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Soilless Agriculture Greenhouse Development: Perspective of Uşak Province

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Abstract

In soilless agriculture, a different medium is used to grow plants instead of the traditional soil. One of these methods is soilless, in which the plant roots grow in water, usually in a nutrient solution. Soilless farming is considered a more efficient growing method as the roots are directly supplied with the nutrients required for plant growth, unlike the traditional use of soil. The advantages of soilless cultivation include water conservation, more controllable nutrient uptake, disease and pest control, the possibility of year-round production and greater efficiency. The disadvantages of soilless farming include high initial costs, system complexity, energy requirements and maintenance. In this study, land selection, legal procedures, site analysis, greenhouse installation phases and a financing model for the soilless agriculture project in Uşak province are examined in detail. In addition, a SWOT analysis is conducted to determine the most suitable location for the project. This research underlines the importance of feasibility studies in real estate development projects.

Keywords: Property Development, Greenhouse Development, SWOT Analysis, Soilless Agriculture, Uşak

INTRODUCTION

In the face of population growth and changing climatic conditions, the agricultural sector must now focus on more efficient and sustainable solutions. Greenhouses for soilless agriculture have become an important area where modern agricultural techniques are applied that go beyond traditional farming methods. This study focuses on the development of soilless greenhouses in Uşak province, which is one of the regions with high agricultural potential in Turkey. Uşak province stands out as an important center of agriculture due to its rich soil structure and suitable climatic conditions. The aim of this study is to examine the soilless agriculture greenhouses applied in the region and to evaluate the potential contributions and advantages of this modern agricultural method to the agricultural sector of the region in detail. In this context, using Uşak province as an example, the analysis will help to understand how soilless agriculture can change regional agricultural practices(Khan, 2018.; Sambo, et.al., 2019).

Soillessagriculture is a farming method in which traditional land use is replaced by various growing media and modern agricultural techniques are used. These methods include various techniques in which the plant roots are cultivated in water, air, special culture media or nutrient solutions instead of soil. The main components of soilless agriculture are divided into five categories: Soilless farming, aeroponic farming, smart farming and aquaponic farming. (Lee and Lee, 2015; Maucieri, et.al., 2019; Son, et.al., 2020; Resh, 2022).

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SOILLESSSTRAWBERRY CULTIVATION IN TURKEY

Turkey has considerable potential for strawberry cultivation due to its diverse climate and soil characteristics, with intensive cultivation taking place mainly in the Mediterranean region (177,971 tons), followed by the Aegean (90,227 tons), and the Marmara region (63,466 tons) (Anonymous, 2015). At the provincial level, strawberry production is highest in the provinces of Mersin (Anamur, Silifke), Antalya (Gazipaşa, Serik), and Aydın (Sultanhisar, Koeşk). While the protected cultivation system is widely used in strawberry cultivation in our country, soilless cultivation techniques have not yet become established to the desired extent (Morillo et.al., 2015; Oğuz et.al., 2022).

a- Region Where the Project Will Be Implemented

Uşak is a province in the Aegean region of Turkey. The geographical location of the province has been influenced by various cultures throughout history, resulting in a rich historical heritage. Here is an introduction to the geography of Uşak:

Location:Uşak is located in the northwest of the Aegean region. It borders Manisa to the north, Afyonkarahisar to the east, Denizli to the south and Kutahya to the west.
Area: The total area of Uşak is approximately 5,341 km^2.
Climate: The region has a Mediterranean climate with hot and dry summers and mild winters. The effects of a continental climate are also generally felt in the province.
Geographical features: Most of the province consists of mountainous and rugged terrain. The most important mountain systems within the province's borders are the Murat Mountains and the Bozdağlar. The UşakÇayı (Uşak River) is one of the most important rivers in the province(Uğur, 2019; Doğanay, 2015).

MATERIAL AND METHODS

a-Land Selection For Soiless Strawberry Greenhouse

Issues to be considered when choosing land for a greenhouse (Table 1) (Mercan and Sezgin, 2023):

CONSIDERATIONS FOR LAND SELECTION TABLE - 1

Is the location of the land suitable? (Light transmission is the most crucial factor for the greenhouse.)	Is it a prohibited area or not? (Greenhouses cannot be established in prohibited areas with agency support.)
Are there objects that will cause shading on the land?	Is it in the irrigation land from DSI?
Is the slope of the land suitable?	A preliminary ground survey of the land should be carried out (underground water source, whether it is rocky, a landslide, a landslide hazard, etc.).
Will there be a need for additional land leveling or excavation processes? Is there a road for access to the land?	Is there a problem with buying or renting the land? (Factors such as the number of heirs, mortgage, and annotation should be investigated.)
Is the land suitable for drilling/water well installation?	Are the weather conditions in the region suitable?
Is the land suitable for the construction of an irrigation pond?	Are measures taken to combat dangerous biological factors (plants, animals, substances of animal origin, organic dust, waste, etc.) in the working environment?
Is the location of the land suitable? (Light transmission is the most crucial factor for the greenhouse.)	

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b-Location Analysis

In real estate development projects, the evaluation of the site analysis of different alternatives in the working area is crucial for the selection of the most advantageous project. This study focuses on three different alternatives.

Alternative 1

The project is located in the Aegean region, in the province of Uşak. In Hasan village, Banaz district, Uşak province, a 7600 m^2 soilless strawberry greenhouse will be constructed on the 149th plot and incentives will be provided. The working area is located in the east of Uşak province and is 70 km away from the city center. There are no traffic problems in the working area. The project area has the climatic characteristics of Uşak province, with hot and dry summers and cold, rainy winters. The project area is a field with a total area of 32,855.55 m^2. The village to which the project area belongs has no problems with telephone, electricity or water supply. The economy of the village depends entirely on agriculture and livestock farming. The district belonging to the project area covers a large and productive plain, the Banaz plain, which is not only densely forested but also serves as an agricultural production area. Another notable feature of the district is the presence of hot springs such as Evrendede, Çatalçam and Hamamboğazı, which serve as accommodation, relaxation and health centers(Fig-1).

Fig -1: Location of the Working Area and Satellite Image

Alternative 2

The project is located in Uşak, in the Aegean region of Turkey. It is being built in the village of Yayalar in the district of Sivaslı, which belongs to the province of Uşak, on plot 438. The working area is located in the southeast of Uşak province, 40 km from the city center and 12 km from Sivaslı district. There are no traffic problems in the working area. The project area has the climatic characteristics of Uşak province: hot and dry summers and cold and rainy winters. The project area is a field with a total area of 8,600.00 m^2. The village of Yayalar, to which the project area belongs, lives from farming, trade, weaving and seasonal work, among other things. However, agriculture is the main source of income. Although it is no longer practiced as intensively as in previous years, both large and small livestock are kept in the village. The village

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has a water supply and a sewage system(Fig-2).

Fig -2: Location of the Working Area and Satellite Image

Alternative 3

The project involves the construction of a soilless strawberry greenhouse in Kızılcasoeğuet/Cumhuriyet Beldesi, 118 Ada, 101 Parsel, in the Banaz district of Uşak province in the Aegean region of Turkey. The working area is located east of Uşak city center of Uşak and is 26 km away from the city. There are no problems with the accessibility of the working area. The project area reflects the climatic conditions of Uşak province, with hot and dry summers and cold and rainy winters. The project area covers an area of 30,061.94 m^2, which is designated as agricultural land. The village's economy is based on agriculture and livestock farming. There are no problems with telephone, electricity or water supply in the village where the project area is located(Fig-3).

Fig -3: Location of the Working Area and Satellite Image

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SWOT ANALYSIS

SWOT analysis, which was initially used for business management purposes in the 1970s, has established itself as an analysis and planning tool in various areas in the years since. SWOT stands for Strengths, Weaknesses, Opportunities and Threats, which corresponds to the initial letters of these terms. This method is based on the principle of analyzing and evaluating existing structures by examining four parameters, whereby both quantitative and qualitative analyzes are carried out. The SWOT analysis is a strategic management tool that includes an assessment of the internal and external situation and greatly facilitates the understanding of the situation and perspectives from the management's point of view. In other words, SWOT analysis is used to obtain basic information for planning (URL 4; Newton, 2013; Karapınar, 2017). In the study area, SWOT analysis was conducted to examine the feasibility of such a project and to determine which area is suitable (Table 2).

SWOT ANALYSIS OF SELECTED ALTERNATIVE THREE LAND SAMPLE TABLE - 2

Alternative 1	
Strengths	**Weaknesses**
The slope of the project site is one of the most suitable places for the function of the project.	It is located in the agricultural area.
There are no natural structures and facilities that prevent sunbathing.	The plot requires an association process.
The duration of sunbathing is quite high.	The bureaucratic process takes a long time.
There is no transportation problem.	High initial investment costs for the project plant
It is not located in the mining zone. The hot water from the Hamamboğazı thermal facilities located near the project area can be used in thermal glass greenhouses.	Occurrence of force majeure (excessive rain, snow, etc.)
Opportunities	**Threats**
High Productivity and Fast Growth	High Initial Costs
Water Saving	Energy Consumption
Seasonal Independence	Business Complexity
Disease and Pest Control	Technical Information Requirement
Area Restriction	

Alternative 2	
Strengths	**Weaknesses**
The slope of the project site is one of the places suitable for the function of the project.	High initial investment costs for the project plant.
There are no natural structures and facilities that prevent sunbathing.	Inexperience of staff in maintenance and repair work.
The duration of sunbathing is quite high.	Lengthy bureaucratic process.
There is no transportation problem.	Location in an agricultural area.
It is not located in the mining zone.	Force majeure (excessive rainfall, snow, etc.).
Opportunities	**Threats**
High Productivity and Fast Growth	High Initial Costs

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Water Saving	Energy Consumption
Seasonal Independence Disease and Pest Control	Business Complexity Technical Information Requirement
Area Restriction	

Alternative 3	
Strengths	**Weaknesses**
The slope of the project site is one of the places suitable for the function of the project.	High initial investment costs for the project plant.
There are no natural structures and facilities that prevent sunbathing.	Inexperience of staff in maintenance and repair work.
The time spent in the sun is quite high.	The bureaucratic process is lengthy.
There is no transportation problem.	The location in an agricultural area.
It is not located in the mining zone.	Force majeure (excessive rainfall, snow, etc.).
Opportunities	**Threats**
High Productivity and Fast Growth	High Initial Costs
Water Saving	Energy Consumption
Seasonal Independence	Business Complexity
Disease and Pest Control	Technical Information Requirement
Area Restriction	

As a result of the SWOT analysis, it was decided that the most suitable location for the project area is the 32,855.55 m^2 area on Block 149, Plot 139 in Hasan Village, Block 149, Plot 139 in Banaz District of Uşak Province, referred to as Alternative 1, since the hot water to be supplied by the Hamamboğazı thermal plants near the project area has a great advantage such as the possibility of being used in thermo-glass greenhouses(Table 3).

GREENHOUSE BUILDING DESIGN FEATURES TABLE - 3

Greenhouse Building Design Features	
Type of growing product : Greenhouse for strawberries	Number of Tunnels : 10 Ad.
Cultivation System : Soilless agriculture	Max. Tunnel Length : 105 mt.
Roof Covering System : Polyethylene plastic	Height Under Groove : 5.5 mt.
Forehead and Side Cladding : Polycarbonate coating	Greenhouse Height : 8.15 mt.
Electric Current : 380 3f 50 Hz.	Max. Wind Load : 120 km/h
Standard : EN-13031-1	Max. plant load : 35 kg/m2
Greenhouse Area (Strawberry) : 8.000 m^2	Δt : 24 C°
Total Area : 8.000 m^2	

Soillessis an agricultural method that is used in glass greenhouses in particular. Glass greenhouses allow plants to create a warmer climate and be protected from external influences by keeping the growing environment under control. The technical features of soilless agriculture in glass greenhouses are explained below:

OPERATING COST PRICING

For the project of a modern greenhouse for soilless agriculture, the average cost for approx. 8000 m^2 in 2018 was TL 1,500,000. Looking at the construction cost index and the rate of change, the

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costs have increased about tenfold between 2018 and 2023. According to this calculation, the cost of the modern greenhouse project for soilless agriculture is estimated at 15,000,000 TL.

For example, if we examine the annual market prices in Izmir, we see that the average monthly selling price is 50 TL/kg. Let us assume that the selling price for our project is at least 50.00 TL/kg. For 1 acre, i.e. 1000 m^2, 12,000–24,000 plants can be planted. Let us assume an average of 20,000 seedlings. With a cultivation area of 8 hectares, that would be 8 x 20,000 = 160,000 seedlings, with an annual yield of 0.60 kg per seedling and an average selling price of 50.00 TL/kg: 160,000 x 0.60 x 50.00 = 4,800,000 TL.

A greenhouse project for soilless agriculture is implemented on an area of 8,000 m^2 in Hasan village, Banaz district, which is 70 km away from Uşak city. 15.000,000 TL / 4,800,000 TL = 3.1 (years) It is expected that this investment in Uşak will be amortized in about 3 to 4 years with well-designed systems.

RESULTS AND DISCUSSION

Investors who have the means and can raise additional funds naturally seek to invest their funds in low-risk, high-return investment areas. It is therefore essential to carry out a 'real estate development" study before making a decision on the planned capital investment. Preliminary studies include all economic and technical work related to a project before an investor makes his final decision on an investment. Once the preliminary studies have been positively evaluated by the investor, the detailed work, i.e. the real estate development, is initiated.

As an example of a real estate development study for soilless agriculture, a preliminary feasibility study was conducted for the selected investment site in Hasan Köy, Banaz district, which is 70 km away from Uşak, to establish a greenhouse project for soilless agriculture on an area of 8,000 m^2. It is expected that this investment in the Uşak region will pay for itself in approximately 3 to 4 years if the systems are properly designed. Taking into account the risk factors, this plant is expected to generate profits for at least 20 years with an economic life of approximately 25 years, as calculated.

During project development, the analyzes performed help to eliminate the increasing complexity of real estate projects. Potential problems can be identified, solutions sought or alternative projects developed before the project begins. Approaches for efficient use can be formulated and implemented. Particularly in the case of large and cost-intensive projects, real estate development of this kind is of crucial importance in terms of ensuring sustainability and is an indispensable process.

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Biography of Authors

Dr. Fatih TAKTAK was born in 1978. He graduated from Selçuk University, Department of Geodesy and Photogrammetry Engineering in 1996. He received his master's degree in 2005 from AfyonKocatepe University. He completed his Ph.D. degree in 2013 at Yıldız Technical University. Between 2014 and 2021, he served at Uşak University Faculty of Engineering, and since 2021, he has been continuing his role as Assistant Professor at Sivaslı Vocational School. He also holds the position of Head of the Department of Urban Transformation in the Graduate Program. Currently, he is engaged in research on land management, GIS, and urban transformation.