



Agriculture and Water Resources of Karaman: Potential, Water Use in Agriculture and Reasons of Water Problems on Konya Basin

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Abstract

In this study, land and water potential with water use status of Karaman situated at Konya Basin, was analyzed with detail. In both Karaman and Konya Basin, efficient uses of land and water resources are necessarily prerequisites for economical and social development for sustainable environment. Like the general of Turkey, there are some problems associated by water use in agriculture. The main reasons of this are that water resources are scant for irrigation of whole lands in Karaman due to the existence of semi-arid climate and agricultural drought within basin. According to the results, the water used in Karaman agriculture is higher than the available water potential, and excess water has been extracted from the groundwater resources. The main reason of excess water use is the increase in areas opened to irrigation.

Key words: Karaman, water potential, irrigation, water in agriculture.

INTRODUCTION

Konya Closed Basin, KCB, one of the important water basins of Turkey has 280 mm to 350 mm (almost arid climate) in most parts [7]. Therefore, total semi-arid lands of the world are 14.2% and Konya basin is located in these areas [1]. Annual available water potential of basin is 750 m³/ person so basin is called as water poor basin. This is an indicator that water resources must be used efficiently. Present irrigated agriculture has resulted excess uses of basin water resources [7,9,12]. The reasons of excess water use in agriculture are; increase of irrigation areas of high water consuming crops and adding new crops to the basin crop pattern [11]. Some studies [9-11] showed that irrigation areas have expanded unplanned and senseless in basin and these are resulted from unregistered 70 000 public wells. This has caused 1.4 billion m³ excess water extractions from basin groundwater resources [12].

The increase water use in basin agriculture has resulted significant problems, such as wiping out groundwater resources, declining water levels in some lakes, and completely drying of some water-ecosystems.

In this study, therefore, present land and water potential of Karaman province, agricultural potential, and water use in agriculture were analyzed with detail and the effects of water uses on excess water consumptions were discussed by comparison.

KARAMAN in KONYA BASIN

General information

KCB is one of the 25 river basins of Turkey and covers most parts of Konya, Karaman, Niğde, and Aksaray provinces and accounts of 5.6% of total surface area of Turkey.

Karaman province is situated southern part of basin with 940 000 hectares (ha) surface area. The districts of Karaman namely Ermenek, Sarıveliler and Başyayla are out of the basin whereas Ayrancı, and Kazımkarabekir, most parts, are within the basin.

Karaman is the second grade drought region of Turkey according to the climate characteristics. Some long term climate data of Karaman are given in Table 1.

As seen Table 1, annual rainfall is 316 mm in Karaman province. The rainfall during the vegetation period is 105 mm and accounts of 33% of total rain. By evaluation these, Karaman is drought for summer crops and fruit gardens. Irrigation is necessarily prerequisites for various crop production, yield and quality.

Land potential and agricultural status

Total arable land potential of Konya basin 2.754 million ha and 290 000 ha of this is within Karaman province [2]. It is equal to 1.14% and 10.5% of Turkey and basin general, respectively. Most parts of arable land are in Ayrancı, and Kazımkarabekir districts. The irrigable

Table 1. Averages of Long Terms Climate Data (1975-2005)

Meteorological Records	Months												Years
	1	2	3	4	5	6	7	8	9	10	11	2	
Temperature, °C	0.3	1.7	5.5	11.5	16.1	20.5	23.7	23.0	18.7	12.8	6.1	2.4	11.9
Rainfall, mm	36.2	33.3	35.8	34.5	39.2	21.0	5.1	6.1	4.8	23.5	34.3	42.4	316.3
Relative Humidity, %	75.7	72.8	65.2	58.0	55.9	49.4	45.3	46.0	51.0	60.2	70.0	74.8	60.4
Wind Speed, m/s	2.2	2.4	2.5	2.7	2.3	2.3	2.4	2.2	1.9	1.8	2.0	2.2	2.2

lands are 140 000 ha, 50 000 ha and 22 000 ha in Ayrancı and Kazımkarabekir districts of Karaman, respectively.

Dry farming is mostly dominated due to the low rainfall amount and its distribution through the year in Karaman. Sometimes very severe drought has observed and cereals are very common crops. In arable lands opened to irrigation, wheat is top growth crop followed by sugar beet, grain and silage maize, dry bean and fruit gardens.

Water resources potential

The important factor restricted to agricultural production of Karaman is low rainfall and contribution of this to the agriculture is small during the vegetation period. As mentioned above, irrigation is necessarily prerequisites for various crop production, yield and quality. In such regions, availability of water resources for irrigation is quite important. Available water resources potential of Karaman is presented in Table 2.

Table 2. Available Water Resources Potential of Karaman [7]

Water Resources	Available Water (million m ³)	Developing Water (million m ³)	Total (million m ³)
Surface	55	63	118
Groundwater	180	-	180
Total	235	63	298

As seen Table 2, like basin general, Karaman is water poor province. Available water potential of Karaman is 10.2% of total basin general. It is 235 million m³ and 77.5% of this is obtained from groundwater resources. There is an effort that 63 million m³ additional surface water will be developed.

The available and developing surface water of Konya province have planned for irrigation purposes. The active surface water resources used irrigation has obtained from Ayrancı and Gödet Dams. In addition, Dokuzyol small dam within Ayrancı district was built for irrigation of 30 ha land, but it has not stored enough water due to the deficiency in storage and low rainfall. Therefore, it has not considered in our evaluation. By development of İbrala and Deliçay dams, 63 million m³ additional water will be used. The some part of water obtained from Deliçay dam within Karaman-Kurtderesi will be used as drinking-residential purpose.

Safely available groundwater potential of 182 million m³ water has been used by active 38 groundwater cooperatives in irrigation [6] and in residential areas as drinking-residential purpose.

IRRIGATION in KARAMAN and AVAILABILITY of WATER RESOURCES

Irrigation area

The information obtained from different officials related to lands opened for irrigation in Karaman province is very different. According to 2001 agricultural records [2], irrigated land potential of Karaman is 77 636 ha and 53 724 ha of this is field crop production area. In another literature [3], it is almost 150 000 ha. The difference between those two records is very high and disagreement. In this evaluation, land size opened to irrigation was obtained from General Directorates of State Hydraulic Works. The present irrigation organizations those are responsible available water potential of Karaman are given in Table 3.

In Table 3, irrigated areas by Water User Associations and 38 Ground Water User Associations are 21 438 ha and 31 391 ha, respectively. The number of public wells used in management of groundwater resources is also common. The active 3 408 wells of total 6385 is unregistered [10]. None records are available about the size of lands irrigated by those wells. By considering land size, parcel number, basin public irrigation and number of wells [4], average irrigated area per public well was estimated. By use this value, the public irrigation area has found as 22 604 ha. Therefore, Total area opened to irrigation has obtained as 75 433 ha.

The sprinkler irrigation has used as 50% in irrigation of sugar beet, potato, dry bean and cereals. Surface irrigation has used in rest of area for irrigation of cereals, maize and sunflower planted areas; surface and drip irrigation have used in fruit gardens. The farmers of Karaman have 11 589 sprinkler and 3 952 drip systems [5].

Irrigation applications of Karaman obtained from Provincial Directorate of Agriculture and observations in province are presented in Table 4.

Table 3. Land Size Opened to Irrigation at Karaman Province.

Irrigation Organization	Organization and Managed Well Number		Water resource	Irrigation Area, (ha)
	No of Organization	No of Well*		
Water User Association	2*	-	Surface	21 438*
Water User Association	38*	734	Groundwater	31 391*
Public Irrigation	5651**	5651 (2222 ^a +3408 ^b)	Groundwater	22 604***
TOTAL				75 433

a: Registered; b: Unregistered (İşçioğlu, 2008). *: Anonymous (2007) **: İşçioğlu 2008).

***: Estimated by Konya General Directorates of State Hydraulic Works Records

Table 4. Irrigation methods and Number of Irrigation.

Crop	Irrigation Method	Number of Irrigation
Cereals	Surface	3-4
	Sprinkler	4
Sugar beet	Sprinkler	10
	Drip	8-10
Maize	Surface	5
	-	
Bean	Sprinkler	8
	Drip	8
Sunflower	Surface	4
	-	
Fruit	Surface	6
	Drip	7-45

Crop pattern in irrigation area

Crop pattern in irrigated areas were evaluated by Turkish Statistical Institute, Karaman Provincial Directorate of Agriculture, Ayrancı and Karaman Local Directorate of Agriculture for Karaman center and Ayrancı and Kazımkarabekir plains. Crop pattern for irrigated areas is an average of 2008-2009 years. Crop pattern, crop water requirements, and irrigation water requirement and water used in irrigation are presented in Table 5.

As seen Table 5, cereals are main crop in Karaman province with 50% production area. The most of the cereals are growth for macaroni sector. The pattern of fruit is about 20% and apple trees are very widely growth. In irrigated areas, sugar beet cropped land has increased over 10 000 ha with 15% crop pattern. The total pattern

of maize, bean, sunflower and potato is almost 15%. In current pattern of irrigated areas, low water consuming wheat is highly dominated. The water requirement of irrigation area is estimated as 344 mm. The one third of water requirement is of sugar beet and planting area of this crop has increased gradually.

Water requirement of irrigation area and water use

Irrigation water requirement and water used in irrigation of irrigation areas of Karaman plain were calculated by use Table 5 data and results are given Table 6.

In Table 6, net water requirement of opened irrigation areas in Karaman plain has calculated as 259.5 million m³. The cereals and sugar beet have the highest water requirements as 74.8 and 76 million m³, respectively. Total applied water for plain irrigation has estimated as about 400 million m³. The highest water consuming crops are cereals and sugar beet as 62.5%. In plain, excess water use is present especially in cereals irrigation.

The available water potential, water requirement of crop pattern in irrigated areas and applied water data were compared and Table 7 is designated for doing required evaluations.

In Table 7, net irrigation water requirement of areas opened to irrigation of Karaman plain is higher than available water potential. This is a great inverse about efficient water resources uses. Evapotranspiration of irrigation area is 25 million m³ higher than current available water potential. Farmers have applied about 400 million m³ water to meet evapotranspiration. In

Table 5. Technical Details Related to Crop Pattern of Irrigation Area

	Crop Pattern						
	Cereals	Sugar beet	Maize	Bean	Sunflower	Potato	Fruit
Pattern,%	49.6	14.4	7.1	6.7	1.3	1.3	19.55
Evapotranspiration, mm*	450	812	610	460	684	550	900
Water Requirement, mm	200	700	510	400	550	450	700
Applied Water, mm**	380	1000	900	650	720	750	750
Average Net Water Requirement,mm	99.2	100.4	36.2	26.8	7.1	5.85	68.2
	344						

*: Anonymous (1982)

** : Estimated by data obtained from study region.

Table 6. Water requirement of irrigation area and applied water

	Crop Pattern						
	Cereals	Sugar beet	Maize	Bean	Sunflower	Potato	Fruit
Planting area, ha	37 401	10 855	5 368	5 063	1 000	1 000	14 746
Water requirement, million m ³	74.80	75.98	27.37	20.25	5.50	4.50	51.61
Applied Water, million m ³	142.12	108.55	48.31	32.91	7.20	7.50	55.29
Total Water Requirement, m ³	259 489 520						
Total Applied Water, m ³	401 892 300						
Irrigation Efficiency, %	64.6						

this case, almost 167 million m³ (402-235=167) extra evapotranspiration is present. This excess water has extracted from groundwater resources. Since, there are only two surface irrigation systems (Gödet and Ayrancı irrigation systems) and maximum 55 million m³ water can be used from those sources. Last 3-5 years, those dams have stored insufficient water and give remarkably low water for use.

Irrigated agriculture in Karaman plain has resulted excess water extraction from groundwater resources. The extraction of water from groundwater resources is 347 million m³ (402-55=347). The reasons of excess water consumption in province are follows:

1. Crop pattern of irrigation area has no effect on excess water use. Since, water requirement of such crop pattern is quite low as almost 344 mm.

2. The main reason of excess water use is the size of the land opened to irrigation. By considering the available water potential of province, irrigation area should be 45 000 ha (235x106/0.532=44 173), but, it is 75 000 ha.

3. It is obvious seen that irrigation applications of local farmers have effect on excess water use. Since, the groundwater wells has the share of 86% to irrigate the 75 000 ha area opened to irrigation. Under this condition, estimated 64.6% irrigation efficiency is low. It is possible to obtain 75% irrigation efficiency by well management of sprinkler and drip irrigation methods. It means that almost 70 million m³ less water will be used from groundwater resources.

Table 7. Water Requirement of Karaman Plain and Comparison of Water Uses

Water Resources	Available Water Potential, (million m ³)	Water Requirement of Irrigation Areas, (million m ³)	Water Use in Agriculture, (million m ³)
Surface	55		
Groundwater	180		
Total	235	259.5	401.9

EFFECTS of KARAMAN IRRIGATION on WATER PROBLEMS

As we all know that water resources of Konya basin are scant, and 12% of arable lands of Turkey are in this basin. According to Anonymous (2010c), the area opened to irrigation is 570 843 ha. In this area, irrigation water requirement of current pattern is 2.65 billion m³ and water used in irrigation is 3.78 billion m³ [12]. The available water potential for basin agriculture is 2.308 billion m³ [7]. By this evaluation, 1.472 billion m³ (3.78-2.308) excess water has been used from basin resources and this excess water has extracted from groundwater resources.

The uses status of groundwater resources of basin general and Karaman province are summarized in Table 8.

In present, water extractions from groundwater resources are 2.88 and 0.347 billion m³, respectively. The effect of Karaman irrigation on extracted water is 12%. The excess extractions from groundwater resources are 1.472 and 0.167 billion m³ in basin general and Karaman province, respectively. The effect of Karaman on excess water extraction of basin is almost 11%.

CONCLUSION

Like the Konya basin, water scarcity is present in Karaman. In currently, farmers can not obtain water with desired time and amount. Since, groundwater level

Table 8. Information About Groundwater Use in Basin General and Karaman Province, (billion m³)

Groundwater Resources	Karaman Plain	Basin General	Share of Karaman, %
Available water	0.180	1.408	12.8
Extracted Water	0.347	2.88	12.05
Excess Extraction	0.167	1.472	11.3

has reduced gradually and never reached the former level. This is a good example showed that groundwater resources are finite source.

Present water resources are not enough for areas opened to irrigation in province. The area opened to irrigation has increased unplanned. To sustain the present irrigation areas, it is compulsory to make solutions in a short period. Manageable and sustainable irrigation plans, high irrigation efficiency in farmer irrigation applications, subsidizing of deficit irrigation programs are necessarily prerequisites.

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