

Report.

Recommendations to the Mauritania and Senegal Governments to Better Cope with the Growing Influence of the Sahara Desert on their Climates.

By: Prof. EL OUALI AAILAL.

Professor at the National School of Business and Management of Dakhla (ENCG Dakhla).

Dakhla, Morocco.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
INTRODUCTION	3
RECOMMENDATIONS	4
CONCLUSION	10
REFERENCES	11

EXECUTIVE SUMMARY.

Mauritania and Senegal, two West African countries, are significantly affected by the adversity of climate change. They, like all the Sahara and Sahel countries, are seriously suffering from the impacts of climate change, primarily caused by human activities, particularly the emission of greenhouse gases such as carbon dioxide (CO₂). Since Mauritania is situated in the Great Sahara desert, and Senegal is a neighboring Sahelian country, they are highly vulnerable to its environment, which explains the intensity of the effects of climate change on these two countries.

This report aims to provide practical recommendations to the governments of Mauritania and Senegal to cope with the negative impacts of the Sahara desert on climate change in their countries.

INTRODUCTION.

The Sahara desert has a significant impact on the climate of neighboring regions. As the largest hot desert in the world, the Sahara plays a crucial role in shaping the climate patterns of North Africa and the Sahel. The dust and sand particles carried by wind from the Sahara can have global implications, contributing to the formation of atmospheric aerosols that affect cloud formation, precipitation patterns, and even influence global climate systems. The presence of the Sahara significantly affects the climate of neighboring regions, causing changes in rainfall patterns, wind systems, and contributing to the expansion of desert conditions. The impact extends beyond the immediate area and can have global implications through the transportation of dust particles.

Here are three main ways that the Sahara affects neighboring regions: Firstly, the expansion of the Sahara due to climate change has implications on Mauritania environment as a Sahara desert country. Rising temperatures and reduced rainfall in the Sahara contribute to desertification, leading to the encroachment of desert conditions into previously inhabitable areas. This expansion adversely affects ecosystems, water availability, and agriculture, impacting the livelihoods of communities in the neighboring regions. Secondly, the Sahara acts as a source of dry, hot air. The intense heating of the desert surface causes the air to rise, creating low-pressure systems that draw moist air from surrounding regions towards the desert. This can lead to the movement of the Inter-Tropical Convergence Zone (ITCZ), a region of heavy rainfall that affects the climate of the Senegal, which is mainly a tropical climate except the northern arid parts situated in the Sahel.

Finally, the Sahara Desert influences the formation of the Harmattan winds. These dry and dusty winds blow from the Sahara towards the Gulf of Guinea in West Africa. The presence of the Sahara Desert enhances the intensity of these winds, which can carry dust particles over long distances and have implications for air quality and health in downwind regions.

The Sahara desert environment has negative impacts on both Mauritania and Senegal. The country's arid landscape in Mauritania is already largely covered by the Sahara Desert, and climate change exacerbates desertification. This, in turn, leads to the expansion of desert areas and soil degradation, which threatens the livelihoods of many Mauritians who rely on agriculture and pastoralism. Additionally, drought and water scarcity are persistent problems in Mauritania, and climate change is expected to make these issues worse. Reduced rainfall and increased evaporation can lead to water scarcity, affecting agriculture, livestock, and human populations. Furthermore, changes in the ocean environment, such as perturbations in ocean water temperatures, negatively impact fishing activities in Mauritania. This affects the fisheries sector, which is a significant contributor to the country's economy.

Similarly, Senegal is also vulnerable to climate change. Drought and desertification are common issues in Senegal, as is the case in many parts of West Africa. Climate change exacerbates these issues, making it more difficult for farmers to grow crops and for communities to access clean water. Agriculture is a crucial sector in Senegal, and changes in temperature where the mean annual temperature has increased by 0.9°C since 1960, and the variability of the precipitation patterns can significantly affect crop yields. Irregular rainfall patterns and prolonged droughts can harm food security and livelihoods. Moreover, changes in the ocean environment, such as changes in ocean temperatures and currents, can affect the distribution and abundance of fish species, potentially impacting the livelihoods of fishermen and the country's revenue from fisheries, which is also a significant contributor to the country's economy.

RECOMMENDATIONS:

1. **Desertification control:** Desertification is the process by which fertile land turns into desert due to factors such as climate change, deforestation, overgrazing, and unsustainable land management practices. Reforestation and afforestation can help combat desertification by stabilizing soil, reducing erosion, and increasing biodiversity. It is recommended to use native species that are adapted to arid conditions for planting trees and restoring forests. In addition, techniques such as terracing, mulching, and soil stabilization can be employed to protect the soil from erosion and degradation. Controlled and sustainable grazing methods should be promoted to prevent overgrazing and land degradation. Useful approaches include rotational grazing and setting stocking rates. To prevent desertification and preserve the fragile ecosystems of both Senegal and Mauritania, it's essential to promote sustainable grazing practices and land management, which are critical components of rangeland management, with a particular focus on developing sustainable grazing and livestock management in Mauritania as it is home to one of the largest livestock herds in Africa.

2. **Expanding the successful experience of the Great Green Wall Initiative:** The Great Green Wall Initiative is a large-scale project to combat desertification, land degradation, and climate change in the Sahel region of Africa. Initially launched in 2007, the initiative involves planting a massive belt of trees and vegetation across Africa from the Atlantic Ocean in the west to the Red Sea in the east. Its goal is to prevent the Sahara Desert's southward spread and restore degraded lands in the region. Starting from the successful experience of the Great Green Wall, it will be very beneficial to expand this project eastward and westward by planting more trees and vegetation, even on a small scale, which will contribute to implementing sustainable land management practices across Mauritania and Senegal, and seek financial and technical support, resources, and expertise from various African and international organizations, governments, and NGOs. Local communities could play a crucial role in the success of any extension of the Great Green Wall Initiative. Involving them in decision-making and implementation of the extension project is essential to ensure its sustainability and effectiveness. Such expansion comprises a range of activities beyond tree planting, including sustainable agriculture, water management, and soil conservation. These efforts aim to improve the livelihoods of people in the region while combating desertification. In addition to preventing desertification and land degradation, the tree plantation contributes to biodiversity conservation, climate change mitigation, and poverty reduction in the region. This operation is a continuing process that will have constant challenges, such as funding issues, logistical difficulties, and changing climate conditions.
3. **Sea and ocean water desalination:** Desalination technology can be a lifesaver in dry and arid areas where freshwater is scarce. It offers a reliable source of freshwater from the vast seawater reserves in coastal regions of Mauritania and Senegal. The choice of desalination method depends on factors such as energy availability, infrastructure, and local conditions. To determine its feasibility, the cost of desalinated water must be compared to other water supply options. Solar desalination is a promising option for Mauritania where there is abundant sunlight, as it helps reduce the reliance on fossil fuels. Desalinated water is commonly used for irrigation in dry regions, making it an invaluable resource for agriculture. It enables the cultivation of crops that would otherwise be unsustainable due to water scarcity.
4. **Water management and Conservation:** Water management and conservation are crucial in addressing the issue of water scarcity in the Sahara and the Sahel regions. Implementing efficient water management strategies, such as rainwater harvesting, can provide a valuable water source. Techniques such as rooftop harvesting, surface runoff collection, subsurface dams, and water recycling can be employed to conserve water resources. It is important to promote responsible use of water resources to reduce wastage. Drip irrigation systems, which deliver water directly to plant roots, are

especially effective for agriculture in arid areas as they reduce evaporation and waste. Effective water management and conservation strategies are essential to address the challenge of water scarcity in these countries.

5. **Promoting renewable energy investment:** Investing in renewable energy sources such as solar and wind power is crucial for reducing the dependence on fossil fuels and combating climate change. Mauritania, and in some extent the Senegal, have gained increasing attention in recent years due to their vast potential for solar and wind energy generation.

Solar energy has significant potential in desert regions for several reasons. Firstly, deserts receive a high level of direct sunlight throughout the year, making them ideal locations for solar energy generation. Additionally, solar panels can be deployed on a large scale to capture the sun's energy and convert it into electricity. Concentrated solar power (CSP) plants, which use mirrors or lenses to focus sunlight, are also suitable for desert regions. The vast, open areas in Mauritania deserts allow for the construction of large solar farms that can generate significant amounts of electricity. However, water resources for cleaning solar panels and cooling CSP systems may be limited in arid regions, necessitating innovative water-saving technologies.

Wind energy is also a viable option in the Senegal and Mauritania arid regions. Some arid regions experience consistent, high-speed winds, which are ideal for wind energy production. Wind farms with tall wind turbines can harness this energy. However, understanding local wind patterns is crucial for siting wind farms effectively and optimizing energy production. Furthermore, transmitting the electricity generated in remote desert areas to urban centers requires a robust grid infrastructure.

It is important to carefully consider the impact of renewable energy projects on the fragile ecosystem and mitigate any negative effects through sustainable practices and responsible land management. Developing renewable energy projects in arid regions can create jobs and boost local economies, while also contributing to a cleaner and more sustainable future.

6. **Developing dry (arid) agriculture (Desert agriculture and farming):** Developing agriculture in arid and dry regions of Mauritania and Senegal presents unique challenges and opportunities. To ensure food security in these areas, sustainable agricultural practices that are adapted to arid conditions must be encouraged. This includes investing in drought-resistant crop varieties, efficient irrigation systems, and soil conservation techniques. To succeed in arid regions, it is crucial to select and develop drought-resistant crop varieties such as millet, sorghum, and drought-resistant varieties of certain legumes, oilseeds, and trees like acacia varieties. Efficient water management is also essential, and techniques such as drip irrigation, rainwater harvesting, and utilizing underground aquifers can help make the most of the limited

water resources available. Soil quality is often poor in arid regions, which is why implementing soil improvement techniques like adding organic matter, using cover crops, and practicing minimal tillage can enhance soil fertility and water-holding capacity. Crop rotation is another crucial strategy to avoid soil degradation and manage pests and diseases. Alternating between different crops can help maintain soil health and reduce the risk of crop failure.

7. **Initiating afforestation and reforestation:** Afforestation and reforestation are initiatives that involve planting trees and shrubs to combat desertification, restore degraded lands, and enhance carbon storage. These initiatives are critical in deserts, arid dry lands, and particularly the Sahara, as they can help mitigate climate change and promote sustainable land management. Moreover, afforestation and reforestation projects can bring a range of ecological, social, and economic benefits.

Environmental benefits of afforestation and reforestation initiatives include soil conservation, climate change mitigation, and biodiversity promotion. Planting trees and shrubs helps bind the soil, reducing erosion and improving soil fertility. Forests act as carbon sinks, absorbing carbon dioxide from the atmosphere and helping combat global warming. Furthermore, reforestation efforts can restore native plant species and provide habitat for wildlife, promoting biodiversity.

Economic benefits of afforestation and reforestation initiatives include the production of wood and non-timber products, which can provide valuable resources such as timber, fruits, nuts, and medicinal plants, contributing to local economies. Restoring natural landscapes can attract eco-tourism and create jobs in the region. Moreover, afforestation and reforestation projects can create employment opportunities for local communities. However, afforestation and reforestation initiatives face some challenges. Water scarcity is a significant challenge in arid areas, making sustainable water sources or efficient water management a necessity. Selecting drought-resistant and native tree species, like the acacia raddiana, is essential for success, as well as, engaging local communities in planning and execution.

8. **Strengthen local community involvement and taking advantage of indigenous knowledge:** Local communities in Senegal and Mauritania possess valuable knowledge and practices that can help build resilience. Involving them in decision-making processes and adaptation efforts, and tapping into their indigenous knowledge, can help implement effective mitigation strategies.

Education and awareness campaigns on climate change and its impact on arid regions can also promote sustainable land use practices and natural resource management. Additionally, international cooperation can support capacity building and education programs to enhance the skills and knowledge of local communities, enabling them to better manage their lands and adapt to changing conditions.

Encouraging sustainable practices and responsible resource management at the community level is crucial. Social policies should be developed and implemented to protect vulnerable populations, particularly those who rely on traditional livelihoods in arid regions.

Collaboration with local communities on climate change mitigation projects, such as tree planting, renewable energy initiatives, and sustainable land management projects, can align with their indigenous knowledge and traditions. It is important to ensure that local communities have a say in the development and implementation of climate policies and projects that affect them, tailoring strategies to their specific needs and circumstances.

9. **Adaptive policy framework and legislation:** Developing an adaptive policy framework and legislation for fragile arid or dry lands is crucial for their sustainable development and preservation in the context of climate change. Such a framework should address the unique challenges of arid environments and aim to mitigate the impacts of climate change while supporting the resilience of local communities and ecosystems. To create an effective framework, it is important to establish adaptive policy frameworks that can be adjusted as climate change patterns evolve. Additionally, regulations and policies should be in place to promote sustainable land use, water management, and climate resilience while discouraging harmful practices. Financial support and incentives should also be provided for promoting climate resilience. Public-private partnerships should be encouraged to leverage resources and expertise in implementing climate-resilient projects. Opportunities for participating in carbon trading and offsetting programs should be explored to generate revenue and invest in sustainable development projects. To combat desertification, a comprehensive climate assessment and monitoring system should be established specifically designed for arid regions. This system should track temperature changes, precipitation patterns, and desertification rates. Legislation should also be in place to enforce land-use practices that prevent soil erosion, deforestation, and unsustainable agriculture.
10. **Fostering regional and international cooperation:** Fostering international cooperation is crucial when it comes to addressing transboundary issues related to climate change mitigation. International partnerships play a crucial role in managing shared ecosystems and adapting to climate change. To successfully combat desertification, the expansion of the Sahara, and climate change in arid dry lands, a comprehensive approach combining environmental, social, and economic initiatives is necessary. To achieve this, governments of Mauritania and Senegal, non-governmental organizations, researchers, and local communities must work together to find effective solutions to these pressing challenges.

Regional partnerships and collaborations are particularly essential to address the Sahara desert negative impact on the climate in Senegal and Mauritania. Many regional organizations and countries in the affected areas need to work together to share knowledge, technology, and best practices for land restoration and sustainable management. International agreements that focus on reducing greenhouse gas emissions and adapting to a changing climate, such as the Paris Agreement, indirectly address desertification and arid lands.

The United Nations Convention to Combat Desertification (UNCCD) is the primary international treaty addressing desertification, land degradation, and drought. It promotes sustainable land management and provides a framework for countries to work together to combat desertification and its impacts.

11. **Enhancing scientific research and innovation:** Investing in scientific research and innovation related to climate change adaptation is decisive. It is important to support the development of innovative solutions to the unique challenges presented by these areas. Mauritania and Senegal face environmental, social, and economic challenges due to climate change impact of the Sahara desert, and it is essential to combine scientific research with practical solutions and sustainable practices to mitigate its effects and ensure a more resilient future for these regions and their inhabitants.

Scientific research and innovation in the context of deserts, particularly the Sahara, with a focus on climate change, are critical for addressing the challenges posed by a warming planet. Some key areas of research and innovation in this field include climate modeling and prediction, developing advanced climate models specific to arid regions like the Sahara to understand the complex interactions between various climate variables, creating predictive models to anticipate the impact of climate change on desert ecosystems, water resources, and weather patterns.

Another key area of research is desertification and land degradation. It involves studying the causes and consequences of desertification to develop sustainable land management practices and implementing innovative techniques for combating land degradation, such as afforestation and sustainable agriculture. These practices can help to restore degraded lands, increase the carbon sequestration potential of these regions, and create new livelihood opportunities for the people living in these areas.

12. **Adopting an environment-friendly architecture and urban planning:** Creating an environmentally friendly architecture and urban planning is important to reduce the Sahara impact on the climate in Senegal and Mauritania. This requires a holistic approach that considers the sharing of knowledge. Collaboration between architects, urban planners, local communities, and government authorities is key for successful implementation and long-term sustainability.

To achieve this, it is important to adopt a Climate-Resilient Infrastructure which includes building and upgrading infrastructure that can withstand extreme weather

events such as storms, floods, and sandstorms. This includes resilient housing, transportation networks, and water supply systems.

Sustainable building design is another important aspect and passive solar design principles need be incorporated to maximize natural heating and cooling. This includes designing buildings with proper orientation and shading to reduce energy consumption. Using materials with high thermal mass to store heat during the day and release it at night helps to stabilize indoor temperatures. Investing in excellent insulation is also crucial to prevent heat transfer and reduce the need for air conditioning.

CONCLUSION.

After conducting a thorough analysis, this consultancy report has identified the urgent need to address the devastating effects of the Sahara desert environment in the climate change in both Mauritania and Senegal. The expanding Sahara desert has led to various challenges, including desertification, water scarcity, food security issues, and increased vulnerability to extreme weather events. To effectively mitigate these impacts, a comprehensive approach is required.

The following recommendations are essential for mitigating the negative effects of the Sahara desert on Mauritania and Senegal climate:

1. Desertification control;
2. Expanding the successful experience of the Great Green Wall Initiative;
3. Sea and ocean water desalination;
4. Water management and Conservation;
5. Promoting renewable energy investment;
6. Developing dry (arid) agriculture (Desert agriculture and farming);
7. Initiating afforestation and reforestation;
8. Strengthen local community involvement and taking advantage of indigenous knowledge;
9. Adaptive policy framework and legislation;
10. Fostering regional and international cooperation;
11. Enhancing scientific research and innovation;
12. Adopting an environment-friendly architecture and urban planning.

Addressing the harmful influence of the Sahara desert on Mauritania and Senegal climate change is a complex and long-term challenge that requires commitment and cooperation from governments, local communities, non-governmental organizations, and the international community. By implementing the recommended measures and adopting a holistic and sustainable approach, both Mauritania and Senegal can work towards a more resilient and secure future. This will help to mitigate the consequences of climate change in the face of the expanding Sahara desert.

REFERENCES.

- 1- United Nations Convention to Combat Desertification (UNCCD). The Great Green Wall: Hope for the Sahara and the Sahel; United Nations Convention to Combat Desertification: Bonn, Germany, 2016; p. 15.
- 2- World Bank. 2019. "The Role of Desalination in an Increasingly. Water-Scarce World." World Bank, Washington, DC.
- 3- Pausata, F. S., Gaetani, M., Messori, G., Berg, A., de Souza, D. M., Sage, R. F., & DeMenocal, P. B. (2020). The greening of the Sahara: Past changes and future implications. *One Earth*, 2(3), 235-250.
- 4- MDEDD, 2010. Institutional Review of the Environment Sector in Mauritania; BM / GTZ,102 p.
- 5- IRENA (2016), Investment Opportunities in West Africa: Suitability maps for grid-connected and off-grid solar and wind projects, International Renewable Energy Agency (IRENA), Abu Dhabi.
- 6- World Bank. 2011. "Climate Risk and Adaptation Country Profile: Senegal." World Bank, Washington, DC.