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Climate Change and Its Impact on Vegetable Cultivation in Iraq (article review)

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Abstract: Various internal and external factors contribute to the difficulty of Iraq's cultivation of vegetables, with climate change being one of the most prominent factors. There exists a symbiotic relationship between climate and agriculture because the agro-ecological zone determines the possible crops and their cultivation. In this paper, we evaluate the consequences of climate change on vegetable farming in Iraq and develop several countermeasures to the impact. There are many adaptive measures that can and should be taken such as modern irrigation, protected agriculture measures, and remote sensing and other technologies. Such measures can increase productivity of vegetables and food aid in Iraq **(FAO, 2017)**.

Key words: Climate Change, Vegetable Cultivation, Food Security, Water Management, Protected Agriculture

Introduction

It is crucial to comprehend the vegetables' role in our lives in order to achieve food security. To achieve sustainable vegetable production, one needs to adopt agricultural practices that will mitigate climate change effects **(FAO, 2025)**. Vegetable production is impacted by climate change directly, specifically through temperature changes—increases and decreases—and drought, which hinders vegetable development. Hence, there need to be solutions in place to maintain food production **(World Meteorological Organization, 2024).** Embracing modern

agricultural practices and improving water management are among the key means of addressing climate change. Boosting crop management, in turn, is a key driver of vegetable production **(FAO, 2023).**

Climate Change and Its Impact on Vegetable Farming: How Can We Achieve Food Security?

It is important to understand the effects of climate change and how to achieve food security because climate change results in temperature and rainfall fluctuations, which influence plant growth and crop productivity. Agriculture plays significantly towards economic development and achieving food security **(IPCC, 2024)**. The major climate changes and their effects can be encapsulated by various factors, including changes in temperature and rainfall. It also increases plant and vegetable productivity. Conversely, less rain reduces the cultivation of vegetables and crop productivity in Iraq **(IPCC, 2024)**. Food security benefits the economy of Iraq a lot by delivering food to its citizens, thereby requiring a sound agriculture system. Iraq is one of the globe's biggest importers of food **(FAO, 2025)**. There is a direct relationship between climate and agricultural production on the farm **(Desert Agriculture Journal, 2024).**

The Relationship Between Climate and Agricultural Production in Iraq

Farmers in Iraq are, for the first time, facing unprecedented difficulties in agricultural production. Agriculture and climate are interlinked, with the climate affecting vegetable growth and yields. Climate change adversely affects agriculture in a variety of ways: First, with the rise in temperature, it alters the cropping cycle of vegetables, impacting not only the crop quality but also the productivity. Second, the amount of rainfall is altered, leading to alterations in water availability that can directly affect vegetable crop growth **(FAO, 2017).** Therefore, climate and agricultural production are interlinked, and climate change affects plant growth and crop yield. In order to attain food security, certain steps must be considered for increasing agricultural production, which are as follows: Firstly, application of adaptive agricultural practices, e.g., hydroponics and cultivation in protected environments, in order to reduce the negative effects of climate change. Secondly, application of climate-resistant varieties. Third, application of modern irrigation practices and regulation of water loss **(UNDP, 2019 and CGIAR, 2020).** One of the effective ways to mitigate the impacts of climate change on agricultural production is adaptive agricultural practices like hydroponics to reduce water consumption in agriculture **(National Oceanic and Atmospheric Administration, 2020)**.

Challenges of Vegetable Crop Cultivation in Iraq Due to Climate Change

The importance of climate change has been affected by the deterioration of the vegetable cultivation situation in Iraq due to extremely cold winters and extremely hot summers in most of the provinces of Iraq. Higher temperatures and arid weather harm plant growth, resulting in poor agricultural yields. However, when the temperature increase is beyond the threshold vegetative complex temperature plants have major problems with their main functions. Photosynthesis, which gives the plant energy, becomes ineffective and respiration rates are increased, which results in loss of energy. At the same time, plants are unable to take up water and nutrients, causing cells to suffer dehydration and growth to slow down. This all aids in

producing low quantity and poor quality of the crops particularly if the heat exposure is prolonged. As a result, some preventative action should be taken by the farmers to avoid the plants being affected, for example increase the irrigation or cover the crops with shade to keep the plants healthy **(Wahid et al., 2007)**. The dry climates lead to lowered water levels **(International Journal of Climate Change, 2024).**

When it comes to cold weather in Iraq, we see a direct effect on vegetables as they vary in their resistance to frost and cold weather. Chilly climate causes crops to grow slower, or simply causes seeds not to germinate at all, particularly in sensitive crops like pepper and tomatoes. Frost transforms the water in those tissues into ice, destroying the cells and tissues, and severely cold temperatures can burn roots and leaves or destroy the plant entirely. The severity of the impact depends on the crop, growth stage and duration of cold exposure. Farmers use these to treat such impacts, with greenhouse application, high-quality fertilizer, and organic mulch **(Hatfield and Prueger, 2015).**

Since farmers in Iraq will have to adapt to climate changes in order to achieve food security, Improved water management and other cultural practices are needed to increase productivity and lower costs, including adopting advanced irrigation techniques **(FAO, 2023).**

How Extreme Temperature Variability Affects Vegetables

The plants that are grown in temperature play a huge role in temperature variation too. This sort of temperature change causes an alteration in the planting seasons giving rise to a vary in plant development and productivity. April 2, 2023 Vegetables Growth in Iraq Temperature changes disrupt the growth of plants, which are an essential part of agriculture, and such climate changes cause farmers problems in growing vegetables, where there are differences in shape and size in the proportion of produce. Identifying the effect of these changes is required since the changing temperatures directly affects the growth of plants and leads to variability in growth rate. By these diferences they kill people and quality of the vegetables also. This means that it is essential to plan responsive steps to mitigate these impacts **(International Journal of Climate Change, 2024).**

Tech Methods of Dealing with Climate Change

They are technologies we require if we are to optimise food security. Some of them are: (1) application of efficient irrigation systems that do not waste so much water, i.e., drip irrigation systems, (2) application of sheltered cultivation systems as well as (3) application of technology in the process of planting crops, to check growth and gain the maximum farming yield. We can increase food security with these great technological solutions, and we must do it together. This would make agriculture sustainable in the future **(WMO, 2023).**

Third, protected agriculture is among the top strategies for protecting crops from the environment and increasing agricultural productivity **(International Water Management Institute, 2024).** Of these, intelligent greenhouses are among the most important solutions and one of its key technologies. They provide for a very controlled climate, which is just perfect for plants in that you can control temperature and the humidity. It also provides a healthier cultivation of vegetables and fruits **(FAO, 2023).**

Drip irrigation is a modern irrigation method that offers several advantages, making it a perfect irrigation method for farming regions with limited or reduced water supply. It saves water significantly and minimizes the water loss (wastage) for efficient utilization of the water resource. It enhances the growth of vegetable crops as water and nutrient directly supplied near the roots and reduce the incidence of weed as the water is directed only to the place where plant required, which also led to reduce the incidence of plant disease by reducing moisture on the leaves. It also resonates clearly in fertilizer efficiency, as it is applied with irrigation, resulting in lower losses of fertilizer. Finally, this system can be implemented under other many agricultural conditions **(International Journal of Climate Change Strategies and Management, 2023).**

Due to climate change and declining natural resources, it is essential to combat severe environmental conditions through breeding to sustain productivity and food security **(Araus and Cairns, 2014).** Therefore, these types are the best suited for farmers as they have developed for drought resistance, high and/or low temperature resistance as well as salt tolerance. They help sustainable agriculture and they have also been shown to lower water and fertilizer requirements **(Tester & Langridge, 2010).**

Desert and Extremely Cold Climate Sustainable Agriculture Practices

Iraqi Weather; It is cold, dry, and vegetable farming is subject to serious limitations. So, sustainable farming practices need to be implemented. Among these, one of the most significant ones is introduction of new irrigation methods, i.e., drip irrigation that minimize the water loss and maximizes the efficiency of water use. Plants cultivated in high technology greenhouses benefit from a protection environment that impedes the influence of ambient climatic parameters. All these existing technologies can help to enhance the 19 EL-Ayashi vegetable production in Iraq, which in turn they can help to sustainable increase the food security. Hydroponics is among the agricultural systems. Which can save the limited water resources available for such nations with low water resources, like most of the desert nations.

Hydroponic farming principal advantages in arid regions can be summarized as follows: (1) Water efficiency, up to 90% less water consumption compared to conventional farming systems **(FAO, 2017)**, (2) Crop productivity, up to 30% more yield than in traditional farming systems **(IWMI, 2020)**, (3) High quality of vegetables arising from increased control of temperature and humidity **(UNDP, 2019)**. These techniques enhance the vegetable output of farmers in Iraq; thus, food security is reached with this climatic effect.

The Role of Technology in Achieving Full Agricultural Yield

Realization of food security is made possible by practicing the improved farming by the use of technology. The prospect of drone farming, satellite farming has made possible to monitor the crop health and doing their proper water and fertilization needs of crops, which reduces wastage and increases the production. Moreover, some smart irrigation technologies, like sensor based drip irrigation, have enabled farmers to save up to 70% of water as compared to original methods.

In addition to this, genetic modification has also assisted in the growing of crops that are can resist drought, salinity, and pests and thus, be able to survive extreme climate conditions. However, robots (either autonomous and unmanned or supervised) and AI have enabled effective and timely execution of farm and harvesting tasks with less manual input while maintaining low operational costs **(Garnett and Godfray, 2014).**

Other innovations include smart fertilization and biotechnologies to enrich soils and facilitate better nutrient absorption, along with hydroponic farming and greenhouses that provide 30-50 per cent higher productivity regardless of weather. These technologies are now also enabling sustainable agriculture for a growing population to meet the future stable demand for food in our world **(Saudi Agricultural and Livestock Investment Company, 2024).**

Climate Change Implications on Water Management Strategies

The farmers have to be compatible with the climate of Iraq for the sake of food security. Of doing so, a combination of officials and farmers needs to come together to execute the best practices in water management. This includes the application of new irrigation methods like drip irrigation, maximizing water efficiency and constructing reservoirs to store water during dry spells. By working together to carry out these practices, we achieve food security.

Room for improvement also exists in the examples of broader nations — including among bitter rivals — as Iraq and others in the region struggle to generate success stories in climate and water management. Research and development of these farm technologies is also needed as they might enhance the productivity of crop and append sustainability in it also. For instance, in many countries, we can learn a lot from international experience in counteracting climate change, even the usage of improved irrigation technology, which actually makes irrigation efficient and reduces the water consumed **(International Water Management Institute, 2023).**

The climatic and environmental challenges facing the agricultural sector in Iraq are obtained through the cooperation of the neighboring countries of the same climatic condition and agriculture challenges. Hence it is advisable for scientist of these countries to carryout mutual scientific research to formulate sustainable plans to overcome the climate change consequences and to improve the water and soil resources management practices and to develop crop tolerance against adverse conditions. Not only do these region-centric research collaboratives contribute to the maintenance of food security, they can also play a key role in the progression of knowledge and novel technology that can improve the manner with which designs of sustainable and restored methods for economic development as well as ecosystem management are tailored to the particulars of regional societies **(Godfray and Garnett, 2014).**

Climate change context: The future of agriculture

Exciting advances are on the way; however, we have to be thinking ahead in respect of securing innovation to actually achieve food security. Food security comes under pressure, because climate change affects agricultural production. Thus, we require sustainable solutions to reduce these forces. Come future sediments show that a strides in climate changes. And on the other, we need to scale up agricultural production to adapt to these changes.

Practical Guidance for Farmers

In the context of climate change both in Iraq and across the world, farmers need to adopt these practices which will lead to sustainability of their crops. They could employ elaborate irrigation systems and climate control strategies that save water. Climate change has a great effect on the local cultivation of vegetables in Iraq and farmers should adapt accordingly. They can utilize technological interventions and best practices for agriculture. A more actionable recommendation is the incorporation of linkages between university faculties, of farmers, of farming and agricultural production within the ministryTop of Form.

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التغيرات المناخية وتأثيرها على زراعة الخضراوات في العراق (مقاله مرجعية)

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الخلاصة

تُعدّ زراعة الخضروات في العراق نشاطًا زراعيًا يواجه جملةً من التحديات الناتجة عن تفاعل عوامل داخلية وخارجية متعددة، ويأتي التغير المناخي في مقدّمة هذه العوامل لما له من تأثيرات مباشرة وغير مباشرة في النظم الزراعية. وتُظهر العلاقة بين المناخ والزراعة طابعًا تكامليًا واضحًا، إذ تتحكم الخصائص الزراعية–البيئية في تحديد أنواع المحاصيل القابلة للزراعة وأنماط إدارتها وإنتاجها. يهدف هذا البحث إلى استعراض وتقييم انعكاسات التغير المناخي على إنتاج الخضروات في العراق، مع طرح مجموعة من الإجراءات والتدابير التكيفية الكفيلة بالحد من آثاره السلبية. وتشمل هذه التدابير اعتماد تقانات الري الحديثة، وتوسيع تطبيق أنظمة الزراعة المحمية، وتوظيف تقنيات الاستشعار عن بُعد وغيرها من التقانات الزراعية المتقدمة. ومن المتوقع أن تسهم هذه الإجراءات في تحسين كفاءة الإنتاج الزراعي لمحاصيل الخضروات ودعم تحقيق الأمن الغذائي في العراق (FAO، ٢٠١٧).

الكلمات المفتاحية: التغير المناخي، زراعة الخضروات، الأمن الغذائي، إدارة الموارد المائية، الزراعة المحمية