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# ECONOMIC EFFICIENCY OF INTRODUCTION OF INNOVATIVE TECHNOLOGIES IN GRAIN SUB-COMPLEX OF KAZAKHSTAN

# ҚАЗАҚСТАННЫҢ АСТЫҚ КІШІ КЕШЕНІНЕ ИННОВАЦИЯЛЫҚ ТЕХНОЛОГИЯЛАРДЫ ЕНГІЗУДІҢ ЭКОНОМИКАЛЫҚ ТИІМДІЛІГІ

# ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ВНЕДРЕНИЯ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ В ЗЕРНОВОМ ПОДКОМПЛЕКСЕ КАЗАХСТАНА

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**Abstract. Grain farming is a historically basic and strategic sector of the agricultural sector of the economy of Kazakhstan - the main producer of food products and the main source of livelihood of the population, on the dynamic sustainable development of which the food security of the country depends. The article analyzes grain sub-complex of Kazakhstan, investigates the problems of production and consumption of grain products as a backbone segment of the agro-industrial complex and the basis for solving food problem. The dynamics of the gross harvest of wheat in the country as a whole is analyzed, including in Akmola region - the leader in the ranking of grain yields. The tendencies of changes in the volumes of commercial grain production in the region are revealed. Method of comparative assessment of the main economic indicators of grain industry before and after the introduction of innovative technologies is proposed, recommendations on the expediency of their implementation are given. Summarizing the above, we can come to the following conclusion: the innovative development of grain industry can be the most effective in systemic complex of directions, priorities and tasks. The innovation process in the country's grain production has a number of positive aspects: carrying out work on reproduction of soil fertility, preventing their degradation; the use of various cultivation techniques, incl. energy and resource saving technologies for production, storage and processing of grain; elaboration and development of State innovation policy at the level of the entire AIC and grain cluster.**

**Аңдатпа. Астық шаруашылығы – бұл елдің азық-түлік қауіпсіздігін қамтамасыз ету серпінді тұрақты дамуына байланысты тамақ өнімдерінің басты өндірушісі және халықтың тіршілік әрекетінің негізгі көзі - Қазақстан экономикасының аграрлық секторының тарихи базалық және стратегиялық саласы. Мақалада Қазақстанның астық кіші кешеніне талдау жасалып, агроөнеркәсіптік кешеннің жүйе құраушы сегменті ретінде астық өнімдерін өндіру мен тұтыну проблемалары және азық-түлік проблемасын шешу негіздері зерттелген. Жалпы республика бойынша бидайдың жалпы түсімінің динамикасы, оның ішінде Ақмола облысында – астық өнімділігі рейтингінде көшбасшы талданған. Өңірде тауарлы астық алу көлемдерінің өзгеру үрдістері анықталған. Инновациялық технологияларды енгізгенге дейін және одан кейінгі астық саласының негізгі экономикалық көрсеткіштеріне салыстырмалы бағалау әдістемесі ұсынылған, оларды енгізудің орындылығы туралы ұсынымдар берілген. Жоғарыда айтылғандарды қорытындылай келе, астық саласының инновациялық дамуы бағыттардың, басымдықтар мен міндеттердің жүйелік кешенінде неғұрлым тиімді болуы мүмкін деген қорытындыға келуге болады. Елдің астық өндірісіндегі инновациялық процестің бірқатар оң жақтары да бар: топырақтың құнарлылығын қалпына келтіру**

**жөніндегі жұмыстарды жүргізу, олардың тозуының алдын алу; өсірудің әртүрлі тәсілдерін, оның ішінде астықты өндірудің, сақтаудың және өңдеудің энергия және ресурс үнемдеуші технологияларын пайдалану; барлық АӨК және астық кластері деңгейінде мемлекеттік инновациялық саясатты әзірлеу және дамыту.**

**Аннотация. Зерновое хозяйство – это исторически базовая и стратегическая отрасль аграрного сектора экономики Казахстана – главного производителя продуктов питания и основного источника жизнедеятельности населения, от динамичного устойчивого развития которого зависит обеспечение продовольственной безопасности страны. В статье дан анализ зернового подкомплекса Казахстана, исследованы проблемы производства и потребления зерновых продуктов как системообразующего сегмента агропромышленного комплекса и основы решения продовольственной проблемы. Проанализирована динамика валового сбора пшеницы в целом по республике, в том числе в Акмолинской области – лидере в рейтинге урожайности зерновых. Выявлены тенденции изменения объемов получения товарного зерна в регионе. Предложена методика сравнительной оценки основных экономических показателей зерновой отрасли до и после внедрения инновационных технологий, даны рекомендации о целесообразности их внедрения. Резюмируя вышесказанное, можно прийти к следующему выводу, заключающемся в том, что инновационное развитие зерновой отрасли может быть наиболее эффективным в системном комплексе направлений, приоритетов и задач. Инновационный процесс в зерновом производстве страны имеет ряд позитивных сторон: проведение работ по воспроизводству плодородия почв, предотвращение их деградации; использование различных приемов выращивания, в т.ч. энерго- и ресурсосберегающих технологий производства, хранения и переработки зерна; разработка и развитие государственной инновационной политики на уровне всего АПК и зернового кластера.**

**Key words: grain crops, sown area, grain production, yield, gross harvest, wheat, elasticity, innovative technologies, prices, export.**

**Түйінді сөздер: дәнді дақылдар, егіс алаңы, астық өндірісі, түсімділік, жалпы жинау, бидай, серпімділік, инновациялық технологиялар, бағалар, экспорт.**

**Ключевые слова: зерновые культуры, посевная площадь, зерновое производство, урожайность, валовый сбор, пшеница, эластичность, инновационные технологии, цены, экспорт.**

**Introduction.** Grain production is the leading branch of agricultural production. The gross collection of the grain determines the food security of the country since it provides the country with food, feeding, and seed grain, and also makes a raw material base for the development of many industries. Currently, the gross collection of grain in the country is fragile and depends on many factors, such as zonal and weather conditions, technical and technological features of grain production in various farms, etc; and has not yet reached the standard of 1000 tons per one resident of the country [1].

At the present stage, when Kazakhstan has entered a qualitatively new phase of economic modernization, the issues of innovative development of grain production, which, due to its conservatism, is least susceptible to technical and technological changes, come to the fore. The growing demand for grain in the world ensures the sustainability of the grain sector, which is the basis for the state's food security [2].

Market conditions determine the processes of re-converting agricultural enterprises, lead to the production of products that give the highest profit during their sale. However, competition and rapidly changing market conditions equalize prices and profitability of commodity producers, which ultimately leads to an underutilization of the production potential of the agricultural sector, a decrease in the volume and sustainability of production [3].

One of the key areas of the agro-industrial complex is the cultivation of grain crops. Every year the regions increase grain production by expanding crop acreages and increasing yields, which serves as a kind of integrated efficiency indicator of using different tillage technologies. At the same time, the crops grown according to the minimum and zero practice, as shown by empirical research, are not inferior in yield to those cultivated on plowing [4].

In increasing yields and grain gross collection, one of the most effective ways is to create and accelerate the introduction of new technologies into production. However, until

recently, the question of the economic efficiency of resource-saving methods of agricultural production remained unexplored [5]. The economic effect is determined by a comparative analysis of costs, and the methods for determining the influence of progressive technologies on the gross output growth are overlooked, therefore, the proposed methodology on the example of Akmola region, will find its practical application.

**Material and methods of research.** At the stage of econometric research, a regression analysis was carried out, an economic interpretation of the calculation results was made. The research showed that the main factor influencing the gross collection is the yield of grain crops. This is confirmed by the value of the elasticity coefficient exceeding one unit [6].

According to the statistical data under study, the crop acreages had a weak effect on the gross collection of grain crops. These results of the study confirm the need to increase the yield of grain crops through the introduction of modern cultivation technologies and the use of seed grains of quality varieties. The results of the theoretical and economic analysis showed that the main factors influencing the gross collection of grain crops are the crop acreage and yield.

**Results and their discussion.** In Kazakhstan, for the 2015-2017 period, 11.5-15.1 million tons of wheat were produced, which enables the country to be in third place in the CIS after Russia and Ukraine. The average yield of grain is 9.0 - 13 c / ha. The growth in grain production contributes to an increase in its sales and an increase in the profitability of the industry. On average, 2.8 - 7.0 million tons of grain are shipped for export. Besides, about 1.3 - 2.2 million tons of flour are exported. Spring wheat occupies over 3/4 of the grain crops. It is sown mainly in the northern part of the republic, and winter wheat is cultivated in the south. When constructing an econometric model of the gross collection of grain crops at the information stage, official statistical data were used (table 1).

Table 1- Database for the study of the gross collection of wheat, Akmola region

| Years | Crop acreage, ths.ha | Crop yield 1 c/ha | Gross collection, ths tons |
|---|---|---|---|
| 2015 | 3 660.6 | 10.8 | 3 953.4 |
| 2016 | 3 855.9 | 11.1 | 4 280.0 |
| 2017 | 3 719.4 | 10.9 | 4 054.1 |
| 2018 | 3 599.0 | 11.1 | 3 994.9 |
| 2019 | 3 621.2 | 9.2 | 3 331.5 |
| Source: http://stat.gov.kz [7] | | | |

Let us come up with effective features and factors:

$y$ – the effective feature: a gross collection of grain and leguminous crops;

$x_1$ – the first factor: crop acreage of grain and leguminous crops;

$x_2$ – the second factor: the yield of grain and leguminous crops.

OVERALL RESULTS

*Regression statistics*

| | |
|---|---|
| Multiple R | 0.99 |
| R-square | 0.99 |
| Standard R-square | 0.99 |
| Standard error | 1.23 |
| Findings | 5.0 |

Thus, the analysis of the grain production showed the following results: an increase or decrease in acreage for grain and leguminous crops has a weak effect on the growth (decrease) of the gross collection (the value of the elasticity coefficient confirms this fact); change in the yield of grain and leguminous crops directly and significantly impact the change in gross collection. The total crop acreage for wheat is 11-13.0 million hectares. The yield of 9-13 c / ha makes it possible to obtain 11.2 - 16.6 million tons of wheat. Of these, 7.4 -7.53 million tons are spent on domestic consumption, and 3.0 - 8.2 million tons are exported. The carry-over stocks are 1.0 - 3.0 million tons (figure 1).

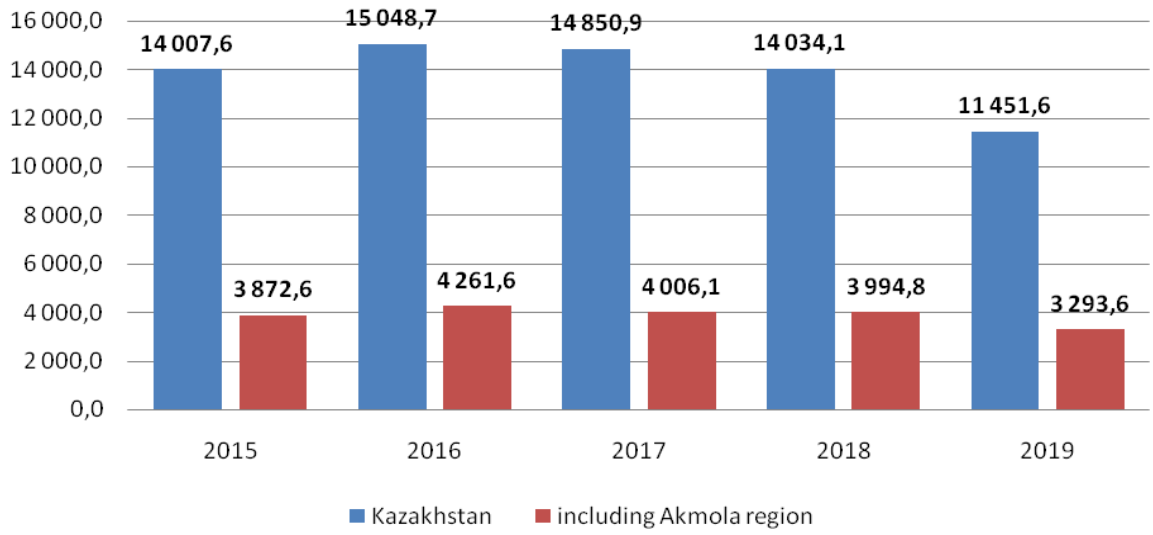


Figure 1- Gross collection over the years in the Akmola region for 2015-2019, thousand tons

Figure 1 shows that the gross collection of wheat in the Akmola region taken into account the loss allowance in 2019 amounted to 3 293.6 thousand tons, which is lower than the levels of 2017-2018 by 712.5 thousand tons and 701.2 thousand tons, respectively [8,9].

In recent years, instead of traditional intensive cultivation technologies, resource-saving methods of minimum and zero tillage have been increasingly introduced internationally. In many regions of our country, these methods are already being effectively applied, while in other regions, there is an increasing interest in them [10].

The calculation of the gross production of wheat in the Akmola region was carried out based on data on yield, crop acreage, and sales prices for the corresponding year in the period from 2015 to 2019. A deflator was used to ensure the comparability of the cost data over time. Calculations of gross production for the period from 2015 to 2019 taking into account the deflator are given in table 2.

Table 2- Calculation of gross output in wheat production, taking into account the deflator, years

| Indicator | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Price, tenge/c | 3 560 | 3 869 | 3 854 | 4 467 | 5 910 |
| Crop yield, c/hectare | 10.8 | 11.1 | 10,9 | 11,1 | 9.2 |
| Crop acreage, ths. hectares | 3 660.6 | 3 855,9 | 3 719,4 | 3 599,0 | 3 621.2 |
| Gross output, ths. tenge | 137 864.6 | 164 881.3 | 154 395.1 | 178 448.6 | 194 652.4 |
| Source: http://stat.gov.kz [lk.7] | | | | | |

The introduction of new technology is quantitatively expressed in a change in crop yield. Therefore, the change assessment of yield on the volume of gross output gives a completely objective picture of the impact of the new technology introduced on the level of the studied indicator (gross output).

Table 3 shows the calculations of the weighted average price and gross output in wheat production before and after the introduction of progressive technology in the period from 2015 to 2019.

Table 3 - Weighted average yield, price, gross output

| Indicator | Before the introduction of new technology | After the introduction of new technology |
|---|---|---|
| Weighted average yield, c/ha | 10.4 | 10.9 |
| Weighted average price, tenge/c | 3 761.0 | 4 743.7 |
| Gross output, tenge/ha | 39 114.4 | 51 706.3 |
| Source: calculations based on the previous table | | |

To calculate the impact of new technology on the gross output of the industry, it is also necessary to conduct a factor analysis using the index method.

To analyze, we will use the following formula 1, 2:

$$GP_0 = P_0 \times Y_0 \quad (1)$$

$$GP_1 = P_1 \times Y_1 \quad (2)$$

Where $GP_0$ and $GP_1$ is the gross product, respectively, before and after the new technology introduction, tenge/ha, $P_0$ and $P_1$ is the price of the product, respectively, before and after the introduction, tenge/c, $Y_0$ and $Y_1$ is the wheat yield, respectively, before and after the introduction of new technology, c / ha, formula 3.

$$\Delta GP\ yield = P_0 \times Y_1 - P_0 \times Y_0 = P_0 \times \Delta Y \quad (3)$$

Then, the value will represent the increase in production due to changes in yield from the introduction of new technology;

value $\Delta GP\ y = P_1 \times Y_1 - P_0 \times Y_1 = \Delta P \times Y_1$ is the increase in production due to price changes [11].

The increase in output due to changes in yield from the introduction of new technology amounted to: 3 761.0 × (0.5) = 1 880.5 tenge/ha;

The increase in output due to price changes is 4 743.7 × 10.9 - 3 761.0 × 10.9 = 51 706.3 – 40 994.9 = 10 711.4 tenge/ha

At the same time, the total increase in gross production is equal to:

$GP_p$ = 1 880.5 +10 220 = 12 591.9 tenge/ha

The growth rate of gross output in wheat production due to changes in yield from the introduction of new technology is (1 880.5 / 39 114.4) × 100% = 4.8%

Next, let us calculate the total increase of gross output in wheat production per one farm from the introduction of new technology according to the formula 4:

$$\Delta GP\ entire\ cur.year = \Delta GP\ yield \times S \quad (4)$$

Where $\Delta GP_{entire\ cur.year}$ is the increase in gross output when using new technology for the enterprise as a whole, tenge (tugrik); $\Delta GPyield$ is the increase in gross production per hectare from the use of new technology, tenge/ha; S - total crop acreage for wheat, ha.

Overall, the increase in gross output due to the introduction of new technology for farms amounted to:

2015 - $GP_{entire\ current\ year}$ (1.880×3 660.6) = 68 819.3 ths. tenge

2016 - $GP_{entire\ current\ year}$ (1.880×3 855.9) = 72 490.9 ths. tenge

2017 - $GP_{entire\ current\ year}$ (1.880×3 719.4) = 69 924.8 ths. tenge

2018 - $GP_{entire\ current\ year}$ (1.880×3 599.0) = 67 661.2 ths. tenge

2019 - $GP_{entire\ current\ year}$ (1.880×3 621.2) = 68 078.5 ths. tenge

**Conclusion**

1. High volatility of grain production, the predominance of monoculture - wheat, weak diversification of crop acreage, low grain yield.

2. With the need to increase the gross collection, progressive technologies are being introduced, which leads to the need to develop a methodology for determining the economic effect for making management decisions.

3. Therefore, the assessment of the influence of factors on the gross collection makes it possible to quickly assess the current trends, and carry out a comparative analysis of the industry with the regions, other types of economic activity in the region.

4. The research results can be used in the development of agricultural policy, development strategies at the regional and sectoral levels, which will help to make decisions about the need to introduce advanced technologies to increase the gross collection.

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