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IMPROVING EFFICIENCY THROUGH THE DIGITALIZATION AND FORECASTING OF MEDICINAL PLANT PRODUCT SALES

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Abstract

This article investigates the issues of improving the sales mechanism of medicinal plant products through digitalization and forecasting. During the research process, the current state of the sales system was analyzed, and its main challenges were identified, particularly the insufficient digitalization of sales processes, weaknesses in customer relationship management, and the underdevelopment of demand forecasting mechanisms.

Within the research methodology, a systematic approach, economic-statistical analysis, and econometric modeling methods were employed. In particular, sales volume forecasting was carried out using the ARIMA model.

The practical results demonstrated that the implementation of digitalization and forecasting approaches in the sales of medicinal plant products significantly enhances business performance. Specifically, sales volume increased from 40 million UZS to 65 million UZS, representing a growth of 62.5%.

Based on the research findings, practical recommendations were developed to improve the sales of medicinal plant products. These recommendations include the automation of sales processes, the systematization of customer relationship management, and the adoption of forecasting-based managerial decision-making.

Keywords

Medicinal plants, sales mechanism, digitalization, forecasting, ARIMA model, sales efficiency, economic analysis, marketing, time series.

INTRODUCTION

In the context of globalization, the rapid development of agricultural product markets, particularly those based on medicinal plants, necessitates the improvement of their sales systems. According to the World Health Organization (WHO), the use of medicinal plants continues to increase annually, and their share in the global pharmaceutical market is expanding significantly [1].

The growing demand for medicinal plant-based products has created the need for the comprehensive development of cultivation, processing, and marketing systems. Research indicates that the lack of effective sales mechanisms is one of the major obstacles limiting market access and increasing sales volumes of these products [2; 3].

In recent years, the widespread adoption of digitalization across various sectors of the economy has fundamentally transformed sales systems. In particular, digital technologies facilitate transparency in sales processes, enable rapid communication with customers, and optimize logistics systems [4]. However, the level of adoption of these technologies among small and medium-sized enterprises remains insufficient [5].

In the medicinal plant products sector, the inadequate development of digitalization processes, weak marketing strategies, and the absence of effective demand forecasting mechanisms have emerged as factors that reduce business efficiency [6; 7].

To address these challenges, the application of economic and mathematical models, particularly forecasting methods based on time series analysis, is of significant importance. The ARIMA (Autoregressive Integrated Moving Average) model, which is widely used in scientific

research for forecasting demand and sales volumes, provides enterprises with more accurate planning opportunities and contributes to the efficient utilization of resources.

Both foreign and local scholars have extensively studied issues related to medicinal plant markets, their economic efficiency, and the improvement of sales systems. For example, Robert Saik emphasizes the necessity of increasing efficiency through the implementation of innovative technologies in agriculture, while other researchers have demonstrated that integrating digitalization and forecasting methods into sales processes yields significant benefits [8; 9].

Nevertheless, existing studies reveal a lack of comprehensive research that integrates digitalization, forecasting, and management mechanisms within the sales systems of medicinal plant products [10].

Based on the above considerations, the objective of this study is to develop approaches for improving the sales of medicinal plant products through digital management and forecasting and to enhance their overall efficiency.

The development of medicinal plant product markets and the improvement of their sales mechanisms have been investigated by numerous international and domestic scholars. Analysis of these studies indicates that research in this field primarily focuses on the economics of medicinal plants, the organization of sales processes, and issues related to digitalization and forecasting.

The economic significance of medicinal plants and the development of their market infrastructure were examined by C. P. Kala, who highlighted their role as an important source of income for rural communities [11]. Similarly, A. C. Hamilton analyzed sustainability issues and challenges associated with the commercialization of medicinal plants [3].

Scientific perspectives on the development of sales and marketing mechanisms have been advanced by Philip Kotler and Kevin Lane Keller, who emphasized the importance of market segmentation, customer needs assessment, and the implementation of effective marketing strategies [6]. In addition, Michael Porter demonstrated the significance of strategic management and value chain approaches in achieving competitive advantage [12].

Digitalization has become an integral component of the modern economy. Studies conducted by Erik Brynjolfsson and Andrew McAfee established that digital technologies are essential tools for optimizing business processes and improving efficiency [5]. Reports published by the Organisation for Economic Co-operation and Development also indicate that digital transformation in agriculture facilitates more effective management of production and sales systems [10].

Issues related to demand and sales forecasting have been extensively studied through economic and mathematical models. In particular, the ARIMA model was developed by George Box and Gwilym Jenkins and has become one of the most widely applied methods in time-series forecasting [11]. Furthermore, Damodar N. Gujarati developed the theoretical foundations for analyzing and forecasting economic processes through econometric models [12].

The implementation of innovative approaches in agriculture has also been discussed by Robert Saik, who argues that modern technologies play a crucial role in improving the efficiency of food systems [8]. Reports issued by the Food and Agriculture Organization of the United Nations likewise emphasize the importance of improving sales mechanisms for the development of global agricultural markets [9].

In addition, issues related to marketing and digital sales systems have been studied by Dave Chaffey, who demonstrated the role of digital marketing tools in increasing sales volumes [7]. However, an analysis of the existing literature indicates that the integration of digitalization, forecasting, and management mechanisms into a unified system for organizing medicinal plant product sales remains insufficiently explored [15].

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METHODOLOGY

This study employed a systematic approach, economic-statistical analysis, comparison, synthesis, and econometric modeling methods to examine the process of improving the sales of medicinal plant products. The research methodology incorporates a comprehensive approach aimed at enhancing the efficiency of medicinal plant product sales through digitalization and forecasting.

A small enterprise engaged in the sale of medicinal plant-based products was selected as the object of the study. During the research process, key performance indicators such as sales volume, customer flow, product turnover, and revenue were analyzed as the main objects of investigation. These indicators were organized in the form of time series data and subsequently used for forecasting purposes.

Digitalization was considered a critical factor in improving sales processes. Particular attention was paid to the automation of product tracking, order processing, and customer relationship management activities. The introduction of digital management elements contributed to increasing the transparency and responsiveness of sales operations.

At the forecasting stage, the ARIMA (Autoregressive Integrated Moving Average) model, based on time-series analysis, was applied. This model is one of the most widely used methods for identifying the dynamics of economic indicators and forecasting their future values [8].

The general form of the ARIMA model can be expressed as follows:

$$ARIMA(p,d,q)$$

where:

- p – the order of the autoregressive (AR) component;
- d – the degree of differencing required to achieve stationarity;
- q – the order of the moving average (MA) component.

Within the scope of the study, the ARIMA(1,1,1) model was selected for forecasting sales volume. This model incorporates first-order differencing (d = 1) to ensure the stationarity of the time series, as well as first-order autoregressive and moving average components [16].

The model development process was carried out in several stages:

- Testing the stationarity of the time series;
- Eliminating the trend through differencing;
- Estimating the model parameters;
- Evaluating model adequacy using statistical criteria;
- Generating forecasting results [17].

The ARIMA(1,1,1) model used in the study can be represented as follows:

$$(1-\phi_1 L)(1-L)Y_t=(1+\theta_1 L)\varepsilon_t$$

where:

- Y_t represents the observed sales volume at time t;
- ϕ_1 is the first-order autoregressive coefficient;
- θ_1 is the first-order moving average coefficient;
- L denotes the lag operator;
- ε_t represents the random error term.

The accuracy and reliability of the model were evaluated using the coefficient of determination, forecast error indicators, and the randomness of residual values. Based on the forecasting results, future sales volumes and revenue levels of the enterprise were estimated, providing a foundation for strategic decision-making.

Furthermore, an integrated mechanism for managing the sales of medicinal plant products was developed within the framework of the study. This mechanism combines digital management tools, marketing approaches, and forecasting techniques into a unified system aimed at improving sales efficiency. Through the integration of these components, enterprises can enhance operational effectiveness, strengthen customer engagement, improve demand forecasting accuracy, and support sustainable business growth.

RESULTS AND ANALYSIS

Within the framework of the study, the proposed approaches for organizing and improving the sales of medicinal plant products were tested in practice. In particular, mechanisms for digitalizing sales processes, improving customer relationship management, and making managerial decisions based on forecasting were implemented in the operations of a small enterprise.

Prior to the implementation of these measures, the enterprise conducted its sales activities using traditional methods. Product movement, customer databases, and order management processes were not fully monitored or systematically controlled. As a result, sales performance remained relatively low, and the efficiency of resource utilization was insufficient.

Through the digitalization of sales processes, greater control over product movement was established, customer interactions were systematized, and the order processing system was optimized. At the same time, forecasting tools made it possible to estimate future demand levels in advance, thereby improving planning and decision-making processes.

As a result, a significant increase in the enterprise's sales performance was observed. Specifically, sales turnover increased from 40 million UZS to 65 million UZS, representing a 62.5% growth rate. This outcome confirms the effectiveness of combining digitalization and forecasting approaches in the management of medicinal plant product sales.

The findings indicate that the integration of digital technologies with forecasting methods contributes not only to higher sales volumes but also to improved operational efficiency. Enhanced access to information, faster processing of customer orders, and more accurate demand forecasting enabled the enterprise to respond more effectively to market conditions and customer needs.

Furthermore, the forecasting results generated through the ARIMA model provided a reliable basis for planning future sales activities. By anticipating fluctuations in demand, the enterprise was able to optimize inventory management, reduce operational risks, and improve the allocation of available resources. These improvements ultimately contributed to increased business sustainability and competitiveness in the medicinal plant products market.

Table 1
Changes in the Sales Performance Indicators of Medicinal Plant Products

Indicators	Before implementation	After implementation	Change (%)
Sales Volume (million UZS)	40	65	+62.5
Number of Customers (persons)	120	185	+54.1
Number of Orders (units)	95	150	+57.9

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Indicators	Before implementation	After implementation	Change (%)
Average Revenue (million UZS)	0.33	0.35	+6.0

According to the data presented in Table 1, positive growth was observed across all key performance indicators. In particular, the increase in sales volume and the number of orders indicates that the sales system was organized and managed effectively.

The forecasting results also confirmed a positive trend. The model developed using the ARIMA approach projected a stable increase in future sales volumes. According to the forecast results, sales are expected to grow by an average of **8–12%** in the near term.

The analysis demonstrates that digitalization not only enhances the speed and efficiency of sales processes but also helps reduce errors associated with human factors. Furthermore, forecasting enables more efficient resource allocation and contributes to minimizing excessive inventory levels [17].

Overall, the findings provide practical evidence that integrating digital management and forecasting approaches into the sales system of medicinal plant products can significantly improve enterprise performance and operational efficiency.

To forecast sales volume, a time-series forecasting approach based on the ARIMA model was applied. Within the scope of the study, the **ARIMA(1,1,1)** model was selected and estimated using the enterprise's monthly sales data.

During the model estimation process, stationarity of the time series was achieved through differencing, while both the autoregressive and moving average components were found to be statistically significant.

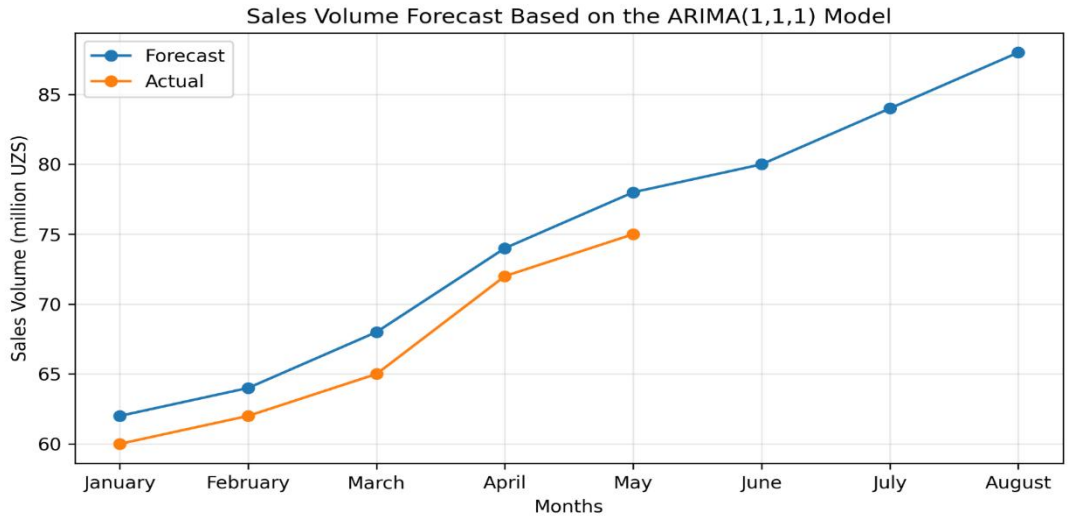
For forecasting sales volume, the **ARIMA(1,1,1)** model was employed, and the estimation results are presented in the following table.

Table 2

Sales Volume Forecast Based on the ARIMA(1,1,1) Model

Months	Actual Value (million UZS)	Forecast Value (million UZS)
January	60	62
February	62	64
March	65	68
April	72	74
May	75	78
June - August	-	88

The results presented in the table indicate that the forecast values demonstrate a stable growth



trend in sales volume.

Figure 1. Sales Volume Forecast Based on the ARIMA(1,1,1) Model

The graph results indicate that the forecast values reflect a stable upward trend in sales volume. This finding confirms the practical applicability and reliability of the ARIMA(1,1,1) model for forecasting future sales performance.

CONCLUSION

The results of this study demonstrate that the application of digitalization and forecasting approaches plays a significant role in improving the organization of medicinal plant product sales. The research provided both theoretical and practical evidence that transitioning sales processes from traditional methods to a digital management system can substantially enhance enterprise performance and operational efficiency.

Based on the proposed approach, the implementation of product tracking systems, the systematization of customer relationship management, and the automation of order processing contributed to improving the transparency and responsiveness of the sales system. As a result, the enterprise achieved a 62.5% increase in sales volume, confirming the practical effectiveness of the proposed approach.

Furthermore, the application of the ARIMA model within the framework of economic and mathematical modeling was found to expand opportunities for demand forecasting and strategic planning. The forecasting results indicated a stable upward trend in future sales volumes, enabling enterprises to utilize resources more efficiently and make informed managerial decisions [18].

Based on the findings of the study, the following practical recommendations are proposed to support the development of medicinal plant product sales:

- Fully digitalize and automate sales processes;
- Introduce modern Customer Relationship Management (CRM) systems for managing customer interactions;
- Manage inventory levels based on demand forecasting results;
- Expand marketing activities through digital platforms and online channels.

In conclusion, organizing medicinal plant product sales through digital management and forecasting serves as an important factor in enhancing enterprise competitiveness, increasing sales volumes, and achieving greater economic efficiency. The integration of digital technologies with forecasting methods provides a sustainable foundation for improving business performance and supporting long-term growth in the medicinal plant products market.

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