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Performance assessment of transferred irrigation management: Case study of Düzce Irrigation District in Turkey

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In this study, physical and financial performance criteria of transferred irrigation management of Düzce Irrigation District were evaluated between 2006 and 2012. Physical and financial performances are irrigation ratio and sustainability of irrigated land, and cost recovery ratio, maintenance expenditure to revenue ratio, operational cost per unit area, total cost per personnel employed on water delivery, revenue collection performance and service area per personnel, respectively. The analysis results indicated that irrigation ratios were between 12.8 to 23.2% while sustainability of irrigated land rates were between 1.33 to 2.40 for the studied years. On the other hand, cost recovery ratio and revenue collection performance values were changed between 56.4 to 89.4 and 70.9 to 93.2%, respectively. Moreover, maintenance expenditure to revenue, operational cost per unit area, total cost per person employed on water delivery and service area per personnel had between 4.8 to 24.4%, 111.3 to 183.9 US$ ha^{-1}, 7288.5 to 13168.8 US$ ha^{-1} and 116.9 to 234.9%, respectively. As a conclusion, it was stated that transferred irrigation management for Düzce Irrigation District does not have enough financial and physical performances and needs recovery.

Key words: Sustainability, irrigation ratio, operating cost, water delivery, Düzce.

INTRODUCTION

Water is a precious resource for agricultural production and unavoidable component for food security. Therefore, water scarcity and abuse create a serious threat to life and sustainable development. Increasing yield in many places to sustain food production depends on irrigation, as water is the limiting factor around the world. For that, water protection and development are considerable for irrigation opportunity (Sampathkumara et al., 2012).

Irrigation is the most important factor in agricultural development strategy in Turkey. This importance is growing steadily considering dependence of the country's industry on agriculture. Water sources decrease day by day in Turkey because of increasing population as in the whole of Middle East. It is not only due to industrialization but also with global warming and the lack of uniformity in the distribution resources within the country, it increases the severity of this problem quickly (Çakmak and Aküzüm, 2006).

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Figure 1. Location of Düzce Area in Turkey.

A total of 28.05 million ha is arable out of the total area of 78 million ha in Turkey. A total of 25.75 million ha of agricultural area can be irrigated. Economically, Turkey's potential surface and groundwater resources are sufficient for irrigating a land area of 8.50 million ha; 4.89 million ha of which was opened to public and private irrigation presently. 94% of the irrigated area is irrigated by means of open canal systems while 6% of that uses pressurized irrigation systems in Turkey (Anonymous, 2008).

In Düzce Area, 36% in the total irrigation area of 22,250 ha is irrigated. Düzce Irrigation District uses 78% of the total irrigated area. Between 5 and 10% of the irrigated area is irrigated by means of pressurized irrigation systems in Düzce Irrigation District (Özmen, 2013).

During the last two decades, there has been an increasing amount of effort to transfer the management of irrigation schemes from government organizations. However, irrigation management transfers that are initiated by governments have had poor management performances, lack of operational and maintenance funds and/or very low water charge collection from the farmers (Kloezen and Samad, 1995). Therefore, some of performance analyses such as physical and financial performances need to be searched in the transfer irrigation management.

Dorsan et al. (2004) studied about some physical, economic and institutional performance criteria of transferred irrigation schemes of Lower Gediz Basin for pre and post-transfer periods in Turkey. Researchers found out that all performance criteria was changed positively but the most positive change has occurred in the collection of irrigation fee (Yercan et al., 2009). Similar results were obtained by Nalbantoğlu and Çakmak (2007) in the Central Anatolia Region.

Şener et al. (2007) assessed the performance of Hayrabolu Irrigation Scheme of the Thrace district in Turkey. They found economic performance indicators showed that the scheme had a serious problem about the collection of water fees. Additionally, it was achieved that physical performance, evaluated in terms of irrigation ratio and sustainability of irrigated land, were poor in this study. However, Şener (2012) pointed out that the irrigation management transfer program increased the system performance and the schemes have become more self-sufficient under the management of Water User Associations (WUAs) in another study in the same region.

In this sense, such investigation has so far not been done in Düzce Area. Hence, the aim of this study is to evaluate physical and financial performance criteria of Düzce Irrigation District using transferred WUAs from State Hydraulic Waters (SHW) for the years between 2006 and 2012 in the Düzce area localized in the northern Turkey.

MATERIALS AND METHODS

In this research, Düzce Irrigation District serving under the fifth SHW regional directorate after the year of 2005, which is located in Düzce Area in Turkey, was examined (Figure 1). Annual average precipitation for the last 40 years in the studied area is 814 mm.

Table 1. Long term and annual rainfall (mm) between 2005 and 2012 in studied area.

Months	Long term average rainfall (Last 40 years)	2006	2007	2008	2009	2010	2011	2012
January	82.6	66.2	100.8	76.6	66.4	101.2	68.4	59.1
February	70.1	54.7	28.4	17.2	86.2	105.3	21.2	119.1
March	71.6	48.7	92.2	89.4	90.9	97.7	104.5	84.6
April	59.6	7.2	34.5	13	48.7	67.7	88.3	39.6
May	61	39.4	56.5	66	25	65.7	39	74.6
June	57.2	33.2	84.4	13	37.4	96.6	61.3	38.4
July	44.2	8.8	28.8	22.8	94.8	7.4	18.7	23.1
August	52.8	4.2	34.2	0.0	9	2	33.8	90.6
September	48.3	101.9	14.4	120.2	149.3	69.1	17.6	0.4
October	83.5	34.2	67.2	73	57.4	137.2	64.2	51.1
November	84.5	67.2	85.8	46.4	56.3	10.5	22.6	44.8
December	98.7	61.3	58.2	90.2	77.5	120.8	62.1	129.5

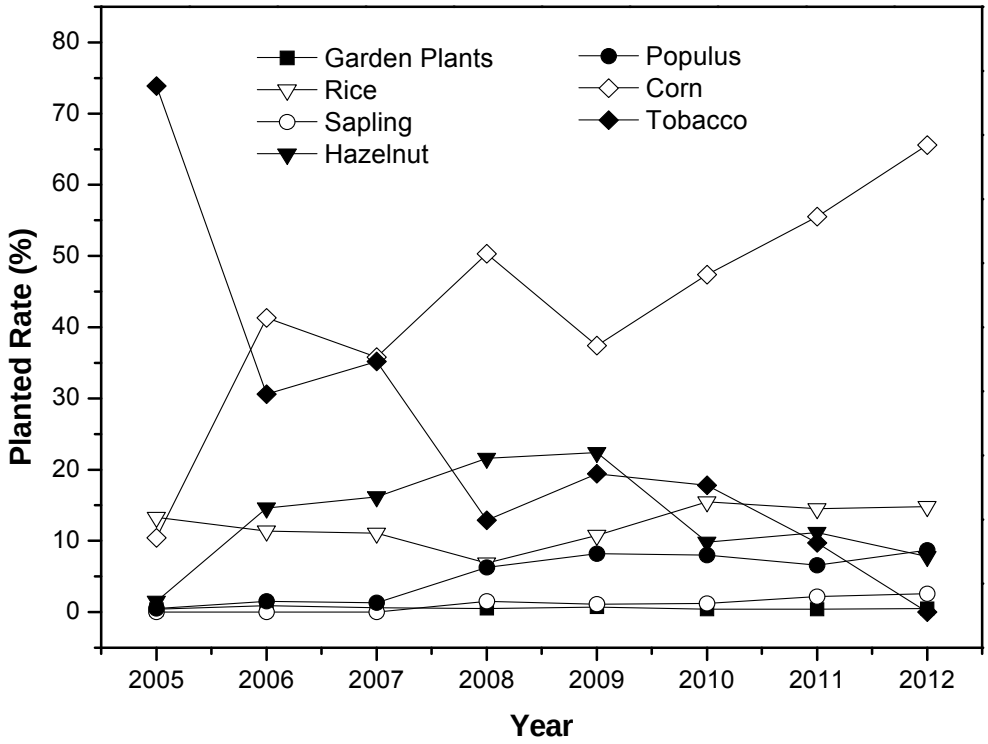

Figure 2. Planted rate in the Düzce area between 2005 and 2012.

Monthly average precipitations for the long term and studied years are given in Table 1 (Anonymous, 2013).

In the studied area, hazelnut, corn, populous, sapling, tobacco and garden plants are generally planted (Anonymous, 2012a; Figure 2). However, tobacco planting rate is decreased from 2005 to 2012 while corn planted rate is increased in the same period but others stayed the same thanks to policy of government.

Düzce Irrigation District was assessed for their physical and economic performance criteria. The analysis is based on time series. Time series covering a period of 7 years were collected to measure any change in performance over time at the scheme level. Performance criteria (Malano and Burton, 2001) are given in the Table 2. Related data for this research were taken from records of SWH fifth Regional Directorate and Düzce Irrigation District Presidency (Anonymous, 2012b). The currency unit was converted from Turkish Liras to American Dollars using the Central Bank of Turkish Republic's foreign exchange rate.

RESULTS AND DISCUSSION

Irrigation ratios of Düzce Irrigation District between 2006 and 2012 according to the records of the SWH in the

Table 2. Selected performance indicators**.**

Activity area	Performance indicator	Data required
Physical performance	Irrigation ratio	Irrigated area/Irrigation area
	Sustainability of irrigated area	Irrigated area/Initial irrigated area
Financial performance	Cost recovery ratio	Total revenue collected from water users/Total management, operation and maintenance cost
	Maintenance expenditure to revenue ratio	Total maintenance expenditure/Total revenue collected from water users
	Operating cost per unit area ($ ha^{-1})	Total management, operation and maintenance cost/Total command area serviced by the system
	Total cost per person employed on water delivery ($/person)	Total cost of management, operation and maintenance personnel/Total number of people employed
	Revenue collection performance	Total service revenue collected/Total service revenue due
	Service area per personnel (ha/person)	Total command area serviced by the system/ Total number of management, operation and maintenance staff

Table 3. Irrigation Ratios of Düzce Irrigation District.

Years	Irrigated area (ha)	Irrigation area (ha)	Irrigation ratios (%)	Sustainability irrigated area rate
2006	1644.6	11000.0	15.0	1.55
2007	1717.5	11000.0	15.6	1.62
2008	2547.5	11000.0	23.2	2.40
2009	1934.0	11000.0	17.6	1.83
2010	1766.7	11000.0	16.1	1.67
2011	1712.2	11000.0	15.6	1.62
2012	1403.3	11000.0	12.8	1.33

Table 4. Cost recovery ratio of Düzce Irrigation District.

Years	Total revenue collected from water users (US$)	Total maintenance operating management cost (US$)	Cost recovery ratios (%)
2006	161838.5	183062.9	88.4
2007	206519.2	305310.0	67.6
2008	286969.5	320984.4	89.4
2009	180440.9	258229.2	69.9
2010	211007.3	265491.3	79.5
2011	184900.6	264219.6	70.0
2012	145461.8	258078.7	56.4

study area are given in Table 3. Ratios are similar to results of works by Yercan et al. (2004) but are mostly lower than study reported by Çakmak (2002) and Şener et al. (2007) due to regional conditions.

Sustainability irrigated area rates were changed between 1.00 to 2.40 during studied years. The highest rate was in the year 2008 with value of 2.40 because of higher irrigated area comparing with initial irrigated area (Table 3). The reasons for lower values of sustainability irrigated area rates could be due to land degradation by drainage problems and misuse of land or management problem. Study results are similar to values of study by Dorsan et al. (2004).

Cost recovery ratio was maximum in the year 2008 with 89.4% (Table 4). Data shows that the total revenue collected from water users were insufficient to cover the maintenance operation management costs in this study. However, Beyribey (1997) pointed out that average cost recovery ratio of the country was 65%. Hence, cost recovery ratio results of this study seem acceptable but

Table 5. Maintenance expenditure to revenue of Düzce Irrigation District.

Years	Total maintenance cost (US$)	Total revenue collected from water users (US$)	Maintenance expenditure to revenue ratio (%)
2006	31874.1	161838.5	19.7
2007	26421.5	206519.2	12.8
2008	25237.5	286969.5	8.8
2009	8635.7	180440.9	4.8
2010	18965.3	211007.3	9.0
2011	45106.0	184900.6	24.4
2012	21428.7	145461.8	14.7

Table 6. Operating cost per unit area of Düzce Irrigation District.

Years	Total maintenance operating management cost (US$)	Irrigated area (ha)	Operating cost per unit area (US$ ha^{-1})
2006	183062.9	1644.6	111.3
2007	305310.0	1717.5	177.8
2008	320984.4	2547.5	126.0
2009	258229.2	1934.0	133.5
2010	265491.3	1766.7	150.3
2011	264219.6	1712.2	154.3
2012	258078.7	1403.3	183.9

Table 7. Cost per personnel of Düzce Irrigation District.

Years	Total cost of maintenance-operating-management personal (US$)	Total number of people employed person	Cost per personnel (US$/person)
2006	42428.7	5	8485.7
2007	72884.6	10	7288.5
2008	108515.6	11	9865.1
2009	124198.1	11	11290.7
2010	131688.0	10	13168.8
2011	109891.7	9	12210.2
2012	126706.7	10	12670.7

should be recovered.

The highest maintenance expenditure to revenue ratio was obtained in the year 2011 with 24.4% (Table 5). For this study, the results are higher compared with study of Nalbantoğlu and Çakmak (2007). However, revenue collected from water users seems sufficient to maintenance costs during the studied years (Table 5).

Regarding the operational-cost per unit irrigation area, the highest cost per unit area was obtained from the year of 2012 with US$ 183.9 ha^{-1} (Table 6). Values are higher than the studies done before (Çakmak et al., 2010). Total maintenance operating management costs are higher according to irrigated area in the study area.

The highest cost per personnel was provided in the year 2010 with 13168.8 USD per person (Table 7). Labour costs are generally higher for all year in the study years.

The highest revenue collection performance was estimated for the year 2007 with 93.2% (Table 8). Revenue collection performance values are mostly over 80% during the studied years except last year. Similar results were reported by Yercan et al. (2009). Obtaining results showed that revenue collection performances seem sufficient but not enough during the years in this study.

The highest values of service area per personnel were found in the year 2006 with 211.8 ha $person^{-1}$ (Table 9). The number of labour for an irrigation scheme should be less than 3 per 1000 ha of irrigated land for an efficiency consideration (Yercan et al., 2009). However, the current data analysis implies that more than enough people are employed for the study area (Table 9). Therefore, service areas per personnel values of the study area are higher for that reason.

Table 8. Revenue collection performance of Düzce Irrigation District.

Years	Total collected water fee from the users (US$)	Total water fee to be collected (US$)	Revenue collection performance (%)
2006	161838.5	187412.6	86.4
2007	206519.2	221538.5	93.2
2008	286969.5	342187.5	83.9
2009	180440.9	218831.2	82.5
2010	211007.3	243333.3	86.7
2011	184900.6	215476.2	85.8
2012	145461.8	205056.2	70.9

Table 9. Service area per personnel of Düzce Irrigation District.

Years	Irrigated area (ha)	Total number of personnel employed in operation and maintenance	Service area per personnel (ha/person)
2006	1644.6	7	234.9
2007	1717.5	12	143.1
2008	2547.5	13	196.0
2009	1934.0	13	148.8
2010	1766.7	12	147.2
2011	1712.2	11	155.7
2012	1403.3	12	116.9

Conclusion

The results of this study showed that total revenue collected from water users were not sufficient to meet the maintenance operation management costs but were generally sufficient to meet maintenance cost during the studied years. Moreover, operating costs per unit irrigation area and cost per personnel were found higher in the ending of studied years. However, revenue collection performance results were over 70%, which seems sufficient. Concerning service area per personnel, it can be explained that all irrigation services have excess employed personnel thanks to distribution network of irrigation scheme. Conclusively, physical and financial performances need further studies.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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