

Impact and causes of Desertification

Jean-Sebasten Ward

Environmental and Earth science Gateway, McMaster University, Ontario Canada.

ANSTRACT

This article studies the impact and causes of desertification. Desertification is a type of land degradation in drylands in which biological productivity is lost due to natural processes or induced by human activities whereby fertile areas become increasingly more arid. It is the spread of arid areas caused by a variety of factors, such as through climate change (particularly the current global warming) and through the overexploitation of soil through human activity. In drylands, more people depend on ecosystem services for their basic needs than in any other ecosystem. Indeed, many of their resources, such as crops, livestock, fuelwood, and construction materials, depend on the growth of plants, which in turn depends on water availability and climate conditions. The effect of global climate change on desertification is complex and not yet sufficiently understood. On the one hand, higher temperatures resulting from increased carbon dioxide (CO₂) levels can have a negative impact through increased loss of water from soil and reduced rainfall in drylands. The struggle against desertification can occur at several levels. Since regional variations in climate are the main causes of the loss of dryland productivity, it is important to understand the influence of global warming in specific dryland regions. According to some models of climate change, many grasslands in western North America, for example, are predicted to be at greater risk of drought due to projected increases in summer temperatures and changes to existing rainfall patterns. Desertification poses one of the greatest environmental challenges today and constitutes a major barrier to meeting basic human needs in drylands. Desertification is land degradation that affects biological productivity as well as the livelihoods of millions of people.

Keyword: Impact, causes, desertification.

INTRODUCTION

Desertification is defined as a process of land degradation in arid, semi-arid and sub-humid areas due to various factors including climatic variations and human activities. Or, to put it in another way, desertification results in persistent degradation of dryland and fragile ecosystems due to man-made activities and variations in climate [1] [2]. Desertification, in short, is when land that was originally of another type of biome turns into a desert biome because of changes of all sorts. A huge issue that many countries have is the fact that there are large pockets of land that are going through a process that is known as desertification.

Overgrazing is the major cause of desertification worldwide [3]. Other

factors that cause desertification include urbanization, climate change, overdrafting of groundwater, deforestation, natural disasters and tillage practices in agriculture that place soils more vulnerable to wind. Desertification affects topsoil, groundwater reserves, surface runoff, human, animal and plant populations. Water scarcity in drylands limits the production of wood, crops, forage and other services that ecosystems provide to our community

Desertification is a type of land degradation in drylands in which biological productivity is lost due to natural processes or induced by human activities whereby fertile areas become increasingly more arid. It is the spread of

arid areas caused by a variety of factors, such as through climate change (particularly the current global warming) and through the overexploitation of soil through human activity [4].

When deserts appear automatically over the natural course of a planet's life cycle, then it can be called a natural phenomenon; however, when deserts emerge due to the rampant and unchecked depletion of nutrients in soil that are essential for it to remain arable, then a virtual "soil death" can be spoken of, which traces its cause back to human overexploitation. Desertification is a significant global ecological and environmental problem with far reaching consequences on socio-economic and political conditions [5].

Desertification the process by which natural or human causes reduce the biological productivity of drylands. Declines in productivity may be the result of climate change, deforestation, overgrazing, poverty, political instability, unsustainable irrigation practices, or combinations of these factors. The concept does not refer to the physical expansion of existing deserts but rather to the various processes that threaten all dryland ecosystems, including deserts as well as grasslands and scrublands [6] [7].

Impact of Desertification on human well-being

In drylands, more people depend on ecosystem services for their basic needs than in any other ecosystem. Indeed, many of their resources, such as crops, livestock, fuelwood, and construction materials, depend on the growth of plants, which in turn depends on water availability and climate conditions [8] [9] [10]. Fluctuations in the services supplied by ecosystems are normal, especially in drylands, where water supply is irregular and scarce. However, when a dryland ecosystem is no longer capable to recover from previous pressures, a downward spiral of desertification may follow, though it is not inevitable.

Desertification affects a wide range of services provided by ecosystems to humans: products such as food and water, natural processes such as climate

regulation, but also non-material services such as recreation, and supporting services such as soil conservation. Changes can be quantified and methods are available to prevent, reduce, or reverse them.

When faced with desertification, people often respond by making use of land that is even less productive, transforming pieces of rangeland into cultivated land, or moving towards cities or even to other countries. This can lead to unsustainable agricultural practices, further land degradation, exacerbated urban sprawl, and socio-political problems [11].

Causes of Desertification

- **Overgrazing:** Animal grazing is a huge problem for many areas that are starting to become desert biomes. If there are too many animals that are overgrazing in certain spots, it makes it difficult for the plants to grow back, which hurts the biome and makes it lose its former green glory.
- **Deforestation:** When people are looking to move into an area, or they need trees in order to make houses and do other tasks, then they are contributing to the problems related to desertification. Without the plants (especially the trees) around, the rest of the biome cannot thrive.
- **Farming Practices:** Some farmers do not know how to use the land effectively. They may essentially strip the land of everything that it has before moving on to another plot of land. By stripping the soil of its nutrients, desertification becomes more and more of a reality for the area that is being used for farming.
- **Urbanization and other types of land development.** As mentioned above, development can cause people to go through and kill the plant life [12]. It can also cause issues with the soil due to chemicals and other things that may harm the ground. As areas become more urbanized, there are

less places for plants to grow, thus causing desertification.

- **Climate Change:** Climate change plays a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent. Unless climate change is slowed down, huge areas of land will become desert; some of those areas may even become uninhabitable as time goes on [13].
- **Stripping the land of resources.** If an area of land has natural resources like natural gas, oil, or minerals, people will come in and mine it or take it out. This usually strips the soil of nutrients, which in turn kills the plant life, which in turn starts the process toward becoming a desert biome as time goes on [14].
- **Natural Disasters:** There are some cases where the land gets damaged because of natural disasters, including drought. In those cases, there isn't a lot that people can do except work to try and help rehabilitate the land after it has already been damaged by nature.

Effects of Desertification

- Farming becomes next to impossible. If an area becomes a desert, then it's almost impossible to grow substantial crops there without special technologies. This can cost a lot of money to try and do, so many farmers will have to sell their land and leave the desert areas.
- **Hunger:** Without farms in these areas, the food that those farms produce will become much scarcer, and the people who live in those local areas will be a lot more likely to try and deal with hunger problems. Animals will also go hungry, which will cause even more of a food shortage.
- **Flooding:** Without the plant life in an area, flooding is a lot more eminent. Not all deserts are dry; those that are wet could

Ward

experience a lot of flooding because there is nothing to stop the water from gathering and going all over the place [15]. Flooding can also negatively affect the water supply, which we will discuss next.

- **Poor Water Quality:** If an area becomes a desert, the water quality is going to become a lot worse than it would have been otherwise. This is because the plant life plays a significant role in keeping the water clean and clear; without its presence, it becomes a lot more difficult for you to be able to do that.
- **Overpopulation:** When areas start to become desert, animals and people will go to other areas where they can actually thrive. This causes crowding and overpopulation, which will, in the long run, end up continuing the cycle of desertification that started this whole thing anyway [16].
- **Poverty:** All of the issues that we've talked about above (related to the problem of desertification) can lead to poverty if it is not kept in check. Without food and water, it becomes harder for people to thrive, and they take a lot of time to try and get the things that they need.

Link between desertification, global climate change, and biodiversity loss

Desertification diminishes biological diversity, a diversity which contributes to many of the services provided to humans by dryland ecosystems. Vegetation and its diversity are key for soil conservation and for the regulation of surface water and local climate. Desertification also contributes to global climate change by releasing to the atmosphere carbon stored in dryland vegetation and soils [17].

The effect of global climate change on desertification is complex and not yet sufficiently understood. On the one hand, higher temperatures resulting from increased carbon dioxide (CO₂) levels can have a negative impact through increased loss of water from soil and

reduced rainfall in drylands. On the other hand, for certain species, an increase in carbon dioxide in the atmosphere can boost plant growth [18].

Environmental management approaches for combating desertification, conserving biodiversity, and mitigating climate change are linked in many ways, thus a joint implementation of the U.N. Conventions to Combat Desertification, on Biological Diversity, and on Climate Change can yield multiple benefits

Solutions to Desertification

The struggle against desertification can occur at several levels. Since regional variations in climate are the main causes of the loss of dryland productivity, it is important to understand the influence of global warming in specific dryland regions. According to some models of climate change, many grasslands in western North America, for example, are predicted to be at greater risk of drought due to projected increases in summer temperatures and changes to existing rainfall patterns [19] [20]. Many authorities argue that since desertification and global warming are so closely related, one of the main solutions to the former may be the implementation of effective economic policies (such as carbon trading) and technical measures (such as carbon sequestration) that reduce the production of greenhouse gases.

At local scales, however, desertification is often the result of unsustainable land and soil management. To maintain the biological productivity of the land, soil conservation is often the priority [21]. A number of innovative solutions have been devised that range from relatively simple changes in how people grow crops to labour-intensive landscape engineering projects. Some of the techniques that may help ameliorate the consequences of desertification in irrigated croplands, rain-fed croplands, grazing lands, and dry woodlands include:

1. Salt traps, which involve the creation of so-called void layers of gravel and sand at certain depths in the soil. Salt traps prevent salts

from reaching the surface of the soil and also help to inhibit water loss.

2. Irrigation improvements, which can inhibit water loss from evaporation and prevent salt accumulation [22]. This technique involves changes in the design of irrigation systems to prevent water from pooling or evaporating easily from the soil.
3. Cover crops, which prevent soil erosion from wind and water. They can also reduce the local effects of drought. On larger scales, plant cover can help maintain normal rainfall patterns. Cover crops may be perennials or fast-growing annuals.
4. Crop rotation, which involves the alternation of different crops on the same plot of land over different growing seasons. This technique can help maintain the productivity of the soil by replenishing critical nutrients removed during harvesting.
5. Rotational grazing, which is the process of limiting the grazing pressure of livestock in a given area. Livestock are frequently moved to new grazing areas before they cause permanent damage to the plants and soil of any one area [23].
6. Terracing, which involves the creation of multiple levels of flat ground that appear as long steps cut into hillsides. The technique slows the pace of runoff, which reduces soil erosion and retards overall water loss.
7. Contour bunding (or contour bundling), which involves the placement of lines of stones along the natural rises of a landscape, and contour farming. These techniques help to capture and hold rainfall before it can become runoff. They also inhibit wind erosion by keeping the soil heavy and moist.
8. Windbreaks, which involve the establishment of lines of fast-

growing trees planted at right angles to the prevailing surface winds. They are primarily used to slow wind-driven soil erosion but may be used to inhibit the encroachment of sand dunes.

9. Dune stabilization, which involves the conservation of the plant community living along the sides of dunes. The upper parts of plants help protect the soil from surface winds, whereas the root

Ward
network below keeps the soil together.

10. Charcoal conversion improvements, which include the use of steel or mud kilns or high-pressure compacting equipment to press the wood and other plant residues into briquettes. Conversion improvements retain a greater fraction of the heating potential of fuel wood [24].

CONCLUSION

Desertification poses one of the greatest environmental challenges today and constitutes a major barrier to meeting basic human needs in drylands. Desertification is land degradation that affects biological productivity as well as the livelihoods of millions of people [25]. It is caused by a combination of human and natural factors that contribute to an unsustainable use of scarce natural resources. Some 10 to 20% of drylands are already degraded, and the ongoing desertification threatens the world's poorest populations. Various scenarios that explore the future of desertification and human well-being in drylands show that global desertified area is likely to

increase. Prevention is the most effective way to cope with desertification, because later attempts to rehabilitate desertified areas are costly and tend to deliver limited results [26]. Combating desertification yields multiple local and global benefits and helps fight biodiversity loss and global climate change. Efforts to reduce pressures on dryland ecosystems need to go hand in hand with efforts to reduce poverty as both are closely linked. Effectively fighting desertification will help reduce global poverty and will contribute to meeting the Millennium Development Goals [27].

REFERENCES

1. Abend, Lisa (2010). "How eating grass-fed beef could help fight climate change". *time.com*. Retrieved May 11, 2013.
2. Beiser, Vince (2017). "A tree grows in China: can a "Green Great Wall" stop sand from devouring the countryside?". *Mother Jones*. **83** (4).
3. Dougill, Andrew (2016). "Lake drying and livelihood dynamics in Lake Chad: Unravelling the mechanisms, contexts and responses". *Ambio*. 45.
4. Dregne, H.E. "Desertification of Arid Lands". Columbia University. Retrieved 3 December 2013.
5. Duval, Clay. "Bison Conservation: Saving an Ecologically and Culturally Keystone Species" (PDF). Duke University. Archived from the original (PDF) on March 8, 2012. Retrieved April 13, 2015.
6. Geeson, Nichola; et al. (2002). *Mediterranean desertification: a mosaic of processes and responses*. John Wiley & Sons. p. 58. ISBN 978-0-470-84448-9.
7. Geist (2005), p. 2
8. Gillet, Kit (2011). "A way of life in crisis: on the sparsely inhabited steppes of Mongolia, the lifestyle of the nomadic herder has always been a hard one.
9. Goudie, Andrew S. (2014). "Desert dust and human health disorders". *Environment International*. **63**: 101-113.
10. Hecke, Geoffrey Van (2012). *Humanum 3, le secret d'Épidaure: suivi de Amazone City*. Mon Petit Éditeur. p. 192. ISBN 978-2-7483-9214-2.
11. Helmut J. Geist, and Eric F. Lambin. "Dynamic Causal Patterns of

- Desertification." *BioScience* 54.9 (2004): 817.
12. K. Wright, David; Rull, Valenti; Roberts, Richard; Marchant, Rob; Gil-Romera, Graciela (2017). "Humans as Agents in the Termination of the African Humid Period". *Frontiers in Earth Science*. 5: 4.
 13. Klausmeier, Christopher (1999). "Regular and irregular patterns in semiarid vegetation". *Science*. 284 (5421): 1826-1828.
 14. Laduke, Winona (1999). *All Our Relations: Native Struggles for Land and Life*. Cambridge, MA: South End Press. p. 146. ISBN 978-0896085992. Retrieved 30 March 2015.
 15. LOWDERMILK, W C. "CONQUEST OF THE LAND THROUGH SEVEN THOUSAND YEARS" (PDF). Soil Conservation Service. United States Department of Agriculture. Retrieved 9 April 2014.
 16. Mainguet, Monique (2003). *Les pays secs: environnement et développement*. Ellipses.
 17. Mohamed, Dounia Ben (2015). "New Urgency in Battle to Halt Spread of Desertification". *New African*. 556 - via Gale Academic OneFile Select.
 18. Mortimore, Michael (1989). *Adapting to drought: farmers, famines, and desertification in West Africa*. Cambridge University Press. p. 12. ISBN 978-0-521-32312-3.
 19. Namdari, Soodabeh; Karimi, Neamat; Sorooshian, Armin; Mohammadi, GholamHasan; Sehatkashani, Saviz (2018).
 20. Onamuti, Olapeju Y.; Okogbue, Emmanuel C.; Orimoloye, Israel R. (2017). "Remote sensing appraisal of Lake Chad shrinkage connotes severe impacts on green economics and socio-economics of the catchment area". *Royal Society Open Science*. 4 (11): 171120.
 21. Rafferty, John P.; Pimm, Stuart L. (2019). "Desertification". *Encyclopædia Britannica*. Retrieved 2019-11-06.
 22. Riebeek, Holli (2007). "Defining Desertification: Feature Articles". earthobservatory.nasa.gov. Retrieved 2016-11-30.
 23. Stanelle, Tanja; Bey, Isabelle; Raddatz, Thomas; Reick, Christian; Tegen, Ina (2014). "Anthropogenically induced changes in twentieth century mineral dust burden and the associated impact on radiative forcing". *Journal of Geophysical Research: Atmospheres*. 119 (23): 13, 526-13, 546.
 24. Torres, Laura; Abraham, Elena M.; Rubio, Clara; Barbero-Sierra, Celia; Ruiz-Pérez, Manuel (2015). "Desertification Research in Argentina". *Land Degradation & Development*. 26 (5): 433-440.
 25. United States Geological Survey, "Desertification", 1997
 26. World Bank (2009). *Gender in agriculture sourcebook*. World Bank Publications. p. 454. ISBN 978-0-8213-7587-7.
 27. Zeng, Ning; Yoon, Jinho (2009). "Expansion of the world's deserts due to vegetation-albedo feedback under global warming". *Geophysical Research Letters*. 36 (17): L17401.