

セイハン川下流域プロジェクト水灌漑組合の経営効率性

The Efficiency of WUA Management in the Lower Seyhan Irrigation Project

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1. Introduction

During the last decade, many government managed water allocation schemes were transferred to private organizations such as water users' associations (WUAs). The transfer of water management authority from government to WUAs had significant impacts on improving operation and maintenance of irrigation canals as well as increasing water fee collection rate. However, recently some WUAs are having difficulties in management because of their small-scale operation size. We observe the case study of WUAs in Lower Seyhan Irrigation Project in Adana, Turkey and apply data envelopment analysis to compare efficiency levels.

2. The overview of WUAs in Lower Seyhan Irrigation Project

Lower Seyhan Irrigation Project (hereafter LSIP) in Adana was initiated by the Turkish government as one of the important irrigation project located in southern Turkey. In LSIP area, 18 WUAs were established during 1994-1996. WUAs manage operations and maintenance of canal networks in the command area. However, recently some WUAs are having difficulties in management because of their small-scale operation size. It has been suggested that some WUAs in LSIP should merge to a larger operation size so as to solve their financial and logistic problems. We tentatively merged current eight WUAs in the right bank into three and ten WUAs in left bank into three, six WUAs in total.

2. Estimation results

i) Efficiency scores of 18 WUAs

We performed the efficiency analysis by estimating input-oriented CCR efficiency scores for three models,

management efficiency, engineering efficiency and welfare focused models (Charnes, Cooper and Rodes, 1978). The efficiency score shows the efficiency level of each WUA relative to the efficient frontier.

Table 1 indicates the result of efficiency scores.

Table 1. Efficiency scores of 18 WUAs in Lower Seyhan Irrigation Project

No.	DMU	ME Score	EE Score	W Score	Composite Index
1	Toroslar (R)	1	0.973	1	0.991
2	Yesilova (R)	0.930	0.786	0.930	0.879
3	Altinova (R)	1	1	1	1
4	Cukurova (R)	1	1	1	1
5	Yukari Seyhan (R)	1	1	1	1
6	Seyhan (R)	0.877	0.869	0.877	0.875
7	Onkoy (R)	0.945	0.753	0.945	0.876
8	Pamukova (R)	1	1	1	1
9	Y. Akarsu (L)	0.980	0.861	1	0.945
10	Cumhuriyet (L)	0.709	0.700	0.719	0.709
11	Kuzey Y. (L)	0.764	0.744	0.768	0.759
12	Cotlu (L)	1	1	1	1
13	Gokova (L)	0.924	0.888	1	0.936
14	Guney Y. (L)	1	0.966	1	0.989
15	Kadikoy (L)	1	1	1	1
16	Yeni Gok (L)	1	1	1	1
17	Gazi (L)	0.977	0.939	1	0.971
18	Ata (L)	1	1	1	1
Right Bank average		0.968	0.917	0.968	0.951
Left Bank average		0.929	0.903	0.942	0.925
18 WUAs average		0.946	0.909	0.954	0.936

Key: ME: management efficiency; EE: engineering efficiency; W: welfare; R: right bank; L: left bank.

For management efficiency (ME), 10 WUAs are on the efficient frontier. The one of the least efficient DMUs in this category includes Cumhuriyet (0.709) and Kuzey Yüreğir (0.764). Cumhuriyet is the one of WUAs that have financial difficulties because of its small operation size. On average, the right bank management efficiency (0.968) is slightly better than the left bank (0.929).

The second column shows the engineering efficiency (EE) scores. Eight WUAs scored 1 and are on the frontier, and Cumhuriyet (0.700) and Kuzey Y. (0.744) again showed low performance in engineering efficiency because of large number of technical staff employed by WUAs.

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The third column shows the welfare focused efficiency scores that take into account agricultural revenue. Thirteen WUAs formed a frontier and Cumhuriyet (0.719) and Kuzey Y. (0.768) are low performers. The last column shows the composite index which is estimated by taking geometric mean of three efficiency scores. The results indicate that eight WUAs scored composite index of 1, namely Altınova, Çukurova, Yukari Seyhan, Pamukova, Çotlu, Kadıkoy, Yeni Gök and Ata.

Table 2. Projected input levels to reach efficient frontier for Cumhuriyet and Kuzey Y. WUAs

DMU Input/Output	Score Data	Projection	Difference	% change
Cumhuriyet (L)	0.719			
Gross water/WUA (M m3)	25.44	18.28	-7.16	-28.13%
O&M costs (MTL)	29812	21425.72	-8386.28	-28.13%
Staff salary (MTL)	58394	41967.44	-16426.56	-28.13%
Technical staff	5	2.36	-2.64	-52.74%
Delayed payments (MTL)	73766	39762.81	-34003.19	-46.10%
Gross revenue from production (BTL)	6941.30	6941.30	0	0.00%
WUA fee revenue (MTL)	95616	95616	0	0.00%
Total irrigated area (ha)	1651	1675.26	24.26	1.47%
Kuzey Y. (L)	0.768			
Gross water/WUA (M m3)	55.959	42.98	-12.98	-23.19%
O&M costs (MTL)	60883	36090.13	-24792.87	-40.72%
Staff salary (MTL)	47703	36639.74	-11063.26	-23.19%
Technical staff	6	2.03	-3.97	-66.19%
Delayed payments	94849	56216.06	-38632.94	-40.73%
Gross revenue from production (BTL)	10479.05	10479.05	0	0.00%
WUA fee revenue (MTL)	115475	123933.31	8458.31	7.32%
Total irrigated area (ha)	3606	3606	0	0.00%

Key: M m3: million cubic meters; MTL: million Turkish Lira; BTL: billion Turkish Lira

Table 2 shows the projected input levels to reach efficient frontier of welfare model for Cumhuriyet and Kuzey Y. WUAs that resulted in lowest performance in all categories. The projection shows the level of input that are can be reduced to reach the same level of output by comparing other efficient DMUs. For example, the delayed payments of Cumhuriyet can be reduced by 46% or by 34,003 MTL, thus the efficient level of delayed payments are 39,763 MTL. Similarly, actual water supply, O & M costs, staff salary and the number of technical staff can be reduced by 28%, 28%, 28%, and 53% respectively. In case of Kuzey Y., the major reduction of input should come from O & M costs (41%), technical staff (66%) and delayed payments (41%).

ii) Efficiency scores of merged WUAs

In the second stage, we performed efficiency analysis of welfare model for artificially merged WUAs for R-1, R-2, R-3, L-1, L-2 and L-3. First, data sets of all 18 WUAs were merged into 6 WUAs. Newly created 6 WUAs (DMUs) were included in estimating the efficiency scores together with current 18 WUAs to compare the efficiency scores of new DMUs in

Table 3. Efficiency scores of merged WUAs

No.	DMU	W Score	Rank
1	Toroslar (R-1)	1	1
2	Yesilova (R-2)	0.930	19
3	Altınova (R-2)	1	1
4	Cukurova (R-2)	1	1
5	Yukari Seyhan (R-2)	1	1
6	Seyhan (R-2)	0.877	21
7	Onkoy (R-3)	0.945	17
8	Pamukova (R-3)	1	1
9	Y. Akarsu (L-1)	1	1
10	Cumhuriyet (L-1)	0.719	24
11	Kuzey Y. (L-1)	0.768	23
12	Cotlu (L-2)	1	1
13	Gokova (L-2)	1	1
14	Guney Y. (L-2)	1	1
15	Kadikoy (L-3)	1	1
16	Yeni Gok (L-3)	1	1
17	Gazi (L-3)	1	1
18	Ata (L-3)	1	1
19	R-1	1	1
20	R-2	0.916	20
21	R-3	0.939	18
22	L-1	0.867	22
23	L-2	1	16
24	L-3	1	1

Key: W: welfare; R: right bank; L: left bank.

reference to the existing DMUs.

Table 3 shows the results of efficiency scores of merged WUAs with current WUAs. R-1, L-2 and L-3 scored 1 because they are consisted of originally efficient WUAs as show above. On the other hand, L-1 showed lowest scores among new WUAs, 0.867, because it consists of originally inefficient Cumhuriyet and Kuzey Y. It is obvious that simply merging inefficient WUAs will result in inefficient WUA. By merging WUAs, the average efficiency score improved slightly from 0.954 to 0.966. However, by simply merging to less number of WUAs does not improve the efficient level significantly. In order for new WUAs to reach frontier, significant reorganization, i.e., reduction of some inputs, is required.

3. Conclusion

This paper tries to address the relative efficiency of WUA management by suggesting alternative composite efficiency index. The analysis revealed that some WUAs are suffering from unfavorable management practices and there is a scope for major reorganization. In order for new WUAs to reach frontier, significant reorganization, i.e., reduction of some inputs, is required.

4. References

Charnes, A., W.W. Cooper and E. Rhodes. (1978) "Measuring the Efficiency of Decision Making Units" European Journal of Operational Research 2: 429-444.