Application of modern business models when implementing resource saving technologies in the agrocomplex

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Abstract: the study analyzes the experience of foreign researchers in using various business models in agricultural complexes to improve the efficiency of crop cultivation. The issues of applying modern business models for processing liquid waste from pig complex using reagents are considered. The existing business templates that are most often used in the implementation of innovative technologies in agricultural complexes are studied. The article presents the experience of implementing the technology of reagent preparation of liquid organic waste from pig-breeding farms using the "Trash into cash" template, which allows obtaining valuable organic and mineral fertilizer. An economic assessment of reducing the cost of cultivating various crops, reducing the cost of production and increasing the yield of corn, barley, sunflower, wheat in the period from 2016 to 2020 was carried out. The advantages of using liquid organic waste from pig complexes as an organic-mineral fertilizer in the agricultural complex are shown.

In recent decades, technological advances in the cattle-breeding and recycling the waste have led to the creation of larger and more specialized cattle-breeding complexes and have led to an increase in the number of livestock business. This intensification caused the formation of a large amount of animal excrement and, consequently, the degradation of the technosphere, for example, soil, water and air pollution. The volume of concentrated manure in intensive cattle-breeding farms significantly exceeds the needs of plants with the consequences of soil and water pollution [1,2]. There are a wide range of possibilities for solving the problem of environmental pollution caused by intensive cattle breeding: anaerobic and aerobic aeration, biocomposting and other new technologies, as well as traditional methods such as the tillage method and the biogas process method. It is important to know whether new technologies are more efficient than existing waste recycling technologies in order to improve the economic and ecological situation caused by intensive production of cattle breeding waste. Thus, the purpose of the study is to evaluate the effectiveness of modern business models in the implementation of resource-saving technologies for the disposal of liquid cattle-breeding waste.

As for the treatment of manure in intensive cattle-breeding, many studies focus mainly on the balance of nutrients in the entire agricultural complex [3-6]. To understand the complex relationship between agriculture and the environment, numerous studies have used bio-economic modeling approaches that combine biological and economic models that take into account the complexities of relationships between all components. However, there is almost no research devoted to the study of technological options and technical optimization for improving waste treatment methods within the framework of a
holistic integrated bio-economic model that can be used for complex technological, economic and ecological analysis. Technological options for waste utilization in conditions of intensive pig farming are not only economically efficient, but also have ecological value. Currently, in many countries of the world, there are no effective and efficient ways for utilization and for reusing liquid organic waste [7,8]. Unlike traditional methods of tillage, manure treatment requires technologies that change its physical or chemical characteristics. Therefore, it is necessary to refine bio-economic models with technological options that can assess the economic and ecological impact on intensive cattle-breeding production technologies.

This research is aimed at developing an economic and environmental model that includes the functions of technological options for modeling the economic and ecological impact on the configuration of technologies under various ways.

**Figure 1. Business template: "Licensing" commercialization of intellectual property.**

The setup allows not only to process liquid waste, but also to use water in production after cleaning for a second time. The main advantage is the resulting organic-mineral fertilizers, which can be used on the nearest agricultural land or sold on the foreign markets.

Target customers are large pig farms, as it is possible to get the fastest payback period and high profit by ensuring continuous operation of the setup. This significantly narrows the market for developers of resource-saving technologies, but leads to an inflow of paying customers-large pig complexes and farms.

The price of a product is based on the uniqueness of the development and the benefits that can be extracted in the future of its implementation. Reduce costs by using treated wastewater and prepared second-time waste, reduce taxes for recycling waste, and sell fertilizers.

The cost of the setup is dictated by its uniqueness, and the costs will be significant only at the implementation stage, since the equipment and reagents are relatively inexpensive. This will allow you to start making a profit quite quickly, with the involvement of a party interested in fertilizers.

Another actual business template for processing liquid organic waste from pig farms: "Linking" customers" is shown in figure 2.

By selling a patented technology that is unique, advanced training courses are also sold and service personnel are trained to work on the treatment plant's production line. Pig complexes that purchase the technology, at the stage of the license to use the patent, receive a number of advantages in its implementation and prospects for improvement.

Even if the customer does not use the development, they do not get their funds back. Therefore, the client is most interested in implementing the technology in production, in high-quality training of the required personnel for its maintenance and continuous operation of the treatment facilities to maximize the benefits for themselves.
This business template is convenient for technology developers, because after selling a patent, personnel training services are immediately sold and it is possible to make a profit from the supply of reagents and fertilizers obtained during recycling process.

Customers are "attached" to the products and services of a particular seller. Switching to another seller is only possible at significant costs. The "attaching" of customers is carried out either through technological mechanisms or through the significant interdependence of goods and services.

In the business template “Trash into cash”, fertilizers obtained in the way of processing liquid organic waste from pig-breeding farms act as a commodity product figure 3.

Fertilizers obtained in the way of processing liquid organic waste from pig complexes are considered as a marketable product.

Potential customers-farmers who use fertilizers for their agricultural land, large green-housing lands, and to a lesser extent, small batches of fertilizers can be sold in various garden stores.

This fertilizer is a by-product of processing liquid waste from pig complexes. Cost are calculated not for obtaining fertilizer, but for cleaning up waste. The cost itself is insignificant, only storage and transportation of fertilizers are required. It is possible to offer the client a minimum price if you buy large volumes or a long-term cooperation agreement.

Profit is generated at the expense of low cost, high-volume sales conditions, and long-term cooperation. Difficulties include: long-term storage and transportation, in case of insufficient territories
for implementation in the nearest areas. When using this business template, used products are collected and processed into new products. The scheme of obtaining income is usually based on zero or very low purchasing costs. Resource costs are practically minimized, since materials are provided by suppliers free of charge or at reduced prices. This template appeals to customers’ ecological awareness.

In the technological line of fertilizer production, the financial flow is provided by continuous operation (provided that the capacities are correctly selected).

Material and production stocks should be received evenly and constantly. The pig complex provides a constant load on the treatment facilities, therefore it ensures continuous operation of the setup.

Operating expenses are expenses for maintenance of sewage treatment plants, storage of fertilizers until the moment of sale, transportation.

According to “The Integrator” business template shown in figure 4, pig complexes are offered a wastewater treatment plant, fertilizer sales to farmers and green-housing lands, training services for equipment maintenance at treatment plants, and assistance in supplying the required reagents.

[Diagram of business template]

**Figure 4. Business template "The Integrator".**

The cost of goods and services consists of several components:

- the cost of a license to use a patent;
- cost of equipment, installation in general;
- cost of training courses;
- the cost of fertilizer.

When using this template, participation is taken in all possible stages of the project development, from the beginning to the end, extracting the maximum profit.

A company that adheres to "The Integrator" template controls most stages in the value creation process, including all resources and capacities. Increasing productivity, saving on coverage, or reducing dependence on suppliers helps reduce costs and create stable value.

Based on the selected business templates, you can develop the most effective business model. Let's divide the use of templates into stages:

1) "Licensing" + "Linking" clients;
2) "Trash into cash";
3) "The Integrator".

The first stage involves generating revenue from the sale of patented technology and training staff. This allows you to get additional funds.

The second stage (intermediate) provides an opportunity to sell a product that has not been purposefully invested and opens up prospects for increasing the number of customers interested in both the main features of the setup and the product obtained during the cleaning process.
The third stage involves the complete establishment of work, from the sale of rights to use the patent, to the sale of fertilizers. It provides not just control over the technological process, but also effective work, which will create a price policy that suits all parties.

Based on the business template "Trash into cash", the authors introduced a technology that offers a method for reagent preparation of liquid organic waste from pig complexes for agricultural use, which significantly simplifies the process and reduces the cost of reagent processing, increases the efficiency of separation into liquid and solid fractions and their agricultural meliorative value while reducing the settling time (figure 5). The technical result is the production of organic mineral fertilizer, as well as treated wastewater with high concentrations of biogenic components.

The technology was implemented on the territory of the Novominsky rural settlement in the Kanevsky district of the Krasnodar territory in the period 2016-2020.

The study took into account: yield, cost of cultivation and the cost of cultivation of grain crops.

![Diagram](image.png)

**Figure 5.** Scheme of implementation of technology for processing agricultural-complex waste.

The proposed scheme considers an agricultural complex consisting of a pig complex with storage lagoons related to it, agricultural land on which grain crops are grown for sale, and a feed base of the pig complex. Thanks to the implementation of the pig complex waste management system, we get a number of advantages:

- Purified water that can be used for second-time use, or for irrigation.
- Organic-mineral fertilizers. The main part of them is applied to agricultural land, and surplus fertilizers are sold.
- Vacant territory after processing waste from lagoons, which can be used for: temporary storage of fertilizers; construction in case of expansion of the pig complex; increase in agricultural land areas.

The results of the study of changes in the yield of grain crops for the period 2016-2020 are shown in figure 6.
Figure 6. Changes in grain yield (%).

Changes in the cost of cultivating corn on the cob, winter wheat, sunflower and barley are shown in figure 7.

Figure 7. Changes in the cost of grain cultivation (%).

Figure 8 shows a reduction in the cost of wheat and sunflower (by 30-35%) in comparison with the cultivation technology, which does not involve the use of organic-mineral fertilizers based on processed liquid organic waste of the pig complex. The cost of cultivation of corn on the cob and barley decreased by 35-40 %.
Based on the results of the study, the actual annual economic effect of implementation is calculated using the formula:

\[ E = [(C_2 - Z_2) - (C_1 - Z_1)] \times A; \]
\[ B = A \times Y; \quad Z = S \times Y; \quad C = Y \times W, \]

which: \( E \) - the economic effect, in thousand roubles; \( C_1 \) - the value of gross output for the base variant, thousand rubles/ha; \( C_2 \) - the value of gross output of the implemented activities, thousand rubles/ha; \( Z_1 \) - the cost of production of the basic variant, thousand rubles/ha; \( Z_2 \) - the cost of production of the implemented option, thousand rubles/ha; \( A \) - the actual implementation in physical terms, ha; \( B \) - the gross production, t; \( Y \) - average yield, t/ha; \( A \) - area of implementation, ha; \( W \) - realized price, thous RUR/t.

The actual annual economic effect from the use of organic and mineral fertilizers in the agricultural complex, obtained using the resource-saving technology for processing liquid organic waste of the pig complex, was 48%.

With the increasing scale and intensification of cattle-breeding, increased attention should be paid to waste utilization and integrated use of resources to address the problem of environmental pollution from intensive livestock. In this study, a complex integrated bio-economic model was used for a comprehensive technological, economic, and ecological analysis. By implementing new technologies, a pig complex can increase waste processing capacity, improve resource efficiency, reduce waste utilization costs, increase economic benefits, and improve environmental impact.

From the point of view of policy tools, it is necessary to take into account the strategy of technological and cattle-breeding in the field of waste management and the use of resources in intensive livestock. The high technical efficiency in developed ways, it should be considered as an important element of increasing the profit of livestock farms. In addition, specific economic incentive policies need to be implemented, such as subsidies to promote waste management and resource use on livestock farms. Technological and ecological-economic tools should be used in an integrated manner to “turn waste into resources”, promote economic and ecological benefits, and achieve sustainable cattle-breeding development.

The developed business model is the most suitable for implementing resource-saving technologies for processing liquid waste from pig complexes. To maximize benefits, you need to implement customized business templates at certain stages of your work. Timely inclusion of templates in the developed model, and further use of several templates at the same time, will allow you to make a profit at the early stages of project development. This is possible by attracting funds from individuals interested in creating technological lines for processing liquid organic waste from pig complexes, as well as in fertilizers obtained during cleaning.
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