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Economic Summary of Biofuel Resources in Agricultural Development Conditions

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Abstract

Objectives: Efficient management of organic waste is necessary in order to avoid negative impacts on the environment and a high potential for conversion into biofuel. The aim of this study is to conduct a preliminary analysis of the organic waste used for the production of biofuels. **Methods/Statistical analysis:** This study examines the relevant literature on biofuels and biofuel analysis from the perspective of small and medium business in Kazakhstan context with related biofuels stakeholders and social capital theories. According to our assumptions, the main obstacle on the way biofuels is the personal characteristics of solid property owners, their financial constraints, as well as technical support questions. **Findings:** The practice of corporate social responsibility is a recognized tool for achieving sustainability. The main factors of biofuels are customer satisfaction, loyalty and highly motivated employees, the best reputation, the best network of business partners and authorities, as well as an increase in sales due to competitive advantage. **Application/Improvements:** This study contributes to the motivation of the green economy in the Republic of Kazakhstan. After some investigation, we can determine how biofuel entrepreneurs understand the essence, so you can find interested parties for further partnerships.

Keywords: biofuel resources, agricultural, energy, estimate, rural consumer

1. Introduction

This article addresses the development of processes involved in the use of biofuel resources and demonstrates the need to form a theoretical and methodological foundation that accounts for the organizational and economic mechanisms of interconnected systems and research, including the scientific and technological development involved in a pilot production of biofuels marketing. Moreover, the paper highlights the efficiency of agricultural producers, which is achieved by offering new and competitive projects for the production and use of unconventional fuels, such as the development of profitable business projects.

2. Formulation of the problem

Finding the means to unlock the energy stored in agricultural production to meet the demand for fuel resources has been a slow and arduous process. The primary obstacle to accelerating this process and tapping into this energy source involves those issues of material interest to agricultural producers. Moreover, there are no criteria and no economic rewards incentivizing the efficient use or production of biofuels involving sales pricing and/or the provision of financing or credit.

Studies have identified the main features in the use of resources to develop innovative processes to produce biofuel:

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- The substantial variety of agricultural products and processed products used in the production of biofuel and the significant differences in the technologies used to cultivate the biofuel resources in the production process;
- Significant differentiation of geographical areas in terms of the production of biofuel resources;
- The dependence of agriculture production technologies on natural and weather conditions;
- Substantial differences in the production cycle for certain types of agricultural products and in the processing cycle for certain agricultural products;
- High degree of territorial fragmentation of agricultural production;
- Isolation of agricultural producers from organizations that engage in scientific and technical production (biogas plants, biodiesel);
- Substantial variation in the different social classes of agricultural workers; similarly, there is a great variety in the production structure of agricultural producers and links with innovative production structures;
- The absence of an efficient and scientifically sound organizational and economic mechanism to transmit scientific advances to agricultural producers and, as a consequence, a significant backlog in the development of industry innovations related to production.

3. Innovative aspects of the activity

PA Andreev said that "the process of innovation in agriculture has its own specifics that allows you to select features of the mechanism of its functioning – it is a complex interconnected system with many forward and backward linkages, including the following sub-systems: research, scientific and technological development, pilot production of biofuels, marketing" [1]

Research, research and development, production, and preparation for the processing of agricultural products are the main functional areas and stages for the use of biofuels as part of an innovation process in agriculture.

Agricultural producers can become more efficient by undertaking new projects involving the production and use of innovative fuels, by developing profitable business projects exploiting these fuels, and, of course, by implementing policy resources.[2]

4. The purpose of the study

To develop innovative processes as part of a collection of coherent actions for the production of biofuels and the organization of its use in agricultural production. As market conditions stabilize, agricultural production can increase by ensuring the rational use of non-conventional fuel resources, including biofuels.A key objective of more efficient use of biofuels in agriculture is to reduce the energy intensity of production.

5. The main results of the study

In cropping technology, energy consumption due to soil treatment is 17-62% of the total consumption of traditional fuel resources in cultivation. The most energy-intensive operations, plowing, accounts for 45-70% of the cost of fuel resources.[3] The volume of fuel resources consumed in the cultivation of crops differs significantly depending on the type of agricultural production. Cultivating crops requires 1.9 times more energy to produce than 100 kg of fodder crops[4]. Additionally, the growth rate of agricultural production must outpace the growth of energy consumption. The general trend in the nature of power consumption in agricultural production is characterized by an increase in the intensity of energy consumption per unit of land and labor to the growth of energy consumption in 2013 Table 1.

Table 1. Changes inenergy consumptionin the agricultureof the East Kazakhstanregion

Indicators	Periods								2013%
	2006	2007	2008	2009	2010	2011	2012	2013	2006
1	2	3	4	5	6	7	8	9	10
Energy cost ofagricultural production, total milliontons of standard fuel	39,8	47,0	45,8	53,8	40,3	39,7	37,5	42,6	61,0
Energy costs, kg of fuel									
-Onaverage,1person employedin agriculture	134,1	184,6	175,7	180,6	132,7	158,2	150,0	137,7	102,6
-Per hectareof agricultural land	6,8	8,2	8,0	9,4	7,1	6,9	6,6	7,5	110,3
- 1mof gross agricultural output	0,8	0,16	1,09	2,1	1,2	1,73	1,6	1,4	175

An analysis of fuel consumption in agricultural production in the region of East Kazakhstan shows a decline in efficiency. The unfavorable situation of the fuel and energy structure in the Republic of Kazakhstan – in addition to asymmetric increases in energy prices compared with the purchase prices of agricultural products – has become an objective reality for agricultural production in the near future in the face of shrinking – or at best the same – fuel resources[5]. Experts have developed a wide variety of resource-saving measures that are primarily technical and organizational in their orientation. The main works on energy savings analyze events and base their research on choosing a set of reasonable measures for economic stimulation. Against this background, there is a problem of reliability to ensure that biofuel resources can lead to energy conservation in agricultural enterprises[6].

In this regard, the urgent problem is economic proof of energy savings: the introduction of new energy-saving technologies, new machines to help create optimal organizational and economic conditions of production and the efficient use of biofuels. Therefore, the effective functioning of agriculture in Kazakhstan depends on fuel resources as a whole, including non-traditional bioenergy resources[7]. Energy conservation in agricultural production is a process of rational use of materials, technical resources, manpower and financial resources to obtain agricultural products with the highest quality indicators and with minimum specific energy consumption[8].

The current socio-economic situation in agriculture requires a new approach to energy conservation measures, with design that should consider the following:

- Management structures that differ not only in the form of ownership of the means of production but also with respect to the amount of arable land and with production technologies, and also the means of production;
- If a monopoly dictates matters regarding the fuel and energy resources available to agricultural producers, alternative service is needed for fuel supply, which might solve problems by providing a high-quality supply of fuel resources to the rural consumer;
- Rising prices for fuel resources and limited natural resources aggravates the problem of energy savings and suggests the need for alternative energy sources, such as biofuel;
- With market conditions predetermined by the need for the development of a coordinated state policy in the fuel sector in agriculture as a whole[9]. A block diagram of energy savings measures is presented in Figure. 1.

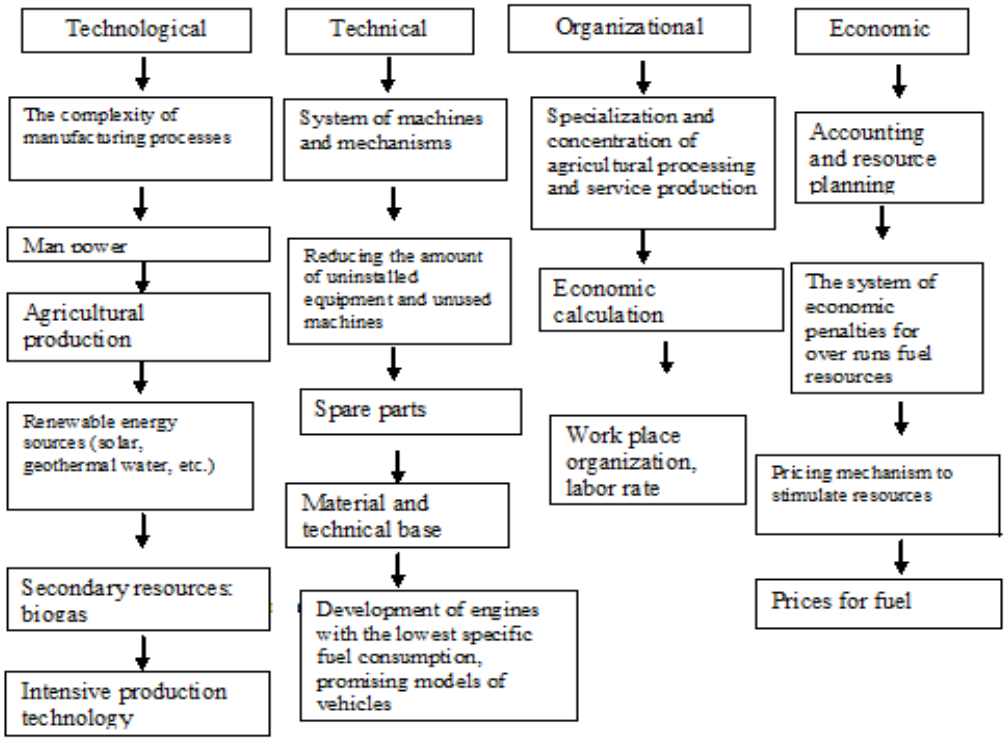

Figure 1. Block diagram of energy-saving measures.

Obtaining the highest economic benefit and fuel savings possible can be enabled with the introduction of technological measures for energy efficiency, including the most urgent, which are those aimed at reducing the energy intensity of production. Processing operations of soil are the most energy-intensive technologies in the production of wheat and canola and require up to 60% of the total consumption of fuel resources; thus, energy-saving measures should be focused on this segment of the process[10].

Introducing combined units for tillage technology can lead to fuel savings of up to 25% with minimum tillage[11]. In addition, intensive technologies applied in the cultivation of crops – planting – can lead to fuel savings per unit of product produced of 15%. The most energy-intensive process in agriculture is corn drying, which annually consumes approximately 0.5 million tons of fuel oil and approximately 1.2 billion kW h of electricity.

With respect to technical measures to conserve and improve the efficiency of fuel resources for the East Kazakhstan region, transitioning from boilers with liquid and solid fuels to more economical gasoline will save 7% fuel. Each boiler consumes approximately 27 tons of fuel per year. Thus, the cost of capital investments per boiler is approximately 2.3 million tenge[12].

The fastest return can be obtained by eliminating waste and loss of fuel resources through technological efficiencies. Thus, a sealed tank can save up to 1.9% of the fuel utilized; eliminating pipeline and gas tank leaks, eliminating soot in combustion chambers, and removing scale in the radiator can save up to 5.7% of the fuel utilized; and timely replacement of faulty spark plugs or injectors in four-cylinder engine can save up to 22% of the fuel utilized in operations[13]. Through such activities, agricultural enterprises can make a profit, and failing to implement such activities can lead to loss. Therefore, this group of activities is the responsibility of the agricultural enterprises themselves.

Undertaking the technological, technical and organizational measures that are designed to save fuel resources requires significant capital investment. For individual farmers/producers, it ispractically impossible to implement of these activities due to capital limitations. In a market economy, energy conservation is required to improve fuel efficiency, including biodiversity.

Measuring energy consumption in the economy has overall economic value because economic indicators can be used to characterize productive forces. The concept of normative power measurements in the economy, in relation to the production system means measuring final energy consumption, which allows for a valuation of useful work in the creation of products and quantitatively characterizes production[14].

In most cases, an analysis of the effectiveness of the use of biofuel resources is undertaken by comparing the actual specific fuel consumption during the year with rules or plans regarding ideal consumption amounts. The importance of applying economic methods of management and evidence-based approaches to the allocation system of indicators on the use of fuel is based on these analyses.

The main planned fuel resources are as follows: gasoline, diesel fuel, boiler and furnace fuel, energy, thermal energy and biodiesel. The fuel consumed by boilers and furnaces ranges from solid (coal and wood), liquid (fuel oil, heating oil, domestic), gas (natural, associated, biogas) and other types of fuel. Biogas is used as fuel for the production of electricity, heat and steam and is also used as an automotive fuel[15].

The development of the relationship between energy prices and the prices of agricultural raw materials is one cause of excitement based on biofuel production. Using general trends in attempting to assess the co-movement of energy prices and the agriculture prices, we present econometric evidence of this relationship. In addition, regime changes can alter the relationship between energy and agricultural commodity prices under certain conditions. Thus, the problems associated with the movement of energy and agricultural commodity prices in the future may be scattered, which has important implications for biofuels and food policy[16].

Because heating of livestock farms and complexes is mainly decentralized, the main resource for thermal energy is boiler and furnace fuel and electricity. At this stage, approximately 45% of livestock heating is fuel oil based. The remainder of livestock heating is produced with electric and electrode boilers[17]. The resource potential of biofuel consists of a set of tools, supplies, and opportunities; the use of biofuels provides not only economic but also environmental benefits. This type of resource potential is part of the production potential.

The system of indicators of development and efficiency of biofuel resources is shown in Figure. 2.

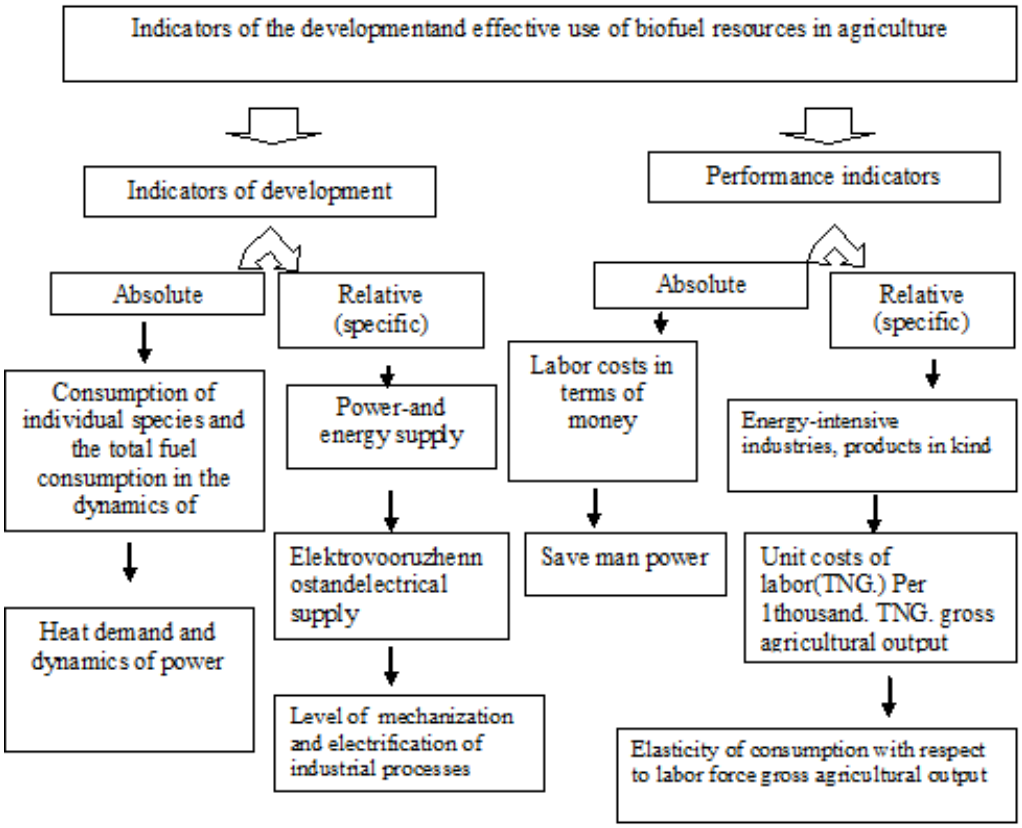

Figure 2. The system of indicators of development and efficient use of biofuel resources in agriculture.

Planning for fuel, heat and electricity consumption as part of a comprehensive assessment of the efficiency of fuel resources requires the development of specific energy distributions (design, planning, actual), including the cost of all fuels and energy (including biofuels) per unit of production. Such a generalized index is best used as an indicator of expenses for biofuel resources.

In the future, the analysis of the effectiveness of the use of biofuel resources in agriculture will employ the indicator labeled, "TR unit costs. The index and unit costs relative to gross income can be used to eliminate double-counting errors and provide an opportunity to obtain an estimate of the efficiency of the use of biofuel resources near the outcome. However, comparing the results of individual farms, regions and years requires a more precise characterization of a given unit cost of biofuel resources relative to gross agricultural output in constant prices.

The cost of biofuel resources takes an average of 1.5% of the cost of livestock products, and 2.7% of the cost of crop production. When the analysis is re-run, the error in the costs of biofuel resources is small (no more than 0.9% of the unit cost). The indicator unit cost of biofuel resources to produce a unit of agricultural products not only reflects their consumption but also points to the optimality of the existing structure of energy[18]. However, the same indicators of unit costs of biofuel resources in different farms total energy consumption can be different: it will be more in those households with a more efficient energy structure, i.e., where there is a structural shift of cheaper, alternative fuel resources (biogas, biodiesel, fuel briquettes).

In the business environment, the dynamics of biofuel production should increase and will result in the preferential growth of competitiveness, which is by far the main factor in the Economics and Management of Agriculture[19]. Production of biodiesel encourages unused agricultural land to be entered into circulation and will lead to the creation new jobs in agriculture, engineering, construction. Unit costs show that the efficient use of fuel resources led to the largest amount of gross production at the same cost of fuel and energy. In relation to the production of agricultural products, the unit costs for resources of biofuel units of production include one

metric ton of milk, meat, andwool, as well as the content of one head or the flow rate per ha[20,21].

The effectiveness of the use of biofuel resources in agriculture can be estimated from the total fuel consumption in terms of conventional fuel. Thus, it is possible to estimate both absolute and relative costs[22]. Conversion factors in tons of conventional fuel are provided for certain types of biofuels. When this is taken into account in parallel with power consumption in kilowatt-hours, it can be converted into an energy conventional fuel ratio of 1 kW · h = 3.6 MJ = 0.123 kg of oil equivalent. The purpose of this transformation is to ensure that during direct electrical heating generated by 1 kW h of electrical current work 860 kcal of heat energy (equal to 0,123 kg of fuel) is produced.

Consumption of certain types of biofuels and energy can be defined for all agricultural products on the basis of the cost of certain items from the annual reports, which have been established in recent years based on the structure of individual consumption of resources and energy prices.Primary accounting is used to determine the exact consumption of certain types of fuel in different processes with product data. To evaluate the effectiveness of the use of biofuel resources for production of certain agricultural products, expedient implementation of individual performance – mainly the energy intensity of production – is required. In this case, in our opinion, we must separately consider energy consumption, petroleum products (gasoline, diesel fuel), fuel oil, and waste energy (biogas, biodiesel) Table 2. The indicators considered in analyzing the efficiency of fuel resources are mostly random, but they are treated as constant over a given planning period. In the dynamic evaluation of energy use, it is better to use the elasticity of energy savings with respect to economic growth, which characterizes the level of energy intensity of the industry and is the ratio of the rate of growth of energy consumption to the gross domestic product growth rate.

In practice, the aim is to achieve an energy-saving coefficient of elasticity of not more than 0.6. The most important energy issue is to improve energy use, obtaining maximum useful work and improving the technical efficiency of energy. These properties are associated with the concept of exergy (Gr. Ex - a prefix meaning a high degree; and ergon - work) - part of the energy is equal to the maximum useful work that can generate a thermodynamic system in the transition from a given state, which shows how much work you can get from the system. It is known that not all energy and not all conditions are suitable for technical use. The value contained in this system is dependent on the energy state in the system and environment.

6. Exergy - a function of the state of the system and environment

Exergy's analytical value is determined by the product of energy and energy efficiency ratio[23]. The exergy concept is widely used, although it is sometimes formulated differently by different authors. For some, it is efficiency of energy use, defined as the ratio of energy values at the boundaries of the stage in "input-output". This concept can be attributed to the use of non-conventional energy.

Considering the concept of exergy, Kaygorodtsev[24] noted that the highest exergy for small consumers is found in electricity. Under current market conditions on the basis of diverse forms of ownership, achieving maximum exergy in the livestock industry is very important. There are many methods of graphical integration of the energy balance, including the most widely used method, the Grassmann diagram.A model of energy consumption in large farms of in the region of East Kazakhstan from 2005 to 2010 is presented in the form of a Grassmann diagram Figure. 3.

Table 2. Characteristics ofthe normativeflow ratesof fuel resourcesin agriculture

Types of indicators	Standardized documents	Affiliation indicators	Objects related to		Typesof products and services
			Economy	Technology	
1	2	3	4	5	6
Plansflow(group, individual). Tasks required for average reduction plan	Boiler andheating oil, motor fuels, including gasoline, diesel, and more. Electricity, alternative fuels (biogas, biodiesel)	By long-term, the current; not associated with a particular type of plan	Areas, associations, complexes, farm jobs.	Methods of content, technological systems, machines, machines, plants,	Pastoralism services providing dairy and meat (pigs, sheep, poultry and others).

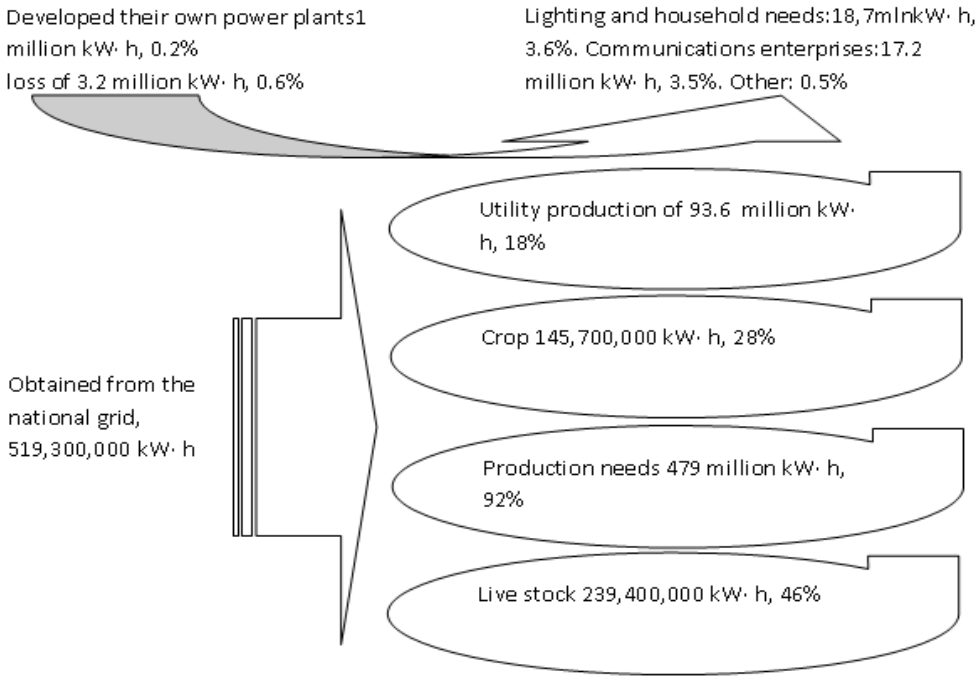

Figure 3. The modelof energy consumption in households of the East Kazakhstan region.

In recent years, electricity generating its own power has tended to decrease. Electricity utilized for production needs increases by 1.4 times for the period[25,12]. In addition, consumption of electricity in the home increased under similar production. Recorded losses in transmission lines changed slightly and amounted to an average of 3.2 households mln.kV.ch. This model can be considered in greater depth at the individual agricultural production sectors, sub-sectors, types of products, production processes and transactions for the modernization of agriculture.

These models are based on statistical materials and the analysis of flow sheets for the production of agricultural products and reflect the approximate fuel situation in the industry. Problems associated with these models include deficiencies in accounting and lack of instrumentation resulting from the lack of attention to energy conservation. Currently, there is intensive development of biofuel technology as a component of agricultural crops. Many countries have adopted national programs to create and develop their own biofuel industry; as a result, the global market for biofuels has increased by 20-25%.

The Republic of Kazakhstan has all the economic conditions for the production and use of biofuels, increased internal demand for cheaper and more ecological forms of energy, and there is space available for the cultivation of cereals and oilseeds along with the technical and human capacity to produce[26,12]. The economic and environmental features of the output and use of the waste from the biofuel plant species will significantly increase the profitability of agricultural enterprises in the East Kazakhstan region and will create a stable base fuel for diesel internal combustion engines, although this will decrease the environmental impact on the environment[27,28].

Thus, the development of biofuels should not be to the detriment of the food security of the Republic of Kazakhstan, as the following raw materials will mainly be used: technical crop production, production waste and surplus food commodities (including class 3 and 4 wheat. At the initial stage only low-quality products will be utilized, which will produce up to 800 thousand tons of biofuel. At the second stage, fallow land will be used to produce another 1.7 million tons of environmentally friendly fuel[29,24].

According to preliminary estimates, Kazakhstan biofuel will have a low production cost: it will be 10% cheaper than Brazilian and 1.5 - 2 times cheaper than the cost of US and European biofuel.

7. Conclusions

Biofuel production has strong comparative advantages next to the traditional production and export of grain

because such production is based on advanced processing of raw food. In this case, extracted components with a value for the food and pharmaceutical industries (gluten, carbon dioxide, glycerol), which are used as stand-alone products, already pay for a significant portion of the cost of production and use of biofuels. Biofuels are safe and do not result in side effects[30,31].

The prospects for the development of biofuels in Kazakhstan are embedded in the industrialization of agriculture in Kazakhstan, which is necessary to introduce additional capacities of the biofuel industry and to create the conditions for accelerated formation of this industry. In present-day Kazakhstan, there are unresolved problems hindering the further development of the biofuel industry:

- The lack of legislation regulating the biofuel market (standards, regulations, environmental restrictions);
- The lack of tax incentives;
- The lack of domestic scientific developments in the biological industries;
- Lack of awareness of the latest technologies for biofuel production;
- The possibility of food insecurity due to imbalances in the commodity market;
- The lack of methods for calculating the feasibility and cost-effectiveness of the use of certain types of biofuels in agriculture.

To solve these problems, and to develop the potential of a biological industry, a concept of market development of biofuels must be developed for the Republic of Kazakhstan

8. The concept of development of the biofuel market in Kazakhstan until 2010

The main aim of this concept was sustainable development of agricultural production and improved efficiency through the development of a biofuels industry in Kazakhstan. The concept was proposed to implement measures in three areas. The first task was to broaden the base of raw materials for the biofuels industry by expanding the acreage, including the use of fallow land and land previously removed from agricultural use, of agricultural and industrial crops, the raw material for the production of biofuels, to ensure appropriate public support for the expansion of the relevant crops. The second trend was the development and regulation of the production activities of the biofuel industry through the development and adoption of a legal structure defining the conditions for the production and use of biofuels in the Republic of Kazakhstan[32].

In the future, the export potential of biofuels based on internal needs will be from 3 to 6 bn per year, which will allow Kazakhstan to become one of the world's leading manufacturers and exporters of biofuel. The task of the near future will be to provide legislative support for biofuel production. Thus, the concept of the development of the biofuel market up to 2010 was drafted, along with a draft law on the state regulation of production and sales of biofuels.

The third undertaking was to integrate Kazakhstan into the global system of biofuel production and distribution, for which work is needed to conduct research into the biofuel market, to develop standards for biological fuel production that are harmonized with international standards, and to conclude intergovernmental agreements on trade biological fuel production that provide favored status for Kazakhstan in the biofuel export markets.

In connection with this decision of the Government of the Republic of Kazakhstan, dated May 31, 2008 at the Majilis of the Parliament of the Republic of Kazakhstan, considered number 534 draft Law of the Republic of Kazakhstan, "On state regulation of production and turnover of biofuels"[32,33]. This law regulates public relations arising in the field of biofuel production and trafficking, and its purpose is to protect the environment, develop biofuel production and trafficking, and ensure food security of the state in the production of biofuels for the purposes of the following objectives:

- Reduce emissions that pollute the atmosphere;
- Increase production and exports of goods with high added value;
- Support research and implementation of advanced scientific technologies in biofuel production and trafficking;
- Introduce rules allowing the Government of the Republic of Kazakhstan to determine the threshold levels of capacities for the production of biofuels and to establish quotas on food raw materials used for the processing of biofuels[34].

State support is planned for the development of biofuel market in the following forms:

- Funding research on priority areas for development of the biofuel market;

- The organization of leased deliveries of machinery and equipment to participants in the biological fuel market.

Production and use of biofuels should be safe for human life and health, in addition to environmental protection. In many ways, the relevance of the production and use of biofuels is determined by fears regarding declining oil and gas reserves, as well as by rising prices of petroleum products. Pro-environmental arguments are also made in favor of biofuels because its use will reduce pollution and its use will reduce emissions of carbon dioxide into the atmosphere[35].

In many countries, increasing the share of biofuels in the total consumption of energy is considered a strategic objective. The 21st century will be the century of biological energy because the use of biofuels helps protect the environment, and this development provides the impetus for the development of economy, science, new technologies in the Republic of Kazakhstan.

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