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Abstract. The research focused on two production systems of fattening pigs: conventional system (housing on cross-barred floor) and ecological system (housing on deep litter). Favorable climatic conditions for pig meat production, possibilities to produce cheaper food of better quality and great amounts of litter, are a good basis for making ecological pig production widely accepted by family farms. Ecological aspect of such production of pigs, along with its economic analysis will be key factors, which will influence pig producers in their choice of the most suitable technological solution. In comparison to the conventional way of keeping pigs, main advantages of pig housing on deep litter are cheaper building and equipping of pens, better effect on health conditions of pigs, as well as easier manipulating with manure. Following this context, the research objective was to analyze economic indicators of different pig production systems and to compare economic results obtained in conventional and ecological way of pig production. The research aim was to determine economic possibilities and to evaluate results of production systems in question, justifying their economic and social aspects.

Keywords: Economic Analysis, Conventional Production, Ecological Production

Introduction

Fattening of pigs on deep litter becomes a very popular way of producing high quality pig meat, especially in well-developed agricultural countries. For that reason, there is an increased scientific interest in the deep litter housing system. Such system is lately being widely applied in pig production, as it has many advantages referring primarily to better effects on animal welfare and their production traits, to quality manure, cost effectiveness and environment protection, thus making such pig production ecologically desirable, which final products are marked as healthy food. Fattening of pigs on deep litter as a meat production system is especially recommended for family-owned farms. When compared to conventional housing system, many scientists agree that there is a cost benefit of the deep litter housing system, as it is cheaper^[5, 18] and more favorable for animal welfare and environment protection^[15, 4, 2, 11, 13, 8, 19]. Referring to the productivity and slaughtering characteristics of finishing pigs, the majority of authors point out advantages of the deep litter housing system^[1, 17, 2, 21, 22, 13, 16, 14], however, some also point out negative effects that this way of pig housing has on the above mentioned

characteristics [7, 9, 18, 19] Opposite results can be justified through numerous specificities of such housing system. Compared to conventional facilities, facilities needed for deep litter housing of pigs are cheaper to build and maintain. Gentry et al. [6] calculated the costs of deep litter housing to be about 40% lower than the costs of conventional keeping. Pigs are kept in larger pens, in groups of 15 to even 2000 animals [19]. Klemola [12] stated that up to 50 animals in a pen is an optimum. Pen area per pig is 1-2 sq.m. [18], however, this depends on a fattening stage. Larger pen area per pig did not have any effect on improvement of productivity of finishing pigs [7]. As far as equipment is concerned, pens are equipped only with feeders and watering places. There are no grids, sewer channels, ventilators or heaters. Since the equipment is the most expensive input, facilities used for deep litter housing of pigs contribute to lowering of production costs. Beattie et al. [2] observed that pigs kept on deep litter were more active and less aggressive than pigs kept on slated floor. Similar observations referring to pig aggressiveness were described by Morrison et al. [18]. They also noticed that pigs on deep litter spent more time moving around and standing than pigs kept in a conventional way. Favorable effects of deep litter housing system on animal welfare and behavior were also pointed out [4, 11, 22, 3]. Honeyman and Harmon [9] found out that, in comparison to the pigs kept on slated floor, pigs kept on deep litter had higher average daily gain in the summer months, while in the winter months, they had equal average daily gain, but weaker conversion. Klont et al. [13] found out that water release capacity was considerably lower in pigs kept on deep litter than in pigs kept conventionally, which could have positive economic results. Authors did not determine any significant differences regarding other slaughtering traits between pigs kept on deep litter and on slated floor. Gentry et al. [6] also did not determine differences in meatiness, meat color or muscle tissue percentage between pigs kept conventionally and on deep litter (Table 3). Similar results were obtained by Spolder et al. [21], as well. Opposite to above mentioned results, some researchers pointed out weaker productivity and slaughtering characteristics of finishing pigs kept on deep litter. Morrison et al. [18, 19] determined more fatty tissue deposition, weaker food conversion and less growth of pigs kept on deep litter. They justify these occurrences with less food intake and longer period of feeding than of pigs produced in a conventional way. Honeyman and Harmon [9] proved pigs on deep litter to have thicker back fat and lower muscle tissue percentage than pigs kept conventionally.

Material and Methods

The research was carried out on 200 crossbreeds (LW x GL) x GL, which were divided into two groups. Pigs of the first group were kept on straw-bedded floor, while the second group was kept on slated floor. Pigs in each group were fed equally. In the first fattening phase (up to 60 kg), pigs were fed a mixture that contained 16% of crude proteins and 13.0 MJ/kg ME; while in the second phase of fattening (60-110 kg) that

mixture contained 14% of crude proteins and 13.0 MJ/kg ME. Throughout the fattening period, the average daily weight gain and costs of live weight gain were calculated and the food consumption and conversion were controlled. Meat portion (M%) in carcasses was obtained during slaughtering by applying the “two points” method ^[23], based on the following formula:

$$M\% = 47.978 + 26.0429 \frac{F}{M} + 4.5154 \sqrt{M} - 2.5018 \log_{10} S - 8.4212 \sqrt{S}$$

F-thickness of fat with skin (in mm) on the midline of the split carcass, covering the lumbar muscle (*M. gluteus medius*), M = the visible thickness of the lumbar muscle (in mm) on the midline of the split carcass, measured at the shortest connection between the front (cranial) end of the lumbar muscle and the upper (dorsal) edge of the vertebral canal.

Costs of housing, feeding, health protection, as well as other costs related to specific conditions were taken into consideration in order to determine economic indicators of different housing systems.

Results and Discussion

Starting weight of pigs did not differ between pig groups (Table 1). Fattening period of both groups lasted for 110 days. At the end of fattening period, pigs kept conventionally weighed more (103.4 kg) than pigs kept on deep litter (100.3 kg), as pigs kept conventionally had higher average daily gains. They also consumed less food per kg of gain (3.02 kg) than pigs produced ecologically (3.12 kg). However, mortality of pigs was higher in the group kept on slated floor (6%) than in the group kept on deep litter (3%).

Table 1. Data of fattening productivity

Indicator	Housing system	
	Deep litter	Conventional
Input (No. of pigs)	100	100
Output (No. of pigs)	97	94
Duration of fattening (day)	110	110
Input weight of pigs (kg)	25.1	25.2
Weight of finishing pigs (kg)	100.3	103.4
Total gain (kg)	75.2	78.2
Daily gain (g)	684	711
Food consumption (kg/pcs)	235	236
Food conversion (kg/kg)	3.12	3.02

Moreover, behavior of pigs differed significantly between groups. Pigs on deep litter spent more time moving around and were less aggressive than pigs without deep litter. Similar results referring to reduced aggressiveness were obtained by Morrison et al. [18], who also observed that pigs on deep litter moved around and stood more than pigs kept conventionally. Favorable effects of deep litter on health condition, welfare and behavior of animals were confirmed [4, 11, 22, 3]. Particular housing systems also affected slaughtering traits of pigs (Table 2).

Table 2. Slaughtering characteristics of carcasses

Housing system	Mean carcass weight (kg)	Mean F (mm)	Mean S (mm)	Meatiness	
				%	kg
Deep litter	80.0	13.10	70.10	57.50	46.00
Conventional	82.4	15.79	68.28	56.10	46.23

Based on the obtained research results, an economic analysis of two different pig housing systems was performed, taking into consideration some production norms applicable on Croatian market (Table 3).

Table 3. Productivity norms for pig fattening

Indicator	Housing systems	
	Deep litter	Conventional
Total gain during fattening (kg)	75680	78709
Daily gain (g)	234	245
Food consumption (kg/pig)	3	6
Mortality (%)		
Carcass weight (kg)	80	82.4

Meatiness (%)	57.50	56.10
Lean meat (kg)	46.00	46.25

Table 4. Calculation of incomes and costs in pig production (500 pigs)

Indicator	Housing system			
	Deep litter		Conventional	
	Kn	€	Kn	€
Costs structure				
Pig (25 kg)	187500.0	25337.8	187500.0	25337.8
Food consumption	0	4	0	4
Water	215631.0	29139.3	218785.0	29565.5
Professional assistance	0	2	0	4
Deep litter	2500.00	337.84	2500.00	337.84
Veterinary costs	500.00	67.57	3000.00	405.41
Facility	17500.00	2364.86	-	-
amortization	12500.00	1689.19	13000.00	1756.76
Equipment	17500.00	2364.86	25000.00	3378.38
amortization	2500.00	337.84	10000.00	1351.35
Machinery				
Human work	16500.00	2229.73	16500.00	2229.73
Cleaning and	7500.00	1013.51	7500.00	1013.51

disinfection	2500.00	337.84	2500.00	337.84
Other costs	10000.00	1351.35	10000.00	1351.35
Total costs (1):	492631.00	66571.76	496285.00	67065.54
Income structure (a)				
Delivered pig	542133.00	73261.25	538221.50	73732.64
State subventions	43650.00	5898.65	42300.00	5716.22
Total income (2):	585783.00	79159.86	570521.50	78448.85
Difference 2-1(profit)	93152.00	12588.11	74236.50	11383.31
Profit/pig	186.30	25.18	148.47	20.06
Income structure (b)				
Delivered pig	408273.00	55172.03	397796.25	53756.25
State subventions	43650.00	5898.65	42300.00	5716.22
Total income (2):	451923.00	61070.68	440096.25	59472.47
Difference 2-1(profit)	-40708.00	-5501.08	-56188.75	-7593.07
Profit per pig ^(b)	-81.42	-11.00	-112.38	-15.19

Referring to the current conditions observed on Croatian market of pigs and pig meat ^(a), housing of pigs on deep litter assures better profitability of agricultural farms. This is explained by a lower product burdening with fixed costs and lower losses during fattening. Calculation does not include economic value of produced manure. However, in comparison with the value of pigs on the EU market, Croatian pig production is non-competing and non-profitable ^(b), Table 4.

Considering production norms for each housing system, economic analysis that was performed on the basis of production of 500 pigs on deep litter and on slated floor showed that production on deep litter was more profitable than production on slated floor. Realized profit per a fattening pig, as of Croatian circumstances, is 25.18 € if pig was produced on deep litter, and 20.06 € if produced conventionally.

Economic analysis (profitability) of different housing systems of fattening pigs was done on the basis of variable costs that occurred during fattening period, as well as on the basis of market value of produced pigs and state subventions. Due to disturbed market of pig meat (production

cycles of every 3-4 years), deficit of pig meat does occur occasionally. Through subvention measures, the state encourages family farms to produce pigs more intensively. Current state subvention per fattened (delivered) pig is 12.16 €

Conclusion

Based on the comparative research into production of pigs either ecologically or conventionally, from the production point of view the following is concluded:

Ecological fattening assures better meatiness of pig carcasses, lower mortality rate and better health condition of pigs.

Fattening on slated floor results in better gains, but with increased costs of food.

Economic analysis of both pig housing systems is in favor of ecological fattening.

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