RESCHEDULING OF ALLOCATED WATER RESOURCE IN OLD IRRIGATION AND DRAINAGE SYSTEMS CASE STUDY: MOGHAN IRRIGATION AND DRAINAGE SYSTEM

CHANGEMENT DE L'ALLOCATION DES RESSOURCES EN EAU DANS LES ANCIENS SYSTEMES D'IRRIGATION ET DE DRAINAGE ETUDE DE CAS : SYSTEME D'IRRIGATION ET DE DRAINAGE DE MOGHAN

M. Afshar Asl[1], N. Ebrahimian[2], P. Rahbari[3]

ABSTRACT

Nowadays, one of the most significant challenges for managers of operating systems is change in irrigation system operation, especially for irrigation and drainage network older than 30 years. Economic progress, productivity increase, societal changes, policy perspectives, environmental concerns and development of new technology require such a change.

Damages to the ecosystem due to incorrect management, revised and often downscaled availability of water resources, new cropping pattern, demand for fresh water from other sectors, etc., are some of the reasons that make the older systems of irrigation and drainage net work operation inadequate for the current needs.

In this paper, some of the significant parameters that cause change in water supply and water use in irrigation systems are analyzed. For this reason Moghan irrigation and drainage network is selected as case study, because it is more than 30 years old. In recent times, there has been improvement in irrigation efficiency, rise in water demand from the industry

1 Project Manager, Irrigation and Drainage Department, Yekom Consulting Engineers, Tehran, Iran; E-mail:mohamad.afsharasl@gmail.com
2 Master Student, Department of Irrigation and Drainage Engineering, University of Tehran, Tehran, Iran; E-mail:n.ebrahimian@ut.ac.ir
3 Responsible Expert of Irrigation and Drainage Departments, Mahab Ghods Consulting Engineers, Tehran, Iran; E-mail:panteha_rahbari@yahoo.com

and domestic sectors and augmentation of agricultural land due to land leveling and soil reclamation. All these factors demand a re-look into the old operation and management policy of the network.

Key words: *Irrigation Network, Moghan, Rescheduling, Water Resource.*

RESUME ET CONCLUSIONS

Au moment actuel, les gestionnaires font face au défi que pose le changement du fonctionnement du système d'irrigation, notamment le réseau d'irrigation et de drainage qui fonctionne depuis plus de 30 ans. Le progrès économique, l'augmentation de la productivité, les changements sociétaux, les perspectives politiques, les préoccupations environnementales et le développement des nouvelles technologies exigent de tel changement.

Les dommages causés à l'écosystème en raison de la gestion inappropriée, la disponibilité réduite des ressources en eau, les nouveaux assolements, la demande en eau douce à partir d'autres secteurs, etc, sont quelques-unes des raisons qui font le fonctionnement des anciens systèmes d'irrigation et de drainage insuffisant pour satisfaire les besoins actuels.

Ce rapport analyse certains importants paramètres qui ont causé de tels changements dans l'approvisionnement en eau et l'utilisation de l'eau dans les systèmes d'irrigation. A cette fin, le réseau d'irrigation et de drainage de Moghan est retenu, car il fonctionne depuis plus de 30 ans. A ce moment, on constate les améliorations dans l'efficience d'irrigation, l'augmentation des demandes en eau industrielle et domestique et la disponibilité élevée des terres agricoles en raison du nivellement des terres et de la mise en valeur des terres. Donc, il est nécessaire de réétudier la vieille politique de l'exploitation et de la maintenance des réseaux.

Mots clés: *Réseau d'irrigation, Moghan, changement, ressources en eau.*

1. INTRODUCTION

Moghan irrigation and drainage network is one of the most important agricultural regions in Iran. Construction of this network began in 1959 and finished in 1964. Operation of Moghan Network was satisfactory during the last four decades, although some problems did occur due to change in circumstances. So, new planning and management according to new technologies, policies, social conditions and international relationships is needed to justify the investments on the network. One of most important parameters is re-planning of water resources management.

Araks River is water supplier of Moghan network. The river starts within the borders of Turkey from the glacial lakes of moraine sediments located between watershed saddleback of the upper reaches of Armenian Byurakn mountain plateau and clinker springs located on elevation of 2200-2700 m. Flowing in eastern direction the Araks crosses Armenian border twice, thus becoming a border-river between Armenia and Turkey as well as Armenia and Iran. In the downstream the river Araks crosses Azerbaijan-Iran border and flows along Azerbaijan

territory to join the Kura River on its 1072 km, and after another 241 km it falls into the Caspian Sea. So, policies of these countries affect on water resources, especially at the downstream.

Construction of hydro infrastructures increases water consumptions at the upstream and decrease water resources at the downstream. Moghan network is located at Iran territories near Azerbaijan boundary at the downstream of Araks River. So, this network is affected significantly by increased water consumption at the upstream. At present, water allocated for Moghan network is according annual agreement between Iran and Azerbaijan and more than the defined water rights.

All networks with common water resources have the same problems like Moghan network. Therefore, re-planning for old networks is necessary, because of two significant challenges: (i) Regional problems due to new water rights and (ii) Internal problems due to water shortage.

Moghan network has about 7100 ha area and in the past, the network was operated by the government. Today, the network is operated by a private agency due to privatization policy of the government.

Most important challenging parameters at water resources in old irrigation and drainage networks include:

i. Construction of new hydro infrastructures at upstream and water resource decrease at downstream
ii. Change in initial monthly distribution of water demand rather than new conditions
iii. New regional and national policies
iv. New internal consumers

This paper attempts to introduce significant challenges and discuses approaches to face them. It is hoped that the paper can be utilized as a guide for water resource planning. The Moghan Network is selected for the case study. All the findings and conclusions may not be applicable as such to other locations and networks.

2. NEW UPSTREAM HYDRO-INFRASTRUCTURES AND WATER RESOURCES CHANGING

New water consumers are undoubtedly formed after over three decades of construction of an irrigation network. Establishment of new habitation centers, expansion of agriculture, industrial development, growing ecological concerns, all put pressure on the capacity of older infrastructures. Water supply for cities near Araks river, construction of irrigation and drainage networks in Turkey, water transmission out of watershed and finally, increasing of urban and industrial water consumption cause changes in the demand for quantity and quality of Araks water resources.

Moghan Irrigation and Drainage Network according international protocols between Iran and CCCP in 1980 had about 684 MCM water allocated. While water allocated to Moghan Network was predicted 320 mcm in 2020. One of most important parameters for reducing

water allocation was Khodaafarin Dam's operation at upstream. Table 1 shows Iranian water right according Iran-CCCP protocols.

Table1. Moghan water right according Iran-CCCP protocols (MCM)

Year	1980	1985	1990	1995	2000	2010	2020
M.N.W.R*	684	674	500	460	430	400	320

* Moghan Network's Water Rights

In spite of defined water rights, Moghan Irrigation and drainage network harvested more water than the protocol because of sufficient Araks water resource in initial operating years. Due to this reason, water consumers grew significantly. Today, Araks available water resource is decreased and cannot supply same volume for Moghan. But water demands remain the same and even more.

3. CHANGING AT INITIAL MONTHLY DISTRIBUTION WATER DEMAND RATHER THAN NEW CONDITIONS

Long duration of network operating makes change at initial monthly distribution water demand. The change is because of new cropping pattern, new irrigation methods, urban and industrial consumption. Cropping pattern usually changes at large scale networks due to economic and social conditions. Sometimes, operators cultivate plants with low water requirements for better management of available water. It causes changes in the monthly distribution of irrigation water.

New irrigation methods whit high efficiency cause decrease in water demands. Establishment of Industries and Appearance of new settlements like cities and villages with the earlier rate of monthly distribution of water cause mismatch between demand and supply.

After the construction of Moghan Irrigation and Drainage network, Pars-Abad, Aslandooz and Bilesavar localities were formed and grew. In addition some villages were formed near the main and primary canals. Water demand of all cities and villages is supplied from these canals. So, water should always flow in the canals. For example at the end of network, where Bilesavar is located, water flow should be at least 0.5 cm for supplying drinking and other needs of the city, while the available water is just 0.2 cm.

First cropping pattern of Moghan with plants like cotton had high water requirements. But changes at cropping pattern caused lower water requirement than the initial conditions. Some of plants were either eliminated completely or were reduced in area coverage due to water shortage. For example cotton with 20% area at the initial stage decreased to just 3% later.

Table 2 shows average monthly water harvesting for two periods of time include 1983-93 and 1994-2005. Figure 1 represents trend of monthly water delivery changes in these two periods.

Table 2. Average monthly water delivery for two periods of time (MCM)

Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
1983-1994	37	37	47	102	135	139	122	125	92	43	32	35	947
1995-2005	21	23	27	62	118	109	112	131	83	22	20	23	752

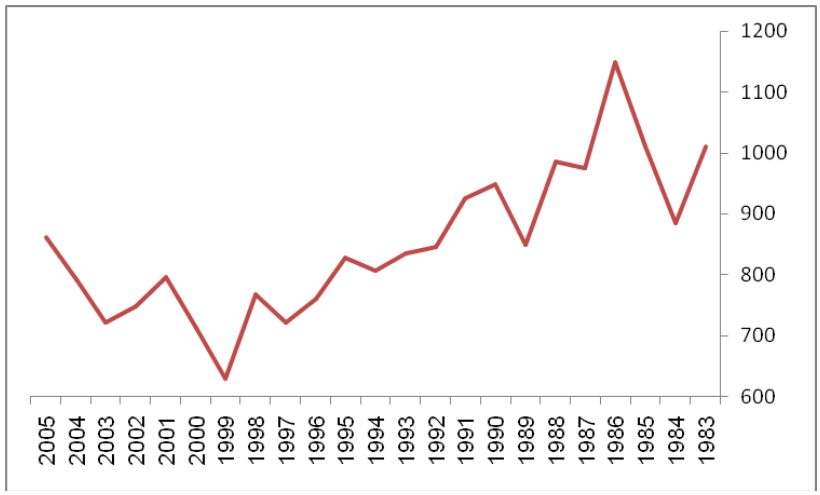

Fig. 1. Trend of monthly water delivery changes in two periods

As the Figure illustrates, the two significant differences include: (i) water delivery reduction from April to August during 1994-2005 and (ii) reduced water delivery from September to March during 1994-2005.

4. NEW REGIONAL AND NATIONAL POLICIES

Governments usually change their policies according to world evolutions. These policies affect industrial and agricultural parameters. In addition, regional relationship between countries affect water allocations especially for common water resources.

Privatization Policy was one of most important changes in the last decade in Iran. The policy causes networks' transfer from government to private operators. Although, PIM and IMT had positive and negative results, but integrated management of networks was a problem. Increase in irrigation efficiencies on one hand and increased water demand for more agricultural productions on the other were due to privatizations policies in Moghan network. In spite of more welfare, some problems occurred between suppliers and consumers, because supplier was state supported and consumers were private entities. The consumers wished to access water on the real time need basis, which the suppliers could not meet.

New political structure of countries changes regional relationships. For example, overthrow of CCCP caused not to provide enough energy for water pumping toward irrigated land in new

countries like Azerbaijan. So, more water was diverted to Moghan network and operators expanded agricultural lands in beginning of 1990 decade. After 1995, Azerbaijan provided needed energy. So, new agricultural lands faced water shortage in Moghan network.

In addition, better financial condition in Turkey motivated constructions of water infrastructure at the upstream in the last two decades causing lesser water delivery to the Moghan network.

5. NEW INTERNAL CONSUMERS

Large scale irrigation and drainage networks are suitable places for human settlement. So, industries, especially agro-industries will appear near these populated colonies. To provide drinking water for populated colonies and to supply water for industries water demand pattern changes from the initial plan.

Before construction of the network, land use of Moghan plain was according to the local tribe's wish. So, drinking and industrial water needs were negligible. But three cities and some villages with high volume of drinking water and industrial water demands are established today.

6. RESULTS AND DISCUSSION

According to available statistics, water delivery to Moghan network was decreased during 1983 to 2005. Dividing this period of time to two parts, 1983 to 1993 and 1994 to 2005 shows that first period has 947 mcm and the second has 752 mcm annual mean water deliveries. While irrigated farms increased during this period, the water delivery decreased.

Figure 2 indicates annual water delivery to Moghan network during 1983 to 2005. Analysis of water balcony shows that a lot of water passes through drainage. It seems that operation of drained water can be one of approaches for water shortage prevention, but it is not suitable option because of high investigation and decrease of drained water at future.

Table 3 shows average monthly entrance water and drained water for 2006 to 2008. Notice to ratio of drained water to entrance water indicates that at some months the ratio rise to near 40 percentages. While, the rate decreases up to 20 percentages at high demanded months like June. It shows that water shortage causes better uses of water and operators can manage available water better.

Improvement of irrigation methods, like sprinkler and localized irrigation, are very important for decreasing water requirement.

Direct water harvesting from Araks River for water supply of cities and villages can decrease needed water of network. It seems that high amount of water flow into the network, especially in September to March period is because of industrial and drinking water supplies. So, with direct water harvesting the amounts will be dropped.

Table 3. Average monthly entrance water and drained water for 2006 to 2008

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drained Water	17	15	19	29	31	28	26	25	25	23	17	20
Delivered Water	45	26	76	122	129	127	130	137	107	54	47	61
Ratio	37	57	25	24	24	22	20	18	23	42	36	32

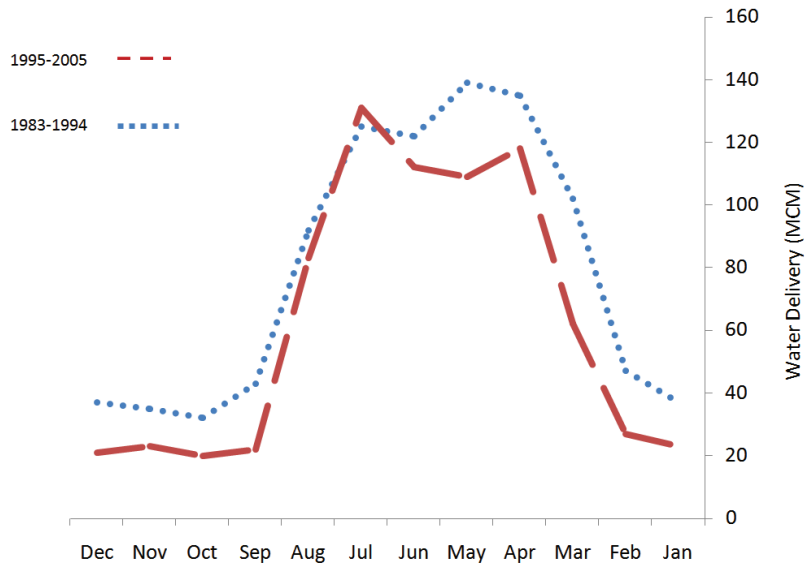

Fig. 2. Annual water delivery to Moghan network during 1983 to 2005 (MCM)

7. CONCLUSIONS

According to the study, water resource of old networks will be decreased with passage of time. So, reprogramming is very essential because of change in initial monthly distribution of water demand, new regional and national policies, new interior consumers and change in water resource management at upstream. Ignoring these parameters will adversely affect the operation of the network in future times.

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