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The reciprocal effect of global warming and climatic change (new perspective): A review

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ABSTRACT

Climate change is one of the most pressing problems among scientists worldwide, with experts warning about it and even referring to it as unfathomable human agony. In this study, we reviewed previous studies and examined two gaps in the existing approach to climate change studies. First, look at the "side effects" of global warming that have been overlooked in the process and then look at the leading "cause" of global warming, namely "humans" and not its "effects". The findings revealed that a 1.4 °C temperature increase (as predicted by United National (UN) projections) would not only raise this amount but also trigger further global warming. As a result, the premise that global warming produces additional global warming was proven. In the Water Area (WA) class, radiant energy increased by 1194.8%, compared to 1205.8%, 1154.9%, 1115.6% and 1229% in the Vegetation Area Class (VAC), Agricultural Area Class (AAC), Bare Area Class (BAC) and Salt Lake Class (SLC), respectively. Although the Land Surface Temperature (LST) of all classes has only increased by about 0.4 °C, these changes in radiant energy are much more pronounced. The current study also revealed that most legitimate research on this subject has focused on the effects of global warming on environmental variations. These studies, which see these changes as "results" of climate change and global warming, have overlooked the primary cause, "human demands", which has prompted humans to alter or exploit their surroundings actively. This study found that concentrating on humans and encouraging them to focus on happiness rather than pleasure is more helpful in addressing global warming issues than focusing on its impacts, such as rising sea level, storms, drought, etc. The results of this study are helpful for a deeper understanding of global warming and a careful study of the cause and dimensions of this phenomenon.

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Introduction

Climate change is one of the biggest concerns of scientists around the world these days (Wuebbles *et al.*, 2017), and scientists are sounding the alarm about that every day and even calling it "human untold suffering" (Lynas *et al.*, 2021). Climate change is becoming one of the biggest environmental problems of humankind. Drought, fire, flood, and increasing amount of rainfall (and consequently, rising water level) are some of the effects of climate change (Fritz & Ramirez, 2021). However, the questions that the present study intends to address are: Is global warming the main reason? If so, what is the root cause of global warming? Is that based solely on physics and mathematics calculations? Does global warming simply mean burning fossil fuels and coal, and releasing CO2 and greenhouse gases?

According to Nda *et al*. (2018), Climate change is often used interchangeably with the term global warming, but it is a much broader term that includes global warming and some other climate changes that have been observed on our planet over the last few decades. A wide range of scholars defines global warming as an average increase in the atmosphere's temperature near the earth's surface and the troposphere. While it can occur from various causes, global warming often refers to the warming due to the increase in emissions of Greenhouse Gases (GHG) from human activities (Dube *et al.*, 2016). GHG includes carbon dioxide, water vapor, methane, nitrous oxide, chlorofluorocarbons, and others. The GHG hypothesis predicts global warming trends because of the trapping of high outgoing wave radiation from the Earth's surface by increasing concentrations of greenhouse gases. Trapping longwave radiation in the atmosphere theoretically, alters the earth's radiative energy balance and therefore, the temperature (Ramírez & Finnerty, 1996).

Global warming contributes to changes in global climate patterns. Climate change refers to any notable difference in climate measures (e.g., temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from natural factors such as solar cycle variation, volcanic eruptions, or slow changes in the earth's orbit around the sun. Also, natural processes within the climate system, e.g., changes in ocean circulation and human activities, change radiative transfer due to changes in the atmosphere's composition. Other factors include deforestation (e.g., burning fossil fuels) and the land surface (e.g., reforestation, urbanization, desertification, etc.). Currently, the phrase climate change is growing in preferred use to global warming because it helps convey that there are other changes in addition to rising temperatures (Zhang & Surampalli, 2013).

The increasing global mean temperature has been a concern for several years. For example, according to NASA (National Aeronautics and Space Administration), the average earth's temperature has increased by about 1°C during the 20th century; as small as this increase may seem, its effects on our environment have established otherwise. This insignificant variation in temperature is enormous and responsible for causing changes in the hydrological cycle, the occurrence of a more substantial number of extreme rainfall events, more extended drought periods and warmer waves, and more severe storms (Berggren *et al*., 2012). Overall, it is expected that global warming will cause increased rainfall events worldwide. Enhanced temperatures will, in turn, increase the amount of evaporation from water bodies and storage, which may cause drought in so many regions. As well as extreme drought in some areas, flooding and erosion will increase in others. Drought-affected areas will be more susceptible to flooding once there is a rain event of high intensity. Global warming will enhance droughts and potentially devastating consequences for agricultural yield, water supply, and human health (Nda *et al*., 2018).

Nda *et al*. (2018) stated that rising infrastructural development, urbanization, and industrialization give rise to natural resources unsystematic usage, natural disasters, pollution, and an irreversible imbalance of the earth's structure. The primary human-induced driver on climate change is said to be GHG, which includes carbon dioxide, methane, and nitrous oxide. Carbon dioxide is the dominant component of the modification as it contributes almost 75% of global emissions; this is so as a result of fossil fuel burning (Houghton, 2009; Weber & Stern, 2011). Many scientists have concluded that the earth's temperature is rising at nearly twice the rate it was some 50 years ago. This rapid warming rate and the pattern is unexplainable by natural cycles alone. The only meaningful explanation of this rising trend is to include the contributions of GHGs emitted by humans. Since the inception of the Industrial Revolution in about 1750, human activities, i.e., the burning of fossil fuels (including oil and coal) have dramatically raised the GHG concentration in the atmosphere (Zahran *et al*., 2006).

Al-Ghussain (2019) in a study of the driving forces of global warming and highlights the significant contributors to this phenomenon, presents some mitigation techniques. Their results indicate that water vapor is responsible for two-thirds of global warming; however, CO_2 is considered the controlling factor. In other words, if the concentration of CO_2 did not increase, global warming would not have happened. Based on mentioned research, scientists claim that doubling or halving the CO_2 in the atmosphere causes the change in the average surface temperature of the earth by +3.8 °C or −3.6 °C, respectively. However, this change depends on the change in the humidity of the air, which in return depends on the air's temperature. Conversely, even though the other GHGs, such as CH_4 and N_2O, have a more vital ability to absorb radiation, their contribution to global warming is insignificant because of their low concentration in the atmosphere compared with CO_2. The adoption of mitigation and adaptation strategies at the same time is the most influential economic and technical solution for the global warming issue. He examined factors such as Global Warming and Greenhouse Gases, Heat Retention Mechanisms, Natural Events, Anthropogenic Emissions, Carbon Dioxide, Oceans and Marine Life, Extreme Weather Events, and Temperature Rise. Earth's average surface temperature will continue to rise as humankind continues its environmentally harmful activities especially burning fossil fuels. Based on three CO_2 emissions scenarios, scientists predict that the average surface temperature will increase by 2–6C by the end of the 21st century (Riebeek, 2010). Moreover, the increase in the global temperature will lead to an increase in the intensity and the spread of extreme weather events such as droughts, hurricanes, heat waves, and floods (Dosio *et al*., 2018), which will increase the number of human and material casualties. In addition, as the climate gets warmer, the snow and the ice meltdown, causing not just the sea level to increase but also the transformation of sunlight-reflecting surfaces (snow surfaces) to sunlight-absorbing surfaces which will cause more energy to be trapped in the earth atmosphere (Riebeek, 2010).

In a study by Christidis *et al*. (2011), they detect the contributions of external forcings to recent changes in hot days using nonstationary extreme value theory. They tried to partition the observed change in warm daytime into possible causes. They stated that Changes in the extreme temperatures were represented by the temporal changes in a parameter of extreme value distribution. Regional distributions of the trend in the parameter were computed with and without human influence using constraints from the global optimal fingerprinting analysis. Anthropogenic forcings alter the regional distributions, indicating that hot days have become hotter. In this regard, Aizebeokhai (2009) showed that global warming and climate change are significantly affecting the biosphere. additionally, they stated evidence suggesting that the increasing concentration of atmospheric greenhouse gases due to human activities is mainly responsible for global warming and climate change are presented (Aizebeokhai, 2009).

Given that Climate change alters the functions of ecological systems, Nelson *et al*. (2013) discussed some of the observed and anticipated impacts of climate change on ecosystem service provision and livelihoods in the US. Climate change translates into a change in the way governments, companies, and citizens conduct their daily business. If society begins to adapt to change without an overarching framework to decide which changes are most damaging and what can be tolerated, resources could be squandered and the impacts of climate change exacerbated. A dynamic national tally of natural capital and assets, including associated ecosystem services, promises to serve as an ideal framework for designing national, regional, individual, and private-sector responses to climate change. They argue that establishing a national-level natural capital and natural asset "balance sheet" will guide the nation and its citizens and businesses toward more efficient investment in ecosystem-service-based climate-change adaptations (Nelson *et al*., 2013).

AghaKouchak *et al*. (2020) reviewed observed and projected changes in different climatic hazards (heat waves, droughts, wildfires, extreme precipitation, and flooding) and their interactions, including different types of compound and cascading hazards. They reviewed the impacts, historical and projected changes, and theoretical research gaps of key extreme events (heat waves, droughts, wildfires, precipitation, and flooding). Also, highlight the need to improve the dependence between individual and interrelated climate extremes because anthropogenic-induced warming increases the risk of not only individual climate extremes but also compound (co-occurring) and cascading hazards. Climate hazards are expected to increase in frequency and intensity in a warming world. Anthropogenic-induced warming increases the risk of the compound and cascading hazards. They say Chains of cascading events can interact with the primary event or events, creating feedbacks that are difficult to model. An additional challenge in studying and modeling cascading events resides in the (in)ability to identify these events in historical observations. For example, extreme rain over burned areas or shifts from extremely high temperature and low soil moisture to extreme rainfall (a drought-flood shift) can trigger catastrophic landslides (AghaKouchak *et al*., 2020). The accuracy of predicting the consequences of cascading extremes will depend on improving data availability and characterizing the potential influence of increased human activities (Gariano & Guzzetti, 2016).

The United Nations (UN) estimates that an area of fertile soil the size of Ukraine is lost every year because of drought, deforestation, and climate instability (Zhang & Surampalli, 2013). The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has warned international communities that the increase in anthropogenic GHG emissions results in a climate change problem. The expected rise in global temperature will cause changes in precipitation patterns and an increase in quantities, frequency, and intensity of other critical natural hazards (Al-Ghussain, 2019). However, the production of consistent future agricultural yield situations remains thought-provoking due to significant variabilities in climate change predictions (Riebeek, 2010).

As can be seen from the review of the reference research in the preceding paragraphs, the research emphasis on the causes of climate change and global warming is more on the "environmental consequences" of "human activities". Most of them consider global warming as a part of the consequences of climate change and some consider it as a reason for climate change; sometimes, some calculations (such as average temperature, precipitation, etc.) are considered factors in climate change, and sometimes as its consequences. This study intends to address the neglected main factor(s) that cause climate effects in another dimension. Some scientists consider the world to be entropy-driven; we consider it heat-driven. Because, we can say that any change, including physical, chemical, biological, or even emotional, is accompanied by a change in heat. The change in temperature leads to the change in matter and conversely results in the change in its temperature, and this mutual interaction governs the world. Heat changes can be a solid indicator to detect many alterations in natural phenomena. So, is it not appropriate to consider that heat (Global Warming) as the leading cause of climate change? In other words, climate change is due to changes in heat or the balance of input and output energy. Obviously, Global warming is one of the significant consequences of human activities where the overuse of fossil fuels as energy resources caused an increase in the concentration of greenhouse gases in the atmosphere, causing the increase in the average surface temperature of the earth. We want to say that heat is the primary driving force of global warming and highlights the significant contributors to this phenomenon. Water vapor is responsible for two-thirds of global warming; however, CO2 is considered the controlling factor of global warming. Furthermore, despite much research, a crucial gap known as the "reciprocal effects" has not been addressed. As a result, the interaction impact of climate change has been investigated by evaluating numerous reputable sources and also by calculating an example of this effect by reviewing the most critical studies in the previous few years.

Material and methods

Study area

The study area includes different parts of Iran (Tehran, Mazandaran, Golestan, and Semnan provinces), part of Turkmenistan, and part of the Caspian Sea. The area is located from 35° to 38° of northern longitude and 53° to 55° of eastern latitude, which includes an area of 68492.3 km^2. The selection of this geographical area was based on the presence of vast water, dense vegetation, shrub and grassland, and barren land. This area includes Alborz Mountain, Kiasar and Kaboudwal forests, Dasht-e Kavir, Miankaleh wetland, Gorgan Bay, Jahan-Nama protected area, Khartouran, and Turan national park and included two complete frames of Landsat 8 image in one date (Figure 1).

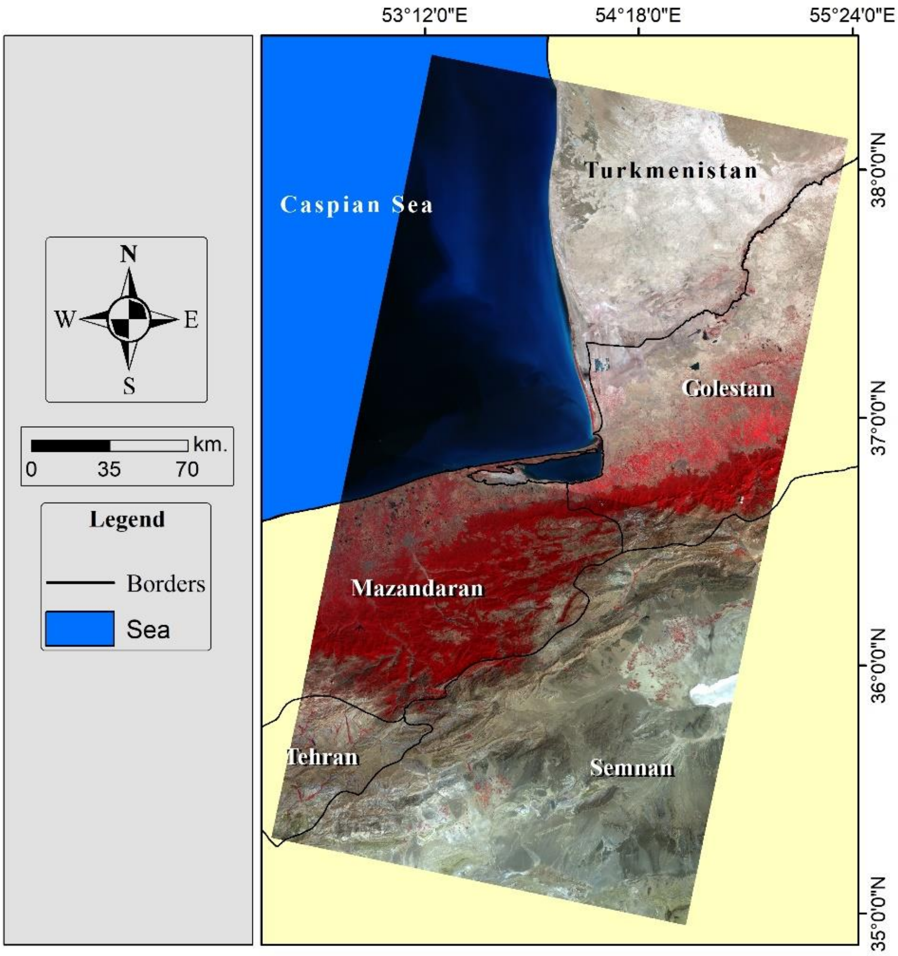


Figure 1. Location of the study area, Landsat-8 image in false color composite (5,4,3)

Data and Materials

In the present study, two Landsat scenes that cover a wide range of water, dense vegetation, grassland, and barren land were used. These images are downloaded from NASA's USGS website (www.earthexplorer.usgs.gov) and their properties are given in Table 1.

Table 1. Properties of images used in the present study

Satellite/ Sensor	Image ID	Date	Hour (GMT)	Cloud cover
Landsat OLI	LC08_L1TP_163034_20210830_20210909_02_T1	2021-08-30	07:01:44	0.01
	LC08_L1TP_163035_20210830_20210909_02_T1		07:02:08	0.02

Methods

In order to review previous studies on global warming and climate change, the articles used in the present study are based on authoritative articles by experts that have the most relevance to the topic "Reasons and factors affecting climate change with a global warming approach focused on humans". The leading search keywords we used for these articles were "Reciprocal effect of Global warming and climatic change", "Global warming and heat", "Relationship between Global warming and climatic change", "Role of human activity on global warming", and other related keywords. Also, to provide an example of the different warming effect of land covers that causes more global warming (reciprocal effects), the present study uses Landsat-8 images to examine the effect of adverse factors (reciprocal effects) on global temperature change beyond the 0.4 °C UN declaration (1.5 °C compared to 170 years ago) (Fritz & Ramirez, 2021) and warns of its neglected effects. These changes were examined in five major land cover classes, namely Water Area Class (WAC), Vegetation Area Class (VAC), Bare Area Class (BAC), Agricultural Area Class (AAC), and Salt Lake Class (SLC). First, before any calculations, the images used in the present study improved through the necessary corrections in ENVI software. Corrections include radiometric corrections on multispectral and atmospheric corrections on multispectral images by the Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes (FLAASH) algorithm, which is recommended for atmospheric correction over the ocean or water body (Exelis, 2015; Mansourmoghaddam, Ghafarian Malamiri, Rousta, *et al*., 2022). Thermal bands were also corrected using Thermal Atmospheric Correction tools. Both images were then mosaiced and prepared for the following process. To differentiate natural land cover classes, this study used the Maximum Likelihood (ML) supervised classification, the performance of which has been proven in many studies such as (As-Syakur *et al*., 2012; Dean & Smith, 2003; DeFries & Townshend, 1994; Strahler, 1980; Wei & Mendel, 2000) to produce land cover map.

Maximum Likelihood (ML) classification algorithm

The Maximum Likelihood (ML) estimation is a method of evaluating the parameters of the Gaussian Probability Density Function (PDF). It works in such a way, that the observed data is given by the chosen statistical model as the one having the highest probability (Paola & Schowengerdt, 1995). To perform classification, more than a thousand ground truth samples were taken for each class based on Google Earth images, ground truth map and user experience, 85% of which were used in the learning process of the ML algorithm and 15% of which were used to accuracy assessment of resulted map.

Accuracy assessment

To determine the classification accuracy for each LU/LC class, a stratified random sampling approach was used (Bokaie *et al*., 2016; Pal & Ziaul, 2017). To evaluate the precision of classification such quantities as the user, producer, and overall accuracy, and the Kappa coefficient, were determined; As other studies such as (Sexton *et al*., 2013; Ziaul & Pal, 2016;

Ishtiaque *et al*., 2017; Sultana & Satyanarayana, 2018; Maleki *et al*., 2020; Zare Naghadehi *et al*., 2021; Asadi *et al*., 2022; Mansourmoghaddam, Ghafarian Malamiri, Arabi Aliabad, *et al*., 2022; Mansourmoghaddam, Rousta, *et al*., 2022;) have also used these methods.

Derivation of Land Surface Temperature (LST)

In order to carry out the mentioned example in this research, the Land Surface Temperature (LST) which incorporates the effects of changes in ambient by climate change (Alavipanah *et al*., 2022) was used for thermal evaluation. LST was calculated from the brightness temperature using emissivity correction (Eq. 2). To aim this, the temperature value at the sensor (brightness) for band 10 of Landsat-8 was extracted using Eq. (3) (LANDSAT 8 data users handbook, 2015):

$$LST = \left[\frac{\tau}{1+w\left(\frac{\tau}{p}\right)\ln(e)}\right], \quad (2)$$

$$\tau = \left[\frac{K_2}{\ln\left(\frac{K_1}{L_\varphi}+1\right)}\right], \quad (3)$$

Where τ is at-sensor brightness temperature, w is the wavelength of emitted radiance (10.8 μm Landsat-8 TIRS 10th band), $p = h \times c/s$ $(1.438 \times 10^{-2}\text{m} \cdot \text{K})$, with h being the Plank's constant $(6.626 \times 10^{-34}\text{J} \cdot \text{s})$, s the Boltzmann Constant $(1.38 \times 10^{-23}\text{J/K})$, c the velocity of light $(2.988 \times 10^{8}\text{m/s})$, and e the land surface emissivity. K_1 and K_2 are the thermal conversion constants, for Landsat 8 Thermal Infrared Sensor (TIRS); based on metadata, they are 774.8 and 1321.0 $\text{w/m}^2\times\text{sr}\times\mu\text{m}$ for band 10, respectively (Mansourmoghaddam *et al*., 2021). To calculate at-sensor brightness temperature τ from the thermal bands (Landsat-8 10th band), (another Landsat thermal band (band 11) was not included in calculations due to some uncertainties of the band (USGS, 2014)). Raw data has to be transformed into spectral radiance values using Eq. (4) (LANDSAT 8 data users handbook, 2015):

$$L_\varphi = M_L * Q_{Cal} + A_L, \quad (4)$$

Where, L_φ is top of atmosphere (TOA) spectral radiance [W/(m2·sr·μm)], M_L is a multiplicative rescaling factor dependent on the metadata for a particular band, Q_{Cal} is the quantized and calibrated standard product's pixel values (DN[1]), and A_L is the additive rescaling factor dependent on the metadata for a particular band.

Finally, To evaluate the changes in thermal energy radiated over radiant energy for hot objects other than ideal radiators, Eq. 5 was used (Alavipanah, 2018; Xie *et al*., 2009):

$$E = e * \sigma * T^4, \quad (5)$$

Where E is radiation energy, e is emissivity given in Table 2, σ is Stefan–Boltzmann constant that is $5.67037441 * 10^{-8}$ in $\text{W*m}^{-2}\text{*K}^{-4}$, and T is the temperature in Kelvin. An overview of the research process is schematically shown in Figure 2.

Table 3. Emissivity derived for Salt Lake Class (SLC), Water Area Class (WAC), Bare soil Area Class (BAC), Vegetation Area Class (VAC), and Agricultural Area Class (AAC)

Land cover	Emissivity	Reference
WAC	0.980	(Qin & Karnieli, 1999)
BAC	0.920	(Qin & Karnieli, 1999)
AAC	0.970	(Oke, 2002)
VAC	0.985	(Yusuf *et al*., 2014)
SLC	0.780	(Bobrov & Galeyev, 2001)

[1] Digital Number

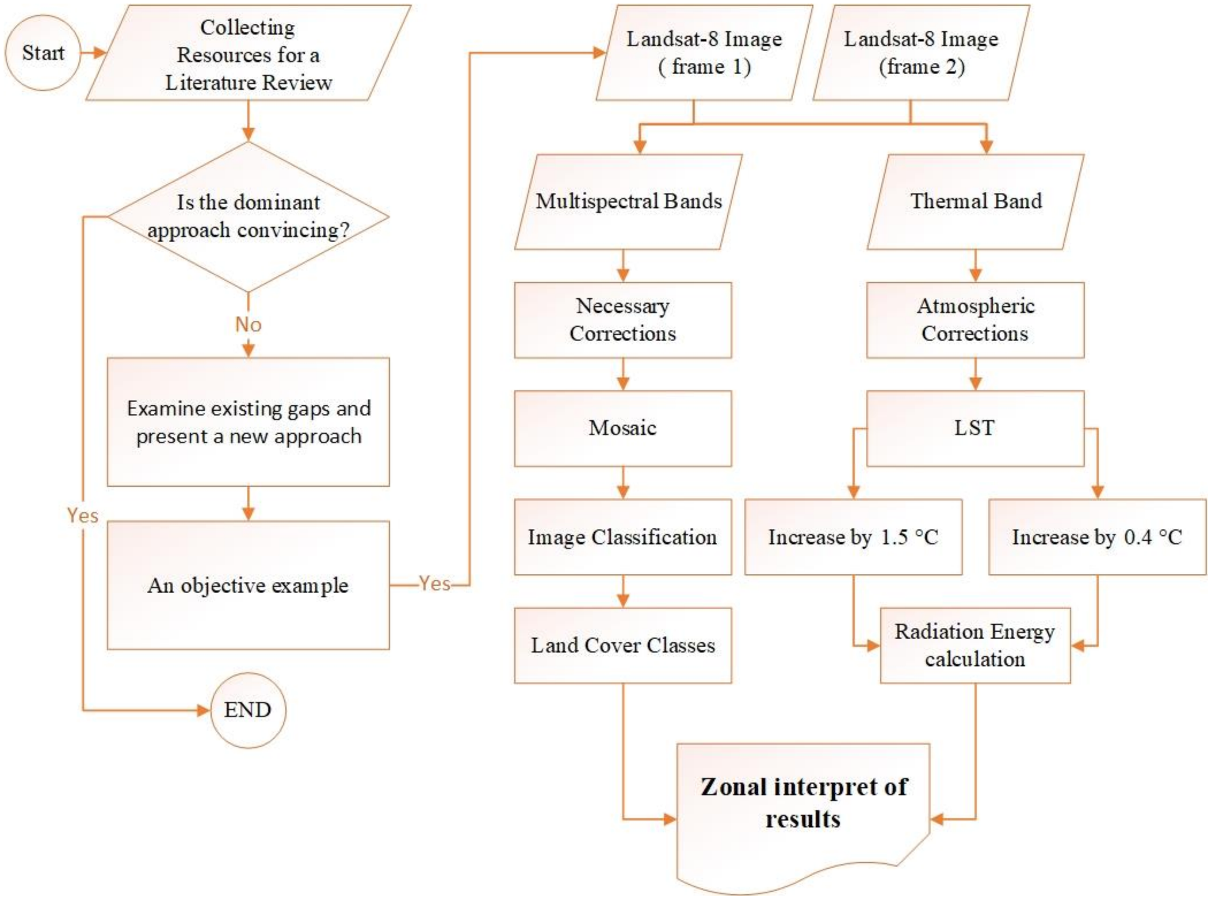


Figure 2. Flowchart showing the initial idea and steps of the research

Results

This research aims to examine the primary factor(s) that produce climate consequences in another dimension that has been overlooked. The focus of previous studies on the causes of climate change and global warming, as indicated in the reviewed reference, is primarily on the "environmental implications" of "human activities". Most of them see global warming as one of the results of climate change, while others see it as a cause. Some computations (such as average temperature, precipitation, and so on) are viewed as factors in climate change, while others are viewed as its effects. This study also examines how global warming itself leads to more warming, which its intensity may vary due to differences in reflection and radiation of each land cover type. So, to identify natural land cover, the MLC algorithm was first used to produce the Land Cover map of the study area (Figure 3).

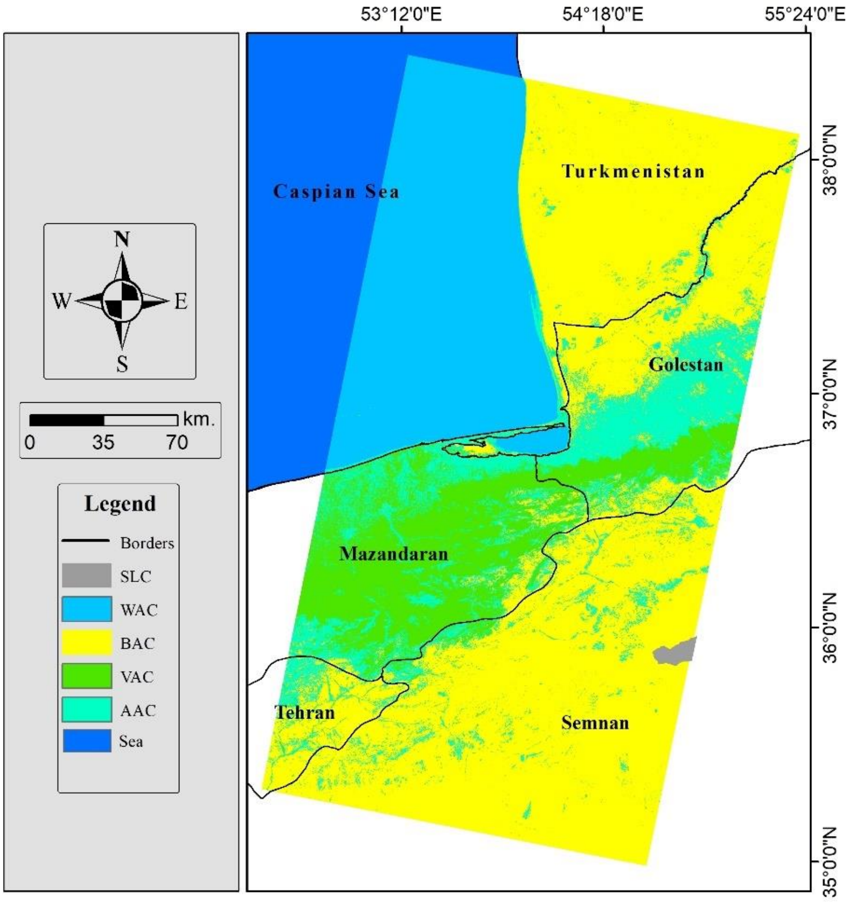


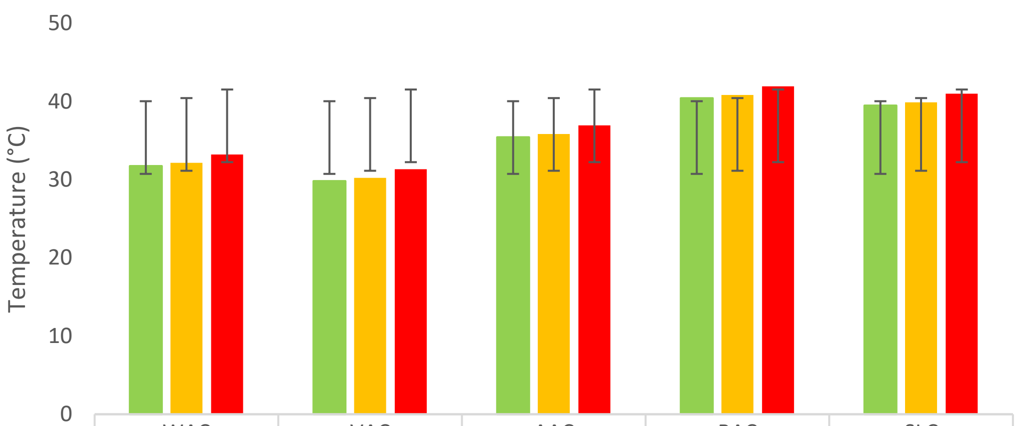
Figure 3. Land cover map derived based on the Maximum Likelihood Classification (MLC) algorithm for Salt Lake Class (SLC), Water Area Class (WAC), Bare soil Area Class (BAC), Vegetation Area Class (VAC), and Agricultural Area Class (AAC)

Based on the results, out of the total 404229.5 km2 studied, 169.1 km2 of SLC, 47635.6 km2 of WAC, 177591.6 km2 of BAC, 84740.9 km2 of VAC, 94089.4 km2 of AAC, and land were identified. These results were obtained based on accuracy assessment with an overall accuracy of 80.86% and a kappa coefficient of 75.81% (Table 3).

Table 3. Accuracy assessment of classification for Salt Lake Class (SLC), Water Area Class (WAC), Bare soil Area Class (BAC), Vegetation Area Class (VAC), and Agricultural Area Class (AAC)

Overall accuracy	Kappa	User Accuracy					Producer Accuracy				
		WAC	BAC	AAC	VAC	SLC	WAC	BAC	AAC	VAC	SLC
80/86	75/81	89/7	67/02	69/14	89/63	90/7	98/67	55/26	73/68	80/67	92/82

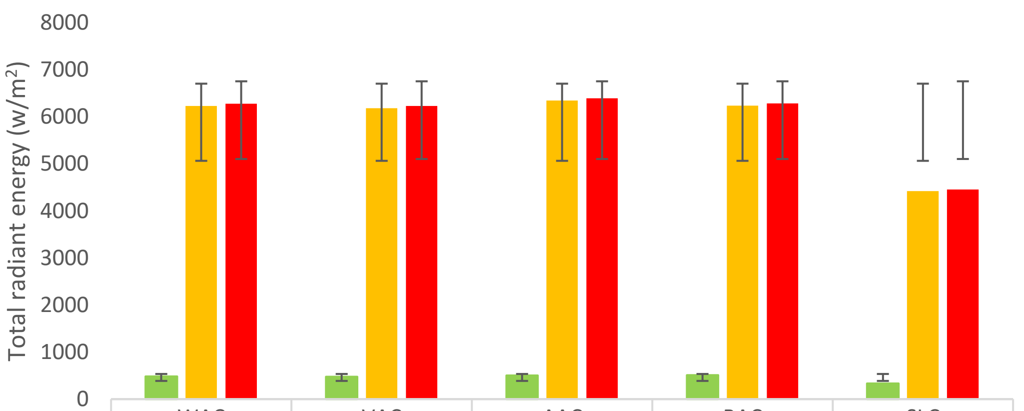
According to the results of the LST change effects assessment, the average surface temperature in 2021 in WA and DVA classes was equal to 32.4 °C, in SGA equal to 39 °C, and in DSA equal to 45 °C. These temperatures were then calculated in the first place with 0.4 °C and in the second place with an increase of 1.5 °C (Figure 5).



	WAC	VAC	AAC	BAC	SLC
2021	31.8	29.9	35.5	40.5	39.5
2030	32.2	30.3	35.9	40.9	39.9
+1.5	33.3	31.4	37.0	42.0	41.0

Figure 5. Results from the actual surface temperature (2021) and an increase of 0.4 °C for 2030 as well as a 1.5 °C increase for Salt Lake Class (SLC), Water Area Class (WAC), Bare soil Area Class (BAC), Vegetation Area Class (VAC), and Agricultural Area Class (AAC)

With the changes in the LST of the surface different coverages, the results of the changes in radiated energy are also calculated and shown in Figure 6. Accordingly, with increasing LST by 0.4 °C and 1.5 °C for each class, the SLC radiant energy will change with an increase of 1229% and 1239.4%, respectively, as the most severe changes, and BAC by 1115.6% and 1124.7% as the least. The VAC radiant energy will increase by 1205.8% and 1215.8%, respectively. The WA class radiant energy will increase by 1194.8% and 1204.6%, respectively. The AAC radiant energy will also change by 1154.9% and 1164.4%.



	WAC	VAC	AAC	BAC	SLC
2021	480.7	473.4	505.6	512.9	332.5
2030	6223.9	6181.6	6344.9	6234.9	4419.2
+1.5	6271.3	6228.9	6392.9	6281.6	4453.4

Figure 6. Change in radiant energy in following changes in surface temperature, by class for Salt Lake Class (SLC), Water Area Class (WAC), Bare soil Area Class (BAC), Vegetation Area Class (VAC), and Agricultural Area Class (AAC)

Discussion

First of all, in order to clarify the definitions, the authors believe that although climate change and global warming are complementary, if only "global warming" is considered an influential factor, it can include "climate change". It is because "heat" is a fundamental phenomenon that accompanies any change. Hence, climate change is associated with its effects (e.g., floods, storms, droughts, etc.) (Seneviratne *et al*., 2012), which are directly related to heat.

Numerous studies by scientists and experts on climate change and global warming have focused more on the effects of climate change and global warming in terms of "environmental consequences" that arise from human-alien activities in the environment (Ramírez & Finnerty, 1996; Aizebeokhai, 2009; Riebeek, 2010; Christidis *et al*., 2011; Berggren *et al*., 2012; Nelson *et al*., 2013; Zhang & Surampalli, 2013; Dube *et al*., 2016; Dosio *et al*., 2018; Al-Ghussain, 2019; AghaKouchak *et al*., 2020; Nda *et al*., 2018). These studies either see global warming as part of the consequences of climate change or as a reason for that. These studies consider some calculations and monitoring, such as the average temperature, rainfall, etc., which have changed under the influence of factors such as increasing GHG, fossil fuel consumption, etc., as factors in climate change or its consequences. According to the Sixth Report of the IPCC, the undisputed and primary cause of these climate changes and global warming is "humans" (Zhongming *et al*., 2021). Nevertheless, as much attention has been paid to this effect, its side effects have been neglected. The fact that the current research has addressed is that "global warming is causing more global warming". In this regard, with an example, the factor "reciprocal effect" was investigated concerning global warming in this study. For example, the present study examined the side (interaction) effects of land cover on global warming by 0.4 °C (1.5 °C from 170 years ago), which is estimated by the United Nations (Fritz & Ramirez, 2021) and even more. The results showed an increase of 1194.8% in radiant energy in the WA, which was equal to 1205.8%, 1154.9 %, 1115.6% and 1229% for VAC, AAC, BAC, and SLC, respectively. Although the surface temperature of all classes has only increased by 0.4 °C, these changes in radiant energy are much, much more pronounced. Therefore, since the selected images in the present study are from summer and also surface temperature and air temperature are strongly and directly related in this season (Mutiibwa *et al*., 2015), this further increase will increase global warming even more than expected. In fact, heat (global warming), also has a reciprocal effect on further warming. This means that when the temperature of the universe in general and the temperature of each phenomenon or object in particular rises, the amount of thermal infrared energy to the Earth's surface and finally the Earth's atmosphere rises as the temperature rises, depending on the emissivity of that phenomenon. This increase in emittance increases the greenhouse effect, which in turn causes more global warming and more climate change. Furthermore, when global temperatures rise, extreme weather phenomena such as droughts, storms, heat waves, and floods will become more intense and widespread. Also, when the temperature increases, snow and ice melt, producing not only an increase in sea level but also the shift of sunlight-reflecting surfaces (snow surfaces) to sunlight-absorbing surfaces, trapping more energy in the earth's atmosphere. According to our study heat is the fundamental thermodynamic parameter that could be related to any change in the world, so it can be said that global warming or heat alone could be the main cause, and climate change and other changes happen subsequently. Therefore, global warming is the leading cause of this process, and climate change is the effect of global warming, and there are causes and effects. We suggest extensive research on the topic of thermal reactions of all matters, phenomenon, and their impact on more warming due to the Emissivity behavior.

Furthermore, another considerable gap in studies and approaches related to global warming and climate change is the fact that the main reason for this climate change and global warming is "human needs", which is one of the main focuses of this article. Because in climate change and global warming discussion, attention has always been paid to the "effects" and the main cause, i.e. humans and their needs, has been ignored or less considered. To point out, global warming itself as one of the "effects" has fallen victim to the greed of some leaders of countries that see their interests at stake (Fritz & Ramirez, 2021). Needs have taken hold of humans because he does not distinguish between external and internal pleasure, and are turning the earth (as the only safe habitat at present) into hell for him or, in other words, destroying it. The "external" and "internal" needs that will be addressed in this article are the equivalent of the same terms "pleasure" and "happiness", as expressed by endocrinologist Dr. Robert Lusting. As he explained, there are differences between pleasure and happiness, which are as follows: 1) pleasure is transient, while happiness is long-term. 2) Pleasure is material, but happiness is spiritual. 3) Pleasure is taking, while happiness is forgiveness. 4) Pleasure can be obtained with material things (such as money and gold), but happiness does not come from material things. 5) Pleasure is experienced alone, but happiness is felt in social groups. 6) Extreme pleasure leads to addiction, while there is no such thing as happiness addiction. 7) Pleasure is based on dopamine, but happiness is based on serotonin, which is the most critical difference (Lustig, 2017, 2018). Therefore, given that man has based his "utilitarianism" on the satisfaction of his needs, it is suggested that instead of examining the "effects" of climate change (such as heat, rain, etc.), its root, "human" and their "Needs" to be addressed

Conclusion and suggestions

The present study aimed to highlight and examine two gaps in significant studies related to climate change and global warming. The first, the "reciprocal effect", was examined with a thermal and remote sensing approach and the second: the "human" and "needs" assessment in the study of climate change. The results demonstrated the "reciprocal effect" of global warming and showed that a 1.4 °C increase in temperature (according to UN forecasts) would increase not only this amount but also cause more global warming than this. Accordingly, it proved the claim that global warming causes more global warming. The present study also examined the second gap; most of the valid research in this field has studied global warming about natural changes. These studies, which consider these changes as "effects" of climate change and global warming, have neglected the leading cause, "human needs", which has caused human beings to change their environment or overuse it voluntarily. This study concluded that if the focus is on humans and leads them to focus on inner pleasure (happiness) instead of external pleasure (pleasure), it may be more effective in solving global warming problems than focusing on effects such as rising sea levels, storms, drought, etc.

Based on the findings and cases discussed in this study, it is suggested that in future research related to global warming and climate change, instead of effects, the main case, humans, be addressed, because man and his needs have caused these changes on the planet. Also, in the specialized discussion of heating, attention should be paid to the side effects of the phenomena, because the "reciprocal effect" causes global warming to go beyond what is expected and imagined. Although this study has given examples, more extensive research in this field should be done in various geographical areas, and not just the "global warming" concept is enough to pay attention to this.

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