



Journal of Pars Arian Territories

The Journal of Pars Arian Territories (JPAT) is a scientific publication dedicated to exploring a wide range of earth science topics that hold regional significance to the Mesopotamia to Transoxiana Lands. The journal welcomes submissions from researchers and scholars working in several fields, as well as interdisciplinary studies that bridge multiple earth science disciplines.

ISSN 3041-9344



Fossil Fuel Impacts on the Environment: A Perspective on the Middle East and Iran

Eskandar Poorasgari^{1✉}, Nasim Ghorbani, Rowshanak Arghae

Abstract

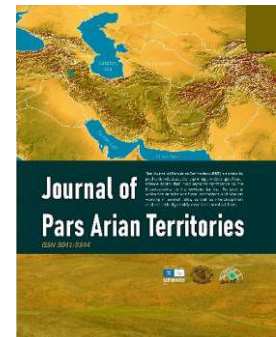
The composition of the Earth's hydrosphere and atmosphere at the beginning of the Earth's formation and the Archaean was very different from its current state. In the Archaean, the atmosphere's composition was predominantly CO₂, with small amounts of methane and nitrogen gases, and almost devoid of oxygen. Additionally, ocean water had an acidic pH. After several hundred million years of geological and biological activities, almost from the late Proterozoic and Phanerozoic, the composition of the atmosphere and hydrosphere has taken its current form. From the beginning of the Paleozoic to the Miocene, for more than four hundred million years, as a result of biological activities and geological phenomena, a part of carbon dioxide gas of the atmosphere has accumulated in fossil fuels (oil, gas, coal). Human civilization, after the industrial revolution, with the use of fossil fuels and the peak of their use in 1950 until now, and the continuation of this trend until 2050, in about 100 years, will consume almost 80% of the world's accumulated reserves of fossil fuels. A sudden increase in CO₂ in such a short time means introducing a sudden shock to the composition of the atmosphere, resulting in an increase in the Earth's heat, and this process is expected to become more intense. This problem has caused changes in the climate of the planet, and the result will be extreme changes in rainfall, drought in some areas, including Iran, the Middle East, and North Africa, changes in the rainfall pattern and its type in the year on the planet, drying up of many lakes and rivers in regions with the latitudes 20-35 degrees, as well as changes in the water level of the oceans and even their pH changes, which will threaten human society and some biological species.

Cite this article:

Poorasgari Eskandar, Ghorbani Nasim, Arghae Rowshanak (2024) Fossil Fuel Impacts on the Environment: A Perspective on the Middle East and Iran. *Journal of Pars Arian Territories* 2: 21-29

DOI: 10.61186/jpat.2024.2.3

Publisher: Pars Arian Insistue © The Author(s).



ARTICLE HISTORY

Received:

6 August 2023

Revised:

8 September 2023

Accepted:

9 October 2023

Published:

15 October 2023

KEYWORDS

Fossil Fuels, Precipitation, Climate Change, Climate of Iran and Middle East

CORRESPONDING

AUTHOR AFFILIATION



Saskatchewan University, Department of Geological, Civil and Environmental Engineering, Saskatoon, Canada

¹ Eskandarpoorasgari@gmail.com

Geospatial Abstract



Declaration of Readiness for Cooperation

Yes No

Prepare to share experiences

Yes No



Eskandar Poorasgari

INTRODUCTION

When the earth was created from the chondritic solid meteorites, there was no atmosphere and hydrosphere. Once geological activities such as volcanism began, the volcanic gases led to the formation of atmosphere and hydrosphere. Although their composition was very diverse, H₂O and CO₂ were the major components. Water vapor made hydrosphere and CO₂ along with some other gases such as N₂ and NH₃ formed the atmosphere. The primary atmosphere was mainly composed of CO₂ (more than 90%) lacking oxygen. The pH of the primary hydrosphere was highly acidic due to being in equilibrium and relation to a CO₂ rich atmosphere and because of ample sulfur gases the Archean volcanism, which were higher than the current volcanisms. The subsequent geological and biological events changed the primary atmosphere and hydrosphere by adding cations released from wash-off and decomposition of the volcanic rocks, which were formed in the beginning of the earth's creation. Such an event shifted the pH from acidic to the neutral and current basic levels (i.e., 8.2). These conditions led to the gradual release of CO₂ in the cycle of sedimentary rocks and the caused formation of carbonate rocks, and oxygen initially produced by photosynthesis led to the Fe²⁺ from ocean waters forming the Banded Iron Formations (BIFs). The volcanism is still active. Finally, the geological and biological activities made atmosphere and hydrosphere have their current shape and composition.

These The biological and geological activities, especially the sedimentary ones, caused the major parts of CO₂ of atmosphere during the Phanerozoic time to accumulate in coal, oil, gas, oil shales and Tar Sands. Although the geological activities were not continuous, it can be generally said that the formation of fossil fuels on earth took almost 400 million years. These fossil fuels are forming huge deposits and reservoirs including, of which more than 1 billion tons of coal, around 2000 billion barrels of conventional oil, more than 2000 billion barrels of the unconventional oil (Tar Sands and oil shales) and around 200 trillion m³ of natural gas have so far been known. Despite the relatively long use of fossil fuels in human life, the application of fossil fuel energy in large amounts dates to the beginning of the industrial revolution in Europe. Use of fossil fuel intensified especially from the second half of the last century (1950), which is anticipated to continue until the second half of the current century (2050). This means humans will consume approximately 50% of the world's coal and more than 80 % of world's oil and gas in about 100 years. This denotes that in about 100 years humans will release in the atmosphere a large part of what nature has accumulated in the fossil fuels from atmospheric CO₂ in fossil fuels over 400 million years. It means that the whole CO₂ content which had been saved in the nature as the fossil fuels during almost 400 million years will be added to the atmosphere during only 100 years. This swift increase of CO₂ and some other gases such as SO₂ and N₂O₂ will make a sudden shock firstly to the atmosphere and then to the hydrosphere. The result can be shown described by this famous Persian proverb: There would be no sign of both; the grapevine and the planter. No sign will be left from the grapevine, nor will be from the vine planter.

There have been a lot of discussions about increase in carbon dioxide gas over a short time (about 100 years), and its consequences have been emphasized. International conferences are currently being held (agreed treaties like the Paris accord), and the issue will likely reach the security council. Nevertheless, it has not been taken seriously and attention has not been paid to all its impacts. Beside warming of the earth, increase in CO₂ leads to the melting of polar ice, rising of sea levels and other problems, and it can submerge some countries. It would not be the biggest threat, and although it can onerously be dealt with by human beings, the subsequent problems will not be solvable by humans or any other creature. Some of those problems are as follows:

Severe climate change: the current increase in earth temperature increases the total evaporation from oceans. Such evaporation increases the overall precipitation on earth. At first glance, the increase in precipitation seems felicitous. However, it disturbs the current trend of precipitation, so that the

precipitation will go up at higher latitudes and will go down at lower latitudes. This will be explained more in the following.

On the other hand, the thermal equilibrium of the earth will be upset. This means that, especially in the middle east, precipitation will possibly reduce during winter and increase in summer and early autumn. Also, the type and intensity of precipitation will completely change; meaning snowfall will lessen and rainfall will increase, the number of mild rains will decrease and that of torrential rains will increase. As such, the overall precipitation of Iran in the first three months of 2019 has been unprecedented in recent 100 years (Figure 1). Human life, and agricultural and industrial activities, have been adjusted and stabilized with the current trend of precipitations. It is obvious that what a disaster will happen with a change in this equilibrium.

In this article, we have tried to first examine the process of creation and evolution of the composition of the two spheres (atmosphere and hydrosphere) from the past to the present, and then point out their evolution in the future regarding the consumption of fossil fuels. However, climate change is caused by the increase in carbon dioxide and its greenhouse effect. It will also affect the hydrosphere. According to the recent thirty-year changes obtained from meteorological statistics, as well as the author's observations of the surface changes of the earth, such as land, lakes and rivers in Iran and some countries in the Middle East, which the author observed, and also by analyzing the book of the world in the year 2050, of which the author was the editor of its translation and addressed climate changes in the Middle East and especially Iran; It matches.

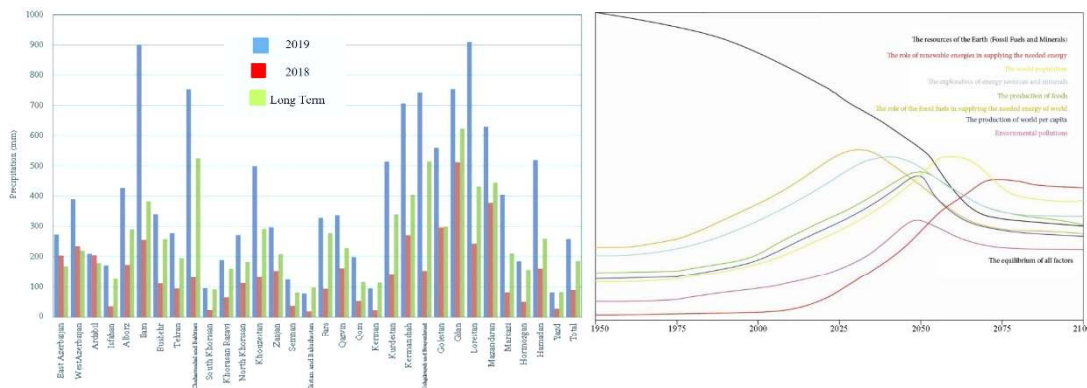


Figure 1. The precipitation rates of different provinces of Iran in September 2018-March 2019 and the long-term precipitation (data from the National Drought Warning and Monitoring Center). Figure 2. This diagram shows the trends of the main factors affecting the world from 1950 up to now and predicts future changes.

CO₂ and Hydrosphere

The increase of carbon dioxide, sulfur and industrial acidic gases in atmosphere will make the pH of precipitations deviate from neutrality, turn them acidic gradually, and these acidic waters will enter the seas. As already mentioned, the current pH of seawater is about 8.2; close to neutral. We know that near-neutral pH is very sensitive, and it changes a lot with the concentration of H⁺ or OH⁻ ions. Entrance of acidic water in the sea and melting of polar ice with pH about 7 may reduce ocean water pH to 7. This might not have such an impact on oceans that contain large volumes of earth's water but can affect closed and semi-closed seas, such as Caspian Sea and black Sea, and lakes. The pH 8.2 has remained constant for a billion years. Changes in pH are a shock to the hydrosphere and these conditions are a catastrophe for most living sea creatures because they have acclimatized with pH 8.2. Even small pH changes that causes the death of many creatures and leads to the disturbance of marine ecosystems. This will cause changes in

terrestrial ecosystems, and variations in the global ecosystems in turn will cause mass extinction of a group of living creatures. These aspects indicate how the six components of nature (i.e., climate, water, energy, population, geographical location, natural features like minerals and forests) will act together and react to each other, and how their complex relationship and mutual effects will reveal and become more intense in near future between 2030 and 2070 (Figure 2). In the not so-far-future, between 2030 and 2070 (around 2050), the world undoubtedly will be another world, very different from now. The mentioned components have mutual effects on each other (Figure 2), whose intensification will be noticeable from 2030 onwards and will adapt to the future events and reach a relatively stable equilibrium in 2070. After this time, once the world has passed the profound episodes, it reaches a new quiescence. Although in the four decades starting from 2030 the world will see many events, changes and shocks, in my opinion, these episodes will stabilize completely until 2070, and after that a quiescent and stable world will come into existence.

Hydro-atmosphere changes

The globe will continue to change through six components. We have to know these components and their mutual effects, which we have to mitigate as much as possible because it is us humans that caused problems and unbalances by employing an ever-increasing amount of fossil fuels within the last 100 years. Overcoming the mentioned problems is very difficult without having sufficient knowledge about the components. These mutual effects are more pronounced in middle eastern countries because they have the most fossil fuel resources, highest per capita energy consumption and least vegetation cover, and are located within latitudes sensitive to climate change (25° - 35°). Due to the increase in greenhouse effect, which is primarily the result of fossil fuels, it has been a few decades since the warming of the earth's climate has begun, and its intensity will go up given the global appetite to consume fossil fuels. It is anticipated that the earth's temperature will increase by 5 degrees until 2050. Such an increase means melting of all snows in the northern latitudes, and a lot of changes in the amount, time and location of precipitations (e.g., precipitation will increase within the latitudes 0° - 30° and 60° - 90° , and it will decrease within middle latitudes, whereby arid areas will expand). These disturbances will intensify and the overall precipitation on earth will increase, and soil erosion will increase subsequently. Unfortunately, Iran is located within the middle latitudes, as are other middle eastern countries.

The changes can be depicted as a reduction in snowfall and increase in rainfall. Also, the timing of the precipitation changes (e.g., we possibly see winter precipitation reduce and summer precipitation increase). In addition, precipitation shifts from mild to heavy and torrential. Economically, it should be noted that most impacts of the environmental phenomena in Iran are incurred by flood rather than earthquake. For instance, the precipitation that occurred in the end of March 2019 has been unprecedented within the last 100 years and caused losses of life and properties to the Iranians (Figure 3). Climate change will cause changes in vegetation cover. Overall, the northern latitudes will become greener and lower latitudes, especially middle latitudes, will become drier. As Iran is located within the middle latitudes, we need to be concerned about the disappearance of forests, and indeed we need to increase forests and grasslands. At this stage, the global community should act, and engage in research and educational projects. Based on the knowledge of the first author of this article about the climate and morphology of Iran and other middle eastern countries, it is feasible to allocate areas of higher altitude than 2500 m to the cultivation of trees compatible with the climate of Iran, especially Ooras cedar [*Juniperus*]. Besides preventing the reduction in the greeneries of the country, this action may be of help to counter the problems that will occur.

Undoubtedly, countries located within middle latitudes will face intense water scarcity by 2050, and this water issue that has been raised in the regional conflicts and disputes will be inevitable in the near future. With war and terrorism, this issue will be more acute in middle eastern countries because some countries are causing aridity in other countries such as Iraq and Syria by constructing dam on the upstream tributaries

of large rivers. This can lead to dryness and disappearance of vegetation cover. On the other hand, it can result in typhoon and swarm of fine particles in the eastern region of Iran. In our country, the problem is much more severe as the observed trend has started since a for a few decades, many internal lakes have dried such as Hamoon lake in Sistan and Baluchistan, Qom Lake, ..., and where is the water-abundant Urmia Lake), and this trend is going on.



Figure 3. The recent floods in Iran and their damages (March, 2019); A. The city of Agh Ghala, Golestan Province; B. The remained mud after the flood in houses, Pol Dokhtar, Lorestan Province; C. Flood-water running in the vicinity of the Pol Dokhtar city. (Photos by Mehr, Fars and ISNA news agencies, respectively). Figure 6. The Kashkan Bridges; A. Before the flood; B. After the flood. Note that the historic bridge that shows minor changes compared to the new one (Photos by Pars Geological Research Center and ISNA news agency, respectively). Figure 7. The remnants showing the method of plowing in old times perpendicular to the topographical dip, Astamal, East Azerbaijan Province, Iran (Photo by the Pars Geological Research Center).

Ground water level has gone down to 200 m in some regions of the country. The problem of water scarcity in the country cannot be solved with a project, water transfer, constructing a few dams, using deep waters and/or desalination. Indeed, all these options need to be studied and be on the agenda to be effective. In near future, the world has to cut on fossil energy consumption. Of course, this willingness exists but it is not achievable in the short term. The reason is the global transport and growth of developing countries, whose needs for these fuels are increasing by day, have been shaped by low price of fossil fuels, which have low price, ease of access and transport on the one hand, and are needed by universal industries such as big factories. It will take years until clean energies become comprehensive alternatives for fossil fuels. Although strict frameworks for the consumption of fossil fuels in the future, and carbon tax will be increased, some states might not be committed to those actions due to nationalist and populist views. On the other hand, the world does not have the capacity for the rapid replacement of the current energy sources, and further consumption of these fuels will result in further warming of the earth. Therefore, climate change, water scarcity in middle latitudes, and the disturbance of precipitation equilibrium and life will continue seriously.

Climate change with increased use of fossil fuels, global warming, changes in precipitations, use of clean energies with global population increase and demanding for more welfare, and the growth and the development of countries will be confronted with geographical shifts and increased metropolitan cities. It is anticipated that with population growth, increasing life expectancy, increase in the number of large cities, and ever-increasing fossil energies (especially gas consumption for supplying electricity and water in future) will be inevitable in Iran.

In summary, the six mentioned components will be more impactful in Iran because of being located within middle latitudes (20° - 40°), abundance of energy (third component), and water scarcity (second component). These conditions sometimes make the governments implement projects without fundamental studies and sufficient and region-specific knowledge, whose consequences can be very dire for the environment. For instance, the state has committed itself to supplying all homes and residential buildings of Tehran with gas, which has contributed to the pollution of the city. While a major part of the country's electricity is produced from fossil fuels, the state could build gas-fueled power plants in southern Tehran and supply the household with heat from the electricity production. There is need for a strategic organization to study the effects of climate, water, energy, population, and geographical location, so that it would coordinate all construction projects and the reduction of the impacts with other organizations and ministries, the president and parliament.

Another example is a current project being carried out by the water and wastewater organization of Tehran province. It is building wastewater systems to transfer the sewage to the southern parts of the city. Implementation of this project may lead to drying of the underground in the northern part, which if happens, will be followed by many problems including land subsidence. To prevent such a thing from occurring, an increase in the green areas and parks of northern Tehran is suggested. Middle eastern countries, especially Iran, have specific characteristics, which is due to its geographic location and topography and mountain ranges (Figure 4). Some those characteristics are as follows:

Low annual precipitation, whose spatiotemporal patterns are very different (Figure 5). Natural features such as plains, vegetation cover and their distribution, as well as alluvia and seasonal and permanent rivers indicate that the country has experienced both droughts (like the one in Summer 2018) and torrential precipitations (like the one in March 2019). The average annual rate of the precipitation is not high and the temporal and spatial distribution of precipitation is varied (Figure 5). Precipitation of the wet year 2018-2019 should not be considered as the beginning of wet years because we have no long-term statistics to support such a consideration, and many experts believe so. The country's precipitation data from the wet years 2017-2018 and 2018-2019 must be observed and be a base for planning. Also, we should also look at the precipitation data of the year 2020-2021. sedimentological studies is carried out in Iranian plains (e.g., Tehran, Abadeh, Fars, Bandar-e-Abbas, Kermanshaah, Sar-Pol-e-Zahaab, Elaam which includes Mehran, Dehloran, Elam-Dgavaar, Saraabeleh route), which are primarily located on Zagros and Alborz mountain ranges, it will be revealed that intense precipitations have occurred in the country in recent millennia and/or centuries. However, none of them caused the destruction and loss that the one in March-April [Nowruz] 2019 did.

Environmental changes

If an accurate investigation is conducted, it will be revealed that intervention in the environment has caused the losses due to this precipitation (in March) to be far more destructive than what they would be under normal conditions. It can be easily understood as to why previous torrential rains have not been as such. Why the historic bridges Kashkaan and Gaav Mishaan with an age of more than 100 years have been damaged and destroyed, while previous torrential rains - more intense based on sedimentological evidences - were not able to destroy them, they had remained sound (Kaskaan bridge, Fig. 6). The city of

Agh Ghalaa is not a city that has not been built in recent years. Several factors are noticeable in the destruction and loss resulted by this precipitation (in March 2019), which are as follows:

- A. Constructing buildings without finding appropriate locating, construction projects with contemplating all aspects especially natural and geological aspects, incorrect implementation of the projects, and creating homes with paying attention to natural geographic location, environmental regulations, climate and geotechnical issues.
- B. B- Shift in the agricultural patterns, in which numerous mistakes can be seen, including those mentioned below:
- C. - Change in plowing method: when agricultural work was conducted with traditional method in Iran, plowing (using cow) was done in a way that it was perpendicular to topographic slope and the direction of water flow, and in fact pouches would be created which would result in further percolation of water. This situation was, however, disturbed when mechanised plowing (i.e., tractor) replaced the tradition method, and most of the lands with dry farming were plowed in the same direction as topography. This was indeed inevitable in some cases as the lands were divided in ways that it was not possible for the tractor to turn around in rectangular smallholdings. The government has of course taken actions towards integrating agricultural lands, which have to be seriously followed up on. Also, farmers should be informed about the plowing procedure (Fig. 6), meaning that, plowing and terracing should not be in the same direction as topographic [slope] (Fig. 7).

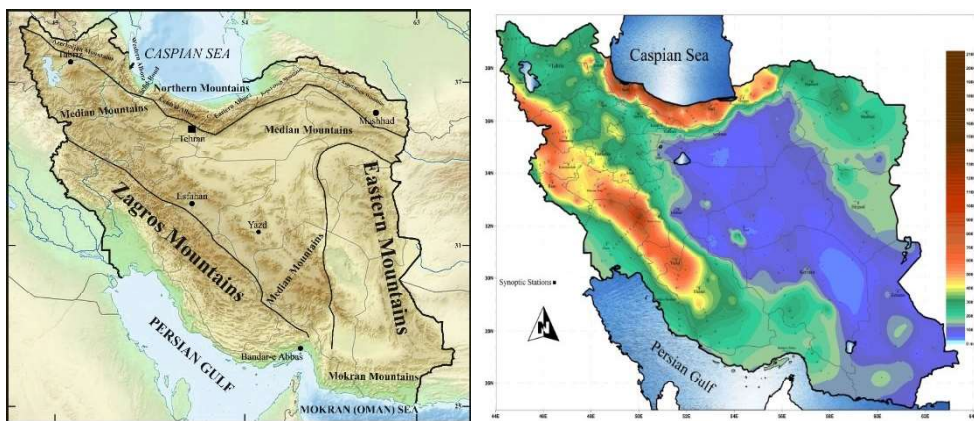


Figure 4. The mountain ranges of Iran (Ghorbani et al, 2018). **Figure 5.** The map showing the precipitation rate of Iran in average (Ghorbani et al, 2023).

Change in the cultivation method of the region without paying attention to the condition of the ecosystem in that region: if we analyze the Wet Azarbaijan and areas surrounding Urmia lake as well as the orchards in the region, we will find out that most of the plantations were previously vineyards that have been replaced with apple orchards. The amount of water required for apple orchards is incomparable with vineyards. Also, the cultivation methods of these two crops are different. For example, the apple tree needs 10 irrigations per year but the grapevine needs 3 irrigations per year; therefore, grapevine is better.

If we look at the aerial pictures in 1:50000 scale obtained from across Iran in 1956 and the those taken in 1997-1999, receding forests and reduction in the vegetation cover of the forest will become evident. We can now figure out to what extent the forest vegetation cover has reduced in the past years. What has been said is part of the occurred issues, which have been intensified with climate change. Therefore, the issues should be looked at comprehensively to prevent these problems in the future, and a specific committee should be set up to complete the approach.

Conclusion

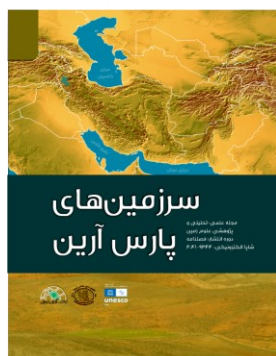
According to what is stated in the text of the article, the earth's atmosphere as a whole, due to the combined shock caused by the increase in carbon dioxide as a result of the fossil fuels that have entered it for about 100 years, will undergo a shock of changes in the heating of the earth's surface. It will have a great impact on the climate and waters, especially the water of the lakes and the discharge of the rivers, which we are witnessing even now. This issue is more acute in our country and Middle Eastern countries. The changes resulting from this climate and following the changes in the waters of lakes, seas and even oceans will be a threat to human life and many plants and animals. Therefore, to compensate for it, a global wisdom and global decision-making is needed to manage the rate of consumption of fossil fuels and man-made structures related to the surface changes of dam construction, changes in cultivated land and forests, and changes in watersheds and water transfer, and provide expert opinion. And in this regard, it is necessary to form a global organization and this organization should have many branches in different regions of the world. This organization can determine laws with incentives for developing countries and fines for violating countries, and put them on the agenda, and opine with the contribution of the representatives of different countries.

REFERENCES

- Curtis, John. 2008. "The Oxus Treasure." In *Ancient Persia*. London: British Museum Press.

اثرات سوخت‌های فسیلی بر محیط زیست: با نگاهی به خاورمیانه و ایران

اسکندر پورعسگری[✉]، نسیم قربانی^۲، روشنگ ارغایی^۳



چکیده

ترکیب هیدروسفر و اتمسفر زمین در ابتدای شکل‌گیری زمین و آرکن با وضعیت فعلی آن بسیار متفاوت بود. در آرکن، ترکیب جو عمدتاً CO₂، با مقادیر کمی گازهای متان و نیتروژن و تقریباً بدون اکسیژن بود. علاوه بر این، آب اقیانوس دارای pH اسیدی بود. پس از چند صد میلیون سال فعالیت‌های زمین‌شناسی و زیستی، تقریباً از اواخر پروتروزویک و فانروزویک، ترکیب جو و هیدروسفر شکل کنونی را به خود گرفته است. از آغاز پالئوزویک تا میوسن، برای بیش از چهارصد میلیون سال، در نتیجه فعالیت‌های زیستی و پدیده‌های زمین‌شناسی، بخشی از گاز دی‌اکسید کربن جو در سوخت‌های فسیلی (نفت، گاز، زغالسنگ) تجمع یافت. پس از انقلاب صنعتی تمدن بشری بر استفاده از سوخت‌های فسیلی افزود. با اوج استفاده از این منابع در سال ۱۹۵۰ تاکنون و ادامه این روند تا سال ۲۰۵۰ یعنی در حدود ۱۰۰ سال، تقریباً ۸۰ درصد از ذخایر انباشته جهان را مصرف خواهد کرد. سوخت‌های فسیلی، افزایش ناگهانی CO₂ در چنین زمان کوتاهی به معنای وارد کردن یک شوک ناگهانی به ترکیب جو و در نتیجه افزایش گرمای زمین است و انتظار می‌رود این روند شدیدتر شود. این مشکل باعث تغییراتی در آب و هوای کره زمین شده و نتیجه آن تغییرات شدید بارندگی، خشکسالی در برخی مناطق از جمله ایران، خاورمیانه و شمال آفریقا، تغییر الگوی بارندگی و نوع آن در آینده نزدیک خواهد بود. سیاره زمین، خشک شدن بسیاری از دریاچه‌ها و رودخانه‌ها در مناطقی با عرض‌های جغرافیایی ۲۰ تا ۳۵ درجه و همچنین تغییر در سطح آب اقیانوس‌ها و حتی تغییرات pH آنها جامعه بشری و برخی از گونه‌های زیستی را تهدید می‌کند.

تاریخچه مقاله

تاریخ دریافت: ۱۴۰۲/۵/۱۵

تاریخ پذیرش: ۱۴۰۲/۶/۱۷

انتشار برخط: ۱۴۰۲/۷/۷

واژگان کلیدی

سوخت‌های فسیلی،
بارش، تغییر اقلیم،
اقلیم ایران و خاورمیانه



وابستگی نویسنده

دانشگاه ساسکاچوان، گروه
زمین‌شناسی، مهندسی عمران
و محیط زیست، ساسکاتون،
کانادا

استناد: پورعسگری، اسکندر، قربانی، نسیم، ارغایی، روشنگ (۱۴۰۲). اثرات سوخت‌های فسیلی بر محیط

زیست: با نگاهی به خاورمیانه و ایران، *سرزمین‌های پارس آرین*، سال اول، شماره دوم (۸۶)

شناسه دیجیتال: DOI:10.61186/jpat.2024.2.3

ناشر: مرکز پژوهشی زمین‌شناسی آرین زمین © نویسنده.



¹ Eskandar.poorasgari@gmail.com

سال اول
شماره دوم
زمستان
۱۴۰۲

۲

۱-۸۶



سرزمین‌های پارس آریین

مجله علمی-تحلیلی و
پژوهشی علوم زمین
دوره انتشار: فصلنامه
شاپا الکترونیکی: ۳۰۴۱-۹۳۴۴

