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## Analysis of the hydro-geomorphology and environmental potentials of Orumieh Lake basin in order to Planning

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### Abstract

Orumieh Lake due to economic, tourism, microclimate effect, agricultural activities have an important role in the northwest of Iran. This lake basin area is 52700 km<sup>2</sup> with 102 islands, as known a familiar it as known one of the protected areas, with 186 species of birds, and animals. The water of lake is very salty (240 gr in winter and 260gr in summer) and fluctuation of Lake water level threaded 500km<sup>2</sup> of banks or shorelines lands. Water level rising in intensive rainfall years caused damage for ports instruments in shoreline and agricultures lands. This tectonically Orumieh Lake surrounded by agricultural plains and consists of 10.5 % of basin area and has 340 million m<sup>3</sup> water resources. The ratio of salt in soils is from %1 an Ec 8 mmhose to %3 and Ec more than 40 in around lake expanded in vast area. Due to the construction of many dames on the main rivers, dominated of drought climate, diverting river water to agriculture land and Tabriz city water supply, sea level this lake intensively decreased. For control satiation preceding and rehabilitation marginal soils due to environmental potential, some techniques suggested for land using of shoreline.





## Introduction

Coastal population always are threatened or at the risk of sea or lake water fluctuation (Almost rising). Also the coastal area is an aggravatingly to management and to day it is of crucial significance for the future humanity and the ecosystem processes upon which we all depend (Timothy & et al, 2000).The coastal marginal areas include, shorelines offshore sediment nourishment and estuaries. Iranian shorelines due to infrastructures and impact land use, in future will be comforted with problems such as coastal erosion, ecosystem variation, water pollution, marginal soil Salinity and decrease of aquatic lives (Saiko, 2001). The touristy Orumieh Lake shoreline waters production due to the economical, ecological conditions, absorbing more people increasable. and also intense human interfere to the shorelines area led to the ecology variation, soil erosion, waters pollution and fluctuation of lake level. Therefore study and management of basin and especially shorelines of them via impact are necessary.

Parimalarenganayaki,(2014), has a research about The criteria for adopting a particular method of MAR depend on the local condition (topography, drainage, land use), aquifer type (confined, unconfined and semi-confined) and water quality (Storms water, recycled water). Abedini (2015), has down a research such as An analysis of hydro- geomorphology of the Neor lake in Ardabel in order to land use planning (with an emphasis on soil erosion and sediment).the results showed the average sediment yield of 338.65 ton/ha/year and total annually sediment yield 1794845 ton/ha/year in the small watershed indicated the high ratio of soil erosion. Ultimately for establishing suitable construction on the Neor lake (water space and their banks and margins) with considering future and environmental potentials, land use map and

some suggestion are suggested. Yoshio, (2014), has a research on functional role of Nitrogen cycle with hydrologic in Kurobe river basin. Ryoji et al (2014), has done a research about modeling of paddy irrigation process with large reservoirs and quantification of river flow regimes affected by Anthropogenic activates. The result showed the reservoir operation model reproduces water management during the rainy seasons and the release of irrigation water in response to water requirements during dry seasons. Also modeling of water management in reservoir irrigation improves the simulation accuracy of river discharge in dry seasons when the water release from reservoirs is dominant in river flows.

## Methods and Materials

In order to studding and analyzing soil erosion and sediment yield, we obtained used from geology and 1:100000, Topographic 1:50000, aerial photos 1:55000, 1:20000 and some field work. For determining and analyzing potential of basin to gully genesis and some proprieties of soil formation, we utilized from data average of climatic and laboratory experiment of sampling soil from basin. Then several equation and formula we applied for calculating and analysis the rate of sedimentary yield.

The Study area is located in the northwest of the Iran between the Caspian Sea and Van Lake, Turkey located (fig 1). Uromieh lake basin receives 398 mm annual average precipitation and with semi-arid climate has second rank between the regional basin of Iran. Also study area is the portion of Iranian flatus with Alpine sedimentary folded and mountains. The lake water levels from Ocean base sea level is the 1274 m upper and average depth of them 6 m, also occupied 9.5 to 10.5 % of whole basin area.



**Natural Condition (Geology, Climatology and Hydrology)**

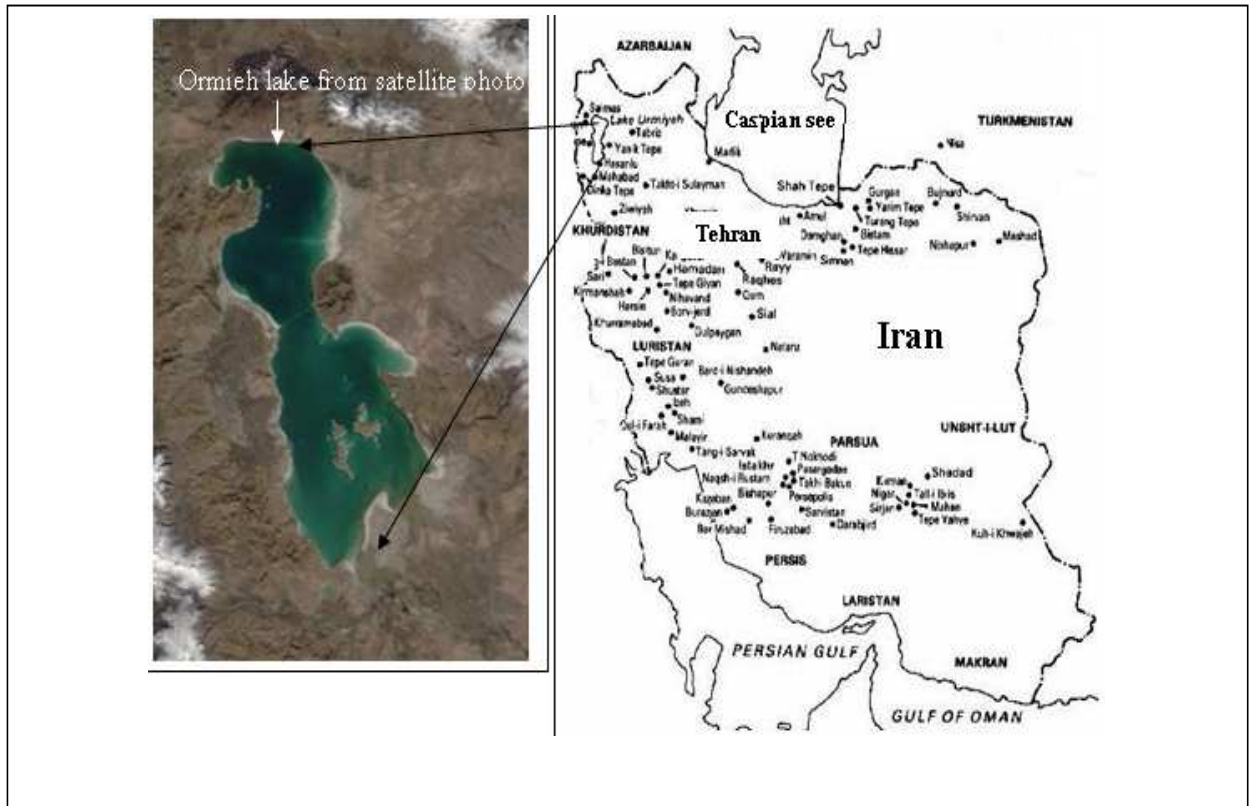


Fig 1.shows the situation of Orumieh Lake in the Northwest of Iran

The whole water of them is 5500 km<sup>2</sup> have equal about 1000 milion m<sup>3</sup> (Movahed Danish, 2003). According to the hydrology zone, study basin is divided to three areas such as western, eastern and southern sections. The main rivers of east area include Aji, Buok, Galeh, Sofi, Mordag and Lillian all together occupied 34.4% (17075 km<sup>2</sup>) of whole basin area. The main rivers of South area including Zareneh, Semineh, Moehabad and Gadar rivers, all together occupied allocated 37.6% (19815 km<sup>2</sup>) of whole basin area .Also the main river of west area including Barandoz, Roza, Nazi, and some small rivers with area of about 15.4(8116km<sup>2</sup> a) and all together occupied 34.4% (17075 km<sup>2</sup>) of whole basin area.

In the small portion of whole basin area (about %25 of marginal and mountainous area) from heights of 1350 m to maximum heights (Sabalan

Mountains with 3852m) soil erosion via runoff is high. Also in the about 55% of basin with deferential heights of about 1000 m included low gradient slopes and scattered mountains sediment yield is possible and via local runoff erosion. But in the 40% of basin included plains and small plains areas with deferential heights of 226m occurred some riverbank and bed erosion, sediment deposit to be accomplished (table 1).

These areas almost allocated to agricultural, residual, and shoreline structures (Except small salty area near the shorelines). Today with satellite technology it is possible to map potential wave energy for different wind directions, and thus to explain the pattern of erosion and accretion zone for subsequent planning purposes (Timothy & et al, 2000; 246); (Charlies & Charlifr, 2005).



Table1. shows hypsometric condition of Orumieh Lake basin

Erosion and Deposition area	topography	Relative Height (m)	Height (m)	Percentage of area in upper basin	Percentage of area in down basin	percentage of distribution
Deposition area	Shoreline	0	1274	100	0	40.9
Deposition area	marginal area (Plaines)	226	1500	58.4	40.9	34.4
Both erosion and deposition	Pediment and low gradient slopes	726	2000	24.20	74.70	19.8
erosion dominated to deposition	Debris or gentle slope	1226	2500	4.90	95.01	4.40
High erosion	High gradient slopes	1726	3000	0.6	99.35	0.7
Very High erosion	Very High gradient slopes	2226	3500	0.03	99.97	0.02
Very High erosion	Mountain apex	2576	3850	0	100	0

**Environmental potentials and economical and social capability.**

The Orumieh Lake is the important protected area with 102 islands, familiar national park, with 186 species from birds, and animals. Where this lake is the biggest basin in the western Asia, and due to Rio conference published Declaration in 1994, the Orumieh Lake ecosystem and national park of it as known one of the protected area between the 9 protected areas. So must be utilized from Global Environmental Facilities (GEF) between the developing country. Also the National park of Orumieh, among the 14 national park in the world utilized from spatial limitations. The UNESCO organization in the world program (Human and Biosphere or Man and Biosphere (MAB) emphasized on the protection settlement regain and one of them is Orumieh Lake. In this framework other direct observation from Iran Orumieh Lake ecosystem as known primary area for protecting. This lake basin area is 50892 km<sup>2</sup> with 102 islands, familiar national park, with 186 species from birds, and animals. Due to economic, touristy, agricultural activates has a special role in the northwest of Iran. Every year more than three million people visit attractive national park and shoreline for swimming. The Islands of Ashak Dagi (with 3175 ha), Aspher (2550 ha) and Arizo 2500 hac) are important locations for wildlife and utilization of bioenvironmental tourism attractions with worldwide value. In the Islands of national park are recognized some big animals and about 27 kinds of shorelines and land birds,

more than 33 kinds of migration birds. The water of lake is high density salty (240 gr in winter and 280 gr/liter in summer) Toluoi (1996). In the salty water of lake several kind of Planktons such as Enteromorpha and Artemia Ormiana are exist and some migrating birds feeding from Artima. Investigation of Azari (1368) indicated that the Orumieh Lake Artemia is a special species in the world, and he called Artemia Ormiana. The result of cooperation study together by Iranian Fishery and Gaunt university of Belgium, estimated the average alive or wet Altima's Ovals to be about 400000 tons and dried 3200 tons. This production has annually more than 1000× 106 economic value income for Iran (Mohammadi, 2006).

According to the Hydro-chemical study of Engineering Consulting Energy and Industry (EECI), this lake water known one of the high salty water of lake with suspended solution elements of Na, Mg, So<sub>4</sub>, CL in the world. Density of salt rates in water is various due to the season's variation and draught year. The average weight of salt in years fluctuated deferent between 150 to 400 mg/liter and usually are changed in spring 240 mg/liter and in summer 280 gr/liter. According to the annual salt input ratio, it is possible every year could be 2 to 5.5 million tons salt approvable (Mohamadi, 2006).



**Analysis basin form simulation ratio.**

**- Rotundity Coefficient**

Equation 1:

$$K_c = \frac{.28 \times 1225}{\sqrt{52700}} = 1.48$$

**- Drainage Density Equation:**

Equation 2:

$$Dd = \frac{Ld km}{A km} = \frac{2630}{52700} = 0.05 \text{ km/km}^2$$

Where in equation  $Dd$  is drainage density,  $Ld$  is the length of drainage system, and  $A$  the basin area. Drainage density due to the vast plain area in basin with penetrated formation (Alluviums with gravel, sand and clay and silt) is very low (about ( 0.05).

**-Equation for determining rectangle ratio for Lake Basin**

Equation 3:

$$L = \frac{1.38\sqrt{83100}}{1.12} \left[ 1 \pm \sqrt{\frac{1.12^2}{1.38}} \right] = \left[ \begin{matrix} 1779 \\ 466.2 \end{matrix} \right]$$

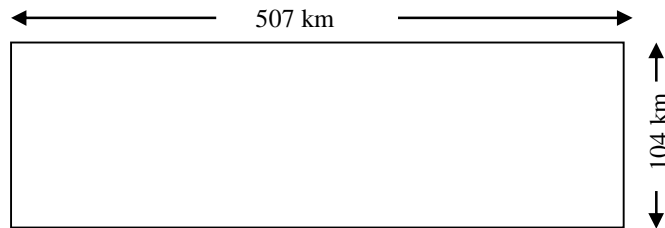


Fig 2. Shows rectangle ratio of basin

**- Determining Triangle Ratio:**

Equations 4, 5, 6:

$$D = \sqrt{\frac{4 \times 52700}{\pi}} = 258.9 \quad (4)$$

$$b = \frac{2A}{L} = \frac{2 \times 52700}{258.9} = 406.7 \quad (5)$$

$$L_t = \sqrt{\frac{52700^2 + 258.9^2}{258.9^2}} = 328.6 \quad (6)$$

**- The Equation of Parabola Ratio**

$$b = \frac{3A}{2L} = \frac{3 \times 52700}{2 \times 258.9} = 305.3 \text{ km} \quad (7)$$

$$y = \frac{4L}{b^2} x^2 = \frac{4 \times 258.9}{305.3^2} x^2 = 0.011 x^2 \quad (8)$$

The results show high adoption or simulation of basin shape with parabola and rectangle ratio as you see in the above equations). To this form basin almost the ratio of concentration time is rapid and high, so intensive rainfall led to occurrence of flood flash runoff Waters.

**-Human activities, basin and shorelines management**

Due to the concentration of city, village, infrastructure, agricultural land use and tourism structures (Intensive human activities) ecosystem condition changed almost during the several decade. Investigations showed around the lake, especially in sweet water valleys and some slopes the forest land distracted. Therefore many biology species are of animals, birds, plant of lake and land died or immigrated. Due to the construction of many dams on the main rivers, dominated of drought climate, diverting river water to agriculture land and Tabriz city water supply, sea level this lake intensively decreased. So the amount of salt in liter is mort ham 300 gr reaching on the summer. Therefore agricultural land around the lake in human life in residential

area vividly is threatening. Also today the tourist and economic roll of this lake increasingly decreased.

Establishment of causeway has an important role that can be attributed to its effect in connecting West and East Azerbaijan. This causeway led to interruption of north and south lake waters connection. Therefore ecological effects of them with concentration of more sediment and suspended salty elements in the north section, and Lake water level appeared. But in the south section Lake water level increased and sediment and salinity of water decreased. Also this cited subject with ecological variation recognized by satellites photos and laboratory analyzing (Sadigyan & Bozorgmeher; Jamab Engineering Consul, 1994; Alavipanah & Khodai, 2005).

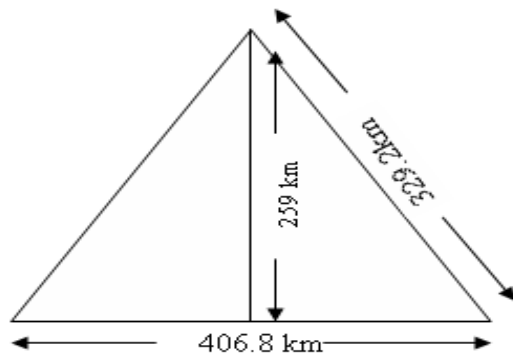


fig3. Shows triangle ratio of basin

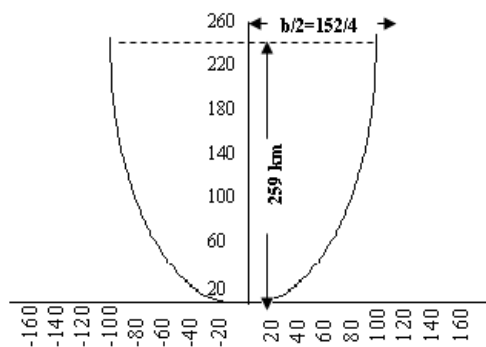


Fig 4.shows the parabola ratio of basin

Infrastructure of dames, rise up salinity of lake water and irrigation saline water in some point intensified soil salinity almost in east ward, caused of lake water and marginal agricultural land .To control progress of soil salinity and rehabilitation of salient soil lands some techniques are useable as flow:

- 1- Controlling of lake level rising is the very important factor (with dam's reservoir).
- 2- Establishment of derange system adaptation with condition of area.
- 3- Irrigation with clean water (especially in autumn and spring due to available more rainfall water).
- 4- Addition of chemical fertilizer such as Nitrate and Soleplate Ammonium, because Soleplate Ammonium is one of the best fertilizer for saline soils and prevents the concentration of suspension salty elements in the soils with acidification and decrease of PH ratio.

### Conclusions & Suggestions

Orumieh Lake water and National park of it have important roles in the economy of Iran via, tourism, and approving Artemia, salt, healing plant and flowers, moderating local climate an also connecting east and west Azerbaijan. During several decades by impact land use ecological variation emerged in the lake basin and especially in the shorelines and water. Some species of life creatures (planet and animals and birds) are destroyed.

Establishment of causeway between the lakes caused the emergence of water suspended materials density in the then must be the new up water way without interruption of water connection way soon completed. According to this case study results, some suggestions are proposed:

- 1-Decision makers must be seriously with regulation programs have been controlled the reservoirs, water diverting to agricultural land, also has application project for water transforming to Orumieh Lake.
- 2- Controlling the lake level fluctuation especially water level rising (with dams reservoirs) is very important factor in decrease of salt progressing in marginal soil.
- 3- Establishment of tourism structures in shorelines especially in port Shakhe Vally, Sharafkhaneh, (e.g. according to topography condition establishment of Telehcabin) is very necessary.



4-Completing up water bridge Ariel causeway and destroying land causeway between the East and West Azerbaijan provinces according to ecological problems, water sediment and suspended salty elements and water level variation, is very necessary.

5-Rehabilitation of salient soils especially in east of lake shoreline margin with, controlling water fluctuation, artificial drainage system, irrigation with surplus Autumn and spring clean water, addition chemical fertilizers (Nitrate and Soleplate Ammonium), and halophyte trees and vegetables.

6- Increasing of the number of boats and transporting ships between ports of East and West Azerbaijan provinces is very necessary.

7- Determining wind direction and speed over long time and also relationship between speed and direction of wind heights. For management of offshore transport and touristy recreational (Touristy structures) are necessary.

8- Establishment of resistant protecting walls, dunes with long rooted tree or shrub, and big stone fragments for controlling shoreline erosion are necessary.

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