Death of Urmia Lake, a Silent Disaster Investigating of causes, results and solutions of Urmia Lake drying

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Abstract

Urmia Lake is one of the wonders of today world and unfortunately is in the danger of drying in a near future. In this paper we investigated the factors which caused this drought using statistical data and tried to understand what kind of effects and disadvantages we will encounter with, if this process continues. In this way we used experiences from global and regional examples. And finally possible solutions for this environmental problem were investigated and it was tried to determine benefits and disadvantages of each method and suggest the best method for performing.

1. Introduction

Urmia Lake in northwest of Iran is the second great saline lake in the world. Average altitude of the lake is 1276m and salt amount vary from 185 to 220g/ltr. Surface flows, direct rainfall and groundwater flows are the main water sources of the lake. This lake forms a rare and important ecologic, economic and geo tourism zone in the world and country. This lake is hosting for more than 20000 pair flamingo and about 200 to 500 pair White Pelican every winter. Furthermore, this place is a second great reserve of Artemia that have high economic values [1]. All these led to announcement of this lake as one of Biosphere Reserve of UNESCO in 1975. In addition to these, Urmia Lake moderates temperature and humidity of the region and provides a suitable place for agricultural activities. Ultimately, picturesque landscapes and remedial effects of slough of the lake made it an important ecotourism centre. Unfortunately these entire features tend to disappear through these years of drought and shall continue to fade completely if any urgent interference doesn't take place immediately.

2. Discussion

LANDSAT images from 1976 to 2005 display sudden and distinct dropping pattern in lake area especially in eastern and southern parts of the Lake [5]. Relevantly, Statistical data from 1955 to 2007 show an overall decreasing trend in area from 5800 km^2 to 4017 km^2 and this leads to appearance of 1800 km^2 salt marsh on adjacent lands.

2-1. Causes of drying of Urmia Lake

Climate changes, dam constructions and devoting water sources to agricultural, industrial and domestic uses are the most important factors for water surface slump. Long periods of drought led to decrease in the amount of direct rainfall and water input by the rivers as in 98-99 water year, 1.36 million m^3 was entered in to lake that was less than half of the average entry (3.42 million m^3). This dramatic decline accompanied by a gradual increase in evaporation from water surface. All these factors come together to decrease the volume of the water from 42

milliard m^3 in 1995 to 22 milliard m^3 currently. Input efficiency caused an increase in the amount of salt as current amount of salt in 162 g more that its 40 years average which resulted in huge salt deposits. Water level also fell to the lowest point in recent 40 years. Current water level is 1271.67 m about 3.93 m less than the average amount. The minimum biological water level of the lake designated as 1274 m according to high council of water regulation and hitting water level beneath this minimum is a potential danger for environment and people living near by.

Another reason for drying is dam construction. Capacity of current water reservoirs of dams in the basin is 1.624 milliard m^3 which will rise to 3.568 milliard m^3 and it is obvious that the process will make the situation more critical. and finally rapid growing of agricultural and industrial activities in another reason. Statistics show that average consumption rate of Urmia Lake Basin is 7.84 milliard m^3 which 94% is dedicated to agricultural activities. Statistics revealed that currently 670 thousand hectare in devoted for agriculture that grows more that one and half time comparing with 30 years before (approximately 430 thousand hectare). Continues of this process will lead to more consumption of water storage of the basin and so less amount of water will enter the lake every year.

2-2. Results of drying of Urmia Lake

Effects of Urmia Lake drought could be classified in ecological, health, social and economic problems. Unique ecosystem of the lake will be destroyed completely parallel with salt increase. Another main problem is appearing a salt desert with area more than 5000 km^2 which overlaid with a 50-60 cm thick salt deposits. When drought happen, wind will carry out these salts and chemicals and pesticides deposited in the lake basin to adjacent areas as far as 300 km (up to Zanjan plain) and these contemplators will damage agricultural lands, polluted the ecosystem and cause variety of disease in near by urban and rural areas. The same process is happening in nearly dried Aral Lake currently as winds erode the Lake basin and deposit ten million tones of dust on near by habitats [3, 4, 6]. Another live instance is Ebinor dried Lake in China which estimated that 4.8 milliard tones of salty dust are carrying from dried surface of this lake annually [1]. As mentioned before, salt and contemplators which carried by winds can cause different diseases. Distinct example here is Aral Lake which salt and transformed chemicals caused respiratory diseases, malnutrition, anaemia and leber. Furthermore, increasing death rate of infants, decreasing IQ of children and psychic disorders are other problems. Along with them water pollution led to outbreak of epidemic disease like typhoid, A hepatitis and diarrhoea. Relying on these evidences it may be predictable that if Urmia Lake dries, the entire region will affected by health problems for several generations. And ultimately all these problems influence livings of near by people. Extensive devastate of farms and garden by contaminators and salt and distraction of harbours will result in immeasurable loss of work which means poverty will extended and people will have to migrate to other places and this may cause even more critical social and economic problems.

2-3. Solutions for drying of Urmia Lake

Calculations show that to provide the minimum biological demand of the Lake we need 3 milliard m^3 water annually which means a flow with $100 m^3/s$. To achieve this goal different methods were proposed and this paper tries to evaluate each one and choose the best solution.

Trying not to increase water consumption is one of the methods for disaster management of Urmia Lake which seems unpractical regarding to intense dam construction and extensive agricultural projects. Another method is raising farm efficiency 3 and 15 percent for 5 and 25

years ahead respectively. Calculations show that the amount of saved water by this method is 0.35 and 1.7 milliard m^3. Considering the minimum 3 milliard m^3 demand of the lake it seem that 0.6 percent eficiency increase per year result in saving 350 million m^3 annually can not afford claims of the Lake singly. The ultimate solution is to transfer water from adjacent basins. Meanwhile, there are different projects for reclamation of Death Sea and Chad Lake by this method. One of suggested solutions is water transfering from Aras and Zab border rivers. Evaluations reveal that the volume of water we can conduct from Zab is only 625 million m^3 annually and we should also mention we are allowed to take water from Aras International River only with 10m^3/s rate; and these amounts won't make a helpful compensation at all. Furthermore, water obtained in this way is usable in agriculture and drinking proposes and it is not logic to be released in to a saline Lake. When all solution seems to fail to produce a practical method for saving Urmia Lake it seems that the most efficient way for rescuing the Lake is transferring water from Caspian Sea. Pooyesh Pazhooh Parlag Consulting Engineering Corp. dealt with this project for a long time. Estimation of water demand of the Lake, investigating hydrochemistry of Urmia Lake and Caspian Sea, studying the path of transferring and trying to find solutions for technical problems are some of the tasks performed by this corporation. Calculated distance for convey is 300km and it was suggested that water to be transferred by piping along entire route. Demanded electric power for this project is 3000 megawatt hour which 500 megawatt hour of it could be provided by potential difference along the rout and the rest of it can be attained by constructing geothermal power planets and using natural energies like wind and solar energies.

This method as well as other solutions suggested in comprehensive management of Urmia Lake document could recover the ecosystem and return life to the region and save Artemia from danger of extinction which can be considered as an important source of revenue for the region. To transfer the water from Caspian Sea will preserve a valuable amount of river yield which can be used for agricultural and industry purposes. constructing pools for growing fishes in the path of transfer are some other examples of be benefits of this project and when Lake become stable planning can be done for making Urmia Lake one of greatest ecotourism sites in the country and the world. Ultimately it is obvious that preventing the losses and effects of agricultural destroying, infections, poverty and migration are the most important outcomes of this project which can save the lives of thousand of animals and millions of people live adjacent to this natural phenomenon.

3. Conclusion

Urmia Lake is the second great salty Lake in the world. Unfortunately in the recent years water level and area of the lake show a great decrease and this lake in threatened by the risk of drying. In this paper we analysed different statistic data about the lake in the 40 years time period which illustrate that if this process continues, the lake is going to be dried up in the near future. Investigations demonstrated that climate changes and dam constructing are the most important reasons for this disaster. Continuously we studied the wide variety of problems which this drying may cause and used the information of worldwide lake which are extinguished or are going to die soon. Investigations show that if this enviemental disaster takes place we will encounter a wide area of problems like extinct of most of animal types and

creation of a huge salt desert. This desert will be the source of contemplated winds which carries dust, salt and chemical fertilizers from dried surface of the lake to the region as far as 300km. This huge amount of contaminants will cover farms, fruit gardens and urban areas and will make different social, economic and health problems. Finally, we researched the methods and solutions to prevent this catastrophe. Not to increasing water consumption, raising agricultural efficiency and finally water conduction from nearby basins like Aras and Zab rivers and Caspian Sea are some of them. In this process we tried to define the most important benefits and shortcomings of each method and reach to the practical solutions.

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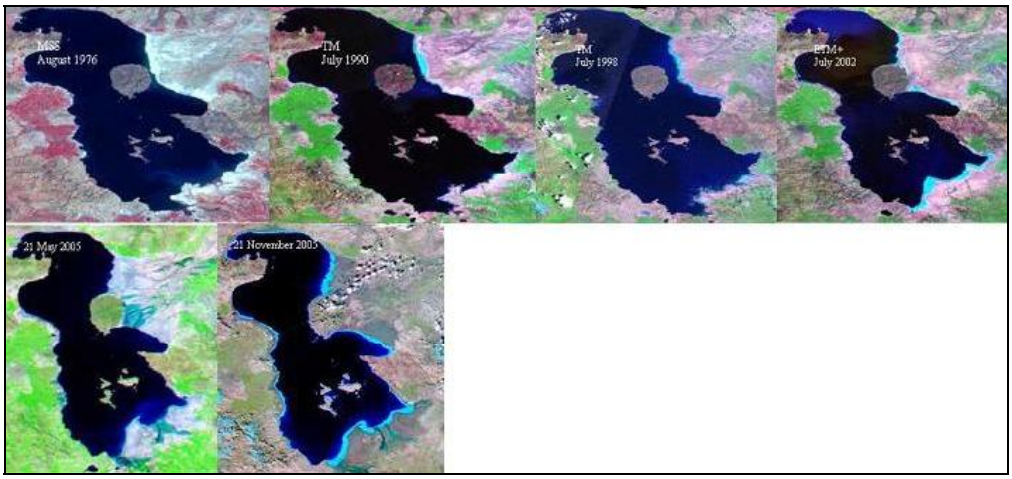

Figure1. Decreasing area of Urmia lake since 1974 to 2005 shown in LANDSAT images [5]

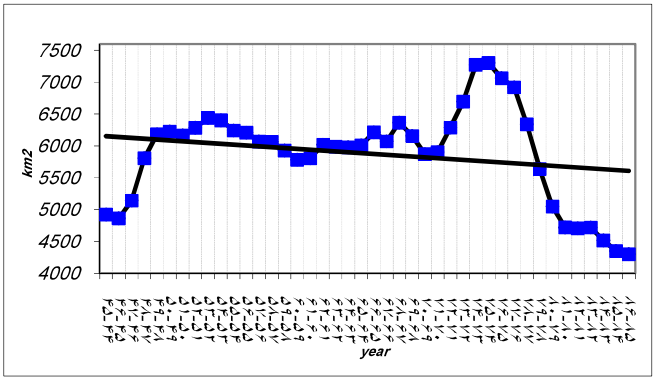

Figure2. Fluctuation of area of Urmia Lake during 40 years time period

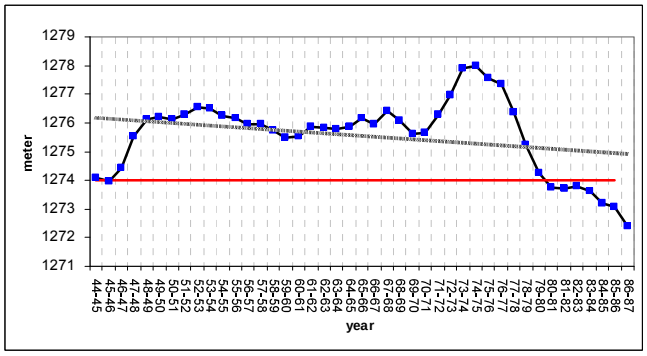

Figure3. Fluctuation of Urmia Lake water level during 40 years time period. Stable line shows the minimum level that was assigned by high council of water regulation

Figure4. Birds die when they being trapped in salt deposits

Figure5. Left: Sharafkhane harbour in East Azerbaijan province damaged vastly because of water retrogradation. Right: Death Artemia on salt deposits