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ANALYSIS OF OPPORTUNITIES AND ECONOMIC EFFICIENCY OF LEMON PRODUCTION IN SMALL AREAS

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ABSTRACT

Lemon cultivation has gained global significance, especially during the COVID-19 pandemic, as demand for immune-boosting foods surged. Lemons, rich in vitamin C and antioxidants, are increasingly valued for their health benefits. This study examines the economic efficiency of lemon farming, focusing on advanced cultivation technologies such as trench-style and film greenhouses, which are widely adopted in Uzbekistan. The research analyzes the cost-effectiveness of these methods, highlighting their ability to generate high yields even on small land areas. Findings indicate that trench greenhouses, which do not require heating systems, are twice as cost-effective as film greenhouses, making them a preferred option for farmers. A single lemon tree can produce 200-250 fruits in trench greenhouses and 400-500 fruits in film greenhouses annually. Farmers also optimize profitability by intercropping garlic in the early years of lemon cultivation, achieving steady income while waiting for lemon trees to mature. The study reveals that investment costs, including greenhouse construction, seedling procurement, and agro-technical measures, are recoverable within five years, supported by soft loans under the "Every Family is an Entrepreneur" program. The integration of cooperative farming and resource-sharing models enhances production efficiency and market accessibility. Lemon farming not only contributes to local economic stability but also supports export potential, addressing food security and sustainable agriculture goals. The adoption of modern cultivation techniques and agrarian policies ensures long-term profitability while maintaining environmental sustainability. This research underscores the importance of technology-driven approaches in fostering the sustainable development of the lemon industry.

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INTRODUCTION

Citrus fruits, especially lemon products, are among these products and are considered one of the main products consumed to maintain a stable human immune

system [1]. This is because the sharp increase in demand for lemon products in the global lemon market over the past half century coincided with the COVID-19 period. The pandemic has underscored the importance of immune-boosting foods, and lemons, rich in vitamin C and antioxidants, have become a staple for many households [2]. Therefore, great attention is being paid to the sustainable development of lemon cultivation based on modern technologies in the world. These efforts focus on ensuring consistent production levels while addressing environmental challenges, such as water use efficiency and soil health, to meet the growing global demand [3].

In some sectors of agriculture, there are high possibilities of high income even on small areas [4]. For example, specialized crops like lemons can generate significant revenue when cultivated using optimized methods. In certain industries, which have a special nature of the implementation of the production process, there are specific features of determining the economic efficiency, such as the impact of technological, natural factors, the requirements for maintaining environmental sustainability [5]. These include considerations of climate conditions, pest management, and the adoption of innovations such as greenhouse farming. Moreover, the ability to maintain productivity while adhering to sustainability principles ensures that economic gains do not come at the expense of long-term agricultural viability [6].

To meet the increasing demand, many countries have started investing in advanced cultivation techniques for lemon farming. Greenhouse farming, for instance, is gaining popularity due to its capacity to provide controlled environments that optimize yield. Additionally, governments and private sectors are collaborating to provide farmers with access to high-quality seedlings, irrigation systems, and fertilizers to enhance productivity. These initiatives aim to bridge the gap between traditional farming methods and modern, technology-driven practices, ensuring that even small-scale farmers can participate in the lucrative citrus market [7], [8], [9].

Furthermore, the global lemon trade has seen a notable shift toward sustainability. Exporting countries are focusing not only on quantity but also on quality and traceability. Certifications and adherence to international standards have become critical for accessing premium markets. As the world embraces sustainable agriculture, lemon farming stands out as a model for balancing profitability with environmental responsibility. With strategic planning and investment, the sector holds the potential to significantly contribute to local economies while addressing global challenges such as food security and climate change.

METHODS

The most important issue for lemon growing farms, which is the object of our research, is to obtain annual economic efficiency [10]. This, in turn, is directly related to the state and technology of labor organization, which allows to ensure a systematic benefit from the production process.

First of all, the level of economic efficiency of lemon growing is greatly affected, first of all, by the investment costs associated with the construction of greenhouses, purchase of seedlings and agro-technical measures before the harvest of lemon trees.

At the same time, the current costs associated with the implementation of agro-technical measures after the harvest of lemons also have a direct impact on the economic efficiency of lemon cultivation [11].

In the current situation in Uzbekistan, the state statistics bodies do not have information and data that fully reflect the cost of establishing greenhouses and agro-technical activities for the cultivation of lemons, the level of marketability of lemon products, sales prices and other economic indicators. In this regard, it is not possible to analyze a large number of national statistics to determine the effectiveness of lemon growing [12].

Therefore, during the study, we conducted our analysis to determine the cost-effectiveness of lemon growing on the example of monograph-studied farms, landowners, and some lemon farms.

The evaluation of the economic efficiency of lemon growing was carried out on the basis of the following methodological procedure [13]:

1. Expenditures of monographically studied farms on the establishment of greenhouses for the cultivation of lemons and the purchase of lemon seedlings and the level of their coverage;
2. Current costs of material, labor and services for the cultivation of lemons;
3. Lemon yield from 1 lemon tree and unit of land area;
4. The volume of exports of grown lemons and the economic efficiency achieved.

RESULTS AND DISCUSSION

The analyzes show that in all types of greenhouses and in all lemon-growing subjects whose activity has been monograph studied, the efficiency and quantity and value indicators are high. In particular, the effectiveness of lemon growing was studied in 52 lemon growing farms operating in Andijan, Asaka, Balikchi and Altynkul districts of Andijan region.

Eighty-two percent of the greenhouses for growing lemons in residential areas are trench-style greenhouses and 18 percent are greenhouses. Analyzes show that the cost of setting up a trench greenhouse for growing lemons is at least 2 times cheaper than the cost of setting up a film greenhouse. Therefore, most of the greenhouses in residential areas are organized in the trench method [14], [15], [16].

An average of 5.5-6.0 mln. 12.0-12.5 million soums for the construction of a film greenhouse. UZS are spent (Tables 1 and 2). The main reason for the low cost of trench greenhouses is that they do not have a heating system.

Table 1. Average costs for the establishment of a trench * greenhouse for growing lemons on 1 hectare of land in Andijan region.

No	Events	Unit of measurement	Quantity	Total expenses, thousand soums
1	Trench construction costs			4 760
1.1	Digging a trench	Square meters	100	1 800
1.2	Construction of steel structures			2 960
	carcass and truss (fittings 14 mm)	Metr	120	1 620
	wire (2 mm)	Metr	360	540
	labor costs			800
2	Polyethylene cellophane (0,08 mm)	Kg	10	250
3	Seedling consumption	Thing	10	300
4	Fertilizer consumption			170
4.1	local fertilizer	Kg	640	160
4.2	mineral fertilizer	Kg	1,5	10
5	Chemical control costs			50
	Total costs			5 530

*Trench scheme 5 × 20 meters. Lemon seedling planting scheme 3 × 3 meters.

The cost of construction of film greenhouses is 5 mln. 683 thousand soums or 45.8% are spent on the heating system.

Table 2. Average costs for the establishment of a film greenhouse * for growing lemons on 1 hectare of land in the residential areas of Andijan region.

No	Events	Unit Of Measurement	Quantity	Total expenses, thousand soums
1	Greenhouse construction costs			11893
1.1	Construction of steel structures			5210
	columns (corner 50mm)	Meters	90	2250
	carcass and truss (fittings 14 mm)	Meters	120	1620
	wire (2 mm)	Meters	360	540
	labor costs			800
1.2	Building a heating system			5 683
	Boiler room			1500
	heating pipes (57 mm)	Meters	140	3500
	heating pipes (25 mm)	Meters	15	183
	labor costs			500

No	Events	Unit Of Measurement	Quantity	Total expenses, thousand soums
1.3	Polyethylene cellophane (0,08 mm)	Kg	40	1000
2	Seedling consumption	Thing	10	300
3	Fertilizer consumption			170
3.1	local fertilizer	Kg	640	160
3.2	mineral fertilizer	Kg	1,8	10
4	Chemical control costs			50
	Total costs			12413

* Greenhouse scheme 5 × 20 meters. Lemon seedling planting scheme 3 × 3 meters.

When lemon seedlings are grown in ditches, an average of 200-250 fruits can be obtained from a single tree after full harvest, while in greenhouses, up to 400-500 lemons can be obtained from a strongly developed tree [17].

It is known that within the framework of the program "Every family is an entrepreneur", commercial banks provide soft loans for the establishment of a trench greenhouse for growing lemons in the backyards.

It is known that newly established lemon groves start to bear fruit from the 2nd year and high yields by the 5th year. Therefore, the organization of lemon growing, it is possible to repay the money spent on the purchase of the necessary planting material, the necessary materials for the construction of the greenhouse, or the loan obtained only after the harvest of lemon seedlings.

With this in mind, the cultivation of garlic as an additional crop for the first 2 years between rows of lemon trees in the backyards of the population ensures a higher cost-effectiveness of the use of greenhouses (Table 3).

Analyzes show that the use of greenhouses for growing lemons, planting vegetable crops between rows of lemons, ensures a high level of profitability in the production and sale of products. Farms that organize production in this way will be able to earn a steady income from sales and efficient use of greenhouses.

Table 3. The period of yield and income from the cultivation of lemons in the trench-style 1-hectare greenhouse in residential areas.

No	Events	Unit of measurement	1-year	2- year	3- year	4- year	5- year
1	The average cost, including:	thousand soums	5 500	200	200	200	200
	- to build a greenhouse	thousand soums	5000	x	x	x	x

	- for lemon seedlings (10 pieces)	thousand soums	300	x	x	x	x
	- To plant garlic onions	thousand soums					
	- for agrotechnical measures	thousand soums	200	200	200	200	200
2	Yield of 1 bush lemon tree	Kg	x	3,0-3,5	15-20	30-35	45-50
3	Gross yield	Kg	200	230	200	330	475
	- garlic	Kg	200	200	x	x	x
	- lemon	Kg	x	30	170	330	475
4	Gross income	thousand soums	3 000	3 500	3 500	6 600	9 500
5	Distribution of investment costs for the establishment of a lemon grove by years (current costs together)	thousand soums	3000	2700	200	200	200
6	Benefits	thousand soums	0	800	3 300	6400	9300
7	Reimbursement of investment costs (including current expenses)	%	54,5	61,4	1,75 one more times	3,3 one more times	4,75 one more times

Data Source: Calculated by the author on the basis of data from the Republican Association of Lemon Growers and Exporters.

This is explained, on the one hand, by the high demand of the population for lemons and garlic, and, on the other hand, by the exportability of these products.Thus, the analysis of the cost-effectiveness of lemon growing shows that the industry is highly profitable and has the potential to actively pursue an expanded reproduction process.

In the course of the research, the main directions of agrarian policy in the development of the lemon industry were developed on the basis of the results of the analysis conducted to study the current state of lemon growing. Based on the above, in

our opinion, the introduction of the latest technologies in lemon growing is one of the important measures to ensure the sustainable development of the lemon industry.

We believe that this issue will lead not only to the economic stability of lemon growers, but also to providing the population with lemons and lemon products, increasing foreign exchange earnings by increasing the export potential of these products, increasing agricultural culture and expanding resource efficiency.

According to the results of the study, in the climatic conditions of Uzbekistan, the lemon plant is grown in three different technologies. That is, in modern or simple type film, modern type glass and trench or semi-trench type greenhouse conditions. Each technology used in this area has its own advantages and disadvantages. Growing lemons in glass and film greenhouses requires additional heating equipment, while in the trench or semi-trench method, lemons can be maintained without additional heating equipment.

This mechanism fully covers the issues of financing the cultivation of lemons, the supply of material resources, the provision of services and quality delivery of products to domestic and foreign markets through the establishment of trench greenhouses on the land through cooperation through the establishment of cooperatives, which do not allocate large areas of land for lemon growing.

CONCLUSION

The cultivation of lemons, particularly using trench-style greenhouses, demonstrates significant economic potential and sustainability in regions like Uzbekistan. With strategic investments in efficient technologies and agrotechnical practices, lemon farming offers high profitability even in limited land areas. The research highlights the cost-effectiveness of trench greenhouses, which require fewer resources for establishment and maintenance, compared to other greenhouse types. Moreover, integrating additional crops, such as garlic, during the initial years further enhances profitability, ensuring optimal use of resources. The adoption of cooperative models and modernized farming techniques can support small-scale farmers in accessing broader markets while maintaining environmental sustainability. Thus, the implementation of advanced cultivation methods and support policies can foster the sustainable development of the lemon industry, ensuring economic stability for growers, meeting domestic and export demands, and contributing to agricultural advancements.

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