

## OPERATING COSTS OF FARM BUILDINGS IN SELECTED ECOLOGICAL HOLDINGS

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**Summary.** The aim of the article was to specify and analyze the replacement value of farm buildings and the annual and unitary costs of their operation in terms of labor productivity. For comparative analysis of the test objects, these objects were divided into area groups: to 10 ha, from 10.01 to 20.00 ha and above 20 ha of arable land. The scope of research included organic farms located in the mountain region specializing in livestock production.

**Keywords:** operating costs, farm buildings, organic farms, area groups, labor productivity.

### INTRODUCTION

One of the factors of production is capital, whose components are: working capital and assets capital, including buildings and structures. In order to be able to run efficient production processes, holdings must have livestock buildings, other buildings and warehouses adapted to the size and type of business and for the stored material [Tabor, Malaga-Toboła 2004; Tabor, Kuboń 2004; Kuboń 2006; Malaga-Toboła 2009]. In light of the ongoing structural changes and the possibility of implementing new technologies in agricultural production, especially livestock production, there is a natural need to balance the building stock and assess their technical and technological state. The demand for the various production buildings mainly determines the direction and the specialization of production. Holdings specializing in crop production are investing in barns, warehouses, sheds and silos. Horticultural farms - in warehouses, storehouses and sheds. However, holdings specializing in breeding and raising animals are building or modernizing production facilities, primarily cowsheds, piggeries and barns [Lorencowicz, Włodarczyk 2009]. The investment decisions of the farmers are influenced by the support for agriculture from both domestic and European legislation. It is expected that, thanks to the EU funds, the period of 2007-2013 financing will increase the level of construction investment in the countryside. This is confirmed by data from the first half of 2007, where the number of granted building permits for agricultural buildings was already 26.4% higher than in the corresponding period the previous year and continues to grow [Traffic Building ... 2008, 2010].

## PURPOSE, SCOPE AND METHODOLOGY OF WORK

Livestock is becoming a very attractive and effective method of improvement of the economic efficiency of organic farms, especially now in the era of increased interest in the quality of animal products, especially dairy production. However, wishing to acquire high-quality raw materials, breeding systems should be implemented in functional buildings, ensuring the welfare of animals. Buildings should be designed and implemented in accordance with the standards of technology and technological systems used in animal husbandry and should also minimally threaten the environment [Romaniuk and others 2007].

The aim of this study was therefore to determine the status of farm buildings in terms of number, age, size, and cost analysis of their operation, in terms of labor productivity and arable land.

The scope of study covered 25 ecological buildings, specializing in livestock production, mainly in milk production. Farms were located in the mountain region, in Hańczowa.

The study was conducted through interviews with the owners of the holdings. The information collected in order to achieve the goal of the work included: kinds of buildings, their surfaces, building material, material and energy inputs and also the volume of production and labor productivity. The data concerned the year 2010.

For comparative analysis, the surveyed holdings were divided into 2 groups, taking as the criterion for allocation the arable area (UAA). There were 7 objects with the area of 10 ha, 10 holdings from 10.01 to 20 ha and 8 with the area of more than 20 ha.

The buildings were divided into: livestock buildings, which included barns, piggeries and poultry houses, bifunctional buildings, warehouses, which also included barns, storages and refrigerators, garages and sheds, silos and dryers.

Replacement value of buildings was identified as the product of the surface and the current unitary cost of its construction, which was adopted by the current tables of PZU (Polish Insurance). The operating costs of production buildings and warehouses included amortization, insurance, electricity consumption, and repairs and maintenance [Kuboń 2007, Michałek et al. 1998]. Amortization was calculated as the ratio of the replacement value of buildings for the period of amortization, insurance costs were adopted on the basis of evaluation of buildings for insurance purposes (PZU 2010.), And the costs of electricity consumption, repairs and maintenance - according to the accounts.

Labour productivity is defined as the quotient of the value of clean production produced in the holding to the workload [Kierul 1986, Fereniec 1999, Gębska, Filipiak, 2006].

## CHARACTERISTICS OF THE SURVEYED HOLDINGS

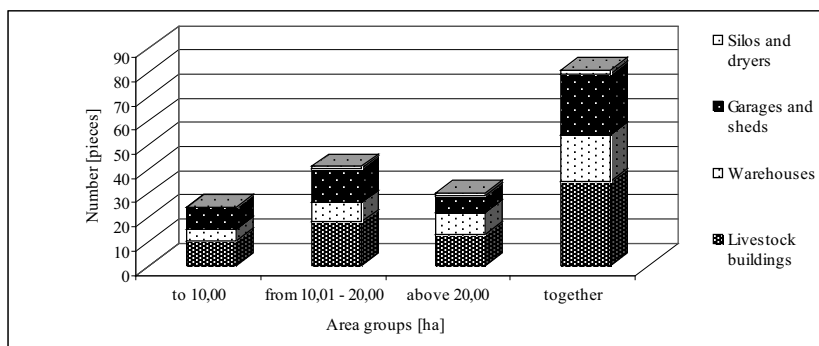
The average area of arable land in the surveyed holdings was 18.06 ha (Tab. 1). The structure of land use was dominated by permanent pasture, involving 75% of the total arable land. However, in the crop structure 65% of arable land was occupied by fodder, 28% - grain, while on the remaining area root crops were grown. Average density of livestock was  $1.03 \text{ LU} \cdot \text{ha}^{-1}$  of arable land. The main direction of activity of the surveyed holdings was the production of milk, hence 90% of stocking density were dairy cows.

Table 1. Characteristics of the surveyed holdings

Specification	Area groups [ha]			
	to 10,00	from 10,01 - 20,00	above 20,00	average
Number of holdings	7	10	8	25
Cropland [ha]	7,63	15,85	29,93	18,06
Arable land [ha], in it:	3,26	3,87	6,56	4,56
Grain crops	1,68	1,48	0,70	1,29
Root crops	0,39	0,37	0,14	0,30
Fodder crops	1,20	2,02	5,71	2,97
Grassland [ha]	4,37	11,98	23,38	13,50
Stocking [LU·ha <sup>-1</sup> of arable land]	1,02	1,16	0,86	1,03
Number of machines and tools [pieces · holding <sup>-1</sup> ]	14,14	14,10	15,15	14,45
Replacement value of park machine [t zł · ha <sup>-1</sup> of arable land]	21,64	14,00	7,80	14,16

Source: Author's calculations

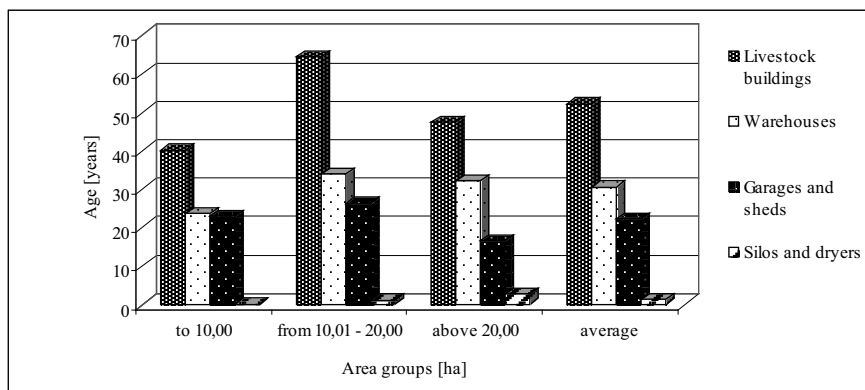
The machine park in the surveyed holdings was really diverse. On average, on one farm there were 14.45 units of machines and tools. It is worth noting that the technical background, in quantitative terms, was virtually the same both in small farms and in the objects of a large area of land, which proved the technical overinvestment of small farms and, in consequence their low profitability. You can see it very clearly, looking at the replacement value of the machine park, which in the smallest farms was almost 3-fold higher than in the larger farms. Machines for animal production were the leading group of the technical means, which was obvious from the specification of the surveyed holdings.



Source: Author's calculations

Fig. 1 Quantitative assessment of the farm buildings in the inspected holdings

The only data that give a picture of the current number of agricultural buildings are the data from the CSO census [Mulica, Hutnik, 2007]. In 25 surveyed holdings the total of 81 farm buildings was reported. Most of the buildings (41 units) were on the farms ranging in size from 10 to 20 ha of arable land (Fig. 1). On average, there were 2 livestock buildings, 1 warehouse and garage / shed per farm. Due to the direction of production, 42% were livestock buildings, 31% - garages and sheds, 25% - warehouses, including the vast majority of the barn, and only 2% - silos and dryers. Cattle was primarily fed by haylage, hence the small number of silos silage, in spite of the dairy direction of production.



Source: Author's calculations

Fig. 2. Age of buildings in the surveyed holdings

Stankiewicz [2003], the technical condition of livestock buildings and farm buildings was assessed as low, due to the fact that almost half of the buildings (46% sheds, 50% piggery and 44% barns) were built before 1960. In the surveyed holdings the average age of building was 27 years. The oldest buildings, with an average age of 31 occurred on farms with the area from 10 to 20 ha, while the youngest (22 years) at the smallest area. While taking into account the type of buildings, by far in all the area groups the oldest were livestock buildings, whose average age is 52 years and warehouses - 30 years old (Fig. 2)

Table 2. Surface of the buildings in the surveyed holdings [m<sup>2</sup>]

Specification	Area groups [ha]			
	to 10,00	from 10,01 - 20,00	above 20,00	average
Livestock buildings	147,60	199,50	218,10	190,90
Warehouses	57,10	81,40	94,60	78,80
Garages and sheds	83,40	85,20	86,50	85,10
Silos and dryers	0,00	2,00	3,80	2,00
Together	288,10	366,10	399,30	354,90

Source: Author's calculations

According to the Central Statistical Office, the area of production buildings used by Polish farmers is small, as the average size of a cowshed is 95 m<sup>2</sup> and of a barn - 128 m<sup>2</sup>. Only in the western and northern provinces the area is larger in the case of cowshed and piggery, which stems from the fact that in these regions a large proportion of arable land belonged to State Farms [Central Statistical Office 2007]. However, in the surveyed holdings the average size of livestock buildings was relatively high and amounted to more than 190 m<sup>2</sup>, but it resulted from the direction of activity (Tab. 2). However, a small warehouse space (78.8 m<sup>2</sup>) resulted from the feeding system of cattle. Farmers produced for haylage, which was stored in the field, so warehouses were used for storing fodder and hay, which were a dietary supplement.

### THE RESULTS OF THE RESEARCHES

Replacement value is the value which corresponds to the cost of replacement of the building, an asset that means restoration to the state of a new one, but not improved in view of the existing dimensions, construction and materials.

Average replacement value of buildings in the surveyed holdings stood at 132.12 t PLN (Tab. 3). More than half of this value (61%) were the livestock buildings, 21% - warehouses and 18% - garages and sheds. The replacement value is determined by the type of building material, in addition to surface. Most of the buildings, especially livestock buildings and garages were built with airbricks. Also wood was used, especially in the case of barns and occasionally also buildings from blocks of brick were reported. It is worth noting that the replacement value of the distinguished types of buildings grew along with the area of arable land.

Table 3. Replacement value of farm buildings [t PLN]

Specification	Area groups [ha]			
	to 10,00	from 10,01 - 20,00	above 20,00	average
Livestock buildings	64,07	84,52	90,61	80,74
Warehouses	20,68	28,53	31,51	27,28
Garages and sheds	22,71	23,64	24,61	23,69
Silos and dryers	0,0	0,40	0,75	0,40
Together	107,46	137,08	147,48	132,12

Source: Author's calculations

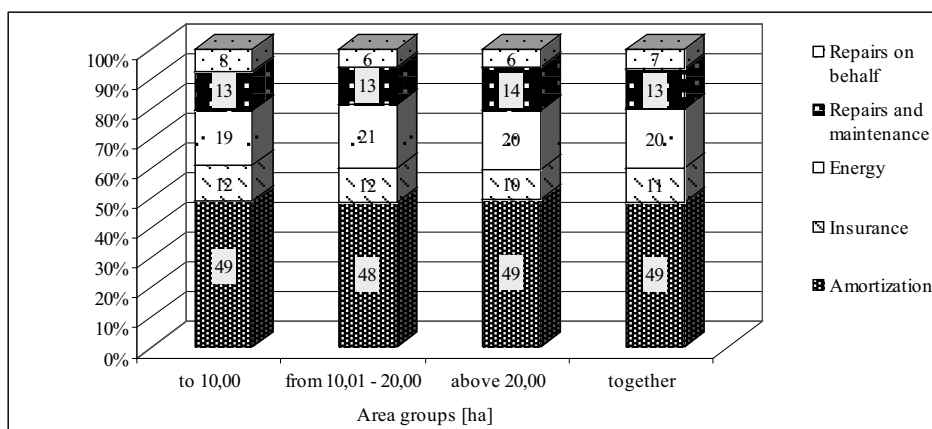
Farmers undertaking new investments or modernizing buildings were increasingly starting to pay attention to costs incurred for this purpose that did not cause the increasing of the financial outlays in production costs and those expenditures amortized in a relatively short time.

Table 4. The annual operating costs of buildings [t PLN·year<sup>-1</sup>]

Specification	Area groups [ha]			
	to 10,00	from 10,01 - 20,00	above 20,00	average
Livestock buildings	3,02	3,94	4,05	3,72
Warehouses	0,35	0,47	0,77	0,53
Garages and sheds	0,87	0,92	0,87	0,90
Silos and dryers	0	0,01	0,02	0,02
Together	4,24	5,34	5,66	5,15

Source: Author's calculations

On average, total annual operating costs of buildings amounted to 5.15 t zł (Tab. 4). These costs, like the replacement value, grew along the surface of arable land, therefore the highest costs were in the holdings above 20 ha of arable land. This regularity was noted for all the types of buildings, except garages and sheds, where the costs of their operation were the smallest, and the largest holdings were at the same level. As many as 72% of the total operating costs were spent on the livestock buildings. Garages and sheds absorbed 17% of the cost, and warehouses only 10%. The structure of total costs in the area groups was nearly identical (Fig. 3).



Source: Author's calculations

Fig. 3. The structure of the annual operating costs

The largest share in the structure of the total operation costs was amortization, accounting for almost half of them (49%) and energy costs constituting 20%. The share of other operating costs such as the performed repairs and maintenance, insurance, and repairs amounted to: 13, 11 and 7%.

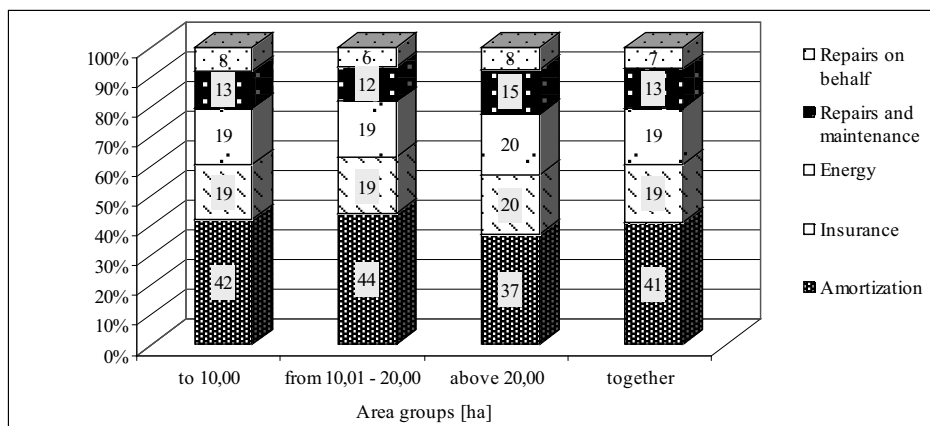
Table 5. Unitary operating costs of buildings [PLN·m<sup>-2</sup>]

Specification	Area groups [ha]			
	to 10,00	from 10,01 - 20,00	above 20,00	average
Livestock buildings	23,92	22,91	22,99	23,22
Warehouses	4,75	5,05	15,61	8,34
Garages and sheds	13,10	13,59	10,41	12,44
Silos and dryers	0,00	0,65	0,71	0,49
Together	41,77	42,20	49,72	44,49

Source: Author's calculations

The total operation costs with respect to the surface of the buildings were 44.49 PLN·m<sup>-2</sup> (Tab. 5). Comparing them in area groups it is worth noting that in the smallest farms up to 10 ha of arable land and average sectorally, with the area from 10 to 20 ha of arable land, unitary costs differed by only 0.43 PLN·m<sup>-2</sup>, but in the largest farms they were 7.95 PLN·m<sup>-2</sup> higher than the lowest. This difference was due to high operating costs of warehouses in this group which were more than 10 PLN·m<sup>-2</sup> higher than those incurred in the smallest objects. On average, the highest unitary costs were incurred in the livestock buildings, garages and sheds.

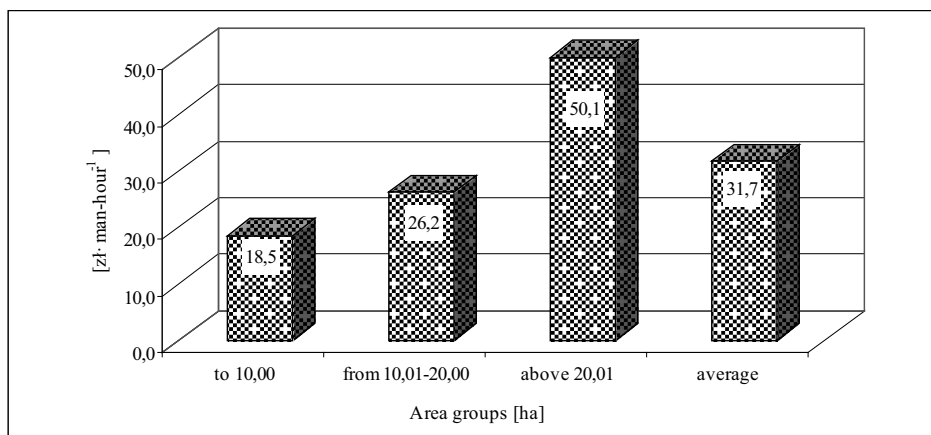
The structure of unitary costs was similar to the annual costs (Fig. 4).



Source: Author's calculations

Fig. 4. The structure of unitary operating costs

According to Myczko [1995] operation costs of buildings and technical equipment depends of labor productivity, which depends on the direction of production, techniques and animal welfare and adaptation of the premises and equipment to the implemented technology.



Source: Author's calculations

Fig. 5. Labour productivity in the surveyed holdings

Average labor productivity in the surveyed farms was 31.70 PLN · man-hour<sup>-1</sup> (Fig. 5). Noteworthy is the fact that this ratio in the largest objects was nearly 2-fold higher compared to the other two groups. Thus, the most effective work was only on the farms with the area exceeding 20 ha of arable land. In these holdings the highest value of pure production was obtained, at the lowest labor outlays.

A very big impact on the increase of the labor productivity is exerted, for example, by the mechanization of production processes [Winnicki 1995; Malaga-Toboła 2008; Michalek, Kuboń 2009; Slawinski 2010].

The paper analyzes the correlation considering independent variables of the replacement value of buildings and the costs of their operation as well as the dependent variable of labor productivity. The relationship between these variables was statistically insignificant. However, a statistically significant relationship was noted between the operating costs of buildings and their replacement value. The correlation coefficient was 0.90, so this relationship was very high.

The analysis of variance showed the significance of differences in labor productivity in each area group. In comparison, there were large deviations from the mean average value of labor productivity in the buildings with up to 10 ha and from 10.01 to 20 ha of arable land, compared with the objects of the largest area.

## CONCLUSIONS

In the surveyed holdings 81 farm buildings were reported, of which 42% were livestock buildings. With regard to the age of buildings in Poland, they were mostly relatively young objects, with an average age of 27. The average size of livestock buildings was 190.9 m<sup>2</sup>, garages and sheds - 85.1 m<sup>2</sup> and warehouses - 78.8 m<sup>2</sup>, while the holdings had at their disposal about 354.90 m<sup>2</sup>.

The average annual operational costs were at the level of 5.15 t PLN and were aligned in various area groups nevertheless they were the highest in the facilities with the largest area (although the differences were small).



Average unitary costs were  $44.49 \text{ PLN} \cdot \text{m}^{-2}$ . These costs were 10 PLN per  $\text{m}^2$  higher in the largest objects than in the holdings to 20 ha of arable land. In the cost structure of both the annual and unitary costs, the largest share belonged to the costs of amortization of buildings and energy.

The statistical analysis shows that the increase in the replacement value of buildings by 1 t PLN will increase annual operating costs by about 32.68 t zł.

The highest labor productivity ( $50.09 \text{ PLN per man-hour}^{-1}$ ) occurred on the holdings with over 20 ha of arable land and was statistically significantly different from that obtained in territorially smaller holdings. Therefore, the surface of 20 ha of arable land is a threshold at which the production starts to be economically justified.

The relationship between the replacement value of buildings, their operating costs and labor productivity proved to be statistically insignificant.

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## KOSZTY EKSPLOATACJI BUDYNKÓW GOSPODARCZYCH W WYBRANYCH GOSPODARSTWACH EKOLOGICZNYCH

**Streszczenie.** Celem artykułu było określenie i analiza wartości odtworzeniowej budynków gospodarskich i rocznych oraz jednostkowe koszty ich działalności w zakresie wydajności pracy. Do analizy porównawczej obiektów badań, obiekty te zostały podzielone na grupy wg powierzchni: do 10 ha, od 10.01 do 20.00 ha i powyżej 20 ha użytków rolnych. Zakres badań obejmował gospodarstwa ekologiczne znajdujące się w górskim regionie i specjalizujące się w produkcji zwierzęcej.

**Słowa kluczowe:** koszty operacyjne, budynki gospodarcze, gospodarstwa ekologiczne, grupy obszarowe, wydajność pracy.