



Article

Analytical Analysis of Factors Affecting the Efficiency of Product Quality Management in Fruit and Vegetable Enterprises

Yuldasheva Xafizaxon Abdurahim qizi¹

1. Andijan Institute of Agriculture and Agrotechnologies, Uzbekistan
Correspondance: xafizaxonyuldasheva1995@gmail.com

Abstract: This article analyzes the factors influencing the efficiency of product quality management in fruit and vegetable production and processing enterprises. During the study, the impact of raw material quality, technological processes, the logistics system, personnel qualifications, international standards, and innovative technologies on product quality indicators was evaluated. Opportunities for increasing the competitiveness of enterprises through the improvement of the quality management system have also been identified. Based on the research results, practical recommendations have been developed for the development of quality management at fruit and vegetable enterprises.

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1. Introduction

Fruit and vegetable products play an important role in ensuring global food security and increasing export potential. In recent years, the increasing volume of agricultural product processing has necessitated the improvement of the quality management system at enterprises [1].

In a market economy, product quality is considered one of the primary criteria for an enterprise's competitiveness. Ensuring quality indicators that meet international standards is becoming a priority task, especially when entering export markets. From this perspective, an in-depth analysis of factors influencing the efficiency of product quality management at fruit and vegetable enterprises is of scientific and practical importance [2].

In the scientific research conducted by economists, various interpretations of factors affecting product quality and management efficiency have been studied; while some approaches focus primarily on technological factors, other studies prioritize organizational-economic, institutional, logistical, and market factors. In the example of fruit and vegetable enterprises, it is important to analyze these factors not separately, but as an interconnected system [3]. This is because product quality is simultaneously influenced by the quality of seeds and seedlings, agrotechnologies, soil fertility, water supply, mineral fertilization, harvest timing, technical equipment, personnel qualifications, standardization and certification, transport and logistics, market requirements, and the quality of management decisions [4].



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When analyzing factors affecting the efficiency of product quality management at fruit and vegetable enterprises, it is advisable to conventionally divide them into internal and external factors. Internal factors include the enterprise's production and technological potential, material and technical base, innovative activity, resource utilization level, state of labor organization, quality control system, management structure, and personnel qualifications [5]. External factors are expressed by indicators such as market conditions, consumer demand, state regulatory mechanisms, standardization and certification requirements, infrastructure development, access to financial resources, export market requirements, and the competitive environment. Each of these factors directly or indirectly affects product quality; therefore, it is important to evaluate their level of influence on a scientific basis [6].

The content of analytical analysis is not limited to listing factors, but also includes determining their dynamics, structural changes, interdependence, and influence on the final result. From this perspective, it is advisable to use scientific methods such as a systematic approach, factor analysis, comparative assessment, determination of correlation relationships, the index method, integral assessment, and expert evaluation when analyzing factors affecting product quality management efficiency [7].

The scientific works of W. Edwards Deming, Joseph M. Juran, and Philip B. Crosby occupy a special place in the development of quality management theory. Deming proposed quality management through continuous improvement and statistical control, while Juran developed the concept of quality planning, control, and improvement. Modern research extensively highlights the significance of HACCP and ISO systems in the food industry [8]. According to the scientific views of our economist F. Juraev, who conducted scientific research in this field, the relevance of analytical analysis of factors affecting quality management efficiency in fruit and vegetable enterprises allows for assessing the validity of management decisions, identifying problematic points, and utilizing internal reserves [9]. For example, in some cases, the decline in product quality is directly related to violations of agrotechnological discipline, while in other cases, it can be explained by poor storage conditions, the transportation process, packaging quality, or a low level of adaptation to market requirements [10]. Consequently, a correct analysis of the influence of factors creates a methodological basis for developing targeted measures aimed at improving quality at the enterprise. Although domestic researchers have conducted scientific research to increase the efficiency of storage, processing, and export of fruit and vegetable products, the issue of a comprehensive assessment of factors influencing quality management efficiency remains relevant [11].

2. Materials And Methods

The following methods were used in the study:

- economic and statistical analysis;
- comparison method;
- expert assessment method;
- analytical grouping;
- methods of induction and deduction;
- systematic approach.

During the analysis, factors affecting product quality at fruit and vegetable enterprises were divided into internal and external groups.

Internal factors:

- raw material quality;
- technological equipment;
- employee qualifications;

- production control.

External factors:

- logistics infrastructure;
- market demands;
- standardization system;
- state policy.

3. Results

During the scientific research, we studied and analyzed the factors influencing product quality management.

1. Raw material quality

The quality of fruit and vegetable products primarily depends on the quality of raw materials. High-quality raw materials ensure the following results:

- reduce waste volume;
- improves the appearance of the product;
- extends the shelf life;
- improves compliance with export requirements.

According to the results of the expert assessment, 30% of the effectiveness of quality management depends on the quality of raw materials [12].

2. Technological processes

The use of modern technologies ensures the stability of product quality.

This includes:

- automated sorting systems;
- vacuum packaging;
- IQF (fast-freezing) technology;
- digital monitoring systems.

The impact of this factor was estimated at 25 percent [13].

3. Logistics and storage system

Due to the biological properties of fruit and vegetable products, logistics quality is a crucial factor in maintaining the consumer value of the product.

The development of refrigerated warehouses and "cold chain" technologies can reduce losses by 20–30 percent [14].

4. Staff qualifications

The success of the quality management system depends on the knowledge and skills of employees.

Regularly at enterprises:

- professional development;
- trainings;
- internal audits;
- improves quality indicators [15].

5. Implementation of international standards

Implementing quality management standards at enterprises increases export potential.

Key Standards:

- ISO 9001;
- HACCP;
- GlobalG.A.P.;
- ISO 22000.

6. Innovative technologies

Digitalization and artificial intelligence-based monitoring systems are elevating quality control to a new level [16].

Table 1. Relative share of factors affecting the effectiveness of product quality management

No	Factors	Share (%)
1	Raw material quality	30
2	Technological processes	25
3	Logistics & Storage	15
4	Staff qualifications	12
5	Standardization	10
6	Innovations	8
	Total	100

As seen from the table data, the quality of raw materials and technological processes are of priority importance in the quality management system. As a result of the analysis of the main factors affecting the efficiency of product quality management at the aforementioned fruit and vegetable enterprises, their degree of influence on increasing competitive advantages, criteria and indicators for evaluating product quality management efficiency based on the diversification of the production system, and systems of product quality management efficiency criteria, the effectiveness of product quality management at fruit and vegetable enterprises in real conditions was theoretically determined [17].

Suggestions and recommendations. To increase the efficiency of product quality management at fruit and vegetable enterprises:

1. Conclusion of long-term quality contracts with raw material suppliers.
2. Implementation of modern laboratory equipment.
3. Full implementation of HACCP and ISO 22000 systems.
4. Wide application of digital monitoring systems.
5. Modernization of logistics infrastructure.
6. Regular professional development of employees.

4. Conclusion

The research results showed that the efficiency of product quality management at fruit and vegetable enterprises is a multi-factor system. The main influencing factors were the quality of raw materials, technological processes, and the logistics system. The quality and competitiveness of products can be significantly improved by introducing international standards, applying digital technologies, and increasing the potential of qualified personnel at enterprises.

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