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WATER AND IRRIGATION SYSTEMS MANAGEMENT AT KINGDOM OF SAUDI ARABIA, A REVIEW

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Abstract

The development of irrigation in the Kingdom of Saudi Arabia was a result of government policies to boost agricultural production in the 1970s. Well drilling permits were granted to farmers and private sector companies in the areas where excavations carried out by the public sector revealed that there are 50 water in the groundwater. These permits allowed farmers to drill wells with interest-free loans and with a subsidy of one hundredth of the cost of pumping stations. Moreover, farmers could obtain interest-free loans to equip their farms with modern irrigation systems, such as central pivot irrigation, as well as other purposes. About two thirds of the irrigated area are now equipped with modern irrigation systems, In an effort to popularize modern irrigation techniques, the Ministry of Agriculture now provides subsidized tree seedlings, but this is only done for farms already equipped with these systems. Indeed, subsidized seedlings were introduced nearly twenty years ago to enhance the production of fruit crops such as citrus trees in Najran, tropical species in Jizan, and date palm in many areas and other species in other places (olive trees, etc.). In fact, this encourages farmers to switch from growing wheat to planting fruit trees as a result of a government policy to reduce the area planted with wheat by reducing the quantities purchased from farmers.

Keywords: Water Management, Drip, Sprinkler, Modern Irrigation systems, Kingdom of Saudi Arabia

Introduction

Heavy rain sometimes leads to sudden floods for short periods. The river beds remain dry the rest of the time. Part of the runoff of surface water is carried out through sedimentary layers in the valleys, and groundwater regeneration, while some are lost through evaporation. The large amount of water flow occurs in the western region, accounting for 60% of the total water flows, although it covers only 10% of the total area of the country. The remaining 40% of the total water flow occurs in the far south of the West Coast (Tahama), which does not cover 2% of the total area of the Kingdom. Surface renewable water resources are estimated at 2.2 km3 annually, most of which leaks to replenish the water bearing layer. Estimated total renewable groundwater resources by 2.2 km3 and overlapping by 2 km3, bringing the total renewable internal resources to 2.4 km3 annually. Total reserves of groundwater (including fossil groundwater) were estimated at 500 km3, of which 340 km3 can be extracted, most likely at acceptable costs, given the economic conditions of the country. The Kingdom of Saudi Arabia is the largest producer of desalinated water from sea water. There were 30 seawater desalination facilities in 2004, with 24 facilities on the West Coast and 6 on the East Coast. In 2006, 1.03 km3 was produced, by desalinating sea water and the water produced is used for domestic purposes. The produced quantities cover about 48% of household uses, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

The Kingdom of Saudi Arabia, with a total area of 2.15 million square kilometers, is the largest country on The launch is in the Arabian Peninsula, bordered to the north by Jordan, Iraq and Kuwait, and to the east by the Gulf Where the coast line extends about 480 km and is bordered to the southeast and south by Qatar and the Emirates United Arab Emirates, Oman and Yemen, and to the west the Red Sea, with a coastline of 1750 km. The kingdom can be divided into four main natural geographical units:
The western mountains, called the Arabian Peninsula Shield, have a peak of 2,000 meters above it
Sea level and crossed by deep valleys; Central hills, which extend near the western mountains and are located in the center of the country. Their elevations range from 900 to 1,800 meters above sea level;
The desert areas, which are located to the east of the central hills, where the heights range »»

Between 200 and 900 meters. Sand dunes are usually found in these deserts,(FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Coastal areas, which includes the coastal strip along the Red Sea with a width of »

Between 16 and 65 kilometers. The important part of these areas are the Tihama plain to the south. It overlooks The plain on the eastern side of the bay is a wide plain that includes the oases region;
The arable area was estimated at 52.7 million hectares, which is close to about 25 percent of the total area of the country. In

2005, the cultivated area was 1 million, 213 thousand and 586 hectares consisting of annual crops around 1011 923. Hectares and perennial crops about 201 663 ha as shown in Table 1. The area planted with annual crops decreased by 33 percent, while the area planted with perennial crops increased by 111 percent, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Prospects for water management for agriculture in the Kingdom of Saudi Arabia, (FAO, 2008):

Irrigated agriculture has reached a stage where it needs reform that focuses on productivity and the sustainability of investments in the public sector and private farmers, as well as in the rational use of limited water resources. Irrigated agriculture depletes many water-bearing layers and jeopardizes the sustainability of the investments used. Water productivity is still relatively low despite the application of modern irrigation techniques. The Ministry of Agriculture is developing a new strategy for agriculture that is geared towards increasing the macroeconomic development of the sector, while achieving sustainability of core resources and increasing their productivity.

A "Future Plan for Agriculture" (draft November project (2004)) was drawn up in studies conducted by the PARCI Institute (King Saud University). With regard to land and water resources, the plan by the Institute (2007) calls for the following (FAO, 2008),

»Reducing the demand for water through a policy to diversify agricultural production, which takes into account the comparative advantages of each region in the Kingdom; »Halting the expansion of water-consuming crops such as dates and fodder;

»Focusing on value-added crops;» Stopping the distribution of agricultural lands except in areas that have sufficient renewable water resources;

»Promote irrigation water management and the use of modern irrigation methods, and stop any support for drilling wells or extracting water;

»Estimating water crop needs;

Encouraging farmers to take advantage of tools that help advance irrigation water management, such as soil sensors, to improve schedules for irrigation water supply;

»Make a decision to regularize the conditions for the open use of drilling wells, whether through the use of adequate pumping systems or the closure of these wells and other drilling;

Controlling water consumption by using meters to measure the amount of water flowing from wells;

»Water pricing for all water used that exceeds crop water needs, from agricultural companies and specialized farms;

»Intensifying agricultural extension to increase farmers' awareness of the need to conserve the water resource and to encourage a new vital role for agricultural associations and cooperatives in this field;

»Establishing conditions for the issuance of permits for agricultural projects in order to use irrigation techniques to conserve water, as well as assessing the characteristics of each region and its water potential;» expanding the use of treated wastewater in agriculture and the industrial sector;

»Directing and supporting research aimed at producing crop varieties resistant to drought, salinity and acidic soils The next step for the Ministry of Agriculture is to develop an irrigation strategy that includes all of its procedures and activities to achieve the goals included in the agriculture plan by 2020.

The Kingdom of Saudi Arabia is located in the tropical and subtropical desert region. The winds reaching the kingdom are generally dry, and almost all the land is dry. Because of this drought, and hence the relatively cloudless sky, extreme extremes of temperature prevail, except there Also, there are wide variations between seasons and regions. In the central region, with hot and dry weather prevails in summer (May-October), with temperatures reaching over 50 degrees, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Celsius, while dry and cold weather prevails during the winter when the night temperature approaches zero. Saudi Arabia 383 Severe frosts can occur in general and even weeks of snow on the mountains. The western and eastern regions are characterized by hot and humid weather during the summer months, where the maximum temperature reaches a degree Celsius while the winter is warm. The prevailing wind comes from the north, and when it blows over 42 coastal areas, it becomes possible in summer and even refreshing in winter. North winds result in sand and dust storms, which can reduce visibility to a few meters in some areas. 200 mm. This level decreases, 100 and in the north, the annual rainfall ranges between 100 mm. However, the parts when heading towards the south, with the exception of near the coast, to less than the elevated parts of the western and southern regions are exposed to heavy rains, and it is common to reach at 500 mm annually. He estimated the average annual rainfall for a long time at about some small areas to 114 mm / year for the whole kingdom. Annually, it is equivalent to 3,245.5 km, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

The total population of the Kingdom is 24.6 million (2005). The rural population constituted 11.5 percent of them (Table 1). In 2005 it was estimated that about 76 percent were Saudi nationals, and during the period 2000-2005 the rate of population increase in the Kingdom of Saudi Arabia was. 2.7 percent In 2006, 97 percent of the urban population had access to improved water sources, and in 2006 all urban residents had access to improved sanitation facilities, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Geography, climate and population of the Kingdom of Saudi Arabia (KSA) as showing in Fig. (1) .

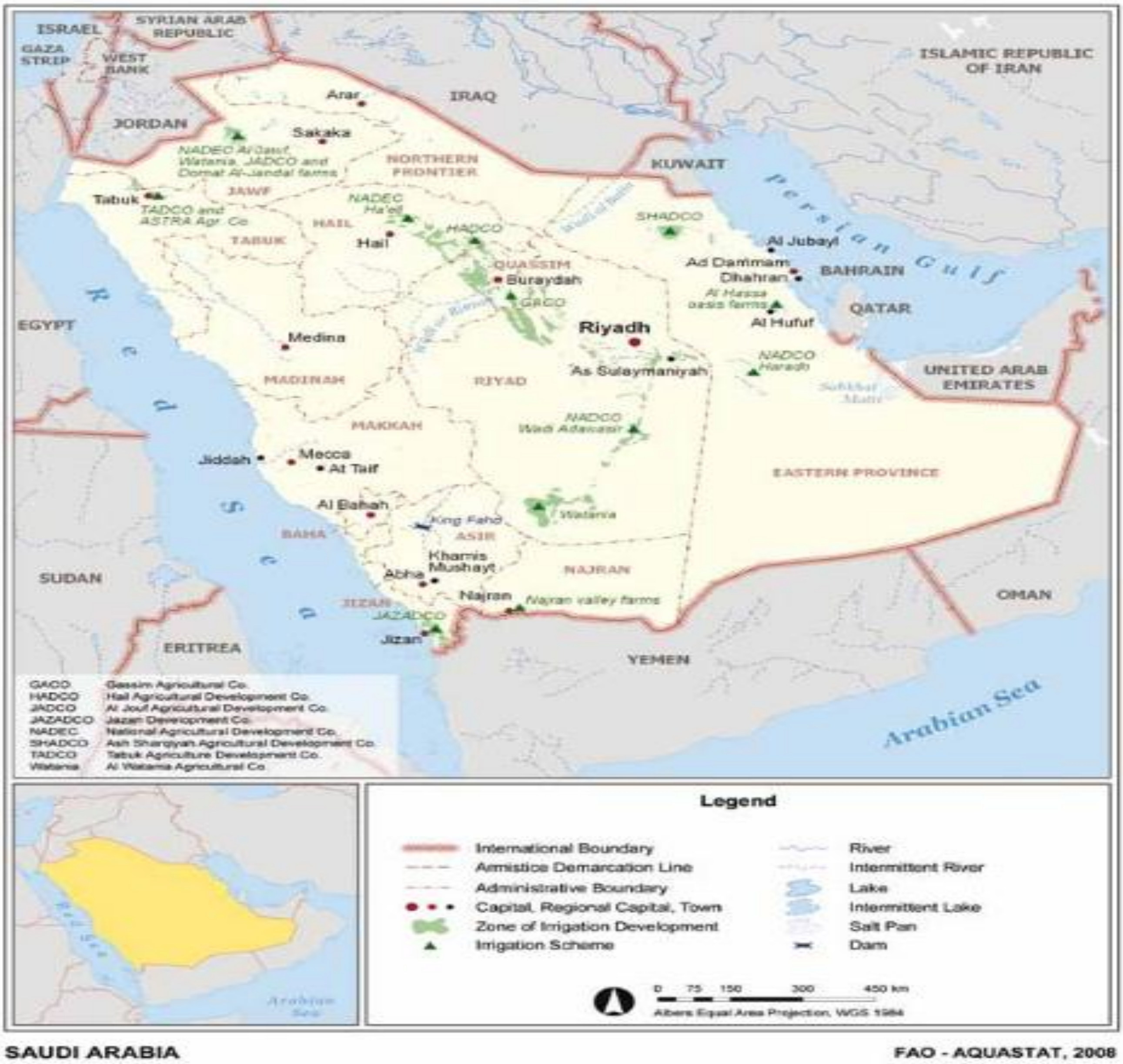

Fig. 1: Geography, climate and population of Kingdom of Saudi Arabia (KSA) as showing in .

Legislative and institutional framework for water management:

Water management is generally based on 14 of the 18 countries in the Middle East region that are available Information about her to a water blog, a specific water law, or several water laws. Armenia signed Azerbaijan is a water blog in 2002 and 1997, respectively. Specific water laws were in place In Georgia (1997), the Islamic Republic of Iran (1982), Palastin lands (1959), and Lebanon (2000), The Occupied Palestinian Territories (1996) and Yemen (2002). Six other countries (Iraq and Jordan) organize Oman, Qatar, Saudi Arabia and the Syrian Arab Republic (certain aspects of administration. Water, such as pollution, potholes, irrigation, or water rights, but these specific arrangements do not Collected by a water blog. Iraq enacted an irrigation law in 1995. In Jordan, laws and regulations are imposed To enable the authorities and other bodies to perform their water duties. And issued in Oman several Decrees related to water and irrigation, and in Qatar a decree was issued to regulate the drilling of wells and the use of groundwater. In the Kingdom of Saudi Arabia, various water laws are being revised and reformulated, though Among the gray areas where responsibilities for irrigation are still overlapping and the monitoring and implementation of reuse Using water for irrigation. More than 140 water laws have been passed in the Syrian Arab Republic since 1924. No information is available on Bahrain, Kuwait, Turkey and the United Arab Emirates, though These countries had institutions responsible for managing water or water supplies. The national institutions responsible for management and planning of irrigation development in the vast majority of countries. The Middle East (12 out of 18 countries) are departments or divisions of the Ministries of Agriculture. They adopt a department. Irrigation in Azerbaijan is based on the Water Management and Improvement Committee, and in Jordan it relies on the Ministry of Water and Irrigation, In Kuwait, the General Authority for Agriculture Affairs and Fish Resources. It is found in the Arab Republic. The Syrian Ministry of Irrigation, and in Turkey responsibility for irrigation and drainage development activities lies with the Directorate General for Water Works and General Directorate for Rural Services. Responsibility for the management and conservation of water resources generally lies with a different ministry (environment or Protect nature, natural resources, energy, or water resources (although they are located in Palastin lands is the responsibility of the Water Committee (part of the Qatar Ministry of Infrastructure), and the Palestinian Water Authority In the Occupied Palestinian Territories, the Permanent Committee for Water Resources in Qatar, and the Board of Directors of the Authority The General Authority for Water Resources in the Syrian Arab Republic, and the General Authority for Water Resources in the Emirates United Arab Emirates. Municipal water supply and wastewater treatment are approved in some countries. In turn, it has to do with another ministry (such as local administration, health, public works, housing, or construction).

Irrigation systems are generally managed jointly with the state in relation to infrastructure or public systems, and take over Performed by user associations or independent users in the case of secondary or tertiary structures or Special systems. There are countries that do not have water user associations, such as Lebanon. Following Soviet era, the state in the Caucasus country separated from the irrigation sector and then moved towards construction User associations already created or being created.

Water utilization:

It was estimated that the total water withdrawal in 2006 was 23.7 km3, 40% more than in 1992, this total is distributed among different sectors as follows: agriculture 88%, household purposes 9%, industry 3% and the prosperity of desert cultivation increased the volume of water used for irrigation three times what it was before from about 6.8 km3 in 1980 to about 21 km 3 in 2006, (FAO, 2008).

Irrigation development has evolved:

In the year 2000, there were 1 730 767 hectares equipped for irrigation, which means an average increase of 0.9% per year since 1992. However, only 70% of this area was actually irrigated). The water source is almost fossil groundwater (more than 95 percent), Covering localized and sprinkler irrigation, which is what is called modern irrigation, is about 66%, while the remaining area of 34% is subject to surface irrigation, which is called conventional irrigation. The largest irrigated areas are in the areas of Riyadh, Qawasim, Jizan, Hill, Sharqiya, and Al-Jawf. There are three types of irrigation projects that differ from each other in terms of size, level of modernization, and ownership, (Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos an Kassam (1979), De and Van (1987), Dawson (2015).

The role of irrigation in agricultural production, economy and society of the area equipped for irrigation estimated at 1 730,767 hectares in 2000, only 1,213,586 hectares were irrigated from 2005-2011, in 2012, the irrigated crop area covered about 1 214 000 hectares, 56% of which consisted of yields (wheat in the first place, followed by sorghum and barley), 17% of forage, 17% of perennial crops (slender dates in the first place), and 9% of vegetables, Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos an Kassam (1979), De and Van (1987)

Institutions:

In 2001 a Ministry of Water was established to include a part of the Ministry of Municipal and Rural Affairs and part of the former Ministry of Agriculture and Water. This new ministry has become responsible for overseeing the water sector, setting water-related policies, establishing mechanisms and means aimed at managing water resources and implementing water services in an efficient and sustainable manner, Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos an Kassam (1979), De and Van (1987).

In 2004, the Ministry of Water also became responsible for the electricity sector, and it was reconfigured as the Ministry of Water and Electricity to ensure optimal coordination between developing seawater desalination operations and generating electricity. The water sector has, within the framework of the Ministry of Water and Electricity, two main programs: Water Resources Development, which is The program includes all activities related to geological and hydrological studies, wastewater reuse surveys, wells digging, dam construction and preparation of the annual water plan. Supply of drinking water, and includes the establishment of drinking water supply networks to various municipalities and cities that do not exist Here local authorities or municipalities are responsible for water, The Ministry of Agriculture is responsible for the operation and maintenance program of the project, while the responsibility for water management at the farm level rests with the farmers. The Ministry is responsible for issues affecting more than one farm, such as irrigation, drainage and pest control networks, (Todorovic, et al, 2009; Sheaffer et al, 2008).

In view of the government's awareness of water scarcity, the Ministry of Agriculture implemented several measures to encourage farmers to apply economical techniques in using irrigation water. Moreover, some subsidy and subsidy programs that have contributed to the depletion of groundwater resources in agriculture have either been discontinued or revised. A collaborative project with the World Bank has been launched to provide technical assistance to reorganize the entire water sector, The Ministry of Agriculture provides technical training courses and workshops for irrigation water management to employees as well as others in various public and private sectors. Some of the courses are coordinated with international organizations, such as FAO. Unfortunately, the Ministry of Agriculture lacks sound and effective extension services, and does not have a capacity building strategy, and its information management systems are weak. Moreover, there are no links for water users in the Kingdom. An academic association, the Saudi Water Sciences Society, has recently been established and hosted by King Fahd University of Oil and Minerals. Its main purpose is to provide a group of experts, scientists, businessmen, etc. who all have interests in water concerns and issues in the Kingdom, (Zelek et al, 2011; Vaux and Pruitt, 1983; Touré et al, 1995; Todorovic, et al, 2009; Sheaffer et al, 2008; Shaaban, et al, 2009).

Water efficiency in agriculture:

Globally, agriculture is the largest user of water (85%) of water withdrawn in the MENA region. In addition, water use in agriculture is often very ineffective as only a fraction of the water diverted to agriculture is used effectively for plant growth, with the remainder lost by evaporation. With population growth and increasing abundance, the need for food and hence agricultural water for irrigation increases. At the same time, the quantity of sufficient quality water decreases. There is also an increasing demand to convert more water used in agriculture into higher-value urban and industrial uses. Thus, producing more food and clothing with less quantity than is the only option. Water efficiency in agriculture has been extensively researched for many years. However, globally applicable solutions are difficult to reach, especially due to the different contexts and the specificity of agricultural practices. But the efficiency gains are often possible through appropriate crop selection, appropriate irrigation scheduling, effective irrigation techniques, and the use of alternative water sources for irrigation. It should be noted that increasing the efficiency of water use often provides benefits far beyond the use of water, Zelek et al, 2011; Vaux and Pruitt, 1983; Touré et al, 1995; Todorovic, et al, 2009; Sheaffer et al, 2008; Shaaban, et al, 2009; Robertson et al, 2013and Nevo and Chen, 2010, Mansour, et al, (2019a, b, c, d, e) Mansour and Aljughaiman (2012) and Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), Mansour et al., (2014).

Improve irrigation water efficiency:

Watering is necessary when plants cannot meet all their water needs through natural precipitation - this practice is also called irrigation deficit. Therefore, ideal irrigation efforts aim to bridge the deficiency between the optimum water needs of the crop and what it can eat by natural means. Because of the arid, semi-arid and desert conditions prevailing in the region, irrigation is indispensable. Climate conditions, soil type and structure, plant type and applicable irrigation systems are among the main factors affecting the efficiency and effectiveness of irrigation operations. With regard to a specific site and climatic and soil conditions, the efficiency of the irrigation process can be improved by making the right decisions regarding (crop type, irrigation scheduling, irrigation method, soil service system and irrigation water source), Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos an Kassam (1979), De and Van (1987), Dawson (2015).Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), and Mansour et al., (2014).

Irrigation schedule:

The scheduling of irrigation helps eliminate or reduce cases where too little or too much water is used on crops. Scheduling is carried out by all farmers in one way or another. However, proper scheduling of irrigation includes controlling the time and amount of water added to crops based on the water content in the root zone, as well as the amount of water the crop consumes since the last irrigation, and the growth stage. One of the most useful methods for irrigation scheduling is direct estimations of soil moisture content, which depends on the extent to which farmers use advanced irrigation for their access to water and labor. Economies, especially the importance of water availability for the crop, play an important role in the process of absorption and irrigation scheduling. Crops require different amounts of water at different stages of their growth cycle. In addition, climatic and soil conditions affect the availability of water for crops. Hence, it should be borne in mind that excessive water savings can also backfire because crops cannot use excess water and may be stressful due to low levels of oxygen in saturated soils. Hence, this practice will not only waste water but also increase energy costs (pumps) used in the irrigation process. Thus, it is necessary to properly plan irrigation and the suitability of the amount of water supplied with the water needs of the crop - which will improve both productivity and water use efficiency. With proper irrigation scheduling, the soil reservoir is managed so that the optimum amount of water is available when plants need it, Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos an Kassam (1979), De and Van (1987), Dawson (2015).

Good irrigation scheduling requires knowledge of the following:

• Water requirements of the crop grown during different growth cycles, soil moisture content and the soil's ability to conserve water

Weather conditions.

During the planting stage at the beginning of the season, the water requirements are about half less than what is required in the mid-season stage, where the crop has completely developed and reached the required peak of the water. Demand is late season and farmers need to be vigilant to this irrigation schedule and for the irrigation system to be able to adapt to these changing requirements. Monitoring the soil moisture content provides a good assessment of the water crop needs. There is a wide range of methods that provide different levels of precision to monitor soil moisture, each with their own strengths and limitations.

These previous studies according to Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), McKenzie et al, 2011, Mansour et al., (2014), Zelek et al, (2011),Vaux and Pruitt, (1983), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

Water is rationalized across the field as follows:
• An effective role for agricultural extension supervisors in raising awareness and multiplying visits and seminars to fields committed to applying technology and development
• Highlight the importance of using the required amount of water in a timely manner (irrigation scheduling)
• Clarify available irrigation methods and highlight the benefits of each type until the appropriate irrigation method and system is used

• Using automated methods to operate the irrigation system
• Selecting strains that consume the least amount of irrigation water
Direction with irrigation in the early morning or night irrigation
Irrigation water pricing
It is necessary to focus on the causes of irrigation water loss at the farm level and focus on good management by knowing the factors that increase the efficiency of rationalizing the use of irrigation water. These are the main reasons for the loss of irrigation water at the farm level:
1. Irrigation networks.
2. The irrigation methods used.
3. Choose the crop.

Irrigation networks:

Before starting cultivation, you should focus on designing the network as well as setting practical programs for its periodic maintenance. Drip and sprinkler networks such as showing in Figures (1, 2 and 3).

Network design:

The design of the irrigation network is laid out by knowing the following data:
The quantities of irrigation water available on the farm after the inventory is complete, whether it is surface water (and associated with it such as the available rotation, which is the period of availability of water) or the number of wells and their locations and disposal to facilitate the process of providing the water needs of crops with the required quantity and in time for irrigation. And then the topography of the farm, which plays an important role in helping the farmer to know the cost of the required survey and determining the number and locations for laying the main and sub irrigation pipes, valves and other irrigation works in order to facilitate the service process on the farm.

Network maintenance:

Maintenance of the irrigation network is one of the most important processes that help in raising the efficiency of irrigation, and the farmer must consider the following:

• Regular maintenance of the main and subsidiary irrigation pipes, pumping units and cocks to ensure that they work in a highly efficient way to avoid water loss during operation.

• Ensure that sprinklers are working regularly and with high irrigation efficiency and do not suffer from a special blockage during the use of relatively high salinity or surface water irrigation.

Install appropriate filters to remove impurities from irrigation water.
• Washing the main and subsidiary pipeline network at the beginning and end of each agricultural season, and whenever necessary.

• Providing irrigation materials in the farm depot so that the lack of necessary materials does not delay and delay the maintenance process, and thus the loss of irrigation water at the farm level.

2- The irrigation methods used Agricultural crops are irrigated by traditional irrigation methods (ponds) and by modern methods (drip and spraying). It should be noted here that the traditional irrigation methods lead to the loss of irrigation water due to the low efficiency of irrigation when used, it may reach (50 - 60%), and therefore the management of water at the farm level becomes a difficult matter that requires a lot of skilled labor and continuous follow-up during the process Irrigation.

Here we recommend the use of modern irrigation methods such as drip irrigation or sprinkling due to its high efficiency, which ranges between 85 - 95%, but it is necessary to know the type of crop to be grown and choose the appropriate irrigation method.

The appropriate way to add irrigation water. The correct choice of the method of irrigation of the crop helps raise the efficiency of irrigation water use (i.e. Increasing the production from the available irrigation water unit)

3- Choose the crop: Different crops require specific needs of added irrigation water during their growth periods. Which means that we have to calculate what the crop needs water to meet its needs. Hence, an emphasis must be placed on developing an irrigation program, taking into account the following factors:

Soil type:

The different stages of crop growth: Cultivation method (open field or protected cultivation)
It is also necessary to know the quality of the irrigation water added, as plants differ in their tolerance to the quantities of soluble salts in water and the quality of the constituent elements of them, as this affects production. The salts also affect the soil. Undoubtedly, the farmer has the greatest effect on the system of rationalizing the use of water, and if some of them do by nature, it is possible to summarize the farmer's role in the following:

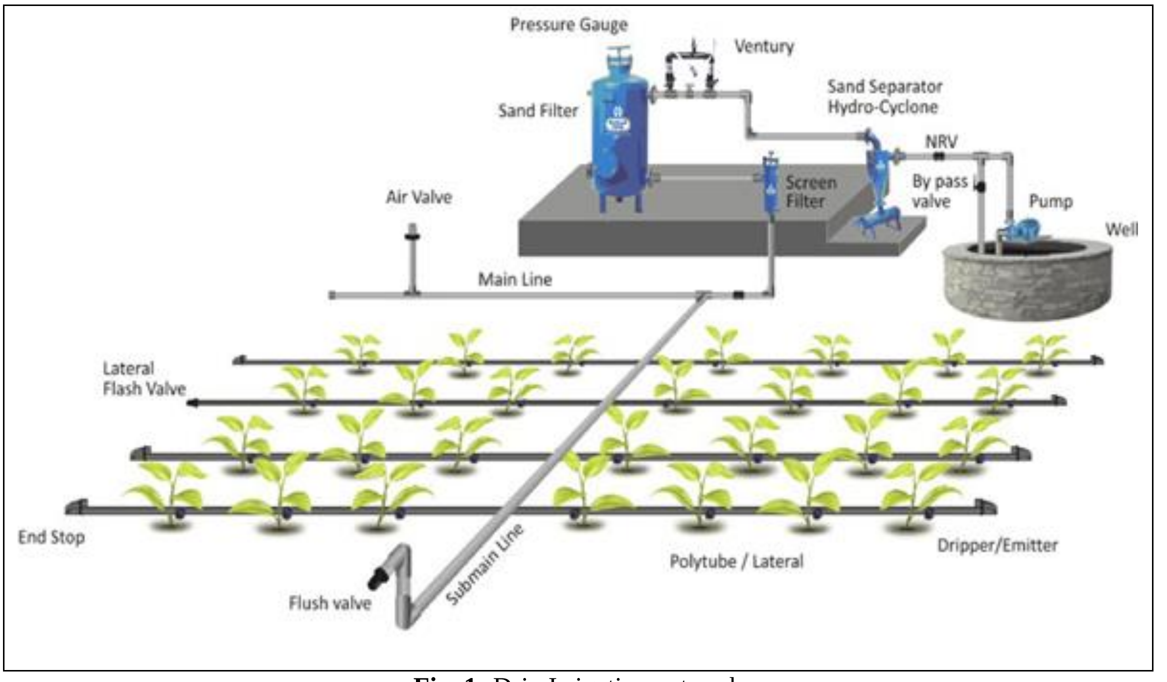

Fig. 1: Drip Irrigation network

Irrigation valve

Drip irrigation for palm dates

Fig. 2: Several locations showing parts of the drip irrigation network

Fig. 3: Sprinkler Irrigation network

The use of trained laborers to carry out various agricultural activities, including the irrigation process.

Submit notes to the concerned authorities through the agricultural extension agents who are considered as the link between the farmer and the agricultural engineer.

Participate in carrying out applied experiments on his farm (allocating a pilot field for applying agricultural research outputs), Commitment to research outputs, especially with regard to the field of irrigation, as we see that water is the main determinant and not land is the most important in irrigated agriculture. Also, carrying out applied research related to farmers 'problems and focusing on introducing modern technologies to raise productivity on the one hand and preserve natural water resources on the other hand is one of the goals that should be pursued. Enhancing the role of agricultural extension through enhancing agricultural extension with extension workers with high scientific and practical competencies. Educating farmers through audio-visual equipment and their participation during field experiments on their farm, Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), McKenzie et al, 2011, Mansour et al., (2014), Zelek et al, (2011),Vaux and Pruitt, (1983), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

. Continuously reduce the area of the ponds and irrigation on the garrison. Rehabilitation and training of workers, especially with modern irrigation systems. Obliging farmers to use modern irrigation methods (drip and sprinkler).

Volume of treated wastewater (km / year): (Wastewater: treated volume):

The amount of wastewater generated that is treated in a given year and discharged from the treatment units (Liquid Waste). Wastewater treatment is the process of converting this water into safe water To meet the environmental standards applicable to drainage.

Three stages of traditional treatment can be distinguished:

Primary treatment, secondary treatment, and advanced treatment of the third degree. Criteria vary The flow varied greatly from country to country, so the treatment stages also differ. When calculating The total amount of treated wastewater is that the reported volumes and loads are only recorded The "highest" type of treatment you undergo.

Irrigation and water management:

Irrigation potential The methods used in countries to estimate their irrigation potential vary, and this has a major impact on the results obtained. When calculating available water for irrigation, some countries limit themselves to resources Renewable water, while other countries, especially arid countries, consider the availability of water resources Fossil or unconventional water sources. Therefore, caution should be used when comparing countries. In the case of transboundary rivers, calculations by each country may result in irrigation potential the same river basin to duplicate the calculation of part of the shared water resources. Therefore, it cannot be compiled Country figures are systematically obtained for regional estimates of irrigation potential. As indicated in the previous chapter, many countries in the Middle East are already accredited Great for fossil groundwater and unconventional water sources, or their freshwater resources are depleted Renewable. The expansion of irrigation in these countries requires more fossil groundwater or Unconventional water sources if water efficiency and productivity do not improve, Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), McKenzie et al, 2011, Mansour et al., (2014), Zelek et al, (2011),Vaux and Pruitt, (1983), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

The largest irrigation potential is concentrated in the Islamic Republic of Pakistan, which has 5.6 million hectares Renewable water resources alone (Table 48). Estimates of the Syrian Arab Republic and the UAE indicate The United Arab Emirates has reduced its irrigation potential below the area currently equipped for irrigation. And maybe it returns the reason for this is the increase in demand for water for domestic and industrial purposes, and the depletion of groundwater, which It has already begun, and non-consideration of the availability of non-traditional sources of water, and these countries also include countries That developed unconventional water sources, and irrigation potential is estimated in these two countries and in other countries. Without data it is the sum of the area equipped for irrigation in order to calculate the regional average. Appreciated The irrigation potential in the Middle East region is over 38.4 million hectares, of which 76 percent is for the republic Islamic Pakistan, Turkey and Iraq. The Caucasus countries account for 12 percent of the total irrigation potential The Middle East region, while the countries of the Arabian Peninsula represent only 7 per cent. Arid countries where agriculture is irreversible without irrigation tends to look at the arable land As the potential irrigation area, its development will certainly depend on water use Underground fossil and unconventional water sources, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Irrigation classification and water management Irrigation, according to the sub-regions, is an essential technology without which agricultural production would be almost impossible In dry countries, or as a means to increase productivity and crop density and encourage crop diversification in the most humid countries.

The level of use of lands equipped for irrigation with full / partial control:

It is difficult to calculate the irrigated areas already in the Middle East region as a whole due to the absence Information on most countries in the two GIS surveys Water and agriculture. Previous survey data are used when new data are not available in the country. Given that data on already irrigated areas are available from only 7 out of 18 countries. Usage rates vary greatly between the countries providing that data. And in Bahrain and Yemen The sum of the area equipped for irrigation with full or partial control is the same as the area actually irrigated. In Jordan, the rate exceeds 90 percent, and in Turkey it is 87 percent. Rates drop Use in Armenia and Saudi Arabia is about 70 percent, and more than that it does not exceed 49% in Qatar. In many cases, the lower rates are due to the deterioration of the infrastructure due to lack of maintenance (due to lack of experience or inappropriate techniques) or political and economic reasons. Other causes include insufficient management of technical means of production using irrigation, poor soil, instability and insecurity At the local level, reduce public funds for irrigation. Crop density:

Crop intensity, another indication of the use of the equipped patch, is calculated based on the area already irrigated in full or partial control systems in the seven countries for which information is available. In the other eleven countries is equivalent to the area equipped for irrigation with full or partial control. Therefore, the crop density may be estimated to be less than reality because the irrigated area may actually be smaller than The area equipped for irrigation in many of these ten countries. Only irrigated crops are counted. This means that only crops that are irrigated in countries with a rainy season or two rainy seasons are taken into account. This excludes crops grown in areas Equipped with complete / partial control systems during the rainy season without irrigation (but using the remaining moisture in the soil) when calculating the crop density, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Irrigated crops in full / partial control systems: Table 22 shows the sub-regional distribution of irrigated crops in the countries and territories that provided Information about those crops. And areas with multiple cropping cycles prepared annually It counts multiple times, which explains why the total is greater than the fitted spaces Actual or actually irrigated areas in some countries (Table 51). This also gives a picture of Crop intensity in irrigated agricultural areas (see below). Georgia falls within the total area Irrigated crops, although not covered by the distribution of each crop due to lack of data. Yields represent approximately 44 percent of the area of the irrigated crops represented . Wheat is 60 percent of it. And as for the vegetable group, including roots, tubers, and legumes It is the second most common crop, accounting for 16 percent. This is followed by irrigated feed plants Which represents 9 percent, and cotton 6 percent of the area of irrigated crops harvested. And act. Perennial crops are 15 percent. Crops and perennial crops predominate in the Arabian Peninsula, accounting for 39 and 31 per cent, respectively, followed by fodder crops, which represent 15 per cent. The United Arab Emirates accounts for the largest area planted with perennial crops (most of the dates), which account for 82 percent of the total area of irrigated crops in the country. The perennial crops in Oman and Bahrain represent 58 percent and 55 percent, respectively. In the Caucasus countries, they do not Perennial crops are only 10 percent on average, while yields are 55 percent, and vegetables are 12 percent, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015)..

In Iraq, the largest country in terms of area of irrigated crops, yields represent 48 percent, 21 percent and 70 percent, respectively. In Turkey, irrigated fodder crops represent approximately 10 percent. As it stands 49%, 27% and 12% in Saudi Arabia, respectively, of the total area planted with this crop in the Middle East. The Islamic Republic of Iran accounts for 76 percent of the rice cultivated area in the Middle East, followed by Iraq, where the rice cultivation area is 15 percent. Vegetables in Turkey (including roots and tubers) represent 23 percent. Turkey and the Islamic Republic of Iran represent 35 percent and 34 percent, respectively, of the total area planted with vegetables (including roots and tubers) in the Middle East region. Turkey and the Republic of Iran Islamic is 53 percent and 33 percent of the total area planted with pulses, followed by Yemen which represents 6 percent, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Dawson (2015)..

The total area in which other types of water other than direct rain are used is also called Agricultural production has “the area of land under water management”. The term “irrigation” refers to spaces Land equipped for crop irrigation. Tables 47 and 48 show the distribution of these subject areas To manage water by country, distinguishing between irrigated areas that represent the total area The lands in which irrigation is used with full / partial control, and the lands in which it is used Flood irrigation, equipped lowlands) wetlands and bottoms of inland valleys and regions Flood recession (and areas where other forms of water management are used, which is land Unprocessed lowlands) wetlands, inland valleys, and farmland areas Flood Reduction (. Sometimes it is difficult to distinguish between irrigation and water management In particular, the distinction is made between the area of prepared and unprocessed lowlands, because of the context involved Often ambiguous, so data on the area of cultivated cultivated land are not available In the areas of flood recession in the region, except for the Islamic Republic of Pakistan, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

The total area equipped for irrigation covers more than 23.3 million hectares in the Middle East region, However, the geographical distribution is very uneven across the subregions and countries (Table 14 and Figures 19 and 20). More than 71 percent of the area equipped for irrigation is concentrated in the Republic Islamic Pakistan (35 percent), Turkey (21 percent) and Iraq (15 percent) Arabia, the Kingdom of Saudi Arabia has the largest area equipped for irrigation, accounting for 7 Percent of the total area in the Middle East region, followed by Yemen, which has 3 percent.

Finally, the Caucasus countries have 9 percent of the area equipped for irrigation, which is a large proportion Compared to its total area of no more than 3 percent of the area in the Middle East region. Flood irrigation is usually a distinguishing feature of dry countries. Yemen is the only country to present 217 hectares (Tables 15 and 47). Lands abound with data on 541 flood irrigation Low equipped in countries with more sources of fresh renewable water, such as Georgia13 hectares, respectively. In Yemen, however, the figure is 31 hectares and Turkey, which represents 500 7 hectares. Also 799 One of the most widespread irrigation is irrigation with full / partial control, covering 23.1 million hectares In the Middle East region. This type of irrigation accounts for 98.9 percent of the area equipped for irrigation Of which 71 percent are concentrated in three countries (KSA, Iraq and Turkey) (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015)..

The per capita share of water withdrawal in the municipal sector increased from 74 cubic meters annually, or 203. Daily liters, to reach 89 cubic meters annually, or 316 liters per day. There are some great variations Between subregions and countries. The clouds increased in the sub-region of Arabia 67 cubic meters per year to 69 cubic meters per year, while the Near East sub-region witnessed Increase from 71 cubic meters per year to 96 cubic meters per year. However, clouds decreased. In the Caucasus sub-region, from 148 cubic meters per year to 108 cubic meters per year. Hit increases are highest in Qatar and Iraq from 120 cubic meters to 214 cubic meters per year, and from 63 cubic meters to 149 cubic meters per year, respectively, while the clouds reached their lowest levels United Arab Emirates from 263 cubic meters to 137 cubic meters per year. Furthermore Per capita water withdrawal in Georgia, Azerbaijan and Lebanon decreased by 65 meters Cubic and 38 cubic meters and 16 cubic meters per year, respectively.

In agriculture, it appears that the annual water withdrawal per hectare of area equipped for irrigation has 9 cubic meters. The reason for this is not entirely clear. 8 cubic meters to reach 700 increased from 650. This may be due to the quality of the data or change in the crop pattern. And in the eastern sub-region. 9 cubic meters, and in the Republic of 8 cubic meters to reach the lowest 549, water withdrawal increased from 678, 10 cubic meters, and in the sub-region of the peninsula 8 cubic meters to 576. However, withdrawing water in the sub-region is 9 cubic meters to 765 Arabs from 487,5 cubic meters. In Iraq, water withdrawal increased by 7 cubic meters to 742 from the Caucasus, down from 072, 14 cubic meters, while in the United Arab Emirates it decreased from 11 cubic meters to 752 from 172. 14 cubic meters. Care should be taken in using this data because 21 cubic meters to 115, 616. The reason for the increase in general is not entirely clear, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Fully / partial control irrigation techniques:

Tthe sub-regional distribution of irrigation techniques used in the lands where they are located Full / partial irrigation control. With regard to the countries whose previous publication covered their technologies and no New data are available, as this report uses the previous values in the analysis. The The difference between the total surface irrigation area is recorded in the previous survey and the current survey. However, Table 49 contains the exact data available according to the countries and years they refer to. From Table 16, it is clear that surface irrigation, which accounts for 86 percent of irrigation techniques, is much greater Compressed irrigation techniques are divided into sprinkler irrigation (9 percent) and localized irrigation (5 percent). Compressed irrigation techniques are mainly concentrated in the Arabian Peninsula, where sprinkler and irrigation is used. Topical in more than half the space. This region is dry, but it also includes some of the most countries An advanced use of these technologies. For example, localized irrigation is in the United Arab Emirates It represents 86 percent and sprinkler irrigation in the Kingdom of Saudi Arabia represents approximately 60 percent of irrigation systems techniques. Area In fact, it is used in more than three quarters of the area in all countries except Saudi Arabia and the United Arab Emirates, and represents almost the only technology used, (Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), McKenzie et al, 2011, Mansour et al., (2014), Zelek et al, (2011),Vaux and Pruitt, (1983), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

In Yemen. In the Caucasus, surface irrigation represents nearly 90 percent of the area Equipped with complete or partial irrigation control systems, sprinkler irrigation represents 8 percent and irrigation. Topical 2%. Almost the whole area in Iraq is irrigated using surface irrigation while Surface irrigation in the Syrian Arab Republic and Turkey accounts for approximately 90 per cent of irrigation techniques. In Jordan, localized irrigation represents 81 percent, and in Lebanon, sprinkler irrigation represents approximately 30 percent and localized irrigation represents 9 percent of irrigation techniques. Source of water for irrigation with full / partial control Irrigation water is generated in areas irrigated using full / partial irrigation control systems, which are surface water, groundwater, mixture of surface water and groundwater, and unconventional water sources. Data are available for all countries except Palastin lands. The analysis assumes that 50 percent of the area in Jordan is irrigated with water Surface and 50% of groundwater. Finally, this report maintains percentages It defined the previous data for each source and applied it to irrigation areas with full control / Partial current. Therefore, these values are just the order of magnitude and do not accurately reflect the state the Actual. However, it was important to complete the data based on team field knowledge Global Water and Agriculture Information System to create a more accurate picture of wastewater sources Irrigation in the Middle East. However, Table 50 contains accurate information for all countries As available. With regard to “other water sources”, Lebanon and the Syrian Arab Republic use a mixture of Surface water and groundwater, while Bahrain, Jordan, Kuwait, Qatar, Saudi Arabia and Turkey began using unconventional water resources to increase their resources. Kuwait represents the highest proportion of unconventional water sources, 39%. Surface water is the main source of irrigation water for the Middle East region as a whole (54 percent), Countries like Turkey and Iraq with large irrigated areas depend mainly on irrigation From surface water (78 percent and 94 percent, respectively) that originates mainly from the Tigris basin Euphrates. Surface water in the Caucasus countries represents an average of 94 percent of the equipped area For irrigation, you get it mainly from the Cura and Araks basin. Do not use unconventional water sources in This subregion is not dominated by the same drought conditions that prevail in other subregions. And in On the other hand, the Arabian Peninsula does not have any surface irrigated areas. Groundwater is mainly used in the Islamic Republic of Pakistan, Jordan and the Occupied Palestinian Territories to feed irrigation systems, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992).

Volume of wastewater produced (km / year):(Wastewater: produced volume):

It is the amount of wastewater generated annually in the country, or it is in other words the amount of water that is Contaminated with waste. This water can originate from domestic use (the water used in showers, sewage, cooking, etc. (or industrial wastewater conveyed to Sewage treatment plants. This water does not include agricultural wastewater, which is water Which is withdrawn to agriculture, but not consumed and returned to the system. Soil and water conservation: Soil and water conservation A set of on-site water and soil conservation measures. The measures include soil conservation. Any set of measures intended to control or prevent soil erosion or conservation Fertility. Water conservation includes the use of fenders or barriers to slow or stop water migration Surface.Human Development Index: Human Development Index A brief measure of human development. It measures the average achievement in a country in three dimensions Essential for human development: (1) A long and healthy life, compared to the average life expectancy at birth; Knowledge acquisition, measured by the adult literacy rate (two-thirds of significance) and total. Gross enrollment ratios for primary, secondary and higher schools (one-third of importance). (3) Standard of living. Decent, as measured by GDP per capita (purchasing power parity, USD), Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), McKenzie et al, 2011, Mansour et al., (2014), Zelek et al, (2011),Vaux and Pruitt, (1983), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

See UNDP numbers on this site (http://hdr.undp.org/en/statistics/indices/hdi/) Fully / partial control irrigation: equipped area irrigated by groundwater (ha): Full / partial control irrigation: area equipped irrigated from groundwater (The proportion of the area in which irrigation is fully controlled from well water (shallow wells and wells) Deep tubular (or springs). Full / Partial Irrigation: Equipped Area Irrigation with Surface Water (ha):

(Full / partial control irrigation: area equipped irrigated from surface water): The proportion of the area in which irrigation is fully controlled (from rivers or lakes (using water) Reservoirs, pumping, or diversion of water). (Full / partial control irrigation: area equipped irrigated from mixed ratio of irrigated area using full control systems Surface and groundwater or from unconventional water sources, such as agricultural wastewater and water, treated sewage or desalinated water. Full / partial control irrigation: surface area equipped for surface irrigation (ha):

(Full / partial control irrigation: area equipped for surface irrigation) Surface irrigation systems are based on the principle of transporting water on the surface of the Earth with the slight gravity of hydration the soil. It can be divided into irrigation with grooves, irrigation with border strips, and basin irrigation (including This includes irrigating rice with immersion.) This also includes manual irrigation using buckets or waterers. Irrigation does not refer Surface to the method of transferring water from the source to the field using gravity or by pumping, (Mansour, et al, (2019a,b,c,d,e) Mansour and Aljughaiman (2012), Mansour, et al, (2015a, b, c; d), Tayel et al., (2016), Touré et al, (1995), Todorovic, et al, (2009), Sheaffer et al, (2008), Shaaban, et al, (2009).

Full / partial control irrigation: Area equipped for localized irrigation (ha):

: (Full / partial control irrigation: area equipped for localized irrigation) Localized irrigation is a system in which water is distributed under low pressure through a network of tubes in predefined pattern, by emptying a small amount of water for each plant or plant adjacent to it. There are three Main categories of this irrigation: drip irrigation) using points to slowly distribute water to a surface Soil (sprinkler or small sprinkler irrigation) as water sprinkles on the soil near plants Trees (and sparkling irrigation) use a small stream of water to submerge small ponds or to submerge the soil Near the tree (. The following other terms are also used to refer to localized irrigation: irrigation Flour, surface drip, daily flow, distillation, buried drip, and day irrigation.

Full / partial control irrigation: Area equipped for sprinkler irrigation (ha):

Sprinkler irrigation systems consist of a network of pipes in which compressed water moves before it reaches Crop by sprayers. This system basically simulates precipitation where water is sprayed from Top. These systems are also known as overhead irrigation systems.

Full / Partial Irrigation: Total Equipped Area (ha):

It is the sum of surface irrigation, sprinkler irrigation and localized irrigation. The terms "control" are used Complete ”and“ Full / Partial Control ”of this text without distinction between them.

Water withdrawal for agriculture (million cubic meters / year) :

The amount of water drawn annually for irrigation and livestock rearing purposes. This includes fresh water withdrawal Renewable and potential overuse of renewable groundwater extraction or groundwater withdrawal

Fossil, use of agricultural wastewater, desalinated water, and treated wastewater. It also includes water withdrawn for irrigation and animal watering, although this is the last category Sometimes it is included in domestic water withdrawal, depending on the country. With regard to water For irrigation, its value exceeds the consumption consumption for irrigation due to the water lost in Distribution from its source to crops. The term “ratio of water required” is used Also “irrigation efficiency” (to indicate the ratio between net irrigation water needs or needs Crops of water, i.e. the volume of water required to compensate for the shortfall between potential evapotranspiration The actual precipitation during the crop growth period, and the amount of water drawn for irrigation, including water Wasted. In particular, irrigation of the rice needs additional water to be submerged so that the soil can be prepared and protected the plants. The irrigation water requirement in this case is the sum of the deficiency in the rain, (FAO, 2008, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015)..

The water required to flood rice fields. The value of the proportion of water required can range from one level Systems are between less than 20 percent and more than 95 percent. With regard to watering animals, it is estimated The ratio between net consumption and water withdrawals ranges between 60 and 90 percent percent. The water use for watering animals is automatically calculated as part of the water use Agriculture, although some countries include it to withdraw water for domestic use.

Water withdrawal for industry to withdraw water for industry (million cubic meters / year):

The amount of water drawn annually for industrial use. It includes renewable water resources as well From the potential excessive recovery of renewable groundwater or withdrawal of fossil groundwater, Potential use of desalinated water or treated wastewater. This sector indicates in Habit to industries that supply supplies to themselves and are not connected to any distribution network. The ratio is estimated between Net consumption and withdrawals are less than 5 percent.

Water withdrawal for livestock (:) for m3 / year Some countries include this water in domestic water withdrawals, while others include it In drawing water for agriculture. Dam: cubic kilometers The cumulative total storage capacity of all large dams. According to the International Commission on Big Dams. The Grand Dam is a dam that is 15 meters or higher from its base. And if the dams rise It ranges between 5 and 15 meters and has a storage capacity of more than 3 million cubic meters, it is also classified as Big dams. However, each country has its own definition of large dams, if there is information on Other dams in the country are also used. The value indicates the theoretical initial capacitance that does not It changes over time. The current or actual capacity of the dam is the condition it has at a given time It can decrease due to slander. Detailed information on the African dams can be obtained.

Population affected by water-related diseases (inhabitants):

There are three types of water-related diseases: (1) Waterborne diseases are diseases that are They arise from contaminated water and occur when water is used for drinking or cooking (e.g. Cholera and typhoid (;) (2) Water-source diseases, in cases where water provides habitat for families Parasites that enter the body (such as schistosomiasis); (3) Waterborne insects They are diseases in which insect vectors rely on water as their habitat, but the infection is transmitted only By direct contact with water (such as malaria, river blindness, or elephantiasis). :) Economically active population (:) Number of all employed and unemployed people (including those who are looking for the first time for work). This includes employers; self-employed persons; employees with salary; wage earners; and workers Who assist in unpaid family, agricultural or commercial operations; members of producer cooperatives; And members of the armed forces. The economically active population is also called the "workforce". The economically active population in agriculture (people): : (Economically active population in agriculture) That part of the economically active population that works in agriculture, hunting, or fishing Or forestry (the agricultural workforce) or seek to work in it. An economically active population means the number of all people employed and unemployed (including those who are first looking for work). This includes employers; self-employed persons; employees with salary; wage earners; and workers Who assist in unpaid family, agricultural or commercial operations; members of producer cooperatives; And members of the armed forces. The economically active population is also called the "workforce". :) Population: urban, rural () Population: urban and rural Urban residents are usually defined, and the remainder of the total population is considered rural. Indeed The criteria used to distinguish urban and rural areas vary from country to country else. However, these criteria can be broadly divided into three main categories: They are classified as regions It has a specific size as rural; administrative centers of secondary civil departments are classified as urban; Secondary civil department centers are classified on the basis of a selected standard that may include the type of local government And the number of the population or the percentage of the population working in agriculture. Thus, estimates of the urban population are based And rural people in this field to the differing country definitions of urban areas, (FAO, 2008; Al-Asbahi, 2001 and 2005; Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015).

Average annual increase of the area equipped for irrigation:

Old area x 1 + i (n) = This increase is calculated using the following formula: The new area It is the number of years of the period between the two surveys conducted by the global system "n".

Irrigated spaces:

Trends in irrigated area during the past ten years. Information is noted . (For some countries related to previous years due to the lack of new data). The increase in the equipped area was 12 per cent in the Middle East region, equivalent to an increase 1.31% annual using a weighted annual record. The annual index is calculated It is likely to allocate a weighting coefficient for the year in each country to suit its area equipped for irrigation. Gives more importance to countries with the largest irrigated area. The annual rate of increase in irrigated area is using full or partial control systems Irrigation is 1.35 percent, slightly higher than the annual average for total irrigation. This is due to the lack Increased flood irrigation area at the same rate as increased irrigation area using full control systems or . Partial, also due to the decrease in the area of equipped lowlands since 1997. The rate of increase in the Arabian Peninsula is more than 2.2%. The rate is in the Emirates The United Arab Emirates is 13 per cent, the highest rate of increase in fitted spaces in the Eastern Region Middle. However, this could also be due to the reclassification of areas previously classified as Accept that it is not equipped and that this time it falls within the areas equipped after improving the knowledge of the situation. In reality. Annual rates of increase in other countries in the Arabian Peninsula Such as Kuwait, Bahrain and Yemen 4 percent, while the annual rate of increase in the Kingdom is approaching Saudi Arabia and Qatar from scratch. Oman recorded an average decrease in the areas equipped for irrigation, 0.4% annual. The Caucasus is the only sub-region where there has been no increase in the irrigated area. And hit. The negligence rate of irrigated area with full or partial control is approximately 0.4% Annually in this period) - 0.7% in Georgia, - 0.4% in Armenia,

Average annual increase. The "i" percentage of information about water and agriculture is equal to and where . (i x 100) Average precipitation size (km / year): : (Precipitation in volume: average) The average annual amount of local rainfall (in a long period) in a country at a location. And a certain time). Precipitation in depth: average The average annual depth of local rainfall (in a long period of time) in a country A specific place and time. Population: total According to the definition of FAO, the total population usually refers to the population in The region (indeed), including all persons physically present within the current geographical boundaries. For countries at the midpoint of the reference period. Drained area: total The sum of the dried portions of the area equipped for irrigation and the area of the non-irrigated lands. Area equipped for irrigation: total total area equipped for irrigation (ha) The area provided with water (by irrigation) for crops, which includes the areas equipped Irrigation with full / partial control, lowlands equipped for irrigation, rangelands, and areas Fitted with flood irrigation. Total exploitable water resources (km3 / year): (Exploitable water resources: total) Exploitable water resources) also called manageable water resources or water resources That can be developed (considered available for development), taking into account factors such as economic and environmental feasibility For storing flood water behind dams, extracting groundwater, and the actual possibility of storing Waters that naturally flow into the sea, and the minimum flow requirements (maritime navigation, Environmental services, aquatic life, etc.). Methods for estimating sustainable water resources vary For use from country to country, (FAO, 2008; Al-Asbahi, 2001 and 2005; Louise and James (1996), Lorite et al, (2013), Kiniry et al, (1995), Johnston et al, (2002), Howell et al, (1990), Heng et al, (2009), Farahani et al, (2009), Entz et al, (1992), El-Sharkawy, (2011), Doorenbos and Kassam (1979), De and Van (1987), Dawson (2015)..

Conclusion

In the Kingdom of Saudi Arabia, It could be used new techniques of water management and irrigation systems for crops differ in terms of their daily water needs and their total growth period. Thus, the type of crops is a major factor affecting irrigation water needs. Crops with high daily needs and a long growing season require more water than those with relatively low daily needs and shorter growing seasons. Therefore, the main step towards reducing irrigation water needs is to choose crop varieties that have less water demand but still provide sufficient added value. Improving irrigation methods can:

- Reducing water and pumping costs,
- Reducing costs of fertilizers and other agricultural chemicals,
- Maintaining higher soil quality,
- Increase crop yields - by up to 100%.

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