

Ecotourism Potential' Ecological Monitoring of Chukhuryurd Lake

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Received: 8/10/2022

Accepted: 7/12/2022

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Abstract:

The long term monitoring and observations were carried out in order to study current ecological state of Chukhuryurd lake. The presented research was carried out with the assistance of remote sensing method using several satellites materials from various companies including Shuttle Radar Topography Mission (SRTM), Global Land Cover SHARE database, NASA's MERRA-2 Modern-Era Retrospective Analysis, AskGeo.com, GeoNames Geographical Database. Besides the mentioned sources Bing Map, OSM (Open Street Map), Google Map, Yandex Map and Google Earth were utilized. The first monitoring and investigation for Chukhuryurd lake ecosystem was carried out. The surface water pollution level has been studied in different zones of the lake. Deforestation process is intended to realize for the lake coast to determine soil loss and worthless areas for ecotourism possibilities. The total square of the lake was firstly determined about 87,480 m². The water volume of the lake is revealed more than 903059,6 m³. The surface pollution thickness reaches 5-15 cm. By remote sensing monitoring method the changing in the lake basin was determined. Elevation index of the lake is 1057 m above sea level. The large width of the lake consists of 169.03 m. The narrowest lake width is about 7,83 m. The lake length stretches to 512,71 m. Geographical location coordinates were defined at 40°42'29.61"N latitude and 48°37'17.43"E longitude. Ecotourism potential of the surround territory around the lake was investigated. The agro and natural biocenoses' territory surrounding Chukhuryurd lake have been defined by the help of remote sensing method. The sources of the household wastes were looking through and determined. The first monitoring and investigation for Chukhuryurd lake ecosystem was carried out. Bird migration rout and seasons were determined, dynamics of antropogenous and technogenous impact of the lake have been defined after many years. At the same time climate parameters have been investigated and analyzed. The first investigation about Chukhuryurd lake was carried out because of being polluted by the house hold wastes for many years. In none of scientific literatures or other sources, any information exists about the lake.

Keywords: Environmental safety, water pollution, ecotourism potential, climate condition.

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1- Introduction

Assessing of ecotourism potentials in several countries have been realized up today (Parvaneh. et al, 2022c) because of being actual all over the world. In Iran such researches are being carried out perfectly (Parvaneh et al., 2022b). Thus, lake ecotourism demands periodical monitoring in the research territory as a rule (Parvaneh et al., 2022a). The research object is one of the picturesque lakes existing in Shamakhi district. The long term monitoring and observations were carried out in order to study current ecological state of Chukhuryurd lake. Chukhuryurd lake is situated in the territory of Chukhuryurd village municipality at 40°42'29.61"N latitude and 48°37'17.43"E longitude coordinates (Google Earth, 2022). The lake is surrounded by the hills with agrarian fields and halfly woodlands. In this fields wheat, barley, clover are mainly cultivated. The meaning of Chukhuryurd is the place of residence in the valley. Perimeter of the coast line consists of 1.94 km. Total lake area is near 87,480 m² (8.7 ha) having 903059,6 m³ water volume. The lake width changes between 169.03 and 7,83 m^s. The general lake length reaches to 512,71 m which shows that coast line of Chukhuryurd is enough to increase ecotourism potential. The climate condition of the lake has great advantages to relax around it.

Climate: The region possesses warm, dry, clear sky summer and cold, snowy winter. Generally, the cloudiness is less in the zone, that's why the only Astrophysical Observatory is located near the region in Pirgulu. The high temperature interval changes between -5⁰ C and 31°C but the low temperature variety happens between -9,5°C and 35°C (Gismeteo, 2022). The highest solar radiation (especially direct radiation) data are observed during the beginning of July till 20th (Meteoblue, 2022) of August. The clearness in the sky stars at the end of the May continues till the end of September (Weather Atlas, 2022).

The pick data are observed during August, because the day rime high temperature causes rains at night directly. The appearance of the cloud in the sky takes a little bit time to rain especially at nights. From the morning the Sun shines again in the early morning behind the mountains.

From September to May the most cloudiness period is and the atmosphere precipitations fall down too much in this period. The cloudiest index reaches near 45% (Mammadova, 2012) in the region especially in November. The wetter period on the lake coast lasts for 8 months generally. Indexes of the most wet time is mainly observed in October averagely during 5 days. Drier days begin from the 4th of June and ends on the 9th of September. In July less wet days exist in the territory near 2 days. Rainy days' amount reaches till 5-9 months (from March to December) and snowy days' amount is about 3-4 months (December to March).

Relief: The region where the lake is located is seismic hills stretches beginning domed Pirgulu mountain (Mammadova, 2012) in the territory. There is Paleogene sediments in the region where the lake exists and the zone consists of hills and low lands. The relief has got changeable character to all directions. As the useful stocks bitumen, clay, limestone can be found around the lake territory. Many mineral springs are here for drinkable water, they are utilized. The lake is fed with the ground water and atmospheric precipitations. From the first sight it is evident that the lake basin is the natural or tectonic groove or gavity fulfilled with snow, rain and ground water. The bank is sinuous, in some coasts width becomes narrow completely. Lake shape is seen in the aerospace materials (REMSS, 2003) while watching the orthophoto evidently, the lake form looks like the deer head from the space. The swamp effect and smell is felt and seen on the coast line, reed, cane, rush are growing on the flood lands. The relief and elevation factor have

advantages to use lake water in irrigation for the surrounding fields, pasture and lawn mowers. Age of the lake is near three centuries after the earthquake happened in Shamakhi in 1859. Lake elevation (ASSL- above sea level) reaches 1057 m and eye altitude (AGL-atmosphere above ground level) is 2.41 km due to Google Earth (Google Earth, 2022).

Environmental state: The lake's ecological status isn't acceptable and exhaustive because of the long term anthropogenic impact on the lake ecosystem. Thus household waste water has acidities, chlorine, soap, shampoo, and chemical washing powder which flows into the lake for many years from the houses in the village located near Khukhuryurd lake. The landscape of Chukhuryurd gives a relaxing feeling to every human-being. The population and the tourists visiting the territory are busy fishing on the lake coast. The photos (Figure 1) explaining the above thoughts are given below.



Figure 1. Picturesque View and Fishing in the Lake.

As seen from the first and second photos, a natural panorama of the lake landscape is attractive. Thus the interesting Sun rising and setting may be watched by visitors during summer months with pleasure. Fishing is the main pastime or hobby for populations and visitors on this lake in spring, summer and sometimes in autumn period. Majorly picnics are individually organized on the coast to spend time in all seasons. On the west part the lake is partly surrounded by the forest, on the north and south parts the agrarian biocenosis (Mammadova, 2012) are growing and on the east part the village with the same name is situated. Water level is stable in the lake in distinguishing with other ones near to the territory. Before the color of the water was greenish but now the color became green brown after long term pollution. Even in the soils being flood-lands trees and green bushes are met after destroyed historical forest existed here. The major around territory of the lake is deforested zone. In spite of the deforestation and woodless factors, the microclimate of the lake around gives opportunity to call the region touristic. The lake is one of the most polluted lakes in Shamakhi district. Spiring on the lake shore is especially interesting with the extraordinary nature. In order to determine the situation, the map from the orthophoto done in 2015 (Bing Map, 2022) was given below as a rule.

On the east coast 30.620 m^2 (3.1 ha) territory is under the tree cover and green lands from map 1 which means 1.031 km perimeter. Forest line nearest to the lake consists of 216.800 m^2 (22 ha) which means 2.1 km perimeter that forest is located on the west part of the lake. Bing map gives opportunity to calculate the polygon parameters on the map depending on the intend. Chukhuryurd lake is situated between the village and the woodlands in the natural tectonic cavity.

2- Materials and Methods

The presented research was carried out with the assistance of remote sensing method using several satellites materials (ESA, 2022) from various companies including Shuttle Radar

Topography Mission (SRTM, Global Land Cover SHARE database, NASA's MERRA-2 Modern-Era Retrospective Analysis, AskGeo.com, GeoNames Geographical Database. Besides the mentioned sources Bing Map, OSM (Open Street Map), Google Map, Yandex



Map 1. Chukhuryurd Lake View from Bing Map based on 2015 Orthophoto

Map and Google Earth were utilized. Aero geodesic measurements were realized by the assistance of these maps. Thus, square, perimeter, coordinates, elevation, water volume, lake width and length were determined with the aid of these aerospace materials. Indeed, Chukhuryurd lake was never studied before, that's why there is not enough information about the lake in the scientific literature. Therefore, the lake should be studied from the beginning. Three hundred-year-old Chukhuryurd is one of the lakes occurred at the result of the terrific earthquake. There are plenty of such lakes in the territory of Shamakhi district especially around Pirculu zone which are mainly mountain lakes. In order to study lake's ecological state visual monitoring was realized to learn the situation around the lake. The initial view of the lake was like the following photos.



Figure. 2 Anthropogenic Pollution in Soil and Water

From figure 2 it is clear that not only waste sewerage system pipelines flow into the lake basin and also hard wastes are threw to the lake coasts. The waste consists of plastic bags, bottles, boxes, disposable plates, cups, dishes and other. Such wastes are unprocessed materials in soil and water which are to be collected from around the lake and sorted. Blowing wind makes the plastic bags sail on the lake water, their collection is too hard and hazardous for living organisms in the lake. The local executive and municipality power can't solve this problem in or on time because of the punitive measures' lack. Today's situation will last with ecological calamity at the end. Really the lake is suitable for beach in summer, majorly due to the climate possibilities of the region. The next figure (Weatherspark, 2022) shows the results dealing with the beach season.



Figure 3. Tourism Potential around Chukhuryurd Lake in 2021

In order to define the period suitable for tourism around Chukhuryurd lake along the year, figure 3 was given. As seen from the figure for warm period having rainless, clear sky with 65°F (18.3°C) and 80°F (26.6°C) was determined. The best time for visitors begins from the 1st of June and lasts from the 15-20th of September. Generally, from the beginning of March to the end of October visiting is possible. There are wide places and apple (fruit) orchards to built picnic tents to live independently around the lake. For forest lovers the camps can be organized on the west part of the lake where the deep woodlands appear near by. The calm climate gives the tourists a great opportunity to rest on the shore along the summer fully. The maximum tourism score (Weatherspark, 2022) changes between 7.8 and 8.0.

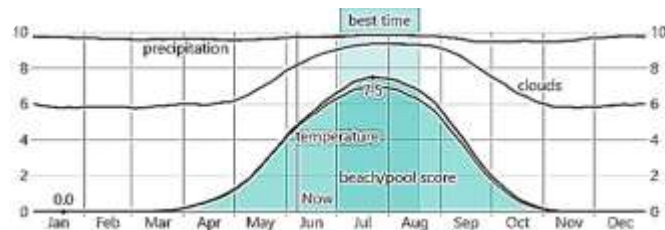


Figure 4. Beach Potential around Chukhuryurd Lake in 2021

As seen from figure 4 beach period around Chukhuryurd lake begins from the 1th of July to 20th of August having rainless and clear sky when air temperature changes between 75°F (23.8°C) and 90°F (32.2°C). According to the total beach potential, the best time for swimming in the lake is in summer period mainly. Maximum beach pool score consists of 7.5 in the middle of July and all climate parameters were taken into consideration. The lake has got sweet-water naturally which gives opportunity to swim in the lake. After such huge pollution by the sellers and visitor there is no any strong smell on the lake coast. Lake's latest view based on the aerospace materials (Google Earth, 2022) was given below.



Map 2. Chukhuryurd Lake General View based on 2022 Google Earth Orthophoto.

As seen from the Google Earth map (Map 2) the total area of the lake is enough to develop ecotourism on the coastline. The surrounding land around the lake concerns to the state land foundation. There's natural border between village and lake, it is evident from the map.

Weather Atlas (Weather Atlas, 2022) data for climate showings were analyzed some diagrams were given below to show the real climate situation. The temperate climate concerning to Chukhuryurd region makes resort condition surround the lake. The wind potential in Chukhuryurd village was given at the next diagram (Weather Atlas, 2022).



Figure 5. Average Wind Speed in Chukhuryurd village.

As seen from figure 5 maximum wind speed reaches to 9.3 km/h (2,6m/sec) which makes cool breeze (Global Wind Atlas, 2022) on the lake shore that gives visitors excellent feeling. This situation attracts tourists much more to the territory. And minimum average wind speed is about 7 km/h (1.9 m/sec) which continues the breeze effect on the lake coast along 24 hours.

As for the air temperature either high or low, both are important for the resort effect of the region. According to the Climate Atlas (Weather Atlas, 2022) the mentioned air temperature properties this dependence on the months was given below.

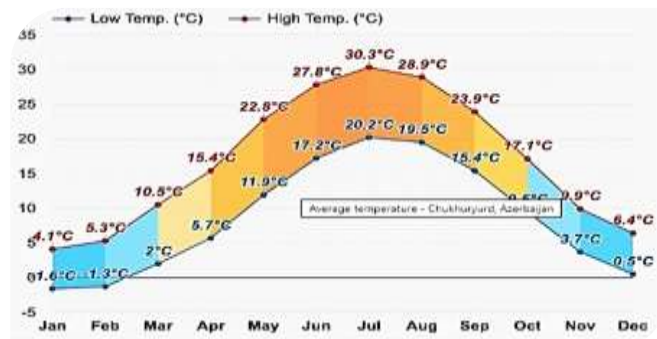


Figure 5. Average Wind Speed in Chukhuryurd village.

From figure 5 peach points for maximum average 30.2 °C and the low temperature index is 20.2 °C concerning to the middle July month in the region. Temperature increasing begins from March and ends in November. Comfortable period changes between April and October. The beach season surrounds June and August months on the lake coast.

The current ecological state's under bad condition, that's why including soil, water, the initial full ecosystem studies should be carried out before the infrastructure built. The relaxing climate condition, geographic location possibilities make the lake more important for the tourism sector.

3. RESULTS and DISCUSSION

While studying the real current state of Chukhuryurd, it was revealed that household wastes and sewage water made the lake be under bad condition. Indeed, this lake has great ecotourism potential (Mammadov et al., 2022) to attract the visitor and tourists to the region. The natural condition including relief, geographical location, climate, less distance between Chukhuryurd and Baki (capital), picturesque landscape creates huge ecotourism potential and proves this.

Pollution doesn't exist in only water but also in flood land soils surrounding the lake. Cleaning the lake water from sewage remnants will take too long time but it is possible.

Solving the ecological aftereffect the deed dynamics is to be staged for some steps:

- ◆ Initially water cleaning by the assistance of water filters and apparatus with high power;
- ◆ Biological soil recultivations by foresting on the lake coast (choosing tree species for flood land soils);
- ◆ Landscaping is the third stage in which the coat fixing works have to be organized;
- ◆ Infrastructure construction is the final stage for this measurement. In order develop tourism sector in the region by utilizing natural resources of Chukhuryurd lake (cottage, hotel and entertainment centers building, parasailing on lake, boat sailing, catamaran, swimming and so on).

The territory Chukhuryurd village is resort area because

of climate, relief and location parameters. So many sources were studied to determine the climate condition of the lake around and finally it was revealed that wind potential gives opportunity to built the infrastructure for the ecotourism sector.



Diagram 1. Chukhuryurd Lake Rehabilitation Stages

The ecotourism development will increase the budget possibilities of Chukhuryurd municipality year by year economically. From environmental point of view atmosphere, soil and water safety could be supplied in this case. Thus, ecological investigations should be

certainly carried out around the lake. After the monitoring and remote sensing observations, it was revealed that the lake water must be treated and the restoration works is to be organized on the shore. The pollution existing in the lake has to be gradually solved firstly. The clean lake could be the tourism center for the visitors. While summarizing the final results the followings were obtained:

- ◆ Development of new infrastructure for lake territory (forestation in flood lands, projecting hotels and cottages, entertainment centers' building);
- ◆ Construction of communication lines (telephone, internet and other);
- ◆ Gasification, electrification, water supply (spring, artesian) for the territory;
- ◆ Renewable energy sources usage (Solar and Wind energy potentials);
- ◆ Determination of the rent possibilities for the local house;
- ◆ Establishment of the road infrastructure for Chukhuryurd village;
- ◆ Organization of creative governmental approach to Chukhuryurd lake;
- ◆ Building of first and modern sewerage system;
- ◆ Ecotourism map design (the necessary places for tourism);
- ◆ Estimation of the complete ecotourism potential of the lake;
- ◆ Distances between the picturesque places with Chukhuryurd lake;
- ◆ Establishment of the offline interactive maps for visitors;
- ◆ Touristic tour network between Pirgulu Safary Park, Astrophysical Observatory, Natural Water falls (Khalit water fall and other), lakes (Yashil gol), ancient villages and settlements is to be organized (at map 3);



Map 3. Chukhuryurd-Astrophysical Observatory-Khalit Waterfall-Yashil gol Rout Distance.

As seen from the sample map (Google Earth, 2022) the real distances were calculated on Google Earth between Astrophysical Observatory, Khalit waterfall and Yashil gol (Green lake) to

which tourists located in Chukhuryurd can visit. The total distance changes between 5 and 11 km, thus the mentioned object aren't far from one another. Due to the model map other marsh rout maps can be developed for touristic online booklet or offline map.

Thus the lake has huge ecotourism potential which was never appreciated before. Today the tourism sector is being improved as the alternative sector fetching economical advantages for the Republic. So, recultivation and treatment of Chukhuryurd lake are worthy to develop the ecotourism sector in the region.

4. CONCLUSIONS

The first investigation about Chukhuryurd lake was carried out because of being polluted by the house hold wastes for many years. Long term monitoring in the natural condition was realized, at the same time remote sensing studies have been done for the lake. In none of scientific literatures or other sources, any information exists about the lake. Using aerospace method, square, capacity, width, length, coordinates, absolute height and eye altitude of Chukhuryurd lake were defined. Due to the radar measurements climate condition and parameters (wind speed, low and high temperature and so on) were studied for all seasons. Comparative photos were given in the paper to identify the situation around the lake.

Thus, Chukhuryurd lake basin has to be treated and cleaned for improving ecotourism potential in the region as Khanbulan and other lakes'. Thus, lake ecology is too actual in the Republic for developing ecotourism and improving environmental safety. It is worthy to built the tourism sector around this lake from also economical point of view.

Acknowledgement

Great thanks to *Pr., Dr. Alekber Huseynov, Pr., Dr. Gulqiz Huseynova and Pr., Dr. Fuad Mammadov* for motivation and support me to write this paper about Chukhuryurd lake. In preparing the paper aerospace materials of NASA, OSM, Bing Map, Google Earth, Goggle Map, Yandex Map and several other agencies and companies were used.

Shuttle Radar Topography Mission (SRTM, Global Land Cover SHARE database, NASA's MERRA-2 Modern-Era Retrospective Analysis, AskGeo.com, GeoNames Geographical Databases' materials were used, too.

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