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Planning Strategies to Build Resilience in Wetland Regions of Kerala

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ABSTRACT: The loss of wetland regions poses a serious threat to people's lives and livelihoods in nations all over the world. The main aim of this study is to formulate planning strategies for building resilience in wetland regions of Kerala. The literature study was conducted to study the planning resilience concept in wetland regions and analyzed different types of resilience planning in wetland regions. The case studies that are covered in this paper can help readers comprehend different approaches and techniques for dealing with resilience planning in wetland areas.This study develops specific strategies and guidelines for building resilience in wetland regions due to the comparative examination of case studies.Planning strategies for resilience in wetland zones have been developed.

KEYWORDS:Climate change, low-lying areas, Resilience, Wetlands

I. INTRODUCTION

Wetlands are disappearing around the world at an alarming rate three times faster than forests. Wetlands are one of the habitats with the greatest diversity of life. Wetlands are hotspots for biodiversity and are effective at storing carbon in their soil and biomass, which can make a significant difference in enhancing resilience. Wetlands are a naturally occurring solution that is created and maintained by nature. Over time, it has become clearer that climate change poses threats. These effects are being felt internationally across a range of ecosystems and sectors, which has a detrimental effect on the lives, health, and economy of many low-lying places. Resilience is crucial to reducing these problems. The ability to foresee, prepare for, respond to, and recover from large multi-hazard threats with little detrimental effect on the environment, the economy, or societal well-being is known as resilience.[13] Organizations must "respond or reorganize in ways that preserve their essential function, identity, and structure while also preserving their ability for adaptation, learning, and transformation" to accomplish this [1].

II. NEED AND FEASIBILITY OF STUDY

[12] Degradation of wetland regions poses a serious threat to people's lives and livelihoods in nations all over the world. Since there is no way to eliminate these risks, so this study helps to identify different strategies to build resilience in low-lying areas under climate change and supports individuals in managing them. According to a recent analysis, doing so necessitates thinking forward and implementing proactive steps that decrease climate risk, speed up growth, and alleviate poverty. This study helps to revise the land use plan and protect critical infrastructures. Since they have a considerable impact on significant private investments in housing and productive assets, urban and land use plans are also important public sector obligations. As a result, it is crucial that resilience planning helps to adapt to the changing climate risks to prevent people from being trapped in high-risk locations. Farmers in the state are the most at risk from climate change since their livelihoods are exposed and less climate-resilient. Drastic changes in the climate like floods affect the farmer's livelihood and forced them to change their profession for a better future. It tackles climate change policy challenges with an emphasis on the empirical data for developing practical measures to improve resilience in low-lying places.

RESEARCH QUESTION

What planning strategies and recommendations can be adopted to build resilience in wetland regions of Kerala?

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AIM

To develop planning strategies for resilience in wetland regions of Kerala.

OBJECTIVES

1. To study the planning resilience concepts in wetland regions.
2. To identify and evaluate the methods used to develop various forms of resilience in wetland areas.
3. To understand and analyze various assessment tools in planning resilience for wetland regions.
4. To develop planning strategies for building resilience in wetland regions of Kerala.

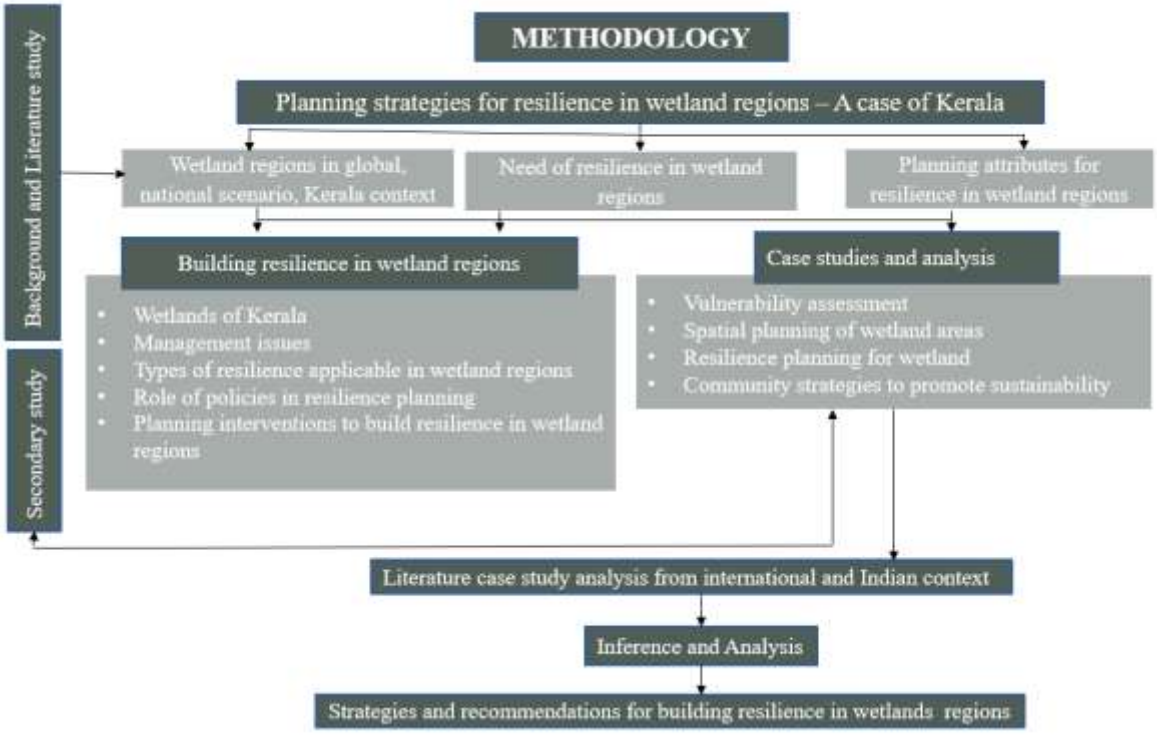
SCOPE OF THE STUDY

The study helps to identify new strategies for land use planning that helps the people living in wetlandareas to ensure better living condition. It also helps to identify the policy issues in climate change at a regional level.

LIMITATIONS

The study is limited to the literature study and available secondary data.

III. METHODOLOGY



IV. LITERATURE REVIEW

Ramsar defines a wetland as any area with marsh or water, whether it was developed intentionally or organically, and whether it is flowing or still, salty or fresh. [2]Wetlands are classified under 2 main categories: Inland wetlands and Coastal wetlands. Inland wetlands are isolated depressions surrounded by dry land, around the edges of lakes and ponds, and other low-lying regions where groundwater interrupts the soil surface or when adequate precipitation saturates the soil. Coastal/tidal wetlands are closely related to the estuaries in our nation, where the mixture of fresh and saltwater yields an environment with a range of salinities. Two key elements influence the deterioration of wetland habitats. They are both physical and human elements. It is feasible to determine how human factors have significantly influenced the current state of the wetlands among these components. Wetland erosion is influenced by a trinity of physical, environmental, and human variables that have all stronger over time as the effect of human causes has increased. [10]

Over 2300 Ramsar sites cover almost 250 million hectares of land. Inland regions make up 93% of wetlands, whereas coastal areas make up 7%. In the past 300 years, wetlands have been destroyed worldwide by 87%.[10] Wetlands make up about 4.63 percent of India's total land area. Over the past four decades, urbanization,

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agricultural expansion, and pollution have caused India to lose close to one-third of its natural wetlands. There are 217 wetlands in Kerala in all. 93% of them are coastal wetlands, while 64% are There were different types of resilience for conserving a wetland region. Climate resilience is the capacity to bounce back from or lessen sensitivity to shocks caused by the climate, including floods and droughts.[9]Ecological resilience measures the amount of disruption a system can withstand before its structure or regulatory mechanisms change.[3]Engineering resilience encapsulates techniques for risk assessment using quantitative standards, assessing how soon a system is expected to rebound or bounce back once an incident has happened. [4] Wetlands along the coast are home to a wide variety of organisms. An economic foundation for human groups and poorly suited to ecosystems[5]. Therefore, coastal resilience is crucial.Resilience in transient wetlands includes a wide variety of habitats to control ecosystem services for enjoyment, aesthetics, and provisioning.Dryland wetlands' ability to withstand drought is endangered by climate change[8]Arctic Wetlands: Management and ResiliencePerspectives from the Adaptive Co-Management and Design of a MediterraneanWetland for Local Planning practice towardsresilience [7].

categorized as interior wetlands. [6]. Due to hurried development efforts and careless use of land and water, Kerala's wetlands are currently under severe strain. Although there are no precise estimates of the rate of wetlands destruction in Kerala, it is more or less understood how the ecosystem is degrading qualitatively. The main problems affecting Kerala's wetlands include pollution, eutrophication, encroachment, reclamation, mining, and loss of biodiversity. When it comes to social well-being, the economy, and the environment, resilience is defined as the "ability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimal damage."[11]

V. PARAMETERS IDENTIFIED FOR RESILIENCE PLANNING IN WETLAND REGIONS

Parameters	Dimensions
Environment	• Environmental pollution • Greenhouse effect • Rainfall pattern changes • Changes in temperature • Solid waste management
Economic	• Tourism • Agricultural production • Fishing activities • Industrial activities
Infrastructure	• Transportation • Development of recreation centers like parks • Climate resilient buildings
Disaster management	• Flood • Drought
Land use	• Conversion of paddy land into dry land • Settlements
Political	• Problems in rules and regulation • Illegal hunting • Unauthorised residence
Development activity	• Unplanned irrigation structure • Land reclamation • Garbage disposal • Construction

Table 1: Parameters for resilience planning

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VI. CASE STUDIES

Case studies are chosen and evaluated to determine parameters and different approaches used to develop climate resilience.

Table 2: Comparative analysis of casestudies

VII. WETLANDS OF KERALA

Wetlands are places on land that experience seasonal or persistent flooding or saturation with water.Kerala's three designated Ramsar sites are Ashtamudi, Samsthamkotta, and Vembanad-Kole. The wetlands of Kerala are currently under tremendous strain as a result of increased construction activities and unrestrained land and water use.

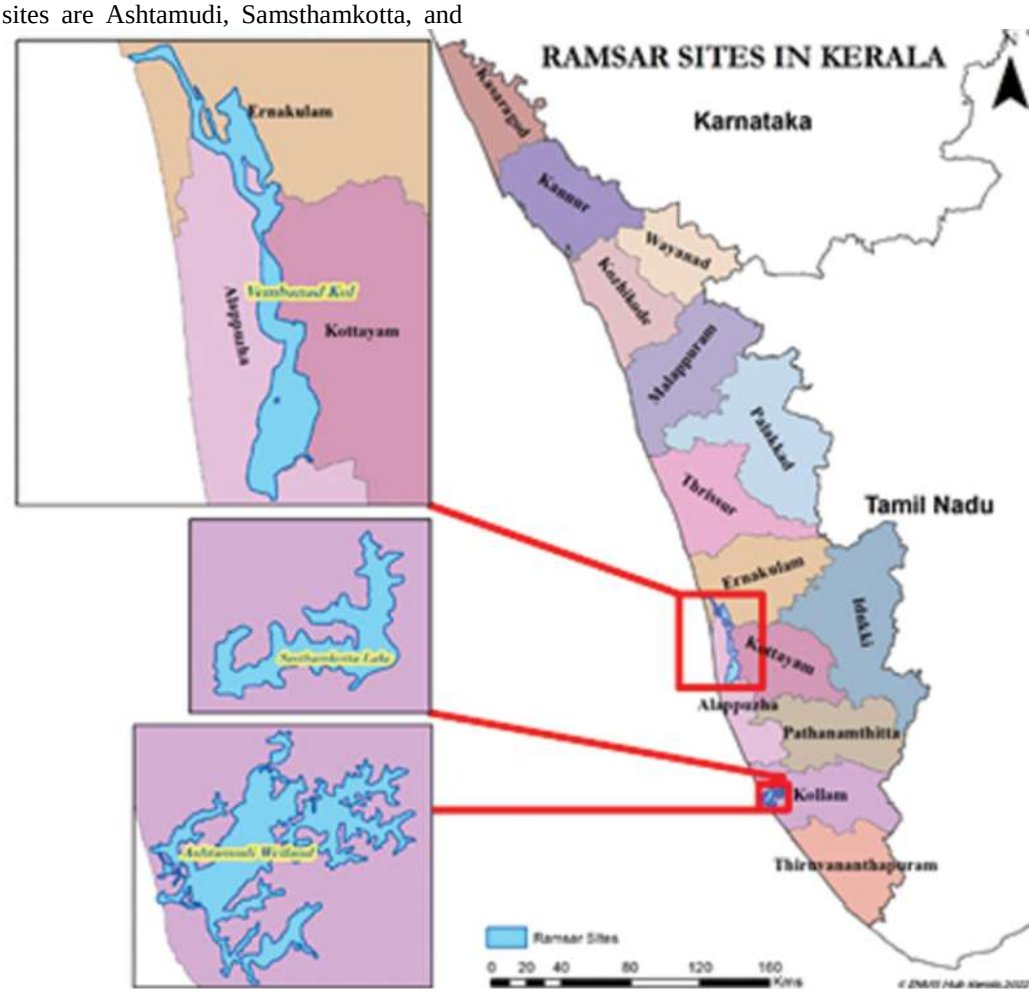

Figure 2: Major wetlands in Kerala

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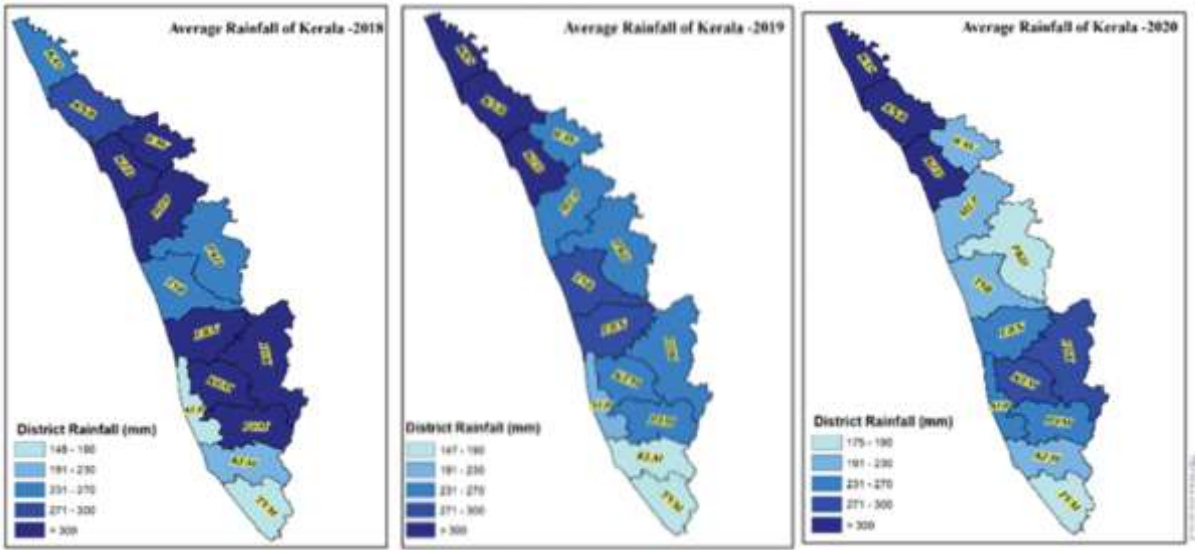

Figure3: Climate trends in Kerala

VIII. SPATIAL PLANNING IN LAND USE CHANGE

By conserving natural resources during the planning process, landuse planning methods assist in identifying the current problems and anticipated changes. Local governments can become more resilient to significant climate shifts through land use planning. It guarantees that our communities have fortifications in place to deal with and lessen such changes.

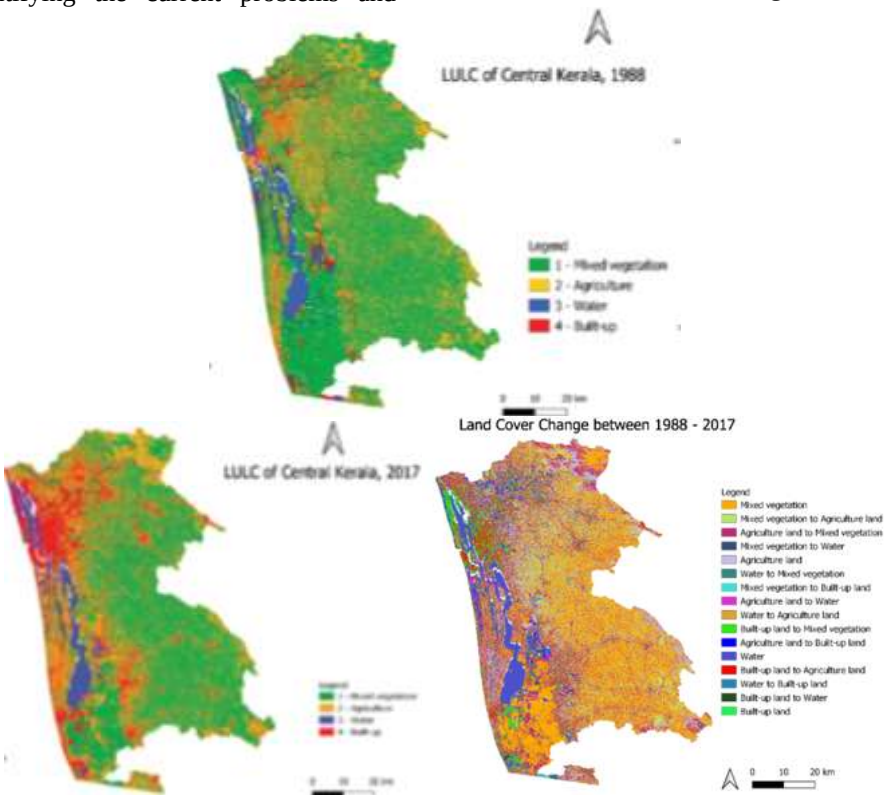

Figure4: Landuse cover change between 1988-2017 of wetland regions in Kerala

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IX. STUDY AREA

In the Indian state of Kerala, the region of Kuttanad includes the districts of Alappuzha, Kottayam, and Pathanamthitta. It is renowned for its sizable paddy fields and unique geological features. The area is one of the few in the world where farming is practised between 1.2 and 3.0 metres (4 to 10 feet) below sea level and has the lowest altitude in all of India. The state's top rice grower and a significant location in South India's ancient history is Kuttanad. Biosaline farming is a well-known practise among Kuttanad farmers.

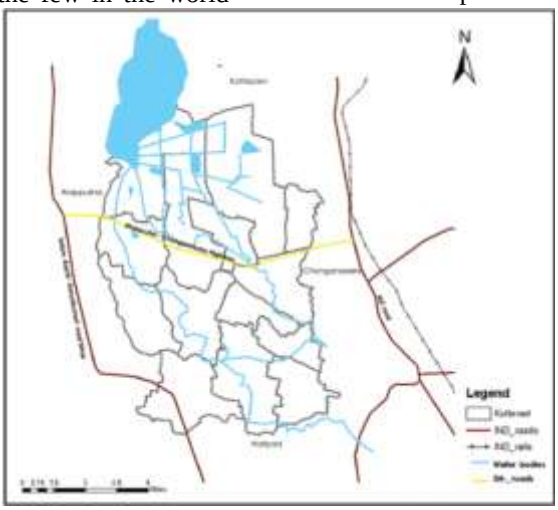

Figure5: Base map of Kuttanad

X. SITE ANALYSIS

A primary survey was conducted in Kuttanad taluk covering 14 grama panchayat such as Champakkulam, ,Kainakary North, , Edathua, Muttar, Nedumudi, Kainakary South Neelamperoor, Pulinkunnu, Ramankary, Thakazhy, Kavalam, Kunnumma, Thalavady, Veliyanad. Random sampling survey is used for analysing stakeholder and people's perception.

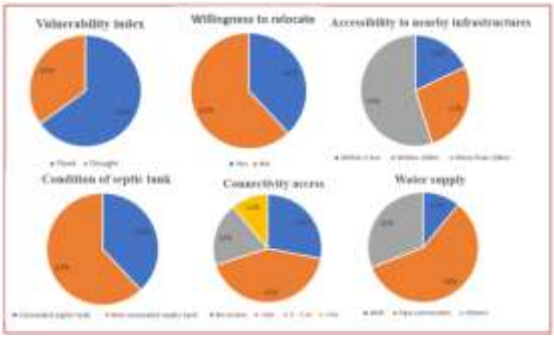

Figure6: Site study analysis

XI. ISSUES FACED IN KUTTANAD

- Species loss
- Waterborne and zoonotic diseases
- Obstruction to navigation
- Decrease in agriculture production and productivity
- Scarcity of potable water
- Flood and drought
- Aesthetic value depletion

XII. STRATEGIES AND ACTION PLAN

Strategies 1 : To enhance resilience in the livelihood of people in wetland regions

- Ensuring effective reaction and relief while taking a compassionate approach to the needs of society's most vulnerable groups.
- Facilitating community-based wetland restoration planning and management.
- Supporting innovative and gender-based adaptive livelihood options.
- Enhancing knowledge management and information sharing.

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- Strict monitoring and evaluation of climate changes.
- Urban forests can be created using the Miyawaki method and are intriguing, complex ecosystems that are in harmony with the soil and climate of the day.

Strategies 2: To enhance infrastructure development and connectivity in wetland regions to promote sustainable development.

- Strengthening ecological infrastructure and drainage systems by developing a sponge city concept for flood management.

Figure 7 : Sponge city concept

- Development of Floating or elevated roads which act as an evacuation route
- Development of infrastructure projects such as recreational parks, waterfront development to promote ecotourism
- Flood-resilient latrines should be designed for the Kerala context. It is suggested to design and construct latrines that are resistant to flooding with practical funding choices in flood-prone areas. The Kerala context calls for the design of flood-resistant latrines. To prevent the contamination of surrounding wells, they should have water-sealed septic tanks. The public should be made aware of the value of the latrine model through campaigns run by Suchitra Mission.

Strategies 3: To create a wetland region in Kerala that is secure and resilient to disasters by creating a comprehensive, proactive, disaster-oriented, and technology-driven plan through a culture of prevention, mitigation, readiness, and response.

- Ensuring effective systems for identifying, evaluating, and tracking disaster risks.
- Establishing institutional and technological legal frameworks to establish a compliance system and an enabling regulatory environment.
- Undertaking reconstruction as an opportunity to build disaster-resilient structures and habitats for ensuring safer living.
- To enhance drain mapping and networking using gis technologies.

Strategies 4: To promote tourism and its infrastructure development

- Promote ecotourism by providing awareness and training programs
- Promote live fishing and agro-tourism in Kuttanad
- Development of infrastructure projects such as recreational parks, and waterfront development to promote ecotourism
- Increase agricultural production by giving incentives to the farmers or taking up the land by the government to promote agricultural activities

Strategies 5: Strengthening ecological infrastructure and drainage systems by developing a sponge city concept for flood management.

Strategies 6: Providing proper roads for transportation and other infrastructural facilities like accommodation facilities, E-toilets, and waste management in wetland regions like Kuttanad can increase ecotourism in Kerala, and this way revenue can be generated.

Strategies 7: Development of sustainable methods of fish culturing and crop cultivation whichprevent artificial fertilizers and protect wilderness and promoteaquaponics farming and permaculture farming.

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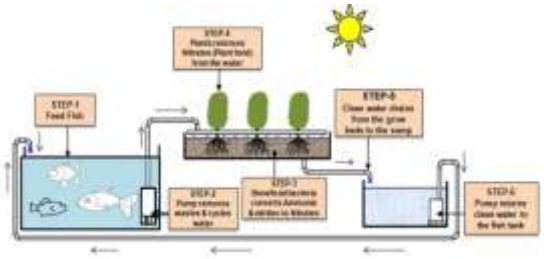

Figure8: Working of aquaponics

Figure: Permaculture

RECOMMENDATIONS

1. Mapping of wetland terrains to monitor their degradation.
2. Incorporate wetland conservation into structure and infrastructure projects such as parks, recreation, waterfront renewal, open space, and greenways along creeks, streams, rivers, and lakes for flood risk reduction.
3. Adopt combined ordinances to regulate wetland conservation and floodplain management.
4. Identify areas where wetland development could reduce peak flows or reduce flood risk.
5. Adopt low-impact development techniques to reduce erosion and improve water quality for wetland areas
6. Adopt community regulations, policies, and codes for stormwater, fills, grading, sanitary/septic waste, vegetation removal, and pesticide usage to reduce pollutants and sediments in wetlands.
7. Promote the use of soil and water conservation practices around wetlands/streams.

CONCLUSION

The study was an attempt to formulate resilience planning strategies for wetland regions. The different types of resilience planning in wetland regions are identified and various threats of wetland degradation are studied to build resilience in wetland regions. These impacts are being felt internationally throughout many different ecosystems and sectors, which has detrimental effects on the wetlands' economies, health, and way of life. Planning for resilience is crucial to reducing these problems. The study was conducted to identify the different parameters to build resilience in the Kerala context. A case of Kuttanad was taken to study the Kerala context to validate the identified parameters to build resilience in wetland regions. This study contributes to the development of fresh approaches to resilience planning in wetland areas that enable residents to secure improved living conditions and adapt to a changing environment. Different planning strategies and action plans are formulated to build resilience in wetland regions. In addition, further research should be done through qualitative and quantitative studies to increase the effective results.

REFERENCES

[1]. IPCC.(2016). Intergovernmental Panel on Climate Change. Six assessment report.
[2]. Convention on Wetlands. (n.d.). https://www.ramsar.org/
[3]. Holling, C. S. 1996. "Engineering resileince versus ecological resilience". In Engineering Within Ecological Constraints, Edited by: Schulze, P. C. 31–45. Washington, DC: National Academy Press.
[4]. Hashimoto, T., Stedinger, J.R. and Loucks, D.P. (1982) Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation. Water Resources Research, 18, 14-20.

[5]. Tahsin, S.; Medeiros, C.S.; Singh, A. Resilience of coastal wetlands to extreme hydrologic events in Apalachicola Bay. Geophys. Res. Lett. 2016, 43, 7529–7537.
[6]. Kokkal, K., Harinarayanan, P., & K, S. K. (2008). Wetlands of Kerala. ResearchGate. https://www.researchgate.net/publication/228409259_Wetlands_of_Kerala
[7]. Salizzoni, E., Pérez-Campaña, R., Alcalde-Rodríguez, F., & Talavera-García, R. (2020). Local Planning Practice towards Resilience: Insights from the Adaptive Co-Management and Design of a Mediterranean Wetland. Sustainability, 12(7), 2900. https://doi.org/10.3390/su12072900
[8]. Sandi, S.G., et al. Patch organization and resilience of dryland wetlands. Sci. Total Environ. 726, 138581 (2020)
[9]. 2009 UNISDR Terminology on Disaster Risk Reduction - World. (2009, December 31). ReliefWeb. https://reliefweb.int/report/world/2009-unisdr-terminology-disaster-risk-reduction
[10]. Wetlands becoming wastelands; factors contributing to the degradation of wetlands in Sri Lanka. (n.d.). IJRAR, Volume 7,(Issue 3), E-ISSN 2348-1269, P-ISSN 2349-5138. https://www.ijrar.org
[11]. National Research Council. (NRC 2010.) America's Climate Choices: Adapting to theImpacts of Climate Change; The National Academies Press: Washington, DC, 2010.https://doi.org/10.17226/12783.
[12]. Temmer, J., &Venema, H. D. (2017). Building a Climate-Resilient City: The built environment. International Institute for Sustainable Development. https://www.iisd.org/publications/brief/building-climate-resilient-city-built-environment
[13]. Alves, F., Filho, W. L., Casaleiro, P., Nagy, G. J., Diaz, H., Al-Amin, A. Q., De Andrade Guerra, J. B. S. O., Hurlbert, M., Farooq, H., Klavins, M., Saroar, M., Lorencová, E. K., Jain, S., Soares, A. M., Morgado, F., O'Hare, P., Wolf, F., &Azeiteiro, U. M. (2020). Climate change policies and agendas: Facing implementation challenges and guiding responses. Environmental Science & Policy, 104, 190–198. https://doi.org/10.1016/j.envsci.2019.12.001