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Cost-efficiency of animal welfare in broiler production systems: A pilot study using the Welfare Quality® assessment protocol

Éva Gocsik [a,*,1], Suzanne D. Brooshooft [a,1], Ingrid C. de Jong [b], Helmut W. Saatkamp [a]

[a] Business Economics Group, Wageningen University, Hollandseweg 1, 6706 KN Wageningen, the Netherlands
[b] Wageningen UR Livestock Research, PO Box 338, 6700 AH Wageningen, the Netherlands

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ABSTRACT

Broiler producers operate in a highly competitive and cost-price driven environment. In addition, in recent years the societal pressure to improve animal welfare (AW) in broiler production systems is increasing. Hence, from an economic and decision making point of view, the cost-efficiency of improvement in AW obtained from a certain production system is of great importance. Therefore, the aim of this paper was to analyze the contribution of four different production systems to overall AW and the cost-efficiency of increased AW at the farm level. Cost-efficiency was calculated as the ratio of the change in the level of animal welfare and the change in the level of production costs compared to the level of conventional system (i.e., legal minimum standards). The level of AW was measured by the Welfare Quality index score (WQ index score) calculated on the basis of data collected in 168 flocks in the Netherlands, United Kingdom and Italy within the Welfare Quality® project. On the basis of system attributes, three main segments of production systems are distinguished, i.e., conventional, middle-market and top-market systems. The middle-market and top-market systems use a slow growing breed. Stocking density ranges from 25 to 31 kg/m^2 in middle-market systems and from 21 to 27.5 kg/m^2 in top-market systems. In the middle-market systems, a covered veranda is provided to the chickens, whereas in the top-market systems chickens have access to an outdoor range. Results show that the middle-market systems, such as Volwaard and Puur & Eerlijk systems, had the highest WQ index score (736), whereas the conventional system had the lowest (577). Moreover, the WQ index score of extensive outdoor (733) and organic systems (698) was below that of the middle-market systems. The major system attributes that differentiate between production systems are broiler type, stocking density and outdoor access. Three system attributes contributed most to AW in all systems, i.e., broiler type, stocking density and length of the dark period. With respect to production costs, broiler chickens kept in conventional system were produced at the lowest costs, followed by the middle-market, the extensive outdoor, and the organic systems. With regard to cost-efficiency, when shifting from conventional to an alternative system, middle-market systems (i.e., Volwaard and Puur & Eerlijk; 8.37) outperformed the extensive outdoor (3.90) and organic systems (1.03). Overall, it can be concluded that the middle-market systems could be attractive for farmers due to their high cost-efficiency and the flexibility to revert to the conventional system.

1. Introduction

Recently, increasing public concerns regarding animal welfare (AW) led to diversification in broiler production systems in many EU countries, particularly in the Netherlands. A wide array of production systems has been developed to cater different consumer needs regarding AW (De Jonge and Van Trijp, 2013). Developments resulted in three distinct production segments in the broiler sector, which set different requirements in terms of AW, i.e., conventional, middle-market and top-market segments. The conventional segment complies with the Dutch minimum legal requirements (according to the EU Broiler Directive; (EC Directive, 2007)). Accordingly, in conventional systems chickens need to be provided a permanent access to feed and water. Further, a maximum stocking density of 42 kg/m^2 is allowed provided that farms have an adequate ventilation and heating system and that mortality rate remains in a predefined range (i.e., mortality should be below 3.40% at 40 days). The length of dark period should be at least 6 h per day, with an uninterrupted dark period of 4 h. The middle-market segment supplies products that exceed the minimum legal standards in terms of AW, but do not meet organic standards. The top-market segment includes systems that comply with organic standards or that are similar to organic systems in aspects, such as provision of free range area and length of growth period. Organic and similar

* Corresponding author at: Hollandseweg 1, 6706 KN Wageningen, the Netherlands.
E-mail addresses: Eva.Gocsik@wur.nl (É. Gocsik), Suzanne.Brooshooft@wur.nl (S.D. Brooshooft), Ingrid.Dejong@wur.nl (I.C. de Jong), Helmut.Saatkamp@wur.nl (H.W. Saatkamp).

[1] Gocsik and Brooshooft share the first authorship, de Jong is the second and Saatkamp is the third author.

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systems use different broiler breeds, which grow slower than that in conventional systems. Also, broilers in organic systems are kept at a lower stocking density (i.e., 21 kg/m^2) than in conventional systems and provided with outdoor access.

Increasing requirements for AW usually results in an increase in production costs (Ellen et al., 2012). Because the broiler sector is highly cost-price driven, the conventional system is still the most prevalent system. In 2012, conventional systems accounted for ca. 97% of total broiler production in the Netherlands (Ellen et al., 2012). However, because social acceptance of animal husbandry practices is becoming essential for a sustainable broiler sector in the long term (Bergstra, 2014), farmers are increasingly expected to adopt standards that go beyond the legal minimum, i.e., above-legal standards to keep their 'license to produce'. From an economic and decision making point of view, the cost-efficiency of various AW systems is of great importance, i.e., how to achieve the highest level of AW at a given cost. The cost-efficiency of the improvement in AW obtained from a certain production system is defined as the ratio of the change in the level of AW and the change in the level of production costs compared to the level of conventional system. To address this question it is essential to make explicit the degree of improvement in the level of AW obtained from a certain production system and to link AW improvements to production costs. Production costs and feasibility of different broiler production systems have been extensively studied (Ellen et al., 2012; Gocsik et al., 2013). These studies suggest that higher AW standards increase production costs in Dutch alternative broiler production systems. More specifically, in alternative systems feed costs increase due to the fact that the feed efficiency decreases as a consequence of using a slow growing breed and a lower stocking density. Further, fixed costs per delivered broiler increase. That is because a lower stocking density results in that the total fixed costs are distributed to a fewer animals. Also, provision of outdoor access usually requires investment in land, which ultimately increases fixed costs.

Further, that the alternative production systems with higher AW standards were more economically feasible than the conventional system, provided that farmers received a price premium for the provision of higher standards. However, to our knowledge, it has not been studied to what extent higher AW standards in broiler production translate into an increase in the level of AW. Hence, it is also unclear to what extent the increase in production costs leads to an increase in the level of AW. The aim of our research was to fill this gap.

The recently developed Welfare Quality® Assessment Protocol for poultry (WQ protocol) is suitable to assess on-farm AW (Welfare Quality®, 2009). The WQ protocol allows for incorporating the specific welfare measures into an overall welfare score for the production system. Hence, it provides a standardized assessment method to compare the impact of different AW systems on the overall level of farm AW. However, in the scale of AW, there are no meaningful (i.e., completely non-arbitrary) zero value and a golden standard, hence it is difficult to interpret absolute welfare scores. An alternative way to evaluate the level of AW in different AW systems is by analyzing the relative differences, i.e., change in the level of AW compared to a baseline (e.g. AW score of the conventional system). In this way, the somewhat arbitrary nature of welfare measurements is partly overcome due to the fact that it is present in all the measurements across all the AW systems.

Due to the fact that the assessment is primarily based on animal-based measures, the exact contribution of specific systems on overall AW cannot be directly quantified by examining only the attributes of the production system in terms of housing and management. In contrast, when farmers decide on the production systems they usually look at the production system in terms of system attributes, i.e., housing and management. Farmers evaluate how these system attributes contribute to their objectives in terms of AW, but also in terms of several other issues that dominate the public debate on intensive farming, such as environmental emissions and human health risks (Kerkhof et al., 2009). Hence, farmers require information on how these attributes, individually and as a system, contribute to these issues.

In the light of the foregoing discussion, the aim of this paper was to analyze the contribution of different production systems to overall AW and the cost-efficiency of increased AW at the farm level, thereby supporting farmers' decision making regarding their choice of production system.

2. Materials and methods

To analyze the cost-efficiency of various AW systems, a five-step approach was developed. In the following, all the five steps are described in detail.

2.1. Step 1: decomposition of production systems into system attributes

In the Netherlands, various types of production systems exist for broilers. Broiler production is regulated at EU, national and sector levels. The minimum AW requirements for production systems are laid down by the EU and by the Dutch national legislation (EC Directive, 2007; PPE, 2004). For organic broiler production, the Dutch organic certification body (i.e., Skal) sets the standards in accordance with the EU organic regulation (EC Regulation, 2007, 2008). However, the Dutch standards are, in some aspects, more specific than the EU regulation. For example, the EU regulation suggests that broilers should have access to an outdoor area for at least on third of their life. Whereas the Dutch organic standards require that broilers are provided with outdoor access at least 8 h per day (Skal, 2016). Besides, recent market initiatives in the Netherlands formulate additional AW requirements for alternative broiler production systems that to a lesser or greater extent exceed the minimum legal requirements (Ellen et al., 2012; PPE, 2004). In this respect, in this paper three market segments were distinguished, i.e., conventional (which complies with minimum legal standards), middle-market segment (which exceeds the minimum legal requirements for AW), and the top-market segment (which meets the standards for organic systems or comparable standards).

In the study, production systems were selected to represent three different market segments. However, the selection was constrained by the available data on production systems. In the end, five production systems were included in the study, i.e., conventional, Volwaard, Puur & Eerlijk, extensive outdoor and organic. The Volwaard and Puur & Eerlijk systems were categorized as middle-market segment systems, whereas extensive outdoor and organic were categorized as top-market systems. The production systems were described in terms of the following ten system attributes, which were selected on the basis of recent studies (Ellen et al., 2012; Gocsik et al., 2013): broiler type, length of growth period, weight at delivery, enrichment, % grain in the feed, stocking density, outdoor access, provision of daylight, length of the dark period and flock size. Existing animal welfare certification schemes use similar criteria for broiler meat products (De Jonge et al., 2015), which confirms that the selection of attributes in this paper represents well the benefits and detriments in animal welfare. An overview of system attributes of the production systems included in this study is given in Table 1.

2.2. Step 2: calculation of the welfare quality index score for production systems

The WQ protocol defines four principles, each representing a specific area of AW, twelve welfare criteria and several welfare measures (Table 2).

To be able to determine the contribution of each system attribute to the overall AW of the production system, and to eventually calculate an overall Welfare Quality index score (WQ index score) for each system, the system attributes were linked to the welfare measures of the WQ protocol. Welfare measures often have an impact on not one but several