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A Brief Overview on the Problems of Greenhouse Owners in Khorramabad, Iran, Over 2020-2021

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Abstract

In recent years, greenhouse production in Khorramabad city, Iran, has suffered severely from problems such as Corona pandemic, declining average annual rainfall, and severe inflation. On the other hand, the greenhouse development policy in this city is expected to grow 3.16 times more than the present condition for the next four years. This study investigates of the main problem of greenhouse production and development in this city over 2020-2021. To do that, a field study was conducted and data were collected through interviews and direct observations. Then, all greenhouses were divided into three categories; A, B and C, based on characteristics such as type of product, cultivation bed and irrigation system. Results showed that in Type A greenhouses, which grow rose flowers, there are problems caused by Covid-19 (35%) and something else (65%), including a lack of technical staff, insufficient financial and legal knowledge, and equipment. In greenhouse type C, which produces vegetables, the only problem is equipment. The water crisis was not observed in greenhouses A and C and may not be encountered in the near future due to mechanized irrigation equipment and recycled water systems. On the other hand, greenhouses of type B, which mainly produce medicinal plants and vegetables, will face a water crisis (35%) and a lack of technical staff (65%) in the near future. To put it in a nutshell, the risk of continuing Covid-19 in the coming years will only affect Type A, and the water crisis will affect Type C. In addition, the risk of other factors, more than Covid-19 and the water crisis, will affect the development of greenhouses in the city.

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Introduction

Iran's average rainfall is 250 mm per year. Thirty percent of rainfall is snow, and the rest is rain. About 52% of rainfall in Iran is in a quarter of its area, so three-quarters faces water shortages. Decreased rainfall has occurred in Iran in recent decades (Ahmadee et al., 2021). On the other hand, the number and intensity of floods have also increased. For this reason, some researchers believe that climate change in Iran is exacerbating the current water crisis (Yazdandoost et al., 2016). Also, many sources in Iran have reported that about 90% of Iran's water resources are used in agriculture (Yazdandoost et al., 2016; Ahmadee et al., 2021). Policymakers have considered the development of greenhouses with high irrigation efficiency in recent years.

Despite paying attention to the development of greenhouse units in Iran, research conducted in recent years has shown that this sector faces many problems. Although researchers pay less attention to this sector than agriculture and horticulture problems in Iran, the existence of numerous problems indicates that the goals considered for this sector have not been fully achieved yet. For example, Ramezani and Papzan (2019) investigated greenhouse owners' problems in Isfahan province, Iran's center. These researchers used two methods: phone interviews and direct observations to prepare data. These researchers divided greenhouse owners' problems into categories: economics, infrastructure and strategic, human, and extra-organizational. The researchers pointed out the problems caused water shortages, especially in the east of Isfahan province. They explained that these problems could be aggravated due to climate change. For this reason, they suggested increasing water productivity to solve the problems. Amerian (2023) investigated 100 greenhouses in Kermanshah, western Iran. He reported that the main problems of production and development of greenhouse units included six factors: credit barriers, technical and consulting, educational and legal, production and export, infrastructural and sales. Examining these problems from greenhouse experts' opinion showed that technical problems were more important than other problems. Momeni (2023) by investigating the problems of greenhouse owners in Hormozgan province, southern Iran, showed that there is no problem in terms of water and energy supply for production in these greenhouses. The researcher reported that technical problems, such as the lack of greenhouse experts, caused several problems in greenhouse unit production.

Among the studies conducted, it is clear that despite the existence of numerous observations regarding drought types in Iran (Dalezios et al., 2017), this problem may not be an obstacle to the development of greenhouse units in Iran. Actually, researchers and managers always believe water scarcity is the most critical factor in agricultural development in Iran. This trend will intensify in the future. Although this is important, given the general state of water resources in most areas, water scarcity may not always be the most critical deterrent to agricultural development in Iran. The recent outbreak of the novel SARS-CoV-2 virus, also called Coronavirus 2019 (COVID-19), has created one of the situations of the most important pandemic in the past hundred years (Dhama et al., 2020; Sohrabi et al., 2020) which has dramatically affected agricultural production and supply in Iran. However, the production situation of different greenhouse products in Iran was very variable during COVID-19. Since less attention is paid to investigating these problems simultaneously across the published research, the authors asked what factor had the greatest impact on greenhouse crop production; water crisis, COVID-19, or something else.

Materials and Methods

Study Area

Lorestan province, located in western Iran, is a province with diverse climatic characteristics; in the period from 2016 to 2021, greenhouse area has increased 6.6 times (Figure 1). According to greenhouse development policies in this province, in the next four years, the area of greenhouses will increase by 3.16 times compared to the current situation (Anonymous, 2022b). Khorramabad city is the capital of Lorestan province and is located at longitude 21˚ 48' east and latitude 29˚ 39' north (Figure 2). The city has a semi-humid climate with hot summers and cold winters (Rezaei-Banafsheh and Kakolvand, 2015). The northern and eastern regions of Lorestan province have a colder climate, and the southern and western regions have a warmer climate than Khorramabad city.

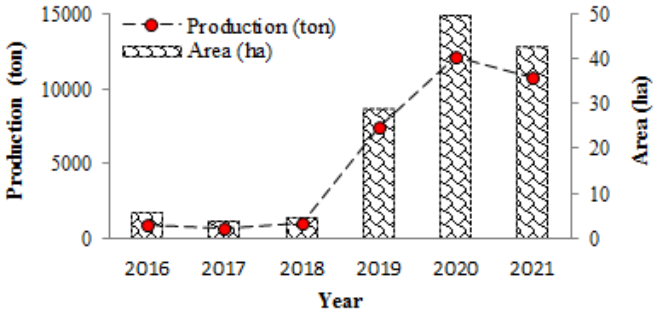

Figure 1. Changes in production and greenhouses' area in Lorestan province, Iran (Anonymous, 2022b)

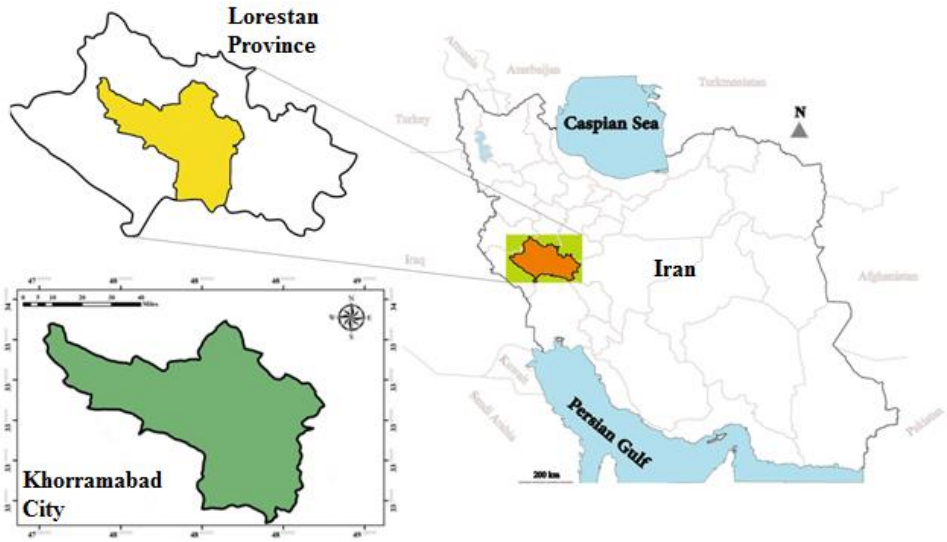

Figure 2. Location of Khorramabad c ity in Lorestan province, Iran

Water status in Khorramabad City

The average annual rainfall in Khorramabad city is shown in Figure (3). Khorramabad's average rainfall is 508 mm per year. This amount is more than twice the average rainfall in Iran. Based on the trend of precipitation changes, there is a downward trend with a low slope in the average rainfall of Khorramabad city. The average rainfall in the 1950s was 569.35 mm, but this amount has decreased since 2011. The average rainfall in the last decade has decreased by 79 mm compared to the 1950s, while this decrease was 19

mm compared to the long-term average. Rainfall changes in the last decade compared to the first decade of the 21st century are about 40 mm higher.

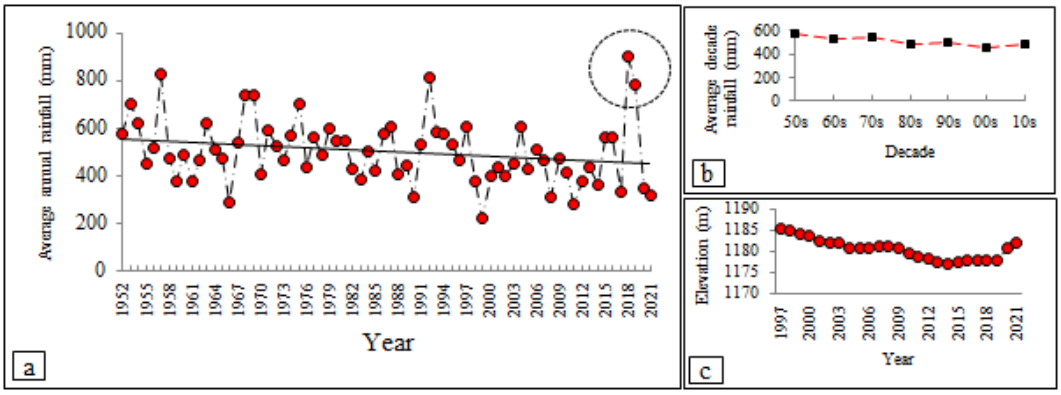

Figure 3. Average annual rainfall (a), average rainfall per decade (b) and average water table height (c)

The two indicators, the standardized precipitation index (SPI) and groundwater resource index (GRI) are used to assess meteorological and hydrological drought, respectively. At the onset of drought, the SPI changes rapidly. GRI is gradually affected by drought and usually has a time difference of one to several years compared to SPI. SPI values were estimated based on precipitation amount as the following function gamma (Eq. 1) (McKee et al., 1993).

$$F(x)=\int_0^x f(x)dx=\frac{1}{\Gamma(\alpha)\beta^{\alpha}}\int_0^x X^{\alpha-1}e^{\frac{-x}{\beta}}dx \quad (1)$$

In which α is the shape parameter (α>0), β is the scale parameter (α>0), and x is the precipitation amount larger than zero. The values of x vary according to α and β. Regarding SPI results, droughts are categorized into some levels of severity, as shown in Table (1). In Eq. 2, GRI is the groundwater resource index, D is the groundwater level, μ is the average groundwater level in the specified period, and ∂ is the standard deviation of groundwater level in all wells in the study time (Mendicino et al., 2008).

$$GRI=\frac{D-\mu}{\sigma} \quad (2)$$

Table 1. Drought characterization based on SPI and GRI values (McKee et al., 1993; Mendicino et al., 2008)

GRI values	GRI Categories	SPI values	SPI Categories
≤-2.00	Very Extreme dry	≤-2.00	Extreme dry
-1.5 to -1.99	Extreme dry	-1.5 to -1.99	Severe dry
-1.00 to -1.49	Severe dry	-1.00 to -1.49	Moderate dry
-0.99 to -0.50	Moderate dry	-0.99 to +0.99	Near normal
-0.49 to 0.49	Near normal	+1 to 1.49	Moderately wet
+0.5 to 0.99	Moderate wet	+1.5 to 1.99	Severely wet
+1.00 to 1.49	Severe wet	≥+2	Extremely wet
+1.50 to 1.99	Extreme wet		
≥+2	Very Extreme wet		

SPI results showed that the meteorological drought situation had improved over the last five years. Even in 2018 and 2019, more severe conditions were observed. This has been due to increased rainfall in recent years (Figure 4). However, normal conditions are observed based on SPI in the most extreme cases, and dry conditions have not been observed since 1997. The GRI index continued to decline until 2013, and the situation in Khorramabad changed from much more dry in 1997 to severely dry in 2013. But after 2013, the condition of this index improved, and from 2020 it changed to moderately wet. In 2018 and 2019, the average annual rainfall in Khorramabad city was 77% and 54% more than the average long-term rainfall in this city, respectively. In this period, researchers observed that this phenomenon caused problems with greenhouse facilities and products due to flooding. However, in the following years, it had increased the water table in this region. Due to the 26% increase in rainfall in the last five years (2017-2021) compared to the study period (2006-2007), the GRI situation in this area has improved. Before 2013, GRI changes did not comply with the SPI due to uncontrolled groundwater abstraction for other uses.

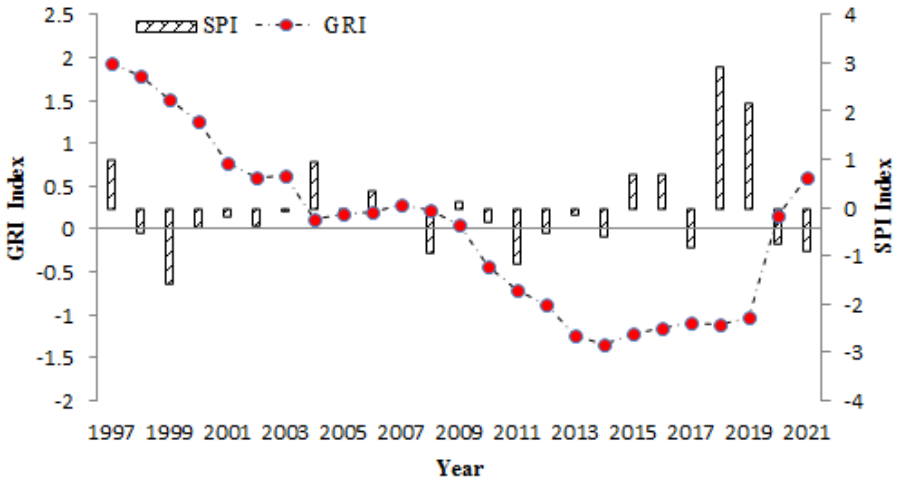

Figure 4. Changes in SPI and GRI from 1997 to 2021

Greenhouses in Khorramabad City

The city's greenhouse area is 18.32 ha. Most Khorramabad greenhouses are located in the southern part of the city. After field visits, all the greenhouses in this city were divided into three groups based on the type of crop grown, irrigation system and cultivated bed (Table 2). Group A includes greenhouse owners who grow Dutch roses. During regular daily programs, these greenhouses feature drip irrigation systems, as well as accurate fertilizer irrigation systems. Workers in Type A greenhouses have been trained to do so. In terms of owners, this group has the largest greenhouse type. Group B is second, including greenhouses with soil beds. In these greenhouses, a variety of vegetables such as cucumbers, bell peppers and tomatoes and some medicinal plants such as thyme and lavender are grown. The method of irrigation in these greenhouses is drip and surface. Group B is weaker than group A in terms of irrigation accuracy, and mainly the time and amount of irrigation in those greenhouses depend on the workers' experience. Group C has the lowest number of greenhouses. In this type, vegetables are grown using a hydroponic system. However, group C is at the highest level regarding technical equipment and staff training compared to the other two groups. Table (2) shows each greenhouse.

Table 2. Details of the greenhouses

Greenhouce type	A	B	C
Products	Dutch rose	Vegetables medicinal plants	Vegetables
Type of irrigation system	Drip irrigation (Tape)	Surface/Drip irrigation	Hydroponic
Cultivation bed	Cocopeat Perlite	Soil	Cocopeat
Destination of sale	Khorram-Abad Tehran	Khorram-Abad GCC Russia	GCC Russia
View			

Results and discussion

Group A: Due to the use of accurate irrigation systems and the presence of up-to-date equipment in most greenhouses in this group, there is no problem with irrigation water supply. Of course, the availability of sufficient groundwater resources has not yet created a problem for the operation for these greenhouses. Some of the greenhouses in this group have a long history of growing Dutch roses. For this reason greenhouses are being expanded in this group. This is because of high profits in previous years and the development of sales markets, especially the export of flowers. Some other greenhouse owners have just started operating their crops, some of which started at the same time as the COVID-19 pandemic. Most Group A greenhouses used a variety of loans to purchase equipment, which is difficult to repay for two reasons. First, greenhouse owners did not have legal knowledge to obtain a loan. For this reason, by changing some conditions at the time of construction and obtaining some licenses, they lost the facilities of low-interest loans. So, in some cases, the loan interest has increased up to three times. Also, due to excessive inflation in the last four years in Iran (Anonymous, 2022a), the equipment purchase price increased quickly, and even greenhouse owners with low-interest loans could not use them to buy all the equipment. Therefore, they needed high-interest loans. Second, with the outbreak of the COVID-19 pandemic, public ceremonies were closed. As a result, flower sales fell sharply to zero in 2021. Thus, greenhouse owners suffered severe financial losses. Therefore, in some greenhouses, the entire crop was destroyed. Similar results were reported by Ramezani and Papzan (2019) and Amerian (2022) for other greenhouse products. This is significant from the perspective of virtual water and the loss of water resources. Of course, unexpected floods in 2019 also damaged to some greenhouses. In addition to destroying some crops, this also caused severe financial losses for greenhouse owners. Despite some support from the Iranian Agricultural Insurance Fund, their problems were not entirely resolved, and greenhouse owners used their funds to renovate their greenhouses. In these greenhouses, refrigeration storage is necessary because Dutch roses are sensitive and require proper maintenance before sale. Due to the problems presented above, some greenhouse owners cannot to buy refrigerator storage. As a result, they sell the harvested product hastily, and they

make less profit.

Group B: The area of greenhouses in this group varies from very traditional and small greenhouses to large production units. The source of water withdrawal in most of these greenhouses is wells. Due to the floods of 2019 and the existence of sufficient water resources in recent years, they have not had any problems with water supply. Although water efficiency is low in these greenhouse units, there was no protest regarding water supply. But this problem will arise in the coming years (Moghadam et al., 2021). Sabzevari and Eslamian (2022) reported that Khorramabad might be affected by drought problems if the SPI index changes because rainfall decreases in dry years. Some vegetables, such as cucumbers, have been removed from production plans in this type of greenhouse due to the pestes increase in recent years. For this reason, most greenhouse owners are eager to produce more profitable crops such as tomatoes and bell peppers. In this type of greenhouse, in addition to meeting part of the needs of the city's domestic market, the export of products to the GCC countries and Russia is also done. Of course, in 2021, the share of exports was more than sales in the city of Khorramabad. Medicinal plants are also of interest to greenhouse owners due to their constant sales throughout the year. Due to the lack of business administration in most of these greenhouse units, most of them export their products. This reduces profits for greenhouse owners; given that these greenhouses are mostly small and without expensive equipment, they do not have operation and loan repayment problems. Also, since the harvested product includes food and medicinal plants, the COVID-19 pandemic outbreak has not affected their sales.

Group C: This group's water supply system is mainly from springs near greenhouse construction sites. Irrigation water is pumped through a pipe to the greenhouse complex and is treated in the greenhouse using a filtration system and used after adjusting the pH. Although the current water supply is sufficient to meet greenhouse irrigation needs, to save water consumption, part of the water used in these greenhouses is collected by the drainage system and then purified in water treatment units. Treated water returns to the irrigation system. The water returned to the system varies based on the hot and cold seasons. In hot seasons the amount of water returned to the system is about 30%, and in cold seasons this amount decreases. Therefore, this type of greenhouse has no problem with extraction from water supply. To grow vegetables, such as tomatoes, seedlings were previously purchased from other production units and then transferred to these greenhouses. In addition, to reduce costs, tomato seeds are now purchased, and seedlings are produced in production units adjacent to greenhouses. Tomatoes are harvested in clusters. These clusters are then transferred to the packing site and sorted at the same location. Other vegetables are harvested by workers by removing them from the cultivation bed. These vegetables are then transported to the packaging site and placed in special baskets. One of the problems is the lack of professional sorting for some vegetables, which reduces their marketability.

Unlike group A and B greenhouses, the business sector is responsible for planting and harvesting crops in group C greenhouses. Accordingly, aftermarket studies and customer needs determine the quantity and type of product. For this reason, there is no problem with the vegetable loss. Vegetables are produced only for export and not sold locally in Khorramabad. One of the problems with these greenhouses is providing high-quality cocopeat for seedling production. Because cultivation beds are imported to Iran from other countries, they are expensive and not always readily available. Cultivated

beds produced in Iran are not used in this type of greenhouse because they lack acceptable quality from the point of view of the experts of these greenhouses. Another problem is the lack of access to quality packaging cartons for the sale of products produced in these greenhouse units. Due to the fact that the products have been in transit for a long time, not using cartons of the desired quality will reduce the quality of the vegetables, and the packaging will not be marketable in terms of appearance. A large number of cartons are imported from Turkey. In addition to the high prices, the special regulations of the countries regarding the import of items during the COVID-19 pandemic affect the availability of the required cartons. Due to the strict regulations of the experts of this type of greenhouse for selecting cartons, the types of cartons produced in Iran do not have the appropriate quality for use in these greenhouses. Also, Iranian cartons are more expensive than Turkish cartons. Accroding to all observations during the study, the problems of the studied greenhouses are summarized in Figure (5).

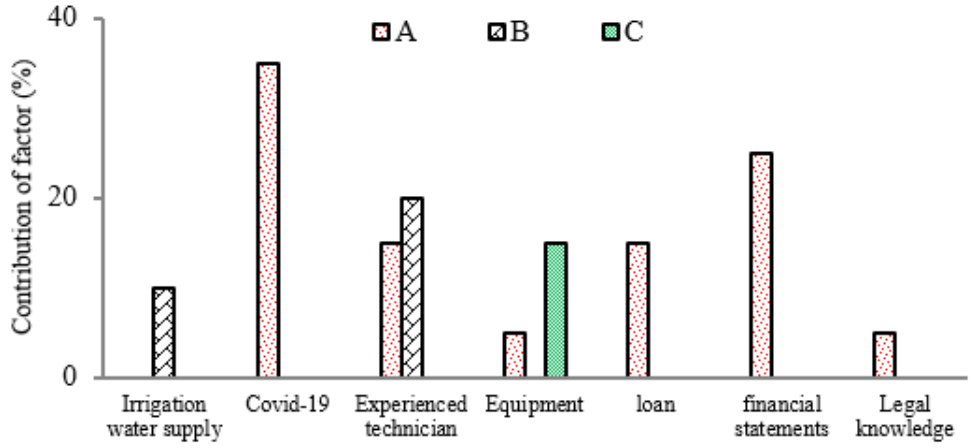

Figure 5. The contribution of various factors to the occurrence of greenhouse problems

Conclusion

In terms of water supply, none of the greenhouse groups involved has had any issues. This condition was due to the rainfall of previous years and the existence of sufficient water resources over the past three years. Although there is no water crisis in the current condition, it can not be guaranteed for years to come, based on a study reported by Moghadam et al. (2021). However, greenhouses of type A and C will have fewer problems due to the use of irrigation systems with optimal efficiency and optimal use of water. Type C had fewer problems in producing products and was better in terms of sales than types A and B. The reason is the existence of specialized units for production, trade and marketing. These cases were not observed in any type A and B greenhouses. This has caused many problems, especially in the sale of products produced by this type of greenhouse. Due to increased profits, greenhouses type A and B are very willing to export products, but due to problems such as lack of business administration and lack of pieces of equipment for storage and packaging, they are not able to do so. For example, to export Dutch roses by plane to Russia, it is necessary to harvest at least ten hectares of greenhouses. Considering that the area of each greenhouse unit in Khorramabad city is less than ten thousand hectares, exporting flowers by plane is not economical for greenhouse owners. Group A also had a forced adjustment due

to the damage suffered in the COVID-19 pandemic, which changed the rate of flower production.

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