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AN ECONOMIC APPROACH TO BROILER PRODUCTION. A CASE STUDY FROM HUNGARY

EKONOMICZNE PODEJŚCIE DO PRODUKCJI BROJLERÓW. STUDIUM PRZYPADKU Z WĘGIER

Key words: broiler chicken, technical and economic efficiency, model calculation, costs/benefits, European Production Efficiency Factor (EPEF), production level

Słowa kluczowe: kurczęta brojlerów, efektywność techniczna i ekonomiczna, model kalkulacji, koszty/korzyści, współczynnik efektywności produkcji europejskiej (WEPE), poziom produkcji

Abstract. The general objective of this study is to present the economic situation of Hungarian broiler production. A deterministic model was constructed to investigate the role of technical efficiency on profitability. As the results demonstrate, in current economic conditions broiler production can be profitable if the European Production Efficiency Factor (EPEF) is above 300-310. A lower level of technology, cheaper feed and chicks in addition to their weaker quality deteriorates the technical efficiency of production, which results in poor economic indicators. Therefore, it is not worth saving on either the level of technology or the quality of chicks or feed. Thus, the key purpose of future developments should be: increasing efficiency.

Introduction

Today competitive broiler production cannot be conceived without the thorough knowledge of the affecting determinant factors and the effective applications of these [Zoltán 2010]. The deterioration of the international competitiveness of the Hungarian poultry sector is a consequence of numerous problems. One of these major problems is traceable to objective competitive disadvantages characteristic of the sector. These include the relatively disadvantageous macroeconomic environment (e.g. high VAT of food products (27%), relatively high energy prices, etc.), which induce permanently low profitability compared to competitors [Nábrádi, Szőllősi 2008].

The examination of technical efficiency has great importance in farming [Nábrádi et al. 2009] since it has an essential effect on the profitability of economic activity. Measuring efficiency is a widely used concept in economics. Economic (or overall) efficiency expressed as a combination of technical and allocative (or price) efficiencies. Technical efficiency is the ability of the farmer to obtain maximal output from a given set of inputs while allocative efficiency measures the ability of the farmer to use inputs in optimal proportions, given their input prices and technology [Begum et al. 2009]. Technical efficiency is a component of economic efficiency [Farell 1957]. Genetic background is primary and determinant in terms of efficient broiler production. Nevertheless as Aliczki and Bárány [2013] stated, though there were no significant differences among the genetic performance of available top hybrids, significant distinctions were presented in the applied technology and the level of expert work. These differences are manifested in the efficiency indicators, the net cost and profitability.

It is generally accepted that feed costs represent about 70% of the cost of poultry production and this makes a bird's ability to use feed efficiently very important. Over the past decades feed efficiency has been improved through changes in a number of aspects of meat poultry production [Willems et al. 2013]. Feed conversion ratio (FCR) can be defined as the amount of feed consumed per unit of weight gain, and is a composite trait of starting and ending body weight and feed intake [Skinner-Noble, Teeter 2003]. Considering the regional average, Hungary has not yet reached the best European competitors in terms of such efficiency indicators which are based

Table 1. Technical efficiency of broiler production in certain EU member states (2011)
Tabela 1. Efektywność techniczna produkcji brojlerów w niektórych państwach członkowskich Unii Europejskiej (2011 r.)

Country/*Kraj*	Average bodyweight [kg/pcs]/ *Średnia masa ciała [kg/szt.]*	Feed conversion ratio (FCR)/*Współczynnik wykorzystania paszy (WWP) [kg/kg]*	Corrected FCR on 2.3 kg/ pcs, average bodyweight/ *Poprawiony WWP na 2,3 kg/szt., śrdnia masa ciała* [kg/kg]*	Mortality/ *Śmiertelność [%]*
Netherlands/*NL*	2.20	1.67	1.71	3.7
Germany/*DE*	2.20	1.68	1.72	3.8
Denmark/*DK*	2.10	1.65	1.73	n.d../*b.d.*
United Kingdom/*UK*	2.30	1.75	1.75	4.0
Poland/*PL*	2.30	1.76	1.76	4.5
Hungary/*HU*	2.30	1.80	1.80	4.0
France/*FR*	1.92	1.75	1.90	4.2

* corrected FCR on 2.3 kg/pcs, average bodyweight = FCR – (average bodyweight – 2.3 kg) ×0.4/*skorygowany WWP na 2,3 kg/szt., średnia masa ciała = WWP – (średnia masa ciała – 2,3 kg) x 0,4*
Source: own calculation based on [Van Horne 2013, Poultry Production Board 2013]
Źródło: badania własne na podstawie Van Horne 2013, Poultry Production Board 2013

on the competence of farmers as well as the modernity of production equipment and technological elements. The feed conversion in Hungarian broiler production is at least 0.05-0.1 kg/kg higher, compared to relevant European competitors (Tab. 1). Nevertheless, in contradiction to the published average data, efficiency indicators expressing professional work are closer to the European leaders among the more exclusive and professional farmers.

The obtainable cost and income proportions are significantly determined by the input-output price through the technical indicators. The price trend is affected by several factors from which the market is determinant. The producers practically have no influence on this factor, since the majority of them follow price taker behaviour. The price-determining effect of the market is slightly affected by other factors (e.g. product characteristics, quality, volume, network of producer, etc.).

The sales price of broiler products and the price of feed, determining the major cost item, the costs of feed within the material costs changed unfavourably during the previous period. The observed alteration in terms of world market prices of wheat, corn and soy beans can be monitored in relation to prices of feed. It is necessary to emphasize the significant volatility of the price of feed materials which is a major uncertainty factor for the poultry sector. Across the poultry industry this has reaffirmed the importance of feed efficiency on profitability [Willems et al. 2013]. Between 2004 and 2012 the price of feed increased by 58.6%. Simultaneously the sales price of broiler products rose by 46.8% in Hungary which presented a definite degradation of exchange ratio. Moreover, the costs of producers have risen continuously because of an increase in energy prices. In Hungary between 2006 and 2012 the price of electricity and natural gas increased by 22% and 99%, respectively.

The average cost and income situation of the Hungarian poultry sector can be described based on FADN data of the Hungarian Research Institute of Agricultural Economics. During the period from 2004 to 2011 the development of income was characterized by a decreasing tendency. The worst year was 2007 due to the recovery from the effects of the bird flu crisis and the price boom of feeds. However, 2008 and 2009 can be considered robust years. 2011 was the second worst year of the examined period. This situation was further deteriorated by the growth of feed prices in 2012. Regarding the sales prices and its income content, the situation is highly disadvantageous in general. The production costs were covered by the sector without state aids only in 3 years from the investigated 8.

Based on FADN data, it can be stated that the enterprises with the worst indicators[1] produced a EUR 24-28 cent higher net cost in 2011 compared to production plants which operated at a higher

[1] Average net cost of those farms, that's net cost higher more than 10% than net cost of all farms

production level[2]. The differences in efficiency are a clear reason for this. Obviously, in light of the recent economic environment, profitable and competitive production cannot be performed under such net cost conditions. In 2011 the average net cost[3] was 85.35 EUR/100 kg. Compared to this, the cost of 100 kg live weight production was EUR 98.83 and 16% higher in farms operating with weaker production indicators. Simultaneously, the net cost of live weight was 74.64 EUR/100 kg in enterprises generating better results which 12.6% lower than the average value. Based on FADN data, in 2011 the proportion of principal product output among the net cost groups was nearly identical in terms of broiler production [Béládi, Kertész 2013].

Research material and methodology

A deterministic simulation model was established to investigate the technical based cost and income situation of broiler production. Different technological and economic input parameters were used for the model. Technological parameters included the technical efficiency indicators of production in which the base values were calculated from farm-level data. The economic parameters contained the input and output prices of production as well as its specific cost items relating to the year of 2012.

Table 2. Basic technological data and technical efficiency indicators of models
Tabela 2. Podstawowe dane technologiczne i wskaźniki efektywności technicznej modeli

Specification/*Wyszczególnienie*	Unit/*Jedn.*	Value/*Wartość*		
		model 1. weaker/ *słabszy*	model 2. average/ *średni*	model 3. higher/ *wyższy*
Useful floor area/*Powierzchnia użytkowa*	m^2	10 000		
Final age days (reared period)/*Okres hodowlany*	days/*dni*	42		
Thinning time/*Okres selekcji*		36		
Weighted average age days/*Średnia ważona wieku* [a]		41.05	41.16	41.21
Down-time/*Przestoje*		14		
Yearly flocks number/*Roczna liczba stad*	flocks/year/*stad/rok*	6.5		
Stocking density/*Obsada zwierząt*	chicks/m^2/*piskląt/m²*	17.00	18.50	19.50
Number of removed broiler (thinning)/*Liczba usuniętych piskląt*	pcs/m^2/*szt./m²*	3.00		
Sold live weight/1 m^2/*Sprzedana waga żywa* [a]	kg/m^2	34.41	44.17	48.55
7-day mortality/*Śmiertelność 7-dniowa*	%	2.50	1.50	0.70
Mortality/*Śmiertelność*		8.00	4.50	3.50
Average daily weight gain/*Średni przyrost wagi* [a, b]	g/day/*g/dzień*	53.60	60.74	62.60
Average bodyweight/*Średnia masa ciała*	kg/pcs/*kg/szt.*	2.200	2.500	2.580
Feed conversion ratio (FCR)(farm level)/*Współczynnik wykorzystania paszy (w gospodarstwie)*	kg/kg/ *kg/kg*	1.98	1.86	1.81
Corrected FCR on 2.3 kg/pcs average bodyweight (farm level)/*Skorygowany WWP na 2,3 kg/szt., średnia masa ciała* [a,c]		2.02	1.78	1.70
European Production Efficiency Factor (EPEF) (farm level)/*Współczynnik efektywności produkcji europejskiej* [a,d]	–	249.0	311.9	333.8
Natural gas utilization/*Zużycie gazu*	m^3/m^2/flock/*stado*	4.30	3.20	2.00
Electricity utilization/*Zużycie energii elektrycznej*	kWh/m^2/flock/*stado*	4.50	3.70	3.20
Number of farm employees/*Liczba pracowników fermy*	person/*ludzie*	8		

[a] calculated by model/*obliczono na podstawie modelu*, [b] average daily weight gain = average bodyweight/ weighted average age days × 1000/*średni dzienny przyrost masy ciała = średnia masa ciała/średnia ważona wieku × 1000*, [c] corrected FCR on 2.3 kg/pcs average bodyweight = FCR – (average bodyweight – 2.3 kg) ×0.4/*skorygowany WWP na 2,3 kg/szt., średnia masa ciała = WWP – (średnia masa ciała – 2,3 kg)* x 0,4, [d] – EPEF = (100 – mortality) × average bodyweight / (FCR × weighted average age days) ×100/ *WEPE = (100 – śmiertelność) x średnia masa ciała/(WWP × średni ważony wiek) × 100*
Source: farm-level data (2013)
Źródło: dane z gospodarstwa za 2013 r.

[2] Average net cost of those farms, that's net cost lower more than 10% than net cost of all farms
[3] Average net cost of those farms, that's net cost differ maximum 10% from net cost of all farms..

In the modelling of different technological and technical quality, various production parameters were assumed (Tab. 2). The European Production Efficiency Factor (EPEF) was used for expressing production efficiency in a single index. EPEF formula is used to express the overall production profile [Shareef et al. 2008, Perić et al. 2009, Nabizadeh 2012, Hristakieva et al. 2014]. Three different models were compiled:

– model 1: as a consequence of lower technological level (obsolete stable and technology), lower chick and feed quality, lower technical efficiency (EPEF: 249);
– model 2: as a consequence of an average technological level (10-20-year-old stable and new technology), average chicks and feed quality, average technical efficiency (EPEF: 312);
– model 3: as a consequence of higher technological level (new stable and technology), better chicks and feed quality, higher technical efficiency (EPEF: 334).

The farm size can be considered to be average. In terms of technological level a distinction was made among farms with average, lower and higher technological levels. The average technological level can be described with 10-20-year-old stables as well as new rearing and feeding technology. In farms with a low technological level the stable and technology are obsolete – older than 20 years.

Table 3. Basic economic data and economic efficiency indicators of models
Tabela 3. Podstawowe dane i wskaźniki efektywności ekonomicznej modeli

Specification/*Wyszczególnienie*	Unit/*Jedn.*	Value/*Wartość*		
		model 1. weaker/ *słabszy*	model 2. average/ *średni*	model 3. higher/ *wyższy*
Broiler price/*Cena broilera*	EUR cent/kg	92.95		
Chicks price/*Cena kurczaka*	EUR cent/pcs/*szt.*	27.99	28.68	29.37
Feed prices/*Koszty pasz:*				
– Starter	EUR cent/kg	34.13	34.83	35.53
– Grower		32.45	33.12	33.78
– Finisher I		31.49	32.14	32.78
– Finisher II		31.49	32.14	32.78
Average feed price/*Średna cena paszy*[a]		31.88	32.53	33.17
Natural gas price/*Koszty gazu*	EUR cent/m^3	51.49		
Electricity price/*Koszty energii elektrycznej*	EUR cent/kWh	9.68		
Average wage (worker)/*Średnia płaca pracownika*	EUR/hour/*godz.*	2.76		
Average wage (farm manager)/*Średnia płaca kierownika*		4.49		
Animal health/*Leczenie*	EUR cent/pcs/*szt.*	4.84		
Depreciation/*Amortyzacja*	EUR/m^2/year/*rok*	2.76	8.15	10.37
Catching (manual)/*Łapanie ręczne*	EUR cent/kg	0.93		
Litter clean out and deliver/*Wymiana ściółki*	EUR cent/m^2/ flock/*stado*	6.91		
Cleanout, disinfection/*Czyszczenie i dezynfekcja*		19.70		
Other material costs/*Inne koszty materiałowe* [b]		73.26		
Management/*Zarządzanie*	EUR/m^2/year/*rok*	4.49		

[a] it was determined as a result of a model considering the feeding system, daily feed intake and timing of death/*obliczono na podstawie modelu biorącego pod uwagę system żywieniowy, dzienne przyjmowanie pożywienia oraz czas śmierci,* [b] included are the costs of repairs and maintenance, litter, carriage and disposal of carrion, as well as the costs of farm administration/*zawarto koszty naprawy i utrzymania, ściółka, transport, utylizacja padliny jak również koszty administracyjne gospodarstwa,*

MNB average rates of 2012: 289.4 HUF/EUR/*MNB średni kurs na rok 2012: 289.4 forintów/euro*

Source: [*Market Price…* 2013] and farm-level data (2013)
Źródło: [Market Price… 2013] i dane z gospodarstwa za 2013 r.

In the case of a high technological level, new buildings and technology were assumed which were built no more than 5 years ago. Apart from depreciation, the specific values of used energy resources are affected by the technological level, which in turn has an effect on technical efficiency. A distinction was not made between the seasons in terms of used energy, since average annual values were calculated. Differences were assumed among the farms characterized by lower, average and higher production parameters regarding non-financial indicators. In comparison, these technical efficiency indicators assumed differences both in technological level and in the quality of used inputs. Regarding the quality of inputs, a distinction was made in terms of chick and feed. Accordingly, the acquisition prices of these differed to each other. We calculated uniformly with thinning in models which is already widespread in native practice. Table 3 contains the basic economic data and the assumed economic efficiency indicators of the model calculation.

Research results

Based on the farm level data with a poultry house of 10 000 m^2, approximately EUR 41 thousand turnover per flock can be achieved by average production parameters (EPEF=312) under given economic conditions. A production cost of EUR 39.3 thousand per flock is incurred for this purpose. Based on these results approximately 1.7 thousand EUR/flock income is achieved. It means an annual budget of EUR 255-267 thousand which resulted in a net income of approximately 11 thousand EUR/year. The cost related profitability is 4.4%. As a consequence of weaker technical efficiency (EPEF=249) the production cost decreases by 15%, while the output declines by 22% which resulted in a clear decrease in income. Thus a loss of 1.5 thousand EUR/flock and 9.5 thousand EUR/year is formed. This is EUR 20.6 thousand less than the annual income which can be reached by average parameters. Enterprises operating under these conditions and technical efficiency go bankrupt quickly, since their activity cannot be sustainable in the short or long term.

Based on the economic results of broiler production with higher efficiency indicators (EPEF=334), the turnover is approximately higher by EUR 13.1 thousand (41%) than in case of farms with weaker efficiency and is higher than the average by nearly EUR 4.1 thousand (10%). The background is the increased marketable live weight (output) related to efficiency. This production requires a production cost of approximately EUR 42 thousand. It is also significantly higher than the values characterized by lower and average parameters (it is higher than the weaker costs by 25% and the average costs by 6.6%). However, much higher income can be realized by the difference between turnover and costs. Thus the income per flock amounts to nearly EUR 3.2 thousand. It means a much higher budget of EUR 273-293 thousand annually which resulted in an income of approximately EUR 20.6 thousand. This is higher by nearly EUR 9.5 thousand than annual income which can be reached by average parameters, while it is higher by EUR 30.1 thousand than result of production with weaker parameters. This result is highly advantageous, since that rate of income is capable of ensuring an appropriate basis for the purpose of future developments.

The easier comparison of the cost and income situation of models – which was made by input-output prices of 2012 and can be characterized by different production parameters – is supported by Table 4. The production of 100 kg slaughter chicken under conditions of weaker production parameters costs 97.2 EUR/100 kg. Thus, beside the sales price of 92.95 a loss of EUR 4.25 is formed per 100 kg. Conversely, the cost of 100 kg broiler production is EUR 86.42 with better production parameters. Thus EUR 6.53 income can be realized per 100 kg. Compared to the net cost of broiler production characterized by average production parameters, the net cost of farm with weaker technical efficiency is higher by 9% (8.13 EUR/100 kg). Conversely, beside better production parameters, production can be performed with lower cost of 3% (2.65 EUR/kg). This difference also appears in terms of attainable income.

In the current study we do not wish to consider the economic results realized with immoderate input-output prices in the year of 2013 only to mention, that with average and better production parameters, positive results could be realised in that year as well. The income of broiler production, which has weak efficiency parameters, decreases to a higher degree in the case of unfavourable economic conditions than those farms with better technical indicators.

Table 4. Specific cost and income situation at different production levels
Tabela 4. Szczegółowe koszty i przychody na różnym poziomie produkcji

Specifiication/*Wyszczególnienie*	Value [EUR/100 kg live weight]/ *Wartość [EUR/100 kg żywej wagi]*		
	model 1. weaker/*słabszy*	model 2. average/*średni*	model 3. higher/*wyższy*
1. Chick cost/*Koszty piskląt*	13.83	12.01	11.80
2. Feed cost/*Koszty paszy*	63.12	60.50	60.04
a) animal health/*leczenie*	2.39	2.03	1.94
b) energy/*energia*	7.70	4.54	2.76
c) labour/*praca*	3.08	2.40	2.18
d) management/*zarządzanie*	2.01	1.56	1.42
e) depreciation/*amortyyzacja*	1.24	2.84	3.28
f) other/*inne*	3.83	3.19	2.99
3. Farm costs/*Koszty gospodarstwa* (a+b+c+d+e+f)	20.25	16.56	14.58
4. Production costs/*Koszty produkcji* (1+2+3)	97.20	89.07	86.42
5. Turnover/*Obroty*	92.95	92.95	92.95
6. Income/*Przychody (5-4)*	-4.25	3.88	6.53
7. Profitability/*Rentowność [%]* (6/4×100)	-4.37%	4.36%	7.55%

Source: own calculation
Źródło: opracowanie własne

Conclusions

According to the EPEF, which expresses technical efficiency in one indicator, it can be stated that broiler production is only profitable with an EPEF of above 300-310. Producers unable to reach this value are expected to go bankrupt in the middle or long run. A weaker level of technology, inexpensive feed and chicks as well as their lower quality deteriorate the technical efficiency of production resulting in unfavourable economic indicators. Thus economizing on technology or on chicks and feed is unconducive. According to our opinion, future developments are well worth subordinating to one purpose, namely the increase of efficiency, since the increase in profitability and competitive superiority are insurable by nothing but this parameter. Compared to international competitors Hungary is backward in this field, therefore this is the area that should be addressed. All the required constituents are available on the market (technology, expertise, etc) thus it is not impossible to achieve. In order to reach these goals a certain amount of capital and an innovative farmer attitude are required.

It can also be stated, that farms described by lower efficiency indicators are more exposed to adverse economic affects originating from the alterations of input-output prices. Weaker technical efficiency makes chicken production more sensitive to the alterations of input-output prices.

Bibliography

Aliczki K., Bárány L. 2013: *Versenyképes-e a magyar húscsirketermelés?* Baromfiágazat, vol. 13, no. 3, Budapest, 6-8.

Begum I.A., Buysse J., Alam M.J., Huylenbroeck G.V. 2009: *An application of data envelopment analysis (DEA) to evaluate economic efficiency of poultry Farms in Bangladesh*, Presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22.

Béládi K., Kertész R. 2013: *A főbb mezőgazdasági ágazatok költség- és jövedelemhelyzete 2011,* Agrárgazdasági Kutató Intézet, Budapest, 40-50.

Farrell M.J. 1957: *The measurement of productive efficiency,* J. Royal Stat. Soc., series A, vol. 120, no. 3. 253-281.

Market Price Information System. 2013: Research Institute of Agricultural Economics https://pair.aki.gov.hu/web_public/general/home.do, download: 10. November 2013.

Nabizadeh A. 2012: *The effect of inulin on broiler chicken intestinal microflora, gut morphology, and performance*, J. Animal and Feed Sci., vol. 21, 725-734.

Nábrádi A., Pető K., Balogh V., Szabó E., Bartha A., Kovács K. 2009: *Efficiency indicators in different dimension,* APSTRACT, vol. 3, no. 1-2, Budapest, 7-23.
Nábrádi A., Szőllősi L. 2008: *A baromfiágazat versenyképességének helyreállítása,* Gazdálkodás, vol. 52, no. 5, Budapest, 418-431.
Perić L., Milošević N., Žikić D, Kanački Z., Džinić N., Nollet L., Spring P. 2009: *Effect of selenium sources on performance and meat characteristics of broiler chickens*, J. App.Poul. Res., vol. 18, 403-409.
Poultry Production Board. 2013: Database, Hungary.
Skinner-Noble D., Teeter R. 2003: *Components of feed efficiency in broiler breeding stock: energetics, performance, carcass composition, metabolism, and body temperature,* Poultry Science, vol. 82, 1080-1090.
Van Horne P.L.M. 2013: *Concurrentiekracht van de Nederlanse pluimveevleessector,* LEI-rapport 2013-037. Mei 2013. LEI Wageningen UR, Den Haag. 29-35.
Willems O.W., Miller S.P., Wood B.J. 2013: *Aspects of selection for feed efficiency in meat producing poultry*, World's Poul. Sci. J., vol. 69, no 1. 77-88.
Zoltán P. 2010: *Jó indítás, eredményes hizlalás,* Baromfiágazat, vol. 10, no. 4, Budapest, 36-42.

Streszczenie

Główny celem badań było przedstawienie ekonomicznej sytuacji chowu brojlerów na Węgrzech. Aby zbadać wpływ technicznej wydajności na rentowność stworzono deterministyczny model. Jak wskazują wyniki, przy obecnych warunkach ekonomicznych chów brojlerów może być rentowny, jeśli europejski czynnik wydajności produkcji (EPEF) utrzymuje się powyżej 300-310. Niższy poziom technologiczny, tańsza pasza i kurczęta oraz ich niższa jakość obniża techniczną wydajność produkcji, która skutkuje niskimi wskaźnikami ekonomicznymi. Dlatego nie warto oszczędzać na poziomie technologicznym i na jakości kurcząt lub paszy. W związku z tym kluczowym celem rozwoju w przyszłości powinno być zwiększenie wydajności.

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