# Resource Saving as the Basis for Efficient Pork Production

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**Abstract.** The article deals with the issues of resource saving at pork production and its impact on the production cost. Based on this analysis, it is shown that pork production's cost is influenced by not only by the unit cost of resources, but also to a greater extent by the resources' cost. Calculations of the cost price and specific resource cost's level, as well as resources' change cost dependence were performed. The specific weight of resource costs for individual technological processes' performance at the pork production is established. The most resource-intensive are the feed distributing and a microclimate technological process providing. It is suggested that for efficient pork production, it is necessary not only to reduce the unit cost of resources (feed, labor, electricity, fuel), but also to restrain the growth of resource prices in every possible way by state regulation. At the present stage of development at acute competition conditions, pork producers need primarily the cost of production reduction and competitive products' manufactory's ensuring to focus.

## 1 Introduction

One of the important indicators characterizing pig farms' efficiency is the production's cost.

The pork production cost is a qualitative indicator reflecting all aspects of the pig-breeding enterprise economic activity. The cost price is the main factor of pig-breeding enterprises' profit formatting, selling pork's price level determining. The cost price has accumulated all of production resources' using results and their consumption efficiency [1-3].

Thus, pork production cost is the most important indicator of the pig-breeding enterprise's economic efficiency. The expanded reproduction rate, pig-breeding enterprises' financial condition, and pork production competitiveness depend on the cost price [4-7].

The pork production cost defining is the monetary cost of all resources required for pork production, the total pork production cost.

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The pork production cost is not only the most important economic category, but also a qualitative indicator, since it characterizes the level of all its resources (variable and constant capital) available for usage on a pig-breeding enterprise.

Many factors influence on the cost price, but the main ones are following: labor productivity, volumes of manufacturing, material resource costs [8-12].

The pork production's resource capacity is total sum of costs to produced products' cost ratio. The resource intensity of production characterizes the level of influence of the production resource intensity on the production cost. The material, energy, and labor cost of producing changes are the main factors which influence on the production cost.

## 2 Materials and methods of research

Pork production technology is implemented through the various technical means used to perform the appropriate technological processes and operations. At the same time, the main problem of resource implementing is technologies saving through production efficiency increase and pork production cost reduction, i.e. producing unit cost reduction.

Material resources are the main pork production main costs.

Resource capacity depends on the volume of commodity products and the amount of material costs for its reproduction. In turn, output in value terms (VT) can change due to the quantity of manufactured products (X), its structure (D) and the level of selling cost (C).

The amount of material costs ($M_Z$) also depends on the manufactured products, its structure, consumption of materials per unit of production ($P_{un}$) and materials cost ($C_m$).

The producing resource capacity depends on the norms of resources consumption and their cost:

$$M_i = \frac{P_{rel_i} \cdot W_{\text{м}i}}{L_i}. \quad (1)$$

The unit cost price is affected by the amount of consumed resources and unit cost of the resources. To determine the resources cost' impact on the unit cost price, the consumed resources' actual amount must be multiplied by the resources price change:

$$\Delta F_{\text{ц}} = \Delta L_i \cdot F_{i\text{cp}}\ , \quad (2)$$

where $\Delta F_{\text{ц}}$ is consumed resources actual amount; $\Delta L_i$ is resources price change; $\Delta F_{i\text{cp}}$ - is the unit cost level's changing.

After calculating of unit cost increase due to resources cost increase, the resource capacity level change can be determined by the formula (3) using $T_{res}$:

$$\Delta T_{\text{res.}} = \Delta F_{com} - \Delta F_z\ , \quad (3)$$

where $\Delta T_{res}$ is the resource capacity level change; $\Delta F_{com}$ is the total cost change; $\Delta F_z$ is the cost price change due to resources price increase.

The relative impact as cost and resource capacity share at cost's growth (Y) is calculated:

$$Y_{dz} = \Delta F_p / \Delta F_{com}\,; \quad (4)$$

$$Y_{dr} = \Delta F_{res} / \Delta F_{com}\,, \quad (5)$$

where $\Delta F_{res}$ is production resource capacity changing.

Thus, pork production cost reducing task is the most important task of farm products producers.

In relation to the pig industry, the main material costs are feed, electricity, fuel, as well as indirectly – labor, which is measured by the size of wages [6-8]. All the above-mentioned provisions on resource capacity in the production of a certain type of product are quite consistent with the principles which take place in the pork production.

Quantifying of the resource consumption level is a complex task which depends on both the structure and production characteristics of a pig farm, as well as the climatic conditions of the region where the pig farm is located. The main resource consumers on pig farms are technological processes of animals' feeding, keeping, manure cleaning and microclimate providing [12-17].

## 3 Results, verification and discussion

In the pork cost's structure, energy resources payment takes from 8,4 till 9,2% of all costs, and energy prices have increased by 3-4 times in comparison with the pre-reform period. The marked increase in energy costs is largely due to increase of all types of fuel and electric energy's prices and tariffs. At current high electricity and fuel tariffs, the energy components of 1 kg of pork producing cost are about 10-12% of total sum, which significantly affects the pork production's total cost.

The performed calculations of electricity costs for 3, 6 and 12 thousand heads per year various capacities farms' technological processes had showed that the largest share of electricity (more than 90%) is spent at pigs keeping technological process on all sizes of the above-mentioned farms. At the same time, for a farm with 3 thousand heads per year capacity, the largest share is at pigsty-feedlot keeping (36%), on a farm with 6 thousand heads per year capacity the single and pregnant sows in a pigsty keeping (29%), and on a farm with 12 thousand heads per year capacity the single and pregnant sows' keeping technological process takes up more than 50% of consumed electricity (Fig. 1).

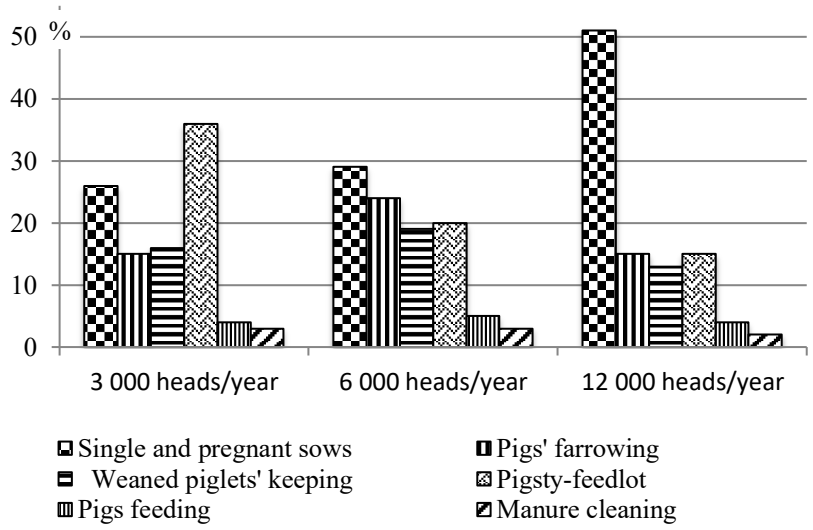


**Fig. 1.** Structure of electricity costs by technological processes on pig farms of various capacities

As for fuel costs, on a farm with a capacity of 3 thousand heads per year, 41% of the fuel cost is in the premises for keeping piglets-weaners, and on a farm with a capacity of 6 thousand heads per year, 39% of all fuel costs are in the fattening pigsty; for a farm with a

capacity of 12 thousand heads per year, as well as for a farm with 6 thousand heads per year, 39% of all fuel costs also fall on the fattening pigsty (Fig. 2).

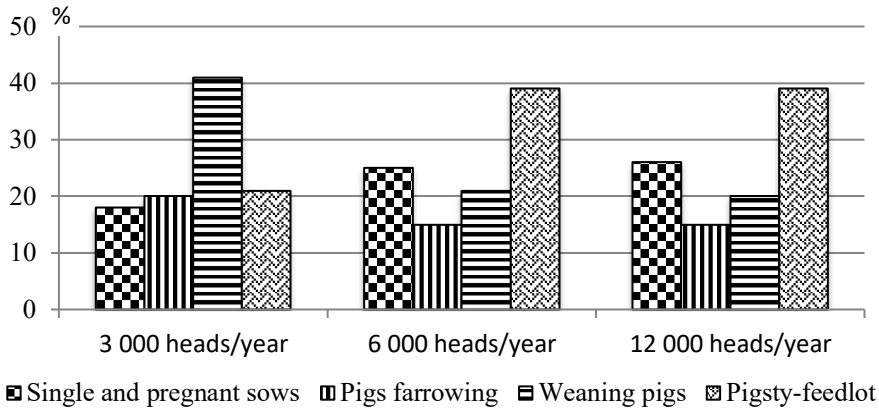


**Fig. 2.** The fuel cost structure for various pig-breeding premises depending on different farms' capacities

The performed calculations of the resource cost structure as a percentage of technological processes had showed that 72,9-79,0% of the total sum are taken by feed costs, 8,9-13,6% - by heating costs, 4,3-5,3% - by labor costs, 3,6 – 4,3% - by electricity and 3,9 – 4,2% - by amortization. (Fig. 3)

Given studies have shown that the parameters of specific resource costs and their cost had different effects on the pork production cost.

To analyze pork production costs' dependence on specific feed costs per 1 kg of pig weight gain and its cost, a linear trend had been used to predict rows which data increases or decreases at a constant rate.

Having built a graph, we see that the costs increase is proportional to the feed price increase. By adding a trend line, the linear equation $y = ax + b$ is obtained, where y is a sequence of analyzed values (in this case – feed costs of, rub): x – feed cost, rub /kg; b – the trend line is intersected with y-axis point on the graph (the minimum level of costs); and a is the value by which the following value in the row is increasing. In this graph, $a > 0$, meaning that the growth dynamics is positive.

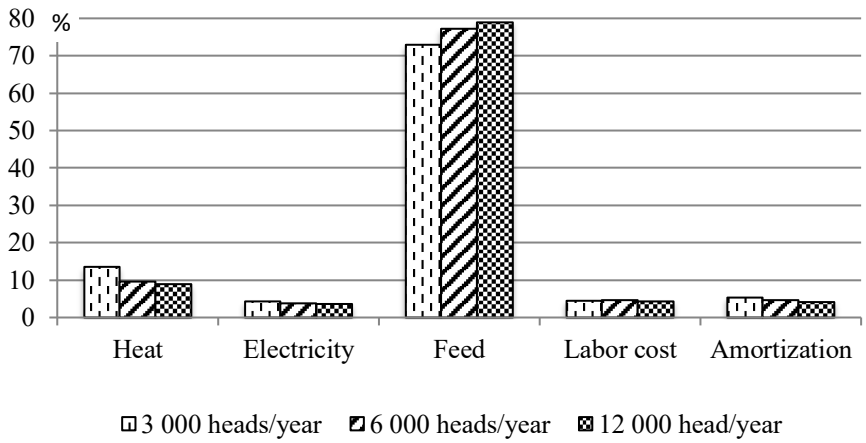


**Fig. 3.** Structure of pork production resource costs by technological processes

The conducted studies have shown that the parameters of the unit costs of resources and their cost have a different effect on the cost of pork production.

To analyze the costs of pork production, depending on the cost of feed and their specific costs per 1 kg of weight gain of pigs, a linear trend is applied, which is used to predict the series where data increases or decreases at a constant rate.

Having built a graph, we see that the increase in costs is proportional to the increase in the price of feed. By adding a trend line, we get a linear equation $y=ax + b$, where $y$ is the sequence of values that we analyze (in this case, the costs of paying for feed, rubles): $x$ is the cost of feed, rub/kg; $b$ – the point of intersection of the trend line with the y-axis on the chart (minimum cost level); a is the value by which the next value of the row is increased. In this graph $a>0$, meaning that the growth dynamics is positive.

The linear nature of the dependence makes it easier to assess the costs of a further increase in feed prices (Fig. 4).

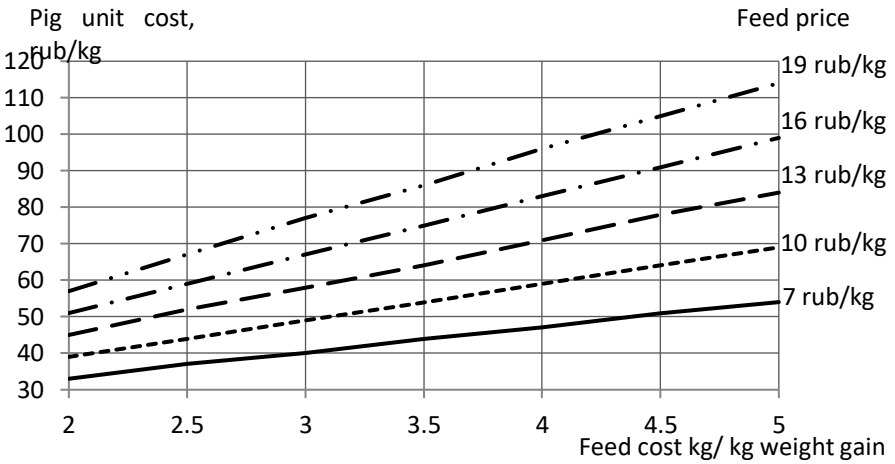


**Fig. 4.** Dependence of the pork production cost on the feed unit cost and its cost

The share of heat supply and microclimate in the pigsty accounts for 40-65% of electricity consumption and 60-90% of fuel consumption. To reduce these costs, it is necessary to carry out a set of measures aimed at optimizing space-planning solutions, increase of the heat-shielding properties of building envelopes, reduction of the cost of ventilation and supply air heating.

Table 1 shows the results of calculations of the dependence of the pork cost on the unit costs of electricity and its cost.

**Table 1.** The dependence of the cost of pork (rubles/kg) on the unit cost of electricity on different prices for electricity

| **Electricity costs, kWh/kg of weight gain** | **The electricity price, rub/kW*h** | | | | |
|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 |
| 2.0 | 52.6 | 56.6 | 60.6 | 64.6 | 68.6 |
| 2.1 | 52.8 | 57 | 61.2 | 65.4 | 69.6 |
| 2.2 | 53 | 57.4 | 61.8 | 66.2 | 70.6 |
| 2.3 | 53.2 | 57.8 | 62.4 | 67 | 71.6 |
| 2.4 | 53.4 | 58.2 | 63 | 67.8 | 72.6 |
| 2.5 | 53.6 | 58.6 | 63.6 | 68.6 | 73.6 |

At 1 kg of pork producing cost, specific fuel costs plays a less significant role than the electricity cost.

Table 2 shows dependence of the pork cost on the fuel specific cost and its price results' calculating.

**Table 2.** The dependence of the cost of pork (rubles/kg) on the specific fuel costs at different prices

| **The fuel cost, kg/kg of gain** | **Fuel price, rub / kg** | | | | |
|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 |
| 0.1 | 51.92 | 52.42 | 52.92 | 53.42 | 53.92 |
| 0.15 | 52.42 | 53.17 | 53.92 | 54.67 | 55.42 |
| 0.2 | 52.92 | 53.92 | 54.92 | 55.92 | 56.92 |
| 0.25 | 53.42 | 54.67 | 55.92 | 57.17 | 58.42 |
| 0.3 | 53.92 | 55.42 | 56.92 | 58.42 | 59.92 |
| 0.35 | 54.42 | 56.17 | 57.92 | 59.67 | 61.42 |

Previously, it was noted that the pork production cost is affected by not only the specific resource costs level, but much more by the resources cost. For a more detailed analysis of the resources' cost impact on pork production cost, the production cost dependence on feed, labor, electricity and fuel costs prices' change was calculated (table 3).

**Table 3.** The results of calculations based on feed, wage, electricity and fuel cost prices (at specific feed cost 4,5 kg, labor 0,045 man*h, power 2,2 kW * h, fuel 0,2 kg per 1 kg of gain)

| **Price ($x$) of combined feed, rub / kg** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dependence of the pork cost ($y$) on feed price increasing ($x$), rub / kg $\boldsymbol{y = 3.48x + 19}$ | 53.8 | 57.3 | 60.8 | 64.2 | 67.7 | 71.2 | 74.7 | 78.2 | 81.6 | 85.1 | 88.6 |
| Wages ($x$), rub / h | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 |
| Dependence of pork cost ($y$) on wages' growth ($x$), rub/ kg $\boldsymbol{y = 0.046x + 49.2}$ | 53.8 | 54.3 | 54.7 | 55.2 | 55.6 | 56.1 | 56.6 | 57.0 | 57.5 | 57.9 | 58.4 |
| Fuel price ($x$), rub/kg | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| Dependence of pork unit cost price ($y$) on fuel price growth ($x$), rub/kg $\boldsymbol{y = 0.16x + 50.92}$ | 53.8 | 54.0 | 54.1 | 54.3 | 54.4 | 54.6 | 54.8 | 54.9 | 55.1 | 55.2 | 55.4 |
| Electricity price, rub/kW*h | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Dependence of pork cost ($y$) on electricity price increasing ($x$), rub / kg $\boldsymbol{y = 2.2x + 48.6}$ | 53.0 | 55.2 | 57.4 | 59.6 | 61.8 | 64.0 | 66.2 | 68.4 | 70.6 | 72.8 | 75.0 |

The table shows that the combined feed cost increases twice while the unit cost increases by 64%, wages increase twice while the unit cost increases only by 8.5%, electricity cost increases by 6 times while the unit cost increases by 41% and fuel cost increases from 18 to 28 rub/kg while the unit cost increases by 2.9%.

More clearly, the dependence of the cost of pork production on changes in the prices of resources (feed, labor, electricity, fuel) is shown in Figure 5.

The graph shows that the change in feed prices most significantly affects the cost of pork production. The second significant factor in importance is electricity. This is explained by the fact that, due to the specifics of production, most technological processes are carried out at pig breeding enterprises using electric energy.

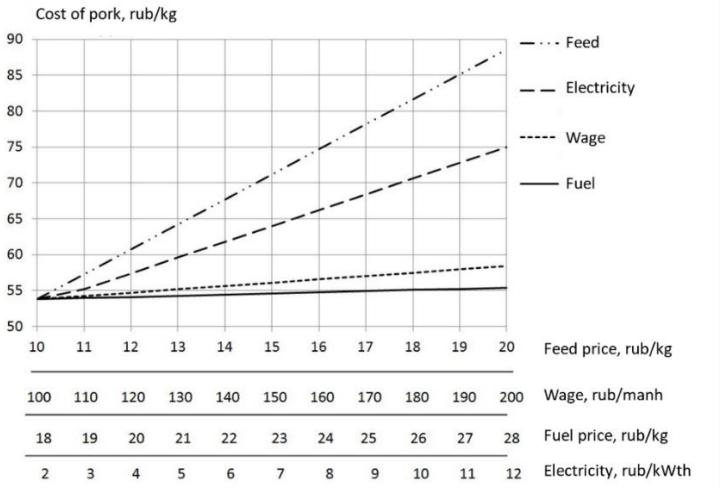


**Fig. 5.** Dependence of the cost of pork production on the cost of feed, labor, and fuel

The conducted studies have shown that the costs of pork production are significantly affected by the cost of material resources used in the process of performing technological processes. The analysis of the dynamics of changes in prices for feed, electricity and fuel in recent years showed that the cost of feed has increased by 41.6% only in the last 3 years, electricity by 4 times, the cost of fuel over the past 4 years has increased by 20.4 %.

At the same time, it should be noted that the average selling prices for pork in 2016-2018 remained practically unchanged – in the range of 101.9-107.1 rubles/kg, and in 2019 they even slightly decreased – to 85 rubles/kg.

Therefore, in a market economy, the state should take part in regulating the cost of resources by economic methods, for example by limiting their increase and linking to inflation at the macroeconomic level. The state can also provide other types of support to domestic pork producers in the form of subsidies for resource costs (feed, electricity, fuel) so that they can compete with foreign pork producers in the external market.

## 4 Conclusions

The showed pork production resources cost change depends on various sizes of premises on pig farms, at mechanized technological types of performed processes. It allows to identify resource saving areas. Thus, the pork production cost is the most influential factor, that gives the most important indicator of the of pig production efficiency.

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