Economic efficiency of small group housing and aviaries for laying hens in Germany

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Abstract: After the ban on cages for laying hens, questions regarding the economic efficiency of keeping laying hens in welfare-friendly alternatives have been raised. Limited information is available on the small group system, which is new and still under debate in Germany. Therefore an analysis is necessary to evaluate costs, returns and their determinants in small group systems compared with aviaries for laying hens.

The calculation of costs and returns is based on a concept proposed by the German Agricultural Society. The empirical basis is a survey of 64 flocks in northern, central and southern Germany presented by a convenient sample. In both systems the production costs per egg decrease from 13 cents to 6 cents with increasing flock size due to improved performance (laying performance, mortality rate). In small group systems the decline of the returns per egg with increasing flock size is less pronounced than the drop of the costs, so the margin of returns and costs increases. It becomes obvious that farms with larger flocks have economic advantages over farms with small flocks. In contrast to small group systems, the margin of costs and returns in aviaries declines with increasing flock size. This implies that an increase of size has more positive impacts on farms with small group systems than on farms with aviary systems. The results reflect that a good technical equipment (e.g. for climate and feeding control) and the careful observation of the animals with a "trained eye" play an important role for the welfare of laying hens and a successful egg production.

Keywords: laying hen, economic evaluation, cost of production, economy of scale, small group system, aviary system, Germany.

Introduction

Husbandry systems for laying hens in Germany have changed fundamentally during the last years. The ban of conventional cages for laying hens has led to a significant change in production structures (Bessei, 2010) and thus improved animal welfare. Laying hens in Germany in conventional production systems are only permitted to be kept in small groups (13 %), floor housing (64 %) or free-range systems (15 %, Beck, 2010). The question on the economic efficiency, animal welfare and environmental impacts of keeping hens in welfare-friendly alternatives is raised. Therefore the Federal Ministry of Food, Agriculture and Consumer Protection commissioned an interdisciplinary project to collection and analyse data to characterise those aspects of small group housing or aviaries of laying hens in practice.

Limited information is available on the Small Group System, which is new and still under debate in Germany. Therefore this study focuses on the calculation of costs and returns in selected German farms and the analysis of their determinants in small group systems in comparison to the presently mainly used floor-housing systems (aviaries) for laying hens**.**

The aim of this analysis is to study how animal housing conditions, as well as the marketing of eggs from small groups and aviaries, affect egg production in practice. Also, based on farm com-

parisons of marketing pathsways, biological performances, animal health and stocking densities, the influence of significant determinants on the costs and yield differences will be identified and discussed.

Materials and methods

A questionnaire was developed in cooperation with the Institute for Biometry, Epidemiology and Information Processing (IBEI) at the University of Veterinary Medicine in Hannover. The data were filled into the questionnaire by the author together with the farmers. The data describing input and output of egg production refer to one laying period from March 2011 to August 2012. They give some detailed insights into the production process of farms with laying hens. The economic data were collected by an economic expert in a personal meeting at the end of the laying period and then digitized in Microsoft Excel. The calculation is based on a concept proposed by the German Agricultural Society (DLG, 2011).

The recruitment of the farms to be included in the study depended on their willingness to participate and was determined by the inclusion criteria that the farms keep a minimum of 2,000 laying hens. Advertising for participants was placed in flyers and newspaper. When farms showed their willingness to answer questionnaires, to record and transmit productivity data and to grant access to the hen houses for health and behavior observations as well as air quality measurements and hygiene evaluation, they were visited a first time to assess whether or not they fulfilled the eligibility criteria. Selected farms were later visited by different project partners for actual data collection. As this data collection was very comprehensive and therefore highly time consuming, cost-intensive and required trained interviewers, the number of participating farms was limited to 70.

In the following sections the difficulties with regard to the selection of the studied farms, the development of the questionnaire and the analysis of the productivity are discussed and summarized based on Thobe and Haxsen (2013). In addition, further results of the analysis of the economic performance of small group husbandry and aviary husbandry systems are discussed in Thobe and Haxsen (in press).

Selection of the studied farms

For the concept of the data survey, the following questions had been discussed:

- Which criteria are significant for the selection of the farms?
- To what extent are the selection requirements appropriate for representativeness?

The studied population included farms from all geographical regions in Germany with small groups and aviary husbandry. The exact size of the target population was unknown due to the inadequate statistical basis. For this reason the study population was selected as follows: first minimum criteria were formulated for the participating farms (i.e. the minimum flock size and the willingness to participate in interviews, as previously mentioned). The farms were required to meet the above-stated inclusion criteria. As participation was voluntary, this process is known as “convenience sampling.”

The empirical basis for the economic evaluation deals with 65 flocks, of these 18 small groups. The participation of farms with very large flocks was relatively low (< 5 %). The surveyed data serves as the empirical basis to identify the determinants of economically successful farms. Since the sample is random it does not consider the large variation of egg producting farms in Germany and the data are not completely representative although consultants confirm, that they cover the most typical and common production systems of small group and aviary husbandry.

Structure of the questionnaire
The evaluation of the economic viability is conducted according to the concept of farm branch accounting. The benefits and costs balances calculated in the framework of the farm branch accounting provide the basis for the analysis of the strengths and weaknesses of small group housing and aviary housing processes.

With the economic questionnaire economic information should be collected with the goal to carry out cost and benefit accounts. The survey questionnaire was developed with the IBEI through several correction rounds and was tested on several pilot farms. The questions make clear, which criteria are significant for the calculation of profitability. In order to evaluate the economic aspects, data on the management and costs of housing facilities are questioned. Furthermore data on animal care, animal genetics, breeding form, feeding litter management and feedstuff prices, young hen prices, veterinary expenses and immune system prophylaxis, energy and water costs, labour time, labour costs and use of capital for buildings and facilities are considered.

The questionnaire is divided into three parts. The first part deals with the documentation of data that affects the entire farm. In the second part is a survey of benefits of the processes. For the most part, these deal with the biological benefits as well as the profits from the marketing of the eggs, old hens and the hen´s dry manure. Since the feed costs comprise a large share of the total costs, these costs are questioned in more detail. Compound feeds and the self-produced feed from the farm are documented separately. Finally, labour, machinery and building costs are recorded. In the documentation of the labour time, regular daily tasks (i.e. monitoring of animals and technology, egg collection, etc.) are differentiated from irregular tasks (i.e. moving into housing, moving out of housing, cleaning/disinfection).

The farm economic survey always took place at the end of a laying period since the most important farm economic data are available at this time. Although the time period of data collection is not identical for all farms, the results of the cost calculation can be considered comparable since the factor input in laying hen husbandry is relatively constant (Gaus; Haxsen, 2003). The problem of different farm output and farm input prices must be considered in the interpretation of the results.

Furthermore the following aspects were considered (Thobe and Haxsen, 2013):

- The farm manager was informed about the contents of the questionnaire in a short accompanying letter before the survey.
- All questions in the survey are formulated in order to avoid different types of questions and thus to avoid misunderstandings and/or personal influence on the answers.
- Complementary to the survey, some ambiguous terms were clearly defined and limited after the pilot project.

Analysis of the profitability
On the basis of the data collected in the farms, total costs and benefits as well as biological performances and success parameters for laying hen husbandry were calculated. Evaluation of economic success focused on the same criteria in small group husbandry and aviary husbandry.

For the calculation of the costs and benefits of the farm branch analysis the proposal of farm branch accounts of the German Agricultural Society (DLG, 2011) was transferred into an own, Excel based calculation model. The calculation model made comprehensible farm branch evaluations possible, is expandable and ensures completeness of data entry.

The Excel calculation model is comprised of a) input and calculation pages for the farm branch data for each farm and b) a list page in which the farm-related input and output data, steered with

macros, can be copied into an overview table. The list page offers the possibility to make graphic presentations of single variables for each farm.

The input data are directly linked to the calculations of the farm branch evaluation at the end of each input page.

In a further Excel-based tool, the calculated farm data can be sorted by documented variables in dependence on the question. In addition, statistical dispersion parameters (mean, standard deviation and variance) are generated for each grouping.

The calculation of the costs and revenues refers to farm groups classified by flock size. The classification has been chosen for a clear presentation of the results and for illustrating the impact of economies of scale. Costs and revenues have been calculated for the average of each group. The following groups have been formed:

Small group housing

- < 3,000 hens: "small" (6 flocks)
- 3,000-10,000 hens: "average" (5 flocks)
- 10,000-30,000 hens: "large" (4 flocks)
- > 30,000 hens: "very large" (3 flocks)

Aviaries

- <3,000 hens: "small" (11 flocks)
- 3,000-10,000 hens: "average" (16 flocks)
- 10,000-20,000 hens: "large" (14 flocks)
- >20,000 hens: "very large" (5 flocks)

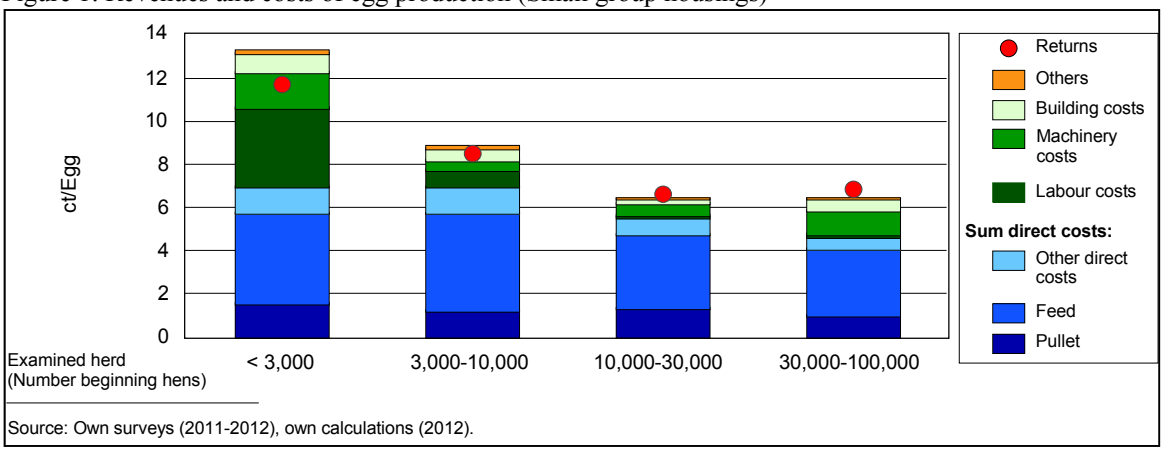
Results

The results of the economic evaluation show for farms with the focus on direct marketing, that the minimum price varies in dependence on flock size from 9.0 cents to 13.2 cents per marketable egg. For farms with an emphasis on selling eggs as a raw commodity, the minimum price amounts about 6.0 cents to 7.9 cents.

Small group housing system

The results of the economic evaluation of the small group housings are illustrated in Figure 1.

Figure 1: Revenues and costs of egg production (Small group housings)



Source: Own surveys (2011-2012), own calculations (2012).

It shows that the production costs per egg decrease with increasing flock size. The cost advantages of larger farms result, inter alia, from price advantages by volume discount on the inputs and also from improved physical performance.

The revenues per egg also decrease with flock size. The smaller farms achieve higher revenues mainly by more activities for the marketing of the eggs. Smaller farms sell up to 44 % of the eggs directly to the consumers, while the larger farms sell most of the eggs (up to 84 %) as a raw commodity, partly to their own subsidiaries.

The larger farms have the advantage of a larger volume of marketable eggs produced[56]. The number of marketable eggs per hen placed varies from 239 in small flocks to 288 in very large flocks. The costs per egg for labour, machinery, building and pullets are lower in the larger farms due to their better physical performance.

The mortality varies from 6 to 7 % in the large flocks to 9 % in the small flocks. A higher mortality rate leads to higher pullet costs per egg. The direct costs vary depending on flock size from 4.7 cents per egg in the largest flocks to 7 cents in the smallest units. The building costs vary from 0.2 cents to 0.9 cents per egg. The farms with bigger flocks have lower building costs not only due to their better physical performance but also due to the economies of scale of larger buildings.

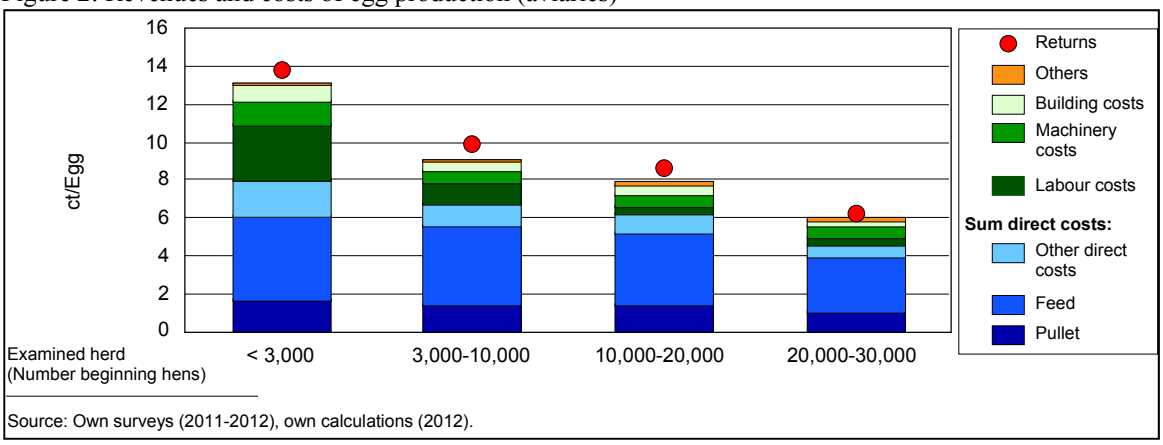
The higher revenues per egg in the smaller flocks compensate the cost disadvantages with regard to pullets and feed. However, the results are worse if the costs of labour, machinery and buildings are taken into account. Then, only 96 % of the production costs are covered by the revenues of farms with small and medium sized flocks, while farms with large and very large flocks have cost coverage of 103 to 106%.

[56] The number of marketable eggs can be calculated (Zapf, Damme, 2012; Lüke, Pottgüter, Grashorn, 2007) on the basis of the number of eggs produced per hen placed per year minus the dirty and misshapen eggs or eggs in the weight class S multiplied by a factor which is drawn from the relation of actual production days to days of husbandry.

Aviaries

The results of the economic evaluation of aviaries are illustrated in Figure 2.

Figure 2: Revenues and costs of egg production (aviaries)



The production costs per egg decrease also with increasing flock size due to better physical performance. However, the revenues decrease more than the production costs.

The average revenue per egg amounts to 10 cents to 14 cents. Farms with smaller flocks achieve higher revenues per egg. They still focus on direct marketing, although the share of eggs sold directly at the farm gate is low (12 to 31 %). They achieve their returns by selling their eggs also to retailers and large-scale consumers. Large farms sell most of their eggs as raw commodity (up to 67 %) to wholesalers, resellers or to the commercial subsidiary at a significantly lower price.

Bigger farms have cost advantages mainly due to better physical performance, but this is less obvious in aviaries than in small group systems. The direct costs vary depending on the flock size from 4.6 cents to 8.1 cents per egg. The feed costs per egg also decline with increasing size. The pullet costs vary from 1.7 cents in smaller flocks to 1.1 cents per egg in large flocks. Building costs vary from 0.3 cents to 0.8 cents per egg, comparable to small group housings.

The higher mortality rate (10 to 11 %) is reflected by higher pullet costs per egg, compared to small group systems. The high losses in the farms often result from feed changes, cannibalism or smothering. 96 % of the hens in aviaries have been beak-trimmed (42 % of the hens in small group systems), which may have an impact on cannibalism (Aerni et al., 2002).

The number of marketable eggs per hen placed per year varies from 241 eggs to 272 eggs (average of very large flocks).

Figure 2 illustrates, that farms with less than 3,000 hens achieve the largest gross margin. The highest profit per egg is achieved in the group 3,000 to 10,000 hens. The higher revenues per egg offset the higher costs for pullet and feed.

In contrast to small group systems, the producer price per egg from aviary systems was high enough to cover total production costs and achieve a profit per egg, thus generating a profit in all farm classes. However, the margin of returns and costs (profit) declines by the increase of the flock size.

Conclusions

In both systems production costs decrease with increasing herd size due to improved biological performance. The recorded farms with aviaries get more revenues per egg, while the farms with small group housing achieve a positive balance of returns and costs only if the size of the herd exceeds 10,000 hens. On the revenue side, farms with smaller herds have distinct advantages because they better exploit the options of direct marketing. The price per egg needed for covering

costs of production and costs of marketing depends on the system of marketing. In contrast to small group husbandry, in aviaries the margin of costs and returns declines with increasing herd size. This implies that an increase of size has more positive impacts on farms with small group systems than on farms with aviary systems.

The results of the farm branch analysis for laying hens show large variations in the economic and physical performance parameters within the groups. This suggests that the influence of the farm management ranks alongside high physical performance as the most important determinant for cost reduction. The large variation of the results within the size classes shows possibilities for optimization (e.g. lighting program, feeding program) in order to stay competitive at a regional or global level in the medium or long term.

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