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Research Article

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The Impact of Hydraulic Structures in Eastern Anatolian Region in Turkey on Agricultural Economy: The Odabaşı Pond Case

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Abstract One of the most important current problems is fulfill the needs of the increasing population for water. In Turkey, there is a lack of irrigation water incertain agricultural areas, while irrigation water is available in high amounts in certain agricultural lands. The optimum irrigation of agricultural lands is very important for Turkish agricultural policies. Efficient and sustainable use of streams is of strategic importance for the national economy. The geographical and climatic conditions in Turkeynecessitate the construction of dams, HEPPs, ponds, irrigation facilities and drinking water projects. Efficient and sustainable use of streams is of strategic importance for the Turkish economy.

The present study discusses the significance of a pond that was constructed within the context of Eastern Anatolian Project (EAP) for the regional development. With the increase in population and the emergence of new settlements, the water scarcity problem in the region increases every day. While construction of ponds meets energy needs and increases agricultural activities, it also contributes to the economic development of the region significantly. The dams in the region solve the long-term urban water needsby providing water reserves. In the present study, the case of Elazığ Baskil Odabaşı pond project was used to investigate the effect of hydraulic structures on the regional economy. Elazığ Baskil Odabaşıpond is built to meet a portion of the irrigation water needs in the province. The pond is built on Beşik brook in the Euphrates river basin. The project aims to irrigate a total area of 467 ha. The project alone will not suffice due to irrigation water needs in other neighborhoods of the Baskil district.Completion of the project would contribute significantly to the socio-economic development of the district center. The most important crop cultivated in this region is the apricot. The market share of apricots in Malatya province and Baskil district within the total cultivation in Turkey is considerable. In Baskil district, irrigation usually depends on underground water. Due to high energy costs, cultivation costs are out of the depth of the farmers. As a result, the water required for the growth of the plant cannot be provided, thus, the yield is not satisfactory. As a result, farmers are almost left without income. Consequently, the farmers tend to abandon agricultural activities, leading to agricultural unemployment and a decrease in rural population.

Keywords Pond, stream, regional development, EAP

Introduction

The provinces of Agri, Ardahan, Bingol, Bitlis, Elazig, Erzincan, Erzurum, Hakkâri, Iğdır, Kars, Malatya, Mus, Tunceli and Van are included within the scope of Eastern Anatolia Project (EAP) [1].

Eastern Anatolia Region is the most elevated region in Turkey. The mountainous structure of the region negatively affects the agricultural product diversity and agricultural activities. However, the presence of wide range of meadows-pastures in the region provides advantages over other geographical regions in terms of animal husbandry activities. Malatya, Elazığ, Erzincan, Iğdır and Van Lake basins have a great potential for crop cultivation when compared to other provinces in the region [2].

Figure 1: Eastern Anatolia Region

Van Lake, Keban and Karakaya Reservoirs, Hazar Lake, Çildir Lake, Euphrates River, Aras River, Kura River, Karasu River and Zap River are important water resources in the region. The basins defined by these water resources in the region and the provinces that these resources are located are presented in Table 1.

Table 1: Water basins in Eastern Anatolia Region

River basin name		Provinces covered
Fırat-Dicle Basin	:	Malatya, Bingöl, Muş, Tunceli, Elazığ, Erzurum, Erzincan, Hakkâri
Aras Basin	:	Ardahan, Kars, Erzurum, Iğdır, Ağrı
Çoruh Basin	:	Erzurum (Northern Districts)
Van Gölü Basin	:	Van, Bitlis

Agricultural activities are the main source of income for the population of the region. The cultivated agricultural area in the region is 2.489.869 hectares and constitute 10.4 percent of the total agricultural land assets in Turkey. The region constitutes 52.9 percent of the meadow-pasture area in Turkey with 7.729.324 Cartesian units.

Although the region has advantages over other regions based on water resources, the resources are not used effectively for agricultural irrigation. However, General Directorate of State Hydraulic Works (DSI) aims the effective use of water resources in the region with the project titled "1000 Ponds in 1000 Days Irrigation Project" [3].

In the present study, the economic impact of the Odabaşı Pond constructed in the EAP region was investigated.

The Significance of Ponds in Regional Development

The International Commission on Large Dams (ICOLD) determined the following requirements for the definition of a large dam:

-Dams with a height greater than 15 m between the crest and the foundation
-or those with an height of 10-15 m and

-crest length > 500m,
-reservoir volume $>1.10^6 m^3$
-the highest overflow rate $>m^3/sn$

are considered as large dams.

Structures that are not considered large dams and those with simple projects that could be built in a shorter period of time are defined as ponds (small dams).

The State Hydraulic Works (DSI) has contributed to the national economy and the farmers living in the rural areas by constructing several ponds during recent years. DSI planned to construct 1071 ponds and irrigation facilities between 2016 and 2019. Construction of 1071 ponds and irrigation facilities by 2019 would ensure the sustenance of the lives of rural people in their native region. The time needed to complete the projects that were

planned within the scope of 1071 Pond Project included 12 months of planning, 6 months of project design, 12 months of pond construction and 14 months of irrigation facilities construction [4].

There are several streams within the EAP region. However, due to the mountainous structure, the water in the streams vary significantly throughout the year. With the construction of the ponds, it was expected that the river regimes would be regulated and utilized more efficiently and safely.

Construction of the ponds on the streams in the region aims

-to increase agricultural production,

-to increase the share of animal husbandry in commerce via improvement of animal races and grazing lands in the areas where husbandry is significant,

-to provide drinking and irrigation water,

-to generate power,

-for flood control,

-to prevent erosion,

-for aquaculture,

-for river transportation,

-and for the social, cultural and economic development of the region by construction recreational areas.

In the present study, the case of Elazığ Baskil Odabaşı Pond was studied to investigate the effect of ponds on agricultural economy.

Odabaşı Pond Project

Figure 2: Odabaşı Pond [5]

The Odabaşı Pond is located in the northwestern part of the Baskil district in the Euphrates river basin in Eastern Anatolia Region. There are 6 villages in Baskil district center and 62 village outside the central district. Baskil has the highest number of farmers in the province except Elazığ provincial center. According to the 2010 census, 4 689 people live in the area covered by the project. The project area is located at a 5 km distance from the Baskil district center. Furthermore, the pond axis is located on the Beşik Brook, which is on the north-west of Kıçhan neighborhood of the Baskil district. Beşik Brook merges to other streams in the downstream and called Bijan Brook and Geli Brook, respectively and finally merges to the Euphrates River [6].

The pond embankment type was selected based on the material available in the vicinity. The material map revealed that sufficient impermeable, permeable and rock material were available in the vicinity of the pond construction area. Since the pond axis was long and the material requirement was high, the pond embankment type was designated as "clay core rock fill".

The Baskil district includes large agricultural lands. The said project aims to irrigate the agricultural fields in Odabaşı, Kıçhan, Eskibaskil, Beyrikkuşağı, Titikan, Mustafa Demireller, Hocalar, and Gavuruşağı neighborhoods in Baskil district. When the pond will be in service, net 467 ha agricultural land and gross 467 /

0.873 = 535 ha land will be irrigated. The irrigation area will include 122 ha land on the right bank and 345 ha land on the left bank of the pond [6].

Since the irrigation area is located on both banks, an irrigation network will be constructed on the left and right banks after the water discharge. The irrigation system will be constructed with Glass Fiber Reinforced Plastic (GFP) and Polyethylene (PE) pipes. The pipe diameters in the network will be selected according to the area to be irrigated on both banks. The total of 467 ha land consists of the half of 34 ha in the zone 1, zone 14 (90 ha) and zone 15 (14 ha) on the right bank, which adds to 17 + 90 + 15 = 122 hectares of irrigation area, and about 345 hectares on the left bank irrigation area. Therefore, mean total plant water requirement of 1806.51 m^3/ha (non-pressurized + pressurized irrigation areas), in other words, 180.65 mm plant water requirement, shared with the right and left shore of the irrigation area, respectively, with 122 ha will be discharged to the network and will be shared between the 122 ha and 345 ha irrigation areas on right and left banks, respectively.

Bottom weir calculations were conducted based on the 0.67 l / s / ha total irrigation modulus, which was found based on 467.5 hectares (net) irrigation area and 180.65 mm plant water requirement (In July, during the maximum plant water requirement) in total irrigation area pond operation works and the effluent flow was calculated as Q=0.400 m^3/s.

In the project, the main canal will be 2202 m long and the irrigation water will be distributed with Ø800 mm (6 ATÜ) GFP pipes in the main channel and with 14458 m long Ø560 mm (10 ATÜ) PE pipes in the secondary and tertiary channels.

Since Odabaşı Pond irrigation system will be constructed and operated with surface piping and pressurized pipes, irrigation water will be supplied until the areas where the pressure can be maintained. Irrigation will not be provided to the areas that will require pumping upgrade, gravitational irrigation will be provided. The irrigation network is planned with surface gravity and pressurized (sprinkling + dripping) pipes. From the bottom weir effluent, 63 hectares of land will receive surface irrigation and the remaining 404 hectares will be irrigated with pressurized irrigation network.

Total area will receive 2 303 466 m^3 irrigation water.

The maximum irrigation period is in May with 2 409 222 m^3 according to the operation table.

The height of the pond was calculated as 44.33 m from the river bed and 52.29 m from the ground.

Bottom weir forced pipe diameter is Ø 800 mm and project flow is 0.400 m^3/s.

The completion of the Odabaşı Pond project will contribute significantly to the economic development in Baskil District center. Agricultural activities are quite extensive in the district center. Survey results identified 40% wheat cultivation, 30% apricot cultivation and 30% fallow application in the area. In the project area, apricots are farmed on irrigated areas and wheat is cultivated on arid lands. Serious improvements are observed in apricot production every year. Annual apricot production in Turkey for the last 10 years is presented in Figure 3 base on Ministry of Food, Agriculture and Livestock figures [7].

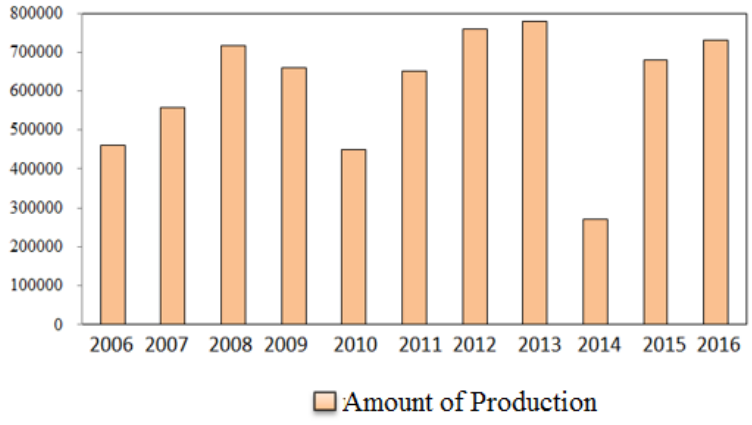

Figure 3: Annual apricot production based on TUIK data

Based on the information provided above, dried fruit production volume in Turkey fluctuates in certain years and low fluctuations were observed between 2008 and 2013. However, in 2014, there was a significant decline

in Turkish apricot production. This was due to the frosts experienced on 30-31 March 2014 and 4-5 April 2015. (Agriculture World: Directorate of Apricot Research Institute). As a result, in 2014 and 2015, the exports decreased by 30.76% and 16.16%, respectively, compared to the previous year. On the other hand, although Turkish dry apricot exports fluctuated in the said period, there is a general upward tendency in Turkish dry apricot export figures. In 2006, dry apricot exports were approximately 194 million dollars and increased by 56.2% and reached 303 million dollars in 2015 [7].

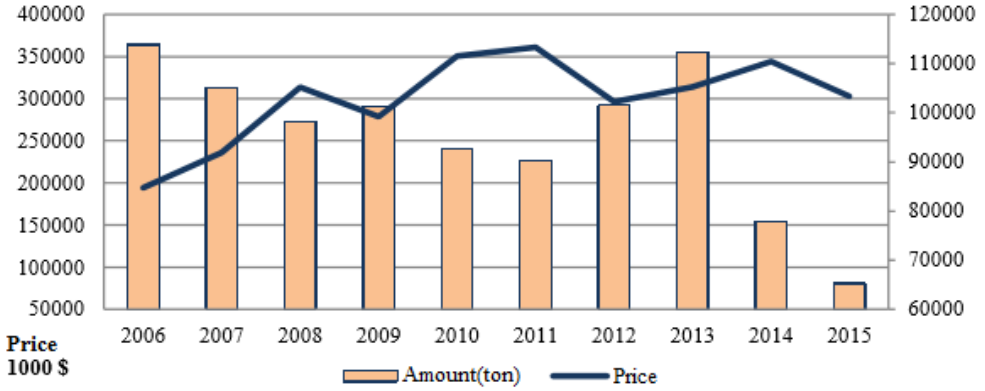

Figure : Development in Turkish Dry Apricot Exports Amount and Price (2006-2015)

The geographical features of Baskil district such as the climate, soil structure and altitude improve the apricot quality. Thus, leading to a considerable increase in apricot exports. Fresh apricots produced in the Eastern Anatolia Region are mostly supplied to the domestic market. Elazığ province contributes a significant share of annual Turkish apricot production volume.

In fact, based on the comparison 2013 (latest) and 2000 data, Turkish dry apricot production reached approximately 132,600 tons, approximately 77.57% of world production (170,945 tons) (National Apricot Workshop, 2014: 33, 42; INC, 2016: 58). In Turkey, there are 60.953 apricot producers based on 2016 data and apricot cultivation provides a significant amount of foreign currency influx in addition to contributing to the employment in Turkish economy (ÇKS, 2017). As a matter of fact, dry apricot exports, which was 110 million dollars in 2000, demonstrated an almost 3-fold increase, reaching 302.7 million dollars in 2015. This volume translated to 73.8% of global dry apricot exports in that year.

Table 2: Annual apricot production volume based on provinces in Turkey (tons) [8]

İller	2010	2011	2012	2013	2014	2011-2014 Ortalaması
Malatya	220.927	409.646	510.000	411.825	38.634	318.206
Mersin	56.430	52.486	46.865	94.055	111.738	72.315
Elazığ	30.179	33.991	38.578	39.514	11.390	30.730
Kahramanmaraş	14.685	14.678	12.521	78.620	994	24.300
Antalya	14.267	18.725	15.691	16.316	27.463	18.492
Isparta	11.405	14.258	16.908	16.582	12.141	14.259
Iğdır	9.222	12.063	17.755	20.342	0	11.876
Kayseri	15.540	11.022	13.683	13.323	1.478	11.009
Hatay	7.186	7.615	8.239	8.535	6.546	7.624
Karaman	1.815	2.221	2.503	9.420	7.090	4.610
Diğer	68.344	73.295	77.257	71.468	52.526	68.578

It is expected to rival the Malatya apricots in taste and aroma. Cultivated apricots have a 10% contribution to Malatya apricots.

However, studies demonstrated that increasing energy and production costs lead to abandonment of this irrigation water by the farmers and local people increasingly engage in other occupations. Thus, it was

envisaged that the project would provide irrigation water without energy costs to the local farmers, and the abandonment of agriculture by people of the region that is rich in fertile soil resources would be prevented.
On the other hand, apart from the proposed pond reservoir, there is no secondary alternative reservoir site for the abovementioned settlements due to technical, geological and topographical factors. Baskil Odabaşı Pond is the most suitable site in the region for a reservoir based on the site surveys conducted in the area. The land within the area of the proposed pond possesses stream bed characteristics. Slopes cannot be used for agricultural purposes due to high gradient, topographical inadequacies and the geological structure.
However, it was observed that farmers were forced to utilize the existing irrigation system desperately, although they tend to abandon this system under the pressure of ever-increasing energy costs. If the water that requires power for irrigation could not be abandoned, there will be a significant decrease in the agricultural employment and a tendency to abandon agriculture in the region.
Since the use of the water needed by the cultivated plants is not inexpensive, farmers cannot consume sufficient water for plant irrigation. As a result, the yield, expected crop productivity and the corresponding revenues cannot be ensured, thus employment in the agriculture decreases every year.
A pumped irrigation system built by DSI and operated by Old Baskil Irrigation Cooperative that has a flow of 77 lt / s is present in the project area. Due to high inputs and high energy costs, labor is wasted. Inadequate irrigation in agricultural areas reduces agricultural productivity, which negatively affects public welfare.

Conclusion and Recommendations

Project area has intermediate constitution soil.
As a result of the field surveys, it was proposed that the drainage would be implemented with surface drainage channels in 118 ha area, and the surface drainage would be provided by farmer arcs in 417 ha. The recommended drainage system should be constructed in the project area to obtain the expected benefits from irrigation, and thus increase the crop yield. Controlled irrigation, farm fertilizer or green manure application, modern farming techniques and irrigation methods need to be provided to farmers by relevant institutions.
It is estimated that the migration out of the region would halt when the project will be completed.
Both agricultural employment and rural population would increase in Baskil district.
It is expected that agricultural diversity and irrigated farming products would increase.

Acknowledgement

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