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Analysis of Water Use in Irrigation for Konya-Çumra Province of Turkey

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Abstract— **This study was conducted to determine water management problems of farmers in Konya-Çumraprovince in Turkey. About 50 farmers were interviewed by using questionnaires. Education levels andfarming experience of those farmers, availability of water, training in water management, size of farmland and cost of irrigation and current crop patterns were researched. The results showed that about 46% of the farmers had primary school education, 30 % of them secondary school education, 20 % high school and 4% university education, respectively.Most of the farmers have more than 20 years of farming experience. Surface water supply was not enough in most during the irrigation season so groundwater has been used intensely. Due to the over water extraction from the groundwater supply, there is gradual water depletion in wells. In general farmers have not informed about the efficient water use in agriculture so they have applied to the water to the cropped lands in accordance of their past experiences. Farmlands in most ranges from 10-19 ha. Around 96 % of the farmersstated that cost of irrigation is expensive.Common crops were cereals, grain or silage maize, sugarbeet, sunflower and dry bean. Although, water consumption of maize crop in is high, it is stillthe highest produce crop in terms of land size.In water shortage regions, crop patterns should be planned in accordance of current water supply.**

***Index Terms*— Water management, Irrigation, Water charge, Water saving..**

I. INTRODUCTION

Water, the beginning of life, is an invaluable resource for producing the nutrients that people need for them to obtain energy and maintaining their activities. Indeed water, with such exceptional qualities is a source of sustenance of all biological lives from the smallest organism on earth to the largest living organism. As it is known, although the surface of the earth is covered with three quarters of water the sources of fresh water suitable for human use are very limited. Only less than 1% of the surface water is suitable for ecosystem and human use [1].A significant proportion of the world's population, about 40%, is living in water scant environments. In addition to global warming water consumption is estimated to rise by 50% within 20-25 years [2].Currently agriculture accounts for 70 % of global fresh water withdrawals and more than 90 % of its consumptive use [3]. In Turkey where precipitation and water resources differ in terms of region, time and distribution the agricultural measures or direction to take for climate change is water saving in irrigation. This is because in Turkey agriculture is the single largest consumer of fresh water resources about 75% of total consumption [4]. The most important issue in raising productivity in agriculture is possible with the correct and rational use of agricultural inputs.In increasing agricultural production, apart from processing soil with suitable agricultural tools and equipment's, fertilizer use, plant protection measures and so on, perhaps the most important is irrigation.In irrigation, irrigation does not only serve to meet the nourishment needed by the plant, but at the same time it also helps the crop for other function such as use of fertilizer. In irrigation the basic purpose is to apply water as homogeneous as possible to the plant root zone. It is a necessity in the arid and semi-arid regions of Turkey; and its costs have the highest share of agricultural production costs. This is because of the high-energy cost in Turkey.Topak*et al*. [5-6]stated that total energy use in irrigation was about 60% of the total energy consumption under full and deficit drip irrigated sugar beet irrigation for semi-arid Konya condition of Turkey.The reason behind the excess water use in irrigation in such area was increase of the irrigation lands with the favor of the high water consuming crops.

The objective of this study was to reveal basic irrigation problems in Konya-Çumra province and offering solutions for efficient water use in agriculture.Such a comprehensive study has not been performed at the farmer level before in the region, therefore, findings will be a guide both to the regional farmers and to the related water users in worldwide.

II. MATERIALS AND METHOD

The study was conducted in the Çumraprovince, which is located between latitude 37º 57' N and longitude 32º 78'E. The study area has a terrestrial climate; the summers are arid and hot and the winters are cold andsometimes snowy.The average altitude of the province is 1013 m[7]. The average temperatures of the irrigation season within the plant growth period according to long-term records range from 10.6 and 22.7º C and the average monthly precipitation ranges from 6.1 mm to 45.5 mm. According to the averages for long terms the annual precipitation is about 326mm and only 40% of this amount falls in the plant growth period Yavuz*et al*. [8]. When compared to Turkey in general which has annual precipitation of 643 mm, the rainfall available in Çumra province is not sufficient for crop production. The soils of the research area in general are characterized by clay, clay-loam textureand high lime content with low organic matter. The main crops grown in the province are cereals, sugar beet, maize, sunflower, dry bean etc.

Data were collected from farmers by using questionnaires.

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About 50 farmers were interviewed using the face-to-face technique to find out what are the water related problems they are facing.

III. RESULTS AND DISCUSSION

The result showed that 46% of the farmers had primary school education, 30 % of them secondary school education, 20 % high school and 4% university education, respectively.The rate of university graduates involving in farming was observed to be increasing. This means that university graduates see farming as a profitable sector. The study also revealed that majority of the farmers (76%) has more than 20 years of farming experience (Table 1). Therefore, the farmers in the region can be as exemplary farmers in Turkey.In Table 1, vast majority of the farmlands are between 10-19.9 ha (38%). As the size of the land increases the marginal lane loss and the amount of labor falling in the unit area also decreases. Moreover, as modern farming techniques become easier to implement, production cost is also reduced resulting in the increase of the net farmer income. In the study area,lands in some villages were consolidated, because of this the land-shapes are level and agricultural activities have been performedmore effectively.

The total farm area of farmers surveyed during the study is about 1202 ha. An interesting discovery was that the plant with the most production area in the studied area was found to be maize with about 34%, followed by cereals with about 30%. When we evaluate the crop pattern in terms of water use in agriculture, the ever-increasing production area of maize plants affect the sustainable use of water resources negatively. The maize plant is like sugar beet and alfalfa, it is a high water consuming crops.

Table 1 Farm Landand Farming Experience

Participants		Land Size (ha)						
		0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	>60
Farmer	Number	7	19	8	6	4	3	3
	%	14	38	16	12	8	6	6
Participants		Years of Farming Experience						
		0-10		11-20	21-30	31-40		>41
Farmer	Number	5		7	15	18		5
	%	10		14	30	36		10

The result of the study showed that irrigation interval of the study area depends on the types of crop been irrigated. Crops such as cereals, sugar beets, dry beans, sunflower, alfalfa, and pumpkin plants are generally irrigated by sprinkler irrigation method; whereas in maize, sugar beet and sunflowerplant it was observed that the drip irrigation technique is preferred. The number of irrigation varies between 2-5 depending on the type of cereals. In general, 3 irrigation applications are more commonly identified. The irrigation interval ranged from 10-25 days depending on the environmental conditions.

In sugar beets the number of irrigation ranged from 6-8 and the irrigation interval ranged from 7-25 days. Albayrak et al. [9]suggested the irrigation number of sugar beet crop as 5-6 depending on the irrigation methods for water-starved Konya region. Our finding is slightly higher than the result of those authors. The possible reason might be differences in environmental conditions of growth years. Generally, 10-15 days irrigation interval is mostly preferred for sprinkler irrigated sugar beet crops.

The irrigation interval for dry beans was found to be 7 days. The number of irrigation and irrigation interval for sunflower is 5, and 10-25 days, respectively.

The number of irrigation for maize crop generally is 8; and the irrigation interval is about 10 days on average. Topak*et al.*[10]reported the number of irrigation as about 12 or 13 for drip irrigated grain maize crop in Konya region of Turkey. Our finding was lower than the result of those authors. The reason behind that could be that in recent years duration of irrigation was greater so same amount of water could be applied to the crops.

For Alfalfa plants, the number of irrigation is 2-4 and the irrigation interval is approximately 15 days. In the case of the pumpkin plant the irrigation number is 7 and the irrigation interval is 8-10 days. Observing the irrigation intervals it is not only affected by climate conditions, but also the irrigation cooperatives' time to deliver the irrigation water to the farmers. Sometimes it will take 35 days before the farmers will receive water from the cooperatives. As a result of the increase in the irrigated areas everyday the farmers who are in the lower parts are affected negatively. It is difficult for them to get water on time, and this leads to a loss of production in agriculture.

The most applied irrigation technique in the study area is sprinkler system. Based on the answers obtained from our survey, sprinkler system is widespread in the region because it is economical in the long run and a very useful irrigation technique for field cropsfarming. The sprinkler irrigation systems used in the region are generally portable systems. Recently, modern irrigation techniques such as center-pivots

have also been introduced in the region and increasing day by day. The main reason for the widespread of this system is because it has shown to have high labor saving capacity. Although the initial investment cost seems high, it is quite economical in the long run. In addition drip irrigation systems have become popular toespecially in the irrigation of crops such as maize, sunflower, and tomato.

One of the main irrigation problems observed in the study area during the irrigation season is the high cost of labor even workers are not always available during this time when the demand is very high. As a result, farmers are sensitive to the use of irrigation techniques that require less labor. Another problem encountered in irrigation by farmers is that they do not get the water they need on time, irrigation water from the cooperatives is supplied to farmers in rotation due to limited water,and farmers' water intake interval is very high. The issue that farmers complained the most is the high cost of irrigation 96 % of the farmers interviewed argued that irrigation cost is too high only 4% said is normal (Table 2). Farmers usually take irrigation water from cooperative wells and pay an average of 35-40 TL/h (10 USD/h) for the water they buy from the wells. But if they irrigate using their own wells they pay an average of 19-20 TL/h.Most farmers opt for electricity as a source of energy because it reduces energy cost, when compared with diesel fuel, which has a very high cost. In general, in a season farmer's expenditure for irrigation water plus energy is around 2000 TL/ha in the region. As a solution,underground water resources should be used in safe way so that the plant pattern in the region should be planned according to the available water resources. In addition, the application of deficit irrigation for some crops should be increased.For sustainable use of water resources it maybe advisable for the government to develop some policies to shape the plant pattern first.One of the most important problems in irrigation is the fragmentation of agricultural land and its irregularities. As fragmentation in agricultural land increases, it becomes difficult to carry out an economic agricultural activity; the amount of cost per unit area also increases.A study by Yuceret al.[11]to find out whether land fragmentation was a problem in Turkey for stakeholders and the result was that 75% of them indicated it was a problem, with the highest rates coming from the Marmara and the Central Anatolia regions. Land fragmentation lead to increase in cost and decrease in production [12]. Land consolidation has been done in some places in the study area and it has been observed that the farmers there are doing more profitable agriculture.Therefore, it is advisable to carry out land consolidation on agricultural land. A study by Hiironen and Riekkinen [13] to evaluate the impacts of land consolidation on agriculture and profitability in Finland indicated that average production cost decreases to 15% as a result of land consolidation. Land consolidation is an effective and feasible land management tool for the improvement of farm structures and water management. Lack of water management training also leads to over irrigation consequently wastage of water almost all the farmers interviewed indicated that they have no formal water management training (Table 2).

Table 2 Cost of water and farmers training in water management

Participants		About cost of water		Training in water management		Total
		Expensive	Normal	Yes	No	
Farmers	Number	48	2	0	50	50
	%	96	4	0	100	100

IV. CONCLUSION

Agriculture is the single largest consumer of fresh water resources in the World. The uncontrolled increase in irrigated areas such as Konya-Çumraprovince have affected timely intake of irrigation water by farmers negatively.Thus, in such region, crop patterns should be planned in accordance of current water supply. In addition, a proper training of farmers is also very important role to play in the sustainable use of water resources.Well or correct management of water resources especially in arid or semi-arid regions with large cultivated lands can be strongly recommended for efficient water use in agriculture.

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