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Research Article

The Development of Green Houses in the Southern Türkiye, with an Emphasis on Their Structural and Agricultural Features : The case of the Mersin province

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ABSTRACT

The aim of this research was to evaluate the agricultural and structural condition of the greenhouses in the Mersin region of Akdeniz district as well as the structural and technical issues. A face-to-face survey conducted in the field to determine the agricultural information in greenhouse enterprises as well as the material information used in greenhouses in the research region. The products, greenhouse types and construction techniques were determined by the survey, measurement, observation and photography studies conducted in the region. Because of the region's climate and economic value of the crop, 95.2% of the producers who took part in the survey cultivate pepper. It was determined that all greenhouses in the region were plastic-covered greenhouses. Greenhouse materials are made of steel profile or steel pipe. Most of the greenhouses were found to be without projects and installed by local manufacturing craftsmen. Furthermore, it has been determined that the region's greenhouses have problems with heating, ventilation, and irrigation system design. It has been suggested that a crop-requirement-driven irrigation schedule in greenhouses can boost output while making cost-effective use of water resources. Additionally, the importance of mechanical ventilation and roof ventilation should be explained to producers. In order to ensure proper ventilation, the design should allocate a minimum of 15% of the floor surface in greenhouses up to three decares, and a minimum of 25% of the floor area in greenhouses larger than three decares.

Keywords: Greenhouse, structural problems, irrigation, greenhouse materials

Seraların Tarımsal ve Yapısal Yönden İncelenmesi ve Geliştirilmesi Üzerine Bir Araştırma: Mersin İli Örneği

ÖZ

Bu çalışma, Mersin ili Akdeniz ilçesindeki seraların tarımsal ve yapısal yönden mevcut durumu, yapısal ve teknik sorunlarının belirlenmesi amacıyla yapılmıştır. Araştırma bölgesinde seracılık yapan işletmelerdeki tarımsal bilgiler ve seralarda kullanılan malzeme bilgileri sahada bire bir yapılan anket çalışmasıyla belirlenmiştir. Bölgede yapılan anket, ölçme gözlem ve fotoğraflama çalışmalarıyla alandaki yetiştirilen ürünler, sera tipleri ve yapım teknikleri belirlenmiştir. Ankete katılan üreticilerin %95.2'si bölgenin iklim şartları ve ekonomik değeri nedeniyle biber yetiştiriciliği yapmaktadır. Seraların tamamının plastik örtülü seralardır. Sera malzemeleri çelik profil veya çelik borundan yapılmıştır. Seraların tamamının projesiz olduğu ve çevredeki imalat yapan ustalar tarafından kuruldukları tespit edilmiştir. Bölgedeki seralarda havalandırma, ısıtma ve sulama planlaması sorunlarının olduğu belirlenmiştir. Üreticilere seralarda bitki ihtiyacına göre yapılacak yeterli bir sulama ile verim artışı sağlanabileceği gibi su kaynaklarının tasarruflu bir şekilde kullanılmasına da katkı sağlanabileceği önerisi yapılmıştır. Buna ek olarak, yeterli bir havalandırma için 3 dekara kadar olan seralarda mutlaka taban alanın en az % 15'i, 3 dekardan daha büyük seralarda ise mutlaka taban alanın en az % 25'i kadar tepe havalandırması olacak şekilde projelendirilmesi ve kurulumunun buna göre yapılması önerilmiştir.

Anahtar kelimeler: Sera, yapısal sorunlar, sulama, sera malzemesi

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The Development of Green Houses In The Southern Türkiye, with an Emphasis on Their Structural and Agricultural Features : The case of the Mersin province

Introduction

Greenhouses are structures or construction parts that are covered with light-permeable materials, including fiberglass, plastic, or glass, and whose climatic conditions can be adjusted to create an ideal atmosphere for plant development. These are facilities designed to economically produce a wide range of crops, along with their seeds, seedlings, and tree saplings, all year round by fully or partially regulating, depending on the environmental conditions related to temperature, light, humidity, and air quality (MEGEP, 2007). In Türkiye, greenhouse agriculture has gained commercial importance with the beginning of the use of plastic in agriculture. The 1970s and 1980s showed a rise in greenhouse production in areas with favorable ecological conditions. A major portion of the area increase in the 1990s was also attributed to resource utilization and support fund incentives provided to greenhouse investments and expanding (Tuzel et al., 2020). Turkey is ranked second in Europe behind Spain, although it is ranked fourth globally in terms of greenhouse economy (Gürpınar and Aktürk, 2023). In Turkey, the distribution of greenhouse agricultural regions and the distribution of yearly average temperatures are nearly identical. The majority of Turkey's greenhouse area is located around the southern coast, where the climate is most ideal. The proliferation of greenhouses, particularly in coastal locations, has been made possible by the steel material's durability and the plastic's ease of use.

In Türkiye, Antalya leads overall in greenhouse production. The provinces of Mersin, Adana, and Muğla are the ones that come after this one. Approximately 90% of the nation's total greenhouse production is produced in these provinces with an overall greenhouse production in these four provinces is estimated to be 6.7 million tons (Tarım ve Orman Bakanlığı, 2019; Gürpınar and Aktürk, 2023). In Mersin, which has a significant share in greenhouse cultivation, this area is 196554.5 decares. While 57.8% of the covered areas are plastic and glass, the remaining 43.2% consists of low and high plastic tunnels (TUİK, 2018)

The greenhouse sector is constantly expanding in Türkiye and is becoming more attractive for investment day by day. However, there are certain structural and agricultural problems with greenhouse farming. These problems include improper greenhouse design, wrong material selection, unsuitable greenhouse type selection for the area, and incorrect plant selection for production. In light of these issues, greenhouses with adequate technical and agricultural infrastructure have been erected. There will be a variety of crop yield losses if the environmental regulations are ignored and the growing conditions in the greenhouse are not maintained. This can be accomplished by controlling agricultural practices like structural improvements of greenhouses, appropriate irrigation application, efficient fertilization, appropriate spraying, availability of mechanization, use of high-quality seeds, and so on. This will increase production and provide a greater income for the local producers.

Thus, this study examined at the agricultural and structural elements of greenhouses in the Adanalioglu region in the central Akdeniz district of Mersin province. The products grown agriculturally in the region, the growing conditions and the structural condition of the greenhouses were tried to be determined by a survey conducted to the producers. Fieldwork and producer interviews were used to identify the enterpresis in the research region. Surveys, observations, measurements, and photos were used to give the producers the information they needed about the enterprises.

Materials and Methods

The basic data used in the study was gathered from a questionnaire that was given to small-scale greenhouse producers in the Akdeniz district of Mersin province, which are situated on the country's eastern Mediterranean coast (Figure 1). Due to the unique climate of the research region, which has a Mediterranean climate, intense greenhouse farming is practiced therein. In the region, it could be partially seen the continental climate from the coast towards the Taurus Mountains. The fact that the Taurus Mountains extend in the east-west direction in Mersin prevents the cold air coming from the north. In this case, greenhouse cultivation contributes to the winter months in the region. Due to the characteristics of the Mediterranean climate, there are very few frosty days in the region, making greenhouse cultivation in the area even more convenient. The altitude of the region is 8 meters close to the seashore.

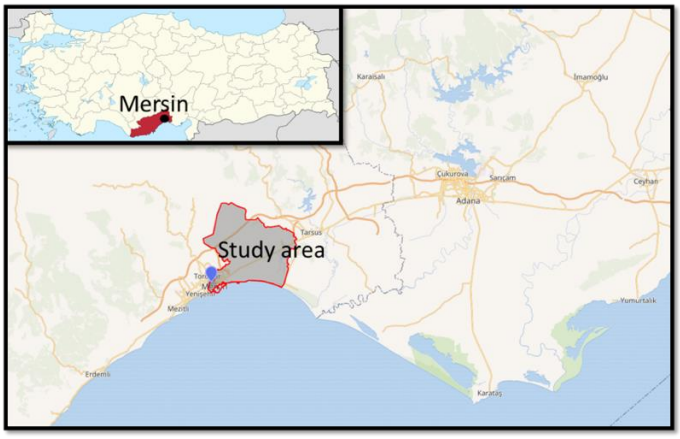

Figure 1. The area bordered in red is Mersin province and the working area Akdeniz district is shown by the gray part (TUBS, 2024)

The district's high tunnel was chosen as the most productive area in 2018, despite the fact that glass greenhouses and low tunnels were not used for production. Second place goes to Plastic Greenhouse, with an output of 13,000 decares. Pepper is the most grown product in the region (Table 1), with a production of 97,500 tons in high tunnels on 15,000 decares and 70000 tons of pepper in plastic greenhouses on 10000 decares (Table 2) (TÜİK, 2018).

Table 1. High tunnel vegetable cultivation in Akdeniz district, Mersin province

Cultivated High Tunnel Vegetables	Decare	Tons
Pepper	15000	97500
Cucumber	6500	65000
Tomatoes	3500	42000
Aubergine	2000	12000

Table 2. Vegetable production in plastic greenhouses in Mersin province Akdeniz district

Vegetable Produced in Plastic Greenhouses	Decare	Tons
Pepper	10000	70000
Cucumber	1500	18000
Tomatoes	1500	18000

Face-to-face surveys were conducted with farmers located at the study area. The sample size of the research is "Based on Population Ratios" and was determined by the “Simple Random Probability Sampling” method (Malhotra 2004).

$$n = z^2 \times (p \times q) \times d^{-2}$$

n: Sample size
z: 1.64 (standard z value corresponding to 90% confidence level)
p: The proportion of the population that has a certain characteristic based on prior knowledge or prediction about the subject under study. (As a result of the literature study and the test survey, it was determined as 0.2).
q: (1-p) The proportion of the population that does not have the relevant feature
d: The accepted error tolerance level is ±5%.

Accordingly, in the resulting framework list, the number of sample enterprises was calculated as 21 enterprises with a 90% confidence level and a 5% deviation from the average. After the pilot survey application, the surveys were finalized. Fieldwork and producer interviews were used to identify the enterprises in the research region. The necessary data about the enterprises were provided to the producers through surveys, observations, measurements and photographs. There are three distinct sections on the research survey form. The producers' demographic information (age, education level, employment status outside of agriculture, number of family members, etc.) is included in the first section. Questions regarding the enterprise's agricultural practices and problems are covered in the second section. Finally, questions about the structural conditions of the enterprises are covered in the third section. The analysis of the surveys is carried out statistically according to the percentage frequency values of the responses to the survey questions. Microsoft-Excel computer program was used to evaluate the data obtained from the study.

Results and Discussion

An Assessment of Selected Enterprises

In the research area, 21 enterprises were the subject of studies. While some producers own individual greenhouses on separate parcels, others own block greenhouses on a single parcel. In the research region, greenhouse installations are typically planed based on the producer's available parcel shape. All greenhouses evaluated in the study are constructed without project. The installation of the greenhouses was done by the construction foreman and producers themselves in the region. Producers who rent the property often produce in high tunnels, whereas businesses that own the land in the area typically produce in plastic greenhouses. The low installation cost of the high tunnel is the cause of this.

The majority of the producers who took part in the survey (42.9%) had only completed their elementary education, while the lowest percentage (9.5%) had completed their university degree. The percentage of people who completed secondary education was 19%, while the percentage of people who completed high school was 28.6%. In a related study using a survey, Tüzel et al. (2010) reported that 90% of the enterprise owners of the greenhouses in the villages and Serik district of Antalya are primary school graduates and that the greenhouses are small scale, family-run enterprises. So that, Because of variations in study areas and time periods, there have been shifts in educational levels in this location.

Among producers in enterprises, young farmers (those under 40) make up 42.9% of the age group; producers over 40 make up 57.1% of the group. The size of the greenhouse areas in the researched enterprises is that while the smallest greenhouse area is 3 decares, the largest greenhouse area is 25 decares (Table 3).

Table 3. Greenhouse areas of the enterprises in the research (decare)

Enterprise area (decar)	Number of enterprise	Percentage (%)
3	1	4.8
7	3	14.3
7.5	1	4.8
8	3	14.3
9	2	9.5
10	2	9.5
11	3	14.3
12	3	14.3
13	1	4.8
17	1	4.8
25	1	4.8

In the region, 19% of producers rent land, while 81% of farmers grow their crops in their own greenhouses.

Construction Materials for Greenhouses

Due to problems with these materials and advancements in technology, producers who formerly used wood and iron as carrier materials for greenhouses have opted to use steel profiles or galvanized iron. Steel construction material is used in all greenhouses in the research area. Plastic greenhouses account for 90.5% of the enterprises, whereas high tunnels make for 9.5% (Table 4). In the surveyed enterprises, the spring roof and pipe system is most preferred with 52.4%. It is followed by the spring roof profile system with 38.1% and the steel cage system with 9.5%. High tunnels are mostly preferred by producers who rent land (Figure 2).

Table 4. Greenhouse types of the enterprises in the research

Greenhouse Types	Enterprises number	Percentage (%)
Plastic greenhouses	19	90.5
Others (High tunnels)	2	9.5
Spring roof and pipe system	**Spring roof profile system**	**Steel cage system**
52.4%	38.1%	9.5%

All greenhouses examined do not have a static project. Greenhouses are mostly established according to the samples taken by the producer from the neighbouring environment. In this case, it leads to problems with greenhouse structures. As stated in a similar study by Baytorun (1995), wood and plastic were widely used in our country until the mid-1980s, and manufacturers began to use steel pipe or steel profile systems as construction in the 1990s, but structural errors occurred in greenhouses built by people without technical knowledge.

Figure 2. High tunnels and greenhouse with roof spring pipe system in the reseach area

Cover Material

In our country, as well as in others with extensive greenhouse farming, polyethylene (PE) plastic is the most popular covering material. The primary cause of this is the cost-effectiveness of plastic in comparison to alternative covering materials. Manufacturers prefer plastic covers containing UV, IR and antifog additives, which are more durable and have better light permeability.

Additive plastic cover material is used in all greenhouses in the research area. 47.6% of producers alter the cover material for longer than two years, compared to 52.4% who do so every two years (Table 5). It has been reported that while cover materials have grown less durable, their quality has declined recently. In this case, it increases the expenditure for cover material. Zabeltitz (1988) found similar outcomes in his investigation of the requirements of plastic greenhouse producers for greenhouse construction. Furthermore, according to Baytorun et al. (1993), there were significant issues with the cover material selection despite the Mediterranean Region's coastal location having significant advancements in greenhouse agriculture. Normal PE, UV added PE, and UV+IR+Antifog added PE cover materials were employed as plastic covers in the greenhouse investigation. Regarding light, photosynthesis is how plants use sunlight to create organic matter in order to develop. An overabundance of light intensity or low light levels can interfere with photosynthesis in plants, which can impact crop quality, production, and color (Kumar et al., 2022), so that, its important to select the cover materials.

Table 5. The plastic material types and temporal using status

Plastic materials	**Quantity of Enterprises**	**Percentage**
Polyethylene UV (Yellow Plastic)	1	4.8
Polyethylene UV+IR+Antifog	20	95.2
Temporal using status		
2 years or less	11	52.4
2 years < more	10	47.6

Ventilation, Heating and Irrigation

In greenhouses, ventilation is used to lower the temperature and maintain a specific humidity level. Also, adequate ventilation is necessary to provide the CO_2 that plants need. Proper ventilation is necessary in greenhouses because various diseases can arise in environments with inadequate ventilation. Though having the perfect climate in the greenhouse may be best for plant growth, it also encourages the spread of diseases and pests (Canadas et al., 2017).

In the research area, producers use the natural ventilation method. Opening the greenhouses' side walls, front facades, and greenhouse entrances allows for ventilation during extreme temperatures (Figure 3). Producers do not use mechanical ventilation (fan system) and roof ventilation methods at all. There is no infrastructure to provide this type of ventilation in the surveyed greenhouses. For this reason, sufficient ventilation is not provided in the greenhouses in the region. This situation is insufficient for a seaside area with high humidity. Therefore, for adequate ventilation, it must be designed to have at least 15% of the floor area in greenhouses up to 3 decares, and at least 25% of the floor area in greenhouses larger than 3 decares, and the installation must be done accordingly (Anonymous, 2016).

The efficiency of these systems was assessed in order to guarantee effective output in the summer rather than the winter months in Coşkun and Filiz's (1997) study on the PED fan system, an active cooling system in greenhouses in the Mediterranean environment. The study's findings revealed that the internal temperature of the greenhouse dropped to an average of 25 °C when the fan, pad, and shade system were all used simultaneously and this temperature is sufficient for the plant's growth. Similar strategies ought to be applied in this situation to boost output in the field of work along with related areas. In a related study, Sevgican (1999) noted that roof ventilation systems in Turkish greenhouses are not operating at the optimal level and clarified that roof ventilation in greenhouses should be applied at a rate of 20% of the floor area in order to provide optimum ventilation. This value has been determined at 1-4% levels in greenhouses in Turkey.

Figure 3. Ventilation on the front and side parts of plastic greenhouses

Heating in accordance with standards for plant growth in greenhouses is required. If heating is not carried out under appropriate conditions, it causes loss of efficiency in production. Heating in greenhouses in the region is provided only for frost protection. On frosty days, heat balance is tried to be achieved by using a stove in the greenhouse. Another way to prevent frost damage to the plants is to use the mini sprinkler irrigation system that is installed on the greenhouse roofs to irrigate on frosty days, so the temperature raised on the roof. Producers are utilizing this technique in an effort to further reduce heating expenses. The value of heating for improved plant growth and production efficiency is often overlooked by producers. Unfortunately, adequate conditions for heating the greenhouses in the research region are not suitable. Baytorun et al. (1994) determined the humidity, temperature and radiation data required for the development of plants in greenhouses. Accordingly, in greenhouses, the temperature must be at least above 0 °C in order to prevent plants from being damaged by frost. It has been stated that heating should be done in greenhouses when the average temperature is below 12 °C.

Producers choose the irrigation technique based on the region's land conditions, the variety of plant being cultivated, and any pest and disease problems. Artesian wells are utilized by all producers within the research area for irrigation (Figure 4).

Figure 4. Water supply, drip irrigation system and control unit in greenhouse

Each enterprise surveyed uses drip irrigation (Table 6). The drip irrigation method has been found to be the most effective as it involves less labor and allows for simultaneous application of the plant fertilizer that the system requires. Similar studies by Sevgican et al. (2000) examine the techniques for irrigating crops grown in greenhouses. They found that, given grower conditions, drip irrigation is currently the most popular technique because of its many benefits. However, producers in the region do not measure the amount of water applied. The producers' experience and the artesian well's pump power determine how much irrigation water is applied to the crops. This is seen as a major disadvantage of the region in terms of efficient irrigation. Producers irrigate the plant without planning the irrigation water need, irrigation interval and irrigation time. In addition, there is no adequate drainage system in greenhouses which could cause salinity in time. In addition, this circumstance results in an inefficient and costly use of water resources. Additionally, yield loss results from incorrectly estimating a plant's water requirements could occur in the study area. Clogging in the pipes were cited by 28.6% of the growers as the cause of the irrigation method's trouble, while 71.4% reported no problem (Table 6). Çevik (1995) and Cemek and Demir (2004) conducted an evaluation of the irrigation problems in greenhouses by examining the relationships between soil, plant, and water. They found that excessive watering led to both chemical and physical alterations, particularly in soils with insufficient drainage systems. In this context, similar problems have become inevitable for producers in the region. It is envisaged to receive consultancy services on irrigation planning.

Table 6. Irrigation methods, problems encountered in irrigation methods and water resources of enterprises in the region

Irrigation Method	**Quantity of Enterprises**	**Percentage**
Drip irrigation	21	100
Sprinkler irrigation	0	0
Mini sprinkler	0	0
The Problems in Irrigation Method	**Quantity of Enterprises**	**Percentage**
Clogging in pipes	6	28.6
No problem	15	71.4
Water resources	**Quantity of Enterprises**	**Percentage**
Artesian well	21	100
DSI irrigation canal	0	0

Fertigation and Spraying

One of the key elements that increases productivity in greenhouse production is fertilizer and fertilization. Farmers in the area use a variety of fertilizers. Fertilizer is regarded as one of the most crucial components in agricultural production since Kızılaslan and Kızılaslan (2005) found in their study that fertilizer and fertilization are very significant for increasing productivity in agricultural production.

Enterprises in the research area generally use similar fertilization practices because they grow the same type of product. To enhance soil structure and improve productivity, all growers apply chemical and organic fertilizers. Producers use 61.9% animal manure as organic fertilizer, and 33.3% use both animal manure and compost fertilizer (Table 7). Turkey's agricultural soils were found to be deficient in organic matter, particularly nitrogen, according to the findings of Ertiftik's (1998) study. In addition to applying chemical fertilizers containing phosphate,

potassium, and nitrogen, producers also apply fertilizers containing 85.72% micro and macro elements.

Numerous diseases and pests arise in greenhouses since they are enclosed environments used for continuous production. In order to combat these diseases and pests and minimize crop loss, producers in the research area apply pesticides. According to Tudi et. al. (2021), fruit production would have decreased by 78%, vegetable production by 54%, and cereal production by 32% if pesticides hadn't been used. Thus, over the world, pesticides are essential for lowering disease rates and raising crop yields. Fungal diseases are more widespread in greenhouses in the area because of the close proximity of the study area to the seashore and the high humidity levels. Producers mostly combat against fungal diseases, and all enterprises use insecticides and nematicides in addition to fungicides in the region. Although 71.42% of farmers apply pesticides based on their observations of plants and the environment as well as their experience, 28.58% apply pesticides based on their experience as well as technical assistance (Table 7). According to Edward's (1986) research, pesticides are now considered essential due to their potent, fatal effect on pests and ability to produce higher-quality and more abundant fruit and vegetable yields.

Table 7. Organic fertilizer, chemical fertilizer and determining the pesticide use by enterprises in the region

Use of Organic Fertilizer	**Quantity of Enterprises**	**Percentage (%)**
Animal Manure	13	61.9
Compost Fertilizer	1	4.8
Animal Manure+Compost Fertilizer	7	33.3
Use of Chemical Fertilizer use	**Applied enterprise quantity**	**Not Applied enterprise quantity**
Nitrogen Fertilizers+Phosphorus Fertilizers+Potassium Fertilizers	21 (100%)	0 (0%)
Fertilizers containing Micro and Macro Elements	18 (85.72%)	3 (21.28%)
Determining the pesticide	**Quantity of Enterprises**	**Percentage (%)**
Based on Plant and Environmental Observations+Based on Experience	**15**	71.42
Based on Experience+ Taking Technical Support	**6**	28.58

Additional Difficulties

High production costs for inputs are among the primary issues facing producers in the region. The income of growers is significantly impacted by the high costs of pesticides, fertilizer, and diesel fuel. It has been stated that this situation is not sustainable and a solution must be found, and that the insurance costs and labor costs of greenhouses are also high.

In addition to this circumstance, the survey investigation revealed that, according to 47.6% of the producers, the covering material was the

most frequent difficulty they had in their enterprises, with corrosion in the material coming in last at 4.8% (Table 8). Those who wish to build a new greenhouse have two preferences for types of greenhouses: 4.8% want a glass greenhouse and 95.2% want a fully automated greenhouse.

Table 8. Problems Encountered by enterprises and tendency to establish desired greenhouses in the region

The most common problem in enterprises	**Quantity of Enterprises**	**Percentage (%)**
Cover material	10	47.6
Heating	2	9.5
Ventilation	8	38.1
Corosion of materials	1	4.8
Desired new greenhouse characteristics	**Quantity of Enterprises**	**Percentage (%)**
Glasshouse	1	4.8
Modern+full otomated greenhouse	20	95.2

Conclusions

In addition to providing a vital role in Turkey's agricultural production, greenhouse farming contributes significantly to the economy of Turkey. Production can be carried out throughout the year, allowing consumers to access fresh vegetables and fruits in every season. Compared to other agricultural approaches, greenhouse cultivation has a greater profitability rate when done appropriately and on-site. Under proper conditions, greenhouse farming on these lands can be a major sector that boosts productivity per unit area, lowers unemployment, and gives rural communities the appropriate amount of revenue from agricultural activities.

The goal should be to produce superior products in the research area's greenhouses while keeping in mind consumer needs and operating in settings that are safe for both human and environmental health. Producers need a significant income in order to produce under these conditions. However, the high initial costs of the producers cause the production to not be carried out under the desired conditions. Producers should receive support from relevant government agencies in order to lower these expenses.

Food safety and health should be the top priorities for greenhouse growers. In this context, controlling many factors in fully automated modern greenhouses ensures healthy and reliable products. The majority of the greenhouses in the study area are produced as modest family companies and are located remote from these technical advancements. The use of chemical pesticides and fertilizers in this type of production is primarily determined by the producers' experience, which creates challenges with the production of healthy and secure food. This should be avoided by having growers participate in extensive training programs run by the appropriate Ministry of Agriculture and Forestry entity.

In the research area, steel material is mostly used as greenhouse building material. Nonetheless, problems with the greenhouses arise from the fact that most of the greenhouses in the area are constructed by local workers either based on the producer's own design or another greenhouse sample collected from the surrounding area. By receiving technical support to resolve these structural problems. So that, Planning should be done for greenhouses with sufficient mechanical characteristics, high light transmittance, high ventilation efficiency, low heat consumption,

and a robust enough structure. The static structure, strength, and assembly of the greenhouse unit must be installed in accordance with Turkish Standards No. TS EN 13031-1, and all materials to be used in the construction of the greenhouse unit in the project must be at least TSE approved in order for these greenhouses to be approved for funding or financing from government agencies.

Light transmittance is very important in greenhouses. A correct cover material must be chosen to ensure sufficient solar radiation for the plants. In the selection of greenhouse cover materials; Wind resistance, light permeability, hail load resistance, heat permeability, ultraviolet permeability, condensation property, resistance to wear and insulation values should be taken into consideration.

Heating in greenhouses in the region is done only to protect them from frost, due to the Mediterranean climate. Because of this situation, plants are unable to complete their regular growth by spending the necessary amount of time at the right temperature, which has an adverse effect on productivity. Moreover, The plant rows along the greenhouse's outer walls may become damaged by the cold on chilly days due to the lower soil temperature outside the greenhouse. This situation can be prevented by installing an external drainage system of the greenhouse, which is not present in the greenhouses in the study area. Developing a form of greenhouse that will make the most use of renewable energy sources and solar energy with advanced technology is crucial in order to offer heat in greenhouses according to plant needs and at a cheap cost.

Producers primarily utilize natural ventilation. Greenhouse ventilation is insufficient as a result of this condition. It is essential to lower the temperature and maintain a specific humidity level in greenhouses while providing enough ventilation. Research ought to be done in this regard to inform producers about the significance of roof and mechanical ventilation. Plants can be effectively ventilated by using fans in conjunction with mechanical ventilation, particularly during hot weather.

Farmers in the study area irrigate plants based on their expertise rather than measuring the amount of water used. In order to properly irrigate, producers must schedule the time, interval, and amount of water needed by the plant. By adjusting irrigation to the plant's requirements, it is possible to maximize yield while conserving water.

Producers in the study area apply fertilizer and spray in accordance with their continuing knowledge of crop production. More insecticides and fertilizers are used by producers, particularly during the winter. Farmers will be able to apply more precisely and appropriately according to their knowledge with chemical fertilizers and pesticides, as well as soil and leaf analyses and the findings they acquire. In this sense, there should be more collaboration between farmers, district agricultural directorates, faculty of agriculture, and pesticide suppliers.

Therefore, production can be made at the appropriate quality and efficiency for further production by following these recommendations and taking the required measures.

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