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Energy efficient lighting as a transition from incandescent lamps to light-emitting diode solutions

Energy efficiency and energy saving are the national objectives set by the President of the Russian Federation Dmitry A. Medvedev. One of the lines of state policy is application of energy saving technologies to lighting. In this regard, the article analyzes the phased measures taken to replace incandescent lamps with energy efficient lamps, including the national development of the energy effective substitutes and the use of technical regulation mechanisms and quality control of the products delivered to the market.

Energy efficiency, energy saving, incandescent lamp, compact fluorescent lamp, light-emitting diodes, marking.

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It is inconceivable that there is no artificial lighting in the life of modern people. A wide range of the optical sources of artificial lighting, developed and manufactured by different companies, helps us to be more independent of natural lighting. In order to achieve ophthalmic comfort it is necessary to sustain a lot of lighting parameters such as optimal luminance, minimal dazzle, specified brightness distribution, good color rendering. Energy efficient healthy light keeps our safety and comfort, preserves our health, improves labour productivity and raises the level of crop yield and livestock products. It also reduces the consumption of natural resources and lowers fatigability and loss of vision. Today energy efficient lighting is a system that produces high-quality lighting and keeps its characteristics over a long period of time at low costs for energy consumption and low capital acquisition expenditures on electrical equipment. At the same time, energy saving shouldn't be pursued by the reduction in lighting standards because the losses caused by the deterioration of light conditions exceed the cost of saving energy.

Nowadays, according to various sources, about 110 billion kW·h of electricity are used for lighting in Russia. They amount to 20% of electricity output. Virtually, lighting is a major single-type consumer of electricity. Light energy unit is produced at the expense of electricity, which is increased by 1.3 – 1.4 times in Russia as compared with advanced nations. The provision of people in Russia with lighting is 3.5 – 4 times lower than in the U.S., Japan and leading European countries. Therefore, energy efficient lighting is an important component of Russian energy saving policy. In Russia, like in many developed countries, the lighting equipment market is moving towards the production of energy saving light sources and replacement of inefficient light sources by them.

In this regard, it will be possible to achieve a great result such as 34 billion kW·h of saving energy per year in 5 – 6 years if a necessary range of modern energy saving light sources corresponding to technical features are used extensively. This will provide an opportunity to increase light energy consumption by 1.5 times and spend 18 kW·h to produce 1 Mlm·h, but not 28 kW·h as today [1].

Industrial and housing premises are the most intensive electric energy consumers in our country. More than 70% of the total light sources are used by them. Primarily, the problem of energy saving in industrial and housing lighting can be solved through the widespread use of new highly efficient light sources. It is necessary to replace incandescent lamps, which efficiency is 3 – 5%, with fluorescent lamps including compact ones, which efficiency is 5 times higher.

The Russian Government has passed a whole number of laws aimed at the improvement of energy efficiency, including the Federal Law No. 261-FL dated November 23, 2009 "On energy saving and improvement of energy efficiency and on amendments to certain legislative acts of the Russian Federation" (hereinafter referred to as the Federal Law "On energy saving"). This law has determined the state regulation in the field of energy saving and energy efficiency of products, providing for the prohibition or restriction of production and turnover of goods with low energy efficiency in the Russian Federation, if there are the similar goods with high energy efficiency in circulation and their amount meets the population's demand. According to this law, energy efficiency includes "the characteristics reflecting the ratio between useful effect of energy resources and the energy expenditures produced in order to obtain such an effect in relation to production and process technology" [3]. The Federal Law "On energy saving" has become a major factor in the development of energy saving lamps market.

According to the law, 100-watt and more incandescent lamps, which can be used in AC circuits for lighting, have been banned since January 1, 2011. Since January 1, 2012 it has been prohibited to order for state and municipal needs 100-watt and more incandescent lamps, which can be used in AC circuits for lighting. In order to implement the requirements to reduce the turnover of electric incandescent lamps sequentially, it could be prohibited to use in the territory of the Russian Federation 75-watt and 25-watt incandescent lamps, which can be used in AC circuits for lighting, since January 1, 2013 and January 1, 2014, respectively [3].

This means that the production of 100-watt and more incandescent lamps have been stopped since January 1, 2011. The producing and sale of 75 watt incandescent lamps could be banned since January 1, 2013. These lamps should have been withdrawn from the production and sale by January 1, 2014.

This law favours the active development of the Russian market of energy saving lamps. In this regard, Russia follows lead of other developed countries, where the similar measures have been taken. According to the assessment of Rusnano (Russian Corporation of Nanotechnologies), in 2010 42% of the world markets were occupied by compact fluorescent lamps, 6 % – by LED lamps and about 52% – by incandescent lamps. The Russian market counted to 6% of compact fluorescent lamps, 4% of LED lamps and about 90% of incandescent bulbs in the same period.

Due to the ban on production and turnover of incandescent lamps in Russia, it was reasonable to raise a question about the appearance of high-efficient energy lamps at the light market. They are compact fluorescent lamps with integral starting controller and standard screw caps, which could substitute for incandescent light bulbs. Such lamps save a lot of energy because their light output is 4 – 5 times greater than the light efficiency of incandescent bulbs.

Sales volume of the Russian retail market of compact fluorescent lamps amounted to 16 billion rubles in 2011. Budget institutions of Moscow, St. Petersburg, the Bryansk Oblast, Voronezh, Tyumen and Tomsk switched over to the use of such lamps. It is necessary to emphasize that the Russian lighting equipment market is presented by import compact fluorescent lamps made in China, as a rule. Most Russian companies only assemble compact fluorescent lamps out of Chinese component parts. There is no approved manufacture of component parts for fluorescent lamps in Russia. At the same time, there is a full manufacturing cycle to produce incandescent lamps in electric-bulb plants.

It is also necessary to point out the shortcomings of compact fluorescent lamps. Firstly, they include high cost of these lamps. For comparison, the average price of incandescent lamps in Russia is only about 11.8 rubles; compact fluorescent lamps cost 131.8 rubles. It should be noted that there are a lot of fluorescent lamps of low quality in the lighting equipment market in Russia. Average declared service life of these lamps is 8000 – 10000 hours, but it doesn't exceed 4000 – 4500 hours according to the opinion of consumers. So, it has been overstated by 2 times or more.

The measuring and testing results, founded by the Testing laboratory of the State Unitary Enterprise of the Republic of Mordovia "Centre for Test Run and Implementation of Scientific and Research Institute of Lighting Sources named after A.N. Lodygin" in 2011, proved that Chinese compact fluorescent lamps "Ekola" had lower values of light and luminous efficiency, and therefore they didn't meet the requirements of GOST R 53879-2010 (IEC 60969:1988) and the RF Government Decree № 602 "On approval of requirements for lighting devices and electrical lamps used in AC circuits for lighting" dated 20 July, 2011. There is also an unsolved problem of mercury-containing compact fluorescent lamps recycling.

It should be noted that compact fluorescent lamps are characterized by a stroboscopic effect. It is a pulsating light beam, which can have a negative impact on the human sight. There is an opinion of foreign dermatologists that the people, who have high light sensitivity of their skin, can suffer from compact fluorescent lamps.

In accordance with the global energy saving trends, a major part is assigned to LED light sources and LED lighting systems as the most efficient, economical and safe. The use of light-emitting diodes in illuminating engineering is also developed. According to experts, these products will gradually put traditional light sources out of the market within the next ten years.

The main criteria for the predominant use of LED sources in lighting, even in comparison with promising energy efficient gas-discharge lamps, are the following: low energy consumption during operation; a great service life – up to 50 – 60 thousand hours (it is more by 5 – 10 than service life of fluorescent lamps); the absence of pulsations of light characteristics; the ability to work both at low and high ambient temperatures (from -50 ° C up to +60 ° C), that is especially important for cold and hot regions of our country; resistance to mechanical effects; a high level of security (they don't contain harmful substances, ultraviolet or infrared radiation, mercury, they are not dangerously explosive, etc.) [1]. It is an incomplete list of the advantages of LED light sources.

Our country has begun to develop and use light-emitting diode sources. But unfortunately, this process is too slow. The first samples of Russian LED lamps have come into the market in Moscow and St. Petersburg. The cost of a lamp from the first parcel is about 1 thousand rubles. It is planned that the price will have dropped to 250 rubles by 2014.

The Government of the Russian Federation has approved the document "The procedures for producing efficient light sources "New Light" [2] in order to transform the structure of the lighting market in Russia in favor of energy efficient illumination and protection of the domestic market against energy-intensive unpromising domestic and imported products.

The total investment in the project "New Light" is 12.7 billion rubles, including 6.8 billion rubles of off-budget funds and 4.3 billion rubles of Rusnano. The project "New Light" has found that the introduction of energy efficient light sources and the organization of their production in Russia will be implemented in three phases:

2009 – 2012: Removal of incandescent lamps and introduction of compact fluorescent lamps.

2013 – 2016: Sales peak of compact fluorescent lamps.

2017 – 2020: Active introduction of LED equipment.

The implementation of these activities in the country must ensure a system modernization of lighting products at the expense of domestic production of energy efficient lamps and gradual exclusion of imported products.

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AGRICULTURAL ECONOMY

UDC 338.43 (470.12)

Agriculture of the Vologda Oblast on the eve of Russia's accession to the World Trade Organisation

This article presents the main problems of the Vologda Oblast agricultural development, the rapid solution of which becomes even more important in the conditions of joining WTO. The authors also consider the region's opportunities of food security provision. In general, the problems raised in the article, highlight the main directions of the necessary activities of the regional authorities and handling the threats that may emerge in the agricultural sector of the Oblast economy.

WTO, Vologda Oblast, agricultural production, efficiency, problems of development, food security.

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The federal authorities consider Russia's joining WTO as the step of paramount importance, which will give an impetus to the modernization of the national economy. At the same time, it is acknowledged, that Russia's accession to WTO will lead to serious complications in the functioning of certain real sector branches. First of all, it concerns agriculture and the provision of the country's food security. As a matter of fact, the national economy considerably lags behind the developed countries in the issues of productivity and competitiveness.

Despite the fact that WTO norms and regulations will be introduced gradually, the fundamentally new economic and organizational-legal environment is being created for Russian agribusiness.

Acute issues of the Oblast's agricultural development

Agricultural branch of the Vologda Oblast at the beginning of 2011 was represented by 480 agricultural organizations (including part-time farms of enterprises, organizations, educational institutions), 2363 peasant (farmer) enterprises, including individual entrepreneurs, and 258.9 thousand individual farms (private subsidiary plots of the population). 29% of the Oblast population live in rural areas. 7% of those employed in the region's economy work in the agricultural sector [1, 8].

Possessing 0.6% of the Russian Federation's agricultural land, the Oblast produces 0.7% of the country's gross agricultural output. According to the agricultural enterprises' production volume per capita in 2011, the Oblast ranks 3rd in milk production, 8th – in egg production, 24th – in meat production.

However, it should be emphasized, that the branch is functioning under difficult economic conditions determined by the lack of financial resources of agricultural goods producers, obsolete agricultural material and technical base, unfavorable price ratio between agricultural and industrial products, as well as other adverse factors, many of which have been formed in the process of transition to a market economy [5]. As a result, the Oblast's agricultural potential is used not to the fullest extent.

Low efficiency of agricultural land usage is the major problem. For 20 years of market reforms 106 thousand hectares of cropland have been excluded from agricultural usage, and the share of ploughland used for cultivation of crops has decreased from 95.7% to 60% *(tab. 1)*.

The process of soil fertility reduction is taking place. One of the factors, hampering the development of crop growing, is the unsatisfactory physiochemical state of soils (overacidity and hyperhydration, negative balance of nutrients and humus, etc.), which can be improved by implementing a set of special measures, but the actions, undertaken in this direction, are extremely limited *(tab. 2)*.

During the years of reforms, the input of organic fertilizers decreased 8.3-fold, mineral fertilizers – 7.5-fold, and calculated per 1 hectare of crops – 4-fold and 3.5-fold respectively; liming of acidic soils has been practically abandoned (areas of liming have decreased 125-fold). Due to the lack of funding, the melioration systems, created earlier, are now deteriorating.

Table 1. Dynamics of agricultural land area in all types of farms, at the end of the year, thousand hectares

Indicators	1990	1995	2000	2005	2010	2011	2011 in % to 1990
Agricultural land, total, thousand hectares	**1369**	**1335**	**1189**	**1141**	**1096**	**1089**	**79.5**
Including cropland	851	847	792	764	748	745	87.5
Including ploughland under crop	815	757	686	542	478	446	54.7
Share of ploughland under crop, %	95.7	89.4	86.6	70.9	63.9	60	-35.7 p.p.
Natural hayfields and pastures	468	469	357	326	295	291	62.2
Other	50	19	40	51	53	52	104.0

Table 2. The volume of works aimed at increasing soil fertility of the Vologda Oblast agricultural land

Indicators	Year						1990 to 2011, fold
	1990	1995	2000	2005	2010	2011	
Organic fertilizers input							
Total, thousand tons	7770	3695	1653	1249	922	936	8.3
Per 1 hectare of crops,	10.1	5.5	2.6	2.5	2.3	2.5	4.0
Mineral fertilizers input (as calculated to 100% of nutrients)							
Total, thousand tons	118.4	22.5	26.3	14.7	13.7	15.8	7.5
Per 1 hectare of crops, kg of active substance	144	32	42	28.5	34.0	41.5	3.5
Liming of acid soils							
Total, thousand hectares	**108.0***	8.8	4.7	2.2	1.4	0.8	135
* In average for the period of 1986 – 1990.							

Table 3. Dynamics of investments in the fixed capital of the Vologda Oblast agroindustrial complex in 2000 – 2011, mln. rubles (in actual prices)

Indicators	Year							2011 to 2000, fold
	2000	2001	2002	2005	2008	2010	2011	
Investments in the agroindustrial complex, total	745.8	973	1024.6	2406.4	3196.6	2845.0	3029.0	4.1
Including agriculture	435.2	593.4	775.8	1075.6	2242.9	1765.5	2153.5	4.9
Share of agriculture, %	58.4	61.0	75.7	44.7	70.2	62.1	71.1	x

The problem of capital assets renewal and provision of equipment. The investments in the fixed capital of agriculture in 2010 – 2011 grew to a lesser extent than in other sectors of the Oblast's agroindustrial complex.

Dynamics of investments, as shown in *table 3*, is presented in current prices of each year, and in the comparable estimation the growth of investments is not detected.

The volume of investments in the fixed capital of agriculture significantly lags behind the requirements, necessary for the restoration of the deteriorating funds (first of all, agricultural machinery) and their quality renovation *(tab. 4)*.

Due to the high costs of the machinery and equipment, the level of agricultural enterprises' technical equipping is decreasing, which leads to the untimely and low-quality seasonal field works, non-observance of technologies and, ultimately, low productivity of agricultural crops.

The problem of human resources availability. Despite the fact that in rural areas there is a considerable number of unemployed able-bodied population, agricultural enterprises experience the shortage of qualified personnel of all categories – from managers to workers *(tab. 5)*.

As of the beginning of 2012, only 54% of household managers had a higher education, and 13% of them did not even have a specialized education. From 3793 actually working professionals 2395 persons (63%) do not have a higher education, 453 persons (12%) are of the retirement age. The greatest shortage of the leading specialists is registered among agronomists, economists and zootechnicians.

The shortage of qualified specialists in the Oblast's agricultural sector, current as well as anticipated in the mid-term perspective, is determined by a rather tough intersectoral competition and the sector's low competitiveness in the labour market (wages in agriculture in 2011 equaled 69% of the average Oblast level). In this respect, the state should implement the system of cardinal measures aimed at the provision of social guarantees and benefits to the graduates of universities, technical schools and other educational establishments [4, 8].

Table 4. The availability of technical means in the Vologda Oblast agricultural organizations, units at the end of the year

Types of machinery and equipment	Year								2011 in % to 2000
	2000	2001	2002	2005	2008	2009	2010	2011	
Tractors	10417	9686	9218	6722	5055	4699	4397	3907	37.5
Seeders	1527	1315	1246	1083	788	731	690	549	36.0
Combine harvester threshers	1458	1361	1321	937	698	655	579	554	38.0
Flax harvesters	307	246	218	109	74	76	64	60	19.5
Forage harvesters	886	906	892	729	539	539	496	436	49.2
Pickup balers	1108	1061	1023	775	568	526	516	462	41.7

Table 5. The need, availability and shortage of managerial personnel and specialists in the Vologda Oblast agricultural organizations as of January 1, 2012

Position	Staff requirement, persons	Availability, persons	Shortage, persons	Staffing level, %
Managerial personnel and specialists, total	4636	4345	291	93.7
Including: - directors of an organisation	247	245	2	99.2
- main specialists, total	993	887	106	89.3
Among them: agronomists	134	105	29	78.4
Zootechnicians	169	154	15	91.1
Veterinarians	125	111	14	88.8
Engineers	159	147	12	92.5
Economists	114	93	21	81.6
Accountants	226	220	6	97.3
Others	66	57	9	82.6
- specialists of all fields (excluding main)	2109	1984	125	94.1
- middle managers	750	726	24	96.8
- personnel management employees	95	91	4	95.8
- others	442	412	30	93.2

The problem of high production costs in agricultural enterprises. The production and sales costs in the Oblast's agricultural enterprises per unit of production, due to a number of objective and subjective reasons, are significantly higher than the selling prices, which results in unprofitability and low cost-effectiveness of agricultural production *(tab. 6)*.

This is mainly caused by the yearly increasing disparity of prices for production resources and agricultural products.

Due to the unfavorable market price ratio of agricultural production and material-technical resources used in this sector, agricultural enterprises have to attract credits and loans in increasing amounts.

This results in the growing debt of enterprises. For example, accounts payable for the period from 2000 have increased 2.9-fold (from 1636.5 million rubles to 4728.0 million rubles at the end of 2011), indebtedness under short-term credits and loans – 59-fold (from 86.3 million rubles to 5088.3 million rubles, respectively), long-term liabilities on credits and loans of industrial enterprises – 17.9-fold (from 381.2 million rubles to 6812.3 million rubles, respectively).

By the end of 2011, the Oblast's agricultural enterprises, that submitted the financial accounts to the Department, have received the revenue from the realization of products, works and services in the amount of 15.4

Table 6. The ratio of production costs and selling prices for the main types of agricultural products in the Vologda Oblast, rubles/t

Type of production	2010				2011			
	Production cost (manufacturing)	Selling price	Selling price to production cost ratio	Selling profitability % (without subsidies)	Production cost	Selling price	Selling price to production cost ratio	Selling profitability % (without subsidies)
Grain	7141	5142	- 1999	- 4.9	6475	6355	-120	4.8
Potato	5062	8908	+ 3846	51.1	4209	12103	+7894	97.8
Milk	11507	14979	+3472	21.5	12891	16988	+4097	20.1
Cattle meat	105827	56132	- 49695	- 32.5	120357	65695	-54662	- 29.6
Pork meat	64905	68959	+4054	13.0	77571	69742	-7829	- 8.1
Poultry	42466	57861	+15395	18.2	49593	70572	+20979	4.8
Eggs, rub./1000 pcs.	2060	2309	+249	20.6	2072	2308	+236	21.1

Table 7. Dynamics of the quality of raw milk, sold by the Vologda Oblast enterprises

Indicators	Years						2011 +,- to 2000
	2000	2005	2006	2009	2010	2011	
Total amount of milk sold, thousand tons	282.6	360.7	382.4	403.0	392.3	410.3	+127.7
Including:							
highest grade and 1st grade, %	84.6	95.3	93.8	88.8	94.6	95.3	+10.7
2nd grade, %	14.4	4.5	5.8	10.7	5.2	4.6	-9.8

billion rubles (117% to the level of 2010); pre-tax profit equaled 0.65 billion rubles (83.8%), including at the expense of subsidies charged to the profit – 1.06 billion rubles; cost-effectiveness +4.5% including the subsidies and – 2.8% excluding the subsidies. Thus, without the state support, the sector remains unprofitable [7, 9].

The problem of the manufactured and sold products quality. The quality of the products significantly affects their selling price. However, so far the sold products quality remains unstable *(tab. 7)*.

Russia's accession to WTO requires improving the quality of sold products. This will largely depend on its competitiveness in the food market and, consequently, the prospects of the agricultural organizations [2].

The problem of the agricultural enterprises insolvency. The total share of insolvent enterprises of the 3rd group (insolvent, requiring non-market measures to improve their financial and economic status), the 4th group (insolvent and unable to manage the assets) and the 5th group (bankrupt enterprises, without commodity production) in the total Oblast indicators equals: by the number of enterprises – 39.9%, by the number of employees – 39.6%, by the ploughland area – 43.2%, by the cost of basic production assets – 41.1% *(tab. 8)*.

Thus, almost 40% of the Oblast's farms are insolvent, requiring a certain form of state support. Given the conditions under which the agricultural enterprises function if Russia joins WTO, the additional measures aimed at reducing the number of unprofitable and insolvent enterprises should be determined and implemented [4, 5].

The problem of agricultural development in the Oblast's peripheral areas. As a result of the action of market mechanisms, given the imperfection of the state regulation measures, the territorial differentiation in the Oblast's agricultural development has increased sharply.

Table 8. The number of Oblast's insolvent agricultural enterprises and their provision with basic resources as of January 1, 2011

Indicators	Total in the Oblast	Including insolvent enterprises				Share of enterprises of the III, IV, V groups in overall Oblast indicators, %
		III group	IV group	V group	III, IV, V groups in total	
Number of enterprises	258	40	53	10	103	39.9
Number of employees, thousand persons	22.3	4.5	4.3	0.03	8.83	39.6
Ploughland area, thousand hectares	437	91.9	91.7	5.3	188.9	43.2
Cost of main production assets, mln. rubles	18967	4376.6	3416.2	0.7	7793.5	41.1

Table 9. Indicators of territorial differentiation in the development of the Vologda Oblast agriculture in 1990 and 2010

Districts	Share of districts in the oblast indicators, %							
	Area of agricultural land		Value of gross production		Pretax profit of agricultural enterprises		Subsidies allocated to the revenues of agricultural organizations	
	1990	2010	1990	2010	1990	2010	1990	2010
Suburban districts: Vologodsky, Gryazovetsky, Cherepovetsky, Sheksninsky	28	29	50	62	46	77	x	65
The rest 22 oblast districts	72	71	50	38	54	23	x	35
In the oblast on the whole	100	100	100	100	100	100	x	100

In 1990 the agriculture of four suburban districts (Vologda, Gryazovets, Cherepovets and Sheksna) produced 50% of the gross output and received 46% of profit, and in 2010 these indicators reached 62 and 77%, respectively, taking into account profitable farms. In 2010 the agricultural enterprises of these four districts received from the budgets of all levels 65% of the subsidies charged to profit *(tab. 9)*.

In turn, the remaining 22 districts, with 65% of the rural population, account for only 38 % of the agricultural output and receive 35% of the state support.

22 peripheral areas account for only 39% of milk and 12% of meat and poultry, sold by the Oblast's agricultural organizations.

The agriculture in the half of these regions experiences the process of uncontrolled transition to the extensive way of development and the gradual elimination of some of its branches. The economic activity is connected exclusively with dairy livestock breeding in 18 districts of the oblast. At the same time, in 11 districts the cow density equals less than 10 head per 100 hectares of agricultural land, and in the Babushkinsky, Vytegorsky and Kaduysky districts there are not more than 3 dairy cows per one agricultural worker.

While in the suburban areas investments in fixed capital are growing, advanced technologies are being implemented, large-scale investment projects are being realized, incentives for further agricultural development are being created, the most part of the rest of the oblast's territory experiences the deterioration of agricultural commodity production, that is the rural population employment basis and income source, this state of events will provoke the aggravation of the crisis situation.

The agricultural production volumes decrease in peripheral areas leads to the growth of fixed costs per unit of production, underutilization of processing enterprises' available capacity, unprofitability and cessation of production activity of some of them and, ultimately, to undesirable social consequences.

Food security issues

Food security is ensured, if:

– foodstuffs are available on the market in the amounts, sufficient for providing the population with the recommended consumption rates;

– population's real incomes allow consuming foodstuffs in recommended rates;

proper quality of foodstuffs presented on the market is ensured [6].

Table 10 presents the data on production and consumption of basic food products per capita for the oblast. It can be seen, that for a number of products consumption lags behind the standards [1, 6, 8].

In solving the food security problems of the oblast's inhabitants, a special role belongs to meat and dairy industry as the vital sphere of the agro-industrial complex. According to the Vologdastat (regional authority of the Russian Federal State Statistics Service) these branches provide 62% of the oblast's volume of commodity production of foodstuffs.

Annually, the oblast's population consumes:

- 148 thousand tons of whole-milk products (in milk equivalent), 91% of which are produced in the Vologda oblast;
- 4.6 thousand tons of butter, 54% of which are produced in the Vologda oblast (import of butter from other regions equals 46% due to the influence of the price factor);
- 4.3 million of standard cans, 88% of which are Vologda products;
- 5.2 thousand tons of cheese, 17% of which are produced in the Vologda oblast (import of these products equals 83% due to the absence of necessary capacities for their production).

The oblast's meat market peculiarity lies in the fact that its main volume (90% are the sausage products and semi-finished products) consists of the finished foodstuffs of local production. At the same time, 56% of the imported raw meat is used for sausage and semi-finished foodstuffs production.

As for the other food products, the oblast population's actual provision with internal resources (taking into account the export) equals: 64% for eggs and egg products, 98% for potato, 46% for vegetables and melons, 10% for fruits and berries, 14% for food grain, 71% for flour, 70% for bread and bakery products, 13% for fish and fish products.

One of the most important products, which are not produced in sufficient amounts in the oblast, is food grain, used for flour production. The import of this type of product is 95 – 100%. In addition, the oblast imports fodder grain – up to 70% of the required amount.

The delivery contracts for the foodstuffs, not produced in the oblast, like sugar, salt, cereals, vegetable oil, are concluded directly by the economic entities of wholesale trade. They also determine the price and assortment policies.

In the period of economic crisis they were recommended to retain the two-month supply of these goods. The Department, in turn, carries out the monitoring of commodity stocks of foodstuffs with long-term storage period, imported into the oblast, as on the first day of each month.

Table 10. Production and consumption of basic food products per capita in the Vologda Oblast in 2010, kg

Products	Production	Consumption	Rational norm	Consumption, in % to the norm
Milk and milk products	368	237	320 – 340	72
Meat and meat products	42	66	70 – 75	91
Eggs and egg products, pcs.	488	318	260	199
Potato	144	86	95 – 100	89
Vegetables	44	96	120 – 140	74

According to the information of the Department of International, Interregional Ties and Tourism, the Vologda Oblast has bilateral agreements with 33 different subjects of the Russian Federation, it also signed an agreement with the Republic of Belarus. In cooperation with each RF subject the joint measures for these agreements implementation are being developed, that envisage the cooperation in the agro-industrial complex and the supply of food products to the regional markets.

Organizing agricultural fairs is considered very important in the provision of the oblast population with basic foodstuffs at affordable prices. Thus, in 2010, 89 agricultural fairs were organized and their total trade turnover amounted to 156 million rubles.

In 2011, 83 agricultural fairs with a total turnover of 126.5 million rubles were held in 20 municipalities. The average number of trade outlets was 60. According to the oblast local self-governing bodies, the average prices at fairs are 12% lower in comparison with the prices at fixed shop retailing.

Certain importance in the formation of the permanent distribution of agricultural products belongs to agricultural retail markets. This segment of the consumers market is extremely important for organizing the channel of direct (bypassing the wholesale link) supplies of agricultural products to the consumers.

At present, 27 markets are included into the retail markets register. As of January 1, 2012 the total number of market stalls at them was 2598, out of which 37.3% (969 places) were unoccupied. 6 markets out of 27 are retail agriculture markets, 3 of which were opened in 2011 (in the Ust-Kubinsky, Kichmengsko-Gorodetsky and Syamzhensky municipal districts). In 2012 two more agricultural retail markets (in the Kharovsky and Mezhdurechensky districts) are planned to be opened.

In the present-day conditions, among the acute issues is the provision of the remote rural settlements with socially important foodstuffs that is solved by organizing the itinerant trade.

The Oblast Department of Agriculture, Food Stocks and Trade takes the following measures to solve the above stated problems that the agro-industrial complex faces:

The most acute problem of the Vologda Oblast agriculture (which will become even more urgent when Russia joins WTO) is the significant debt load of agricultural producers. Even now the subsidies allocated to a region for the purpose of compensating the part of expenses to pay interest on loans constitute the main part of state support from the federal budget.

On the whole, in Russia the amount of loan debt in agriculture (data of the RF Ministry of Agriculture) exceeds 1 trillion 500 billion rubles, as for the Vologda Oblast, the agricultural enterprises' total loan debt by the end of 2011 exceeded 11.9 billion rubles, which equals almost 77% of the annual gross revenue. About 8% of the revenue is spent annually on interest payments on loans and credits (that is 1.1 – 1.2 billion rubles per year are withdrawn from circulation, and are compensated from the budget partly and after the costs are effected).

In order to increase the domestic agroindustrial complex competitiveness in the conditions of Russia's accession to WTO, the proposals to the Chairman of the Government of the Russian Federation (letter No. 01-33/388 dated March 3, 2012) were sent concerning the revision of the mechanisms of allocating subsidies for payment of interest on loans and credits.

If the federal budget compensated directly to the credit institutions the shortfall in their revenues from the loans and credits granted to agricultural enterprises (similarly to car loans – the RF Government Resolution No. 244 dated March 19, 2009), the agricultural producers would significantly reduce their expenditures for loan servicing and would be able to direct their financial resources to other purposes (wages, taxes, settlements with creditors).

Table 11. Ongoing long-term target programs in the Vologda Oblast agroindustrial complex

№ п/п	Program	Regulatory legal act on the adoption of a program
1.	Development of flax complex in the Vologda Oblast for the period of 2009 – 2012	The Vologda Oblast Government Resolution No. 1719 dated September 9, 2008
2.	Development of dairy cattle breeding in the Vologda Oblast for the period of 2009 – 2012	The Vologda Oblast Government Resolution No. 1727 dated September 9, 2008
3.	Development of beef cattle breeding in the Vologda Oblast for the period of 2011 – 2020	The Vologda Oblast Government Resolution No. 983 dated August 23, 2008
4.	Social development of the village for the period of 2009 – 2012	The Vologda Oblast Government Resolution No.1734 dated September 9, 2008
5.	Preservation and recovery of agricultural lands fertility in the Vologda Oblast for the period of 2011 – 2013	The Vologda Oblast Government Resolution No.1130 dated October 4, 2010
6.	Prevention of Sosnowsky's Hogweed plant spreading on the territory of the Vologda Oblast for the period of 2011 – 2013	The Vologda Oblast Government Resolution No.1122 dated October 4, 2010
7.	Healthy nutrition for schoolchildren for the period of 2009 – 2015	The Vologda Oblast Government Resolution No.1732 dated September 9, 2008
8.	Development of food and processing industry in the Vologda Oblast for the period of 2012 – 2017	The Vologda Oblast Government Resolution No.273 dated March 28, 2011
9.	Development of family farm enterprises in the Vologda Oblast for the period of 2012 – 2020	The Vologda Oblast Government Resolution No.1158 dated September 21, 2011
10.	Provision of quality and security of alimentary raw materials and foodstuffs in the Vologda Oblast for the period of 2012 – 2020	The Vologda Oblast Government Resolution No.1163 dated September 21, 2011

In 2011, the Oblast Government approved the Strategy of the Vologda Oblast agroindustrial complex and consumer market development up to 2020 [8].

Currently, the Department of Agriculture, Food Stocks and Trade is elaborating the State programme on the development of the Oblast agroindustrial complex for 2013 – 2020.

The main sections of the Programme and the guidelines of support correspond to the State Programme of the RF Ministry of Agriculture. The discussion and defence of the Programme will be held in the Oblast Government before August 1 of the current year.

At present, 10 long-term target programmes are being implemented in the oblast *(tab. 11)*. It is envisaged to allocate 455.1 million rubles for their realization from the Oblast and Federal budgets. On the whole, in 2012 it is planned to allocate 1130.7 million rubles from the Federal and Oblast budgets for the support of agriculture. Thus, the Oblast possesses quite a firm basis for ensuring food security and significant reserves for the development and increase of agricultural sector efficiency.

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Quality system implementation of the basis of the stable functioning of processing enterprises

The article proves the necessity to use quality system in the conditions of Russia's accession to the World Trade Organization. It characterizes the main principles of this work in industrial dairy enterprises. The authors present a set of measures to implement the HACCP system (Hazard Analysis and Critical Control Points) at CJSC Totma Butter-Making Plant (the Vologda Oblast) in order to improve the competitiveness of its products.

Quality system, efficiency, competitiveness, dairy products quality, World Trade Organization (WTO), Hazard Analysis and Critical Control Points (HACCP), the critical control points (CCPs).

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Global progress trends in nutrition are associated with the products which are enriched with functional ingredients that contribute to the promotion and strengthening of public health. The improvement of product quality is an essential condition of this process. It is the most important and determining factor of producer's success among the customers [3].

The factors of final dairy output quality include the characteristics of feedstock, components and materials, the individual stages of production that determine the overall

quality level of technological processes, as well as clear control system operation at all the stages of production.

The development of single standards and requirements for product safety is necessary for the members of the Customs Union – Russia, Belarus and Kazakhstan – in order to protect their markets from low-quality imports and reduce of trade barriers for their products and services within the scope of the Common Economic Space that has been formed since January 1, 2012.

The harmonization of technical regulations and standards of the Customs Union and the Single Economic Space will be conducted within the European legislation. It is one of the most important questions for Russia's accession to the World Trade Organization (WTO). Moreover, the problem of WTO should be seen as the problem of protecting domestic markets and the contest for the expansion into foreign markets. This applies primarily to the agricultural and food industries. According to the unanimous opinion of most experts, politicians and state figures, these branches will be the most vulnerable sectors in the first years of Russia's membership in WTO.

Meanwhile, the analysis shows that a lot of Russian enterprises haven't come to the point of this organization's requirements, so they are poorly prepared for Russia's entry into WTO. In this connection it should be noted that Russian companies have already entered the zone of risk; the current state of affairs urge them to think about competitiveness. The growing competition of foreign companies on the Russian domestic market and the low competitiveness of domestic products on the foreign market cause significant economic and social problems. The accession to WTO may increase these problems greatly if we don't reconstruct quality management and don't use the best international and national experience to improve the organization of production. As for the export ambitions of some enterprises, they will have to be left behind [4].

Upon the accession to WTO, many companies and the whole industries couldn't meet competition because of the influx of overseas goods and services which are often cheaper and of better quality. Western foodstuffs, which are well-subsidized and more competitive, will displace Russian products due to their amount and affordability, as it takes place in Ukraine. This will lead to the lack of domestic foodstuff competitiveness and consumer debalance in favor of imported chicken legs, stale meat, dairy products, etc.

According to expert estimates, only 25% of domestic enterprises can be able to compete with foreign producers on the domestic market, especially after the significant reduction of some customs duties.

Today, quality management system is one of the main methods to produce competitive products. Of course, this system should be effective. World experience in quality control management shows that the stable quality of a product can not be achieved without the stabile quality of raw materials. Therefore, there is a trend to closer cooperation between the manufacturers and suppliers of raw materials and component parts. This is true both for developed and developing countries, though these trends are different there. It is no coincidence that the international standard offers the procedure of choosing a supplier as an element of quality assurance system [6].

The cost of quality has a direct impact on the cost price for goods – a key competitive factor. The systematic analysis of these costs in order to optimize them is an integral part of enterprise's quality programs. The role of top management is undeniable in creating such a climate in the team, when the principle of "first and foremost quality" isn't just a slogan.

For over three decades the tasks of creating high-quality products have been solved in the world through the quality control system. Nowadays, the principles of quality management, which are influenced by the development

of economic, cultural and political systems of the country, are quite diverse. As for the quality assurance methods, the long-standing international practice shows that they are similar and some main trends can be pointed out in this connection [2].

Japanese scientist H. Taguchi expressed the essence of modern quality assurance methods in the following statements:

1. It is necessary to assess the damage that poor-quality products can inflict on the society. In this case we take into account the damage caused by finished products (refusals, injuries, accidents, impossibility of own functions performance, failure to meet customer requirements) and the damage in the production of defective products (waste of time, overhead energy, strength and toxicity of some manufacturing processes). It is necessary to take into account the amount of such damages in calculating the preventive costs of quality.

2. A company should continually improve production quality and reduce costs in order to produce competitive goods. It is necessary to take into account the fact that customer requirements increase constantly. This fact should be considered when developing a firm's strategy.

3. The main purpose of the program on improving products' quality must be the permanent reduction in the differences between the product quality indicators and characteristics specified by a customer. This task is associated with the regular improvement of metrological service.

4. The damage, which is suffered by a customer because of failure to comply with his requirements, is proportional to the square of deviation value of quality indicators. This must be taken into account when setting the requirements for the quality of production processes.

5. The quality and cost prices of finished product are mainly determined by the quality of design and technology. Therefore, it is necessary to focus on the requirements for the quality of finished products in designing and planning production process and control methods.

6. The deviation of product performances from the specified characteristics of product quality should be reduced during the development period and prototype tests.

7. It is necessary to identify the dependence of operational characteristics on other parameters of a product and technological process and plan an experiment based on statistical calculations using this dependence [5].

The HACCP system (Hazard Analysis and Critical Control Points) is the main model of quality management and food safety in the developed countries. The HACCP concept was developed in the early 80-ies of the XX century in the United States. The implementation of HACCP began in the European Union with the adoption of the Directive 93/43/EEC on the Hygiene of Foodstuffs. Then these countries developed national documents regulating the requirements of the HACCP system and the procedures for its development. The HACCP system had become the mandatory requirement in the U.S., Canada and most European Union countries by 2000. In 2004 the European Parliament and the Council of the European Union adopted the Regulation on the Hygiene of Foodstuffs instead of the Directive 93/43/EEC. According to Article 6, the executive agencies of the European countries should recognize as necessary the certification of the HACCP system that is carried out by competent authorities, i.e. by authorized governments of the countries in which they are located. In Russia the All-Russian Research Institute of Standards developed the State Standard R 51705.1-2001 "Quality systems. HACCP principles for food products quality management. General requirements" that was enacted on July 1, 2001. In the same year the State Standard developed and implemented the System of Voluntary Certification HACCP. Eleven certification agencies are operating today within the scope of this system.

As for food industry enterprises, HACCP is a system which allows the companies to direct their resources and efforts to the critical zones of production and, at the same time, it reduces the risk of manufacturing and selling a dangerous product. However, this system is a strong evidence of the fact that the producer provides all the conditions which guarantee the stable production of quality and safe products.

The modern HACCP system is based on seven principles, the consequent implementation of which allows the producers to develop, implement and successfully manage this system at the enterprise:

- Principle 1: Conduct a hazard analysis.
- Principle 2: Identify critical control points (CCPs).
- Principle 3: Establish critical limits for each critical control point.
- Principle 4: Establish critical control point monitoring requirements.
- Principle 5: Establish corrective actions.
- Principle 6: Establish record keeping procedures.
- Principle 7: Establish procedures for ensuring the HACCP system is working as intended.

The rapid expansion, general acceptance and extensive use of the HACCP system in the industrial experience can be explained by a number of advantages for the organizations which use it.

There are the following internal benefits of HACCP implementation:

✓ the basis of HACCP is a system approach to the parameters of food safety at all stages of life cycle – from processing raw materials to final consumer use of the product;

✓ the use of preventive measures rather than belated attempts to rework and withdraw products;

✓ the unambiguous determination of the responsibility for ensuring food safety;

✓ the exact identification of critical processes and focusing the main resources and efforts of the company on them;

✓ significant saving due to the reduction of the share of manufacturing defects in the total production volume;

✓ documentary evidence proving reliance upon the safety of foodstuffs that is particularly important when analyzing complaints and litigations.

There are the following external benefits of HACCP implementation:

➢ consumer confidence in products;

➢ the possibility of entering new markets, including the international ones, and expanding the present outlets;

➢ additional benefits for the participation in major tenders;

➢ improved competitiveness of a company's production;

➢ increased investment attractiveness of an enterprise;

➢ reducing the number of reclamations by providing stable quality of products;

➢ building up the reputation for producing quality and safe foodstuffs [7].

We have developed a working program of measures aimed at the implementation of the HACCP system at CJSC Totma Butter-Making Plant. It is located in the Totma District of the Vologda Oblast. The main activities of the company involve milk purchasing and processing. The plant is specialized in producing whole-milk foodstuffs. The main performance indicators of the plant in 2009 – 2010 are presented in *tables 1 and 2.*

The production volume decreased by 17.23% in 2010 as compared with 2009. The decline in whole-milk production is associated with the insufficient supply of feedstock.

There is the largest share of milk, curd and kefir in the output of products because they are the most popular foodstuffs. The company is going to expand the output of dairy products in future.

Table 1. Output volume and product mix in CJSC Totma Butter-Making Plant

Product	2009		2010		Deviation	
	Volume, t	%	Volume, t	%	(+;-)	%
Milk	1152.00	58.92	977.49	60.40	-174.51	84.85
Kefir	175.70	8.98	207.85	12.84	32.15	118.30
Sour cream	108.10	5.53	90.70	5.60	-17.40	83.90
Butter	116.80	5.97	71.52	4.42	-45.28	61.23
Curd	392.20	20.06	259.69	16.05	-132.51	66.21
Cheese	10.50	0.54	11.19	0.69	0.69	106.57
Total	1955.30	100.00	1618.44	100.00	-336.86	82.77

Table 2. Economic indicators of CJSC Totma Butter-Making Plant in 2009 – 2010

Indicator	2009	2010	Deviation, (+;-)
Cost price, thsd. rub.	131704.40	81702.00	-50002.40
Sales proceeds, thsd. rub.	120604.00	73531.00	-47073.00
Profit (loss), thsd. rub.	(12762.00)	(695.00)	+12067.00
Profitability of production, %	-9.7	-0.9	8.8
Profitability of sale, %	-10.05	-0.9	9.15

Unfortunately, a product range is quite narrow now, there is a lack of secondary raw milk products (they use little buttermilk and whey for normalization but the main amount of secondary milk is flown away through sewers. Nowadays, new products with various fillers and high biological and nutritional value are in great demand [1].

These figures show that the production was unprofitable both in 2009 and 2010. CJSC Totma Butter-Making Plant is inefficient. It is necessary to arrange special activities aimed at preventing and reducing damage and losses and increasing investment profit.

The main sources of profit are increased sales, reduced production costs, improving the quality of commodity output. The most important strategic goal of the company CJSC Totma Butter-Making Plant is an increase in the competitiveness of production sold in the markets.

The implementation program of the HACCP system can be considered in the case of the plant's curd production.

CJSC Totma Butter-Making Plant produced curd using traditional vats until 2005. The equipment was both physically outdated and obsolescent. The mechanization of curd making process was excluded. In addition, the produced curd did not always satisfy the requirements: there were the significant deliveries of raw milk of poor quality, so it was necessary to reduce the risk of secondary contamination and extraneous microflora growth in the finished products.

The curd production line by "Alpma" was run at the plant in 2005. The main difference between the curd production line and the traditional patterns of production is fully mechanized process that ensures high hygienic indicators and, consequently, increased shelf life of this product.

Dynamics of curd production by CJSC Totma Butter-Making Plant in 2006 – 2010 is presented in *table 3.*

The average level of dynamics range in that period:

$$y = \frac{\sum y_i}{n} = \frac{142423.00}{5} = 28484.60 \text{ thsd. rub.}$$

Absolute average annual increase:

$$\Delta y = \frac{\sum \Delta y_i}{n-1} = \frac{20890.00}{4} = 5222.50 \text{ thsd. rub.}$$

Table 3. Dynamics of curd production in 2006 – 2010

Year	Commodity output at current prices, thsd. rub.	Absolute increase		Growth rate, %		Rate of increase, %	
		Basic	Chain	Basic	Chain	Basic	Chain
2006	11231.00	-	-	-	-	-	-
2007	21205.00	9974.00	9974.00	188.8	188.8	88.8	88.8
2008	31520.00	20289.00	10315.00	280.7	148.6	180.7	48.6
2009	46346.00	35115.00	14826.00	412.7	147.0	312.7	47.0
2010	32121.00	20890.00	-14225.00	286.0	69.3	186.0	-30.7
Total	142423.00	-	20890.00	-	-	-	-

Growth coefficient:

$$C_g = \sqrt[n-1]{\prod_{i=1}^{n} PC_i} = \sqrt[4]{1.888 \cdot 1.486 \cdot 1.470 \cdot 0.693} \approx 1.300.$$

The curd production volume increased by 186% in 2010 as compared with 2006. But the company has significant reserves to improve the efficiency of curd production which are provided for in the HACCP system implementation at the plant during the period from 2012 to 2014.

Before developing the HACCP plan, the company's management has informed the entire engineering staff about their intentions. The personnel should fully share the idea of implementing the HACCP plan.

Production control at CJSC Totma Butter-Making Plant is effected by technical and microbiological control services, as their goal is ensuring production in strict accordance with the standards, improving taste and nutritional quality, increasing storage quality on the base of adherence to all technological modes of production.

In order to control quality we conducted researches and identified critical control points. The purpose of this phase was to determine the points, steps or procedures that can be applied to control, making it possible to prevent the hazards, eliminate or reduce them down to acceptable levels. There are the following examples of critical control points: thermal processing, cooling, chemical residues test for the ingredients, control over the structure of products, metal contamination test for products.

Critical control points have been set at the plant in accordance with the recommendations of the State Standard R 51705.1-2001 by the "decision tree" method.

Critical control points for incoming inspection of feedstock are shown in *table 4*.

In order to determine critical control points of the production process it was necessary to answer each question sequentially for every stage, where significant hazards had been identified, and for each hazard. Critical control points of the production process are shown in *table 5*.

The production process hazards were divided into the groups *(tab. 6)*.

Thus, five critical control points were identified:

– 1 CCP – spoilage microorganisms;

– 2 CCP – pathogenic and conditionally pathogenic microorganisms;

– 3 CCP – chemical toxicants in the environment;

– 4 CCP – radioactive elements;

– 5 CCP – extraneous impurities.

Monitoring system was developed for each critical control point in order to carry out planned observations and measurements which were necessary for the early detection of critical limits violations and the implementation of appropriate preventive or corrective effects (process setting-up).

Table 4. Critical control points of incoming feedstock (incoming inspection)

Name of feedstock	Hazard	B1	B2	CCP
Raw milk	Toxic elements	Yes	No	CCP (№1)
	Pesticides	Yes	No	CCP (№2)
	Antibiotics	Yes	No	CCP (№3)
	Radionuclides	Yes	No	CCP (№4)
	Coliform bacteria	Yes	No	CCP (№5)
	Quantity of mesophilic aerobes and facultative anaerobes	Yes	No	CCP (№6)
	Pathogens, including salmonella	Yes	No	CCP (№7)
	L.monocytogenes	Yes	No	CCP (№8)
Auxiliary feedstock	Toxic elements	Yes	No	CCP (№9)
	Pesticides	Yes	No	CCP (№10)
	Radionuclides	Yes	No	CCP (№11)
	Mycotoxins	Yes	No	CCP (№12)
	Nitrates	Yes	No	CCP (№13)
	Quantity of mesophilic aerobes and facultative anaerobes	Yes	No	CCP (№14)
	Coliform bacteria	Yes	No	CCP (№15)
	Staphylococcus aureus	Yes	No	CCP (№16)
	Pathogens, including salmonella	Yes	No	CCP (№17)
	Mold	Yes	No	CCP (№18)
	Yeast	Yes	No	CCP (№19)
	Minor impurities	Yes	Yes	Absent

The absence of unacceptable risk ensures frequency of monitoring procedures.

All registered data and documents related to the monitoring of critical control points must be signed by performers and registered in HACCP worksheets.

Corrective actions aimed at the violations of critical limits should be established and documented for each critical control point.

We have studied two competing products by 5 parameters (external qualities, taste, package security, market outlet, enterprise's prestige) of the elements of HACCP quality management system in points on a 5-point scale *(tab. 7)*.

The coefficient of competitiveness can be calculated by the formula:

$$C = (5\times35 + 5\times20 + 4\times15 + 4\times20 + 3\times10)/(5\times35 + 5\times20 + 4\times15 + 5\times20 + 4\times10) = 445/475 = 0.94;$$

$C < 1$ – low competitive products.

The introduction of the HACCP system will improve package security, expand market outlet and increase enterprise's prestige *(tab. 8)*.

There is the following calculation of the competitiveness coefficient:

$$C = (5\times35 + 5\times20 + 5\times15 + 5\times20 + 5\times10)/(5\times35 + 5\times20 + 4\times15 + 5\times20 + 4\times10) = 500/475 = 1.05.$$

$C > 1$ – high competitive products.

So, the implementation of the elements of the HACCP system is efficient and positive for an enterprise's activity.

The elements of production quality system have been implemented at CJSC Totma Butter-Making Plant since 2012. In order to analyze the cost of quality we have defined four groups of costs for the next three years *(tab. 9)*.

Table 9 shows that the structure of cost is changing. The shares of cost of controlling, internal and external costs of defective products are decreasing, while the cost of preventive measures is rising. The most important object of control is the percentage of quality assurance cost *(figure)*.

Indeed, if the quality management system functions, it reduces the amount of defective

Table 5. Critical control points of the production process

Stage of technological process	Hazard	Availability				CCP
		Close to zero	Insigni-ficant	Signi-ficant	Critical	
Cleaning and cooling	Coliform bacteria	No	-	-	-	Absent
	Quantity of mesophilic aerobes and facultative anaerobes	No	-	-	-	Absent
	Pathogens, including salmonella	No	-	-	-	Absent
	L.monocytogenes	No	-	-	-	Absent
Pasteurization and normalization	Quantity of mesophilic aerobes and facultative anaerobes	No	-	-	-	Absent
	Pathogens, including salmonella	No	-	-	-	Absent
	Coliform bacteria	No	-	-	-	Absent
	L.monocytogenes	No	-	-	-	Absent
	Glass	No	-	-	-	Absent
	Metal filings	Yes	No	Yes	No	CCP (№20)
Inoculation and ripening	Quantity of mesophilic aerobes and facultative anaerobes	No	-	-	-	Absent
	Pathogens, including salmonella	No	-	-	-	Absent
	Coliform bacteria	No	-	-	-	Absent
	L.monocytogenes	No	-	-	-	Absent
	S.aureus	No	-	-	-	Absent
	Yeast and mold	Yes	No	Yes	No	CCP (№21)
	Glass	Yes	No	Yes	No	CCP (№22)
	Metal filings	Yes	No	Yes	No	CCP (№23)
Bunch processing	Quantity of mesophilic aerobes and facultative anaerobes	No	-	-	-	Absent
	Pathogens, including salmonella	No	-	-	-	Absent
	Coliform bacteria	No	-	-	-	Absent
	L.monocytogenes	No	-	-	-	Absent
	S.aureus	No	-	-	-	Absent
	Yeast and mold	Yes	No	Yes	No	CCP (№24)
	Glass	No	-	-	-	Absent
	Metal filings	Yes	No	Yes	No	CCP (№25)
Reheating, whey removal	Quantity of mesophilic aerobes and facultative anaerobes	No	-	-	-	Absent
	Pathogens, including salmonella	No	-	-	-	Absent
	Coliform bacteria	No	-	-	-	Absent
	L.monocytogenes	No	-	-	-	Absent
	S.aureus	No	-	-	-	Absent
	Mold	No	-	-	-	Absent
	Glass	No	-	-	-	Absent
Quality control	Coliform bacteria	Yes	No	Yes	No	CCP (№26)
Marking and packaging	Quantity of mesophilic aerobes and facultative anaerobes	Yes	No	Yes	No	CCP (№27)
	Pathogens, including salmonella	Yes	No	Yes	No	CCP (№28)
	Mold	Yes	No	Yes	No	CCP (№29)
	L.monocytogenes	Yes	No	Yes	No	CCP (№30)
	Toxic elements	Yes	No	Yes	No	CCP (№31)
	Antibiotics	Yes	No	Yes	No	CCP (№32)
	Pesticides	Yes	No	Yes	No	CCP (№33)
	Radionuclides	Yes	No	Yes	No	CCP (№34)
	Coliform bacteria	Yes	No	No	-	Absent
Transportation	Quantity of mesophilic aerobes and facultative anaerobes	Yes	No	No	-	Absent
	Pathogens, including salmonella	Yes	No	No	-	Absent
	Mold	Yes	No	Yes	No	CCP (№35)
	L.monocytogenes	Yes	No	No	-	Absent
	Coliform bacteria	Yes	No	No	-	Absent
	Quantity of mesophilic aerobes and facultative anaerobes	Yes	No	No	-	Absent
	Pathogens, including salmonella	Yes	No	No	-	Absent
	Mold	Yes	No	No		Absent
	L.monocytogenes	Yes	No	No	-	Absent

Table 6. Groups of hazards

Relevant hazard	The group of relevant hazards
Yeast and mold	1. Spoilage microorganisms
Coliform bacteria	2. Pathogenic and conditionally pathogenic microorganisms
Listeria monocytogenes	
Salmonella	
Staphylococcus aureus	
Toxic metals	3. Chemical toxicants in the environment
Pesticides	
Antibiotics	
Nitrates	
Radionuclides	4. Radioactive elements
Glass, metal filings	5. Extraneous impurities

Table 7. The competitiveness indicators before the introduction of a quality management system based on the principles of HACCP (in points on a 5-point scale)

Indicators	Curd «Slavic»	Curd «Classic»	Indicator's share, %
External qualities	5	5	35
Taste	5	5	20
Package security	4	4	15
Market outlet	4	5	20
Enterprise's Prestige	3	4	10

Table 8. The competitiveness indicators after the introduction of a quality management system based on the principles of HACCP (in points on a 5-point scale)

Indicators	Curd "Slavic"	Curd "Classic"	Indicator's share, %
External qualities	5	5	35
Taste	5	5	20
Package security	5	4	15
Market outlet	5	5	20
Enterprise's Prestige	5	4	10

Table 9. Plant's costs of the quality system implementation in 2012 – 2014

Group of cost	2012		2013		2014	
	Amount, thsd. rub.	Structure, %	Amount, thsd. rub.	Structure, %	Amount, thsd. rub.	Structure, %
1. Cost of controlling	**176.30**	**25.5**	**138.53**	**21.2**	**129.53**	**20.2**
Remuneration of the personnel engaged in monitoring and testing	160.28		125.94		117.75	
The cost of materials	16.02		12.59		11.78	
2. Internal cost of defective products	**254.43**	**36.9**	**206.75**	**31.8**	**208.25**	**32.5**
The cost of spoiled goods	254.43		206.75		208.25	
3. External cost of defective products	**147.00**	**21.3**	**120.76**	**18.5**	**88.30**	**13.8**
Remuneration of the personnel engaged in reimbursement	17.80		14.69		10.77	
Transportation cost	4.5		2.70		1.80	
Cost price for spoiled goods	124.70		103.37		75.73	
4. Cost of preventive measures	**112.50**	**16.3**	**185.00**	**28.4**	**215.00**	**33.5**
Training, consulting, etc.	112.50		185.00		215.00	
Total costs	**690.20**	**100**	**651.04**	**100**	**641.08**	**100**

The cost structure of product quality assurance

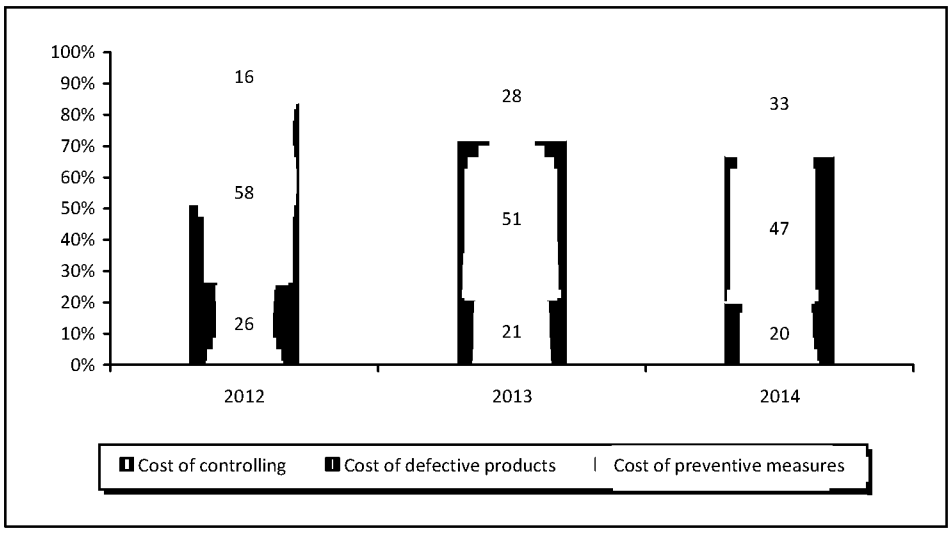

Table 10. Performance indices of CJSC Totma Butter-Making Plan after the introduction of a quality management system

Index	2012	2013	2014
The volume of production, t	250	260	270
Unit cost, rub.	124	127	130
Sell price for production unit, rub.	139	142	146
Cost of commercial output, thsd. rub.	31000	33020	35100
Sale proceeds, thsd. rub.	34750	36920	39420
Gross profit, thsd. rub.	3750	3900	4320
Implementation costs, thsd. rub.	690	651	641
Financial effect, thsd. rub.	+3060	+3249	+3679

products and the cost of controlling, and the main objective of the plant is to guide and coordinate the processes of production.

CJSC Totma Butter-Making Plant will be able to increase the volume of curd production in 2013 and 2014 because this product is competitive and it is in demand *(tab. 10)*.

According to these data, the cost price for curd is rising because the volume of production is increasing. Sale proceeds of these products will increase by 2170 thousand rubles in 2013 as compared with 2012 and by 2500 thousand rubles in 2014 in comparison with 2013.

The growth rate of profit will amount to 104% in 2013 as compared with 2012 and 110.77% in 2014 as compared with 2013.

The effectiveness of quality management is evaluated on the base of profit and profit margins (static values) and the dynamic rate of profit (dynamic values).

Since these values are positive, then the quality management of CJSC Totma Butter-Making Plant can be recognized as effective.

It is obvious that under increasing pressure of regulatory requirements on the food industry, the system similar to HACCP makes business more attractive, increasing its safety and quality standards.

These measures will expand product market of CJSC Totma Butter-Making Plant and, consequently, increase profit that remains at the disposal of the company after the sale of products.

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UDC 658.155:637.1 (043.3)

Methodology of estimating the economic efficiency of milk production technologies in the summer period

The methodology of estimating the milk production technologies efficiency during the summer period is described in the article. Three types of cow housing: stall and pasturable, camping and pasturable, stall and outdoor were analyzed and the results are produced here. It is proved, that for the farms of all types and sizes the camping and pasturable cow housing leads to the lowest values of reduced expenditures and milk cost price during the summer period. These performance indicators can be obtained only if the intensive technologies of milk production are used during the summer period, i.e. the combined green forage chain with the rotational rationed system of livestock grazing and two-shift work scheme.

Milk production technology, cow productivity, production cost, reduced expenditures, economic effect.

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In dairy cattle breeding, summer period is an important organizational and technological stage, which allows without any additional material costs to increase milk yields and reduce production costs, to improve the health of cows and their reproductive functions. With the proper organization of feeding, milking and housing of cows during this period, farm enterprises receive the cheapest milk, the production cost of which is 1,5 – 2 times lower, than during the stall housing [4]. Further improvement of the dairy cattle breeding technical equipment is becoming a trend, and a factor of economic changes; however, the choice of cow housing system in the summer period at the designing stage should be economically grounded, and in case of possessing appropriate means, farms should have a notion about the economic effect, which can be obtained when introducing innovative technologies.

Given the importance of the tasks facing the dairy cattle breeding concerning the production output increase and its cost price reduction, the aim of the work is to improve the methodology of estimating the milk production technologies efficiency during the summer period. To achieve this goal it is necessary to solve the following tasks: substantiate the distinctive features of the proposed methodology; select the criteria for evaluating the economic efficiency of the compared types of cow housing in the summer period; to specify the economic indicators calculation algorithm and approbate the methodology on a real object.

When selecting the most cost-effective technologies of milk production during the summer period it is necessary to correct existing methodical provisions and recommendations concerning the economic justification of standard project solutions of cattle-breeding farms and complexes according to the country's zones [1, 6], in order to estimate objectively the compared types of cow housing in the summer period with regard to the influence of various factors and production conditions.

The most important of these factors are the systems of cow housing and feeding in the summer period depending on the spatial, planning and constructive peculiarities of farms and summer cow camps, means of technological processes mechanization, systems of production and labour organization. The economic performance of technological options depends also on the different sizes and types of farms and summer camps, the productivity levels of cows, forage production options.

The differentiated approach used in the calculation of milk production costs by the periods of the year is the distinctive feature of the proposed methodology. In order to identify the main factors influencing costs in the summer period, it is necessary to vary the production technologies of that period only. It is necessary to consider the widespread cow housing types given the different variants of the green forage chain organisation: stall and pasturable, camping and pasturable with the use of various grazing types; stall and outdoor, camping and outdoor with the use of the green fodder and changing its transportation distance.

Another distinctive feature of the proposed methodology is the clarification of milk production costs calculation by taking into account the capital investments into the main livestock breeding assets along with the capital investments into the main fodder production assets. The latter change depending on the green forage chain options and influence the amounts of current as well as reduced expenditures.

Another distinctive feature of the methodological recommendations is the consideration of the time factor when calculating the reduced expenditures by the reduction of the main production assets to the single moment of time. Capital investments in buildings, constructions, equipment, summer camps, in the animals of the basic herd as well as the machinery for fodder production constitute the main production assets having different lifetime. While using the farm buildings with the longest service life, other fixed assets with shorter life duration will be repeatedly renewed. The total one-time accounting of all capital investments in the reduced expenditures calculation does not assess the compared options objectively enough.

Therefore, in order to take into account the time factor in calculating the reduced expenditures and the annual economic effect according to the technological options, it is necessary to multiply all capital investments in the basic production assets, renewable several times during the operation of the basic objects with the longest service life, by the variable reduction coefficient.

Economic efficiency estimation, when using different technologies and technical solutions, involves applying the system of indicators, reflecting the cost and natural characteristics of the studied cow housing types.

The objects under consideration, i.e. milk production technologies during the summer period, are a complex system; therefore, the technological processes efficiency estimation requires a multi-criterion approach. The efficiency criterion should be considered, taking into account the following aspects: the trends in the development of the summer cattle breeding technologies and forecast of optimal economic indicators of the studied technologies for the specific regional conditions of their application.

The maximum of the expected annual economic effect which is determined as the difference between the reduced costs of compared technological options is used as the global criterion to ensure the adequate, on the social production scale, approach to the planned perspective technologies.

$$E = (R_1 - R_2)A \rightarrow \max, \qquad (1)$$

E – annual economic effect, rubles;

R_1 and R_2 – reduced costs for the unit of production (work), produced (performed) with the use of basic and new equipment, rubles;

A – annual production (work) output with the use of new equipment in the estimated year, in physical units.

The expected annual economic effect describes the peculiarities and efficiency of the object as a whole. It connects the private, integral and local criteria. In the technological processes forecasting and optimization, with regard for the zonal conditions, it is suggested to use the reduced costs minimumas the integral (generalized) criterion, it establishes a linkage between private and local criteria, provides a compromise solution to the problem of technological variants optimization. It is suggested to use the reduced costs minimum index at the stage of making a decision concerning the farm or summer camp reconstruction or the new construction [3, 4].

Essentially, the reduced costs include both intensive and extensive components, i.e. the current production expenses and one-time expenses – capital investments in fixed assets.

Then the reduced costs of milk production during the summer period can be determined as follows:

$$R_{iab} = C_{iab} + E_N K_{iab}, \qquad (2)$$

E_N – normative coefficient of capital investments efficiency equal to the refinancing interest rate established by the RF Central Bank with regard to inflation;

C_{iab} – production unit cost, rubles;

K_{iab} – capital investments in the main production assets according to the technological options, reduced to the initial level by multi-plying by the reduction coefficient, (α_i), rubles.

The amount of capital investments in fixed assets is determined in accordance with the estimates and projects on standard sizes and types of farms or summer camps for cattle. Thereby, the standard general layout projects of the farms and camps' types and sizes are reduced to a comparable view according to the structure of buildings, constructions and the level of equipment, and the estimated costs are adjusted accordingly.

At pasturable cow housing the additional capital investments in permanent fences along drove paddocks, stock driving roads and at stall housing – around barn yards are taken into account.

In order to determine the amount of capital investments in tractors and machinery for forage production given the different variants of the green forage chain organization, the calculation of the required areas for forage procurement is produced here. The areas of herbage procurement for the summer period are calculated by dividing the gross requirement for each crop by its yielding capacity. The areas suitable for cultivation, maintenance and harvesting are multiplied by the specific capital investments in tractors and machinery for fodder production.

The production cost of milk in the summer period will be determined as follows [2, 5]:

$$C_{i\alpha\beta} = C^{F}_{i\alpha\beta} + C^{P}_{i\alpha\beta} + C^{AR}_{i\alpha\beta} + C^{E}_{i\alpha\beta} + C^{W}_{i\alpha\beta} + C^{MD}_{i\alpha\beta} + C^{L}_{i\alpha\beta} + C^{OM}_{i\alpha\beta} - C^{M}_{i\alpha\beta}, \quad (3)$$

i – sizes and types of farms and summer camps;

α – cow housing and feeding options in the summer period, ways of production and labour organization;

β – average productivity of cows in the summer period depending on the duration of the period, kg;

$C^{F}_{i\alpha\beta}$ – fodder price and the costs of its transportation and distribution according to the green forage chain options, rubles;

$C^{P}_{i\alpha\beta}$ – total payroll fund in the summer period, rubles.;

$C^{AR}_{i\alpha\beta}$ – amortization and current repair charges in the summer period, rubles.;

$C^{E}_{i\alpha\beta}$ – electricity costs in the summer period, rubles;

$C^{W}_{i\alpha\beta}$ – water costs in the summer period, rubles;

$C^{MD}_{i\alpha\beta}$ – expenses on medicines and disinfectants in the summer period, rubles;

$C^{L}_{i\alpha\beta}$ – cost of litter in the summer period, rubles;

$C^{OM}_{i\alpha\beta}$ – price for by-products (manure) in the summer period, rubles;

$C^{M}_{i\alpha\beta}$ – production organization and management costs, tax and insurance payments for the summer period, rubles.

The production cost of product unit (1 centner of milk) in the summer period is calculated according to the formula:

$$C^{I}_{i\alpha\beta} = \frac{C_{i\alpha\beta}}{n_i M^{100}_{\alpha\beta} m_\alpha}, \quad (4)$$

n_i – coefficient of cows and heifers population depending on the sizes and types of farms and summer camps;

$$M^{100}_{\alpha\beta} = M^{100}_{\beta} + T^{100}_{\beta} v_\alpha w,$$

$M^{100}_{\alpha\beta}$ – milk production per 100 cows with regard to calf crop, centners;

m_α – coefficient of cows productivity increase depending on the type of summer housing and feeding;

M^{100}_{β} – milk production per 100 cows during the summer period, centners;

T^{100}_{β} – calf crop per 100 cows during the summer period, head;

v_α – coefficient of increase of calf crop per 100 cows depending on the type of summer housing and feeding;

w – coefficient indicating the relation between the number of calves and milk yield accepted at the rate of 1.5 centners for 1 calf.

Fodder price and the costs of its transportation and distribution according to the green forage chain options are calculated by the formula:

$$C^{F}_{i\alpha\beta} = n_i (C^{1003H}_{\alpha} + N^{1003F}_{\alpha} P^{HT} + C^{100RFC}_{\alpha}) + (P^{CF} + P^{CFT}) + (n_{iC} N^{100CFC}_{\beta} + n_{iH} N^{100CFH}_{\beta}) + C^{FL}_{i\alpha}, \quad (5)$$

n_{iC} – cow population coefficient;

n_{iH} – heifers population coefficient;

C^{1003H}_{α} – herbage cost per 100 cows depending the green forage chain options, rubles;

C^{100RFS}_{α} – costs and expenses on the transportation of roughage feed and microaddings from a farm to a camp per 100 cows, rubles;

P^{HT} – cost of herbage transportation depending on the distance, rubles/t;

P^{CF} – price for the concentrated feedstuffs, rubles/t;

P^{CFT} – cost of the concentrated feed stuffs transportation, rubles/t;

N^{1003F}_{α} – requirement for the green fodder procured outside a pasture per 100 cows, t;

N^{100CFC}_{β} – requirement for concentrated feedstuffs in summer per 100 cows, t;

N^{100CFH}_{β} – requirement for concentrated feedstuffs in summer per 100 heifers, t;

$C^{E}_{i\alpha}$ – expenses for fuels and lubricants (fodder loading and distribution) in the summer period per a farm, camp, rubles.

The costs of the feedstuffs are firstly determined per 100 cows by multiplying their gross requirement by the production cost calculated in operation cards; secondly, they are multiplied by the livestock population coefficients, corresponding to the types and sizes of farms and summer camps.

The costs for transportation of mineral additives and concentrates from a farm to a camp are additionally taken into account, as well as roughage transportation in transition periods.

The requirement for feedstuff for several livestock productivity levels is calculated per 100 cows given the feeding rates, which take into account the energy and protein concentration in dry matter of the diet. In order to simplify the calculations, the gross demand for herbage in summer can be considered common for all levels of cows' productivity, but not less than 60 kg per head.

The need for concentrates per 100 cows at different productivity levels is calculated on the basis of 3 physiological groups into which a herd is divided: newly calved cows under 100 days of lactation (26 head),dairy cows 100 up to 300 days of lactation (56 head), dry cows (16 head). This distribution of the cows livestock in a herd is given with regard to regular annual calving.

The green forage chain options, most acceptable in the Non-Black Earth Zone, per 100 cows for different types of pastures and without them are developed for calculating green fodder input in the summer period. Grazing performance, the distribution of green matter yield by the cycles, average yielding capacity of annual and perennial crops are determined by the generalization of the region's data.

The expenses for fuels and lubricants during the loading and distribution of fodder in the summer period are calculated according to the formula:

$$C_{i\alpha}^{FL} = K_i(\sum_{i}^{K} \frac{N^{1003H} + N^{100RF}}{W})P^{FL}, \quad (6)$$

i – types and sizes of farms and camps;

K_i – amount of technical means;

N^{1003H} – need for herbage per 100 cows, t,

N^{100RF} – need for roughage feed per 100 cows in summer, t;

W – technical equipment (loader and fodder distributor) performance per hour of the main time, t/hour;

P^{FL} – cost of fuels and lubricants per 1 hour of operational work of technical equipment, rubles/hour.

In order to calculate the payroll fund for the summer period it is necessary to determine the labour intensity of the works, the number of maintenance and management personnel depending on the size of the farm or summer camp, the system of cow housing in the summer and stabling periods, the average annual and summer productivity of the animals, the work management, the duration of the grazing period.

The number of livestock maintenance personnel (milking machine operators – milkers; livestock maintenance personnel – cattlemen, shepherds; cattle-feeding operators, etc.)is calculated according to the standard norms of livestock maintenance, depending on the level of production organization and mechanization.

The number of administrative personnel can be defined by the norms of technological projecting.

Labor costs per 1 centner of production, depending on the technology options, are determined by dividing the total working time fund by gross milk production.

Depreciation and current repair allocations in the summer period are calculated as follows:

$$C_{i\alpha\beta}^{DR} = (C_{i\alpha}^{DRF} + C_{i\alpha}^{DRC} + C_{i\alpha}^{DRP}) \frac{D^S}{365,} \quad (7)$$

D^S – duration of the summer period, days;

$C_{i\alpha}^{DRF}$ – depreciation and current repair allocations for a farm, rubles;

$C_{i\alpha}^{DRC}$ – depreciation and current repair allocations for a summer camp or summer barnyards, rubles;

$C_{i\alpha}^{DRP}$ – depreciation and current repair allocations for the fencing of pastures and livestock pasture watering equipment, rubles.

The amounts of depreciation and current repair allocations are defined according to the current normative and reference material.

The electricity costs in the summer period are determined as follows:

$$C_{i\alpha\beta}^{E} = n_i E_\alpha 100 P^E \frac{D^S}{365}, \quad (8)$$

E_α – summarized norms of energy consumption in production processes for 1 head of livestock per year depending on the summer housing option, kWh/head a year;

$100P^E$ – price for 1 kW•h of electricity for agriculture, rubles.

The costs of water supply:

$$C_{i\alpha\beta}^{W} = n_i W 100 P^W D^S, \quad (9)$$

W – summarized rate of water consumption for one cow per day, m^3;

P^W – the cost of water, rubles/m^3.

Costs of medicines and disinfectants:

$$C_{i\alpha}^{MD} = n_i 100 P^{MD} \frac{D^S}{365}, \quad (10)$$

P^{MD} – price for medicines and disinfectants for one cow per year in average, rubles.

The cost of litter and by-products (manure) in the summer period are determined according to the formulae:

$$C_{i\alpha}^{L} = n_i 100 N^L D^S P^L, \quad (11)$$

N^L – amount of litter for one cow per day, t;

P^L – price for litter, rubles/t.

$$C_{i\alpha}^{M} = n_i 100 (N^M + N^L) 0.7 D^S P^M, \quad (12)$$

N^M – manure output for one cow per day, t;

0.7 – organic fertilizer output rate;

P^M – price for by-products, rubles/t.

The average data on the regional farms' expenses can be used in order to simplify the calculations of production and management costs, insurance payments in the summer period for all the options.

$$C_{i\beta}^{PM} = n_i 100 C_\beta \frac{D^S}{365}, \quad (13)$$

C_β – farms' average expenses for organizing management and production, rubles.

The three types of cow housing: stall and pasturable, camping and pasturable, stall and outdoor were compared, and the results prove that the lowest values of milk production costs during the summer period are obtained for all farm types and sizes (200, 400, 600, 800 head) when using the camping and pasturable cow housing type [4]. Accordingly, in the summer period, the milk production cost is 19 – 26% lower, reduced costs are 6 – 7% lower, and the profit is 12 – 16% higher than the indicators for the stall and outdoor cow housing.

The stall and pasturable cow housing ranks second according to the performance indicators: the milk production cost in the summer period is 20 – 27% lower, reduced costs are 5 – 6% lower, and the profit is 10 – 15% higher than the indicators for the stall and outdoor housing.

If a summer camp is located at a 12 km distance from a farm, the economic performance indicators decline insignificantly – in the limit of 1%. For the stall and outdoor housing, if herbage transportation distance increases from 3 to 12 km, the milk production cost in the summer period increases by 6 – 8% and reduced costs – by 2 – 3%.

The construction of summer camps requires from 1000 to 3000 rubles of additional capital investments per one cow.

However, this eliminates the need for hard surface barn- and feed yards, which allows reducing capital investments for the farm improvement up to 1000 rubles per one cow. In addition, capital investments in agricultural equipment for fodder production increase 1.2-fold and fuel and lubricants consumption increases by 10 – 14% per year when using the green forage chain of grazing crops as compared to the pasturable cow housing type.

These efficiency indicators can be obtained only when using the intensive technologies of milk production during the summer period [3], i.e. the combined green forage chain with the rotational rationed system of livestock grazing and two-shift work scheme. When using camping and pasturable housing type, it is essential to implement advanced planning and building solutions for summer camps and new technological equipment.

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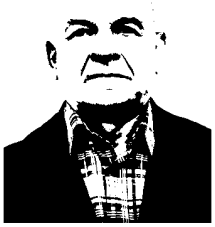
UDC 338.43 (470.13)

Assessment of innovation and investment projects of municipality's development in the northern region*

The article reveals the dependence of the development of rural economy's basis branch – the agricultural sector – on innovation. It shows the role of cattle breeding in providing the people with low-transportable dairy and meat products, peasant employment and rational use of natural forage grasslands. The authors examine the evaluation technique of innovation and investment project efficiency and reveal the effective implementation of such projects in cattle breeding in the peripheral northern rural region in the case of the Republic of Komi. There is a calculation of commercial efficiency indices of constructing 100 and 200 head dairies with the use of innovative technologies in different variants of state support. The article proves that it is necessary to strengthen the state support to farmers' income and prolong the terms of concessional lending for the modernization of innovative cattle breeding.

Cattle breeding, innovation, technique of effectiveness, innovation and investment projects, peripheral region, the Republic of Komi.



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The urgency of cattle breeding development on the base of modernization and innovation technology

The urgency and significance of cattle breeding modernization for the Northern Zone based on the use of innovation technology is caused by the need of preserving and developing this important industry. The development of cattle breeding is constrained by the lack of investment and low level of their efficiency.

* The article was prepared as a part of research projects of UB RAS No. 12-U-7-1013, and young scientists and postgraduate students No. 11-7-NP-399.

The research is aimed at assessing economic efficiency of innovation and investment projects in dairy and beef breeding in the Republic of Komi for making management decisions on attracting investment to the industry. Proceeding from the research objectives, the following tasks were solved:

1. To assess the recoupment of 100 and 200 head dairies construction in different variants of state support, using the indicators of commercial efficiency of innovative and investment projects.

2. To identify the eligibility of current terms of concessional lending and the level of state support for the construction and modernization of livestock houses in the North.

3. To develop practice guidelines for applying a differentiated approach to the terms of concessional lending and pricing support for the industry based on the analysis of innovation and investment projects effectiveness.

Cattle breeding is very important for rural areas of the North. It provides the population with low-transportable dairy and meat products, ensures the whole-year employment and allows peasants to use natural grasslands more efficiently. Northern hayfields and pastures are the sources of the cheapest and complete feed. Huge meadow tracts, laying in high-water beds, are especially valuable from the economic point of view. For example, it is possible to gather more than 410 tons of fodder units from the flood meadows of the Northern Dvina, Pechora, Mezen, Pinega, Vychegda and their tributaries [1, p. 73].

The development of cattle breeding is highly dependent on investment growth and transition to innovative technologies. Investments have been substantially reduced over the years of market reforms. Over the period from 1990 to 2010 the investment share in the fixed capital of Komi agriculture declined from 5.7 to 0.8% when the share of agriculture in the gross regional product amounted to 2.6%. The investment decline rate in the agricultural sector was more than four times higher than in the whole republic [2, p. 26]. Naturally, this affected launching of production capacity, primarily for cattle breeding, and ageing of livestock house and equipment. If 2.8 thousand places for cattle were launched in 1990 due to new construction, expansion and renovation, in 2010 only 0.4 thousand places for cattle were built [4, p. 24].

Figure 1. Launching cattle production capacity in the Republic of Komi in 1995 – 2010, thsd. places for cattle

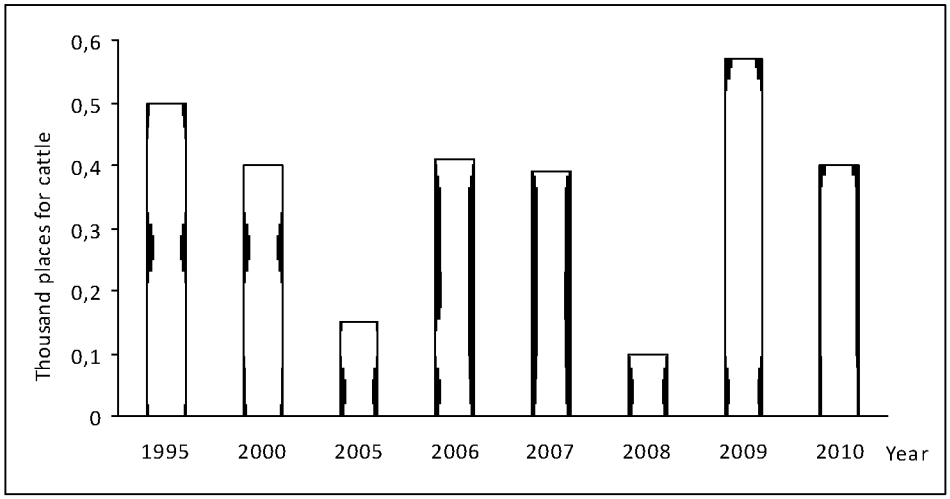


Figure 2. Dynamics of milk production on the farms of all categories in the Republic of Komi in 1990 – 2010, thsd. t

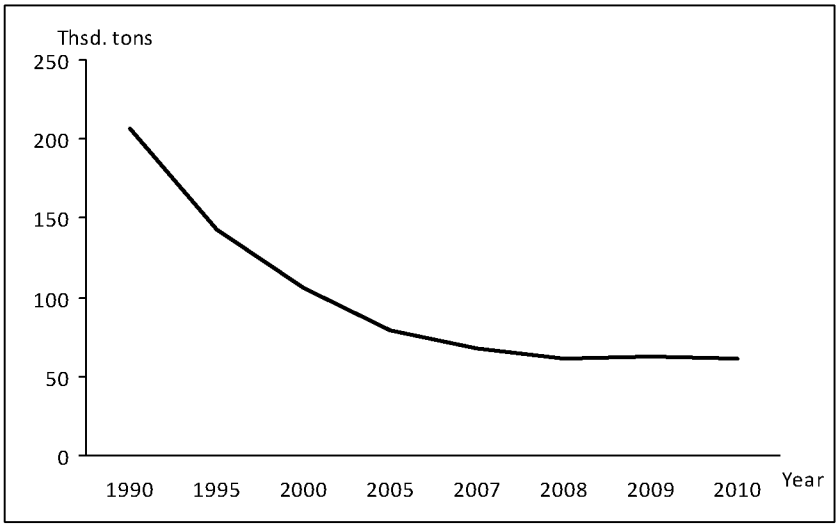
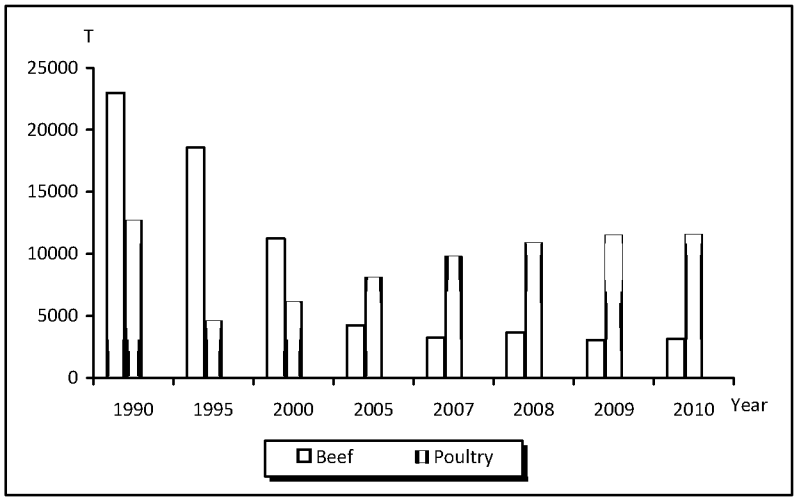


Figure 3. Dynamics of beef and poultry production on the farms of all categories in the Republic of Komi in 1990 – 2010, thsd. t



The implementation of the State Program for the Development of Agriculture and Markets Regulation of Agricultural Production, Raw Materials and Food for 2008 – 2012 slightly revived the innovation activity in the industry *(fig. 1)*. Currently, however, investments are attracted by suburban areas. Peripheral agricultural organizations and farm enterprises are in special need of investments. Fixed assets of agricultural cattle-breeding enterprises in the remote areas are worn out by more than 70%.

The negative situation in the industry is characterized by statistical data *(fig. 2, fig. 3)*. There has been 3.4-fold decrease in milk production and a 5.9-fold decrease in beef production for the period of twenty years [5, p. 45].

Efficiency assessment method for innovation and investment projects

Economic assessment of innovation and investment projects is especially important in connection with the modernization of industry and development of innovation technologies.

The foreign experience in investment calculations, which is based on the analysis of financial flows – dynamics of income and outgoings associated with the project, is significantly interesting. This approach is the basis of the Methodical Recommendations on Assessing Innovation Projects [3].

The Recommendations propose to divide innovation project's efficiency indices into the following types:

- commercial (financial) efficiency indices, taking into account the financial implications of the project for its direct participants;
- budget efficiency indices, reflecting the financial implications of the project for the federal, regional and local budgets;
- economic efficiency indices, taking into account the costs of project's implementation, but which go beyond the direct financial interests of innovation project's participants and allow cost measurement.

The effectiveness of an innovative project is characterized by a system of indices that includes net present value, profitability index, internal rate of return and payback period.

Net present value (NPV) is defined as the sum of present effects, reduced to the initial step, or the difference between discounted profits and costs at a fixed discount rate:

$$NPV = -I + \frac{P_1}{(1+d)^2} + \frac{P_2}{(1+d)^2} + \frac{P_3}{(1+d)^3} + \ldots + \frac{P_t}{(1+d)^t}, \quad (1)$$

where I – investment costs that are required to implement the project;

P – net cash flow at time t;

d – discount rate.

If NPV > 0, return on investment exceeds the minimum discount coefficient. If NPV < 0, project profitability is lower than the minimum coefficient and the project should be rejected.

Profitability index (PI) is the ratio of discounted profit amount to the amount of discounted cost.

The project is considered to be effective if its profitability index is greater than or equal to unity. Profitability index allows us to compare the projects of various scales and choose the most effective project.

$$PI = \frac{\frac{P_1}{(1+d)^1} + \frac{P_2}{(1+d)^2} + \frac{P_3}{(1+d)^3} + \ldots + \frac{P_t}{(1+d)^t}}{I}, \quad (2)$$

The project is considered to be attractive, if PI > 1; the project should be rejected, if PI < 1.

Internal rate of return (IRR) is a discounted rate that makes the net present value equal to zero. An innovative project is considered to be efficient if its internal rate is greater than or equal to the fixed discount rate, corresponding to opportunity cost of capital.

Internal rate of return (IRR) is calculated as follows:

$$IRR = d_1 + \frac{NPV_1}{NPV_1 - NPV_2} \times (d_2 - d_1), \quad (3)$$

where d_1 – discount rate, corresponding to opportunity cost;

d_2 – discount rate for negative net present value (NPV2);

NPV_1 – net present value for discount rate d_1.

Payback period on investment defines the time from project's investment starting till the moment when net project income covers the initial investment. The payback period is determined by discounting. Simple payback period (without discounting) is calculated for approximate calculations. The project is considered to be effective when its payback period is less than the term of project's implementation.

The effectiveness of innovation and investment projects implementation in cattle breeding in a peripheral region of the Republic of Komi

Using this technique, we'll calculate economical construction efficiency of livestock buildings for the agricultural organizations that are situated in peripheral Udorsky District in the Republic of Komi – agricultural production cooperative (APC) Collective Farm Chernu-

tyevskiy and APC Vashka. Nowadays, APC Collective Farm Chernutyevskiy has 55 cows, and it is going to increase the total number of cattle up to 100 head. In order to fulfill this task, the farm should lease 45 Ayrshire heifers in the period from 2013 to 2015. They will cost 2.48 million rubles. The Ministry of Agriculture and Food of the Republic of Komi will refund their purchase in the amount of 1.44 million rubles. The construction of a cowshed, purchasing equipment and heifers will cost 18.28 million rubles. The Ministry of Agriculture and Food will refund 70% of construction and equipment costs.

The system of cattle housing in new buildings will be stall and pasturable in summer and stall and outdoor in winter. There will be untethered method of cattle housing on the farm. Cattle will be kept on deep litter. Cattle's food ration will consist of natural forage, mainly of grass from the meadows and pastures. Cattle breeding in these agricultural organizations meets the principals of organic production. It is planned to breed highly productive Ayrshire cows; fat content of their milk is 4.2 – 4.5%. All processes will be mechanized and automated.

In the scope of this project we calculated the current costs based on the following fact. Five people, two of them are milkmaids, will service cows. It is planned to increase average monthly wage up to 30 thousand rubles, which corresponds to the average level of the republic economy. Depreciation cost is calculated taking into account that cowshed will be exploited for 50 years, equipment – for 10 years and lifespan of cows will be 5 years. Depreciation cost will amount to 740 thousand rubles in 2013. It is planned to increase cow productivity up to 5500 kg per year.

It is assumed in the calculation that the current state support from the budget of the Republic of Komi will be saved. The forecast of cash flows of this innovation and investment project to APC Collective Farm Chernutyevskiy is based on these conditions *(tab. 1)*.

The analysis of financial indicators shows that the net profit of project implementation is 16.9 million rubles, and net income (the difference between net profit and the amount of loan repayment) is estimated at 12.3 million rubles.

The simple rate of return on total investment costs (R) is calculated by the following formula:

$$R = \frac{NP + P/^{t}}{I} \times 100\%, \quad (4)$$

where NP – net profit;

P – interests on loan capital;

I – overall investment costs;

t – investment period.

$$R = \frac{(16942 + 1281)/8}{18280} \times 100\% = 12.5\%.$$

Simple payback period (without discounting) is calculated by the following formula:

$$I = \sum_{t=1}^{T} (NP_t + D_t + P_t), \quad (5)$$

where T – payback period;

NP_t – net income per year t;

D_t – depreciation per year t,

P_t – interests on loan capital per year t.

Simple payback period will be:

$$18280 = (425+740+184)_1 + (602+850+177)_2 + (748+960+170)_3 + (885+990+162)_4 + (971+990+156)_5 + (1075+990+150)_6 + (1173+990+144)_7 + (1368+990+138)_8 + 2252.$$

The components of the right-hand side of the equation allow us to determine the payback period that is equal to 8.93 years.

Return on investment (simple rate of return) is equal to 12.5%, and payback period on investment is 8.93 years, so it is longer than project investment period (8 years). Net profit of the project will be gained in more than 14 years.

Table 1. Cash flow forecast for the implementation of innovation and investment project "100 Head Dairy Farm" with the current state support to APC Collective Farm Chernutyevskiy, thsd. rub.

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	**Total**
1. Cash inflow - total	15300	8893	10166	11853	12559	13322	14212	15174	16091	16916	18015	18746	20153	21568	**212958**
Including: 1.1. Sales revenues	-	7693	9066	10653	11809	12522	13362	14254	15096	15846	16855	17526	18843	20193	**183718**
1.2. Budgetary funds	10700	1200	1100	1200	750	800	850	920	995	1070	1150	1220	1310	1375	**26090**
1.3. Bank loans	4600	-	-	-	-	-	-	-	-	-	-	-	-	-	**4600**
2. Cash payment, total	15800	7938	9094	10515	10594	11221	11731	12524	13171	13423	14190	15050	16100	16995	**178346**
Including 2.1. Investment cost	15800	750	820	910	-	-	-	-	-	-	-	-	-	-	**18280**
2.1.1. Investment in fixed assets	15300	750	820	910	-	-	-	-	-	-	-	-	-	-	**17780**
2.1.2. Working capital financing	500	-	-	-	-	-	-	-	-	-	-	-	-	-	**500**
2.2. Current costs (except for depreciation)	-	6244	7292	8590	9547	10136	10830	11584	12188	12833	13540	14350	15340	16180	**148654**
2.2.1. Wages with taxes	-	2400	2640	2850	2980	3100	3350	3480	3560	3796	3930	4120	4280	4430	**44916**
2.2.2. Material cost	-	3480	4250	5320	6115	6550	6940	7490	7950	8427	8930	9460	10200	10810	**106222**
2.2.3. Interest for loans	-	184	177	170	162	156	150	144	138	-	-	-	-	-	**1281**
2.2.4. Other costs	-	180	225	250	290	330	390	470	540	610	680	770	860	940	**1030**
2.3. Commercial expenses	-	100	115	125	140	165	185	210	235	260	290	320	350	365	**6535**
For reference only: Capital depreciation Product cost Taxable profit Production profitability, %	 - - - -	 740 7084 609 8.6	 850 8257 809 9.8	 960 9675 978 10.1	 990 10677 1132 10.6	 990 11291 1231 10.9	 990 12005 1357 11.3	 990 12784 1470 11.5	 990 13413 1683 11.8	 990 14083 1763 12.6	 990 14820 2035 13.8	 610 15280 2246 14.7	 610 16300 2543 15.6	 610 17155 3038 18.4	 **11310** **162824** **20894** -
2.4. Unified agricultural tax	-	184	207	230	247	260	282	297	315	330	360	380	410	450	**3952**
For reference only: Net profit	-	425	602	748	885	971	1075	1173	1368	1433	1675	1866	2133	2588	**16942**
2.5. Loan repayment	-	660	660	660	660	660	433	434	433	-	-	-	-	-	**4600**
3. Net cash flow (NCF)	-500	955	1072	1338	1965	2101	2481	2650	2920	3493	3815	3696	4053	4573	**34612**

In order to assess the economic efficiency of the project it is important to take into account the various values of funds for project's participants that are gained or spent by them at the different points of time. The flows taking place at different times are compared by discounting, i.e. by the reduction of flows (incomings and outgoings) taking place at different times to a single point of time.

Discount rate in our calculation is estimated at the rate of 8%. Net present value of the project is defined as follows:

$$NPV_1 = -18280 + \frac{955}{(1+0.08)^1} + \frac{1072}{(1+0.08)^2} + \frac{1338}{(1+0.08)^3} + \frac{1965}{(1+0.08)^4} + \frac{2101}{(1+0.08)^5} + \frac{2481}{(1+0.08)^6} + \frac{2650}{(1+0.08)^7} + \frac{2920}{(1+0.08)^8} + \frac{3493}{(1+0.08)^9} + \frac{3815}{(1+0.08)^{10}} + \frac{3696}{(1+0.08)^{11}} + \frac{4053}{(1+0.08)^{12}} + \frac{4573}{(1+0.08)^{13}} = 859.8 \text{ thsd. rub.}$$

A positive value of this indicator proves the economic attractiveness of the project.

Profitability index is calculated as follows:

$$PI = \frac{(884.3+919.4+1082.52+1471.9+1457.0+1593.5+1575.5+1607.0+1780.3+1799.5+1615.4+1640.2+1713.4)}{18280} = 1.04.$$

Profitability index is greater than unity, so the project is considered to be economically advantageous.

It is necessary to calculate negative net present value (NPV_2) to determine the internal rate of return. A discount rate is 12%.

$$NPV_2 = -18280 + \frac{955}{(1+0.12)^1} + \frac{1072}{(1+0.12)^2} + \frac{1338}{(1+0.12)^3} + \frac{1965}{(1+0.12)^4} + \frac{2101}{(1+0.12)^5} + \frac{2481}{(1+0.12)^6} + \frac{2650}{(1+0.12)^7} + \frac{2920}{(1+0.12)^8} + \frac{3493}{(1+0.12)^9} + \frac{3815}{(1+0.12)^{10}} + \frac{3696}{(1+0.12)^{11}} + \frac{4053}{(1+0.12)^{12}} + \frac{4573}{(1+0.12)^{13}} = -188.6 \text{ thsd. rub.}$$

The internal rate of return is calculated by the formula 3:

$$IRR = 8 + \frac{859.8}{859.8-(-188.6)} \times (12-8) = 11.3\%.$$

The internal rate of return is higher than the discount rate (8%), this fact indicates the economic attractiveness of the project.

It is necessary to calculate a cumulative cash flow in order to determine the discounted payback period of the project *(tab. 2)*.

Discounted payback period (DP_P) is calculated by the following formula:

$$DP_P = n - \frac{K_{nt}}{p(t+1)}, \quad (6)$$

where n – the number of years when a cumulative cash flow is less than zero;

K_{nt} – the last year when the value of cumulative cash flow is negative;

$P_{(t+1)}$ – the discounted cash flow that follows the last negative cumulative cash flow.

$$DP_P = 12 - \frac{-853.5}{1713.4} = 12.49 \text{ years}$$

The discounted payback period of the project is equal to 12.49 years; it is longer than the loan taken (8 years). Therefore, this innovation project is considered to be ineffective.

Under the current support the profitability level of agricultural production at APC Collective Farm Chernutyevskiy will amount from 8.6% in 2013 to 18.4% in 2025; these figures are below the optimal rate of return (40 – 50%). In this situation this agriculture organization can start building a farm, if the period of long-term loan will be at least 13 years.

The efficiency of the innovation and investment project for APC Collective Farm Chernutyevskiy is defined in achieving the optimal level of livestock production profitability. It is planned to increase a profitability level from 7.2% in 2013 up to 38.5% in 2015 and up to 48% in 2020. This task will require a significant rise in the guaranteed prices for dairy products and beef.

Table 2. The calculation of a cumulative cash flow of the innovation and investment project for APC Collective Farm Chernutyevskiy in 2012 – 2025, thsd. rub.

Indicator	Cash outflow in 2012	2013	2014	2015	2016	2017	2018	2019
Cash flow	-15800	955	1072	1338	1965	2101	2481	2650
Discounted cash flow	-15800	884.3	919.4	1082.5	1471.9	1457.0	1593.5	1575.5
Cumulative cash flow	-15800	-15800 + 750 + 884/3 = -15665.7	-15665.7 - 820 + 919.4 = -15566.3	-15566.3 – 910 + 1082.4 = -15939.8	-15393.8 + 1471.9 = -13921.3	-13921.9 + 1457.0 = -12464.9	-12464.9 + 1593.5 = -10871.4	-10871.4 + 1575.5 = -9295.9

Indicator	Cash outflow in 2012	2020	2021	2022	2023	2024	2025
Cash flow	-15800	2920	3493	3815	3696	4053	4573
Discounted cash flow	-15800	1607.0	1780.3	1799.5	1615.4	1640.2	1713.4
Cumulative cash flow	-15800	-9595.9 + 1607.0 = -7688.9	-7688.9 + 1780.3 = -5908.6	-5908.6 + 1799.5 = -4109.1	-4109.1 + 1615.4 = -2493.7	-2493.7 + 1640.2 = -853.5	-853.5 + 1713.4 = 859.8

The calculation shows that the return on investment (simple rate of return) is equal to 22.4% and payback period is 4.52 years, which is less than the investment period of this project. The discounted payback period (7.1 years) is less than the period of project's implementation. Therefore, this investment and innovation project will be effective while maintaining the existing state support and ensuring the optimal level of livestock production profitability.

The economic evaluation of building 200 head dairy farm for APC Vashka was carried out similarly. The investment costs of building a cowshed, purchasing equipment and Ayrshire heifers will amount to 30 million rubles.

It is planned to have cattle housing conditions, production rates of cows and the form of state support that are similar to the Project for APC Collective Farm Chernutyevskiy.

With the current state support the net profit of project implementation is 28.8 million rubles and net income (the difference between net profit and the amount of loan repayment) is estimated at 19.8 million rubles.

The simple rate of return on total investment costs:

$$R=\frac{(28778+2510)/8}{34810}\times 100\%=11.2\%.$$

Calculations show that the simple payback period for this project will be 9.16 years.

Payback period on investment (without discounting) is longer than the investment period of this project. Net profit of the project will be gained in more than 15 years.

Profitability index:

$$PI = \frac{1949.1+2354.2+2540.5+2985.1+3034.7+3355.8+3290.7+3243.8+3732.9+3706.1+3701.5+3719.6+3856.1}{34810} = 1.19.$$

Discounted payback period is 11.25 years; it is longer than the implementation period of this project. Therefore, this innovation project is considered to be ineffective.

The calculation of investment and innovation project efficiency indicators for APC Vashka at the optimal level of livestock produce profitability shows that the net profit of project implementation is equal to 48.7 million rubles and net income (the difference between net profit and the amount of loan repayment) is estimated at 39.7 million rubles *(tab. 3)*.

Simple rate of return on total investment costs will amount to:

$$R = \frac{(48721+2510)/8}{34810} \times 100\% = 18.4\%.$$

Simple payback period (without discounting) is calculated as follows:

$$34810 = (2009+1950+360) + (2780+2170+346) + (3607+2320+332) + (4995+2320+319) + (6100+2320+306) + (7417+2320+294) + 2576 = 5.26 \text{ years}.$$

Return on investment (simple rate of return) is equal to18.4%, and payback period on investment is 5.26 years, and so it is less than project investment period.

Table 3. Cash flow forecast for the implementation of innovation and investment project "200 Head Dairy Farm" at the optimal level of produce profitability to APC Vashka, thsd. rub.

Indicator	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1. Cash inflow - total	30000	21621	24399	26942	28536	31761	35188	40432	46307	285186
Including: 1.1. Sales revenues	-	20321	22949	25372	28536	31761	35188	40432	46307	250866
1.2. Budgetary funds	21000	1300	1430	1570	-	-	-	-	-	25300
1.3. Bank loans	9000	-	-	-	-	-	-	-	-	9000
2. Cash payment, total	31500	18667	20404	21960	22526	24646	26276	29364	32572	227915
Including 2.1. Investment cost	31500	1000	1100	1210	-	-	-	-	-	34810
2.1.1. Investment in fixed assets	30000	1000	1100	1210	-	-	-	-	-	33310
2.1.2. Working capital financing	1500	-	-	-	-	-	-	-	-	1500
2.2. Current costs (except for depreciation)	-	15640	17161	18496	20118	22086	24036	26873	29790	174200
2.2.1. Wages with taxes	-	5850	6435	6950	7576	8334	9085	10175	11294	65699
2.2.2. Material cost	-	8680	9550	10314	11242	12366	13480	15098	16760	97490
2.2.3. Interest for loans	-	360	346	332	319	306	294	282	271	2510
2.2.4. Other costs	-	750	830	900	981	1080	1177	1318	1465	8501
2.3. Commercial expenses	-	220	250	275	300	362	406	455	500	2768
For reference only: Capital depreciation Product cost Taxable profit Production profitability, %	 - - - -	 1950 17810 2511 14.1	 2170 19581 3368 17.2	 2320 21091 4281 20.3	 2320 22738 5798 25.5	 2320 24736 7025 28.4	 2320 26718 8470 31.7	 2320 29599 10833 36.6	 2320 32565 13742 42.2	 18040 194838 56028 -
2.4. Unified agricultural tax	-	502	588	674	803	925	1053	1260	1502	7307
For reference only: Net profit	-	2009	2780	3607	4995	6100	7417	9573	12240	48721
2.5. Loan repayment	-	1305	1305	1305	1305	1305	825	825	825	9000
3. Net cash flow (NCF)	-1500	2954	3995	4982	6010	7115	8912	11068	13735	57271

Net present value of the project is defined as follows:

$$NPV_1 = -34810 + \frac{2954}{(1+0.08)} + \frac{3995}{(1+0.08)^2} + \frac{4982}{(1+0.08)^3} +$$

$$+ \frac{6010}{(1+0.08)^4} + \frac{7115}{(1+0.08)^5} + \frac{8912}{(1+0.08)^6} + \frac{11068}{(1+0.08)^7} +$$

$$+ \frac{13735}{(1+0.08)^8} = -34810 + 39498.5 = 4688.5 \text{ thsd. rub.}$$

A positive value of this indicator proves the economic attractiveness of the project.

Profitability index is calculated as follows:

$$PI = \frac{2735.2 + 34269.3 + 4030.7 + 4508.9 + \\ + 4934 + 5723.8 + 6580.3 + 7559.2}{34810} = 1.13.$$

Profitability index is greater than unity, so the project is considered to be economically advantageous.

It is necessary to calculate negative net present value (NPV_2) to determine the internal rate of return. A discount rate is 20%.

$$NPV_2 = -34810 + \frac{2954}{(1+0.2)} + \frac{3995}{(1+0.2)^2} + \frac{4982}{(1+0.2)^3} +$$

$$+ \frac{6010}{(1+0.2)^4} + \frac{7115}{(1+0.2)^5} + \frac{8912}{(1+0.2)^6} + \frac{11068}{(1+0.2)^7} + \frac{13735}{(1+0.2)^8} =$$

$$= -34810 + 23145.1 = -11664.9$$

The internal rate of return is calculated by the formula 3:

$$IRR = 8 + \frac{4688.5}{4688.5 - (-111664.9)} \times (20 - 8) = 11.4\%.$$

The internal rate of return is higher than the discount rate (8%), this fact indicates the economic attractiveness of the project.

Cumulative cash flow, determining the discounted payback period of the project, is presented in *table 4*.

Discounted payback period will be:

$$DP_P = 8 - \frac{-2873.7}{7559.2} = 7 + 0.38 = 7.38 \text{ years.}$$

The discounted payback period of the project is less than its implementation period. Therefore, this innovation project is considered to be effective.

Table 5 presents the performance of projects' efficiency with the different variants of state support.

In summary, we have drawn the following conclusions:

1. The sustainable development of cattle breeding in the peripheral regions requires a considerable increase in investing construction, reconstruction and launching innovation technologies. Therefore, economic assessment

Table 4. The calculation of a cumulative cash flow of the project for APC Vashka in 2012 – 2020, thsd. rub.

Indicator	Cash inflow in 2012	22013	22014	22015	22016	22017	22018	22019	22020
Cash flow	-31500	2954	3995	4982	6010	7115	8912	11068	13735
Discounted cash flow	-31500	2735.2	3426.,3	4030.7	4508.9	4934.1	5723.8	6580.3	7559.2
Cumulative cash flow	-31500	-31500 – 1000 + 2735.2 = -29764.8	-29764.8 – 1100 + 3426.3 = -27438.5	-27438.5 – 1210 + 4030.7 = -24617.8	-24617.8 + 4508.9 = -20111.9	-20111.9 + 4934.1 = -15177.8	-15177.8 + 5723.8 = -9454.0	-9454.0 + 6580.3 = -2873.7	-2873.7 + +7559.2 = 4685.5

Table 5. Assessment of innovation and investment projects' efficiency

Project		Net present value (NPV), thsd. rub.	Simple rate of return (R),%	Simple payback period, years	Profitability index (PI)	Internal rate of return (IRR), %	Discounted payback period (DP_p), years
Constructing 100 head dairy in APC Collective Farm Chernutyevskiy	1	859.8	12.5	8.93	1.04	11.3	12.49
	2	6642.2	22.4	4.52	1.36	16.3	7.1
Constructing 200 head dairy in APC Vashka	1	6660.1	11.2	9.16	1.19	11.6	11.25
	2	4688.5	18.4	5.26	1.13	11.4	7.38
1. With the current state support. 2. With the support to revenue, ensuring the optimum level of profitability.							

of innovation and investment projects is especially important.

2. Calculating the economic efficiency of 100 and 200 head dairies with the use of high technologies and highly productive animals shows that having the current state support to innovation and investment activity and farmers' incomes, the expenses on these projects will be covered in 12.49 and 11.25 years if the length of credit is 8 years. The payback period of these projects will be lower than the term of credit when agricultural organizations reach the optimal level of profitability and the current state support to innovation projects is saved.

3. It is necessary to significantly increase the guaranteed price for milk and beef and strengthen the role of long-term credit in order to enhance innovation in the dairy industry. Soft loan for the construction and modernization of livestock houses in the North should be provided for 20 – 25 years, and the length of loans for purchasing machinery and equipment should be six or eight years.

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NATURE MANAGEMENT ECONOMY

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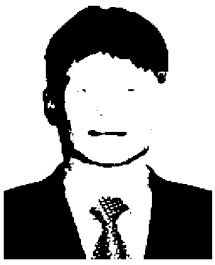
Economic and qualimetric assessment of pine and spruce species in the Vologda Oblast

The Vologda Oblast is among the wooded regions of Russia. Wood requirements of our region, neighboring territories and other countries have been covered for many decades due to the intensive exploitation of forests. At present, the Vologda Oblast that increases production volumes is a leader in wood felling and processing. Intensive forest exploitation has deteriorated the quality and species of wood and reduced the share of valuable coniferous plantations. It is possible to solve these problems due to growing economically valuable species of wood in the logged areas. Economic and qualimetric analysis of pine and spruce species in the Vologda Oblast proves that it is reasonable to grow spruce species in the southern taiga subzone in order to produce pulp wood. This will increase the pulpwood productivity of forest plantations and efficiency of timber production in the region.

Economic and qualimetric assessment, forestry species, cellulose, wood, forest cultivation, pulp and paper industry.



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The Vologda Oblast has been famous for its forest resources for a long time. Vologda timber was shipped to England under Ivan the Terrible; it was used to build the Russian navy under Peter the First. The Vologda Oblast with three-quarters of its territory covered with forest was called Siberia near Moscow [5].

Nowadays, the Vologda Oblast that increases production volumes is a leader in wood felling and processing. According to the Oblast's Forestry Department, wood felling increased by 3.4% for 2011 (in comparison with 2010), the production of timber increased by 10.2%, plywood– by 6.3%, wood-particle board – by 21,1%, fibreboards – by 10.1%, factory-built wooden houses – by 14.8%, cellulose – by 7.5%, paper – by 5.9%, paperboard – by 19.2%. Twelve priority investment projects with the total investment of more than 10.0 billion rubles are being implemented in the region.

Wood and paper products are exported to over 50 countries worldwide. According to the press service of the Vologda Customs, regional timber companies exported wood products to the amount of 172.6 million dollars in 2010 and 203.9 million dollars in 2011. The main types of exported products are plywood, saw timber, wood chips, fuel wood briquettes, joinery products, paper, chipboard, match-wood. In summary it should be noted that the regional forests were intensively exploited; logging volume is increasing today.

The intensive exploitation of forests has resulted in the wood quality and species deterioration and reduced the share of valuable coniferous plantations in the transport accessible and economically sound part of the forest fund. This important issue is studied in the works of a number of researchers [2, 7], and the employees of forestry enterprises that operate in the territory of the Vologda Oblast touch on this question (JSC Holding Company "Vologda Timber Merchants", CJSC "Investlesprom", JSC "Vologdalesprom Corporation", etc.).

It is possible to solve these problems due to sowing or planting of wood species in the logged areas. Experience shows that science-based selection and the adherence to forest growing technology allow us to form high-yield plantations of economically valuable coniferous species (pine and spruce). A retrospective analysis of literature shows that silvicultural theory and practice, as well as growing pine and spruce plantations in the area of more than 0.3 million hectares are wide-spread in the region.

The cultivation of forest species should be based on profound theoretical and validated knowledge of the growth and development of woody plants in the logged areas.

This article deals with the problem of priority selection of wood species for the cultivation of pulpwood to meet the needs of pulp and paper industry in the scope of economic and qualimetric analysis. The fundamental principles of economic and qualimetric assessment of forest plantations are laid by O.I. Poluboyarinov and R.B. Fedorov [6]. In this case the problems of timber quality (qualimetry) are in the limelight. It is very important in the economic substantiation to consider the fact that it is not the cost of wood that is assessed, but the cost of the final product (cellulose), obtained from one hectare of forest area.

It should be noted that, historically, spruce was the main wood species for the pulp and paper industry. It is characterized by the slight gumminess of wood. This feature has a positive impact on the process of pulping and the quality of cellulose. However, a significant share of companies consuming spruce wood predetermines a shortage of raw wood that has recently caused the reduction of sulfite spruce pulping and the implementation of sulfate spruce and pine pulping. The pine, as opposed to the spruce, has a higher density of wood; this feature allows the producers to increase the yield of pulp from a cubic meter of raw wood. These wood species take priority when creating forest plantations in the Vologda Oblast. The analysis of the status and development of the pulp and paper industry proves that pine and spruce remain the main sources of raw wood for pulp production.

Here are the results obtained due to the monitoring of 48-year-old pines and spruces in the Vologda Oblast (southern taiga subzone).

The species are created in the similar conditions according to the same technology and at the same level of investment in their production. The seedlings were planted in the logged areas. Three thousand trees were planted per a hectare. There was no care for pines and spruces before.

The calculation of the yield of stem wood per a unit of forest area (reserve, m^3/ha) was made on the base of methodological approaches that were written by N.P. Anuchin [1] and N.N. Sokolov [8]. The results showed the predominance of spruce reserves over pine at the time of study (392 m^3/ha vs. 325 m^3/ha).

The determination of potential raw wood yield for the pulp and paper industry (pulpwood), performed with the use of forest valuation data [4], also proves the superiority of spruce index by 50 cubic meters per one hectare of forest area *(tab. 1)*.

The pulpwood productivity has been calculated for pine and spruce species. It is a rate of possible cellulose yield (tons) from the total amount of pulpwood growing in the area of one hectare. The calculation was based on the values of qualimetric indicator – pine and spruce density.

The formula for calculating the productivity of pulpwood is as follows:

$$M_{p.} = Y / R, \quad (1)$$

Y – pulpwood yield, m^3/ha;

R – wood consumption rate per one ton of produced cellulose, m^3/t.

The wood consumption rate per one ton of pulped cellulose has been calculated on the base of the recommendations of L.N. Erofeyev [3]:

$$R = \frac{880}{D_{base} P} \times \frac{100}{C}, \quad (2)$$

880 – the content of absolutely dry matter in one ton of raw wood with the humidity rate of 12%, kg/t;

$D_{base.}$ – basic wood density, kg/m^3;

P – pulp yield, % of wood that is loaded into the boiler;

C – the coefficient of effective technological wood processing, the share in unbarked wood.

Sulfate pulp has been chosen as a final product in the calculations because it is the most important and widespread type of semi-fibrous pulp. The yield of sulfate pulp in pulping (P, %) has been adopted on the basis of published data [3, 6]: 45.04 – for pine, 49.04 – for spruce.

The coefficient of effective technological wood processing (C) has been calculated by multiplying the coefficients of technological wood yield for the individual production stages of its preparation as follows:

$$C = C_s \times C_b \times C_{c.s.}, \quad (3)$$

C_s – coefficient of wood yield when sawing;

C_b – coefficient of wood yield when barking;

$C_{c.s.}$ – coefficient of wood yield when cutting, disintegration and wood chips sorting.

$$C_{s,b,c.s.} = \frac{100 - P_{s,b,c.s.}}{100}, \quad (4)$$

P_s – percentage of wood loss and waste when sawing (it is excluded from the calculation due to supplying the pulp and paper industry with raw materials of required size);

Table 1. Forest density and pulpwood yield of pine and spruce species

Cultivated forest species	Cultivated forest density, m^3/ha	Pulpwood yield	
		%	m^3/ha
Pine	325	86	280
Spruce	392	84	330

Table 2. Sulfate pulp costing per one hectare of pine and spruce forest area

Forest species	Pulp yield, t/ha	Market price for one ton of cellulose, rub.	Volume of production per one hectare, thsd. rub.
Pine	48.4	17350	839.74
Spruce	58.9		1021.92

$P_{b.}$ – percentage of wood loss and waste when barking (1,2%);

$P_{c.s.}$ – percentage of wood loss and waste when cutting, disintegration and wood chips sorting. (6,0%).

The percentages of wood loss and waste $P_{s.}$, $P_{b.}$, $P_{c.s.}$ have been determined on the basis of the data published by L.N. Erofeyev [3].

These calculations prove that it is possible to produce 48.4 tons of pulp per one hectare of pine plantations and 58.9 tons per one hectare of spruce plantations. Thus, the spruce pulpwood productivity is 1.2 times higher than the pine pulpwood productivity.

Economic calculation has been carried out on the basis of market prices for market cellulose in 2011 accounting the potential pulp yield per one hectare of forest *(tab. 2)*.

The calculations allow us to judge the possibility to produce sulfate pulp to the total amount of 839.74 thousand rubles form the pulpwood per one hectare of pine plantations and to the sum of 1021.92 thousand rubles per one hectare of spruce forest areas. Thus, other conditions being equal, semi-finished products (sulfate pulp) that are produced from the spruce wood covering one hectare will cost by 20% more than the pulp produced from pine.

In conclusion, it is necessary to note that spruce wood is characterized by a relatively homogeneous structure, which has a positive effect on the process of pulp production and its quality. It should be also considered that spruce wood is not as resiniferous as pine wood. This fact prioritizes the use of spruce in pulp production. All this allows us to recommend spruce for the target pulpwood growing in the southern taiga subzone of the Vologda Oblast. This approach will improve the pulpwood productivity of forest plantations and thereby enhance the effectiveness of silvicultural production in the region.

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