How do manage water resources more productive in water scant agro-zones?

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Abstract: *Irrigated agriculture with a world average of 70% withdrawal is the largest fresh water user among all- consumptions and is even higher than 80% in some regions such as semi-arid Konya plain of Turkey. It is impossible to make economic crop production in such environments without irrigation especially for summer crops. Over water abstractions from the groundwater reservoir is inevitable for meeting whole current crop water requirements so this situation may result serious environmental problems such as formation of sinkholes in some places. Following necessary precautions can be taken into considerations for sustainable usages of current water supplies in water shortage ecosystems like Konya plain of Turkey; 1- Crop pattern should be redesigned in accordance of safely available water supplies, 2- Implementing deficit irrigation program. In that regard, up to 25% deficit irrigation can be suggested for some crops, 3-Developing and widely planting drought resistant cultivars, 4- Improving irrigation areas of practicing pressurized irrigation technologies, 5- Replacement of open channels water delivery systems to the pipe networks, 6- Farmers should be trained about correct agro-water management at farm level with rich visual documents, and 7- Rain-fed farming system could be done for some crops.*

KEYWORDS: AGRO-WATER MANAGEMENT, SUSTAINABLE IRRIGATION, PRESSURIZED IRRIGATION SYSTEMS, WATER PRODUCTIVITY.

1.Introduction

Water is the backbone of the irrigated agriculture and direct effect on both crop yield and quality. The agriculture or irrigation is the major fresh water user sectors as 70% world general [1], greater than 40% in OECD countries [2], and over than 80% in some parts of the world such Konya Plain of Turkey and in those water scant environments it is not possible to obtain economical returns without irrigation. Due to the negative effect of climate change, even winter cereals are growth under two or three irrigation practices for facilitating enough yields in Konya Plain.

In water poor ecologies, it is urgent to attempt practical solutions for water productivity. Konya Plain is about 10% of farming land with only 2.5% fresh water resources. Fortunately, it has rich of groundwater supply and has consumed plenty due to the absent of surface water resources in most periods of crop growth cycle. The water depths of groundwater are getting decrease due to the current agricultural system and lack of rainfall resulted from recent climate changes. This has caused some ecological problems such as formation of sinkholes in some areas. Farmers in such region are rich experiences about all farming activities including irrigation and follow the latest advents about agriculture. They have used pressurized irrigation systems with an increase rate due to the causing water savings. Sprinkler irrigation technology is the most common irrigation method and are used for irrigation of most crops such as sugar beet, carrot, dry bean, vegetables and so on. Due to the introducing drip irrigation system, maize production has increased sharply in last 10-15 years in region.

Utilization of pressurized irrigation systems is around 15% through the world and well-known benefits of such system are best suited for different soil, plant and topographic conditions [3-4]. The only way for improving water saving is to increase the irrigation efficiency [5]. This can be overcome by efforts such as applications high efficient irrigation technologies like drip irrigation, and adopting other farm practices resulting water saving [2]. Another option is deficit irrigation practice and is highly recommended for water shortage ecologies for putting more lands into production [6]. In accordance of research at Gansu Province, China for maize crop [7], deficit irrigation with a certain level in seedling stage of maize may result better water economy and notable increase in water use efficacy particularly water poor zones.

As known that pressurized irrigation systems have also led to optimal water distribution uniformity a cross the whole irrigation areas under well management. The benefits of equal water distribution are leading to minimize losses in both the plant nutrients and irrigation water consequently maximal crop yield [8-11]. Proper management in general means to improve of water allocation and water use productivity. Water allocation is closely relevant to the reliable pricing and water use profitability highly depends on the irrigation systems, and climate conditions [1]. In definition of well agricultural water management [12] is that providing of water amount for both the crops and animals they demand, enhancing water productivity, and protecting ecosystems for the benefit of downstream users and natural resources services.

The aim of the present study, therefore, is to give the practical recommendations for sustainable agricultural water managements in water scant climate regions.

2. Impacts of drought on wheat production in Turkey and Konya province

Efficient water utilization is necessarily prerequisites in arid or semi-arid regions of Turkey since they may expose to the drought problem in some periods. Drought has lots of negative effects on all sectors mainly on agricultural productions. The reason of drought is less rainfall than the normal precipitation amount and its none uniform distribution through the year.

Cereals are the backbone food security crop for the nations and their reduction may have great adverse effect on human health.

There was a severe drought at 1970, 1973 and 1989 in Turkey with a reduction of wheat yield about 42%, and the productions in those periods were around 1160 kg/ha, 1130 kg/ha, and 1730 kg/ha, respectively. Fortunately, after the 2002 it increased gradually and reached up to 2840 kg/ha in 2013 [13].

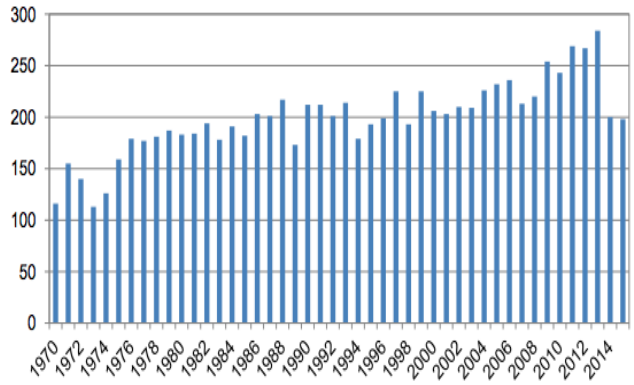

Fig. 1. Wheat yields of Turkey as kg/da [13].

There was a notable decrease in wheat yield in Konya province of Turkey, and grain yields of wheat were 1010 kg/ha, 850 kg/ha, 730 kg/ha, and 1390 kg/ha, respectively in the years of 1970, 1973, 1974, and 1989.

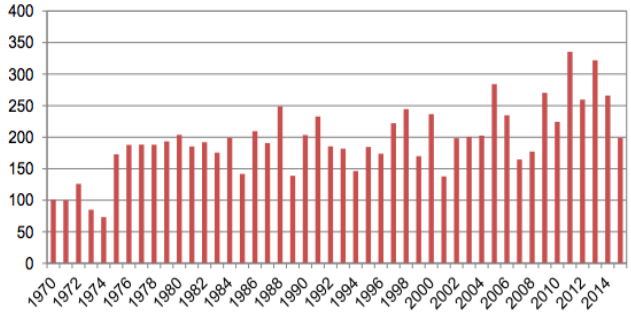

Fig. 2. Wheat yields of Konya province as kg/da [13].

This year, 2021, is also very dramatic in accordance of cereal production. Almost none wheat yield was obtained at rain-fed farming areas. In result, possibly agriculture is the most affected sector from the climate changes.

3. Efficient water saving practices in agriculture for water shortage ecosystems: Sample of Konya Plain

Following water productivity strategies can be addressed in areas having limited water supplies such as Konya plain of Turkey:

Changes in crop patterns: In Konya plain, there is over water extraction from the ground water resources. In that regard, ground water resources are not sustainable by this current utilization. There are two main reasons in reduction of groundwater level at Konya plain general. First, due to the high economical benefit some high water consuming crops such as corn have growth with an increase rate. Second is increase of irrigation areas without control. There is no doubt that irrigated agriculture has very important role to play for increasing the crop production. Particularly increase of farmlands with high water consuming crops has led to more water extraction from the groundwater reservoir. As a result of that there is a gradual depletion in groundwater level in basin general. Possibly current crop pattern is the first rank resulting over water extraction from the groundwater reservoir [14].

Diverting subsidize to less water consuming crops: There is obvious that the reason behind increase of the cropped lands in favor of high water consuming crops is resulting better economical return in region. Corn and sugar beet production have caused high income for farmers. Farmers think their economical gains instead of environmental protection. Due to the government subsidize and well market price, corn production is very satisfactory since farmers get high benefits from such farming activity. This region is known as cereal store of Turkey. The climate is very favorable for cereal production and those crops are within group of the low water consuming crops. In recent years, there is a dramatic reduction in farming areas of cereal production in region due to the not resulting economical return. The crop pattern of those crops was about 35-40% in the past but there is gradual reduction recently. The cereals particularly wheat is vital important for food security in the world so they must be growth for both meeting the food demand of the nation and conserve the water resources. The practical solution is subsidizing of cereal production. In addition, other low water consuming crops such as sunflower, lentil, chickpea and pumpkin should be growth more for sustainable water resources particularly at water poor ecologies like Konya plain, Turkey.

Awareness of public for environmental problems resulted from over water pumping from groundwater resources: There is direct relationship between agricultural activities and efficient water use and environmental protection. Agro-practices likes soil tillage, irrigation, fertilizer uses, disease as well as pest control are relevant to sustainable agricultural water management and conserving of environment [1]. There are some environmental problems associated from the over water pumping from the groundwater supply in our region. The rainfall amount and its distribution are poor in most part of Konya plain. The irrigation process is the main contributor of high crop yield and consequently better incomes for farmers. Due to the reason of increment in irrigation areas of high water consuming crops, we have witnessed some sinkholes in some parts of Konya plain. In that regard, safely available water amount must be used for irrigation at region. In addition, following environmental problems could be observed under intensely use of groundwater [15]: inevitable aquifer depletion resulted from rapid groundwater withdrawal than its recharged by precipitation; during the groundwater pumping process, sinking or collapse (subsidence) of the groundwater; introducing of salty water to the freshwater aquifers at the seaside areas, and; contamination of groundwater reservoir by people activities. In accordance of information [2], over-use of current water supplies particularly by irrigation in some regions leads to deterioration of ecologies by declining water flows below the critical flow regimes in surface water bodies such as rivers, lakes and wetlands which is also damaging to recreational, fishing as well as cultural utilizations of those ecosystems.

Rain-fed farming: The farmland size is large in Konya plain and is impossible to irrigate whole areas by using current water resources. In addition to the low water consuming crops into the current crop pattern, rain-fed farming system is a viable solution in some parts of the region. In that regard, productions of chickpea, lentil, and some cereal cultivars could be growth under rain-fed systems.

Practices of deficit irrigation or pressurized irrigation systems: Deficit irrigation is an applicable practice in sustainable water management in areas with water scant climates. In accordance of our findings of drip-irrigated potato, sugar beet, maize, sunflower and so on [16], up to 25% deficit irrigation resulted none significant yield reduction so that level can be recommended for water shortage regions like Konya plain. Deficit irrigation during the crop growth stages is well meaningful for detection of crops in which stages are

more critical to water stress conditions. In that point of view, deficit irrigation has led to both water and energy savings so it can be taken into considerations in agro-water management works to increase the areas bringing under irrigation with same amount of water utilizations. In order to minimize the pressure on over water usages from the ground water supplies, it is a friendship irrigation program. In one research [1], improving irrigation water use efficiency and usage of marginal waters such as saline, drainage and reclaimed in irrigation are highly recommended for overcoming water scarcity for irrigation. Similarly Seid and Narayanan [17] studied the different water regimes effects on water use efficiency, WUE, and grain yield of maize with various furrow systems under clay-loam soil in Awash Melkassa, Ethiopia. They stated that deficit irrigation increased WUE and it is possible to cultivate additional farmlands having water shortage zones by application of deficit irrigation with great care.

The main target in irrigation for particularly water poor zones is to improve the water savings. In that regard, pressurized irrigation methods are superior over other irrigation techniques under well management. In study [18], drip irrigation resulted great water application efficiency that is very important particularly in water-limited environments. The finding of such study showed that lateral design was also significantly important to obtain satisfactory wetting in soil profile or yield so one lateral use for each crop row led to maximum water productivity for drip-irrigated potato.

Development and introducing of crops having tolerant to the water stress conditions: One of the most important issues in agriculture is selection of crop cultivar best suited to the current environments. Therefore, development of new crop cultivars in which are very resistant to the arid and semi-arid climates is very important to improve agro-production as well as sustainable water management in water shortage ecologies. Those developed crop cultivars will have positive contribution on water productivity in such climate zones. In accordance of report [2] encouraging wider adoption of drought-resistant plant cultivars is viable solution for minimizing adverse effect of climate change on agricultural production in water shortage zones.

Education of farmers about water management at farm level: Efficient water use in farm levels is great interests in water scarcity regions to maximize the water profitability. In that regards, farmers should be educated with rich visual technologies about agricultural water management. In addition, one of the practical ways is to organize farmer's day at farm levels to inform them about efficient water usages in agriculture. Modern irrigation systems have to be introduced to the farmers. In the light of the study [9], education about agriculture is very important role to play for improving water management in farm level and it is very beneficial to train farmers and make them aware about importance of water management in agriculture.

4. Conclusion

Irrigation is the greatest contribution on crop yield and quality in water scant climates. Following practical recommendations can be presented for sustainable agricultural water management in water shortage agro-zones: Increase of farm lands with low water consuming crops, subsidize of low water consuming crops, practicing up to 25% deficit irrigation for some crops likes sugar beet, maize, potato, dry bean, pumpkin, directing of new studies about development of new crop cultivars with resistant to the dry zones, night irrigation practices, and education of farmers about efficient water uses.

Conflict of Interest

The authors declare that there is no conflict of interest.

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