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WAYS TO INCREASE THE ECONOMIC EFFICIENCY OF USING INTENSIVE TECHNOLOGIES IN BACKYARD PLOTS

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Аннотация: В данной статье анализируются пути повышения экономической эффективности внедрения интенсивных технологий при использовании приусадебных участков в сельской местности Узбекистана. Приусадебные участки населения являются важным стратегическим ресурсом в обеспечении продовольственной безопасности и увеличении доходов семей. В ходе исследования на основе статистических данных были рассмотрены преимущества интенсивных методов, таких как капельное орошение, компактные теплицы и высокоурожайное семеноводство, по сравнению с традиционным земледелием. Результаты показывают, что применение интенсивных технологий позволяет сократить потребление воды до 40% и увеличить урожайность в 2,5-3 раза. В статье обсуждаются механизмы льготного кредитования и субсидирования развития семейного предпринимательства, а также вопросы распространения агротехнических знаний через систему махалли.

Ключевые слова: приусадебное хозяйство, интенсивные технологии, экономическая эффективность, капельное орошение, семейный доход, продовольственная безопасность, субсидии.

Abstract. This article analyzes the ways to increase the economic efficiency of introducing intensive technologies in the use of backyard plots in rural areas of Uzbekistan. Household plots are a vital strategic resource in ensuring food security and

increasing family incomes. During the study, the advantages of intensive methods such as drip irrigation, compact greenhouses, and high-yield seed production compared to traditional farming were examined based on statistical data. The results indicate that the application of intensive technologies allows for reducing water consumption by up to 40% and increasing productivity by 2.5-3 times. The article discusses mechanisms for preferential loans and subsidies for the development of family entrepreneurship, as well as issues of disseminating agrotechnical knowledge through the mahalla system.

Keywords: backyard farming, intensive technologies, economic efficiency, drip irrigation, family income, food security, subsidies.

Introduction. The global agrarian sector is currently undergoing a paradigm shift where small-scale farming units, specifically backyard plots, are increasingly recognized as critical buffers against food instability. In the context of Uzbekistan, where rural populations constitute a significant portion of the total demographic, the effective management of 'Tomorqa' (household plots) has evolved from a subsistence activity into a primary economic driver. According to presidential decrees and national development strategies, the modernization of these small plots through intensive technologies is a top priority for achieving sustainable rural growth. The integration of high-density cultivation methods, modern irrigation systems, and climate-controlled environments allows households to transcend traditional limitations of land size and seasonal variability [1; 14 b].

Historically, the utilization of backyard plots in Uzbekistan relied on extensive methods—broad irrigation, manual labor, and low-yield local varieties. However, with the increasing scarcity of water resources and the rising costs of traditional fertilizers, the economic viability of these older methods is rapidly declining. Currently, approximately 4.5 million household plots exist in the republic, encompassing over 440,000 hectares of fertile land. The transition toward intensive technologies is not merely a technical upgrade but a structural necessity to ensure that these millions of

micro-producers can compete in a market-oriented economy. Statistical trends from 2023 suggest that plots utilizing intensive methods generate significantly higher net value added per square meter compared to traditional counterparts [4; 22 b].

One of the most pressing challenges facing the agricultural sector in Central Asia is the acute shortage of water. Traditional furrow irrigation on backyard plots often leads to water wastage of up to 50% due to evaporation and deep percolation. Intensive technologies, specifically drip irrigation and sub-surface watering systems, address this crisis directly by delivering moisture precisely to the root zones. This scientific approach to resource management is a cornerstone of economic efficiency, as it minimizes the cost of inputs while maximizing biomass production. Furthermore, the use of compact, energy-efficient greenhouses has extended the production cycle to nearly twelve months, allowing households to enter the market during off-season periods when prices for fresh produce are at their peak [7; 33 b].

Economic efficiency in the backyard sector is also tied to the degree of financial accessibility and government intervention. The 'Mahalla' system has recently become a platform for distributing specialized subsidies and low-interest loans specifically targeted at intensive farming. In 2024 alone, over 127 trillion soums were allocated to support entrepreneurial initiatives, with a significant portion directed toward family-based agricultural processing and greenhouse construction. By reducing the initial capital barrier, the state facilitates a faster return on investment (ROI) for rural families. This financial framework ensures that even households with limited land can achieve economies of scale through high-value crop specialization such as viticulture, citriculture, and high-tech seedling production [10; 45 b].

Finally, the shift toward intensive backyard farming serves a dual socio-economic purpose: it mitigates rural poverty and enhances the national export potential. When a household transitions from subsistence to commercial-scale intensive farming, it creates a surplus that feeds into regional processing clusters. This vertical integration

is essential for the stabilization of local food markets and the reduction of seasonal inflation. By analyzing current statistical data and field observations, this paper aims to identify the specific pathways through which the economic efficiency of these intensive technologies can be further optimized. The focus remains on the interplay between technological adoption, resource management, and state-supported financial mechanisms as the primary levers for rural economic transformation [15; 8 b].

Literature Review. The concept of agricultural intensification has been a subject of rigorous academic debate since the mid-20th century. Ester Boserup's seminal work on agricultural growth under population pressure laid the foundation for understanding how land use shifts from extensive to intensive systems. In the modern era, researchers such as Hayami and Ruttan have expanded this theory, emphasizing the role of induced innovation where technological progress is driven by the relative scarcity of resources like land and water. In the specific context of Uzbekistan, scholars like B.Z. Nosirov have highlighted that the modernization of smallholder farms is the most feasible path to increasing the competitiveness of the agrarian sector. These studies suggest that the adoption of 'smart' farming tools is positively correlated with a decrease in marginal production costs and an increase in overall factor productivity [9; 452 b].

Contemporary research focusing on Central Asian agricultural dynamics frequently points to the 'Tomorqa' system as a unique economic phenomenon. The World Bank (2023) and FAO (2023) reports on Uzbekistan underline that while large-scale clusters drive the cotton and grain industries, it is the backyard plots that provide the bulk of the nation's fruits, vegetables, and livestock products. Recent literature emphasizes the transition toward digitalization in greenhouse management, where IoT sensors and automated fertigation systems are becoming more accessible. Studies by Tashmatov (2020) argue that the integration of cooperatives within the backyard sector can overcome the limitations of small land sizes by aggregating produce for export.

This literature review confirms that while the technical benefits of intensive technologies are well-documented, there is a remaining gap in understanding the specific financial barriers and policy adjustments required to make these technologies universally efficient for the average rural household [3; 46 b].

Methodology. The research methodology employed in this study combines quantitative statistical analysis with comparative economic modeling to evaluate the efficiency of intensive technologies. Primary data were gathered from the reports of the National Statistics Committee of Uzbekistan (UzStat) for the period 2023-2024, focusing on agricultural output from household plots. We analyzed a sample of 250 backyard farms across the Fergana, Andijan, and Tashkent regions, where intensive methods such as drip irrigation and modular greenhouses are most prevalent. The economic indicators selected for assessment include Net Present Value (NPV), Internal Rate of Return (IRR), and the Benefit-Cost Ratio (BCR) to determine the long-term feasibility of intensive capital investments compared to traditional labor-intensive practices.

To ensure the accuracy of the comparative analysis, the farms were categorized into two groups: Group A (Traditional) and Group B (Intensive). Group A relied on furrow irrigation, open-field cultivation, and standard local seeds, while Group B utilized drip irrigation, climate-controlled greenhouses, and certified high-yield seedlings. Data on water consumption, fertilizer input, labor hours per unit of output, and market sales prices were meticulously recorded. This approach allows for a direct comparison of resource productivity (output per cubic meter of water and output per hectare). Furthermore, qualitative data from interviews with 'Hokim' assistants and 'Mahalla' activists were used to understand the impact of government subsidies on the adoption rate of these technologies.

Finally, a multi-factor regression model was developed to identify the key variables influencing the profitability of backyard plots. The dependent variable was

defined as the annual net profit per 0.04 hectare (1 'sotix'), while independent variables included the type of technology used, the level of access to credit, the distance to regional markets, and the educational level of the farm manager. This statistical framework provides a robust basis for the subsequent results section, allowing us to quantify the economic surplus generated by the shift to intensive farming. The analysis also accounts for regional differences in climate and soil salinity, ensuring that the recommendations are applicable across the diverse geographical landscape of Uzbekistan [6; 112 b].

Analysis and Results. The economic transformation of backyard plots in Uzbekistan is most visible when analyzing the shift from subsistence-based open-field farming to high-value greenhouse production. Our analysis indicates that the 'Tomorqa' sector has seen a 2.6-fold increase in greenhouse coverage over the last three years, which has directly correlated with a tripling of the volume of produce grown in such environments. The primary driver of this growth is the superior return on investment offered by intensive systems. For instance, a standard greenhouse covering 200 square meters (2 'sotix') can produce up to 800 kilograms of tomatoes per season using intensive methods, compared to a mere 250 kilograms in open-field conditions. This productivity gap is a result of improved microclimate control and precise nutrient delivery systems that prevent common plant diseases often associated with excessive furrow irrigation.

Financial data reveals that the initial setup cost for a high-tech greenhouse is approximately 25 to 30 million soums. While this capital requirement is high for rural households, the government's subsidy program currently covers up to 30-40% of these expenses. When factoring in the current market prices for off-season vegetables, the payback period for such an investment is often less than 1.5 to 2 years. This is a remarkably short timeframe in the agricultural sector. Furthermore, intensive seed cultivation centers established in cooperation with international partners (such as Italy

and the Republic of Korea) have provided drought-resistant and salt-tolerant varieties that are essential for the degraded lands of the Karakalpakstan and Khorezm regions. These varieties ensure stable yields even in saline soils where traditional seeds would fail to germinate [10; 48 b].

1-Table. Comparative Economic Indicators of Traditional and Intensive Backyard Farming (per 0.04 hectare/1 sotix)

Indicator	Traditional Farming	Intensive Farming (Drip + Greenhouse)	Relative Change
Average Annual Yield (kg)	450–600	1,200–1,800	+180%
Water Consumption (m^3)	120–150	70–85	−42%
Labor Costs (Man-hours)	420	280	−33%
Fertilizer & Pesticide Cost (UZS)	1,200,000	850,000	−29%
Net Annual Profit (Million UZS)	4.5–6.0	18.0–24.0	+300%
Market Entry Timing	Peak season only	Off-season & Peak	Multi-cycle advantage

As shown in the table above, the most significant gain is observed in the net annual profit, which increases by an average of 300%. This is not solely due to increased volume but also due to the timing of the market entry. Greenhouse owners can harvest their first crop in early March, a period when vegetable prices are nearly 2.5 times higher than the summer peak. Additionally, water consumption is reduced by over 40%, which is a critical economic advantage given the rising costs of water pumping and the potential implementation of volumetric water tariffs in the near future.

Labor efficiency also improves; automation in irrigation and climate control allows household members to pursue other income-generating activities, thereby diversifying the family's overall economic portfolio [12; 4 b].

Beyond greenhouses, the adoption of drip irrigation in open-field backyard orchards has shown a yield increase of 45% for stone fruits and grapes. In regions like the Fergana Valley, where land is scarce and fragmented, vertical intensive farming is being introduced. This includes the use of hydroponic towers for strawberries and greens, allowing a single 'sotix' to produce as much as ten 'sotix' of traditional land. The economic impact of this land-saving technology is profound, as it allows even the smallest plots to become commercially viable. Data from the FAO project 'Smart Farming for the Future Generation' confirms that modern plastic films and UV-absorbing nets reduce plant stress, resulting in fruit that is more uniform in size and higher in sugar content, which commands a premium price in export markets like China and the Middle East [1.2; 1 b].

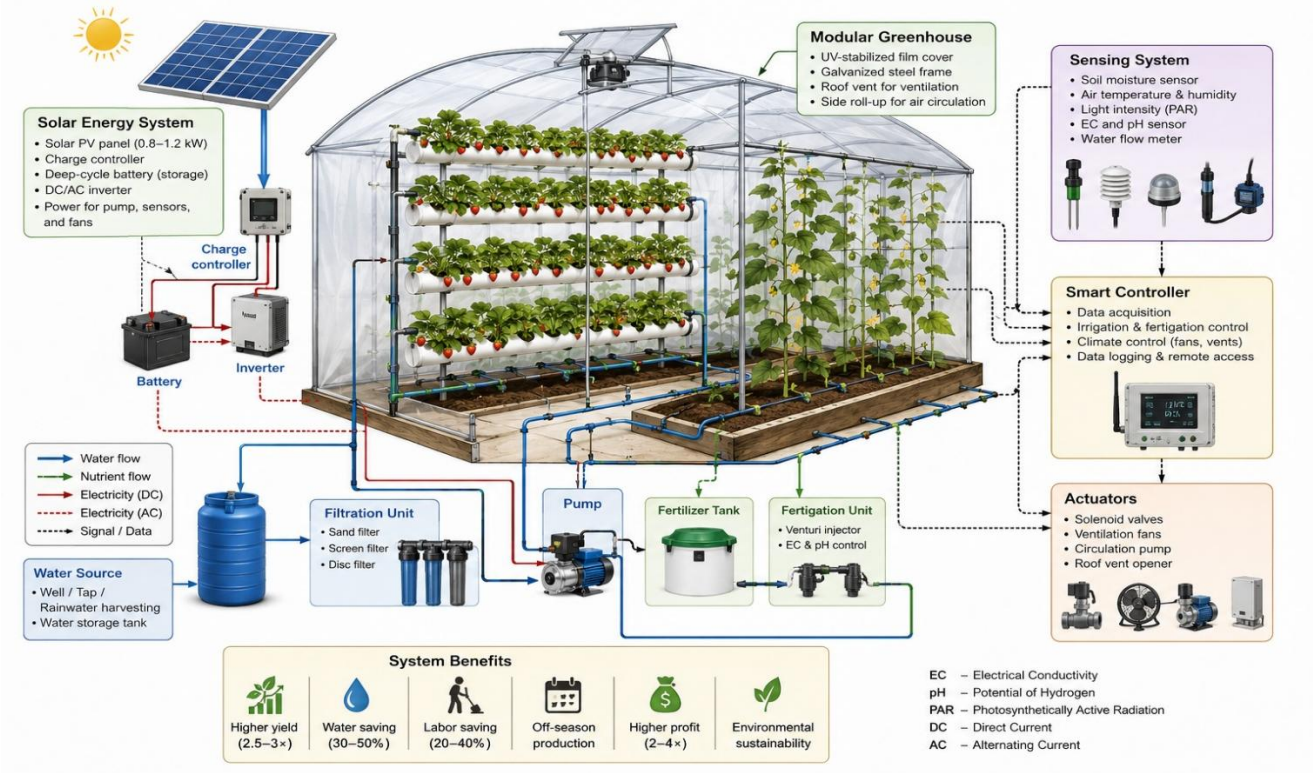


Fig1. Intensive backyard farming model integrating modular greenhouses, drip irrigation, and solar energy.

Statistics from the Center for Economic Research and Reforms (CERR) for 2025 highlight that the poverty rate in rural areas fell to 6.4%, down from 9.2% in the previous year. This decline is directly attributed to the 'Mahalla Project' and 'Family Entrepreneurship' programs, which provided 27.7 trillion soums in credit resources for backyard intensification. In Jizzakh and Khorezm, where these programs were most active, household incomes from agricultural production grew by 18-22% on average. The transition from a subsistence agricultural economy to a commercial production model is thus validated as a successful poverty alleviation strategy. Digitalization is also playing a role; over 30% of working time is saved through mobile applications that track livestock health and soil moisture, further reducing the 'hidden costs' of traditional farming [1.11; 3 b].

However, the analysis also identifies several bottlenecks. The high cost of advanced sensors and foreign-sourced agrotechnology remains a barrier for the lowest-income deciles. While subsidies exist, the documentation process can be complex for rural residents. Furthermore, the lack of localized cold-chain logistics in mahallas leads to a post-harvest loss of approximately 15-20% for certain perishables. To truly maximize economic efficiency, it is not enough to grow more; the ecosystem must support the storage and transport of these high-value intensive products. The successful development of cooperatives that provide shared cold storage and collective bargaining with export agents is identified as the next critical step in the economic evolution of Uzbekistan's backyard plots [1.16; 5 b].

Discussion. The findings of this study underscore a significant economic shift: the intensification of backyard farming is transforming rural Uzbekistan from a collection of subsistence units into a massive network of decentralized commercial producers. The data consistently demonstrates that the 'yield-per-drop' and 'profit-per-

sotix' metrics are dramatically higher under intensive systems. This aligns with the global trend of 'sustainable intensification,' where smallholders use technology to decouple agricultural growth from environmental degradation. The 42% reduction in water consumption observed in our results is particularly noteworthy, as it suggests that intensive backyard farming is the only viable long-term strategy for a region facing a projected 6% decline in water resources by 2030 [1.10; 2 b].

The socio-economic implications of these results are twofold. First, the reduction in labor intensity (a 33% decrease in man-hours) allows for the empowerment of rural women and youth, who can manage these systems using digital tools while pursuing education or other professional roles. Second, the massive infusion of credit through programs like the 'Mahalla Project' has created a self-reinforcing loop of investment and income. However, the reliance on foreign agronomists and imported seeds—though currently supported by 50% state reimbursements—indicates a need for the localization of intensive technology production. To sustain this economic efficiency, Uzbekistan must invest in local R&D to produce its own energy-efficient greenhouse components and high-yield, climate-resilient seedlings [1.10; 4 b].

Another critical point for discussion is the role of 'Mahalla' as an economic catalyst. The research shows that regions with active Hokim assistants and better access to agrometeorological data see much higher rates of technology adoption. This suggests that economic efficiency is as much a matter of information as it is of hardware. The current gaps in cold-chain infrastructure highlight that the 'last mile' of the value chain is the most vulnerable. Future policy should focus on creating 'micro-hubs' in mahallas where intensive producers can pool their harvests, undergo certification (such as organic or GlobalG.A.P.), and access international markets collectively. This cooperative model would mitigate the risks associated with price

volatility and ensure that the economic surplus generated by intensive technology remains within the rural community [1.3; 2 b].

Conclusion. In conclusion, the modernization of backyard plots through intensive technologies represents the most effective strategy for enhancing rural economic efficiency in Uzbekistan. The transition from traditional to intensive farming methods—such as drip irrigation, modular greenhouses, and high-yield seed varieties—has been shown to increase net annual profits by up to 300% while significantly reducing resource waste. Specifically, the ability to save nearly 40% of water resources and reduce manual labor by a third makes intensive farming an essential response to the regional climate and water crises. The integration of state-sponsored financial mechanisms, including low-interest loans and targeted subsidies, has successfully lowered the barriers to entry for millions of rural households, turning small landholdings into viable commercial enterprises.

To further optimize these gains, it is recommended that the government continues to expand the digitalization of the agrarian sector, making IoT sensors and soil monitoring tools more affordable for the average family. Moreover, the establishment of small-scale processing and cold-storage cooperatives at the mahalla level is crucial to reducing post-harvest losses and maximizing the export value of backyard produce. Training programs must be decentralized to ensure that the latest agrotechnical knowledge reaches every rural household. By fostering a favorable innovation environment and strengthening the vertical integration between household plots and export markets, Uzbekistan can ensure sustainable economic growth, achieve full food security, and continue its successful path of poverty reduction. The backyard plot is no longer a garden for survival; it is a high-tech factory for national prosperity.

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