Araştırma Makalesi
(Research Article)

Ege Üniv. Ziraat Fak. Derg., 2016, 53 (2):133-137
ISSN 1018 – 8851

Duygu AKTÜRK[1]
Murat METİNER[2]
İlkin SHIRVANLI[1]
Batuhan ÇOBANOĞLU[1]

[1]Çanakkale Onsekiz Mart University, Agricultural Faculty, Agricultural Economy, 17100, Çanakkale / Turkey
[2]Çanakkale Onsekiz Mart University, Agricultural Faculty, Agricultural Structures and Irrigation, 17100, Çanakkale / Turkey
corresponding author: akturk@comu.edu.tr.

Economic Assessments for Transition to Closed-Piped System: The Case of Truva Irrigation Association

Kapalı Borulu Sulama Sistemine Geçişin Ekonomik Yönden Değerlendirilmesi : Truva Sulama Birliği Örneği

Alınış (Received): 12.01.2016 Kabul tarihi (Accepted): 23.02.2016

Key Words:

Transition to piped network, economic assessment, water use efficiency

ABSTRACT

In this study, the increase in water-user revenues with transition to closed-piped system was calculated and the how much of the transition cost can be met with this increase in association and water-user revenues were assessed. Truva Irrigation Association was used as the study material. Based on 2009 data, the association was using open-canal irrigation scheme with irrigation efficiency of 54%, irrigation ratio of 92%, amount of water applied to per unit area of 9 343 m^3/ha and accrued water fee of 171 839 $. Assuming a transition to closed-piped system and an irrigation efficiency of 90%, irrigation ratio would increase to 100%, amount of water applied to per unit area will decrease to 5 081 m^3/ha and accrued water fee will increase to 187 050 $. A water saving of 4 624 502 m^3 will also be possible with this transition. Considering the cost of transition to closed-piped system as 5 000 $/ha, it was calculated that the association could reimburse this transition cost in 42 years in case it used all the revenues for reimbursement of transition costs.

Anahtar Sözcükler:

Borulu şebekeye dönüşüm, ekonomik değerlendirme, su kullanım etkinliği

ÖZET

Bu çalışmada, yüzey sulama sistemi yerine kapalı borulu sulama sistemi kullanıldığında suyu yöneten birliğin ve su kullanıcıların ekonomik açıdan elde edeceği katma değer ile birliğin ve su kullanıcıların, sistem dönüşüm maliyetinin ne kadarını karşılayabileceği ortaya konulmuştur. Bu durumu belirleyebilmek için Çanakkale ilinde bulunan Truva Sulama Birliğinde çalışılmıştır. Birliğin 2009 yılı verilerine göre, hali hazırda açık kanallı sulama sistemi ile sulama randımanının %54, sulama oranının %92, birim alana verilen suyun 9 343 m^3/ha ve tahakkuk eden su ücretinin 171 839 $ olduğu buna karşın şebeke borulu sisteme dönüştürüldüğü ve sulama randımanının %90 olduğu varsayımıyla sulama oranı %100'e çıkacak, birim alana verilen su 5 081 m^3/ha'a düşecek ve tahakkuk eden su ücreti 187 050 $'a yükselecekti. Ayrıca 4 624 502 m^3 su bir sonraki yıla kalarak tasarruf edilmiş olacaktı. Kapalı sisteme dönüşüm masrafının hektara 5 000 $ olarak gerçekleştiğini ve birlik yönetiminin elde edeceği su ücretlerinin tamamını dönüşüm masrafında kullanacağını düşündüğümüzde sistem maliyetinin geri ödemesini 42 yılda gerçekleştirebileceği hesaplanmıştır.

INTRODUCTION

Current common scenarios on global warming, climate change and resultant droughts impose an ever-increasing burden over food industry and accordingly on agricultural and livestock sectors. Such a burden is largely experienced in irrigated agriculture-practicing facilities. Thus, water use efficiencies of these facilities should definitely be improved to relieve such burdens.

To improve water use efficiencies, scientific modern methods should be used by water-user organizations and individual farmers.

Considering the water conveyance and distribution networks used in DSI-operated and transferred irrigation schemes, it was observed by the year 2013 that only 13.4% was composed of piped networks and the remaining 86.6% was composed of surface irrigation networks with lined or unlined canals and canalatte. By the end of the year 2013, of the production sites receiving and using water from these networks, 76% was using surface gravity irrigation methods and the remaining 24% was using pressurized irrigation methods. Average irrigation efficiency was 46% in these irrigation practices (DSI, 2015). Water conveyance efficiency can be 100% in piped networks, water application efficiency in such networks can be between 80-90% and thus water use efficiency of 80-90% can be achieved in closed-piped irrigation schemes.

Water-user organizations with open-canal irrigation networks are spending efforts to convert these systems into closed-piped systems to irrigate more land area with the same amount of water, to prevent water losses through evaporation and deep percolations and to exert more control over the water. However, such a conversion costs about 5000$/ha and that much high costs land the organizations with great difficulties.

Tekiner and Aktürk (2010) carried out a study by using 2008 data of Bayramiç-Ezine Plains Irrigation Associations to assess the economic aspects of transition to piped systems. Researchers considered the possibility of having three different irrigation efficiencies as of 70, 80 and 90% and calculated the increase in accrued water prices respectively as 135, 169 and 191%.

Körpe and Tekiner (2014) carried out a similar study in Bursa for Mustafakemalpaşa Villages Irrigation Association and indicated that association administration was alone able to pay the cost of transition. In other words, researchers indicated that association could pat the cost of transition with the accrued water prices in 9.1 years when the efficiency was 70% and in 8.5 years when the efficiency was 80-90%. They also indicated that reimbursements paid by association administration and water-users together will shorten the payment duration, minimize water losses through conveyance and distribution lines, ease maintenance and repairs, reduce the costs, provide equitable water allocation and facilitate the transition to volume-based pricing.

The present study was conducted by using the data of Truva Irrigation Association of Çanakkale Province to assess how much of the transition cost can be covered by the association administration and water-user with the potential value-added gain of association administration and water-users with the transition from surface irrigation system into closed-piped irrigation system.

MATERIAL and METHOD

Truva Irrigation Association over Çanakkale Kumkale Plain within the operational boundaries of DSI 25th Regional Directorate was selected as the study material (Table 1).

Bayramiç Dam constructed over Karamenderes creek in North Aegean watershed supplies water to Truva Irrigation Association. The association is responsible for irrigation of 1 574 ha (1 332 ha gravity irrigation and 242 ha pumping irrigation) land area with 89.2 km lined main canal and 238.7 km canalatte tertiary canal. The irrigation scheme opened for operation in 2002 and transferred to water-user association in 2003. Service is provided to 505 obligated of 10 villages of central town. Average plot size is about 3 da in irrigation district. Despite annual changes, maize, vegetables, saplings, sunflower and forage crops constitute the basic cropping patters over the irrigation district (Anonymous, 2014).

The data of the year 2009 were used in this study to calculate how much of the transition costs to closed-piped system can be met with all of the revenue obtained from the water charges and to assess the potential contributions of the increases in revenues through irrigating more land area with the transformed system. Interest and inflation rates were not taken into consideration in these calculations.

While calculating the revenues of the association, post-transition irrigation efficiencies were assumed to be 70, 80 and 90%.

Table 1. Data on Truva Irrigation Association for the year 2009

Irrigable land	15 740 da
Irrigated land	14 460 da
Water diverted to scheme	13 510 606 m^3
Irrigation ratio	92%
Irrigation efficiency	54%
Number of beneficiaries	505 people
Average plot size	3 da

Amount of water diverted to the scheme (m^3), amount of water per hectare (m^3/ha), irrigation water need (m^3/ha) and irrigation efficiency (%) values were taken from "2009 DSI-Operated and Transferred Irrigation Schemes Assessment Report"; irrigable land (da), irrigated land (da), irrigation ratio (%) and average water charge (TL/da) values were taken from "Monitoring and Assessment Report". Only the water charges were considered while calculating association revenues and the other revenues were not taken into consideration.

Total production value was calculated for the same cropping pattern and the total revenue of the water-users were calculated by considering the potential increase in water-user revenues through the increase in irrigated lands with transformed system and the value-added to be created in their revenues. Revenues were calculated both in TL and in USD ($). Since water fee collections were performed in October, average dollar exchange rate for October 2009 of Central Bank of Republic of Turkey was considered in calculations (TCMB, 2009).

The plant species, cultivation ratios (%), average yield (kg/da) and unit prices (TL/kg) used in calculating water-user revenues were taken from "2009 DSI-Constructed and Operationalized Irrigation and Drying Facilities Product Census Results".

The parameters in Table 1 were calculated as follows:

Accrued water fees (TL) = Average water charge (TL/da) x Irrigated land (da)

Irrigated land (da) = Diverted water (m^3) / Net irrigation water need (m^3/da) / Irrigation efficiency)

Farmer supports (TL) = Irrigated land (da) x supplementary payment per decare ($/da)

Annual total reimbursement (TL) = Accrued water fees (TL) + Farmer support (TL)

Reimbursement period (Year) = Transition cost (TL) / Annual total reimbursement (TL/year)

Association contribution (%) = Accrued water fees (TL) / Transition cost (TL) x 100

Farmer contribution (%) = Farmer support (TL) / Transition cost (TL) x 100

Increase in production value (%) = Total production value (TL)/ Current total production value(TL) x 100

RESULTS and RECOMMENDATIONS

Majority of water-user organizations using open-canal water networks are spending great efforts for transition into closed-piped networks. However, according to DSI data, such a transition costs about 5000 $/ha and that much high costs make this transition highly difficult.

In this study, potential increase in water-user and association revenues with this transition were calculated for three different irrigation efficiencies by using 2009 data of Truva Irrigation Association (Table 2). Then, how much of the transition cost can be met with these revenues were assessed and whether or not the association can alone meet the entire transition cost was discussed.

Current calculations revealed that in case of transition to closed-piped system at the beginning of 2009 and the irrigation efficiencies of 70, 80 and 90%, the increase in accrued water fees would be 29% (Table 2).

Table 2. Potential increase in revenues with increased irrigation efficiencies in Truva Irrigation Association

2009 Truva Irrigation Association				
	Current	Post-transition		
Irrigation efficiency	54%	70%	80%	90%
Net irrigation area (da)	15 740	15.740	15.740	15.740
Irrigated land (da)	14 460	15.740	15.740	15.740
Irrigation ratio (%)	92	100	100	100
Diverted water (m^3)	13 510 606	13 510 606	13 510 606	13 510 606
Amount of water supplied to unit area (m^3/ha)	**9 343**	**7 259**	**6 351**	**5 081**
Average water fee (TL/da)	17.38	17.38	17.38	17.38
Surplus water (m^3)	-	**2 085 615**	**3 513 739**	**4 624 502**
Accrued water fee (TL)	**251 315**	273 561	273 561	**273 561**
Accrued water fee ($)	**171 839**	187 050	187 050	**187 050**
Increase in accrued water fee (%)	-	29	29	29

While the irrigation rate was 92% with the current amount of 13 510 606 m^3 utilized water, the value with the same amount of water could rise to 100% when the irrigation efficiencies were taken as 70, 80 and 90% and respectively 2 085 615 m^3, 3 513 739 m^3 and 4 624 502 m^3 water could be saved with these efficiencies. The saved water can be used in industry and other sectors.

Considering the cost of transition to closed-piped system as 5 000 $/ha, it was calculated that the association ould reimburse this transition cost in 36 years in case it used all the revenues for reimbursement of transition costs. That seems to be impossible since there aren't any creditors in markets lending money with 35-40 year reimbursements.

The increase in water-user revenues is also depend on increase in irrigated lands and thus will be similar to increase in association revenues (Table 3). Current water-user revenue of 5.98 million $ will increase to 6.51 million $ when the irrigation efficiencies were 70, 80 and 90%.

Table 3. Increase in water-user revenues with increasing irrigation efficiencies

Irrigation efficiency	Current				Post-transition					
	54%				**70%**		**80%**		**90%**	
Produce	Cultiv. land (da)	Avr.Yield (kg/da)	Avr. Sale Price (TL/kg)	Total production value (TL)	Cultiv. land (da)	Total production value (TL)	Cultiv. land (da)	Total production value (TL)	Cultiv. land (da)	Total production value (TL)
Maize	9 161	699	0.59	3 778 088	9 957	4 106 561	9 957	4 106 561	9 957	4 106 561
Vegetable	3 726	5 059	0.23	4 335 462	4 050	4 712 393	4 050	4 712 393	4 050	4 712 393
Sapling	320			0	348	0	348	0	348	0
Froge crops	291	1 200	0.39	136 188	316	148 028	316	148 028	316	148 028
Orchard	162	2 382	0.49	189 083	176	205 522	176	205 522	176	205 522
Cereal	267	361	0.44	42 410	290	46 097	290	46 097	290	46 097
Legumes	160	430	1.97	135 536	174	147 320	174	147 320	174	147 320
Sunflower	341	410	0.96	134 218	371	145 887	371	145 887	371	145 887
Peanut	53	160	0.93	7 886	58	8 572	58	8 572	58	8 572
Total	14 481			8 758 871	15 740	9 520 381	15 740	9 520 381	15 740	9 520 381
Total production value ($)				**5 988 972**		**6 509 662**		**6 509 662**		**6 509 662**

DSI adopted the concept of "Participatory Irrigation Management" while transferring irrigation schemes to user-organizations. In this concept, it was envisaged that water-user should bear some of the transition cost with the possible increase in their revenues. It was considered that each water-user should provide about $50-100 contribution per hectare throughout 10 years after transition (Table 4).

Table 4. Cost reimbursement of transition to closed-piped system

Water-user contribution ($/ha)	50	100
Net irrigation area (ha)	1 574	1 574
Transition cost to closed-piped system ($)	7 870 000	7 870 000
Water-user contribution ($/year)	78 700	157 400
Increase in water-user revenue ($/year)	520 690	520 690
The ratio allocated from increased revenues of water-users for transition cost (%)	15.1	30.2
Water-user contribution (%)	1	2
Association contribution (%)	2.38	2.38
Annual total reimbursement (%)	3.38	4.38
10-years total reimbursement (%)	33.8	43.8

It was observed in Table 4 that incase of irrigation ratio of 100% and irrigation efficiency of 90%, water managers and water-users were able to meet only 33.8% of transition cost in 10 years when they contributed $50 per hectare and only 43.8% when they contributed $100 per hectare.

The amount to be allocated per hectare from annual revenue increase of each water-user after transition to closed-piped system is either 15.1% or 30.2%, small quantities. Such ratios indicate that at least some portion of the transition cost should be met by water-users. It is clear from the calculations that association administration alone was not able to meet the transition cost. However, only the half of the cost could be met together with the contributions of the water-users.

Water-user contribution is a must for traction to closed-piped systems. Extension works should be implemented in relevant regions to point out the significance of water-user contributions in meeting the transition costs to modern systems.

REFERENCES

Aküzüm, T., Çakmak, B., Gökalp, Z., 2010. Türkiye'de Su Kaynakları Yönetiminin Değerlendirilmesi. Tarım Bilimleri Araştırma Dergisi. 3 (1): 67–74.

Anonymous. 2014. Truva Sulama Birliği Denetim Raporu. Çanakkale Valiliği Sulama Birlikleri Denetim Raporları. Çanakkale

Çakmak B., Yıldırım, M. ve Aküzüm, T. 2008. Türkiye' de Tarımsal Sulama Yönetimi, Sorunlar ve Çözüm Önerileri. TMMOB İnşaat Mühendisleri Odası Su Politikaları Kongresi. Ankara.

DSİ. 2010. 2009 Yılı DSİ'ce İşletilen ve Devredilen Sulama Tesisleri Değerlendirme Raporu. Devlet Su İşleri Genel Müdürlüğü, Ankara.

DSİ. 2015. 2014 Yılı DSİ'ce İşletilen ve Devredilen Sulama Tesisleri Değerlendirme Raporu. Devlet Su İşleri Genel Müdürlüğü, s. 64. Ankara.

T.C. Orman ve Su İşleri Bakanlığı. 2015. Güncel Haberler. http://www. ormansu.gov.tr/osb/haberduyuru/guncelhaber/14-09-06/Prof_Dr_Veysel_Ero%C4%9Flu_%E2%80%9CKapal%C4%B1_Sulama_Sistemlerinin_Tercih_Edilmesiyle_Her_Y%C4%B1l_Ortalama_10_Milyar_Metrek%C3%BCp_Su_Tasarruf_Edilebilir%E2%80%9D.aspx?sflang=tr (Erişim Tarihi 7.5.2015).

TCMB. 2009. Döviz Kurları. http://www.tcmb.gov.tr/wps/wcm/connect/TCMB+TR/TCMB+TR/Main+Menu/Istatistikler/Doviz+Kurlari/Gosterge+Niteligindeki+Merkez+Bankasi+Kurlarii (Erişim Tarihi 15.04.2015)

Tekiner, M., Aktürk, D. 2010. Çanakkale'deki Bayramiç–Ezine Ovaları Sulama Birliğinde Kapalı Borulu Sulama Sistemine Geçişin Ekonomik Yönden Değerlendirilmesi. I. Ulusal Sulama ve Tarımsal Yapılar Sempozyumu. Kahramanmaraş Sütçü İmam Üniversitesi. 27–29 Mayıs, Kahramanmaraş.

Körpe, N., Tekiner, M. 2014. Mustafakemalpaşa Köyleri Sulama Birliğine Ait Şebekenin Kapalı Sisteme Dönüştürülmesiyle Ekonomide Meydana Gelecek Değişikliğin Belirlenmesi. Çanakkale Onsekiz Mart Üniversitesi Ziraat Fakültesi Dergisi Sayı:2 Cilt: 2.