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ECOSYSTEM-BASED ADAPTATION STRATEGIES FOR CLIMATE CHANGE

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INTRODUCTION

Global warming is contributing to a variety of global impacts, including increasing sea levels, increased climate variability, and increased drought, flood, and wildfire severity. The effects of these changes are resulting in increasing social and economic challenges, with an urgent need for adaptation, particularly in countries with low and lower-middle incomes, as well as Small Island Developing States. Climate change has severely affected these regions, which have limited capacity to adapt to it. Healthy ecosystems provide essential services that can assist in climate change adaptation. An ecosystem-based adaptation strategy consists of utilizing biodiversity and ecosystem services as part of a comprehensive adaptation strategy to assist people in coping with the adverse impacts of climate change. (Ojea, 2014). As part of ecosystem-based adaptation, an emphasis is placed on harnessing the benefits of biodiversity and ecosystem services in order to mitigate the threats posed by climate change.

Key Issues in Ecosystem-Based Adaptation

Outpaced Coping Mechanisms

Traditional methods of adapting to climate variability are no longer sufficient due to the rapidly changing climate.

Shifting Weather Patterns

Climate change is causing unpredictable weather patterns, affecting rainfall and temperature, which in turn impacts the ecosystem goods and services vital to communities.

Increased Vulnerability to Disasters

Climate change is exacerbating existing risks and increasing the vulnerability of communities to natural disasters.

Need for Adaptation-based Ecosystem

There is a critical need to shift towards cost-effective, nature-based solutions like sustainable agriculture, conservation natural resources such as water, air and Forests to build resilience against climate change.

Adaptation based on ecosystems involves preserving, managing, and restoring ecosystems such as forests, grasslands, wetlands, mangroves, and coral reefs in order to counteract climate hazards adversely. As a result, rainfall patterns may change, temperatures will shift, storm intensity may increase, and climate conditions may become increasingly unpredictable. Ecosystems should be managed, conserved, and restored in a sustainable manner, providing essential services to communities as they adapt to climate change impacts. This approach aims at improving ecosystem resilience and reducing human and ecological vulnerability to climate

change. However, in addition to preserving ecosystem functions and services, EbA is also an essential component of comprehensive human adaptation strategies. As a cost-effective approach, EbA can be an effective means of reducing disaster risks, supporting livelihoods, improving food security, sequestering carbon, and managing water in an environmentally friendly manner.

Adaptation Strategies

Agro-Forestry Model

Traditionally, agroforestry has played a vital role as a land-use strategy in sustaining agricultural productivity and enhancing the livelihoods of farmers. As agroforestry systems integrate trees and shrubs with crops and livestock, they provide farmers with an alternative source of income while improving soil fertility, conserving biodiversity, and reducing climate change disruptions (Swamy & Tewari, 2017). In agroforestry, the selection of tree species is typically guided by their potential to generate financial revenue and their effectiveness in supporting climate change adaptation.

Teak based Agro Forestry model (Dev et al., 2019)

Scientific Name: *Tectona grandis*

Potential Area Suitable: Middle-Gangetic plains regions, Plateau, and hills region. States like Maharashtra, Chhattisgarh, Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Karnataka

Suitable Intercrops:

***Kharif*:** Black gram, soybean, cotton, red gram, sesame

***Rabi*:** Sorghum, cowpea, linseed

Tree Productivity:

- First thinning (50%) at 7th year: 300 poles/ha
- Second thinning (25%) at 12th year: Small timber (7.65 m^3/ha)
- Final harvesting at 20-25 years: Timber (77 m^3/ha)

Economics:

- Rs. 60,000/ha at first 50% thinning (7 years)
- Rs. 2,28,900/ha at second 25% thinning (12 years)
- Rs. 19,44,000/ha at final harvesting (20-25 years)

Carbon Sequestration:

- 3.80 t C/ha after 7 years
- 5.77 t C/ha after 12 years
- 58.52 t C/ha after 25 years

Changing Cropping Patterns as an Adaptation Strategy

Adapting cropping patterns by cultivating drought-resistant crop varieties has emerged as a crucial strategy for mitigating the impacts of change in climate. This approach is mostly effective in arid zones, where the drought-tolerant crops cultivation can significantly reduce vulnerability to climate-related stresses.

There has been a noticeable shift from the cultivation of water-intensive crops to those that require less water. For instance, farmers in the Ajmer and Barmer regions of Rajasthan have successfully adopted drought-resistant rice varieties as a response to changing climatic conditions (Mohapatra et al., 2022). This strategy not only helps in sustaining agricultural productivity but also contributes to enhancing the resilience of farming communities in these climate-sensitive regions.

Mangrove forest Restoration

India has made significant progress in mangrove restoration and is actively engaged in the Mangroves for the Future initiative was developed by the International Union for Conservation of Nature (IUCN) to conserve coastal ecosystems that play a vital role in sustaining coastal livelihoods. This initiative, funded by the World Bank, highlights the commitment of India to preserving its coastal ecosystems and supporting the livelihoods of coastal communities. A key motivation behind India's mangrove restoration efforts is the use of these ecosystems as a climate adaptation strategy, particularly for disaster risk reduction. Mangroves are often referred to as "bio-shields" due to their ability to protect coastal areas from natural disasters such as storms, cyclones, and coastal erosion. Providing natural barriers against extreme weather events, mangroves are an essential component of India's strategy for enhancing resilience to climate change by reducing the impact of extreme weather events. In India monetary value of mangroves is US$865/ha /year (nutrient retention); and US$116.28/ household (storm abatement) (Badola & Hussain, 2003)

Mixed farming Techniques to maintain Soil fertility and Water Conservation

There is a high prevalence of mixed farming systems in low-income and middle-income countries, such as India, where perennial and annual crops are combined with livestock and fishing. These systems are also becoming increasingly popular in high-income countries, because of their potential to contribute to the adaptation to climate change. A mixed farming system offers a valuable strategy for enhancing the resilience of food production systems in India, where agriculture is deeply intertwined with millions of people's lives. By diversifying within these systems, climate change risks are reduced, livelihoods become more resilient, food security becomes better, and ecosystem services are provided more effectively. It is possible, for example, to increase local and regional resilience through the integration of crop and livestock systems, the use of agroforestry practices, and the integration of aquaculture and contribute to the long-term resilience of the global food system by integrating crop and livestock systems.

Farm management strategies such as crop diversification with short-duration crops such as groundnut, pearl millet, and cowpeas, as well as horticulture crops such as grapes,

pomegranates, and citrus fruits such as limes, have been implemented in the Vijayapura district of Karnataka to combat climate change. In addition, soil and rainwater conservation practices were adopted along with crop diversification to increase crop yields. (Dupdal et al., 2022).

Terrace farming systems to increase soil moisture and reduce runoff

Terrace farming is an effective ecosystem-based adaptation strategy employed in India to combat the challenges posed by climate change, particularly in hilly and mountainous regions. By creating stepped levels on slopes, terrace farming helps increase soil moisture retention and significantly reduces surface runoff, thereby preventing soil erosion. This method enhances water infiltration, allowing for better crop growth and more sustainable agricultural practices. In regions like the Western Ghats and the Himalayan foothills, terrace farming not only supports agricultural productivity but also contributes to the resilience of ecosystems (Datta et al., 2022). By stabilizing the soil and conserving water, these systems protect against the adverse effects of erratic rainfall and the effects of climate change which causes extreme weather events, which are becoming more frequent.

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