Articulo de investigacion

Farmers' Training on Water Management in Order to Manage Droughts and Water Crisis in Iran

Capacitación de los agricultores sobre la gestión del agua para gestionar las sequías y la crisis del agua en Irán

Treinamento dos Agricultores na Gestão da Água para Gerenciar Secas e Crise da Água no Irã

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Abstract

Iran faces a serious water crisis, despite the fact that there are different advanced water management systems in our country. The instability of farmland is increasing rapidly in subtropical dry zone. In the last 50 years, the water crisis has entered a new phase in Iran, due to the advent of technology and the possibility of digging deep wells, dams and consequently, unconventional consumption of underground aquifers, aqueducts, and underground reserves. Iran's cultivated land is estimated at about 16 million hectares of which about half is irrigated and the other half is cultivated as rain-fed. Water management is one of the essential requirements in the recent years due to the shortage of rainfall along with its inappropriate distribution and the occurrence of multiple droughts. Sprinkler and Drip irrigation systems are common methods to save water which also minimize the loss of water via evaporation. Agricultural education plays a significant role in improving water management in the farm and also is essential to train farmers to make them aware of the importance of water. The water crisis may lead to irreparable disasters in the future if we cannot train the people especially the farmers. The aim of this paper is to investigate the strategies of water management by training the farmers in Iran.

Keywords: Iran Agriculture; Water Tension; Farmers Training; Drought Management; Irrigation in Iran

Resumen

Para investigar el requerimiento de agua de las plantas, especialmente en áreas áridas y desérticas y la pobreza de la mayoría de los suelos en estas áreas, llevamos a cabo un experimento para estudiar el efecto del polímero hidrofílico de absorbancia en Panicum antidotale Retz. Con su efecto sobre la lixiviación con nitrógeno en tres tipos de suelos ligeros, medios y pesados en intervalos de riego de 4, 8 y 12 días. La comparación de los resultados con el tratamiento de control mostró que la aplicación de polímero que se llevó a cabo al 0,3% tiene el mayor efecto sobre el crecimiento y la producción de materia seca de Panicum antidotale Retz. El efecto simple de los tratamientos con polímeros, el intervalo de riego y la textura del suelo en seco La producción de materia, la altura de la planta y la lixiviación de nitrógeno del suelo fueron importantes en este estudio. Además, los efectos de interacción del riego x la textura del suelo en la producción de materia seca y la lixiviación con nitrógeno mostraron una diferencia significativa. De modo que la mayor cantidad de materia seca de la planta con 7,2 g se obtuvo a partir de un tratamiento medio con polímero en un intervalo de riego de 4 días. En el tratamiento de control sin el polímero, las plantas se destruyeron antes de la cosecha en el intervalo de riego de 12 días. El efecto de los tratamientos en la altura de Panicum indicó que la adición de polímero al suelo aumentaría la altura del Panicum además de aumentar la producción de materia seca. Además, el efecto del polímero simple en el drenaje de agua de riego indicó que la tasa de lixiviación de nitrógeno de la media de 880 mg N

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/ l de en el control disminuye a aproximadamente 550 mg N / l por el polímero. Por lo tanto, se puede concluir que la aplicación de polímeros no solo influye en la humedad del suelo, sino que también afecta el fortalecimiento del suelo y la disminución de la lixiviación de nitrógeno, especialmente en suelos pobres del desierto.

Palabras claves: polímero hidrófilo; Intervalo de riego; Textura de la tierra; Lixiviación De Nitrógeno, Panicum

Resumo

A fim de investigar a necessidade de água das plantas, especialmente em áreas áridas e desérticas e a pobreza da maioria dos solos nessas áreas, conduzimos um experimento em vasos para estudar o efeito do polímero hidrofílico absorvente em Panicum antidotale Retz. com seu efeito na lixiviação de nitrogênio em três tipos de solos leves, médios e pesados em intervalos de irrigação de 4, 8 e 12 dias. A comparação dos resultados com o tratamento controle mostrou que a aplicação de polímero a 0,3% apresentou o maior efeito no crescimento e na produção de matéria seca de Panicum antidotale Retz. O efeito simples dos tratamentos com polímeros, o intervalo de irrigação e a textura do solo na seca A produção de matéria seca, a altura das plantas e a lixiviação de nitrogênio do solo foram significativas neste estudo. Além disso, os efeitos de interação da irrigação × textura do solo na produção de matéria seca e lixiviação de nitrogênio mostraram uma diferença significativa. De modo que a maior quantidade de matéria seca da planta com 7,2 g foi obtida a partir do tratamento médio com polímero no intervalo de irrigação de 4 dias. No tratamento controle sem o polímero, as plantas foram destruídas antes da colheita no intervalo de irrigação de 12 dias. O efeito dos tratamentos na altura de Panicum indicou que a adição de polímero ao solo aumentaria a altura do Panicum além de aumentar a produção de matéria seca. Além disso, o efeito do polímero simples na drenagem da água de irrigação indicou que a taxa de lixiviação de nitrogênio da média de 880 mg N / l no controle diminui para cerca de 550 mg N / l pelo polímero. Portanto, pode-se concluir que a aplicação de polímero não apenas influencia a umidade do solo, mas também afeta o fortalecimento do solo e diminui a lixiviação de nitrogênio, especialmente em solos pobres do deserto.

Palavras-chave: Polímero hidrofílico; Intervalo de irrigação; Textura do solo; Lixiviação de nitrogênio, Panicum

Introduction

Agriculture is affected by four natural factors, including water, soil, air and genetic resources, as well as four human factors such as capital, technology, market and human resources.In the present situation in Iran, all four natural factors have a bleak situation, and water crisis has become a climatic reality in Iran, and given the increasing need for water in different parts of country, the water crisis will become more acute in the coming years. Land salinization, soil organic matter reduction, and erosion soil resources are three important indicators for reducing the quality and quantity of good soils. The instability of farmland is increasing rapidly in Iran. Due to the uncontrollable nature of the factors called natural factors, what could improve this fragile situation is the development of human factors. The entry of capital into the agricultural sector, the emergence of new technologies, market attention, and the training and use of expert forces will lead to a desirable and effective strategy of knowledge-based agriculture that will control and manage many climate-related disasters and tensions.

With direct access to water resources throughout history, human civilization is constantly evolving. With its qualitative and quantitative effects, water plays an important role in economic and social development. Unlike other sources, water is not interchangeable. Water and consumption have become important due to the growth of societies. This may even be greater in countries where rainfall is limited. Consumption of water per capita depends on the culture, type of activity and climatic conditions that vary in different regions. These differences are such that variations in per capita water consumption can range from 3.0 to 700 liters per day. Iran is located in southwestern Asia, with an annual rainfall of 250 mm. The water crisis in Iran has been raised as a serious problem because its weather is dry and semi-arid. The lack of proper water management and drought are the main reasons for the water crisis in Iran. (Motiee, H., et al., 2001).

About 82% of Iran's area takes place in the arid and semi-arid zone of the world called subtropical dry zone. Iran is one of the Southeast Asian countries (Middle East) which is neighbor with the Caspian Sea in North, and Persian Gulf, and Gulf of Omanin South. The proximity to the Caspian Sea has caused the coastal provinces of the country, such as Gilan, Mazandaran and Golestan, which are enclosed between the Alborz Mountains on the one hand and the sea on the other, to be completely subjected to the influence of the wet winds of this sea. High levels of humidity, especially rainfall during the summer season, have contributed to the growth of vegetation and the creation of forest areas.Iran is a vast geographically diverse country with a very diverse and varied climate.Access to the Persian Gulf and the Oman Sea is very important and significant in terms of connecting it to all countries of the world through free waters (Nazari, M et al., 2016).However, due to the high temperature and humidity, the weather creates a warm and humid environment during the summer.This high land is separated from the west and southwest by a parallel high mountain range from the dry and wet areas of Iraq.In the north and northeast, they are separated by a series of higher mountains, from the Caucasus, the Caspian Sea basin, and Turkmenistan's dry and inert grasslands.Therefore, water crisis is not an unknown phenomenon in Iran.In the fourth inscription Darius, the Achaemenid kings in 522 BC, this is written: “May God Save this Country from Enemies, Famine and Lies”. During these three thousand years, Iranians have always managed this challenge with three key strategies of qanats, nomadic life, and low water consumption patterns. But in the last 50 years, the water crisis has entered a new phase in Iran, due to the advent of technology and the possibility of digging deep wells, dams and consequently, unconventional consumption of underground aquifers, aqueducts, and underground reserves (Mahmoudzadeh, H. et al., 2016).

The construction and operation of hydraulic structures such as dams, channels, and transmission channels for reservoirs, transmission and distribution systems have been experienced by the Iranian people since 3000 years ago. Five decades ago, before 1970, due to the low population density, the nature of agriculture and the low urban population, water supply was not considered a critical problem in the country. Over the past three decades, large dams have been built around large cities such as Tehran, Isfahan, Ahvaz, etc. to provide water for urban, industrial and agricultural consumption. Because surface water is not available, groundwater is also used as water for water supply. By 1990, water supply was not an issue and there was a reasonable relationship between supply and demand. Manouchhri, (2000) suggested four mainly reasons for water crisis in Iran including a rapid population growth that is unusual to environmental capacity, development of different sectors of urbanization, agricultureand industry, reducing the number of suitable structures for storing, distributing and transferring water, and drought occurrence all over the world (e.g. Iran) since 1995. In large cities in Iran, the size of the population is challenging, which is compatible neither with environmental potentials nor with economic growth. Iran's population is projected to reach around 100 million by 2020, and the number of metropolitan areas varies from 600 to 1,000. Finding logical solutions for the treatment of other industrial effluents is another environmental issue that is on the agenda of the Water and Wastewater Group. Lack of financial resources may cause a long delay in exploiting water management projects. This is clearly seen in the construction project of the Karkheh dam, which is expected to be ready for operation for two to three years, but it may take a long time. Today, water scarcity and drought are two main issues. Many rivers such as Zayandehrud and Hirmand have dried up as well as some marshes and wetlands in recent years.

Food security in Iran is dependent on agricultural products. The main challenges in this area include water storage, increased water productivity, and production of more products with less water. Changes in the rate and frequency of drought have a major impact on water management, agriculture and aquatic ecosystems. With the predicted temperature rise, scientists generally agree that the global hydrological cycle is intensifying, indicating that extremism has become or has become more prevalent now (Joetzjer, E. et al., 2013). Rijsberman (2006) suggested that "water is a complex source". Unlike static sources, water appears in a very dynamic cycle of rain, runoff and evaporation, with a lot of changes in quality that determines its value to people and ecosystems. This water can be disturbing (in flood) as well as a source of salvation (in drought), but it's interesting that both conditions can occur in one place in one year. The lack of physical water is when water is not enough to meet all demands including the need for efficient water ecosystems

DROUGHT AND WATER SCARCITY ISSUES

Drought is a dangerous natural hazard which can take long for one or more season and it is a natural part of the climate of almost all areas. This should not be considered as a physical phenomenon. Depends on its impact on local people and on the environment, the drought itself is not a disaster. Both natural and social dimensions are necessary to properly understand the drought. Drought is the result of the interaction between a natural occurrence and the demand for water supply by human systems. The effects of drought are diverse and depend on the vulnerability of the population. Vulnerability, in turn, is determined by a combination of social, economic, cultural and political factors at both micro and macro levels. Social vulnerability appears to increase and drastically increase in many parts of the world. Understanding vulnerability is the first important step in drought management, risk reduction and disaster preparedness. Farmers and human factors play a major role in counteracting the drought phenomenon. One of the most important factors that can be useful in dealing with drought is education of farmers.

Human societies are compatible with the economic system and water resources are one of the most important elements of the economy in many ways. However, water resources in many parts of the world are affected by natural hazards, especially those that are damaged as climate dangers, including droughts and floods, but not limited to it (Pereira et al., 2009). In recent years, a large number of severe droughts have occurred in different parts of the world causing agricultural and economic losses (Orlowsky and Seneviratne, 2012). Water shortages include water stress, water scarcity and water crisis and the concept of water stress is relatively new. Water stress is difficult to find in fresh water sources for use due to the evacuation of resources. Water crisis is a situation in which drinkable and non-polluted water in a region is less than its demand. Today, 1.9 billion people live in countries or regions with absolute water shortages, which two thirds of the world's population will be under tension. The World Bank adds that climate change can change the patterns of water availability and use, and water stress and insecurity, both depend on water.

Water scarcity is divided into two parts: "physical" and "economic". Sometimes it seems that water is abundant, but somewhere too much water is consumed, such as when the hydraulic infrastructure for irrigation is over developed. Symptoms of physical water scarcity include environmental degradation and groundwater abatement. Water stress is harmful to living organisms because every creature needs water to live. Lack of water is occurred due to lack of investment in water or human inability to meet its demand. The symptoms of water scarcity are lack of infrastructure, with people who often need to bring water from the river for household and agricultural use. Large parts of Africa suffer from a shortage of water; increasing water infrastructure in these areas can help reduce poverty. This condition is critical especially in countries where they are poor and weak in terms of political development which often occur in a dry ambient. In other countries, such as india, people also suffer from water scarcity. In India water scarcity is a big problem. People go to the well to bring water to their daily needs. Particularly poor people in the villages and small towns live hard without water. They provide water from 40 to 50 kilometers away from their village. The total amount of freshwater resources has also declined due to climate change that has led to natural glaciers retreating, falling river flows and shrinkage of lakes. Many groundwater aquifers that are over-pumped are not filled quickly. Although not all freshwater sources have been used, many are contaminated, salty, inappropriate or inaccessible for drinking, industrial and agricultural purposes. To prevent a global water crisis, farmers must work to increase productivity to meet growing food demand, while industries and cities are looking for ways to better use water.

WATER CRISES AND DROUGHT IN IRAN

The most important factors affecting Iran's climate are the drying of lakes and rivers, the reduction of groundwater resources, land degradation, water pollution, water supply and interruption regulations, forced migration, agricultural mortality, salt and sand storms, and environmental damages. Centuries before the Romans made their aqueducts and waterfalls, Iranians built Qanat, one of the oldest water settings, surveillance and market systems in history. However, in modern times, rapid economic and social development has created a major water crisis for the country. The ancient Iranians have shown their intention to survive and progress by establishing new methods for regulating, abandoning, transferring, directing and distributing water in a dry area of the world, which is a seasonal availability of water (Ahmadi et al. 2010;). Drought affects many aspects of the environment and society, and any future increase in water demand during severe drought periods will be critical. Changes in the rate and frequency of drought have a major impact on water management, agriculture and aquatic ecosystems. With the predicted temperature rise, scientists generally agree that the global hydrological cycle is intensifying, indicating that droughts and floods are becoming more prevalent (Valipour et al., 2015). Drought can be considered as a natural and frequent climatic phenomenon. This is a relative term that is applicable in any climatic zone. Droughts are usually defined as rainfall or flow defects in comparison with the medium or in terms of the water balance index.

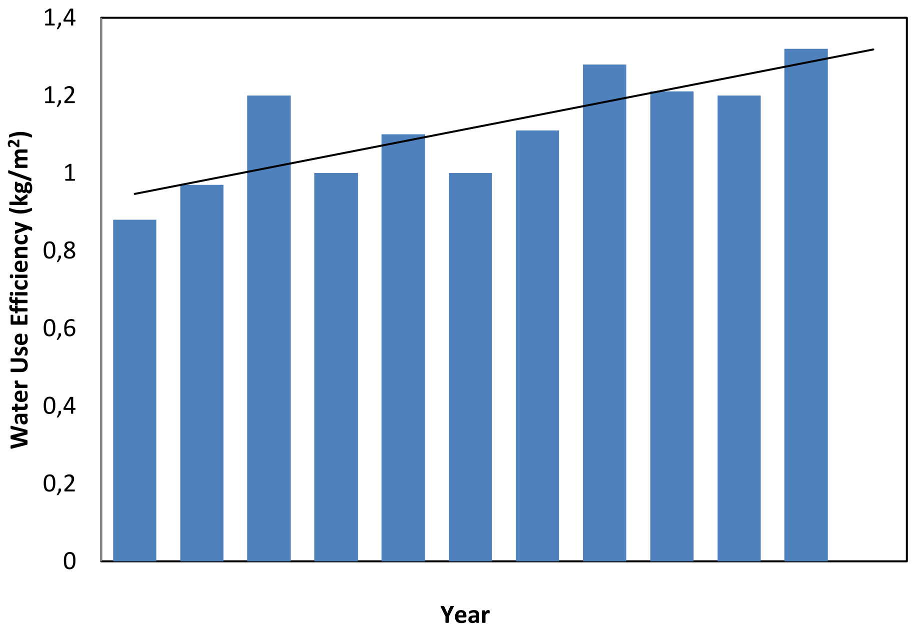

Figure 1 Changes in water use efficiency in Iran from 2007 to 2017

According to Figure 1, water consumption efficiency varies from 0.87 to 1.32 kg / m3 in the last 11 years and its average was 1.9 kg per cubic meter. This means that water use efficiency has risen by 0.41 kg per cubic meter per year in recent years. The country's water productivity index has risen in recent years, which means the effectiveness of the activities carried out in the country. Overall, the country's activities on "increasing production" and "reducing the amount of water consumed" have been the main reasons for the increase in water productivity in the country. Although the water productivity index is a very important criterion in deciding and determining the benefits of cultivation, but sometimes the constraints governing agricultural structure, such as water quality, environmental aspects, production and market risks, processing, and even socio-political issues, make management decisions tailored to the circumstances.

The water productivity index is not affected by the irrigation program alone, and there are many important factors such as quality and quantity of water, water source, irrigation system, irrigation, packaging and cropping pattern, Plant water requirement, Irrigation program, Stopping and drainage level fluctuations, Crop management, Climate and climate parameters, Extraction and collection of rainwater, nutrition, pests and diseases, weeds, economy and market, processing. The water use efficiency index for promoting water use efficiency should be considered in a simple yet meaningful relationship.

$$WP = \frac{(Production)(Net\ income)(Energy)(Protein)}{WU}$$

Where, WP is Water Productivity Index; and WU is Water Use (Mm / m3). (Mahsafar, H., et al., 2017). Also, measures to reduce waste such as adjusting appliances, correcting harvest time, proper packaging, setting up processing units and creating a production chain to consume can indirectly improve productivity.

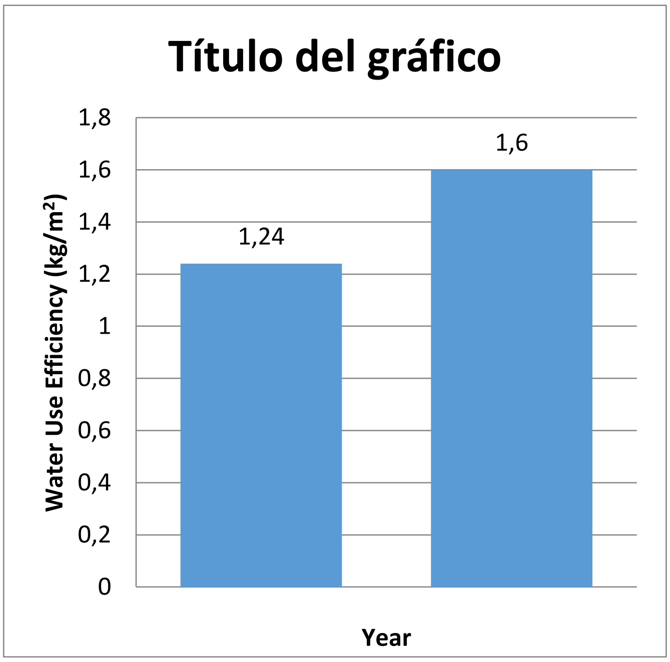

Figure 2 Comparison of the present water use efficiency in Iran and the targeted amount in the 20 years vision plan

WATER MANAGEMENT TRAINING FOR FARMERS

The aim of Farmers' training on water management in Order to manage mroughts and Water Crisis in Iran is to meet the nutritional and textile needs of the community at the present time, considering the ability of future generations to meet their needs. A healthy environment, economic profitability and social and economic rights are the main objectives for educating farmers. Any person involved in the food system, food processors, distributors, retailers, consumers and waste managers can play a role in ensuring a sustainable agricultural system. There are a variety of methods that are commonly used by people who work in agriculture and sustainable food systems. In this regard, farmers can use methods to promote soil health, minimizing water consumption and low levels of contamination in the field. Farmers' training is more than a collection of practices.

Since the early 50's, agriculture has gradually faced a wide range of changes. According to global forecasts, in 2022, per capita water will reach less than 1,400 cubic meters per person per year; and this means the water crisis. According to official statistics, Iranian experts believed that the water crisis was on the verge of collapse and in the coming years, water supply will become one of the biggest challenges in many provinces, cities and regions of Iran. Iran is geographically located in the semi-arid and dry parts of the world, with an average rainfall of about 250 mm, while the global average is about 850 mm, which is more than twice as much as rainfall in Iran. The reasons for the water crisis in Iran are as follows: Rapid population growth and inappropriate dispersion, inefficient agriculture, Mismanagement and excessive thirst for development, inappropriate water governance structure, multiplicity of stakeholders, uncoordinated management, environmental weakness of the organization, and lack of long-term vision. Water management is one of the essential requirements in the recent years due to the shortage of and the lack of appropriate distribution of rainfall and the occurrence of multiple droughts. The Sprinkler Irrigation and the Drip Irrigation are common methods to save water which minimize the evaporation. Agricultural education plays a significant role in improving water management in the farm and it is essential to train farmers and make them aware of the importance of water. The water crisis may lead to irreparable disasters in the future if we cannot train the people especially the farmers. The aim of this paper is investigating the strategies of water management by training the farmers in Iran.

Changing the cultivating pattern is a very important debate that should take more attention.80 percent of Iran's water is consumed in agriculture, while 70 percent of the water consumed in agriculture is wasted. In today's world it is no longer advisable for farmers to plant low value added products. Farmers must always consider two criteria: more value added products and products with less water consumption. The limitations of water resources have been in all ages, one should look for a scientific solution to this great challenge. One of the ways to overcome this challenge is to utilize water resources by changing the pattern of cultivation because water in a natural ecosystem turns from one form to another and does not go out of circulation. Productivity means the least amount of water used to produce a product that is both quantitative and qualitative in terms of economy, which is achieved by realizing a change in the pattern of cultivation. Of course, agriculture certainly needs the cultivation pattern, but it should not harm the life and income of the farmers. Also, greenhouse culture is a solution to increase production and reduce water consumption. Production in greenhouse environments can increase by 20 times, and water consumption drops sharply. In greenhouse cultivation, water consumption decreases dramatically. Despite the great benefits of greenhouse cultivation, farmers are not much concerned about the need for high investment in this type of cultivation. Utilize existing resources without increasing cultivation is another issue that should be taught to farmers. The use of new irrigation systems is another issue that should be addressed. Also, storing floods, preventing the flow of sewage and feeding the aquifers, looking at green water and storing it, and reducing the consumption of unconventional water for the industry is another way of saving water. Implementing the irrigation system requires training. First, it is necessary to teach farmers how to use this method so that they can use water optimally, and their products will be also appropriate in terms of quantity and quality. The second important point in this way is the localization of this system; it must be implemented in accordance with the climate conditions and the climate of each system.

Conclusion

In this paper, the strategies of water management by training the farmers in Iran were investigated. Water management is one of the essential requirements in Iran in the recent years due to the shortage of rainfall along with its inappropriate distribution and the occurrence of multiple droughts. Sprinkler and Drip irrigation systems are common methods to save water which also minimize the loss of water via evaporation. Agricultural education plays a significant role in improving water management in the farm and also is essential to train farmers to make them aware of the importance of water. The water crisis may lead to irreparable disasters in the future if we cannot train the people especially the farmers.

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