

WATER MANAGEMENT EFFECT ON TROPICAL FRUITS: CASE STUDY OF ALANYA, TURKEY

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Abstract. Water is the source of life and is consumed mostly for agricultural purposes. Limited water is always a question in the Mediterranean region due to drought and climate change. Irrigation water requirement changes according to the crop pattern which is totally related to farmer decisions. Alanya is a town where tropical fruit cultivation area has increased dramatically as well as irrigation water requirements. Especially, bananas and avocados have become the most popular plants after citrus trees. The evapotranspiration of tropical fruits is higher than many other plants. For this reason, water becomes more valuable in the region due to limited water resources and irregular precipitation. In addition, rapid urbanization and tourism are the other big questions that cause the shift of agricultural areas to other areas, resulting in inadequate irrigation systems. Banana and avocado producers installed high technology of irrigation methods, such as drip and mini sprinkler systems. However, they do not measure the volume of irrigation water and still consume excessive water. In this study, social and technical precautions are taken by water authorities in the region for agricultural water management related to tropical fruit production. Data are obtained from the Agriculture Municipality and State Hydraulic Works and analysed by SWOT. As a result, the main findings are that irrigation water should be calculated, water volume should be measured at the farm level, and agricultural extension and consultancy should be increased for farmers' education.

Keywords: agricultural water management, Alanya, tropical fruits, SWOT.

Introduction

The world population has been increasing and water demand is following the same increasing curve. Sustainable use of water and its quality becomes a crucial phenomenon for human beings for living [1].

Avocado and banana are both popular fruits that are enjoyed by many people all around the world. While these fruits are known for their delicious taste and nutritional benefits, they also require water to grow and be produced. In this discussion, we will look at the water consumption of avocado and banana.

Avocado is a fruit that is native to Mexico and Central America but is now grown in many parts of the world. The production of avocados requires a significant amount of water. According to a study published in the Journal of Cleaner Production, it takes approximately 2,000 litres of water to produce 1 kilogram of avocados in Mexico [2]. This is because avocado trees require a lot of water to grow and produce fruit, and the majority of the water is used for irrigation.

Furthermore, avocado production is also associated with deforestation, which contributes to water scarcity in many regions [3]. Avocado farming is responsible for significant deforestation in countries such as Mexico, Chile, and Peru. Deforestation leads to soil erosion, which affects water quality and availability in rivers and other water bodies.

Bananas are one of the most widely consumed fruits in the world and are grown in many countries, including India, Brazil, and Ecuador. The water consumption of banana production varies depending on the location and farming practices. In general, banana production requires less water than avocado production.

According to a study published in the International Journal of Life Cycle Assessment, it takes approximately 790 liters of water to produce 1 kilogram of bananas in Ecuador [4]. This is significantly less than the amount of water required for avocado production. Furthermore, bananas are often grown in regions with high rainfall, which reduces the need for irrigation.

However, banana farming also has its environmental impacts. Banana farming is associated with the use of pesticides, which can contaminate water sources and affect aquatic life. In addition, banana farming practices such as monoculture can lead to soil erosion and nutrient depletion, which can affect water quality and availability.

Both avocado and banana require water to grow and be produced. However, the water consumption of avocado production is generally higher than that of banana production. Avocado farming is associated with deforestation, which contributes to water scarcity in many regions. Banana farming, on the other hand, is associated with the use of pesticides and soil erosion, which can affect water quality and

availability. Therefore, it is important to consider the environmental impacts of fruit production and consumption and to make choices that are sustainable and environmentally friendly.

The aim of this study is to investigate banana and avocado production and water management in Alanya, Türkiye, and find what strengths, weaknesses, opportunities, and threats are of these tropical fruits production in terms of agricultural water production in the region.

Materials and methods

SWOT analysis about banana and avocado production on agricultural water management in Alanya [5-10]. The objective of this SWOT analysis is to identify the strengths, weaknesses, opportunities, and threats of banana and avocado production with respect to agricultural water management in Alanya, Türkiye. The data for this analysis can be collected through a variety of sources, such as agricultural surveys, market research, expert opinions, and online databases. The data focused on the production of bananas and avocados, as well as the water management practices used in their production. In this study, data are collected from the Agriculture Municipality and State Hydraulic Works of Alanya.

The SWOT analysis is conducted using the following steps:

1. **Strengths.** Identify the strengths of banana and avocado production with respect to agricultural water management. This may include factors such as the availability of water resources, the use of modern irrigation techniques, and the efficiency of water use in crop production.
2. **Weaknesses.** Identify the weaknesses of banana and avocado production with respect to agricultural water management. This may include factors such as inefficient water use, inadequate water supply, and outdated irrigation practices.
3. **Opportunities.** Identify the opportunities for banana and avocado production with respect to agricultural water management. This may include factors such as the availability of new technologies, government policies to promote water conservation, and the potential for new markets.
4. **Threats.** Identify the threats to banana and avocado production with respect to agricultural water management. This may include factors such as climate change, water scarcity, and competition from other crops.

Analysis and interpretation: After completing the SWOT analysis, the data are analysed and interpreted to identify the key findings and recommendations for improving banana and avocado production with respect to agricultural water management. This may include developing new irrigation techniques, promoting the use of water-efficient crops, and investing in water infrastructure.

Results and discussion

The production area for avocado in Alanya has increased significantly over the years, from 120 da in 2004 to 15,500 da in 2021. This represents a remarkable growth of more than 128 times the initial production area. The data show a steady increase in the production area for avocado and banana each year (Table 1).

Similarly, the production area for bananas in Alanya has also increased significantly over the years, from 7,280 da in 2004 to 21,400 da in 2021. This represents a growth of almost three times the initial production area. The data show a steady increase in the production area for bananas each year, with the exception of some minor fluctuations.

Table 1

Avocado and banana production in Alanya region

Years	Avocado (da)	Banana (da)
2004	120	7280
2005	120	7750
2006	120	7750
2007	420	7750
2008	420	6850
2009	425	6850
2010	425	6850

Table 1 (continued)

Years	Avocado (da)	Banana (da)
2011	425	6850
2012	497	6920
2013	528	7015
2014	2900	9500
2015	2900	10000
2016	2900	11150
2017	3045	11150
2018	3100	13100
2019	4100	13150
2020	4450	21300
2021	14450	21400
2022	15500	21400

The SWOT analysis of banana and avocado production in Alanya region in terms of water management has identified several strengths, weaknesses, opportunities, and threats. The region's adequate water resources, efficient irrigation systems, and water management expertise are positive factors for the industry. However, there are also challenges such as water scarcity, ageing infrastructure, and unequal water distribution. Strengths, weaknesses, opportunities and threats of banana and avocado production in Alanya region are given below.

Strengths

1. Adequate water resources: The Alanya region has a favourable climate and receives sufficient rainfall to support banana and avocado production, reducing the reliance on irrigation water.
2. Efficient irrigation systems: Many farms in the region have modern irrigation systems that allow for precise water application, reducing water waste and improving crop yields. Avocado and Banana producers have used drip irrigation systems in open areas, on the other hand, in green houses, banana producers use drip and mini-sprinkler irrigation techniques.
3. Water management expertise: Many farmers in the region have extensive knowledge and experience in managing water resources, which can help in developing effective water management practices.

Weaknesses

1. Water scarcity: Despite having adequate rainfall, the region is prone to periods of drought, which can limit water availability and impact crop production.
2. Aging infrastructure: Some irrigation systems in the region are outdated and may be prone to leaks and inefficiencies, leading to water waste and increased costs.
3. Unequal water distribution: There may be inequitable distribution of water resources, where larger farms or more influential stakeholders have greater access to water resources, which can put smaller farms at a disadvantage.

Opportunities

1. Water conservation: Improving water conservation practices can help farms reduce water use and potentially lower costs, while also promoting sustainable water management.
2. Water reuse: Implementing water reuse strategies, such as using treated wastewater or capturing and storing rainwater, can provide additional water resources and reduce reliance on groundwater.
3. Government support: The government may provide incentives for water conservation practices or invest in improving water infrastructure in the region, which can benefit the banana and avocado industry.

Threats

1. Climate change: Climate change can impact water availability and quality, and may lead to more frequent and severe droughts, potentially impacting banana and avocado production.

2. Water pollution: Industrial activities or improper waste disposal can lead to water pollution, which can impact water quality and availability for farming.
3. Urbanization: As urbanization continues to grow in the Alanya region, there may be pressure to convert agricultural land into urban development, which can limit the availability of land for banana and avocado production and potentially increase the land costs.
4. Competition for water resources: Other industries, such as tourism or manufacturing, may also compete for water resources, potentially limiting availability for agriculture.

The SWOT analysis of banana and avocado production in Alanya region has identified several strengths, weaknesses, opportunities, and threats. The strengths of the industry include the region's favourable climate conditions, rich soil, established industry, and access to markets. These factors provide a solid foundation for the industry to build on and can be leveraged to capitalize on potential growth opportunities.

However, there are also several weaknesses that need to be addressed. The limited availability of suitable land for cultivation, dependence on the weather, transportation costs, and competition from other regions can pose challenges for the industry. To mitigate these weaknesses, businesses and industry stakeholders can focus on improving efficiencies, exploring new varieties, and developing value-added products to enhance competitiveness in the market.

In terms of opportunities, the growing demand for bananas and avocados, the potential to diversify production, organic production, and export potential are promising areas for the industry. By focusing on these areas, businesses can expand their operations and potentially capture a larger market share.

Finally, there are several threats that need to be considered, such as disease and pest outbreaks, climate change, price volatility, competitors, and urbanization. These threats can impact the industry in various ways, such as reducing crop yields, increasing costs, or limiting land availability. To manage these threats, businesses and industry stakeholders can develop strategies to improve crop management practices, diversify production, and invest in sustainable land use practices.

Overall, the SWOT analysis provides valuable insights into the strengths, weaknesses, opportunities, and threats of banana and avocado production in Alanya region. By considering these factors and developing strategies to address them, businesses and industry stakeholders can work towards a more sustainable and successful industry.

The SWOT analysis is a very effective tool to find the most important headline to give rapid assessment and management [11]. However, some other statistical analysis has also been conducted on agricultural water management.

A PESTEL analysis (political, economic, social, technological, environmental, and legal) to assess the external factors that affect agricultural water management in smallholder farming systems in sub-Saharan Africa. The study identified political instability, economic constraints, social inequalities, lack of technological innovation, environmental degradation, and weak legal frameworks as key challenges to effective agricultural water management [12].

A SOAR analysis (strengths, opportunities, aspirations, and results) to analyze water management in agriculture. The study identified strengths such as the potential for increased water use efficiency, opportunities such as the use of precision agriculture technologies, aspirations such as sustainable water management practices, and results such as improved crop yields and environmental sustainability [13].

A multi-criteria decision analysis (MCDA) to assess the sustainability of agricultural water management methods. The study identified various criteria for assessing sustainability, including economic viability, social equity, and environmental sustainability, and used MCDA to evaluate the effectiveness of different agricultural water management strategies [14].

An analytic hierarchy process (AHP) to assess the sustainability of different water management strategies in agriculture. The study identified criteria such as water use efficiency, environmental impact, and economic viability and used AHP to rank different water management strategies based on their overall sustainability [15].

These studies show that alternative analysis techniques such as PESTEL, SOAR, MCDA, and AHP can provide valuable insights into the complex challenges of agricultural water management and help develop effective strategies for sustainable water use in agriculture.

Conclusions

The SWOT analysis has highlighted various factors that can impact the success of banana and avocado production in Alanya region. While there are strengths and opportunities that can be leveraged, such as favourable climate conditions and growing demand for these crops, there are also weaknesses and threats that need to be addressed, such as limited land availability and competition from other regions. In addition, water management plays a crucial role in the success of banana and avocado production in the region, with adequate water resources, efficient irrigation systems, and water management expertise being strengths, while water scarcity, aging infrastructure, and unequal water distribution are weaknesses.

To overcome these challenges, industry stakeholders can work together to improve the crop management practices, develop value-added products, and invest in sustainable water management practices. Furthermore, collaboration with government agencies and research institutions can help identify and implement innovative solutions that can address these challenges and promote sustainable and profitable banana and avocado production in Alanya region. By considering the SWOT analysis and implementing appropriate strategies, the industry can continue to grow and contribute to the economic development of the region, while also promoting environmental sustainability.

Author contributions

Conceptualization, F.A.; methodology, F.A. and S.K.; investigation, F.A. and S.K. data curation, F.A.; writing – original draft preparation, F.A. and S.K.; writing – review and editing, F.A. and S.K. All authors have read and agreed to the published version of the manuscript.

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