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RESEARCH ARTICLE

INVESTIGATION OF THE EFFECTS OF SALT DUST CAUSED BY DRYING OF URMIA LAKE ON THE SUSTAINABILITY OF URBAN ENVIRONMENTS

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ABSTRACT

Due to the gradual drying of parts of Urmia Lake, several centers of salt dust which is created and influence the agriculture, economy, public health and causes migrations within the region of the Urmia Lake. Hence, knowing the temporal and spatial distribution of this phenomenon is very important to quantify these effects. In the present study, using Sentinel-5 and MODIS products for 2020 in the Google Earth system, have shown despite month-to-month fluctuations, has an increasing trend and the incremental changes of fine dust are more considerable in May and June and their dispersal are greater in the northern and northwestern cities in the basin of the Urmia Lake. The distribution of fine dust in the cities of Tabriz, Shabestar, Urmia, Mahabad, Khoy, Salmas, and Tabak, shows heavy concentrations of the dusts, and exhibits destructive impacts on the economy (60.80%) in December and also has adverse effects on the health index. And most of the referrals of people suffering from diseases caused by fine dust in December is (47.50%). The two indicators of agriculture and migration are closely related and the most effects of salt dust for these two indicators showed (15%) in November and (40.51%) in July, respectively. According to the results, it can be said that these dust particles have the greatest impact on the indices (migration, economy, agriculture, and health) of urban regions of the basin of Urmia Lake from 2019 to 2020. The results of this study can directly contribute to the decision-making process by the local authorities to understand the environmental problems across urban and rural areas of Urmia lakes which is at considerable risk.

KEYWORDS

Salt Dust, Urban Sustainability, Sentinel-5 and Modis Project, Google Earth Engine, Urmia Lake.

1. INTRODUCTION

Urban ecosystems are a complex combination of natural and artificial biological systems (Dizdaroglu, 2015; Nazmfar et al., 2020a). This ecosystem is human-based and is influenced by complex interactions between the types of mechanisms, controllers and the components that outlines social and environmental procedures (Bai, 2016). The growth of human activity has a massive and accelerated influences on the ecosystems, climate, and environment of planet earth, human being activities directly or indirectly affects the changes in ecology services (Falcone et al., 2010; Kuriqi et al., 2019). Particularly, the urbanization and over-renovation have accelerated, which triggered serious destruction to the ecological environment, and ultimately take the lead to the worsening of the ecosystem services value (Abulizi et al., 2017; Nazmfar et al. 2020a).

Urban sustainably is complex and multidimensional and this complex concept indicates the combination of the various systems such as; ecology, economical, technological and social systems (Karam et al., 2019; Ghorbanzadeh et al. 2019; Feizizadeh et al. 2021a). In this regard, in many countries particularly those which situated in arid and semi-arid climate regions, the phenomenon of dust is one of the most important atmospheric highs (Rasooli et al., 2010; Hire math et al., 2013; Madani et al., 2014). The human environment is always subject to natural disasters, one of which is dust storms. The dust crisis is so serious that it has been explicitly mentioned several times in the document (general environmental policies). It has challenged the efficiency of the ecosystem, so this natural phenomenon affects the economic, social, political, and biophysical environments (Gholamreza et al., 2020; Ranjbar Heidari et al., 2016). The human has been as crucial part the ecosystem the last two centuries and earlier as well while due to changes in its demeanor, patterns, scale, and source consumption concentration have caused a drastic variation in the body of ecosystem (Mchphearson et al., 2016; Inostroza et al., 2019). Generally, in many parts of the world, it has introduced environmental, social, and economic crises making the world more insecure (Feng et al. 2014; Madani 2014; Henriquez-Dolea et al., 2018).

Iran is geographically situated in the semi-arid and arid girdle of the planet earth. In recent times, dust storms notably heightened in Iran which have caused in massive and occasionally irrecoverable losses to soi-economic infrastructure (Asl et al., 2018; Dastoorpoor, Idani, Goudarzi; Khanjani, 2018; Goudarzi, Shirmardi, Naimabadi, Ghadiri, Sajedifar, 2019; Khusfi, Khosroshahi, Roustaei; Mirakbari, 2020; Gholamreza et al., 2020; Ranjbar Heidari et al., 2016; Inostroza et al., 2019; Henriquez-Dolea et al., 2018; Lou et al., 2019). In this regard, climate change and extreme consumption of water, have decreased the water which inflows to Urmia Lake and it triggered to generate one of the salt dust storms supplier source in the

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northwest of Iran and caused heaps of environmental problems (Azarnivand, Hashemi-Madani and Banihabib, 2015; Alkhayer et al., 2019; Boroughani et al. 2019; Moghim and Ramezanpoor 2019; Delfi et al., 2019; Goudie, 2018; Gholampour 2015; et al., Ghomashi; Khalesifard, 2020).

Certain problems caused the lake to damage itself, such as; vast death of Artemia, migratory population birds lose, natural vegetation prevention etc. (Esmaeili et al., 2010; Abbaspour and Nazaridoust, 2007; Golabian, 2010). which is greatly affected the sustainable ecosystem of the lake. Furthermore, it caused to increase cardiac problems, to the villages of Urmia region, highly affected the agricultural soils and forced the habitants of the area to migirate and destructed the agronomical system in this region (Samadi et al., 2019). Generally, the sustainability has threatened in an prolonged region in various fields like health, society and economy (Schmidt and Transiskus, 2020; Abbasian et al., 2021; Ahmady-Birgani et al., 2018).

The review of previous research show that a large number of studies conducted to assess the risk of drying up Urmia Lake help to make decisions to minimize and monitor these incidents. For instance, Study of spatio-temporal changes of dust absorption throughout 2000 – 2015 in the basin of Lake Urmia in eastern and west Azerbaijan, (neighboring to the lake using MODIS products has revealed that despite the fluctuation of the annual, there is inclusive intensification of concentrated fine dusts (Namdari and Valizadeh, 2020). Analysis of MODIS products during 2000–2017 also implies strong indications that the dried portion of lake have turn into the active supplying source of dust generating (Boroughani et al., 2019). Researching the effects of drying and reducing level of water in Urmia Lake on landscape households and its analysis Occurrence and various forms of coping strategies of local villagers.

Evidence has demonstrated that rural communities close to the lake are severely dependent on Lake Basin ecosystem services, such as water availability, qualified air, soil, and local climate regulations - all of which are harshly threatened by progressive environmental degradation (Matthias et al., 2020). The densely populated area around it to quantify LU as a source of dust, we examined satellite data 2000-2017 using an extension Dust source amplification technique our results show that some of dust events increased with a significant inverse correlation with the lake area (Hossein et al., 2019). Several studies have discovered numerous factors of anthropogenic which are responsible for the reduction of water in Urmia Lake. Specifically, the increase in the extent and area of the lands of irrigation and, consequently, intensified the demands for the water for agronomical aims are one of the major drivers (Ghale et al., 2017; Chaudhari et al., 2018; Khazaei et al., 2018; Schulz et al., 2018).

They analyzed the level of water at the site, the extent of surface water and the volume of available water in the lake. Changing the water storage of the catchment of the Urmia Lake is used to quantify gravity retrieval and testing the condition of climate of the selected study area (GRACE) and GRACE satellite observations, which present a broad view of the hydrological components. Our analysis indicates a positive tendency of 14.5 cm per year, 204 km, the results showed that the shallow southern region in 2016 and the first half of 2019 may not continue in the event of a long period of drought (Saemian et al., 2020). Investigation of Urmia Lake exhibits the increase of the PM10 due to drought consequences in Tabriz, Applied MODIS data to estimate the dust emission probability around Urmia Lake (Effati et al., 2019; Argany et al., 2021).

The data obtained from CALIPSO satellite and MODIS AOD products were employed from 2006 to 2017 to identify the atmospheric aerosol across the basin of the lake, studied conceivable impacts of emitted aerosols of the lakebed on rainfall properties by assessing sample data during the September 2017 to September 2018 (Ghomashi and Khalesifard, 2020). They discovered that precipitation water around the lake is characterized by high intensities of toxic elements and heavy metals (Ahmady-Birgani et al., 2020). Investigations which is conducted related water loses and drying-up of Urmia lake, but most of this researches are about the drying-up of the lake rather than its consequences its restoration, some of the earlier conducted research have focused on the impacts of dust tornados generated by Urmia Lake on the entire region and to assess its effects on economy and agriculture, and many of the conducted researches utilized remote sensing data; such as, have employed satellite data to study the aerosols in the region of Urmia Lake and, conducted research to assess the probability emission of the salt dust in Urmia Lake (Ghale et al., 2018; Hosseini-Moghari et al., 2020; Schmidt et al., 2020; Bakhshianlamouki et al., 2020; Danesh-Yazdi and Ataie-Ashtiani, 2019; Saemian et al., 2020; Ghomashi and Khalesifard, 2020; Samadi et al., 2019; Effati et al., 2019). continuous droughts in Urmia Lake within the last few years have caused the dust phenomenon to appear more intensely and continuously. A salt storm caused by the continuous drying of water of Urmia Lake with a destructive potential of 1,200 square kilometers has been reported.

It covered whole of Tehran province for three day and Yazd province for four days within a short period of time, 1 (Zarghami, 2011; Naboureh et al., 2017; Mora pour et al., 2020; Najafi et al., 2020). Recently, the diameter of lake dust has increased from about 10 microns to 5 microns, which has increased the risk of damage. In any case, it should be indicated that the crisis of Urmia Lake is different from all wetlands in the country because its catchment area has a population of 7.3 million people who will be affected by this crisis. These conditions can have environmental, economic, and social problems on the sustainability of cities and rural areas surrounding the Lake. Therefore, it is very critical to analyze the situation of the urban environments in the vicinity of the Urmia Lake after the crisis in terms of vulnerability and resilience. The challenge of dust, especially in Urmia Lake, has always caused various problems and difficulties for the stability of the cities and rural areas. This challenge (dust salat storm) is affected by weather conditions that cause irreparable damage to the populations of ULB related to health, socioeconomic, and this incident decreases air quality.

The main purpose of this paper is to use Sentinel-5 and Modis products to investigate the monitor dust of Urmia Lake and lake drying and its environmental effects on the environment of Urmia Lake utilizing visual perception. Therefore, this article consists of two main analytical sections. The first section involves monitoring of the dust produced by drying of Urmia Lake and its consequences the economy of the urbans, public health, migration and agricultural sustainability, and moreover, applying the Modis product, the slope of fine dust and fluctuations in dust and its impacts on the urban regions of Urmia. The basin of thelake and normalized dust will be used for 2019 to 2020.

2. Study Area

Urmia Lake Reality Basin is located in northwestern Iran with an area of 51876 sq kms between the brief 35° 40′ to 38° and 30′ in N and 44° 14′ to 47° and 53′ E (Figure 1). This basin is located in the northwest of Iran and is surrounded by the northern portion of the Zagros Mountains, the southern slope of Sabalan Mountain and the northern, western and southern slopes of Sahand Mountain (Hamzepour et al., 2014; Emdadi et al., 2016). The Urmia Lake is considered as a hyper salty lake which has experienced facing serious conditions due to the climate change and also extensive land use/cover changes by means of extension the farmland, constructing dams on the revisers which feed the lake and harvesting the aquifer (Feizizadeh b et al., 2021; Kazemi Garajeh et al., 2021).

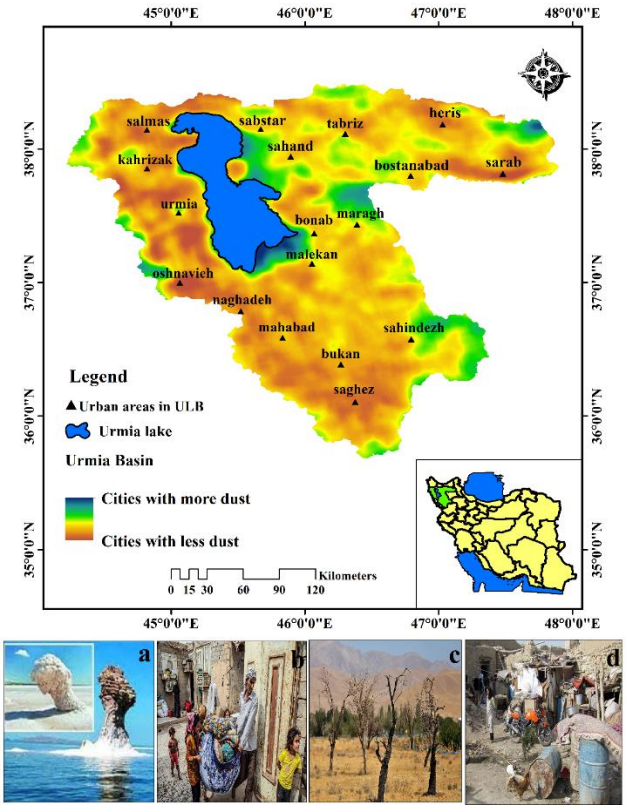

Figure 1: Indicates the location of the cause study, the catchment area of the Urmia Lake, Iran, (a, b, c and d), examples of orchard drying, lake drying, marginalization and observed agriculture.

3. Materials and Methods

3.1 Salt dust monitoring using Sentinel product – 5P

In the present study, the sentinel 5P products (Sentinel - 5P NRTI AER AI: Near Real-Time UV Aerosol Index) was utilized to screen and monitor dust urban environments of the Urmia Lake basin. The band has a spatial resolution (0.01 arc degrees). The satellite is positioned to height of 824 km and able to be employed to detect ozone, methane, formaldehyde, aerosol, carbon monoxide, SO2, and NO2. Therefore, the Sentinel-5 satellite is a joint project between the European Space Agency ESA and the Netherlands, which is led by the Dutch Space Agency and has a Tropospheric Monitoring Instrument. Furthermore, each city which are located within the basin of Urmia Lake was identified and using the google earth engine (GEE) platform system, the dust diagram in the atmosphere of the urban areas in the basin of the Urmia Lake for the period 2019 to 2020 was determined.

3.2 Investigation of salt dust using MODIS product

Modis satellite dust product 1 km per day (MCD19A2.006: Terra & Aqua MALAC Land Aerosol Optical Depth Daily 1 km²) whose data is available from 2000 to 20021 and has two important bands (light depth 0.47 nm) and (Optical depth 0.55 nm) These two bands are called spatial resolution (1000 m). these two bands of Modis products were used to calculate the concentration the dust. these, two bands of Modis products turn into normal (zeros and ones). In the next step, linear regression was extracted using Linear Fit algorithm which shows the slope of dust changes in urban areas of Urmia Lake basin. The detailed information about sentinel 5P and Modis Products presented

Tables (1 and 2). The workflow of the research is described in (Figure 2).

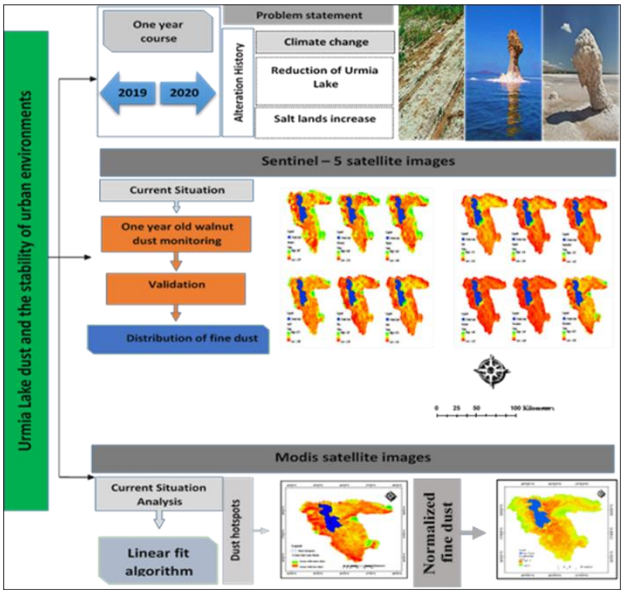

Figure 2: Research flowchart.

Table 1: Sentinel Product Bands - 5P NRTI AER AI: Near Real-Time UV Aerosol

Name	Unit	Min	Max
Absorbing_aerosol_index	M	-25	39
Sensor_altitude	Degrees	828543	856078
Sensor_azimuth_angle	Degrees	180	180
Sensor_zenith_angle	Degrees	0.09	167
Solar_azimuth_angle	Degrees	-180	180
Solar_zenith_angle	Degrees	8	88

Table 2: Product Bands MCD19A2.006: Terra & Aqua MALAC Land Aerosol Optical Depth Daily 1 Km

Name	Unit	Min	Max	Scale
Optical_depth_047-25		- 100	5000	0.001
Optical_depth_055		- 100	5000	0.001
AOD_uncertainty		- 100	30000	0.0001
Finemodefraction		0	10000	0.0001
Column wv	Cm	30000	0.001	0.001

4. Result and Discussion

4.1 Emission of salt dust in the first six months of 2019 to 2020 on the sustainability of cities in the Urmia Salt Lake Basin

Due to the significant decrease in the volume of precipitation, the level of the lake has reached 12735 from 127063 in 2019, which shows a 28 cm reduction in the level of Urmia Lake. Also, the reservoir of Urmia Lake has decreased by 500 million cubic meters compared to 2019, and the water coverage of the lake has reached 21,507 km2 in 2019, reaching 18,198 km² in 2020. In 2020, due to the decrease in rainfall, the amount of harvest from dams to irrigate agricultural fields has increased and has caused the decrease of the amount of water available in Urmia Lake to decrease and has caused the phenomenon of dust in the Basin of Urmia Lake. The released salt dust from Urmia Lake due its drying for the first six months of 2019 to 2020 and its concertation in urban environments of Urmia Lake is represented in (Figure 3).

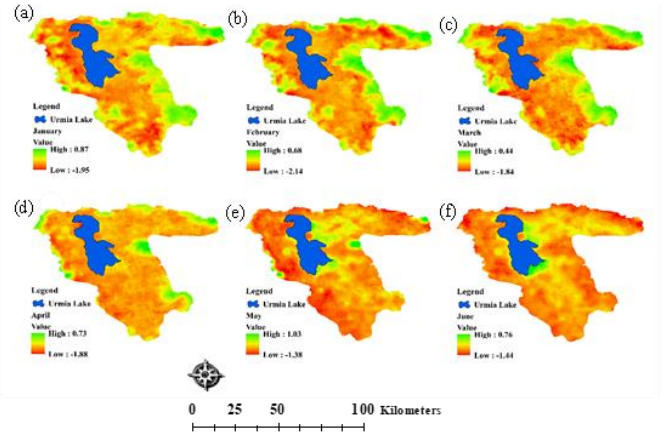

Figure 3: Presents the dispersion and effect of fine dust in Urmia Lake on the stability of urban areas within the Lake basin (a, b, c, d, e and f) in the first six months from 2019 to 2020.

The amount of the dust in the next month in Urmia Lake basin, especially the cities of Tabriz, Urmia, Mahabad, Khoy and Salmas has increased, but in the fifth month (May), the spreading of dust in Urmia Lake environments a city has indicated zero and does not present any dispersal. However, in June, the distribution of this dangerous phenomenon in cities 75 km2 from Urmia Salt Lake decreased. The results showed that in January, the level of dust caused by drought in Urmia Lake was much less. Therefore, the 47000 hectares of dust sources all around the lake could be classified according to social, environmental and health problems. During the six months in late 1019 and early 2020 the unique ecosystem of the lake vanished due to increase of salt, and another significant problem is the occurrence of a salt desert which has an area of more than 5000 km2, which contains 50-60. 47000 hectares of dust center around the lake has been identified so far in 6 months, which requires the control and emergent solutions, otherwise, can increase rapidly and will greatly affect the future urban sustainability within the basin of the Urmia lake and the lives of its inhabitants. Drying 5000 hectares of Urmia Lake for 6 months from 2020 will lead to salt dust. In addition, in the first six months of 2020, in three cities within the catchment area of the Urmia Lake, at least three large areas have been identified as resources. Salt dust resources comprise Urmia, Miandoab and Salmas. These three cities changed into dust roots, in addition to the dry bed of Urmia Lake, which alone stores billions of tons of salt, which can turn into a potential age in any weather and produce good dust.

4.2 Emission of salt dust in the second six months of 2019 to 2020 on the sustainability of cities in the Urmia Salt Lake Basin

During the second six months of 2020, the effect of dust on the sustainability of urban environments in the basin of the Urmia Lake Basin is shown in Figure (4). The basin is Urmia Lake and 300 hectares of land in this village has been turned into quicksand and its volume is increasing every day. The results this study in the second half of 2020 showed that the cities of Tabriz, Urmia, Salmas, Khoy, Oshnoyeh and Mahabad received the most salt dust from Urmia Lake. But the area of fine salt dust in Tabriz is more than Urmia. And Tabriz city has been affected greatly based on the sustainability of urban environments. Dust conditions during this period have damaged the fertile plains of Urmia Lake and the presence of dust has caused harmful challenges for the citizens of this region, while several villages in the east of Urmia Lake have migrated down to existing

problems. Bonab with a inhabitant of 140,000 is situated 110 km south of Tabriz, the capital of East Azerbaijan province, due to its position on the shores of Urmia Lake and the proximity of the city and some of the villages to the lake, one of the cities. Exposed to drying of salt dust caused by drying of Urmia Lake. Also, changes in ecosystems and climatic conditions do not only threaten agricultural land and living organisms.

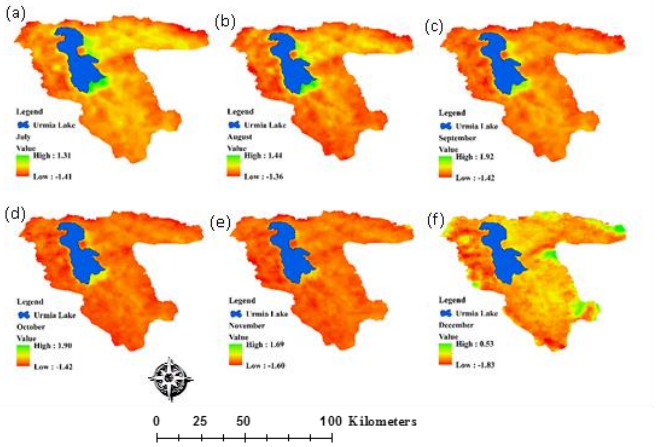

Figure 4: The effect of Urmia Lake fine dust on the stability of urban areas in the basin of Urmia Lake in the second six months from 2019 to 2020. (a, b, c, d, e and f)

4.3 Emission of salt dust from Urmia Lake in Iran

As we approach the end of 2020, the amount of salt dust emission in the cities around Urmia Lake has increased in October, and this indicates a dangerous catastrophe for the municipalities within the basin of Urmia Lake, particularly in Iran, specifically in the cities in a radius of 75 and 100 km2 of this lake are located (Tabriz, Armia, Mahabad, Khoy and Salmas). Even the salt dust of Urmia Lake in the second half of the year has spread to the cities of Iran, which are in a radius of 500 sq km. The emission of the salt dust phenomenon of Urmia Lake within a radius of 75, 100 and 500 km2 across Iran is presented in (Figure 5).

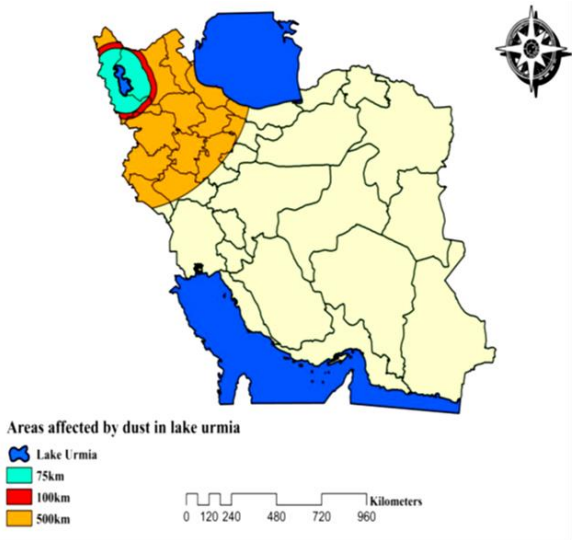

Figure 5: Emission of salt dust of Urmia Lake in Iran in radii of 75, 100 and 500 km^2.

4.4 The effect of salt dust released by Urmia Lake in 2019 to 2020 on the sustainability of urban environments in the Basin of the Urmia Lake

From 2019 to 2020, the salt dust of Urmia Lake usually remains in the cities which are situated within Urmia Lake region with an average activity of (10) people per hour and with (17) breaths per minute and an average of (10) times. Hours. They receive 6.6240 grams of fine dust from Lake Urmia and high concentrations of dust in Urmia Lake cause bronchitis, asthma, allergies and lung damage. The results of this investigation on Urmia Lake and its drying showed that from 2019 to 2020, the dust particles of Urmia Lake are in terms of public health risks. As a consequence, dust particles reflect sunlight directly and indirectly through the creation of the dust clouds. Therefore, due to the pollution of drinking water and gastrointestinal diseases, the mentioned factors have been able to create problems for the cities living in the basin of Urmia Lake. So that the results obtained from the studying of salt dust of Urmia Lake showed that from 2019 to 2020, the number of urban patients in terms of lung problems in medical centres has increased (30%). Rural areas of Urmia Lake are more at risk of salt dust than urban areas. The high concentration of dust in Urmia Lake in cities (Urmia, Tabriz, Mahabad, Miandoab, Khoy and Salmas) has caused respiratory diseases. The special effects and outcomes produced by salt dust of Urmia Lake on the sustainability of urban area for the years 2019 to 2020 are described in Table (3).

Table 3: Impacts and consequences of Urmia Lake salt dust on the sustainability of urban areas from 2019 to 2020.

Row	Month	Economy (%)	Health (%)	Agriculture (%)	Migration (%)
1	January	50.20	20.40	7.21	5.67
2	February	5.32	10.20	4.61	8.23
3	March	4.15	6.29	3.45	2.10
4	April	3.10	7.90	10.12	9.35
5	May	5.6	12.80	5.23	15.67
6	June	6.15	8.25	2.10	32.10
7	July	5.5	5.62	8.32	40.51
8	August	6.18	15.20	4.67	23.70
9	September	4.44	5.37	13.13	30.14
10	October	5.17	23.40	12.61	31.7
11	November	6.75	35.12	15	37.20
12	December	6.80	47.50	13.70	40.12

4.5 Urmia Lake salt dust production centers

According to (Figure 6), the slope of changes in Urmia Lake from 2019 to 2020 has been much more severe than in recent years. It can be concluded that the main reason rising slope of the salt dust is the continual dying of Urmia Lake, the dried area formed the salt dust supplying sources and scatter the salt dust particles to the nonboring area, and cities. In this regard, it can be noted that the lake has undergone severe fluctuations over the past century, the downward trend of the lake after its flood in 1996, and during the twenty years around, the lake level is more than it has dropped 8 meters. According to (Figure 6), it can be stated that in 2020, five salt dust production centres were identified from Urmia Lake, and in these five areas, the changes in salt dust are so great that the largest amount of these changes (2.37%). And while areas with lower salt dust levels have the least impact on the sustainability of urban environments. The slope of its changes was (-2.14%). Meanwhile, 5 identified centers for the production of salt dust in Urmia Lake has highly destructive influences on cities located inside a radius of (75) and (100) km of the lake. The slope of changes and foci of salt dust formation in Urmia Lake in 2020 on the stability of the basin of Urmia Lake areas is shown in (Figure 6).

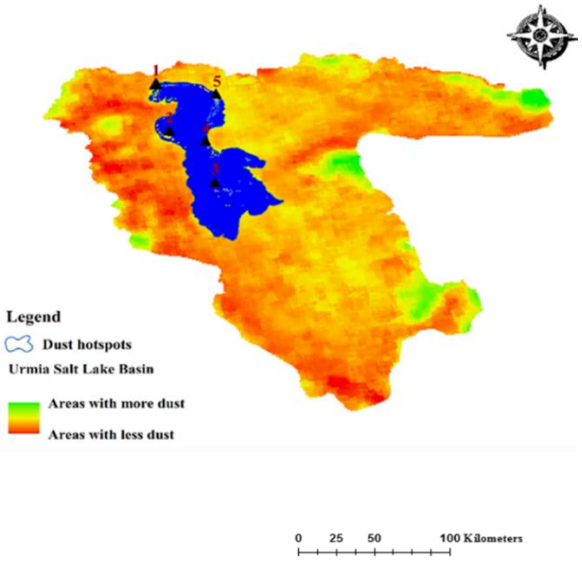

Figure 6: Slope of changes and identification of salt dust production centers in Urmia Lake from 2019 to 2020.

4.6 Normalization of salt dust in Urmia Lake using MODIS product on urban areas of Urmia Lake basin

To display, analyze and spatially distribute the effect of dust in the study area, the fine dust of Urmia Lake was normalized using the modis product in the google earth engine system and binary operations were performed on fine dust maps. Classes became (0-1). Class (1) in the map shows that these areas have the highest amount of dust in Urmia Salt Lake and Class (0) shows that the areas around Urmia Lake have not received any salt dust from Urmia Lake According to (Figure 7), the normal dust map, most areas are in class (one): the cities of Shabestar, Tabriz and Sahand, while in the southern part of Urmia Lake, the city of Malekan has received the highest amount.

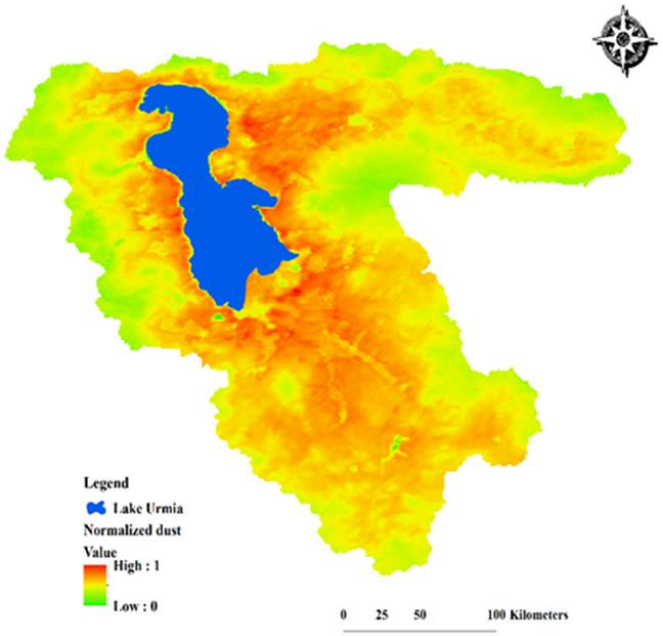

Figure 7: Normalized map of salt dust in Urmia Lake basin using Sentinel-5 product for urban areas around Urmia Lake from 2019 to 2020.

5. Conclusion

Considering that Urmia Salt Lake is one of the centers of the salt dust crisis, it is responsible for the occurrence of salt dust, which reasons many disasters in Iran and the cities which are located in the basin the lake annually. This phenomenon is a serious crisis for the entire Middle East region and requires serious determination to deal with it. The purpose of this study was to investigate the effects of fine dust and drying of Urmia Lake on the sustainability of urban environments using Sentinel-5 and MODIS products in the Google Earth Engine platform for 2020. The results showed that the cities inside a radius of km^2 of Lake Urmia, including the cities which are located in Urmia, Tabriz, Khoy, Salmas, and Mahabad are affected by this destructive phenomenon in 2020 and this phenomenon is economically dangerous in the Basin of Urmia Lake, economically, Migration, agriculture, and health have severely affected the sustainability of urban environments.

In addition to the three mentioned indicators, the most important indicator called migration, which caused residents to flee from the cities of Urmia Lake, in 2020, this will be affected by the phenomenon of salt dust in Urmia Lake. Beside this, the migration from the region of Urmia Lake in July and December were (40.51 and 40.12%) respectively and furthermost migrated to the cities which were located in greater radius of Urmia Lake (500 km), although the salt dust produced by Lake Urmia has affected the stability of cities in a radius of 500 km as well, but its impacts in 2020 has not been significant. Finally, the slope of fine dust changes showed that from 2019 to 2020, five salt dust production centers have been identified from Urmia Lake, although the range of salt dust changes is so large that the highest rate of these changes (2.37%) is showing. In this regard, the greatest impact of salt dust of Urmia Lake on the economic stability of urban environments in December 2020 for the cities of the basin Urmia Lake was shown to be (60.80%).

While the impact of this destructive phenomenon on urban environments around this basin causes very dangerous diseases such as lung diseases, asthma, cataracts and severe and mild bronchitis, shortness of breath and thus leads to the growth in the quantity of patients Because of the stated diseases triggered by the salt dust of Urmia Lake, in December reached (47.50%). It is understood the upcoming environmental issues and the trend of fine dust in the basin of the Urmia Lake still has a significant effect on the urban and environmental sustainability and the health of inhabitants. In this regard, the suggestions presented in this study can provide a basis for the development of these areas by reducing the damage to the sustainability of urban environments. The drought in Urmia Lake region stated out to be a significant environmental problem which threatens the public health and respective challenges; therefore, we conclude that the outcome of this research will be critical for the planners and decision-makers of the local governments and country level and stakeholders as well to create solutions in order to conserve the ecosystem of the area and provide the sustainability for the current and next generation. Results shall support them to develop an efficient program for restoration of the lake and minimizing the environmental issues.

Authors' Contributions

V.I., conceptualized the work and supervised the project. A.Q., and G.K., wrote the manuscript. The final version is confirmed by all of the authors.

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