Optimization of transport and logistics processes in agriculture

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Abstract. This article discusses the optimization of transport and logistics processes in an agricultural enterprise. The use of new engineering support will allow the company to significantly reduce its costs and energy resources. The recommendations received are quite relevant and justified, and will find appropriate application in the production and economic activities of an enterprise of a certain industry affiliation.

1. Introduction
Modern technologies have become an integral part of the life of society as a whole. Now it is quite difficult to imagine an enterprise that would not use the achievements of modern technological progress [1].

The main task of modern scientific technologies is to introduce innovative, effective solutions to the development of all spheres of human activity, starting from the everyday life of everyone and ending with the introduction of developments in industrial production, the agricultural sector and business promotion [2].

Currently, research aimed at increasing the volume of food production and improving its quality is of paramount importance throughout the world.

A special role in increasing meat production in the country belongs to pig farming, as one of the most precocious branches of animal husbandry.

Today, pig farming is a powerful branch of agriculture, which should be based on science, competent personnel and modern engineering technologies.

The search for reserves to increase production and increase the profitability and competitiveness of pig meat is of interest to science, as well as of practical significance for the agricultural sector of the country's economy.

Every company strives to increase profits and reduce costs. One of the most common and low-cost ways to reduce costs is to save the company's resources.

The purpose of the research is to develop organizational and economic recommendations aimed at reducing costs and effective functioning through the introduction of new engineering support [3].

The practical significance of the research lies in the fact that the main provisions and scientific conclusions have a practical orientation and can be useful to enterprises that carry out their activities in a certain industry specifics.
2. Materials and methods

LLC "Complex" is a specialized enterprise, the main activity is the production of pig products. An industry that provides primary and secondary processing of pig products and brings them to consumers. The production halls are connected by galleries where animals are transported. The workshops are divided into three teams: fattening, main herd, and reproducer. Thermal lamps of infrared radiation are used in the workshops. The cost of energy carriers takes a significant share in production costs.

One of the factors that increases costs is the rise in the cost of electricity. Over the years, the cost of electricity has increased several times. Therefore, to form a sustainable production system, there is a need to reduce these costs.

Currently, the Piglet rearing shop (the reproducer team from 0-4 months) is equipped with incandescent lamps IKUF-1, which has a power of 250 W.

Deviation of the ambient temperature from the optimal one leads to a decrease in animal productivity by 15-30% and an increase in feed consumption by 25-50%.

The use of infrared heating lamps does not ensure that the surface is properly warmed up to the required temperature.

In order to save costs, we offer to introduce new engineering equipment in the form of thermal heating plates NP-130 with built-in thermal insulation for local heating of piglets in the farrowing and rearing sections. They are ultra-reliable products made of thermoplastic composites, inside of which there is a heating cable with increased resistance to overheating (table 1-2).

| Physical and mechanical indicators | Chemical resistance                                      |
|-----------------------------------|----------------------------------------------------------|
| Water absorption by weight-no more than 0.6% | Coefficient of resistance to alkalis - 0.75 (medium concentration up to 20%). |
| The tensile strength of the Flexural – not less than 40 MPa. | Coefficient of resistance to bases (lime, soda, basic salts) - 0.8 |
| Impact strength Charpy samples without incision – not less than 5.7 kJ/m. | Coefficient of resistance to acids (mineral, organic, non-oxidizing) - 0.8 (medium concentration up to 20%). |
| Abrasion – no more than 0.1 g/cm. | Coefficient of resistance to solutions (sugar, molasses, fats and oils) - 0.85 |
| Frost resistance – at least 200 cycles. | The coefficient of resistance to organic solvents – 0.85 (with the exception of nitric acid) |
| Water resistant – waterproof | - |

The HP-130 heating plate is a product made of glass fiber concrete, in the thickness of which a high-quality heating cable is placed and filled at the production stage. The heating plates are supplied from a standard AC power supply with a voltage of 220V.

To ensure comfortable conditions for animals and prevent overheating, the maximum surface temperature of the plate is limited to 40°C. The temperature regime is controlled, and if the permissible value is exceeded, a special thermorail temporarily turns off the power. The overall dimensions of 1.15x0.53 meters are sufficient for placing even large animals on the plate. When used in aviaries, pens or cages of a large area, several heating plates are used, connecting them to the electrical network in parallel.

To ensure efficient and economical operation of the product, the heating of the plates can be controlled using a specialized programmable thermostat zooclimate. The control functions of this device allow you to ensure that the surface of the plate is heated in full accordance with the recommendations of animal technicians. In addition, effective heating is achieved through the use of a special thermal insulation layer.
Table 2. Technical data of the NP-130 heating plate with integrated thermal insulation.

| Main parameters                                                                 |       |
|--------------------------------------------------------------------------------|-------|
| Power supply voltage, V.                                                        | 220   |
| Installed power, W.                                                              | 125   |
| The maximum temperature of the heating surface, °C                              | 42    |
| Plate size, mm.                                                                 | 1150x550x50 |
| Plate weight no more than, kg.                                                   | 50    |
| Resistance of the heating element, Ohms.                                        | 392   |
| Heating area, m².                                                               | 0.63  |
| Power consumption, W.                                                           | 80-90 |
| The heating element is a shielded, single-core, Muff-free cable in a single sheath, the length of the cold ends is 2 m. | Teflon + PVC |

In addition, when using heating plates, temperature control is provided. Compliance with the temperature regime allows you to save energy (figure 1.).

Figure 1. Example of weekly temperature maintenance.

Thus, heating piglets from below (on a warm floor) is physiologically more useful than from above (with lamps). In addition, piglets are placed evenly on the plates than under hanging lamps. They do not crowd together and do not lie on top of each other. Maintaining an optimal temperature regime on the floor surface ultimately increases the safety of farrowing by 3-5% or more, and increases the body weight by 4-7%.

The power consumption required to bring the heated floor surfaces to the specified technological parameters did not exceed the established norm and was reduced in comparison with other devices for local heating of piglets by 1.5 - 2 times.

Reliability and durability are provided by simplicity and high quality of manufacture. The system is easy to install and operate.

3. Results

Until recently, the problem of heat heating was solved in the traditional way, as a source of local heat in agricultural enterprises, electric lamps ikz-250-500, IKUF-1, OBU-160 and others with a power of 250 to 500 watts are used. But often this heating system does not provide proper heating of the surface to the desired temperature. Numerous observations of practitioners and special experiments of scientists have proved that the deviation of the ambient temperature from the optimal one leads to a decrease in the productivity of animals and an increase in feed consumption.

A modern solution to this issue is modern engineering support-heating plate NP-130 with built-in thermal insulation. The advantages of which include energy efficiency, ease of installation, wear resistance and resistance to aggressive environments, since the outer shell is made of composite material, a high degree of protection against electric shock.
4. Discussion

HP-130 heating plates were created for livestock complexes with the purpose of heating piglets and young animals of other animals. According to animal specialists, if the air temperature in the room where the animals are kept differs from the recommended one even by 1°C, their productivity decreases by almost a quarter, and the feed consumption increases by the same amount.

Keeping chickens, calves and piglets in optimal temperature conditions dramatically reduces the loss of livestock from colds and other diseases associated with the weakening of young animals. Adult animals in rooms with controlled heating give a greater daily increase in live weight. Previously used systems for heating farms and poultry houses with powerful incandescent lamps are economically much more wasteful, and can not compete with HP-130 heating plates. In addition, the bottom heating provides much better conditions for animals.

The main advantages of heating plates HP-130 over similar systems are:
- Easy to install and use;
- Electrical safety and reliability;
- Long service life;
- Unpretentiousness. HP-130 does not need maintenance;
- Environmental cleanliness, health safety;
- Affordable, financial soundness.

HP-130 plates help not only animals winter. Safe and efficient heating of retail kiosks, warehouses, separate buildings – this is not a complete list of useful uses of these products for the needs of people.

5. Conclusion

Economic efficiency is one of the important categories that characterize the effectiveness of an enterprise and the possibility of implementing a project aimed at improving its performance [4].

The effectiveness of participation in the project is determined in order to determine the feasibility of the project, as well as the interest of its participants in the project (table 3).

Table 3. Economic efficiency of introduction of NP-130 heating plates into production.

| Indicators                                      | Fact   | Project |
|------------------------------------------------|--------|---------|
| Gross weight gain, C                           | 18180  | 19089   |
| Increase in gross weight gain, C               | -      | 909     |
| Total production costs, thousand rubles        | 110172 | 110026  |
| Including the cost of electricity in the growing shop, thousand rubles | 686 | 270 |
| Reduction of energy costs in the growing shop, thousand rubles | - | 416 |
| Sales price of 1 centner, rubles               | 6277   | 6277    |
| Sales revenue, thousand rubles                 | 93214  | 93214   |
| Cost of sales, thousand rubles                 | 87189  | 85595   |
| Profit, thousand rubles                        | 6025   | 7619    |
| Economic effect, thousand rubles               | -      | 1594    |

According to the table, as a result of the introduction of heating plates for piglets in cultivation, the gross weight gain will increase by 909 quintals, and the cost of electricity will significantly decrease by 416 thousand rubles. In General, production costs will decrease by 146 thousand rubles.

Reducing costs will reduce the production cost. As a result of reducing the cost of production, the company will receive additional income.

The effectiveness of implementing new engineering solutions is absolutely justified, as evidenced by the results and conclusions.

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