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Article

Indicators for Assessing the Economic Efficiency of Cotton and Grain Seed Processing Enterprises

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Abstract. This article examines the principal areas for assessing the economic efficiency of cotton and grain seed processing enterprises. Production, technological, resource-use, labour, financial, quality, and market indicators are systematised, and their economic significance is explained. A set of indicators suitable for a comprehensive assessment of enterprise performance is proposed.

Keywords: cotton seed, grain seed, seed processing enterprise, economic efficiency, production capacity, standard-compliant seed, production cost, labour productivity, resource efficiency, product quality, profitability.

Introduction

The performance of agricultural production largely depends on the quality of seed used for sowing and the efficient organisation of seed processing. High-quality seed contributes to the fuller realisation of crop yield potential, improved product quality, and reduced production costs [4, 9, 11]. Therefore, the regular assessment of the economic efficiency of cotton and grain seed processing enterprises is of considerable importance.

Seed processing comprises a sequence of interconnected operations, including raw seed reception, cleaning, sorting, grading, treatment, packaging, certification, and storage [3, 6, 10, 12]. These operations require material, labour, energy, and financial resources, the use of which is reflected in the volume, quality, and production cost of the final output. Consequently, assessing an enterprise's economic efficiency solely on the basis of profit or profitability does not fully reflect all aspects of seed processing operations.

In practice, an increase in production volume does not necessarily indicate an improvement in economic efficiency. Output may rise while raw material consumption, energy costs, or technological losses increase at a higher rate. Similarly, an increase in enterprise profit does not necessarily demonstrate that product quality has improved or that production capacity is being used efficiently. Therefore, economic results and the resources used to achieve them should be assessed in an interrelated manner [2, 16].

The sector-specific characteristics of cotton and grain seed processing enterprises should also be considered when assessing their performance. These characteristics include the seasonal nature of production, the dependence of raw seed quality on climatic conditions, prescribed

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requirements for germination capacity and varietal purity, and the need for specialised storage conditions [6, 8, 9, 13]. Such characteristics directly influence the selection of appropriate performance indicators.

Accordingly, the economic efficiency of seed processing enterprises should be assessed across production, technological, resource-use, labour, financial, quality, and market dimensions. This approach makes it possible to identify underperforming areas, assess unutilised internal reserves, and support well-founded managerial decisions.

The purpose of this study is to systematise the indicators describing the economic efficiency of cotton and grain seed processing enterprises and to develop a set of indicators that can be used for a comprehensive assessment of enterprise performance.

To achieve this purpose, the following research objectives were established:

- to explain the essence of economic efficiency assessment;
- to identify the specific operational characteristics of seed processing enterprises;
- to classify efficiency indicators according to their principal assessment dimensions;
- to clarify the calculation procedures and economic meaning of the selected indicators;
- to develop practical recommendations for assessing enterprise performance.

Methodology

The study employed a systematic approach, comparative analysis, grouping, classification, and scientific generalisation. Based on the systematic approach, the operations of seed processing enterprises were examined as an integrated set of interrelated production, technological, resource-use, labour, financial, and quality-related processes. Using the grouping method, the indicators describing economic efficiency were divided into separate categories according to their content and assessment dimension. Comparative analysis was used to identify the common and distinctive characteristics of cotton and grain seed processing. Based on scientific generalisation, a set of indicators suitable for assessing the performance of seed processing enterprises was developed.

The information base of the study comprised regulatory documents governing the seed sector, national and international academic literature on economic efficiency assessment, and production and economic indicators describing the operations of seed processing enterprises [1, 7–10].

Analysis and Results

Economic efficiency reflects the relationship between the results achieved by an enterprise and the resources used to obtain those results. The results may include the volume of products manufactured and sold, sales revenue, profit, and the quantity of seed that meets established quality requirements. The inputs comprise costs associated with the use of raw materials, labour, energy, fixed assets, and financial resources [2, 16]. A distinctive feature of economic efficiency assessment in seed processing enterprises is the close relationship between economic results and product quality. An increase in seed output can be considered a positive result only when germination capacity, varietal purity, moisture content, and other quality characteristics comply with established standards [4, 8, 11–13]. Otherwise, growth in output does not necessarily indicate an improvement in enterprise efficiency.

For a comprehensive examination of enterprise performance, efficiency indicators should be classified into several principal assessment dimensions.

Table 1

Key dimensions for assessing the economic efficiency of seed processing enterprises

Assessment dimension	Key indicators	Purpose of assessment
Production efficiency	Output volume, production capacity utilisation, processing time per tonne of output	Measures the extent to which the enterprise uses its available production capacity
Technological efficiency	Yield of standard-compliant seed, technological losses, equipment downtime	Measures the effectiveness of raw seed processing and technological operations

Assessment dimension	Key indicators	Purpose of assessment
Material resource efficiency	Materials productivity, material intensity, raw material consumption	Assesses the efficiency of material resources used in producing the final output
Energy efficiency	Energy consumption per tonne of output, share of energy costs in production cost	Describes the efficiency of energy resource use
Labour efficiency	Labour productivity, labour intensity, working-time utilisation	Assesses the productivity and efficiency of employees
Fixed asset efficiency	Capital productivity, equipment utilisation, fixed asset renewal rate	Measures the efficiency with which production assets are used
Cost efficiency	Production cost per tonne, cost productivity, cost savings	Determines the return obtained from funds spent on production
Financial efficiency	Profit, return on sales, working capital turnover	Assesses the enterprise's financial results and the efficiency of its financial resource use
Product quality	Germination capacity, varietal purity, moisture content, share of certified output	Indicates whether processed seed complies with established quality requirements
Storage and logistics efficiency	Storage losses, transportation costs, delivery time	Assesses the efficiency of storing and delivering finished products to customers
Market efficiency	Sales volume, fulfilment of contractual obligations, finished-goods inventories	Describes the enterprise's market performance and demand for its products

Source: developed by the author based on [2–6, 9, 10, 13, 16].

The indicators presented in Table 1 enable enterprise performance to be assessed across different dimensions. Production and technological indicators describe the effectiveness of seed processing operations, whereas resource-use and cost indicators show the level of expenditure required to achieve the results. Financial indicators reflect the enterprise's final economic results, while quality indicators demonstrate whether the processed seed complies with established requirements. These indicators should not be applied separately but should be evaluated in an interrelated manner. For example, a higher production capacity utilisation rate is generally considered a positive development. However, if it is accompanied by a substantial increase in energy consumption, production cost, or technological losses, the enterprise cannot be regarded as fully efficient. Production results should therefore be analysed together with resource consumption and product quality indicators [3, 9, 10, 15].Urug'lik tayyorlovchi korxonalar faoliyatini baholashda qo'llaniladigan ko'rsatkichlarning hisoblash tartibi 2-jadvalda keltirilgan.

Table 2

Key Indicators of the Economic Efficiency of Seed Processing Enterprises

Indicator	Calculation procedure	Economic meaning
Production capacity utilisation rate	Actual output / annual production capacity × 100	Shows the extent to which available production capacity is utilised
Yield of standard-compliant seed	Volume of standard-compliant seed / volume of raw seed received for processing × 100	Measures the technological efficiency of raw seed processing
Technological loss rate	Volume of technological losses / volume of processed raw seed × 100	Shows the share of raw seed lost during processing
Materials productivity	Value of finished products / material costs	Measures the output generated from the material resources used
Energy intensity	Energy costs / volume of output	Shows the amount or value of energy consumed per unit of output

Indicator	Calculation procedure	Economic meaning
Labour productivity	Volume of output / average number of employees	Shows the volume of output produced per employee
Fixed asset productivity	Volume of output / average annual value of fixed assets	Measures the contribution of fixed assets to production
Production cost per tonne	Total production costs / volume of output	Shows the cost incurred in processing one tonne of seed
Return on sales	Net profit / sales revenue × 100	Shows the share of net profit in sales revenue
Share of certified output	Volume of certified seed / total volume of processed seed × 100	Indicates the degree to which finished products comply with established quality requirements
Storage loss rate	Storage losses / volume of products placed in storage × 100	Shows the quantitative losses incurred during storage
Contract fulfilment rate	Volume of products actually delivered / volume specified in contracts × 100	Indicates the extent to which the enterprise fulfils its obligations to customers
Working capital turnover	Sales revenue / average value of working capital	Shows the speed and efficiency of working capital utilisation

Source: developed by the author based on [2–6, 9, 10, 13, 16].

An increase in the value of some indicators presented in Table 2 demonstrates an improvement in economic efficiency. In particular, increases in production capacity utilisation, the yield of standard-compliant seed, materials productivity, labour productivity, fixed asset productivity, return on sales, and the share of certified output are considered positive developments. Conversely, reductions in energy intensity, production cost, technological losses, and storage losses indicate improved enterprise efficiency [3, 6, 9, 10].

Assessment of Production Capacity Utilisation

Production capacity utilisation is one of the principal performance indicators for seed processing enterprises. It is calculated as follows:

$$K_{cu} = \frac{Q_a}{Q_d} \times 100$$

where:

K_{cu} — production capacity utilisation rate, percentage;

Q_a — actual volume of output;

Q_d — enterprise design production capacity.

A low value of this indicator may be associated with underutilised equipment, shortages of raw seed, maintenance and repair work, seasonal interruptions, or insufficient demand for the enterprise's products. The production capacity utilisation rate should therefore be analysed in conjunction with the production programme, raw seed supply, and product marketing opportunities.

An increase in capacity utilisation helps reduce fixed costs per unit of output. However, a high capacity utilisation rate should not lead to a deterioration in product quality or excessive equipment loading.

Assessment of Standard-Compliant Seed Yield

The yield of standard-compliant seed indicates the proportion of raw seed received for processing that is converted into finished products meeting the established quality requirements. This indicator is calculated as follows:

$$K_{scs} = \frac{Q_{scs}}{Q_r} \times 100$$

where:

K_{scs} — yield of standard-compliant seed, percentage;

Q_{scs} — volume of processed standard-compliant seed;

Q_r — volume of raw seed received for processing.

An increase in standard-compliant seed yield indicates improvements in raw material quality, the condition of processing equipment, sorting operations, and laboratory control [3, 4, 10, 13]. A decline in this indicator may be associated with impurities in the raw seed, excessive moisture content, mechanical damage, or failure to comply with technological requirements [10, 11, 15].

Improving the yield of standard-compliant seed enables an enterprise to obtain a larger volume of marketable output from the same quantity of raw material. Consequently, the production cost per unit decreases, while the enterprise's sales revenue and profit increase. This indicator therefore serves as an important link between the technological and economic efficiency of seed processing enterprises.

Assessment of Resource-Use Efficiency. The seed processing process uses raw materials, electricity, fuel, packaging materials, and labour resources. An increase in the consumption of these resources directly affects production cost. Resource consumption should therefore be assessed in relation to both the volume and quality of processed output [2, 3, 10].

Materials productivity is used to determine the efficiency of material resource utilisation:

$$M_q = \frac{Q_m}{X_m}$$

where:

M_q — materials productivity;

Q_m — value of manufactured output;

X_m — material costs.

An increase in materials productivity means that more output is generated per unit of material resources consumed. A decline in this indicator may result from increased raw material consumption, higher technological losses, or the inefficient use of packaging materials.

Energy intensity is used to assess the energy consumption of production:

$$E_s = \frac{X_e}{Q}$$

where:

E_s — energy intensity of output;

X_e — energy resource costs;

Q — volume of manufactured output.

A decrease in energy intensity indicates a reduction in the amount or value of electricity and fuel used to process one unit of output. This can be achieved by introducing energy-efficient equipment, reducing equipment idle time, and improving the organisation of production processes.

Assessment of Labour Productivity. Labour productivity represents the volume of output relative to the average number of employees:

$$M_u = \frac{Q}{X_s}$$

where:

M_u — labour productivity;

Q — volume of manufactured output;

X_s — average number of employees.

An increase in labour productivity may indicate improvements in employee qualifications, the technical capacity of production, work organisation, and the incentive system. However, this indicator should be assessed together with product quality. If output growth is achieved at the expense of seed quality, it does not represent a genuine improvement in economic efficiency.

Since seed processing is seasonal, labour productivity assessment should consider not only the average annual number of employees but also the working time used and the volume of output produced during the processing season.

Assessment of Production Cost and Profitability

Production cost comprises the costs of raw materials, energy, labour, maintenance, storage, and other production inputs used in seed processing. The production cost per tonne of processed seed is calculated as follows:

$$T_b = \frac{X_j}{Q}$$

where:

T_b — production cost per tonne;

X_j — total production costs;

Q — volume of processed output.

A reduction in production cost per tonne, provided that product quality is maintained, indicates improved economic efficiency. Changes in production cost are affected by raw material and energy prices, production capacity utilisation, labour productivity, technological losses, and storage costs.

Return on sales can be used to assess the enterprise's final financial result:

$$R_s = \frac{SF}{ST} \times 100$$

where:

R_s — return on sales, percentage;

SF — net profit;

ST — sales revenue.

An increase in return on sales indicates that the share of net profit in the enterprise's sales revenue has risen. However, changes in product prices, government regulatory measures, and the dynamics of production costs should also be considered when assessing profitability [1, 2, 16].

Assessment of Product Quality

Product quality is an essential component of economic efficiency in seed processing enterprises. High-quality seed generally has stronger market demand, better sales prospects, and relatively stable prices. Products that fail to meet established quality requirements may require additional processing or may not be sold at the intended price [4, 5, 12].

Seed germination capacity, varietal purity, moisture content, the degree of mechanical damage, and the share of certified output can be used to assess product quality [8, 11, 13–15].

The share of certified output is calculated as follows:

$$S_m = \frac{Q_s}{Q_j} \times 100$$

where:

S_m — share of certified output, percentage;

Q_s — volume of certified seed;

Q_j — total volume of processed seed.

An increase in this indicator demonstrates improved compliance of processed seed with established quality standards. This expands the enterprise's sales opportunities and reduces additional costs associated with reprocessing or replacing non-compliant products.

Discussion

The findings demonstrate that assessing the economic efficiency of seed processing enterprises solely on the basis of profit or profitability is insufficient. The enterprise's final financial results are shaped by production capacity utilisation, standard-compliant seed yield, resource consumption, labour productivity, production cost, and product quality [2, 9, 10, 16].

In addition to the relationship between output and the resources consumed, an efficiency assessment should consider whether the processed seed complies with established quality requirements. In particular, a higher yield of standard-compliant seed improves raw material utilisation, reduces technological losses, and contributes to a lower production cost per unit [3, 4, 10, 13].

The indicators should also be compared with previous-period results, planned targets, and the performance of comparable seed processing enterprises. This approach makes it possible to

identify underperforming areas and supports well-founded managerial decisions aimed at improving economic efficiency.

Conclusion

The study demonstrates that the economic efficiency of cotton and grain seed processing enterprises cannot be adequately assessed using a single indicator. An objective assessment of enterprise performance requires an interrelated analysis of production capacity utilisation, standard-compliant seed yield, resource consumption, labour productivity, production cost, profitability, and product quality.

The following measures are proposed to improve the economic efficiency of seed processing enterprises:

- regularly analyse the production capacity utilisation rate;
- increase the yield of standard-compliant seed and reduce technological losses;
- establish consumption standards for raw materials, energy, and other material resources;
- assess labour productivity in relation to product quality;
- continuously monitor the costs that determine the production cost of seed;
- strengthen quality control over seed germination capacity, varietal purity, and moisture content;
- compare economic efficiency indicators with planned targets, previous-period results, and the performance of comparable enterprises.

The proposed system of indicators enables enterprises to identify underperforming areas in a timely manner, assess the efficiency of available resource utilisation, and substantiate managerial decisions aimed at improving economic efficiency.

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