



Study of Thar desert expanding fast with land degradation: A Review

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ABSTRACT:

Impact of extensive desertification in northwest India, Himalayan glaciers depletion and tropical deforestation over Indian subcontinent and Southeast Asia, on Indian monsoon circulations, precipitation, surface fluxes is being studied. In this research paper, by changing vegetation types, the model impact of desertification and deforestation on Indian monsoons is investigated. By performing these sensitivity experiments (extended desertification, and tropical deforestation) it is found that over India, monsoon precipitation is significantly decreased at local and large scales. Decreased surface roughness length and increase in albedo because of desertification/deforestation in the model results in origination of anomalous westerly winds and subsidence, decreasing turbulent flow, decreasing rainfall over land and strengthening over the seas and consequently increases the temperature over land. Further, the hydrological and atmospheric water cycle gets weak because precipitation decreases. Thus any form of deforestation and desertification happening over tropical regions has a severe impact on Indian summer monsoon atmospheric circulations and precipitation.

Introduction

Thar Desert

- The Thar Desert, also called the **Great Indian Desert**, arid region of rolling sandhills on the Indian subcontinent. It is located partly in Rajasthan state, northwestern India, and partly in Punjab and Sindh (Sind) provinces, eastern Pakistan.
- It is **the world's ninth-largest hot subtropical desert**.

About study

- The study was undertaken as part of an assessment of the environmentally sensitive areas within the framework of the **UN Convention to Combat Desertification (UNCCD)**.
 - The scientists associated with the project studied the climate and vegetation in **Thar** to understand the desertification process.

Key Findings

- **Focused Areas:** It focused on Barmer, Jaisalmer, Bikaner and Jodhpur districts covering more than **50% of the Thar desert**.
 - It found that Jodhpur had witnessed a **slow speed of desertification**.
 - It also found that the **vegetation cover and water bodies had increased** in the area in the last 46 years and the complex sand region had decreased by 4.98%.
- **Expansion of Thar desert:** Along with the gradual **destruction of the Aravalli ranges**, the Thar desert is expanding **fast because of the migration of people, changes in the rainfall pattern, spread of sand dunes and unscientific plantation drives**.
- **Impacts:** The degradation of land is posing a **threat to the desert ecology**, while climate change has contributed to the **spread of arid regions**.
 - The loss of Aravali hills because of unchecked mining activities would result in the sandstorms travelling to NCR and Delhi.
 - The suspended particles from the arid region are contributing to air pollution in NCR.
- **Suggestions:** new plans should be evolved for the conservation of the Aravali ranges to stop the desertification towards eastern parts of the State.

What is Land degradation?

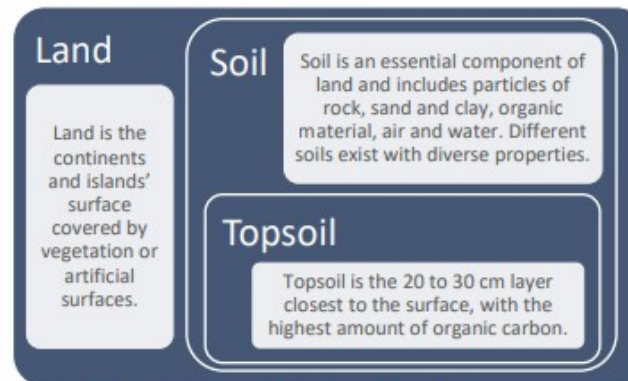
- Land degradation is temporary or permanent degeneration of productivity of land due to physical, chemical or biological factors.

- Land degradation is caused by multiple forces, including extreme weather conditions, particularly drought.
- It is also caused by human activities that pollute or degrade the quality of soils and land utility.
- **Present status of India's Land Degradation:**
 - Some 97.85 million hectares (MHA) of **India's total geographical area** (TGA) of 328.72 MHA underwent land degradation during 2018-19.
 - Land degradation within dryland regions (arid, semi-arid and dry sub-humid regions) is termed 'desertification'.
 - **State Wise breakup:**
 - Around **23.79 per cent of the area undergoing** desertification/land degradation with respect to TGA of the country was contributed by Rajasthan, Maharashtra, Gujarat, Karnataka, Ladakh, Jharkhand, Odisha, Madhya Pradesh and Telangana.
 - However, land degradation and desertification were declining in Uttar Pradesh, **Rajasthan and Telangana in 2018-2019.**

Reasons for Land Degradation

- **Loss of Fertility by Mismanagement:** Due to the use of various scientific inputs like irrigation, fertilisers, pesticides etc. Unscientific cropping practices are also causing harm.
 - This results in problems like soil erosion, loss of natural nutrients, water-logging and salinity and contamination of ground and surface water.
- **Soil Erosion:** This is the process by which the topsoil is detached from land and either washed away by water, ice or sea waves or blown away by the wind.

Figure 1: Land, soil and topsoil



Source: EPRS, based on [EEA](#) information, 2019.

- **Salinity/Alkalinity:** This problem occurs in areas of temporary water surplus and high temperatures due to over-irrigation or high rainfall.
 - The salt layer plays havoc with the fertility of topsoil and renders vast stretches of useful land infertile.
 - This problem is particularly serious in areas with assured irrigation in Punjab, Haryana, Uttar Pradesh, western Maharashtra, Bihar and northern Rajasthan (the Indira Gandhi Canal command area). Such lands are known by local names, such as **reh, kallar, usar, chopan** etc.
- **Waterlogging:** This happens when the water table gets saturated for various reasons—over-irrigation, seepage from canals, inadequate drainage etc. The land under waterlogged conditions can be used neither for agriculture nor for human settlements. This menace can be tackled by adopting scientific norms for the amount of irrigation, checking seepage from canals by proper lining and providing adequate drainage through field channels.
- **Floods and Droughts:** Both these hazards have the harmful effect of limiting the use of good soil.
- **Desertification:** It is also the end result of Land Degradation but it could also be the reason. The advancement of sand from the desert to the adjoining regions is called desertification.
 - The sand covers fertile soil and affects its fertility. This problem is particularly serious in areas adjoining the Thar desert in Rajasthan.

Implications

- Land degradation and desertification can affect human health through complex pathways.
 - As land is degraded and deserts expand in some places, food production is reduced, water sources dry up and populations are pressured to move to more hospitable areas.
 - It negatively affects food production, livelihoods, and the production and provision of other ecosystem goods and services.
 - **The potential impacts of desertification on health include:**
 - higher threats of malnutrition from reduced food and water supplies;
 - more water- and food-borne diseases that result from poor hygiene and a lack of clean water;
 - respiratory diseases caused by atmospheric dust from wind erosion and other air pollutants;
 - the spread of infectious diseases as populations migrate.

Efforts in this direction

At Global level:

- **United Nations Convention to Combat Desertification (UNCCD)**
 - Established in 1994, came into force in 1996.
 - It is the sole **legally binding international agreement linking environment and development to sustainable land management**.
 - It addresses specifically the arid, semi-arid and dry sub-humid areas, known as the **drylands**, where some of the most vulnerable ecosystems and peoples can be found.
 - The new **UNCCD 2018-2030 Strategic Framework** is the most comprehensive global commitment to **achieve Land Degradation Neutrality (LDN)** in order to restore the productivity of vast expanses of degraded land, improve the livelihoods of more than 1.3 billion people, and reduce the impacts of drought on vulnerable populations to build.
- **Bonn Challenge**
- It is a **global goal** to bring **150 million hectares of degraded and deforested landscapes into restoration** by 2020 and 350 million hectares by 2030.
- Launched by the **Government of Germany and IUCN** in 2011, the Challenge surpassed the 150-million-hectare milestone for pledges in 2017.
- Their work is aligned with the Sustainable Development Goals (SDGs), the **Aichi Biodiversity Targets**, the Land Degradation Neutrality (LDN) goal, and the **Paris Climate Change Agreement** – all together providing a roadmap for a sustainable planet.

India Scenario

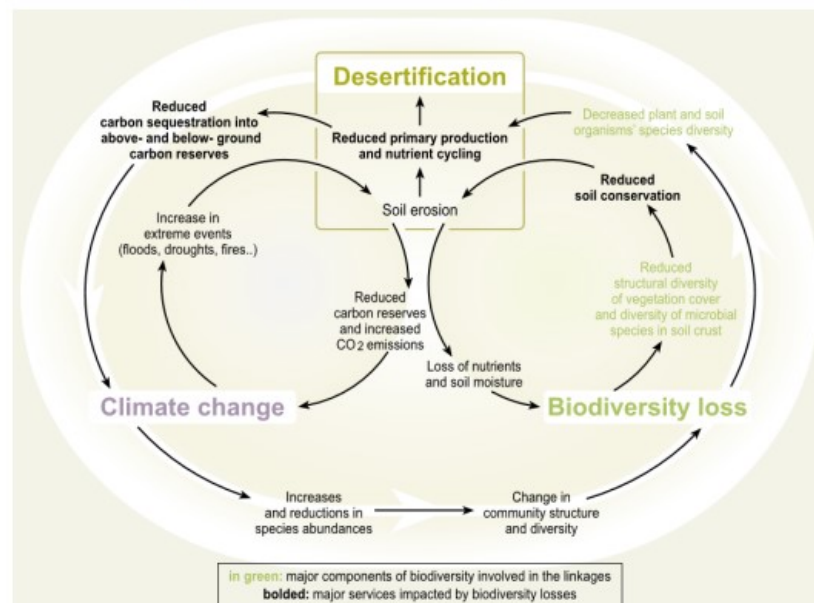
- **National level land degradation mapping:** It is taken up by ISRO along with partner institutions, under the **Natural Resources Census (NRC) mission of DOS/ISRO**, towards generating information on land degradation at 1:50,000 scale, using 23m resolution (multi-temporal & multi-spectral) IRS data.
 - The task involves the adaptation of uniform classification standards along with a common geospatial database framework for generating reliable land degradation information.
- **Signatory to the United Nations Convention on Combating Desertification (UNCCD)**
 - India is a signatory to the United Nations Convention on Combating Desertification (UNCCD).
 - The country is committed to combating desertification and land degradation and intends to achieve land degradation neutral status by 2030.
 - MoEF&CC is the nodal Ministry for the implementation of the UNCCD.
- At the **United Nations Framework Convention on Climate Change Conference of the Parties (COP) 2015** in Paris, **India joined the voluntary Bonn Challenge** and pledged to bring into restoration 13 million hectares of degraded and deforested land by 2020, and an additional 8 million hectares by 2030.
- The government sees schemes are formulated as tools to tackle the problem of land degradation namely
 - PradhanMantriFasalBimaYojana
 - Soil Health Card Scheme
 - PradhanMantriKrishiSynchayeeYojanaetc

What more needs to be done to Check Land Degradation?

- **Improved agricultural practices:** Better practices need to be adopted in different regions. Tillage on higher slopes should be avoided, while contour ploughing on the slopes prone to erosion may help in maintaining the soil depth.
- **Shelterbelts: Planting shelterbelts and stubble mulching** help in conserving the soils in desert regions.
- **Avoid overgrazing:** The pressure of livestock on pastures in hilly, desert and plateau regions has to be reduced in order to avoid overgrazing, such as in Jammu and Kashmir, Himachal Pradesh, Rajasthan and Karnataka.
- **Prevent Ravines:** The ravines and gullies should be plugged to prevent head-ward erosion.
- **Land Degradation Neutrality:** A state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems.
- Regular updates and information on degraded land is essential for the Government to plan necessary measures to tackle degradation processes and to plan for reclamation programmes.
- ‘Sandstorms may travel to NCR in coming years’ Along with the gradual destruction of the Aravali ranges, the mighty Thar desert in western Rajasthan is expanding fast because of migration of people, changes in the rainfall pattern, spread of sand dunes and unscientific plantation drives. The degradation of land is posing a threat to the desert ecology, while the climate change has contributed to the spread of arid region. With these findings, a study on desertification of Thar region conducted by the Central University of Rajasthan has predicted that the sandstorms from the desert will travel as far as the National Capital Region (NCR) in the years to come. The sandstorms will become intense with the erosion of Aravali hills, which act as a ‘natural green wall’ between the desert and the plains. The study was undertaken as part of an assessment of the environmentally sensitive areas within the framework of the UN Convention to Combat Desertification (UNCCD). The scientists associated with the project studied the climate and vegetation in Thar, which is the world’s ninth largest hot subtropical desert, to understand the desertification process.

Desertification: Causes, Effects & Solutions

Figure 2: Linkages and loop interrelations among desertification, climate change and loss of biodiversity



1. Deforestation
2. Farming
3. Excessive use of fertilizers and pesticides
4. Animal grazing
5. Global warming
6. Overpopulation
7. Changes in land use
8. Mining
9. Excessive consumption
10. Waste production and disposal

11. Soil pollution
12. Acid rain
13. Natural causes
Deforestation

One significant cause of desertification can be deforestation.

By cutting or burning down forests, the area that has previously been planted with trees can now be used for farming or other purposes.

However, if this area is not used for other purposes for some reason, chances are that this area turns into arid land.

Moreover, even if this area will be used for farming purposes, it may become desert-like in the long run since our nowadays farming practices are often not sustainable and can be quite harmful to the soil.

Farming

Since in our nowadays world, farming practices are fully optimized for the highest possible yields, this also often implies significant damage to the soil. In many areas, farmers only plant certain kinds of plants for many years, which leads to an extraction of plenty of precious resources and minerals out of the ground.

Sooner or later, due to the excessive farming of only of few plant species, the soil will no longer be suitable for farming since too many minerals have been used and the land has become arid.

Excessive use of fertilizers and pesticides

Moreover, many farmers use excessive amounts of fertilizers and pesticides in order to maximize their crop yields in the short term.

However, in the long run, this often leads to significant damages for the soil, which may turn from arable into arid land over time.

In turn, this often also implies that the former arable land will be no longer suitable for farming purposes after a few years of excessive farming since the soil has been damaged too much over time.

Animal grazing

Grazing can be regarded as natural behavior of many animals like cows or sheep.

However, excessive numbers of animals like in factory farming may lead to excessive levels of grazing, which in turn may lead to the desertification of the grazing areas since plants have no chance to recover in population and may also eventually die off due to excessive manure from those animals.

Therefore, also the excessive cultivation of cattle can lead to significant problems with desertification in the long run.

Global warming

Due to an increase in air temperature due to global warming, water will become a scarce resource in many parts of our planet.

Especially in the Southern hemisphere, water shortages will be a big issue.

Many farmers who currently already struggle to find enough water for farming purposes will suffer even more in the future.

This in turn implies that large areas of land that have been used for farming in the past will become arid and will no longer be suitable for farming anymore due to a lack of water.

This in turn will lead many people to leave the affected areas and the soil in those areas will suffer from significant desertification.

Overpopulation

Another contributor to desertification is overpopulation.

Since our world population is continuously growing, the demand for material goods is also increasing at an alarming rate.

Also, our global demand for food is increasing.

In turn, this implies that we have to optimize our farming processes even further in order to harvest even higher crop yields.

However, this excessive optimization of farming will hurt the soil and will eventually turn into the desertification of land in the long run.

Changes in land use

While in previous times, we had plenty of untouched natural areas on our planet, this changed dramatically over time.

In our current age, large areas of forests have to be cut down or burned in order to get more space for farming to produce enough food for our growing world population.

This change in land use also implies a higher chance for the desertification of certain areas since nature is often not able to sufficiently recover from human intervention.

Mining

Another big reason for desertification is mining.

For mining, large areas of land have to be used.

In turn, this also often implies significant deforestation.

Mining also often implies the pollution of nearby areas.

In turn, once most of the natural resources have been extracted and mining is no longer profitable in the respective area, chances are that this area will suffer from significant levels of desertification since our mining practices may have hurt the soil too much and may not be able to recover.

Excessive consumption

Our overall level of consumption is increasing at a steady rate.

This is due to a growing world population, but also due to the fact that everyone of us always wants to have the newest and hippest stuff, which leads to excessive consumption levels.

However, in order to meet the demand for material goods, large amounts of resources have to be processed by industries.

In order to extract those resources, we have to mine large areas of land, which may turn into arid land once those mining processes have been finished.

Waste production and disposal

Excessive consumption behavior also implies the production of large amounts of waste.

However, in order to get rid of this waste, it has either to be burned or disposed into landfills.

Burning waste implies the emission of harmful gases into our atmosphere, which may contribute to global warming and also imply the formation of acid rain.

The disposal of waste into landfills may lead to serious soil pollution.

All this may hurt the soil in the long run to an extent where the former arable land will now turn into arid land due to soil pollution and a significant change in the acidity level of the soil, which may lead to the extinction of many plant species.

Soil pollution

Soil pollution in general can be regarded as significant cause for desertification.

Many plants are quite sensitive to their natural living conditions.

If the soil becomes polluted due to various man-made reasons, chances are that the respective area of land may suffer from significant desertification in the long run.

The higher the level of pollution, the more the soil will suffer over time.

Acid rain

In our current age, acid rain has become a significant environmental issue.

Although not considered to be a big problem by the general public, acid rain can alter the natural conditions of many plants and may lead to a serious decrease in crop yields over time.

In the long run, acid rain can also contribute to desertification, since if the alteration of the acidity level of the soil is sufficiently high, many plants may no longer be able to grow properly and may eventually even die off.

Natural causes

Apart from man-made issues, desertification can also be caused by natural phenomena.

For instance, natural disasters may also contribute to desertification of the affected areas of land.

For instance, through the eruption of a volcano, the magma may destroy many trees and plants.

This may lead to the desertification of land in the short term.

However, in the long term, it is likely that those areas of land will recover in a natural manner.

Effects of Desertification

1. Decrease in crop yields
2. Poverty
3. Hunger
4. Starvation
5. Weak immune system
6. Destruction of habitats

7. Biodiversity loss
8. Endangerment and extinction of species
9. Floods
10. Water pollution
11. Global warming
12. Migration

Decrease in crop yields

A major effect of desertification is the decrease in crop yields.

Once land turns from arable to arid, it is often no longer suitable for farming purposes anymore.

In turn, many farmers may lose their livelihood, since they often solely rely on farming as their single source of income.

If their land becomes arid, they may no longer be able to provide sufficient crop yields to make a living out of it.

Poverty

Desertification may also lead to serious levels of poverty.

For instance, in many poor areas, people are dependent on the crop yields of farmers in order to be able to ensure their food supply.

However, if crop yields drop significantly due to desertification issues, many people may lose their livelihood and may be trapped in poverty.

Moreover, many people are also employed by farmers.

If these people lose their jobs due to desertification, the poverty issue may even be exacerbated.

Hunger

Poverty caused by desertification may also lead to serious levels of hunger.

If the local population is no longer able to buy vegetables or fruits from farmers due to insufficient crop yield, chances are that many people in poor regions may not be able to get enough food.

This is especially true for quite remote regions that solely rely on agriculture as their food source.

Starvation

In extreme cases, poverty and hunger may also turn into starvation.

Many people may die from the direct and indirect consequences of desertification.

Especially in areas that have been poor for a quite long time, people in those areas often do not have any savings and may no longer be able to get enough food due to the desertification issue, which may take the life of a high number of people.

Weak immune system

Hunger caused by desertification may also lead to a weak immune system for people living in affected areas on our planet.

Our body only works properly if it is supplied by sufficient vitamins, minerals and energy.

If this is not the case due to insufficient food supply, chances are that our body is more vulnerable to diseases.

In turn, even rather harmless diseases may take the life of many people since their immune system has become quite weak over time and the body may simply be no longer able to defend against the bacteria.

Destruction of habitats

Desertification may also lead to a loss of habitats for many animals and plants.

Since the local flora and fauna is often quite sensitive to changes in their natural living conditions, desertification may alter their living conditions in a way that makes it impossible for animals and plants to sustain their populations.

For instance, if some regions suffer from water shortages due to climate change, animals in those regions may suffer from the resulting desertification and may also die since water is vital for all life on our planet.

Biodiversity loss

In general, the destruction of habitats and the desertification may also contribute to a loss of biodiversity.

While some species may be able to adjust to the altered environmental conditions properly, many species will not be able to do so and may suffer from serious declines in population.

Endangerment and extinction of species

If the decline in population is severe enough, species may become endangered or even extinct.

This problem is especially severe for species that are already endangered.

Due to desertification, the small number of remaining animals or plants may also die off over time, which may even lead to the extinction of species due to desertification.

Floods

Desertification may not only lead to droughts and the resulting adverse consequences, it may also contribute to floods.

Since areas that suffer from desertification usually do not have any trees or other bigger plants in place anymore, these areas are more vulnerable to floods and erosion since there is no vegetation which could hold the soil together.

Water pollution

Since an intact soil and plants filter our water, the absence of those factors due to desertification may lead to serious water pollution.

This can be a serious issue, since in many areas worldwide, people rely on clean groundwater for showering and cooking purposes.

Global warming

Since desertification often implies that trees and other plants die off, it also indirectly contributes to global warming.

Since trees are a natural storage space for greenhouse gases like carbon dioxide, if these trees die off, large amounts of greenhouse gases that had been stored in those trees are now emitted into our atmosphere, which accelerates global warming and the dramatic adverse effects.

Migration

Since desertification implies the destruction of the livelihood of many farmers, it also contributes to serious migration movements.

This problem will become even worse since due to global warming, large areas of land that are currently used for farming will then no longer be suitable for farming due to a lack of water.

Solutions for Desertification

1. Stricter regulations regarding farming practices
2. Reduction in fertilizer and pesticides
3. Reforestation
4. Population control
5. Technological advancements
6. Confinement of mining practices
7. Avoidance of pollution
8. Adjustments in consumption
9. Avoid waste production
10. Education
11. Convince others

Stricter regulations regarding farming practices

In order to fight desertification, it is crucial that there are quite strict regulations in place that limit the use of manure.

Moreover, farmers should be forced to switch the sort of plants once in a while so that the soil is able to recover.

By introducing those measures, farming will become much more sustainable since the soil is protected from excessive use and contamination, which will prevent desertification in many cases.

Reduction in fertilizer and pesticides

In general, farmers should reduce their use of fertilizer and pesticides.

In the past decades, there has been a development towards the excessive use of fertilizers and pesticides in farming in order to maximize crop yields.

However, since those chemical substances often hurt the soil and turn the land from arable to arid, there should be a reduction in the use of pesticides and fertilizers in order to prevent desertification and several other environmental issues.

Reforestation

In areas that have been subject to deforestation in the past, it should be considered to plant trees in those areas instead of using those areas for other purposes which may turn them into arid land in the long run.

Our forests are quite important since they contribute to a natural balance and provide a habitat for many animals and plants.

Moreover, they are considered to slow down global warming since trees are natural carbon dioxide storage spaces.

Therefore, it might make sense to fight deforestation and plant trees in the affected areas, not only to prevent desertification but also to fight additional environmental issues.

Population control

Since overpopulation indirectly contributes to desertification through excessive pollution and a contribution to global warming, population control measures should be taken in order to mitigate this issue.

For instance, this could mean setting restrictions for the number of children a family is allowed to have.

By doing so, we could reduce the number of people on our planet in a natural manner, which would fight important environmental problems, including resource depletion and also the desertification issue.

Technological advancements

Research is key to overcome most of our environmental problems.

This is also true for the desertification issue to a certain extent.

By using latest research findings, we will be able to improve our knowledge regarding the drivers of desertification and can take appropriate and effective measures on an individual basis.

Confinement of mining practices

Since mining often implies the destruction of large areas of land, mining practices should be confined by governments so that our nature reserves stay intact and the natural habitats of many animals and plants can be protected.

By doing so, less land will be arid after mining practices have been finished and the desertification issue can be mitigated to a certain extent due to a reduction in mining actions.

Avoidance of pollution

Since pollution of many sorts can directly and indirectly hurt the soil, it can significantly contribute to the desertification issue.

Therefore, it is crucial that we reduce pollution on a global scale, not only to reduce the desertification problem but also to fight several other environmental problems our planet currently faces.

Adjustments in consumption

Our consumption behavior is a main problem for the sustainability of our environmental system.

It also contributes to desertification since excessive consumption contributes to the emission of greenhouse gases, which in turn contributes to global warming.

Global warming exacerbates the desertification issue since it will lead to water scarcity in many regions on the Southern hemisphere, which will make it impossible for farmers to continue their farming practices.

Therefore, it is crucial to adjust our consumption to a more sustainable level in order to fight desertification.

Avoid waste production

Similar to the consumption issue, we should also try to avoid waste on a daily basis, since it indirectly contributes to the desertification problem.

This means that you should not buy products that are excessively packaged.

Instead, try to buy from local organic food stores and bring your own bag.

There are several other ways how you can reduce waste in your daily life, just think about the consequences for our planet when it comes to buying decisions of several sorts.

Education

Education is quite important to fight our environmental issues.

Children should be taught from an early age on how our daily behavior affects our planet and how everyone of us can reduce the desertification issue.

By educating these children, they are more likely to behave in an eco-friendly manner.

Moreover, once they turn into grownups, they are also more likely to behave in a greener way.

Convince others

If you want to multiply your positive impact on our environment, you should also try to convince others about our environmental problems and solutions by showing your family and friends easy measures how we can all improve our ecological footprint.

CONCLUSION:

Desertification is a significant environmental problem, which will likely become worse in the future due to global warming.

In order to mitigate the adverse effects of desertification, governments all over the world have to set strict regulations.

Moreover, industries and also everyone of us can make a positive contribution to fight desertification and to ensure a livable future for billions of people on our planet.

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