Research Journal of Recent Sciences ISSN 2277-2502
Vol. **14(1),** 35-38, January **(2025)** *Res. J. Recent Sci.*

A Comprehensive Study on Climate Change: Mitigation Strategies and Adaptation Measures

Meghana Raikar* and Alice Thomas
St. Paul Institute of Professional Studies, Indore, MP, India
raikarmeghana25@gmail.com

Available online at: www.isca.in, www.isca.me
Received 28th August 2024, revised 16th December 2024, accepted 30th December 2024

Abstract

The Earth is a fine place for flora and fauna but the imbalance extraction of the natural resources leads the entire world into the destruction. Now a day's environmentalists are worried about the climate change which is consequently responsible for the persistent challenges faced by our planet. It is a cause of the important threats to ecosystem, human health, and socioeconomic stability. This comprehensive study specifically focuses on mitigation strategies and adaptation measures that can help lessen the effects of climate change and increase the power of resilience to its impacts. These strategies aim to cut down greenhouse gas emissions and intensify carbon sinks. The transitioning of low carbon economy paves path for the development and deployment of renewable energy technologies to replace fossil fuel-based energy generation. In addition to these mitigation strategies, certain adaptive measures like sustainable land management practices and the protection and restoration of natural ecosystems are essential to combat climate. By implementing effectual mitigation and adaptation measures, we can unanimously work hard towards a sustainable future.

Keywords: Carbon sink, Ecosystem, Reduce Energy, Sustainable, Solution, Global, Resilient, Future, Cooperation.

Introduction

Climate change is a burning global issue that reflects significant challenges to our planet and its ecosystems. Mitigation strategies and adaptation measures play a crucial role in addressing and assuaging the side effects of climate change. These mitigation strategies set to reduce greenhouse gas emissions, ameliorate carbon sinks, and promote sustainable practices to mitigate the major causes and impacts of climate change. Few of the mitigation strategies aim to use clean and renewable energy sources instead of using fossil fuels. Another essential step is to reduce energy consumption through improved technologies and promoting efficient transportation systems.

In addition to these mitigation strategies, certain adaptive measures like restoration of natural ecosystems and the practices for sustainable land management and its protection are some essential measures to combat climate change. It requires global cooperation, policy frameworks, technological advancements, and public participation to achieve significant impact. The Paris Agreement was one of the prominent international agreements that aimed to unite different nations globally to battle climate change, set emission reduction targets, and foster collaboration in research and development of sustainable solutions.

Research objectives: The most prominent objective is to analyze and explore numerous mitigation strategies, and adaptation measures with reference to adopt cleaner production methods, optimize energy use, and implement carbon capture and storage technologies to mitigate its environmental impact.

Mitigation Strategies: World-wide, it was observed that numerous studies were focused towards lessen the temperature and limit it to at least 1.5°C. The prominent role of Paris agreement, aiming this, is highlighted in the research. There are the examples of some effective mitigation strategies that can contribute a lot to decrease the temperature and improve the power of resilience against climate change such as aiding cities in developing more environment friendly modes of transportation like bus rapid transit, electric vehicles, and bio-fuels, promoting the use of renewable energy sources like solar, wind, and hydro, and encouraging more environment friendly land and forest management. We can adopt the soil management techniques, drought-resistant crops, more effective water usage and agricultural diversification to demote the negative effects rise up through climate change.

"Replacement of fossil carbon fuels by alternatives will be essential in the long term, but many are of limited availability, have their own serious environmental problems, or are too costly. It follows that very large cuts in emissions by 2030 will require large reductions in energy use. Technical energy efficiency measures require no changes to existing energy infrastructures, and although more promising than the other approaches (particularly for energy use in buildings), cannot overcome the rising energy demands brought about by economic growth"[2].

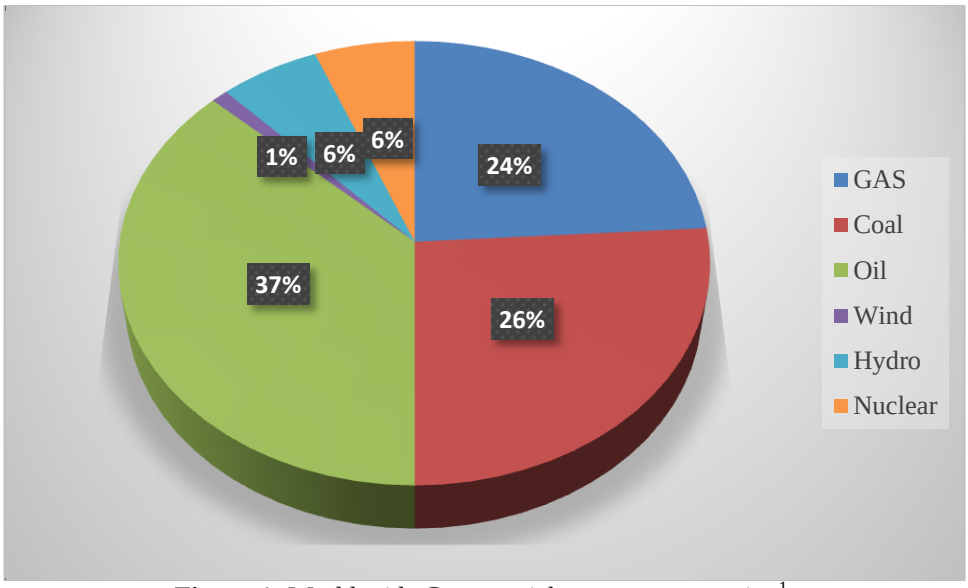

Figure-1: World-wide Commercial energy consumption[1].

Renewable Energy Sources

Solar energy: It is clean, renewable, and produces no waste or pollution while producing heat or electricity. We can lessen our reliance on pricey non-renewable resources by using solar energy. "The energy is emitted from the sun in several forms including ultraviolet light, X-rays, visible light, infrared light, microwaves and radio waves. This energy warms the Earth, drives our weather and provides energy for life. On a bright sunny day around noon, about 1,000 watts of solar energy shines on a square meter of the Earth's surface at the equator. The sun has been emitting this energy for billions of years and it can be truly said to be renewable"[3].

Wind Energy: Wind energy is renewable and one of the least expensive renewable energy sources for producing electricity. Wind power varies as the cube of the wind speed, so doubling the wind speed gives eight times the wind power. Even a small increase in wind speed can result in a large increase in electricity generated[3].

On the basis of this idea very soon wind catcher will be installed in the sea of Norway. It is presumed that 80000 houses will be generated from one tower. These wind towers fall 80 percent less than traditional turbines. They can produce more energy in less space. This technology should also be launched in India.

Hydropower: In some regions, sufficient water flow runs continuously, giving hydropower an advantage over wind or solar power in that it doesn't suffer from intermittency.

Geothermal Energy: Geothermal energy is a renewable source of power since the heat inside the Earth is constantly created. Traditional geothermal energy, which uses an already-existing underground hot water or hydrothermal resource, has been used for heating, cooking, and bathing for generations. "Using geothermal energy produces very little greenhouse gases. It generally has a very low environmental impact and requires less land area for large-scale electricity generation than wind and solar power. It is available 24 hours a day so can provide base load power and has no fuel cost"[3] .

Reducing Deforestation and Land Use Change: We have limited land area for growing vegetation and for Industrial and residential purposes therefore we need to make balance and get maximum benefits of available land. Under few mitigation strategies, sustainable land management practices are advised to apply everywhere hand in hand with low deforestation rate. Keeping the environmental concerns as major aspect, we must design the policies and activities to enhance Sustainable Land Management (SLM) technologies. According to The United Nations, "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long term productive potential of these resources and the maintenance of their environmental functions"[4].

There is the necessity to modify all the possible ways that are used to produce food and manage the land that is available. Land not only provides a setting for agricultural production but also serves as a source and sink for greenhouse gases, recycles nutrients, filters and improves pollutants, and transmits and purifies water as part of the hydrologic cycle. These modifications are required to regulate the temperature below 1.5°C and effectively lessen the emissions at all industrial levels.

To cast down the effect of climate change, few essential requisites have to be implemented- Farmers should be trained to enhance productivity, soil capacity and prevent soil degradation. Residents must promote afforestation and conservation on a daily practice. Government has also initiated to preserve forests

and provided certain rules to follow, under which it boycotts the products of companies involved in deforestation. It compels state governments and industries to make changes in the forest policies. "In 1988, the Government of India introduced a new forest policy that called the significant change in the management of forest land. The National Forest Policy 2016 continues with the national goal of maintaining a minimum of one-third of the geographical area under forest or tree cover"[5].

Transitioning to a Low-Carbon Economy: It is an obvious question how to maintain a low carbon economy and how the greenhouse gas emissions can be minimized. An economic system known as a "low-carbon economy" tries to reduce the percentage of carbon dioxide (CO_2) assimilated in the environment and thus cut down the greenhouse gas emissions. This will result into minimizing global warming and lessen carbon footprints. Nowadays to promote low carbon economy, consumers are encouraged to invest in environmentally friendly infrastructure to lessen reliance on fossil fuel-powered automobiles, such as bike lanes, public transportation, and electric vehicles. US-based economy historian Adam Tooze explains, "The World is going to need vast capacities of battery production. To meet domestic demand in 2030[6].

This transitioning of low carbon economy paves path for the overall growth and deployment of the technologies related to the renewable energy sources which is further to replace fossil fuel-based energy generation. In order to achieve the goals of a low-carbon economy and reducing global warming up to 2 degrees Celsius in various levels, the Paris Agreement, an international climate agreement enacted in 2015, has given a framework for international cooperation.

Adaptation Measures: For following all the adaptive measures, one must have complete knowledge about the harmful effects of climate change and how many ways one can stop or at least reduce its noxious effect up to certain level t therefore internationally 'Future Fuel-Cell Technology has been adopted in which, "Major automotive makers are conducting research into fuel cell power plants, even as they begin introducing hybrid vehicles that use a combination of fossil fuel and electric motors"[7].

The prudential use of water resources is of the utmost importance. Rain water harvesting practices can be broadly grouped as 'in-situ' and 'ex-situ' rain water harvesting technique. In in-situ harvesting technique, "rainfall is collected where it falls. Such as terracing, contour farming, broad bed furrow systems, micro basins, ridge and tie ridging, mulching, deep ploughing etc. where as in ex-situ rain water harvesting, the runoff is diverted and stored in an artificial reservoir for later use"[8].

Climate change is affecting globally in various fields therefore there should be unanimous efforts made to recover it. World-wide some of the international cooperation and agreements are in practice like The United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC) which efficiently execute their planning to save our environment and control the interference of human beings. Few initiatives have been taken place to raise fund under well-known groups to mitigate the effect of climate change. UNFCCC follows the principles mitigation strategies, adaptation measures and its implementation. Another international agreement named The Kyoto Protocol persuaded major countries under one notion to reduce their greenhouse gas emissions. The meeting was held on 16 February 2005. Keeping the same ideology, the Green Climate Fund (GCF) was established in 2010 for mitigation and adaptation and was aimed to invest in such a venture where climate resilient infrastructure is promoted. Many developing countries have created institutions to coordinate adaptation finance from domestic and international funding sources[9].

Climate-Resilient Infrastructure- Infrastructure must be resilient to face any type of climate change. The lives of individuals may be in jeopardy when power lines malfunction, water pipes leak, and transportation routes are destroyed. Infrastructure should be designed and constructed in such a manner that can fully protect the residents from climate variations prepare them to emerging climatic circumstances. Changing the composition of road surfaces comes under structural adaptation measures that will prevent structures not to deform in high temperatures. Building seawalls or using permeable paving surfaces can be the best option to reduce run-off during rains.

Urban planning and design-It plays prominent role in mitigating the bearings of climate change. The use of public transport including pedestrian foot path, separate lane for bicycle riders, walking and cycling would be the best alternatives to reduce energy consumption and greenhouse gas emanations. As compared to nearby rural areas, temperatures in metropolitan areas are frequently much higher due to the urban heat island effect. This effect can be mitigated by developing green area, utilizing permeable or reflective surfaces, green roofs and walls, and reflective roofing which are worthwhile to lessen heat absorption.

Flood protection and coastal defense: This is yet another strategy to resist with climate change. In coastal areas, government can install 'flood warning systems' and advanced 'hydro-meteorological weather forecasting systems' that can assist people in getting out from danger before a weather-related calamity occurs.

Along with these actions, urban resilient infrastructure in which water recharging system, water conservation techniques, sewage and storm water management equipment must be installed to withstand heavy rain fall and heat waves. Urban planners might give the protection of already-existing green spaces top priority while also establishing new ones to increase ecological

resilience. Thus, cities will become more resilient, sustainable, and climate change-adaptive by implementing these ideas into urban planning and design.

Agricultural Adaptation: Total focus of the farmers and agriculturists must be on the development of crops that can grow easily in warmer climates and resist against increasing heat or drought. With this idea, the 50th session of the Intergovernmental Panel on Climate Change (IPCC-50) was organized wherein the special report was released on Climate Change and Land. In this report, Working Group (WG) III Co-Chair Priyadarshi Shukla emphasized that "food security will be increasingly affected by future climate change through reduced yields, increased prices, reduced nutrient quality and supply chain disruptions" IPCC Special Report[10] .

It is necessary to overthrow plastic pollution. In the year 2023, United Nations kept the theme 'Beat Plastic Pollution' of World Environment Day. Many campaigns are being run by the Government of India to stop plastic pollution and has resolved to completely stop plastic pollution by 2024. Citizens are advised to use many other eco-friendly alternatives instead of plastic like paper carry bags, handmade cloth bags, Jute bags etc.

Conclusion

This comprehensive study aims to provide valuable insights into climate change mitigation and adaptation strategies. By understanding the solutions to climate change, policymakers, researchers, and practitioners can make informed decisions to address this global crisis effectively. As far as the rapid climate change is concerned, the research suggests certain changes to mitigate climate change and further, how we can implement these changes to preserve natural resources and making this world a better place.

References

1. Cunningham, W. P., & Cunningham, M. A. (2007). Biomes and biodiversity. In *Principles of Environmental Science*.pp 285. New Delhi: Tata McGraw-Hill.

2. Jenkins, A. (2011). Climate Change Adaptation: Ecology, Mitigation, and Management. Nova Science Publishers.

3. Nicholson, M. (2009). Energy in a changing climate. Rosenberg.

4. Food and Agriculture Organization of the United Nations. (2023). Sustainable land management. www.fao.org/ land-water/land/sustainable-land-management/en/ (Accessed 2023-06-17).

5. Joseph, B. (2018). Natural resources. In Environmental studies. Simplified 3rd ed., p. 25. Chennai: McGraw Hill Education.

6. Goswami, A. (2023). A new order of trade. Down to Earth. New Delhi. ISSN 0971-8079. www.downtoearth.org.in (Accessed 2024-08-26).

7. Joseph, B. (2018). Natural resources. In Environmental studies. Simplified 3rd ed., p. 416. Chennai: McGraw Hill Education.

8. Ghosh, S., & Anand, S. (2023). Water conservation and multiple use management. *Kurukshetra: A Journal of Rural Development*. New Delhi: Publication Division. pp-37.

9. Stavins, R., Zou, J., Brewer, T., Conte Grand, M., den Elzen, M., Finus, M., ... & Winkler, H. (2014). International cooperation: agreements and instruments. *Climate change*, 7(5), 1001-1082. https://www.ipcc.ch/report/ar5/wg3/international-cooperation-agreements-and-instruments/(Accessed 2023-06-19)

10. Dillow, R. K., & Philander, S. (2008). International institute for sustainable development (IISD). In *Encyclopedia of Global Warming and Climate Change*. SAGE Publications, Inc. from https://sdg.iisd.org/news/sustainable-land-management-critical-to-combating-climate-change-ipcc-special-report/(Accessed 2023-06-19)