

# Overcoming the water crisis in the Middle East

Shervin Zahrabi

Senior expert in water resources management, Water Development and Research Office,  
Ministry of Energy, Isfahan, Iran

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## Abstract

The Middle East faces a severe water crisis due to factors such as population growth, climate change, and inefficient water management practices. This paper explores potential solutions to overcome this crisis, including desalination technologies, wastewater recycling, improved irrigation techniques, and regional cooperation. By implementing a combination of these strategies and promoting sustainable water usage practices, the Middle East can work towards ensuring water security for its populations and ecosystems in the face of increasing water scarcity.

**Keywords:** Water crisis; Middle East; Strategy; Water shortage.

## 1. Introduction

Addressing the water crisis in the Middle East requires a combination of strategies such as improving water management practices, investing in purification technologies, promoting water conservation measures, implementing efficient irrigation techniques, and fostering regional cooperation for sustainable water use.

### *1.1. Risk of water shortage*

The World Bank estimates that by 2050, water scarcity will reduce GDP by 14 percent in the region. In 2021, a UNICEF report stated that Egypt could face water shortages by 2025. The water tension in countries like Egypt is aggravated by the restriction of the flow of the Nile River due to the construction of the Grand Renaissance Dam in Ethiopia.

Syria and Turkey have been at loggerheads for years because the Turks built dams along the Tigris and Euphrates rivers that cut off the flow from the south. And among the many issues that pit Israelis and Palestinians against each other is water and who has the right to use the West Bank's aquifers.

In addition to the significant threat extreme heat poses to lives and livelihoods in the Middle East and North Africa, a warmer region has the potential to destabilize politics beyond its borders. It is important to emphasize that this is not an article about "climate conflicts". About a decade ago, there was a flurry of articles on this topic highlighting the Syrian civil war as an example of what the future could look like as the planet warms. As the October 2021 National Intelligence Estimate on Climate Change noted, the U.S. intelligence community "has little to no confidence in the impacts of climate on U.S. national security interests and the nature of geopolitical conflicts, given the complex dimensions of human and governmental decision-making." "average" Basically, spies say it's difficult to establish a cause-and-effect relationship between weather and war because there are so many variables that contribute to conflict.

### *1.2. Dew point temperature in the Middle East*

In mid-July of 2024, the heat index in Dubai was 144 degrees Fahrenheit. In late June, the Grand Mosque in Mecca recorded a temperature of 125 degrees Fahrenheit. This heat coincided with the Hajj season. When the Hajj rituals were over, more than 1,300 people had lost their lives. And in Egypt, temperatures have rarely dropped below 100 degrees since May. Last summer was actually hotter in the Persian Gulf region, peaking at 158 degrees Fahrenheit in coastal areas of Iran and the United Arab Emirates (Livingston, 2023). This unrelenting heat this season exceeded the "dew point temperature" where humans, if exposed for six hours, could no longer cool themselves, leading to heat-related illness and death.

### *1.3. Influx of refugees in the region*

A more obvious and important problem is how people will adapt to rising temperatures and water scarcity. They migrate to places with lower temperature and more water. According to a World Bank report, 19 million people – roughly 9% of the local population – will be displaced by the climate crisis in North Africa by 2050. And for the people of the region, Europe is the destination of choice.

#### *1.3.1 Problems*

First, the bank is generalizing. Political, economic, or technological changes may occur that limit the number of immigrants. Second, not every person who is migrating will migrate because of climate change. And finally, some of these refugees will stay somewhere in the region given the resources needed to cross the Mediterranean. (But this creates its own set of problems. Internally displaced people, who generally live in urban areas, put a strain on budgets and infrastructure in places where resources and capacity to absorb migrants are limited.) However, the claim that immigration brings benefits to society is not convincing to a significant number of Europeans who oppose large numbers of newcomers to their countries. The conflicts that plague the region make aid more difficult, given the fact that water sources often cross borders. But this is a challenge that can be overcome. Not only

are there technical solutions to the water shortage problem, but there are also political motivations to reach agreement even in conflict zones.

Leaders across the region have a political interest in meeting the minimum demands of their people, including access to water. Even with all the nationalist bluster in their respective governments. Without such an idea, the political and economic problems of the countries will deepen and threaten the leaders. This is important and shows a way forward for negotiations on water. Governments should focus on issues where there is a real chance of making a difference. Nothing can be done about extreme heat, and reducing greenhouse gases is not a major problem in the region because it doesn't actually emit that much greenhouse gas. However, water is very important, and this is an area where the region should seek the expertise of countries outside the region.

### 1.3.2 Solutions

To relieve Iran's water crisis, the government invested about US\$1.5 billion in modernizing the country's irrigation systems, aiming to reduce agricultural water demand (Maghrebi *et al.*, 2023). Water is the source of life and the foundation of sustainable development. But water resources in many parts of the world are at risk due to mismanagement, pollution and climate change. Iran's water resources may not be filled like in the past. But according to the researchers, the country should not only reform its water management policies, but also the entire economic structure.

Zayandeh Rood river was a river that turned the ancient city of Isfahan into a cultural symbol that also has a history of being the capital of the Iranian Empire. But today, Zayandeh Rood has dried up like a battlefield. Last month, the people of Isfahan gathered in the dry bed of this river to protest the management of water resources during the worst drought in recent decades. This same summer, Khuzestan, 180 miles from Isfahan, where decades of oil exploitation, unprincipled dam building and poor resource management have dried up wetlands and destroyed fertile land, witnessed unrest in protest against this situation (Motevalli, 2021).

Bloomberg's reporter believes that climate change reveals the inadequacies of an economy based on oil extraction and unsustainable agricultural practices (Fróna *et al.* 2021). According to a 2019 study, as the Earth warms from the middle of this century (Cheng *et al.*, 2020), Iran is likely to experience longer periods of extremely high temperatures, as well as periods of drought and frequent floods. This applies to many places, but the impact will be particularly acute in Iran. According to researches, without well-considered measures to adapt to climate changes, some parts of the country may face limited habitability in the future. Every day, the government news agencies publish news about the sharp decrease in rainfall, the reduction in the stock of dams, and the depletion of underground and surface water reserves. There are some warned conservatives that more than 300 cities and towns are now facing acute water stress. Government meteorologists estimate that 97 percent of the country is at risk of drought, and an academic study says 20 million people will be forced to migrate to cities as farmland becomes unusable.

Many dams have recorded record lows this year, even causing power outages at the height of one of the hottest summers on record. Between 2017 and 2020, snowfall, which makes up 70% of Zayandeh Rood's water, has decreased by approximately 14% (Motevalli, 2021).

### *1.3.3 Inappropriate consumption pattern despite water stress*

Motevalli (2021) stated that despite the decrease in reserves, those Iranians who have easy access to water continue to consume too much water. The water consumption of a citizen of Tehran is three times more than that of a citizen in Hamburg, Germany. In the midst of water scarcity, gardens, public parks and landscaping in the capital of Iran are full of water, and spraying water to wash the passages is still a common method.

Digging illegal wells is also common. A former official of Isfahan regional water company told the Islamic Republic of Iran news agency that Isfahan farmers have dug more than 10,000 illegal wells in recent years.

Implementing water rationing policies and halting illegal drilling risks further unrest. There are 130,000 known illegal wells, but there is no effort to block them. The question is, what will be the alternatives and social consequences of this issue. On the other hand, there is little willingness on the part of Iran, as the sixth largest producer of carbon dioxide in the world, to join global efforts to limit greenhouse gas emissions or invest in water conservation measures. The economy is dependent on oil production and heavy industries for survival. The Iranian government has announced that it will reduce greenhouse gas emissions by 4% by 2030 (a goal that actually means a fivefold reduction from 1990s levels) and could target a 12% reduction if sanctions are lifted.

Madani (2021) alerted about the dangers of mismanagement of Zayandeh Rood for nearly two decades. Sanctions cannot be considered as the main culprit of this situation, but it is obvious that it has acted as a catalyst in creating management problems. The model was rebuilt in 2005 to evaluate potential solutions to reduce the dryness of the river and showed that even diverting water from the river to neighboring provinces would not solve the problem. He ran the model many times and thought there was something wrong until he realized that more water supply would lead to more consumption growth, increasing demand and creating a vicious cycle that would make the situation worse in the long run.

In April 2019, massive floods inundated dozens of villages and destroyed hundreds of homes — partly because wetlands like Hur al-Azim can't absorb rainwater like they used to. Many rural families who lost their wheat crop in that disaster participated in this summer's protests against the drought in Khuzestan province.

### *1.3.4 Necessity of structural reforms*

Iran's water resources may not be supplied like in the past. But according to the researchers, the country should not only reform its water management policies, but also the entire economic structure. The government should invest in businesses that offer farming communities effective alternatives, raise awareness of environmental challenges, and fundamentally modernize the agricultural sector (Moridi, 2017).

Climate change, land subsidence, environmental instability, forest destruction and water tension and crisis and industrial development in the wetlands are among the environmental challenges that the inter-group environment branch of the Academy of Sciences (Timmerman *et al.*, 2020) discussed in a statement. They have called for environmental threats. According to the statement, the 50<sup>th</sup> principle of the Constitution of the Islamic Republic of Iran, "Environmental protection is considered a public duty", and on the other hand, in the 45<sup>th</sup> principle, it is stated "public wealth and assets such as favorable or abandoned lands, mines, seas, lakes, rivers, etc. are at the disposal of the government".

Iran's increasing environmental challenges have recently reached a crisis point, especially soil erosion (water and wind), drought, dust, land subsidence, water crisis, water waste management and air pollution, not only causing social, political and security problems inside the country, but in the future, Iran's relations with its neighbors will also face more challenges. The deterioration of Iran's environmental situation is a potential destabilizing risk for Iran's national security; because it threatens the country's security, internal organization, public health, fragile environment and economy (Nouri *et al.*, 2023).

## **2. Climate change**

Iran is one of the most vulnerable countries to climate change due to its geographical, economic and climatic characteristics. According to the statistics of 2019, Iran is the first country in the Middle East and the eighth country in the world in terms of the emission of greenhouse gases, especially carbon dioxide, which is due to the lack of modernization, low industrial productivity, the non-optimal production, consumption of hydrocarbon products, and the lack of proper development of clean and renewable energies. Furthermore, a large area of the country is prone to floods, the indiscriminate expansion of cities and the destruction of forests have added to the cause, and the warming of the earth and the change in rainfall patterns have led to droughts and fires in forests. Climate change has intensified and repeated natural disasters such as droughts and floods. Some estimates show that in the 21<sup>st</sup> century, Iran will face an increase of more than 2 degrees Celsius in average temperature and a 35% decrease in rainfall (Mansouri Daneshvar *et al.*, 2019).

### *2.1. Environmental instability*

Environmental instability is particularly important in the development of various risks and accidents such as drought, dust storms, floods and earthquakes. Affected by the destruction of the environment and climate change, the people of Iran and the Middle East region may suffer from new diseases, some animals may not survive; because they cannot adapt to the new environment to meet their living needs, including drinking water Madani (2021).

### *2.2. Earth warming*

The average air temperature has become warmer by about 2 degrees in different regions of Iran from 1922 to 2022. All the summers of recent years were unusually hot and dry compared to the past 20 years, and very high temperatures and low humidity in the months of August and September were more than the long-term drought of the region. If the Middle

East becomes drier in the long term due to climate change, dust storms will become more intense (Hansel *et al.*, 2022)

### 2.3. *Production of greenhouse gases*

The growth of CO<sub>2</sub> emissions in the Middle East was the third highest in the world during 1990–2004. The countries in Middle East where are among the highest CO<sub>2</sub> emission rates, are responsible for fossil-fuel CO<sub>2</sub> emissions of the region by more than 65%. However, Iran has national per capita CO<sub>2</sub> emission equal to 2.18 as of 47<sup>th</sup> in the world. The National Climate Change Office of Iran has published the inventory of greenhouse gas emissions in two time-intervals of 2000 and 2010. The report showed that total CO<sub>2</sub> emission from different sectors were about 375,186 and 677,330 Giga tons in 2000 and 2010, respectively. The total CO<sub>2</sub> equivalent emission is estimated to be about 491,051 and 1,092,650 Giga tons in 2000 and 2010, respectively. Moreover, the total CO<sub>2</sub> equivalent emission has been increased by 23% per year (Mansouri Daneshvar *et al.*, 2019).

### 2.4. *Destruction of forests*

During last 6 decades, millions of hectares of the country's forests have been reduced. The area of Iran's forests decreased from 19 million hectares to 2015 to 7.10 million hectares from 1990. If we continue with this process, in 75 years there will be no trace of Iran's forests! Construction, illegal cutting of trees, overgrazing of pastures and forest fires caused by climate change and carelessness of some people are important factors of deforestation (Noroozi, 2023).

### 2.5. *Soil erosion*

Soil is the furthestmost main part to make food safety. Iran is a dry country with an area of nearly 165 million hectares. Of this amount, only about 50 million hectares can be cultivated; but less than 18 million hectares is currently used for agricultural purposes, and water shortage has made the rest useless (Keshavarz *et al.*, 2005). The wind has dried up the earth's surface, increased the dust, and the rise in air pollution has intensified the diseases. As stated by the World Food and Agriculture Organization, Iran loses 2 billion tons of soil annually, which is almost 10 to 15 tons per hectare soil erosion. This is caused by destructive power of wind and water on the soil. Since One percent of the earth's landmass belongs to Iran, the rate of erosion compared to its surface is 8 times the world average. It takes 500 years to compensate each cubic meter of soil erosion. in different climatic conditions, it takes between 300 and 1000 years to make each centimeter of soil (Montanarella *et al.*, 2015).

### 2.6. *Drainage of underground water*

In the summer of 2021, about 350,000 unauthorized wells and about 550,000 authorized wells were reported in the country. The number of unauthorized and authorized wells in Iran in 2015 was about 60,000 rings. About 72% of the total rainfall is spent on evaporation

and transpiration, and from the rest, which is the renewable volume of the country's water resources, it is about 110 billion cubic meters and about 28% of the total rainfall is about 400 billion cubic meters. In the last two decades, on average, about 100 billion cubic meters have been withdrawn from the country's surface and underground water resources for various purposes, which has many negative effects. Decrease in well performance, increase infiltration of salt water into underground aquifers, increase in land subsidence and destruction of groundwater are some of the worrying consequences of this trend (Mirzavand and Bagheri, 2020).

### **3. Tension and serious water crisis**

Out of a total of 400 billion cubic meters of annual precipitation, 290 cubic kilometers are lost to evaporation and transpiration, 110 km<sup>3</sup> are available, of which about 94% are used to irrigate about 8 million hectares of land. In addition to this amount, the average volume of incoming water from the border rivers is about 8 km<sup>3</sup> and the output volume is 33 km<sup>3</sup>. The discharge of the spring is 11 km<sup>3</sup>, the surface water of the rivers is about 100 km<sup>3</sup>, and the annual penetration into the underground aquifers is estimated at 51 km<sup>3</sup>. Groundwater supplies about 60 percent of national consumption in years with "normal" rainfall, and undoubtedly a larger percentage in prolonged droughts, such as the one we are experiencing now (Mesgaran and Azadi, 2018).

#### *3.1. Water stress caused by unprincipled exploitation of water resources*

Unprincipled exploitation of underground water resources is mostly in the agricultural sector. With very low productivity and losses of 30% of agricultural products and the lack of suitable prices for water and energy, it is a big challenge in all sectors, especially in agriculture. Climate change, drought, inappropriate water transfer projects and non-observance of the principles and basics of land use in population and industrial location have caused the emptying of underground water tables, drying up of rivers and wetlands, land subsidence in many plains and the release of fine dust. Unbalanced use of water resources, wrong land development of Iran, especially from 1961 onwards, has caused a disproportionate concentration of the population, especially towards the centers of the provinces and especially towards Tehran. Since the Ministry of Roads and Urban Development is supposed to transfer its lands to the areas where the land is in its possession, including new cities, areas under the responsibility of the Housing Foundation, cities with less than 500,000 inhabitants and in general the lands registered in the Land Bank. Leave it to the construction applicants and housing builders, the areas with the most stress and water crisis should be given the highest priority so that such plans are not implemented in the areas with high water stress. Important areas such as Tehran, Alborz, Kerman, Semnan, Yazd, Isfahan and South Khorasan provinces are among the places where new settlements cause more water stress in these places (Layani *et al.*, 2021).

#### *3.2. Sea pollution*

Caspian Sea is the largest closed body of water in the world; 126 species and subspecies of fish live in this lake. The main source of pollution in the Caspian Sea is the Volga River

with large amounts of industrial and municipal wastewater (Ministry of natural resources and ecology Russian Federation, 2019). The flowing water in 130 rivers is poured into the Caspian Sea, and polluted water is the biggest source of its pollution. Indiscriminate harvesting of sand and pollution caused by domestic, urban and industrial sewage are two important factors in the destruction of rivers in the catchment area of this sea (Melnik *et al.*, 2021). Now, the challenge of establishing petrochemicals in the Miankaleh protected area in the southeast of the Caspian Sea is a serious concern in Iran.

### 3.3. *Population increase and urbanization development*

The increase in population, the development of urbanization, the expansion of industry, and the misuse of natural resources have caused severe environmental pollution in the Persian Gulf, which has polluted its ecosystem up to 47 times the normal level, thus putting its aquatic life and creatures at risk of destruction. The establishment of various industries and the extraction of oil and gas resources, transportation, warship traffic and maritime traffic have caused the Persian Gulf to have special conditions. The existence of refinery and petrochemical facilities in the sea and on the coast has turned this water area into one of the most polluted seas in the world (Hassanshahian *et al.*, 2020).

### 3.4. *Water transfer projects*

Now, various water transfer plans are being implemented around Tehran and all major cities to guide drinking and consumption water. For example, the new city of Parand was located in a completely dry desert climate next to the Imam Khomeini International Airport, but it is not known why the least necessary measures have not been taken in the field of water supply. With the location of industrial projects in industrial areas inside the plateau of Iran and the establishment of more population, the need to transfer water within the territory has increased even more. Every water transfer program disturbs the ecological balance in the source and destination of the transfer. Adding new settlements to dry areas, or not paying attention to the water crisis in plans titled "Giving land to people to build villas and houses from one to three stories" or "Giving government land to people in the form of a self-ownership plan" lead to the pressure of the current governments. Water will be transferred to the next governments to implement new projects (Mesgaran and Azadi, 2018).

### 3.5. *Land subsidence*

It is estimated that about 66% of the country's plains are subject to the phenomenon of subsidence (about 12 million hectares), which mainly occurs due to the extraction of underground water tables. The average volume of natural renewable water resources is 110 billion cubic meters, and the amount of exploitable renewable water resources is estimated at about 70 billion m<sup>3</sup>. The cumulative deficit of underground aquifers has reached 130 billion m<sup>3</sup>, and according to the statistics of the Ministry of Energy, the amount of renewable water in the country has increased from 140 billion m<sup>3</sup> to 105 billion m<sup>3</sup>. In the past years, 74 billion m<sup>3</sup> more than the capacity have been removed from underground water tables and this process continues.



### 3.6. *Loss of wildlife species*

The number of ungulates (cattle, goat, ram, sheep, deer, antelope, deer, zebra, shoka, etc.) has decreased by 90% compared to the time of the establishment of the Environmental Organization. The environment is an ecosystem, if one of its components is removed, all the cycles that depend on it will be destroyed. National protection started more than 50 years ago in Iran and today nearly 10% of the country is protected and remains. About 100 species of vertebrates are vulnerable or endangered.

### 3.7. *Air pollution*

In recent years, the number of days that Tehran and big cities have enjoyed clean and healthy air quality can be counted on the fingers of one hand. The drying of wetlands has been associated with the production of dust and industrial activities, with the increase of particles and dangerous gases in the air, as well as the increase of transportation with the increase of pollutants in the air, especially in cities. The industrial pollution of cities, which is mostly caused by hydrocarbon fuels of cars, makes it difficult to breathe in cities, especially in the second half of the year with the inversion of the air (Abrishamchi, 2013).

### 3.8. *Clean and renewable energies*

Iran's renewable energy market is mainly driven by hydropower projects under construction, which are estimated to add nearly 1,650 megawatts to the country's total capacity by 2030. In addition to water, Iran is planning to expand its solar capacity to increase the share of renewable energy in its energy mix from about 1 percent in 2018 to 16 percent by 2030. Iran has the ability to produce 4.5 to 5.5 kilowatt-hours per square meter per day of solar energy. Based on Iran's solar energy capability - with an average of 280 sunny days per year - there is a wide opportunity to expand renewable energy in the coming years.

### 3.9. *Unsustainable development and exploitation of water resources*

The Gotvand dam was located about 5 km downstream of a large mass of Gachsaran salt. The Gachsaran Formation is outcropped in the Chamshir dam reservoir of Khuzestan with layers of marl, gypsum and anhydrite and between marl layers. The priority of building a dam, for controlling and managing water and electricity production, in Khuzestan and its surrounding region and its consequences, if not considered in a strategic plan for sustainable development, the construction of projects such as Gotvand and Chamshir dams, which will overcome the numerous environmental challenges of the region. They added, it will continue. Indiscriminate dam construction in Iran is one of the most important causes of drying up of wetlands and rivers in the country. The wetlands of Urmia, Bakhtegan, and Gavkhoni are disturbed and in a critical condition, and the reason for such a situation is that their rights are not provided. 104 dams were defined for the catchment area of Lake Urmia, of which 56 dams are in operation and the required water level of the lake is stored behind these dams. These dams were built without much foresight and many wells were dug

around Urmia Lake, when it was very noticeable that these works would dry up the lake (Grobicki *et al.*, 2022).

### *3.10. Industrial development within the boundaries of wetlands*

The local authorities had given permission to build a petrochemical facility in the Miankaleh lagoon, which of course was and still is very polluting. After strong protests from environmentalists, the government opposed the project in early 2022, and the judiciary ordered a halt to construction. Since the beginning of July 2023, the construction of Miankaleh Petrochemical has been resumed. The construction of the petrochemical plant in the Miankaleh peninsula was the subject of serious doubts. It was caused structural-functional changes in the residential habitats of Miankaleh by the destructing of villages, dependency to natural areas, changes in agricultural patterns, destruction of the Miankaleh area and Gorgan Gulf, and death of plant and animal life due to petrochemical pollution. Formation and increase of industrial wastewater, water and soil pollution, instability in existing areas, and finally, the removal of Miankaleh from international conventions due to petrochemical development, and the loss of its environmental characteristics as a global biosphere reserve (Riahi *et al.*, 2022).

## **4. Seventh development and environment program**

Pollution control and environmental protection programs should be integrated with the country's development programs to ensure that environmental activities are considered part of national development. Iran's construction and development programs show that in encouraging and preserving the environment, the role of the government before and after the Islamic revolution, instead of promoting competition, efficiency and protection through the market mechanism, was mainly directive and direct supervision. In the sixth development plan of the country (2016-2020 with a one-year extension), the priorities were more focused on development with respect to the environment than the previous plans. In that program, the government was required to carry out four basic axes in the field of environment. Reducing the emission of environmental pollutants, preventing the destruction and pollution of the environment, preserving and restoring biodiversity, and finally environmental governance in that program to reduce pollutants for 4 goals: development of low carbon economy, development of green technology, improvement of water quality and Air and greenhouse gas control. These programs have not been implemented and there was no guarantee of implementation (Dehghani *et al.*, 2022). On the other hand, in the Seventh Development Plan Bill, which was submitted to the parliament in June 2022 for approval by the government, environmental issues have been slightly emphasized in the third chapter. It should be remembered that the previous approvals of the Expediency Recognition Assembly in the Infrastructure and Production Commission of the Assembly were based on issues that were not considered in the final version of the 7<sup>th</sup> Development Plan, which is a cause for concern.

## Conclusion

Addressing the water crisis in the Middle East requires a multifaceted approach involving efficient water management, investment in desalination technologies, promoting water conservation practices, regional cooperation on water sharing agreements, and sustainable agricultural practices to ensure long-term water security in the region.

This study can be presented as a solution to pay attention to environmental issues in the country's programs, which include: Improving environmental performance indicators, annual reduction of air pollution in metropolises and managing the effects and the effects of climate change using national, regional and international capacities. Maximum increase in crude oil and natural gas production with domestic and foreign investment and participation in the exploration and production of joint reservoirs and fields and Increase in protected oil and gas production capacity in non-joint reservoirs with emphasis on continuous improvement of the recycling rate with domestic and foreign investment. Paying attention to environmental challenges (water, soil, air, energy, production and consumption pattern, agricultural pattern) in the Seventh development and environment program is of special importance.

Furthermore, it is necessary to strengthen the necessary education in schools and universities regarding the environment and to promote the culture of paying more attention to the environment. It is necessary to strengthen non-governmental associations for the growth and strengthening of the environmental culture and to help the growth of the culture of correct use of the environment. In many countries, people stand in front of projects that destroy the environment. It is necessary to strengthen the necessary education in schools and universities regarding the environment and to promote more attention to the environment.

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