Transboundary Aquifers: Challenges and New Directions
Ramsheh plain technical and social analysis

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ABSTRACT

Nowadays, in addition to the amount of surface and ground-water, its distribution and dispersion, ownership, political and geographical boundaries; utilization methods are among the head-on challenges.

Transboundary aquifers, located along the political borders, on one hand are concerned with subjects which directly have effects on their preservation and sustainability and on the other, deal with direct and indirect parameters which can affect utilization potentials and their effects on stake-holders.

Various complexities existing in transboundary aquifers between and/or among countries could be recognized inside the borders, e.g. between two adjacent provinces as well, which shows incremental sensitivity in the water industry.

In Iran, serious challenges are caused due to the change of water basin management into provincial management.

Ramsheh plain, located in the Isfahan province, is nourished by the Izadkhast river of the Fars province, especially, southern flank of Morvarid mountain. Gavkhoni wetland located in North–East, of the area is considered drainage of the plain.

Based on traditional water right, the Izadkhast river has been used by Ramsheh inhabitants for agriculture and recharging of the plain. In addition, its flow has turned water- mills which dates back to some 250 years.

In recent years, construction of Izadkhast dam in the Fars province for agricultural development has stopped the recharge of the Ramsheh aquifer causing transgression of high E.C. water into the aquifer.

This technical investigation on the Ramsheh aquifer is focused on mathematical models, dealt with social problems and their historical evolution is also accessed.

With the use of GMS model (Ground water modeling system) and based on geologic data and measurements of piezometers, the loss incurred by cutting off the water infiltrating into Ramsheh aquifer and its consequent effects on stake- holders, in terms of the Izadkhast dam construction, is evaluated.

Key words: Ramsheh- Esfandaran, aquifer, Gavkhuni wetland, Izadkhast dam

1. INTRODUCTION

The study area related to the present research called, Ramsheh- Esfandaran, in central Iran, is located some 160 Kms south-east of Isfahan, between longitude of 52˚ 41' to 52˚ 47' and latitude of 31˚,17' to 32˚,13'. The present study covers an area of 4768 Km^2, of which, 2408 Km^2 is plain and the rest elevated land. The average plain elevation is 1580 m above sea level, with annual precipitation of 97.8 mm.

The mentioned area has been a suitable sedimentation basin before Tertiary. It had been lifted along with Zagros folding and sedimentation in shallow sea commenced. With Zagros uplift, this area had been disconnected from sea, and for some era remaining a lake then dried up. Gavkhuni wet land is the remnant of the Gigantic Sea that existed before that time.

The most important and sole run-off source of water in the area is the Rahimi river, which flows off the western elevations of Izadkhast water-shed. This river runs down to Esfandaran sub-basin and eventually terminates in Gavkhuni wetland.

The Izadkhast highlands and its main water- basin, is located in the Fars-province, Due to its specific topography,and based on its past history, upstream stake holders have only been able to utilize water in the

form of a narrow band along the Izadkhast valley with their limited agricultural lands extended along the river.The main agricultural lands and ancient riparian inhabitants of the Rahimi river, downstream of the water- basin, are settled in Ramsheh and Esfandaran, in the neighboring Isfahan province.In ancient times, most of the river flow (ranging between 4 to7 M.C.M annually) entered into Ramsheh – Esfandaran.

Furthermore, there existed an agreement in the form of a contract between upstream Izadkhast and downstream Ramsheh water users, which was in force for hundred of years. Thus the inhabitants of Izadkhast area had disclaimed their right to use water upstream and legal downstream users developed Hydro- structures with the aim of running their water mills and recharge water through recharging areas.

In recent years, the Fars Regional Water Board, having neglected the old agreements, implemented the construction of Izadkhast dam, thus preventing water flow to downstream Esfandaran-Ramsheh which naturally has caused water resources problems for downstream stake- holders and riparian rights.

In this research the social consequences and scientific aspects of upstream dam construction has been analysed and forwarded.

2- RAMSHEH-ESFANDARAN HYDROGEOLOGY (WATER RESOURCES)

In the study area of Ramsheh-Esfandaran, there exist 4 deep wells, 158 semi-deep wells and 26 Qanats.

Deep wells Maximum depth = 220m.
Deep wells average potential = 14 lit./second.
Semi deep wells average depth = 14 meters
Semi deep wells Maximum depth = 35 m.
Semi deep wells average potential = 4.7 lit./second.

3-WATER BUDGET (BALANCE)[1]

3-1-Aquifer charging volume: The average annual charge of the aquifer is around 496 million m^3 and the related factors are as the following:

- *Volume of precipitation over aquifer surface area*: Based on thiessen map, long term average precipitation (97.8 millimeters) and its surface area (665.9 Km^2), the volume of precipitation over the aquifer surface area equals 65 million m^3.
- *Volume of precipitation outside of aquifer surface area*: This area equals 4102.1 Km^2 with an average of 102 millimeters of precipitation, resulting in a volume of 418 million m^3 annually.
- *Returning Water Volume*: A volume of 6.75 million m^3 returns to aquifer annually, considering 25% out of 27 million m^3 water used as potable and industry.
- *Fluctuation in alluvial aquifer volume*: By drawing the plain Hydrographs for the recorded years and calculation of around 0.29 meter average annual drawdown of ground-water and regarding the average storing capacity of the aquifer (2/5%) 5 million m^3 is calculated for the annual utilization of the aquifer stored capacity.
- *Volume of water entering the aquifer from the neighboring basin unit*: Regarding the construction of Izadkhast dam and reduction of Cheshmehrizeh River flow (the only surface charge of the aquifer) the maximum expected charge from the neighboring basin unit is estimated 1 million m^3.

3-2-Aquifer discharge volume: The discharged water through pumping wells in the unit is around 14 million m^3 of which, 1 million belongs to the Fars province (Ab-e-shotor plain).The discharge water through Qanats and the existing spring is 10.5 and 2.5 million m^3 respectively.

[1] Balance volume presented in figure.1, refers to the first Dam impoundment on March.9. 1999 .

- *Volume of unit's outlet run-off*: This amount is calculated 38 million m^3.
- *Volume of unit's under-ground drain*: Regarding the piezometric maps, this amount is estimated 10 millions m^3.
- *Evapo –Transpiration*: Considering a share of 87% of the whole precipitation, the calculated volume of ET. is 421 million m^3.

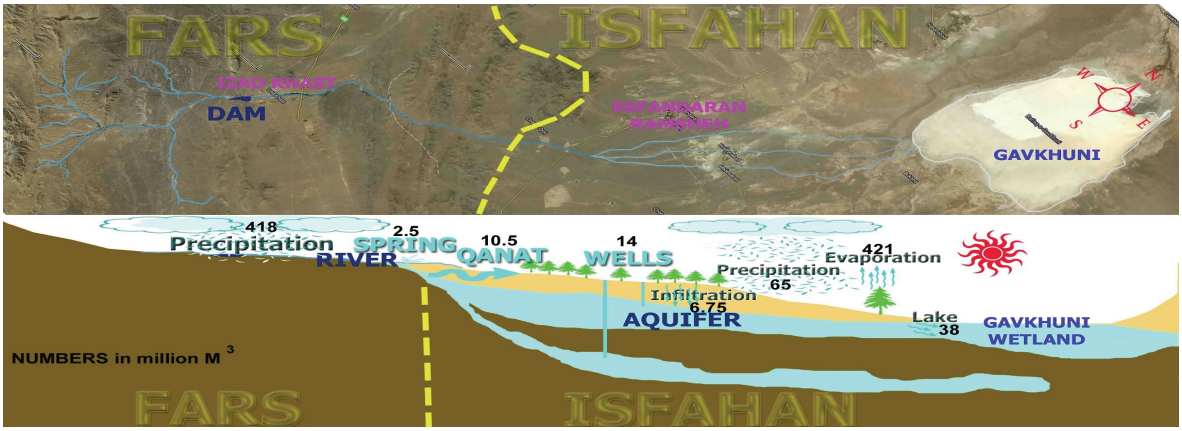

Figure.1: Plan and longitudinal profile of Izadkhast river in Fars & Isfahan Provinces

4-AQUIFER CHARACTERISTICS AFTER DAM CONSTRUCTION

A summary of aquifer Characteristics after Dam impoundment is presented in figure No.2. As noticed, Water table in aquifer has dropped about 1.7 meters which has resulted in a rise of salinity to more than 10000 µM/cm .This situation has endangered the agricultural produce and violated riparian rights, followed by severe reactions and consequences.

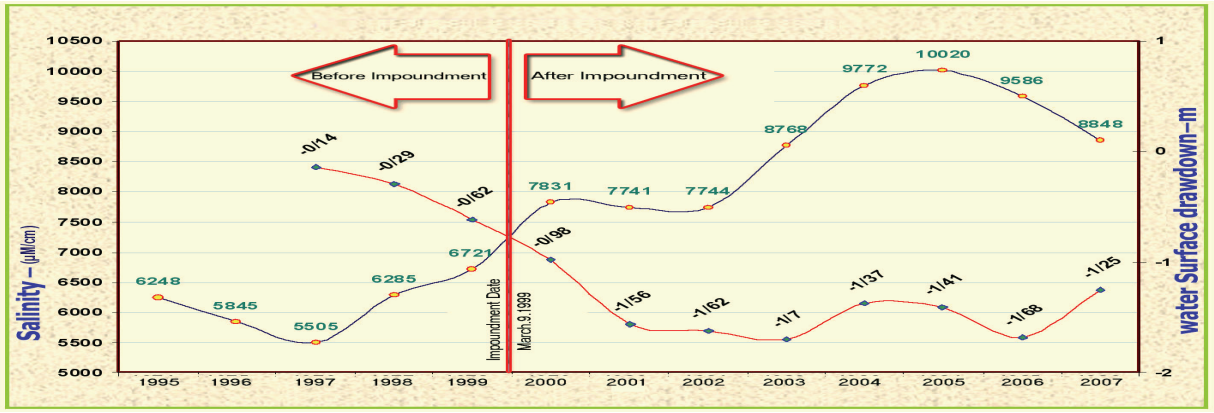

Figure.2: Graphs related to water-table drawdown & salinity in Ramsheh- Esfandaran aquifer

5-CONCLUSION

- Ignoring legal, riparian and stake holders rights, irreversible consequences may arise.
- Before execution of any new Hydro- structure, precise social studies and effects of the planned structures on the aquifer, should be given a high priority and attention.
- The Izadkhast dam construction has resulted in the severe draw-down of water- table and the sharp rise in salinity in terms of doubled E.C. which shows a crisis in the aquifer.