

## **POULTRY PRODUCTION AND STRATEGY FOR SUSTAINABLE DEVELOPMENT OF RURAL AREAS**

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### **Abstract**

**Selection for increased number of eggs from egg-type hens and improved meatiness of broiler chickens that has been carried out over the last fifty years as well as efforts to increase the profitability of poultry production paid scant attention to avian welfare, conservation of genetic resources and the concept of sustainable development. Many human activities in poultry production are therefore not sustainable because they are a threat to the survival of native breeds of birds (extinction of many local breeds such as naked neck and crested hens); fail to guarantee necessary conditions for high welfare levels in birds (in both conventional and alternative systems); pose a threat to human health (crowding of birds carries the risk of a rapid spread of infectious diseases, including zoonoses); and are an environmental threat (water pollution due to inappropriate application of manure to the soil, atmospheric emissions of ammonia, hydrogen sulfide, carbon dioxide and dust substances from intensive breeding systems).**

**Key words: hens, welfare, sustainable development**

The problem of sustained development has been raised by various international environmental organizations and research institutions for several dozen years. In 1992, the United Nations Conference on Environment and Development in Rio de Janeiro adopted the Agenda 21 programme related to sustainable development and the Rio Declaration containing 27 principles of sustainable development ([www.un.org/geninfo/bp/enviro.html](http://www.un.org/geninfo/bp/enviro.html)). The concept of sustainable development was also included in the Constitution of the Republic of Poland, which is the most important legal instrument in Poland. Article 5 of the Constitution provides that “The Republic of Poland ... shall ensure the protection of the natural environment pursuant to the principles of sustainable development” (Konstytucja RP, 1997). At present, the European Union is amending its strategy for sustainable development, adopted in 2001.

The simplest definition of sustainable development states that it “meets the needs of the present generation without compromising the ability of future generations to meet their own needs”. In agriculture, this type of development imposes the need to use technologies that guarantee the conservation of soil, water and plant resources, protect the genetic resources of animals and do not degrade the environment (Wilkin, 2003; Zawisza, 2004).

In line with the concept of sustainable development, farm animal husbandry, including poultry production, should balance production objectives with the needs of animals and the natural environment. Meanwhile, over the last fifty years, poultry producers have carried out selection for increased number of eggs from egg-type hens and improved meatiness of broiler chickens, while efforts to increase the profitability of poultry production were aimed only to meet the needs of the present generation while paying scant attention to avian welfare, conservation of genetic resources and the concept of sustainable development. Therefore, many poultry production activities are not sustainable because they:

- pose a threat to the survival of native breeds of birds,
- fail to provide conditions that ensure high welfare in birds,
- pose a threat to human health,
- pose a threat to the environment.

#### **A threat to native breeds**

Intensive breeding work and the optimization of feeding and housing caused egg production to increase from 176 eggs per laying hen in 1925 to 318 eggs per layer today, while broiler rearing period decreased from 120 days in 1925 to about 40 days today (Wężyk and Paczkowski, 1998). This led to the creation of new, international commercial varieties of hens adapted to intensive rearing while making many local breeds (e.g. naked neck and crested hens) extinct. Meanwhile, Weigend (1999) points to the need for genetic variation of poultry because of the risk associated with a narrow genetic base. This problem has attracted attention from Polish research centres which launched a campaign in the 1970s to save native poultry breeds and varieties from extinction. Poultry genetic resources conservation programmes were developed and implemented to include 14 breeds and varieties of geese, 10 breeds and varieties of ducks, and 10 breeds and varieties of laying hens (Krupiński, 2008). Studies by Mazanowski *et al.* (2006) and Krawczyk and Sokołowicz (2008) report that conservation breeds of poultry are characterized by unique meat and egg quality traits, especially when raised on free range. Because of their lower environmental demands and efficient use of outdoor areas for foraging, these old poultry breeds could be used for the sustainable development of agriculture, which is high on the policy agenda of the European Union.

#### **A threat to avian welfare**

In the European Union Strategy for Sustainable Development, the protection of farm animals through legal measures that promote organic and sustainable agriculture is viewed as a means for achieving goals such as promotion of animal welfare and avoiding overexploitation of animals caused by intensification of breeding. The

practical implementation of these commendable EU guidelines in Poland is supported by the agri-environmental programme found in the Rural Development Plan for 2007–2013 in the form of packages for organic or sustainable farms.

To implement the concept of sustainable development in poultry production, it is necessary to account for the needs of birds. In line with the Code of Recommendations for the Welfare of Livestock, published by the Farm Animal Welfare Council, farmed birds should be guaranteed:

- freedom from hunger and thirst,
- freedom from discomfort,
- freedom from pain, injury or disease,
- freedom to express normal behaviour,
- freedom from fear and distress.

Despite many efforts to improve welfare, no rearing system fully meets the requirements. Intensive production systems are most often associated with increased stocking density per m<sup>2</sup> of floor area, which causes discomfort to birds and makes it difficult to maintain appropriate environmental conditions in both broiler and layer production (Skomorucha et al., 2004; Skomorucha et al., 2007; Sokołowicz and Herbut, 2004; Sokołowicz, 2005; Sosnówka-Czajka, 2004; Sosnówka-Czajka et al., 2007; Zimmerman et al., 2005).

In an effort to improve broiler chicken welfare in the European Union countries, a regulation that limits stocking density per m<sup>2</sup> of usable area is being introduced amid controversy (Council Directive 2007/43/EC). After the implementation of Directive 2007/43/EC in Poland (amendment of law dated 5 March 2009 amending the Polish Animal Protection Act), the maximum stocking density of broiler chickens will be limited to 33 kg/m<sup>2</sup> as of 30 June 2010. Today it is difficult to predict the actual impact of this directive on bird welfare, but the implementation of the directive is expected to cause a notable increase in the cost of poultry meat production (unfavourable distribution of fixed costs per kg live birds).

In Poland and abroad, the majority of laying hens (about 83%) are kept in cages with 3–10 layers per cage and 360–650 cm<sup>2</sup> of floor area per layer depending on the region of the world (Herbut et al., 2005). The main advantages of this production system are low production costs, very good productivity, good egg quality and good hygiene (isolation of eggs and manure). In the cage system, parasites are very rare and cannibalism sporadic, as a result of which mortality is lower compared to alternative systems (Wettenbürger et al., 2005). However, keeping hens in conventional cages reduces the welfare levels of hens, mainly by limiting their opportunity for natural behaviour (Kończak, 2003). In conventional cages, birds are surrounded by empty small space, which prevents them from expressing their natural behaviours such as stretching, wing-flapping, nesting, perch use, sand-bathing and litter scratching (Baxter, 1994; Craig and Swanson, 1994; Olsson and Keeling, 2000; Barnett and Hemsworth, 2003).

In 1999, under pressure from animal rights campaigners who criticize the cage system for hens, the Council of Europe adopted Directive 1999/74/EC, which stipulates that from 1 January 2012, hens can only be housed in enriched cages that increase layer comfort by increasing cage area to 750 cm<sup>2</sup> per hen and provide a nest,

scratching area (litter such that pecking and scratching are possible), perches, and a claw-shortening device.

Increasing cage floor area per bird and feed access, and determining minimum (acceptable) cage dimensions will definitely improve bird welfare (Hughes et al., 1993; Abrahamsson and Tauson, 1997; Tauson and Holm, 2002; Fiks-van Niekerk et al., 2003). However, the introduction of enriched cages will increase individual investment outlays and decrease egg production per m<sup>2</sup> of floor area. It is also expected that feed intake and energy consumption will increase, which is considered contrary to the concept of sustainable development.

One of the most popular housing alternatives to cages is the litter floor system, which is considered more avian friendly. This system allows birds to express various behaviour types at the cost of poorer productivity and feed conversion efficiency. The litter floor system is inferior to enriched cages in terms of feather condition, incidence of foot pad dermatitis, and skin and comb injuries due to pecking (Siegwart, 1991; Tauson and Abrahamsson, 1994; Appleby and Hughes, 1995; Tauson et al., 1999; Hadorn et al., 2000; Tauson and Holm, 2001; Fiks-van Niekerk et al., 2003; Kreinbrock et al., 2004). There is also an increased risk of diseases resulting from the poorer quality of air in the building (Michel and Huonnic, 2003).

In Europe, free-range and organic egg production systems have become more popular in recent years (Herbut and Walczak, 2003). The welfare of layers in free-range and organic systems is a complex issue. On the one hand, free-range birds are allowed to express their natural behaviour and use natural lighting, sand-baths, litter, nests and perches, but compared to the cage system there is a tendency towards greater mortality (Jensen, 2003; Kreinbrock et al., 2004) together with lower productivity and increased feed consumption (Meierhans et al., 1992; Ekstrand et al., 1996; Abrahamsson et al., 1996 a, b; Tauson et al., 1999; Michel and Huonnic, 2003; Kreinbrock et al., 2004). The higher feed consumption under these systems compared to the cage system is related to the greater locomotor activity of the birds (Tauson et al., 1999; Michel and Huonnic, 2003) and greater heat loss (Peguri and Coon, 1993). Poorer feed conversion in free-range systems is incompatible with the two main objectives of sustainable development, i.e. minimum loss of resources (feed, water, energy and soil) and lower N and P release to the environment. Another controversy is represented by a ban on the use of synthetic amino acids, especially methionine, in organic egg production systems. This may lead to feather picking and reduce production in the flock. What is more, a deficiency of different feed amino acids reduces the efficiency of crude protein utilization, which increases nitrogen release into the soil (Koreleski and Świątkiewicz, 2008, 2009).

The health of animals is part of their welfare, and poor health translates into low welfare levels. Kirkden and Broom (2004) reported that low welfare levels adversely affect health. Free-range conditions increase the risk of diseases that cause high mortality, such as erysipelas, intestinal parasites and histomoniasis (Permin et al., 2002; Eriksson et al., 2003).

Taking care of animal welfare and adoption of more sustainable and animal friendly husbandry systems should result in the creation of new jobs in the rural areas and limit the negative effect of animal husbandry on the natural environment. All these changes

may be encouraged by the promotion of new consumption patterns (Kostecka, 2008), which will help farmers to move away from intensive production. An additional support may be provided by increasing the transfer of funds to farms that practice high standards of animal husbandry.

### **A threat to human health**

Intensive poultry production often leads to serious health problems in birds, which presents a serious threat to food safety. Crowding of hens and often unhygienic production conditions are leading to a rapid spread of infectious diseases, including zoonoses (diseases of animals transmissible to humans), in areas where production is carried out. Also selective breeding of animals, which aims to increase the level of production, may reduce animals' immunity, thus exposing them to increased morbidity.

Under pressure from animal rights activists, modern poultry breeders are changing husbandry technology on the grounds of bird welfare. However, production using new technologies, including egg production in enriched cages, also has to be viewed from the viewpoint of quality (Guesdon and Faure, 2004) and safety of eggs to the human health. Although compared to indoor confinement systems, environment-friendly systems offer a greater certainty of safe (residue-free) animal products and provide better conditions for animal welfare, they generate a potentially greater risk of infectious and parasitic diseases. The microbiological contamination of egg shells was shown to be higher in enriched cages than in conventional cages (Mallet et al., 2003; Tauson, 2003). Outdoor rearing of animals exposes them to pathogens present in the external environment, including dangerous influenza (Capua et al., 2007). This fact shows a potential conflict between the implementation of animal welfare requirements and food security standards.

Transportation of birds, often over large distances, carries the risk of spreading the pathogens of zoonoses such as the Salmonella. In a 2004 report by the Animal Health and Welfare Panel of the European Food Safety Authority (EFSA), it is concluded that transportation "may favour the spread of animal diseases and zoonoses over large distances". A report published by the Scientific Committee on Animal Health and Animal Welfare (2002) had concluded that "stress related to the transport can enhance the level and duration of pathogen shedding in subclinically infected animals and thereby enhance their infectiousness". The relationship between low level of animal health and the risk for human health was stated in the Opinion of the Scientific Committee on Veterinary Measures relating to Public Health on Food-borne Zoonoses (12 April 2000).

In poultry production, many pathogens responsible for serious human diseases have become resistant to some antibiotics. This is partly due to the irresponsible use of antibiotics in human medicine, but also results from their excessive use in intensive animal production. Antibiotic-resistant bacteria can be transferred from birds to humans, mainly via the food-borne route (Taylor, 2003). Until 1 January 2006, antibiotics were routinely used in intensive animal production not only to treat diseases but also to stimulate growth (feed additives) and to prevent diseases in large flocks. As a consequence, antibiotics were used as a substitute for proper rearing condi-

tions. An EU-wide ban on the use of antibiotics as feed additives came into effect on 1 January 2006 amid recommendations to use natural probiotics (Huang et al., 2004). In practice, this may not necessarily reduce the number of antibiotics used in bird rearing. The ban on the use of antibiotics as feed additives may just as well increase their therapeutic use, because in large-flock situations antibiotics are administered to all birds in a flock, even if only several birds are ill. Another possible result may be increased use of therapeutic drugs on farms where the consequences of bad practice had previously been masked by prophylactic administration of medications.

### **A threat to the environment**

In accordance with the European Union Strategy for Sustainable Development, renewed in June 2006, economic growth should respect the environment (Kozłowski, 2008). Meanwhile, livestock production, including intensive poultry production is now considered one of the main threats to the natural environment in addition to the industry and municipal waste (Mroczek, 2001). The scale effect makes the intensification and concentration of hen breeding more profitable. On the other hand, this production system poses an environmental threat and may degrade the environment through:

- surface water pollution due to inappropriate application of manure to the soil,
- soil and water pollution by residue chemicals used in bird production,
- improper sewage disposal in farms, including improper sewage treatment before release into waters,
- atmospheric emissions of gaseous substances (ammonia, hydrogen sulfide, carbon dioxide) from intensive poultry systems,
- atmospheric emissions of dust substances (dust from litter, storehouses, feed mills) from intensive poultry systems.

Excessive nutrients in huge amounts of waste from intensive poultry farms are the main source of serious environmental pollution of air, water and soil according to Dobrzański (2001). Six thousand hens from the intensive production and feeding system excrete annually about 3.43 tons of  $\text{NH}_3$  and many other organic compounds in the form of odours that are hard to identify. The management of poultry manure is a major problem (Krawczyk et al., 2003). Harmful nitrogen (0.8–1.8 g per hen/day) and phosphorus compounds (78–156 g/layer/year) in poultry manure cause eutrophication of rivers, lakes and ground waters.

Ammonia is a gas that causes most problems (Erd and Tymczyna, 1998). The contribution of farm animals to ammonia production is high and accounts for 80–85% of global ammonia emissions (Bombik, 2004). In Poland, annual ammonia emissions from livestock manure range from 195,000 to 340,000 tons. During 1990–2006, deposition of ammonia from livestock breeding decreased by over 136,000 due to a declining population of cattle, sheep and horses. During the same time, ammonia emissions from poultry flocks increased by 32%. The annual production of ammonia by hens is 0.26 kg/bird.

Ammonia emissions are recognized as one of the main causes of increased atmospheric acidification (Sapek, 1995). Entering the soil in rainfall, ammonia disturbs the nitrogen balance. In soils with low buffer capacity, excessive nitrogen supply leads

to excessive acidification, which increases the solubility and transferability of some toxic substances, including heavy metals. Derivatives of ammonia released from excreta also accelerate the eutrophization of water reservoirs, which are increasingly affected by the oxygen deficit. Acidification of soil, water and air reduces the diversity and number of species (Kuczyński et al., 2003).

As a member of the European Union, Poland is obliged to undertake activities aimed at reducing the emission of toxic gases to the atmosphere. Directive 2001/81/EC of 23 October 2001 on national emission ceilings for certain atmospheric pollutants obliges Poland to reduce ammonia emission levels in 2010 in accordance with the limits adopted by member countries. Reducing nitrogen loss from animal waste may produce ecological benefits in addition to economic results (Mroczek, 2006).

It is also worth noting that not only intensive systems but also some extensive systems, which are often regarded as environment friendly, may have a negative impact on the environment. Higher feed consumption in litter systems compared to cage systems, poorer feed conversion and the associated higher concentration of nitrogen in waste are contrary to the main objectives of sustainable production, i.e. minimum resource losses and limiting the harmful impact on the environment (Tauson, 2005).

Environmental pollution presents increasingly new challenges to free-range systems. Some nutritionists believe that the risk of aflatoxin contamination of feed is greater in organic farms, where no plant protection products are used, than in conventional farms (SAFO, 2005). Dutch studies showed 14% of organic eggs to contain excessive dioxin levels. The egg dioxin levels were influenced by the access of hens to unsodded outdoor areas, consumption of soil particles by birds, and use of older hens that had longer contact with a dioxin contaminated environment (SAFO, 2005). In addition, Dobrzański et al. (2004) and Polonis and Dmoch (2007) reported that the high contamination of outdoor areas with heavy metals exposes birds to the consumption of hazardous contaminations that are also deposited in table eggs.

In conclusion, the present discussion shows that practical application of the principles of sustainable development in poultry production is a difficult task. Implementing all the goals of sustainable development can increase meat and egg production costs by as much as 100%, which is a considerable demand barrier on these products in Poland (Krawczyk and Bielińska, 2007). Polish consumer surveys suggest that the low sensitivity of consumers to poultry welfare and their reluctance to pay high prices for products from extensive poultry systems (Krawczyk and Sokołowicz, 2009) do not favour the rapid development of this form of agriculture. Supporting sustainable farming from EU funds as part of the first agri-environmental programme (Rural Development Plan for 2007–2013) may provide a solution, but to date, the uptake of these funds has been low (Brodzińska, 2008).

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**Produkcja drobiarska a strategia zrównoważonego rozwoju obszarów wiejskich**

## STRESZCZENIE

Prowadzona w ostatnim pięćdziesięcioleciu selekcja na zwiększenie liczby jaj od kur typu nieśnego i poprawę mięsności kurcząt brojlerów oraz działania na rzecz wzrostu opłacalności produkcji drobiarskiej w niewielkim stopniu koncentrowały się na zagadnieniach dobrostanu ptaków, ochronie zasobów genetycznych i koncepcji zrównoważonego rozwoju. Wiele działań prowadzonych przez człowieka w produkcji drobiarskiej nie ma zatem charakteru zrównoważonego, gdyż zagraża przetrwaniu rodzimych ras ptaków (wyginięcie wielu lokalnych ras, np. „gołoszyjki” i „czubatki”), nie gwarantuje warunków niezbędnych dla zabezpieczenia wysokiego poziomu dobrostanu ptaków (zarówno w systemach konwencjonalnych, jak i alternatywnych), stwarza zagrożenie dla zdrowia ludzi (duże stłoczenie ptaków stwarza niebezpieczeństwo szybkiego rozprzestrzeniania się chorób zakaźnych, w tym zoonoz) oraz stwarza zagrożenie dla środowiska naturalnego (zanieczyszczenie wód w wyniku niewłaściwej aplikacji pomiotu do gleby, emisja do powietrza amoniaku, siarkowodoru, dwutlenku węgla oraz substancji pyłowych z chowu intensywnego).