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Financial modelling of meat cattle breeding in Kazakhstan based on a business process map

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Abstract

The study aimed to develop a standardized map of business processes as a basis for creating a production program for livestock activities and their financial modeling at enterprises in Northern Kazakhstan. General scientific and empirical research methods were applied, including logical and systematic approaches, generalization, analysis, synthesis, comparison, and calculations for data collection and processing. The specific conditions and practices of raising, fattening, and breeding livestock in Northern Kazakhstan were summarized and incorporated into the development of the business process map. The developed map reflects the components of the livestock system, detailing a sequence of tasks and procedures carried out using input resources. The research results make an original contribution by addressing key scientific and practical issues in livestock organization: the specific features of livestock business processes have been clarified; a standardized business process map has been developed; and a definition of business processes in livestock farming has been provided. The research results can be applied in the planning of production programs, financial modeling of business processes, and assessing their efficiency.

Keywords: Activity organization, Business processes, Cattle by-products, Cattle, Financial modeling, Planning, Production program.

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1. Introduction

Cattle breeding in Kazakhstan is of utmost importance for life support, as this industry produces the primary food products for the population, including meat and milk, on a regional, national, and minimal world market scale. Food industry enterprises are linked to the production of cattle by-products, where processing occurs, significantly expanding the range of meat and dairy products. Additionally, cattle breeding reproduces the means of labor (productive cattle).

Cattle breeding is a priority area for ensuring food stability in the country and has the potential for substantial economic growth. The main challenges facing the industry include dependence on natural and climatic conditions, price disparity for agricultural products, weak technical, personnel, and financial support, a high weight of cattle in household farms, a large share of non-purebred cattle, a shortage of pastures for the livestock of rural settlements, a weak fodder base, a low share of forage crops in crop rotation, low productivity of pasture lands, and a challenging epizootic situation [1, 2].

These issues, along with the use of outdated management approaches in activity planning, negatively impact the organization and material-technical support of production processes in cattle farming.

Modern cattle farming conditions are characterized by the following:

- There has been an increase in climatic, epidemiological, and competitive challenges to national food security [3].
- The requirements for the maintenance and methodology of in-house planning for cattle breeding have become more complex.
- There is a growing need for innovative development in cattle breeding, using resource-saving technologies and adhering to environmental standards, which necessitates improved planning efficiency.
- The priority has been established for identifying internal production and technological reserves of savings through financial modeling of business processes to ensure the profitability of enterprises engaged in cattle farming.

Ensuring the competitiveness of a cattle farming enterprise requires qualitatively new approaches to developing production programs, particularly in their planning, through the detailed elaboration of business process maps. There is a need to study cattle breeding organizations in agricultural enterprises, represented by a system of business processes integrated into unified production technology.

The purpose of the study is to develop a standardized map of business processes for creating a production program for cattle breeding and its financial modeling at enterprises in Northern Kazakhstan.

The qualitative development of a business process map and its use in financial modeling in cattle farming will enable the enterprise to maximize resource savings by accounting for the intensity of financial flows and aligning them with the technology of raising and managing cattle. The business process map is essential for planning and evaluating the effectiveness of production programs in cattle breeding, ensuring consistent and well-founded managerial decision-making in milk and meat production. The development of the business process map aims to improve the production programs of cattle enterprises by determining the optimal resource expenditures and revenues in milk and meat production.

2. Literature Review

The issues of sustainable development of agro-systems and livestock marketing management have been addressed by many researchers, including Andriushchenko, et al. [4]; Staal [5] and Abdikerimova, et al. [6]. They examined the forms, features, and challenges of agricultural activities. The economic state of cattle farming has been the focus of works by Belgibaeva [7]; Konyrbekov [8] and Nassyrova, et al. [9]. These researchers explored the economic development of agriculture in changing external conditions and considered the influence of scientific and technological progress.

Researchers at the Kazakh Research Institute of Livestock and Foraging have made significant methodological advancements aimed at improving the activities of farming and peasant households through the use of modern information technologies. These advancements are intended to significantly enhance efficiency, transparency, and quality of decision-making in livestock production, such as the development of a model for effective production management in commercial cattle farms specializing in meat production [10].

Important aspects of the development of the economy and agricultural finances are disclosed in the works of scientists Kühl, et al. [11]; Gaspar, et al. [12] and Couleau, et al. [13]. Their works offer various approaches to solving problems of agribusiness management based on practical examples of enterprises.

The definition of a business process and its various classifications were considered in the works of Hammer and Champy [14]; Scheer [15]; Becker [16]; Harrington [17]; Porter [18] and Andersen [19]. They note that when implementing business processes, resources are used that are the physical basis of the product (services). Displays of business processes based on the construction of mind maps for solving management problems are considered in the work of Buzan and Griffiths [20]. Network business models in the agri-food sector from theoretical and empirical points of view are examined by Barel-Shaked [21] and Shauro [22]. These works provide important theoretical and methodological support for the organization of agricultural production and business processes separately. However, the issues of developing a business process map in cattle breeding in the conditions of Northern Kazakhstan require in-depth study, which will take into account the features of the technology of herd formation, growth, and exploitation of cattle. Such a map is necessary as a practical tool for modeling effective activities, considering the existing resource potential of the enterprise for breeding and growing cattle.

3. Methodology

The study examined meat and dairy production technologies of farms in Northern Kazakhstan under real conditions, taking into account the impact of external and internal factors to clarify business processes. The theoretical basis of the study is grounded in the works of scientists and specialists, as well as the normative, methodological, and regulatory recommendations of the Republic of Kazakhstan (RK). In carrying out the work, general scientific and empirical research methods were employed. Logical and systemic approaches were applied to collect and process the material. Methods such as generalization, analysis, synthesis, comparison, and calculations were also utilized. The combination of these general scientific methods ensured a systemic approach to fulfilling the tasks set before the researchers. Empirical research methods

were used for the collection and processing of practical material, including generalization, observation, systematization, measurement, analysis, evaluation, and techniques of statistical and economic analysis.

The informational and empirical base was formed using official data from the Bureau of Statistics of the Republic of Kazakhstan, analytical reviews and reports from the Ministry of Agriculture of the Republic of Kazakhstan, industry reference materials, periodicals, online resources, monographic studies by researchers, practical recommendations from research institutes, and data from scientific and practical conferences. Production accounting and reporting documentation from agricultural organizations in the Pavlodar region was also utilized. The research was conducted in accordance with the principles of scientific ethics.

4. Results

Cattle by-products play a significant role in the nutrition of the population and in ensuring the country's food security. According to the Food Balance data from the Food and Agriculture Organization (FAO) of the United Nations, the average meat consumption per capita in Kazakhstan is 71.9 kilograms per year, including 26.58 kilograms of beef. In comparison, the global average is around 39 kilograms of meat per capita, including 9.3 kilograms of beef [23].

To ensure the sustainable development of the cattle breeding industry in Kazakhstan, it is important to achieve a harmonious combination of conventional farming methods and the need to utilize modern technologies for breeding, raising, caring for cattle, animal health care, and managing business processes in agro-industrial formations. The indicators of cattle breeding development over the past five years are presented in Table 1.

Table 1.
The indicators of cattle breeding development in the Republic of Kazakhstan at the end of the year.

Indicators	Units of measurement	2019 year	2020 year	2021 year	2022 year	2023 year
The number of cattle.	Thousand heads	7436.4	7850.0	8192.4	8538.1	8608.8
The growth rate of the cattle population relative to 2018.	%	104.0	109.8	114.6	119.4	120.4
Including cows.	Thousand heads	3769.8	4008.	4235.7	4462	4765.7
Production of calves.	Calves per 100 breeding cows	74	73	72	72	72
Cattle losses (deaths and losses)	thousand heads	18.6	17.7	18.1	19.0	20.7
Slaughtered or sold cattle and poultry (in live weight)	Thousand tons	1975.0	2058.5	2162.2	2166.2	2265.4
The growth rate of the live weight of slaughtered or sold livestock relative to 2018.	%	105.5	110.0	115.7	115.7	121.0
Cattle that have been slaughtered or sold (in live weight).	Thousand tons	960.1	1001.3	1039.0	1024.0	1046.6
The share of live weight of cattle in total slaughtered or sold livestock.	%	48.61	48.64	47.96	47.27	46.2
The growth rate of the live weight of slaughtered or sold cattle relative to 2018.	%	105.9	110.5	114.7	113.0	115.4
Slaughtered or sold cattle and poultry (in slaughter weight)	Thousand tons	1 120.6	1 168.6	1 231.1	1 240.6	1302.6
Cattle that have been slaughtered or sold (in slaughter weight).	Thousand tons	501.3	521.8	540.2	533.3	544.3
Cattle meat yield (based on slaughter weight)	%	52.2	52.1	52.0	52.1	52.0
The proportion of the slaughter weight of cattle in the total number of livestock that has been slaughtered or sold.	%	44.7	44.7	43.9	43.0	41.8
The growth rate of the slaughter weight of cattle that were slaughtered or sold relative to 2018.	%	105.0	109.3	113.2	111.7	114.0
Slaughtered or sold cattle and poultry per capita (in slaughter weight).	kg	60	62	65	62	65
The growth rate of the slaughter weight of slaughtered or sold cattle per capita relative to 2018.	%	103.5	106.9	112.1	106.9	112.1
The average live weight per head of cattle that are slaughtered or sold for slaughter.	kg	336	338	339	339	342
The production of cow's milk.	Thousand tons	5819.3	6004.4	6198.8	6320.0	6123.7
The average yearly milk output per dairy cow.	kg	2355	2364	2341	2403	2409
The annual growth rate of milk yield per cow in relation to 2018.	%	100.6	101.0	100.0	102.7	102.9

Source: Compiled by the authors based on data from Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [24] and Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [24].

The number of cattle from 2019 to 2023 showed a consistent upward trend. Compared to 2018, the herd increased by 20.4% over the past five years, reaching 8,608.8 thousand heads. The production of calves per 100 head of breeding cattle and cattle mortality over the past five years experienced slight fluctuations. The slaughter and sale of cattle in live and carcass weight have gradually increased by 21% and 14%, respectively. The meat yield in slaughter weight over the five years ranged from 52.2% in 2019 to 52.0% in 2023. The share of slaughter weight of cattle in the total slaughtered or sold cattle decreased from 44.7% in 2019 to 41.8% in 2023. The per capita slaughter of cattle and poultry in slaughter weight in 2023 was 65 kilograms, which is 5 kilograms more compared to 2019. Despite this, Kazakhstan's import of meat products outweighs its exports, as the consumption rate exceeds the meat production rate per capita. The export of "Frozen Cattle Meat (including frozen beef)" from Kazakhstan in 2023 amounted to $1.37 million, while imports totaled $27 million [25].

Kazakhstan has relatively limited experience in meat production for export compared to major market players such as the United States, Brazil, Uruguay, and Australia. To develop an export-oriented meat production industry, Kazakhstan will face intense competition. The sustainable livestock development program in Kazakhstan aims to increase the cattle population to 15 million by 2027 [26].

Economic results in cattle farming are largely constrained by natural factors, such as the reproductive rates of the herd, environmental and veterinary risks, the length of the production cycle, and the biological characteristics of cattle. A comparison of the growth rates of cattle breeding across various indicators over the past five years is presented in Figure 1.

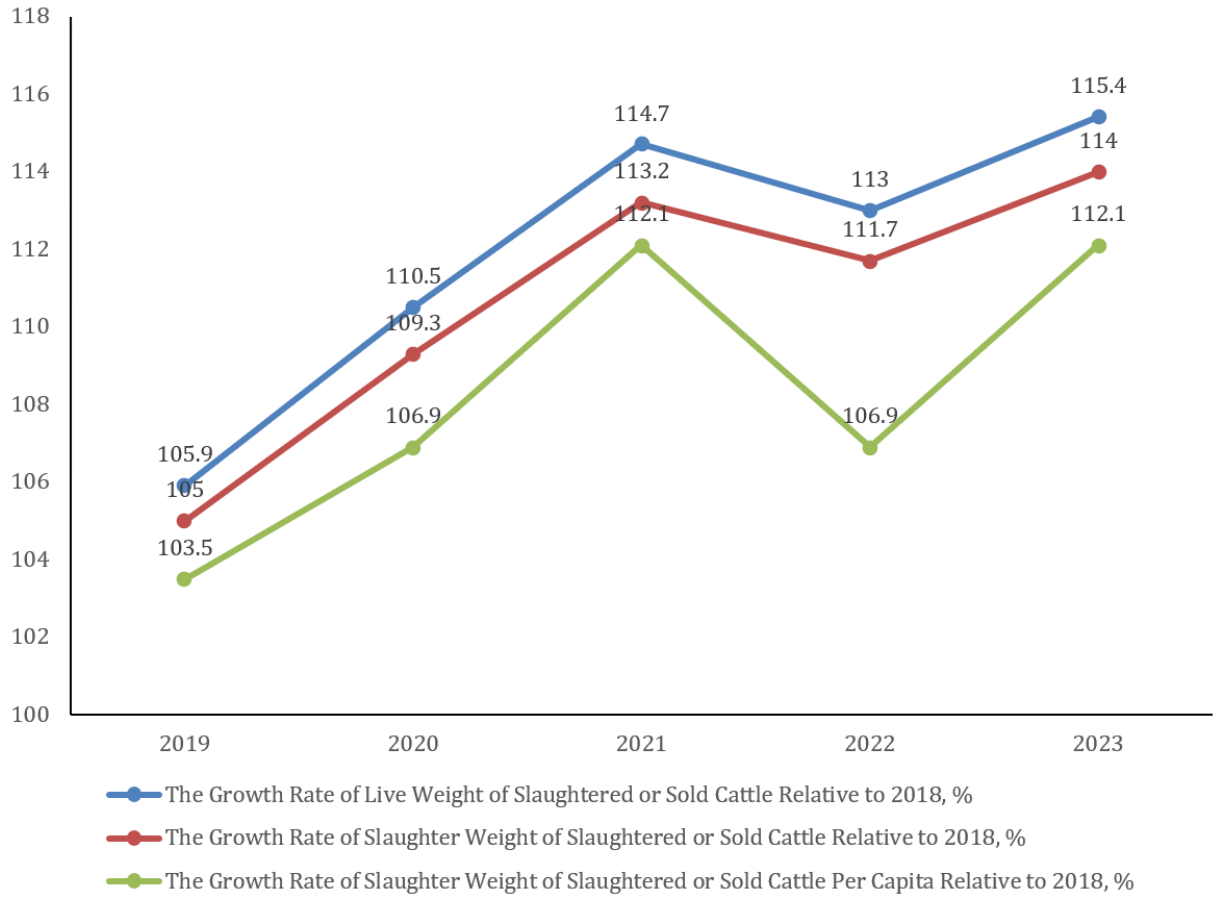

Figure 1.
Comparison of growth rates of cattle breeding indicators in the Republic of Kazakhstan.
Source: Compiled by the authors based on data Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [24] and Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [24].

The volumes of slaughtered or sold cattle in live and slaughter weight have steadily increased over the past five years. This is reflected in the annual growth rates compared to 2018. Notably, the growth rate of slaughter weight almost synchronously aligns with the growth rate in live weight. However, the growth rate of slaughter weight per capita is somewhat lower than the growth rates of the gross indicators in both live and slaughter weight.

It is noted that the actual productivity indicators of cattle, such as meat yield in slaughter weight, milk yield, and offspring per 100 cows, are lower than the standard indicators of productivity for cattle breeds raised in Kazakhstan [27]. In our opinion, the high level of organization of activities, including the use of modern technological approaches to feeding, improving the structure of the herd, selection, care, and veterinary services, holds the potential to increase the productivity of cattle to meet breed characteristics.

A high level of organization in cattle enterprises is crucial for their effectiveness. The main reserve for increasing the level of organization in cattle breeding is business process planning. These processes can be presented systematically in a business process map. Such a map will serve as the basis for planning the production program and financial modeling of

business processes. Financial modeling of business processes is intended for planning the harmonization of input resources and their flows in monetary terms to achieve the target results of cattle-breeding activities over a specified period. A business process map helps to visualize cattle-breeding operations systematically, where input resources and their targeted use to obtain output products are defined. The business process map, Figure 2, was developed by the authors based on consultations with production specialists from cattle-breeding enterprises in the Pavlodar region and recommendations provided by scientists from the Research Institute of Animal Husbandry [10].

Historically, Northern Kazakhstan has been a major producer of livestock products. Due to its climate and natural landscape, the region has developed a strong tradition of cattle farming. In certain areas of Northern Kazakhstan, diverse vegetation provides a good feed base for raising cattle. Some parts of Northern Kazakhstan still practice year-round free grazing of herds and utilize the available pastures. The region comprises four areas: Akmola, Kostanay, Pavlodar, and North Kazakhstan.

Beef cattle are well established in the dry steppe zone of Northern Kazakhstan, with the largest population of cattle concentrated in the Kostanay Region, while mixed beef-dairy cattle are prevalent in the Pavlodar Region. Several breeds of beef cattle have been adapted to the region's conditions through centuries of breeding and modern technologies. In the steppe zone, successful breeds include the Northern Kazakh White-Headed, Auliekol, Aberdeen-Angus, and Hereford. These breeds are adapted to the sharply continental climate, enduring long grazing periods, and can resist temperatures as low as -40°C and as high as +40°C. They effectively utilize pastures and roughage.

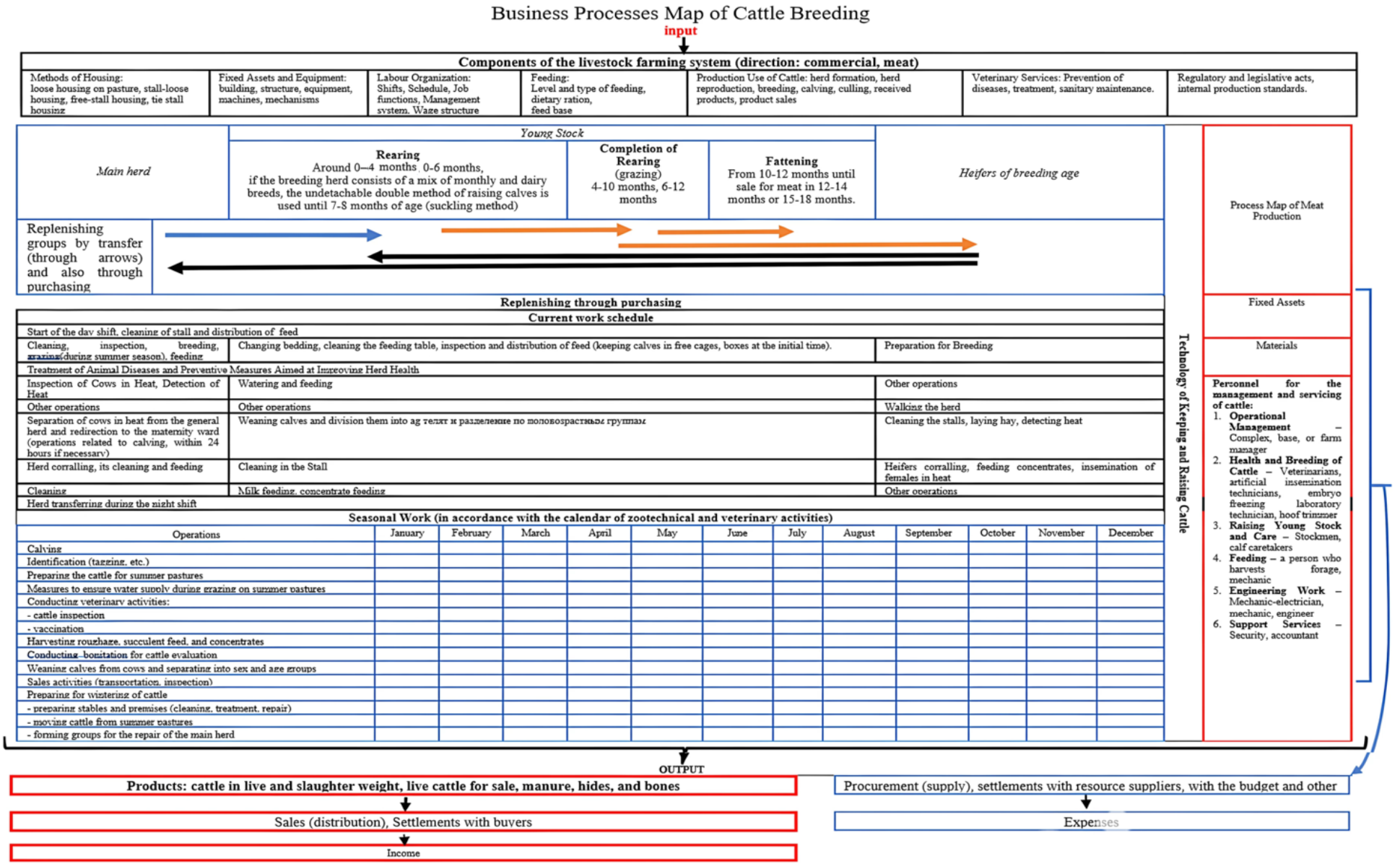

Figure 2.
Business process map for commercial beef cattle farming in Northern Kazakhstan.

In Kazakhstan, there are various methods of cattle husbandry, including loose housing on pasture, stall-loose housing, free-stall housing, and tie-stall housing. Raising and fattening cattle is divided into three periods: rearing, completion of rearing, and fattening [10].

The business process map of commercial beef cattle breeding in Northern Kazakhstan, shown in Figure 2, illustrates the components of the cattle breeding system:

- Cattle housing methods.
- Production fixed assets (buildings, structures, equipment, machinery).
- Labour organization system.
- Feeding organization.
- Production use of cattle, herd formation, reproduction, and replenishment.
- Veterinary and sanitary services.
- State regulation of cattle breeding.
- The main objective of the activity is a cattle herd, categorized by age periods (rearing, completion of rearing, and fattening), as well as its transfer from group to group.

In addition to the main herd, input resources are indicated: materials (feed, veterinary medicines, electricity, etc.), service labor collective, and fixed assets. These resources are used according to the process map.

The map also reflects the schedule of current and seasonal work. The company's specialists indicate seasonal work on the map, following the schedule of zootechnical and veterinary activities.

Calves are raised from birth to 4-6 months of age. At the output of business processes, the expected product indicators are reflected: meat in live and slaughter weight, weight gain, and offspring.

For the main production activities reflected in the business process map, such as feeding and calving, block diagrams are additionally drawn. Figure 3 illustrates a block diagram of the organization of the business process of herd reproduction. It was compiled based on consultations with specialists from leading cattle breeding enterprises in Northern Kazakhstan and a study of the production documentation of these enterprises.

The block diagram indicates input resources, sequential subprocesses, responsible persons, and performers, as well as information and technical support. At the output of the process, indicators of product output and other production metrics reflecting the results of activities are presented. The block diagram helps to clearly define the entire mechanism and scale of the business process resulting from the use of input resources to obtain output products.

5. Discussion

The main reserve for increasing the level of organization of cattle breeding activities is business process planning. M. Hammer and D. Champy define a business process as a set of different types of activities in which one or more types of resources are used "at the input," and as a result of this activity, a product of value to the consumer is created "at the output." Hammer and Champy [14] and Scheer [15] concluded that business processes are, in fact, the transformation of resources through related actions into an economic result. According to Becker [16], a business process is a process that serves to achieve the main business goals of an enterprise and describes its main activity [16]. Many other authors adhere to a similar definition of business processes [17-21].

The author Shauro [22] considers the business process in animal husbandry as a set of interconnected actions at an enterprise engaged in breeding and raising farm animals [22].

Considering all the previously given definitions, it can be determined that business processes in beef cattle breeding are a set of sequential works and procedures carried out using input resources aimed at growing, fattening, and breeding cattle for meat, the output of which is measured in live or slaughter weight, as well as the resulting offspring per hundred heads of cows. In this context, the following can be highlighted:

- Main business processes are directly related to the production of meat in live and slaughter weight, thereby affecting the financial results of the enterprise as they create added value. For example, feeding, insemination, grazing, etc.
- Auxiliary business processes are not directly related to meat production, but without them, it is impossible to perform operations that contribute to the creation of added value. These include veterinary and zootechnical maintenance, as well as the upkeep of technical equipment and machinery.
- Business process development includes the introduction of resource-saving technologies and the modernization of production equipment and facilities.

In various works, the authors also cite other groups of business processes, such as open and closed, quality and cost, horizontal and vertical, etc [17-22].

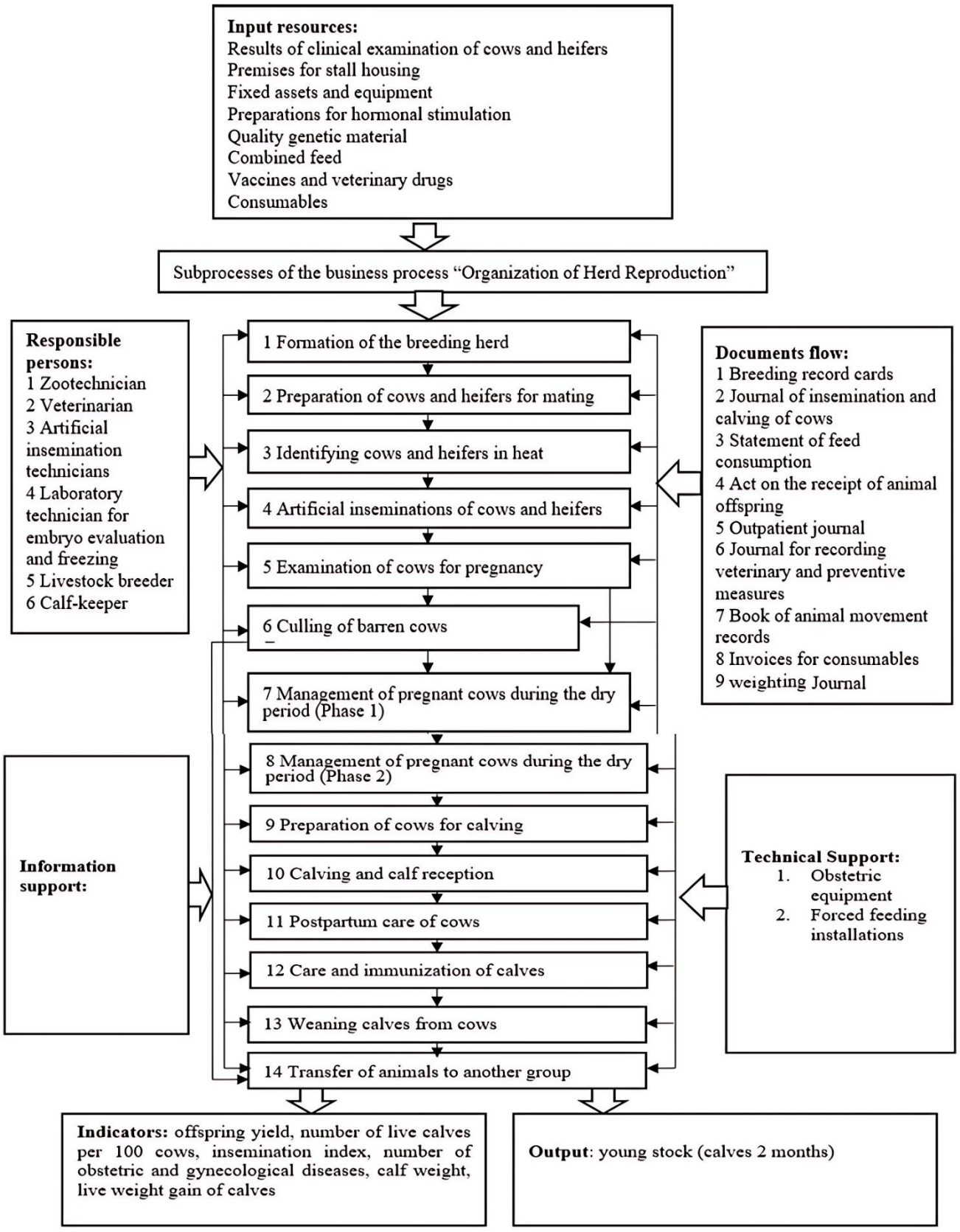

Figure 3.
Block diagram of the business process "organization of herd reproduction"

The established objective of the study defines a specific task for implementation: to develop a map of business processes for the meat sector of cattle breeding. This will be based on the generalization of the technology for growing and selling fattened cattle while adhering to the standards of resource costs and production yield in modern industry standards.

6. Conclusions

The research material addresses the following key scientific and practical issues:

- Clarification and definition of the features of business processes in cattle breeding, considering the production technologies used.
- Development of a standardized business process map for cattle breeding.

The hypothesis of the research is based on the scientific and practical position of the authors, which suggests that planning production programs in cattle enterprises should be upgraded to a qualitatively new level by using standardized business process maps. This aims to improve the effectiveness of strategic and operational management and ensure the sustainable development of enterprises in this sector amidst changing external conditions. Proper use of this approach will offer the following advantages:

- Speed in creating a production program model is crucial for prompt decision-making.
- Possibility of using it for financial modeling of business processes, where resource costs and cash flow (inflows and outflows) from cattle breeding can be balanced over time.
- Reduced labor intensity and improved the quality of planning.

The results of the research can be used in planning production programs for cattle farming, financial modeling of business processes, evaluating their effectiveness, and adjusting agricultural enterprise development plans. By using the business process map for commercial beef cattle farming, it is possible to organize and control the technology of raising and breeding cattle for meat.

7. Limitations and Future Research

The study of business processes in beef cattle breeding at enterprises in Northern Kazakhstan showed prospects for using the business process map in high-quality planning of the production program for the period and financial modeling of business processes, which will ultimately improve the processes of management, organization, financing, supply, and labor discipline of the team. As a result of using the business process map, it is possible to organize and control the production technology.

The current constraints are a weak and unclear structure of production technology and a lack of production workers and specialists for the high-quality development of the process block diagram. The main problem is that a large proportion of cattle are kept in small households. Cattle are kept in the Republic of Kazakhstan and Northern Kazakhstan in different types of farms: agricultural enterprises, individual enterprises, peasant, and household farms. In 2023, the share of household farms in the Republic of Kazakhstan was 51.0%, and in Northern Kazakhstan, the share of household farms was 52.0% [24]. As a rule, small farms have poor technical equipment, and the technology of growing and breeding cattle is at a primitive level and poorly developed. The use of a business process map to draw up a production program and financial modeling of activities is possible under certain conditions. Business processes must be well developed, and the technology must be strictly observed. Currently, most agricultural enterprises are understaffed, and there is no clear regulation of the complex of technological processes, which leads to a decrease in the quality of work performed and does not allow for control over the course of production.

In the future, based on the results of the study, it is possible to develop a standardized financial model of business processes based on a map of cattle breeding sectors (in the form of interrelated calculations). A standardized financial model of business processes will allow, when changing the initial data, to adjust the results of calculations of production and financial performance indicators.

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