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INVESTMENT DYNAMICS AND DEVELOPMENT TRENDS IN THE HORTICULTURE SECTOR: AN INSTITUTIONAL AND ECONOMIC PERSPECTIVE

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Annotation: This article provides a scientific analysis of the current state of Uzbekistan's horticulture sector, its development trends, and the key factors shaping these processes. The study highlights the significance of attracting investments in horticulture, the introduction of modern agro-technologies, and strategies for adapting to climate change. Econometric modeling and statistical forecasting methods, particularly the ARIMA model, were employed to predict the dynamics of changes in horticultural crop areas and gross yields. The findings reveal that under the conditions of limited extensive development opportunities, the transition to intensive agro-technologies and efficient resource management are the main determinants of sustainable growth.
Keywords: Horticulture, investments, agro-innovations, ARIMA model, economic analysis, yield, climate change, modern technologies, agriculture, extensive and intensive development.

Introduction

The horticulture sector is one of the strategic branches of Uzbekistan's agriculture, playing a vital role in ensuring food security, expanding exports, and providing employment opportunities. In the context of global climate change, resource scarcity, and rapid technological advancement, achieving sustainable development in horticulture has become one of the most pressing issues of the national economy. Particularly, attracting foreign investment, implementing innovative technologies, and producing market-oriented products open new opportunities for the sector.

Global experience demonstrates that countries such as China, Singapore, the United States, and Brazil have achieved high efficiency in horticulture by applying modern agro-technologies. According to statistical data, the total global income from horticultural products exceeds USD 100 billion, and by 2024, investments directed into the sector are projected to reach USD 130 billion [FAO stat (2024).].

The horticulture sector contributes to economic growth. Efficiently managed orchards can raise household incomes and reduce dependence on imported food products. However, challenges such as technological gaps, climate change, and market uncertainties remain significant. In recent years, extreme weather events—storms, floods, and heatwaves—have posed serious threats to horticultural infrastructure.

Therefore, introducing modern technological solutions, adopting eco-friendly agro-technologies, and diversifying investments are among the most important tasks today. This article scientifically examines the current state, existing problems, and development trends of the horticulture sector.

LITERATURE REVIEW

To date, Uzbek scholars have conducted a number of studies on the current state and development trends of the horticulture sector. According to J.I. Esbolganov's findings, applying intensive horticultural practices suitable for climatic and soil conditions, efficient water resource utilization, and increasing productivity are essential.[Esbolganov, J. I. (2023).] Researchers O.Q. Abdusalomov and E.F. Tilovqobilov have explored the historical development of horticulture in Uzbekistan, emphasizing the effectiveness of advanced agro-technologies.[*O.Q.Abdusalomov and E.F.Tilovqobilov*] N.Q. Nurxonov argued that expanding exports and introducing intensive technologies are vital for increasing grape and fruit production [Nurxonov, N.Q. (2021).], while

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U. Ergashov demonstrated that developing cluster systems in horticulture can optimize production processes and enhance competitiveness[Ergashov, U. (2021).]. However, in our view, directions for efficiently developing horticulture under Uzbekistan's agro-climatic conditions remain insufficiently explored.

METHODOLOGY

The study utilized document analysis (laws, programs, and statistical reports) and econometric modeling based on data from the State Committee of the Republic of Uzbekistan on Statistics for 2016–2023. Using ARIMA modeling techniques and the Python programming language, projections were made for the fruit and berry crop areas and gross yields.

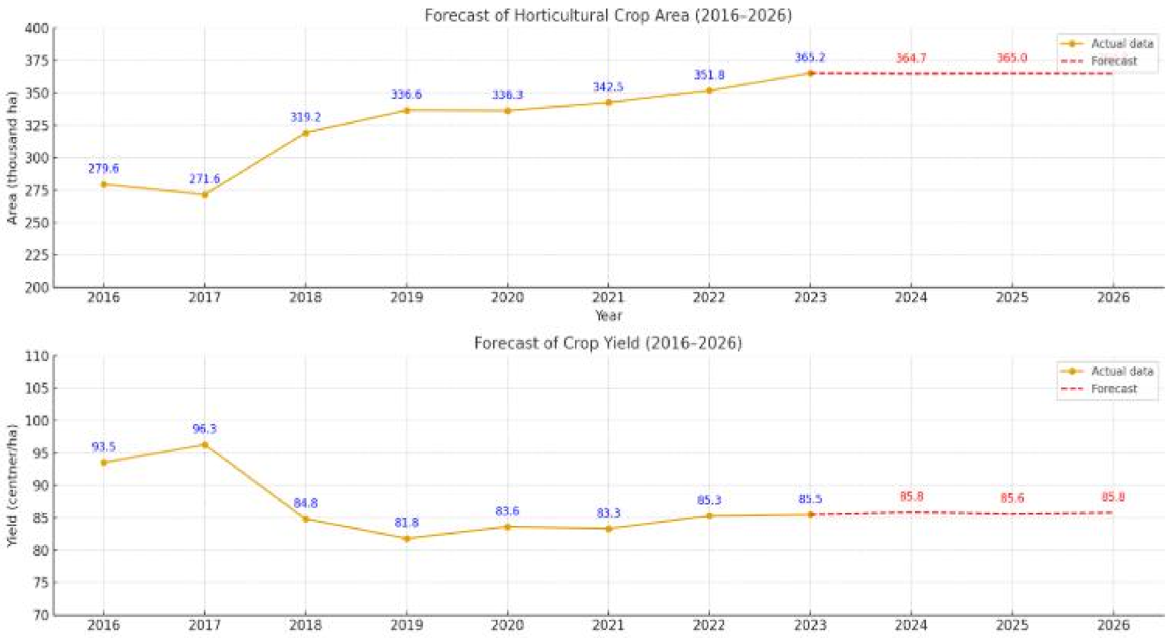
ANALYSIS AND RESULTS

Analyzing and forecasting the dynamics of crop areas and productivity in agriculture are crucial for formulating agrarian policies, planning farm operations, and optimizing resource use. In this study, changes in fruit and berry crop areas and yields from 2016 to 2023 were analyzed, and forecasts for 2024–2026 were made using the ARIMA model.

The ARIMA model parameters were identified through statistical testing. Initially, the degree of integration (d) was determined by testing data stationarity. Results showed that the time series exhibited trends, requiring first-order differencing to achieve stationarity. This transformation removed the general trend and made the data suitable for time-series analysis.

Next, the autoregressive (p) and moving average (q) parameters were determined using autocorrelation (ACF) and partial autocorrelation (PACF) functions. The PACF plot indicated significant correlation at the first lag, showing the influence of previous periods on crop area and yield. Meanwhile, ACF results showed that including a first-lag moving average component improved the model's accuracy.

To optimize the model, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were evaluated, confirming that the selected ARIMA model was the best fit. These parameters aligned with the internal data structure, minimizing overfitting risks and ensuring stability of forecast results.



[Figure 1. Forecast of Fruit and Berry Crop Area and Gross Yield Dynamics (ARIMA Model Results)]

According to Uzbekistan's State Committee on Statistics, the fruit and berry crop area decreased from 279.6 thousand hectares in 2016 to 271.6 thousand hectares in 2017. From 2018 onward, a notable increase was observed—319.2 thousand hectares in 2018, 336.6 thousand in 2019, and 365.2 thousand hectares in 2023, showing a stable growth trend.[stat.uz 2023]
ARIMA model forecasts suggest that crop area will reach 364.7 thousand hectares in 2024, 365.0 thousand in 2025, and 364.8 thousand hectares in 2026. These results indicate that the expansion of cultivated areas is stabilizing due to land constraints, improved productivity, and limited water and climate resources reducing the potential for extensive growth.
In terms of gross yield, the results show steady growth—from 2,612.9 thousand tons in 2016 to 3,121.7 thousand tons in 2023. Forecasts indicate 3,218.9 thousand tons in 2024, 3,310.9 thousand tons in 2025, and 3,398.1 thousand tons in 2026. The continued increase in yield despite stable crop areas suggests that growth will occur primarily through productivity improvements.
The main contributing factors are:
- Agro-technological innovations: introduction of high-yield varieties and expansion of drip irrigation systems.
- Efficient land use: optimization of low-productivity plots.
- Climate adaptation: expansion of greenhouses and water-saving technologies.

CONCLUSION AND RECOMMENDATIONS

The findings indicate that fruit and berry crop areas will stabilize in the coming years, while total output will continue to increase—reaching 3,398.1 thousand tons by 2026—due to rising productivity. This reflects growing efficiency in Uzbekistan's agricultural sector.

Key recommendations include:

- Efficient land management: transitioning from extensive to intensive agro-technologies.
- Productivity enhancement: improving yields through new technologies and seed breeding development.
- Environmental adaptation: implementing water-saving and eco-friendly technologies.
- Investment attraction: financing new technologies and fostering innovation.
- Export expansion: improving quality and export volumes of fruit and berry products.
- Climate resilience: developing sustainable growth strategies.

Overall, sustainable horticulture development requires not only technological solutions but also the integration of agronomy, economics, ecology, and digital technologies.

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