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THE ECONOMIC NATURE AND SPECIFIC FEATURES OF AGRICULTURAL PRODUCT PROCESSING

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Abstract: This article examines the economic nature and specific features of agricultural product processing, using sugar beet and table beet as examples. It explains the role of plant raw-material processing in creating added value, ensuring food security, and improving the efficiency of the agro-industrial sector [1]. The main uses of sugar beet and table beet, the technological features of their processing, and the factors affecting the economic efficiency of processing enterprises are considered. Particular attention is paid to the rational use of raw materials, reducing production costs, improving the quality of finished products, and making comprehensive use of processing by-products. The need to improve economic mechanisms governing cooperation between agricultural producers and processing enterprises is substantiated. The article concludes that the development of beet processing helps increase the competitiveness of the agro-industrial complex, expand the product range, and raise the income of participants in the production and distribution chain.

Keywords: agricultural products, processing, sugar beet, table beet, agro-industrial complex, economic efficiency, added value, production costs, food security, processing industry.

Introduction

Agriculture is one of the most important sectors of the economy, supplying food to the population and essential raw materials to the processing industry. However, agricultural production alone does not always generate the maximum economic benefit. A significant share of value is created at subsequent stages of the production and distribution chain, including storage, sorting, processing, packaging, and sale of finished products. [2]

Processing agricultural raw materials is an important direction for the development of the agro-industrial complex. Its economic significance lies not only in transforming raw materials into food products, but also in creating added value, reducing product losses, extending shelf life, and improving the efficiency of production resource use. [2]

In this regard, beets are of particular interest and are divided into sugar beet and table beet. Sugar beet is an important raw material for sugar production, as well as for by-products used in livestock farming and other industries. Table beet is primarily a food crop and, after processing, can be used to produce canned, frozen, and other food products.

The economic efficiency of processing these types of agricultural raw materials depends on a combination of factors: the volume and quality of raw materials, purchase prices, transportation and storage costs, the technical condition of equipment, energy intensity of production, finished-product yield, selling prices, and the possibility of making rational use of waste.

The aim of this article is to examine the economic nature and specific features of sugar beet and table beet processing and to identify the main ways to improve the efficiency of this process.

The Economic Nature of Agricultural Product Processing

Agricultural product processing is a set of technological and economic processes aimed at transforming agricultural raw materials into products with greater consumer and market value. [2]

From an economic perspective, processing increases the value of the original raw material by changing its consumer properties. For example, after technological processing, sugar beet is transformed into sugar, which is much closer to being ready for final consumption. The process also generates additional products, such as beet pulp, molasses, and other by-products, which may also have economic value.

Thus, processing contributes to the creation of added value. While agricultural production mainly involves the use of land, seeds, fertilisers, water, labour, and machinery, the processing stage requires additional capital, energy, labour, technological equipment, and transport and storage infrastructure.

An important characteristic of agricultural raw materials is their seasonality. Harvesting takes place within a relatively short period, whereas processing and consumption may continue for much longer. Therefore, efficient organisation of storage and processing is essential for stabilising market supply. [3]

Processing also helps reduce physical and economic losses of agricultural products. Losses occur because of spoilage, mechanical damage, deterioration during storage, and the effects of temperature and humidity. Modern processing technologies make it possible to preserve a significant part of the raw material's consumer value.

In addition, processing enterprises create jobs, develop transport and storage infrastructure, increase tax revenues, and stimulate economic activity in rural areas.

Consequently, the economic nature of agricultural product processing lies in creating added value by technologically transforming and preserving raw materials, improving quality, and producing goods that meet the needs of final consumers.

Specific Features of Sugar Beet Processing

Sugar beet is one of the main agricultural crops used to produce sugar. Its economic value is determined primarily by the sucrose content of the roots and by the possibility of making comprehensive use of almost all major processing products.

Sugar beet processing consists of several successive stages. When the raw material arrives at a processing plant, it is received and assessed according to quantitative and qualitative indicators. The beets are then cleaned of soil and plant impurities, washed, and sent for further processing.

At the next stage, the roots are cut into thin strips. Sugar is extracted from these strips by diffusion, after which the diffusion juice is purified. Water is then evaporated, sucrose is crystallised, and sugar crystals are separated from the mother liquor. The resulting sugar is dried, cooled, and packaged.

The economic efficiency of sugar beet processing depends largely on the quality of the incoming raw material. The most important characteristics are sucrose content, soil contamination, the degree of damage, and the length of storage before processing. The higher the sucrose content and the lower the level of impurities, the greater the potential sugar yield per unit of raw material.

Therefore, enterprises have an interest in setting economically justified quality requirements for purchased beets. One of the key challenges is transporting sugar beet from agricultural producers to processing plants. The roots are heavy and contain a large amount of moisture, so transport costs may account for a substantial share of total processing costs. Optimising logistics helps reduce costs and raw-material losses.

Storage duration is also important. During prolonged storage, sugar beet may lose mass and sucrose, directly affecting the economic performance of both processors and producers. Important ways to improve efficiency therefore include better storage conditions, shorter delivery times, and ensuring that processing plants operate regularly.

A distinctive feature of the sugar industry is the comprehensive use of raw materials. Processing produces not only sugar but also by-products. Beet pulp can be used as animal feed, while molasses is used to manufacture various food and industrial products, including as a raw material for further processing. [4]

Thus, the economic benefit of sugar beet processing comes not only from selling sugar but also from the rational use of by-products. [4]

Economic Features of Table Beet Processing

Unlike sugar beet, table beet is used mainly as a food product. It can be sold fresh or sent for further industrial processing.

Table beet processing [4; 3] makes it possible to produce a wide range of products, including cooked and peeled beet, canned products, semi-finished products, frozen foods, juices, purées, and other food products.

The economic significance of table beet processing lies primarily in increasing its consumer value and expanding marketing opportunities. Fresh beet has a limited shelf life and may suffer natural losses. Processing considerably extends the period during which the product can be sold and makes it more convenient for consumers.

The processing of table beet may include sorting, washing, peeling, cutting, heat treatment, canning or freezing, packaging, and storage. The specific operations depend on the type of finished product.

Sorting the raw material is an important economic factor. Roots of different sizes and quality may have different economic value. Modern sorting lines make it possible to allocate raw materials more rationally among different processing options.

Packaging is also important. [4] Modern packaging materials help preserve product quality, extend shelf life, and make goods more attractive to consumers. However, higher packaging costs must be economically justified and take consumers' purchasing power into account.

Processing non-standard products is another important option. Beet that does not meet the appearance requirements of the fresh vegetable market may be used for industrial processing if it has no serious damage. [3] This helps reduce agricultural raw-material losses and increase the overall level of utilisation.

Thus, table beet processing can transform raw materials that are potentially low-profit or perishable into products with higher added value.

Factors Affecting the Economic Efficiency of Beet Processing

Processing efficiency is determined by the relationship between the results achieved and the costs required to achieve them. The main performance indicators are production cost, profit, profitability, labour productivity, material intensity, and energy intensity.

One of the most significant factors is the cost of agricultural raw materials. Raw-material expenses may account for a substantial share of the cost of processed products. Therefore, economically justified relationships between agricultural producers and processing enterprises must be established. [5]

When setting purchase prices, it is advisable to consider not only the weight of the delivered raw material but also its quality characteristics. This approach gives agricultural enterprises an economic incentive to improve yields and product quality.

Energy costs are another important factor. Beet processing includes washing, cutting, heat treatment, evaporation, drying, cooling, and other energy-intensive operations. The use of energy-efficient equipment helps reduce the cost of finished products. [5]

Transport costs also have a considerable impact. Since sugar beet and table beet are heavy and relatively bulky raw materials, increasing the distance between fields and processing plants may raise production costs. It is therefore optimal to locate processing facilities close to raw-material production areas.

Another factor is the utilisation rate of production capacity. When capacity utilisation is low, fixed costs are spread over a smaller volume of output, increasing the cost per unit. Enterprises should therefore aim to use their available equipment as rationally as possible.

The technological level of production is equally important. Modern production lines can automate individual operations, reduce raw-material losses, increase labour productivity, and ensure more consistent finished-product quality.

The main ways to improve the efficiency of beet processing include:

- improving the quality of agricultural raw materials;
- reducing losses during transportation and storage;
- upgrading technological equipment;

• reducing material and energy costs; [6; 7]
• increasing the utilisation rate of production capacity;
• automating production processes;
• making rational use of by-products; [6]
• improving marketing and distribution systems;
• developing cooperation between producers and processors.

The combined effect of these measures enables enterprises to reduce costs while improving product quality.

Improving the Economic Mechanism of Processing [6; 7]

The modern development of the agro-industrial complex requires a shift from the separate operation of agricultural producers and processing enterprises towards closer integration among participants in the production and distribution chain. [8]

One effective approach is to develop contractual relationships between sugar beet and table beet producers and processing enterprises. Signing contracts in advance enables producers to plan production volumes and processors to secure a stable supply of raw materials.

The introduction of digital technologies is also important. Information systems can track raw materials from producers to processing plants, monitor product quality, forecast incoming raw-material volumes, and optimise logistics.

The adoption of resource-saving technologies is another promising direction. Reducing the use of water, energy, and other resources helps lower production costs and improve the environmental sustainability of enterprises. [1]

Particular attention should be paid to comprehensive raw-material processing. [4; 5] Waste and by-products should not be viewed solely as production losses. When appropriate technologies are available, they can become an additional source of income.

For sugar beet, the use of pulp and molasses is especially important. For table beet, a promising option is to use non-standard raw materials to produce juices, purées, and other products, provided that their quality meets food-safety requirements. [5]

Thus, improving processing efficiency should involve not only increasing production volumes but also making more rational use of every element of the raw-material and production potential.

The Importance of Beet Processing for the Development of the Agro-Industrial Complex

The development of sugar beet and table beet processing has a broad impact on the agro-industrial economy. First, it increases the added value of agricultural products. Second, it creates stable demand for raw materials from processing enterprises. [9; 1] Third, it supports the production of goods needed by the domestic market.

For agricultural producers, the availability of processing facilities reduces dependence on selling raw materials exclusively in fresh form. Producers gain additional sales channels and opportunities to enter into long-term contracts.

For processing enterprises, a stable raw-material supply enables more efficient use of production capacity and reduces the risks associated with supply interruptions. For consumers, the

development of processing expands the product range, improves year-round availability, and makes products more convenient to use.

At the macroeconomic level, agricultural product processing strengthens food security, reduces dependence on imports of certain products, and supports domestic production. [9; 1]

It should be noted that processing efficiency must be assessed not only at the level of an individual enterprise. The overall effect across the entire chain—raw-material production, transportation, storage, processing, and sale—must also be considered. Optimising one stage should not increase the total costs of the system.

Sugar Beet Production Trends in Uzbekistan

According to the National Statistics Committee of the Republic of Uzbekistan, sugar beet production across all categories of farms fluctuated considerably: it rose from 0.2 thousand tonnes in 2018 to 3.1 thousand tonnes in 2020, then fell to 1.85822 thousand tonnes in 2024. This trend indicates substantial variability in the raw-material base for processing and the need to take production volumes into account when planning capacity utilisation. [11]

Table 1. Sugar beet production in Uzbekistan, 2018–2024

Year	Sugar beet production, thousand tonnes
2018	0,2
2019	2,5
2020	3,1
2021	2,4
2022	2,0
2023	1,8
2024	1,85822

Source: compiled by the author using data from the National Statistics Committee of the Republic of Uzbekistan. [11]

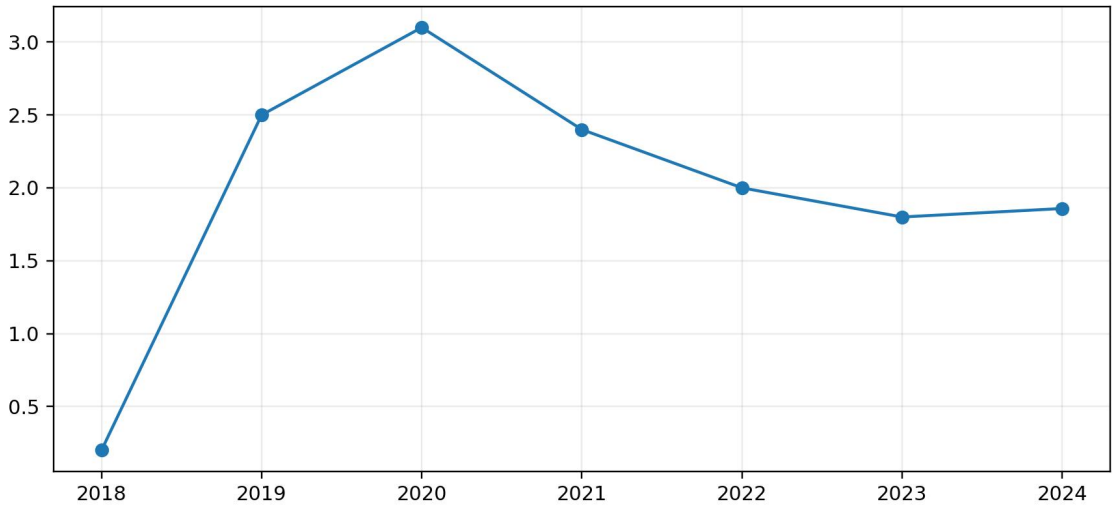


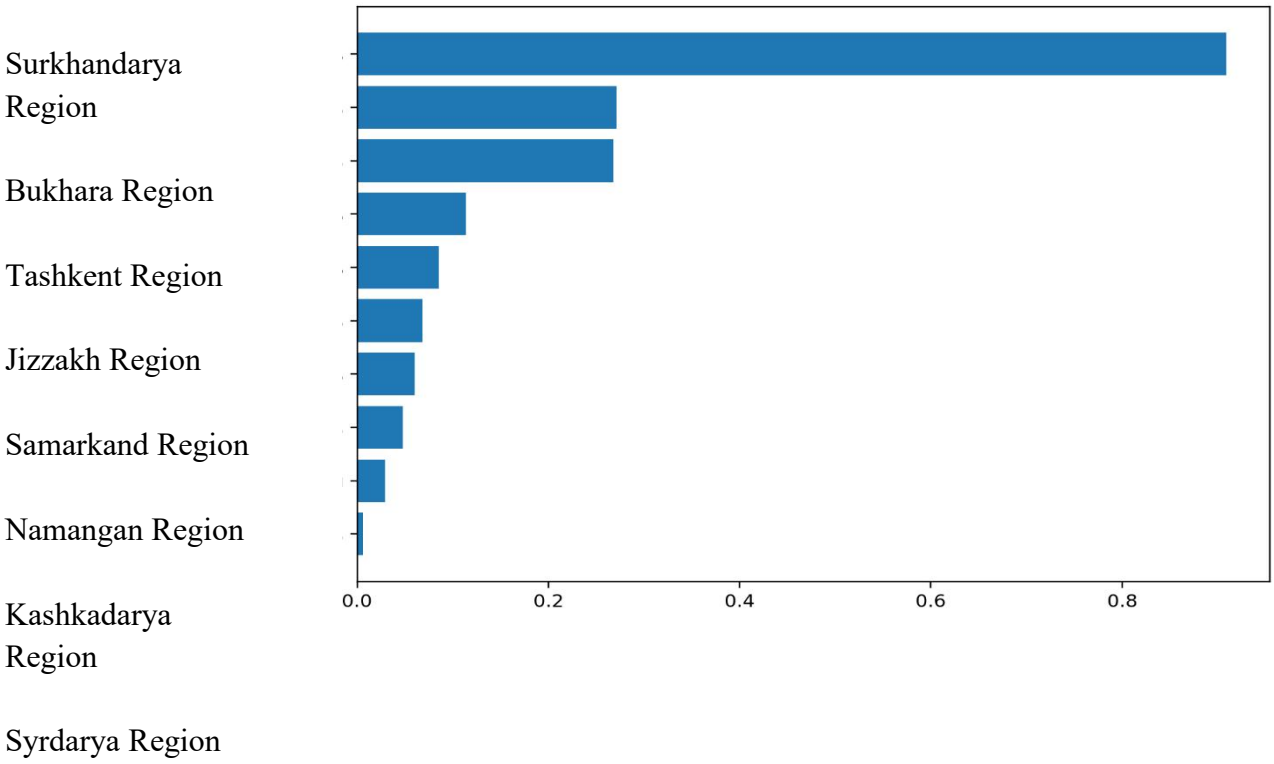
Figure 1. Sugar beet production trends in Uzbekistan, 2018–2024

Source: compiled by the author using data from the National Statistics Committee of the Republic of Uzbekistan. [11]

The regional distribution of production is also highly concentrated. In 2024, the largest volume of sugar beet was produced in Surkhandarya Region—0.909 thousand tonnes. It was followed by Bukhara Region—0.27142 thousand tonnes—and Tashkent Region—0.2682 thousand tonnes. This indicates that the geographical concentration of the raw-material base must be considered when locating processing facilities and planning their capacity utilisation. [10; 11]

Table 2. Sugar beet production by region in Uzbekistan, 2024

Region	Production in 2024, thousand tonnes
Surkhandarya Region	0.909
Bukhara Region	0.27142
Tashkent Region	0.2682
Jizzakh Region	0.114
Samarkand Region	0.085
Namangan Region	0.068
Kashkadarya Region	0.06
Syrdarya Region	0.0476
Karakalpakstan	0.029
Navoi Region	0.006



Karakalpakstan

Navoi Region

thousand tonnes

Figure 2. Sugar beet production in the main regions of Uzbekistan in 2024

Source: compiled by the author using data from the National Statistics Committee of the Republic of Uzbekistan. [11]

Conclusion

Agricultural product processing is a key component of the agro-industrial complex, transforming raw materials into products with higher added value. The examples of sugar beet and table beet demonstrate significant differences in processing methods, while both require rational raw-material use, reduced losses, and improved production efficiency. [3; 4]

The economic nature of sugar beet processing lies in sugar production and the additional economic benefit obtained through the comprehensive use of by-products.

The efficiency of this process depends on the sucrose content and quality of the raw material, transport and energy costs, the technological level of equipment, and the utilisation rate of production capacity. [5; 6]

Table beet processing extends product shelf life, expands the range of products, and increases their market value. The use of non-standard raw materials is particularly important, as they can be processed into food products when appropriate processing methods are applied. [8]

To further improve economic efficiency, it is advisable to strengthen contractual relationships between agricultural producers and processing enterprises, introduce modern resource-saving technologies, automate production, optimise logistics, and develop comprehensive raw-material processing.

Overall, the development of sugar beet and table beet processing contributes to a stable production and distribution system, higher incomes for agricultural producers and processing enterprises, additional jobs, and stronger food security. Improving processing efficiency should therefore be considered a promising direction for the development of the modern agro-industrial complex. [1; 4]

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