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Full Length Article

Assessing the Water Conveyance and Distribution in the Dez irrigation and Drainage Scheme –the case study of the E4 canal in the Eastern Dez network

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ABSTRACT
The ever-increasing population that in turn increased the demand for food and fiber has made sustainable agricultural production hardly possible. Given that various factors such as structural design, management styles during operational phase, climatic conditions, economic, social and environmental factors that affect crop yield, has made the performance of the system challengeable. Irrigation efficiency is usually used as one of the criteria for performance assessment in irrigation and drainage schemes with no need to consider other parameters. For this reason, the experts, researchers and other stakeholders has attempted to substitute other indices to represent irrigation efficiency. These include water, soil and relevant costs of the network operations. The methodology involves application of the irrigation performance indices in the E4 Canal using the IWMI indices. Results show sever signs of water resources limitation coupled with deficient land use practices such as the fallow of the land during summer periods representing the crop-production limitation and development parameters. Results also show that based on the tested indices, the volumetric water allocation and delivery coupled with poor water user's participation have a profound effect on performance, which was shown incidentally to be unsatisfactory. Results further show the necessity for reviewing the establishes operational procedures at farm level mainly focusing on improving the irrigation and application efficiencies through the implementation of pressurized irrigation system development that can have a corresponding effect on water use pattern. This in turn calls for a fundaments review of the water resources management as a pre-requisite for sustainable agricultural and crop production.
Keywords: Conveyance, distribution efficiency, IWMI, E Canal, crop production

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INTRODUCTION

Iran is situated in the semi-arid and arid region of the world with a climatic condition that features a sporadic rainfall with an annual average precipitation of 252 mm which constitutes as the third of the world's average [1]. Given the uneven rainfall distribution in the country, and the higher than average evaporation in Iran, results in 70% of the water to evaporate [2],[3].

The agriculture sector plays a crucial role in the national economy of many of the agrarian countries. It contributes 18% to the Iranian GNP and is a basis for about 25% of the employment and non-petroleum exports [4],[5].

From the 37 million ha of lands suitable for agricultural purposes, only about 8 million ha are under irrigation. From about 93 billion m^3 total accessible fresh water resources of both surface and underground in the country, about 84 billion m^3 are allocated to the agricultural sector [6]. Based on these climatic and topographic realities, sustainable food-production and feasible agricultural activities necessitate optimum utilization of the precious fresh water resources. This objective, as Hedayat (2013) points out, calls for an innovative approach to water resources management that uses the efficiency-

enhancing agro-technologies known universally for their optimization features. Given the numerous parameters such as structural design, management factors, climatic conditions, socio-economic issues and of course, the agro-inputs which have significant influences on crop yield and quality, principal among which is a reliable and sufficient water supply that is very crucial pre-requisite for agricultural sustainability [7]. It is therefore necessary to institutionalize an optimum water abstraction, conveyance and distribution system that the modern irrigation and drainage schemes should provide. Optimization of resource use should therefore, be given a thorough consideration, as the conventional allocation regime which persists on supplying water to grow low-economic-returning crops such as wheat , barley and corns, under the pretext of food self-sufficiency, is therefore questionable. This is because of smaller than 0.5 kg yielding per/m^3 of wheat compared with the global average of 2.5 kg [8].

Since water is beginning to be treated as a uniquely life-sustaining element not only for the human being as such, but also the plants and animals which the former depends on. It is also emerging as a vital element of eco-system and environmental integrity that has attracted the public attention for its protection. In the modern frame of thinking therefore, the water is universally considered as an economic commodity that makes its abstraction, conveyance, distribution and use very challenging indeed. The aim of this paper is to study the manners in which water resources optimization can be achieved in the E4 canal networks under the Dez Irrigation and Drainage scheme to sustain crop production in the command area using the IWMI's indices.

MATERIALS AND METHODS

Dez Irrigation and Drainage Scheme

The Dez irrigation and drainage scheme is the largest of its type in the Middle East, consisting of a complex of a hydro-electric dam, a regulation dam, a diversion weir and three major conveyance canals to irrigate the command area [3]. It consists of the Sabilli canal with a flow carrying-capacity of 14 cubic meters to irrigate a gross area of 12,000 ha, supported by a pumping station. The Western canal that gets its water from the diversion weir has a 150 cubic meters carrying capacity to irrigate the Karkheh flood plain, some of the Andimeshk lands and stretching as far as Shush wheat and corn producing estates, and Haftapeh sugar estate in the southern edge of the Greater Dezful command area. The eastern canal irrigates the eastern agrarian estates of the Greater Dezful stretching as far as sugar producing lands of the Karun agro-industrial complexes in the East.

Evaluation model

The evaluation of irrigation performance is based on the IWMI indices for the operational performance of the E4 canal network. It included important factors such as the irrigation efficiency, irrigation water consumption ,plant's relative water supply , relative irrigation supply, canal capacity to deliver water at system head, gross return on the capital investment, and of course the financial self-sufficiency. These became the basis for qualitative analytical framework for data interpretation on issues related to performance evaluation and operational assessment in the E4 canal network.

RESULTS AND DISCUSSIONS

Results of the estimated standard net value of the food stuff produced in the command area of the E4 during 2012-2013, show an increasing trend relative to the period before this study. The underlying reason for this is presumed to be the increase in the average global value of the base crop as well as the 'intensive cultivation' under the canal's command. Results show that these factors have had a significant increase in those indices (the value of crop per unit water delivered, the value of crop in unit water consumed) that the net standard value of the crops has been used to estimate them. Comparative analysis of these standard values shows a significant increase relative to those estimated for the previous years of irrigation and drainage schemes of Amir and Saaveh[9].

Comparative performance evaluations of the irrigation and drainage schemes from the perspective of physical-managerial performance show a relatively desirable condition for the E4 canal. This is particularly on indices such as the capacity and the ability of the system in question to ensure relative water supply, relative irrigation supply, water delivery capacity and reliability in supplying the timely irrigation water requirements to satisfy the plant-water-requirements as means of preventing crop-water-stresses. These are particularly vital during critical consumption peak that the irrigation and drainage system is expected to meet. Data suggest that although the water requirements of crop growers and the needs of riparian along the E4 canal are currently satisfying the demand side, it is nonetheless important to shift the management paradigm in favor of a supply system that is more users'-friendly than has been the case recently. This substantiates the findings of Hedayat (2005), whose findings in both the Dez and Moghan Irrigation Schemes emphasizes the urgency in advocating an alternative approach to

supply and demand management that in his view is so important to ensure viability of crop-production, sustainability of the scheme and environmental integrity to support the command area.

Given what the findings in the three aforementioned indices show, freshwater resources play a significant role in enhancing crop production and scheme management, while being a limiting factor. The findings further show that despite the crucial importance of these vital resources for crop production sustainability, prevalence of deficient scheme management can exacerbate the situation and threaten its long-term productivity.

Results also show that water delivery index in the E4 Canal has an inherent feature and the necessary capacity in the water delivery system in the aforementioned hydraulic structure to meet the ever-challenging requirements of the water users particularly during the peak demands. Results further show very little symptoms of water-delivery-related stresses linked to deficient water supply or deficit irrigation application that would have affected and impaired crop yield and quality [10].

These results show a relatively high proximity between these results and those reported for the canal conveyance and distribution networks of the Sabilli command area [11]. The reality of having some operational shortcoming in the network under study is a little thing to do with the deficient design features to meet the pre-defined performance requirements as such, rather the manner in which frequent cases of poor resource utilization due to some cases of structural dilapidations adversely affect the delivery performance [3].

These, point at the need to bring about some structural changes aimed at improving current situation by optimizing resources use. This should be achieved in whatever improvement is needed in both the software and hardware components of the scheme under investigation. This is crucial in the light of the research data that show the urgency of having a 'pro-active' approach to maintenance of the water conveyance and distribution system rather than the conventional 'reactive-orientation' taken in the scheme management like the one noted after recent flooding of the River Dez. It also points out the need for taking urgent measures to remedy the current situation, since continuity of this undesirable scheme management is bound to exacerbate the situation. There will be serious dilapidation in the structural components that in turn, would impair the operational efficiency of delivery and conveyance system that have been highlighted as the major source of crop failure to mention a few [5], [3].

Results of the indices evaluation of the performance efficiency shows some dissatisfaction by water users on the quality of services they receive from the water supply system. The findings further show that continuity of the present water supply regime can conceivably be sustainable given the critical nature of the supply-demand curve.

Although some experts argue for the need to introduce pressurized irrigation system as an effective 'efficiency-boosting' scenario in the studied command area, their recommendation however, seem to underestimate the operational challenges like high evaporation and wind-related problems that this system is bound to generate during crop production processes.

Regardless of whatever type of irrigation (modern or traditional) system is used, the issue which needs to be given a thorough consideration, is the change in the water-users' perspective vis-à-vis rational application of irrigation water. This is crucial for meeting the stringent economic and physical environmental criteria. They need to strive towards achievement of economic return without adversely affecting the integrity of eco-system, the very entity that depends on the same source of water as those used for crop-production.

Results show that severe water supply limitation for summer crop-production due to draught exacerbated by the components of climate feature such as the baking heat-waves as frequently seem to present challenges for growers in the command area in the form of decreased crop yield and poor quality. For these reasons, the delivery system is likely to become operationally deficient and more vulnerable if the draught pattern consists, as data seem to confirm. These data confirm the findings on delivery performance in the Dez and Moghan irrigation and drainage schemes [3], which emphasizes on a holistic approach to water resource management as a means of achieving crop-production sustainability in line with the objectives of the Grand Iranian Development Plan Perspective.

This is very significant in the light of Iran expecting to imminently join the global market to channelize its crops through its membership in exclusive economic club of the WTO. Such a bright scope would not be far-reaching as Iran is preparing herself for more collaborations and economic participation in the world scene. Given the borderless nature of the free-market economy that the post-sanction or post-barjam Iran can experience, crop-producers are expected to rip the harvest, provided that appropriate infrastructural foundations for optimizing on-farm operations are in place. Under such circumstances, crop yield and quality can be enhanced in such a manner to render production system competitive and therefore, economically viable. Those being the case, it would not be inconceivable to imagine institutionalization of

crop production regime in the command area that is set to yield a high economic return on the investment can be institutionalized.

CONCLUSIONS

The study focused on performance assessment of water conveyance and distribution in the E4 canal, which showed challenging results. They are challenging, because they highlight the need for a fundamental review of the prevailing water conveyance and distribution system in such a manner to meet the basic demand of the water users in the foreseeable future. It was very clear that a wholehearted effort and unified action plan is needed to address the outstanding operational as well as the macro-planning issues of the sort that will be proactive and highly-responsive in nature. This should be taken on board by the authorities on the policy-making end and by the recipients as the major stakeholders. Unless a concerted effort is made to eradicate the major deficiencies in the processes there would be a little scope for the sustainability of the network in general and the E4 canal in particular.

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