strength (Landete-Castillejos et al., 2012 a). Because of the fact that deer antler is a tissue able to regenerate completely, and is characterized by an enormous growth rate in the animal world, a certain percentage of deer are used for research purposes and are kept in experimental farms (Gomez et al., 2013; Li, 2013).

Another opinion about the main farming directions is that most Polish breeders concentrate mainly on reproduction farming, focused on the development and selling of breeding stock. In this type of breeding, both daily weight gains and the size of the antlers are mostly taken into account. The farmers search for animals characterized by the high daily weight gains or developing magnificent antlers, which suggests their high genetic potential. These animals are used for crossbreeding to consolidate the outstanding feature in the herd and the offspring is sold for further reproduction. The animals with outstanding features may reach the price of tens of thousands of euros in the market (Karpowicz, 2012).

Animal production for hunting clubs and associations is a less popular breeding direction in our country. Deer are usually intended for introduction into new areas or to support local populations. Production for shooting within the tourism hunting is a variant of this type of farming. The deep-rooted hunting traditions in our culture and the growing popularity of tourism hunting may support this direction to become more popular in the future. Spain is an example of this trend. Most enclosed red deer are kept within Private Big Game Estates (PBGEs) and not in farms like in Poland. PBGEs are fenced areas of hundreds to more than a thousand hectares, in which hunting and game competitions are organized, and in which breeding is focused on the production of trophy animals. Thus PBGEs can be an alternative for farm breeding typical in Poland.

The last demand for red deer herd maintenance close to human neighborhoods is to improve the attractiveness of tourist resorts and in agritourism. Animals are usually kept as a hobby and for the amusement of visitors. However we cannot define this type of human-deer coexistence as breeding, because of the usual lack of endeavor to develop new or to spread already existing genetically valuable features. To emphasize the difference between the intentional animal breeding and a simple hobby, we will define the latter as ‘deer keeping’.

The increase of interest in red deer breeding can be explained mainly by the growing demand for its nutritional and versatile meat (Hoffman and Wiklund, 2006). This trend is supported by the rising wealth and awareness of consumers, who more often choose ecologically produced food (Borys et al., 2012). The other issue favoring the expansion of red deer farming is the fact that low quality, fallow and uncultivated farmlands and meadows can be adopted as pastures, in which the high quality animal protein is produced. Most of these terrains are located in the poorer regions of eastern Poland, therefore red deer farming may contribute to economic development in these areas and improve the quality of life of their inhabitants (Drozd and Karpiński, 1998).

On a global scale, two main directions in deer production may be observed. The first is meat production, typical for western countries. Many present consumers pay attention not only to flavor, but also to the low caloric and cholesterol content. Food

scandals of recent years (BSE, dioxins, swine and bird flu) affected a pronounced decrease in the popularity of beef, pork and poultry. This situation has led to a search for alternative sources of meat within game animals, including the red deer (Dubiel et al., 2002). Today the scale of demand for venison in Europe is evidenced by the fact that the great majority of New Zealand's total venison output is sold to Europe, and this country is a world leader in red deer venison production (Griffiths et al., 2009).

The second relevant direction of breeding, focused in the eastern part of the globe, is velvet production. Velvet is a tissue covering the antler during its period of annual development to supply blood circulation and nourishment. This product is widely used in traditional Far Eastern oriental medicine. For many years it was used to treat diseases related to the cardio-vascular system, immuno-deficiencies and tissue regeneration (Wu et al., 2013). There are also reports demonstrating the potential usefulness of velvet-containing products in the control of jaundice, mastitis and breast cancer, as well as infertility in human and/or animal models (Chen et al., 1989; Zhang et al., 2005; Wu et al., 2013). China is the Asian leader in deer breeding (Hou et al., 2003), while South Korea is the world's biggest velvet customer – its annual imports consume 90% of the world production (Suttie and Loza, 1998). However the velvet market is a local eastern field and exceeding a selected limit of supply causes a drastic decrease in profitability of production. Therefore there is no free space in this market for European countries to search for profits. Another limiting issue is the fact that in the European Union, cutting antlers with velvet is prohibited.

However the farm production of fully developed antlers, which are used as the material for production of furniture, ornaments and jewelry, is permitted. The developed antlers are also considered as the hunting trophies, obtained through deer hunting. The quality of antler trophies is evaluated according to special scales, prepared by the International Council of Hunting (CIC, *Conseil Internationale de la Chasse*) or Safari Club International (SCI) (Dziedzic, 2005). It should be indicated that this farming for antler trophies carries considerable financial profits, because antlers with the highest scores reach prices in the tens of thousands of euros.

Potential

It may be impossible to demonstrate in this paper a proper financial analysis that could explain all the gains and losses related to deer farming, however, we may try to reveal its potential. It generally seems that this sector of animal breeding is underestimated in Poland, perhaps because of the fact that people do not realize how profitable it may be and strictly gainful farming is occasional. The situation is different in Spain, where deer farming in large fenced areas generates reasonable financial profits (Landete-Castillejos et al., 2010). According to official statistics from the Spanish administration, 650 thousand animals worth 450 million euros in total were kept in enclosures in 2008. About 70–100 thousand of them are sold each year, which means about 6000 tonnes of meat with a market value of 30–40 million euros is transferred to the biggest European customer – Germany. Cautious calculations show that these numbers come from only about 4% of Spain's territory which in fact is fenced (these data relate to central and southern region of Spain). To compare these numbers to

Poland, 4% of our territory equal 1.25 million hectares of rural areas which are characterized by more abundant vegetation than the corresponding Spanish region. On the other hand, farms in Spain cover usually hundreds of hectares, and according to the Agency for Restructuring and Modernization of Agriculture, an average farm in Poland covers only 10.48 ha. This suggests that the development of deer farming in Poland would require an increase in the size of farms or uniting in the cooperative farms. Still it is achievable while the total surface of rural areas in Poland in 2014 was 18.93 million hectares, which is more than 60% of the surface of Poland. Regarding the different quality of meadows and pastures in Poland we can assume that an average of 5 animals per hectare is a reasonable number to achieve. Therefore Poland has the potential of 6.25 million of red deer, while currently we farm only about 9000! Even if the area for deer farming is reduced to 1% or the number of animals per hectare to 1, it is still enough to hold about 1.2–1.5 million animals. These numbers show the great potential we can have in red deer breeding. This is even more significant as the demand for venison in Europe has been at a stable level for years, and Polish companies involved in the meat trade find Europe a reliable venison market, not endangered with uncertainty or a market crash (Ratajczak, 2011).

Financial profits result from the advantageous character of red deer farming. Why then the Spanish deer farming is better developed than in Poland, even despite the fact that farming in our climate is easier due to the milder weather conditions? This situation may be caused by the fact that, according to the information mentioned above, meat production seems to be dominant in Poland. In turn, in Spain, venison production does not predominate over obtaining farm antlers. Breeding organization may be the key to this situation. In Spain, animals are kept in game estates, which results from the Spaniards' passion for hunting. At the same time, Spain still is a large venison exporter. This means that the style of deer farming adopted in Spain is sufficient to satisfy both main directions of production, when in Poland it is impossible to organize hunting events on the typical farm oriented to produce venison. The reason is that in Poland, agriculture and hunting are treated as two different fields, while in Spain they have joined them. It has to be highlighted that hunting is popular in Poland, as evidenced by the fact that more than 116 thousand people were associated in 2014 in the Polish Hunting Association and this number is rising, as well as the number of foreign hunters who visit our country for hunting tourism. These facts favor the validity of red deer trophy production in Poland.

Today 55% of the European demand for red deer venison is covered by New Zealand, as European production has still not developed to a sufficient level to compete with the Antipodes, even despite the greater advantage in the lower costs of transport. It is therefore worth realizing the potential of red deer breeding in Poland and becoming one of the largest European producers.

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