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Eco-Anxiety and Climate Adaptation Readiness in High- Risk Water Zones

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Abstract

Water scarcity in urban areas like Coimbatore, India, is a major issue due to factors like groundwater decline, pollution, and climate change. To reduce anxiety, residents are adopting affordable technology and climate adaptation solutions. A study analysed the relationship between climate adaptation readiness and eco-anxiety. The study examines the correlation between climate adaptation readiness and eco-anxiety in urban populations in high-risk water zones, particularly in Coimbatore, India, a region increasingly vulnerable to severe water scarcity. Eco-anxiety can act as driving force for proactive behaviour, which makes individuals to engage in climate adaptive solution with the aid of advanced technologies. A mixed method approach involving quantitative and qualitative surveys are used to measure levels of eco-anxiety and Climate adaptation readiness, and qualitative interviews to understand lived experiences and adapted solutions with advanced technologies. The study analyses data from interviews to understand the impact of eco-anxiety on climate-adaptive behaviours in high-risk water zones, identify proactive measures, and explore the potential of advanced technology. The study suggests integrating policy approaches, including mental health support, behaviour change strategies, and advanced technologies like gamified conservation apps, to address eco-anxiety and promote climate resilience, especially in high-risk water zones.

Keywords: Climate adaptation readiness, Eco-anxiety, Water- Scarcity, High risk water zone

Highlights

- In Coimbatore's high-risk water zones, eco-anxiety is widespread,
- Higher eco-anxiety levels are linked to greater climate adaptation readiness and proactive behaviours.
- Residents are adopting blue-green infrastructure like rainwater harvesting and Miyawaki forests to combat water stress.
- Smart technologies, including IoT and SCADA systems, are transforming urban water governance in Coimbatore.
- Strong community action and institutional support are driving integrated, resilient water management strategies.

1. Introduction

In Indian growing cities like Coimbatore, Tamil Nadu, which are sensitive to the environment, urban water security is becoming a major concern. As a tier-2 city, Coimbatore is facing growing issues such as Seasonal water scarcity, falling groundwater tables, and dwindling surface water bodies which impact both demographic and economic growth of the city.

Seasonal water scarcity, falling groundwater tables, and dwindling surface water bodies are some of the growing issues facing Coimbatore, a tier-2 city that is experiencing both demographic and economic growth (India Water Portal, 2024). Due to over-extraction and changes in urban land use, high-density northern and eastern zones have become high-risk areas vulnerable to cyclical shortages.

The city's dependence on surface reservoirs, such as the Siruvani and Pillur dams, has grown more vulnerable. The Coimbatore Municipal Corporation was forced to build 23 new borewells and send out 27 water tankers to cover emergency needs after Siruvani's storage fell to just 18 feet in March 2024 (The Hindu, 2024). However, as a result of ongoing groundwater exploitation, several borewells in the city today reach depths of more than 1,000–1,500 feet (Reddit, 2024a). The urban population is extremely susceptible due to this fluctuation, even though supplies were momentarily restored by seasonal monsoon rainfall in June 2025 (Times of India, 2025).

This material scarcity has increasingly given rise to eco-anxiety which is a form of climate-related psychological distress rooted in chronic uncertainty and lack of control. Especially when the drinking water supply is available once every two weeks, residents of water-stressed places have reported feeling emotionally exhausted, anxious, and tense at the community level (Reddit, 2024b). These experiences align with environmental psychology research that links water insecurity to collective emotional disruption and anticipatory stress (Jeni & Nayar, 2024).

Declining water quality also adds to this mental and physical stress. Particularly in peri-urban and slum regions, pollutants including nitrate, TDS, and salinity have increased along with groundwater depths, increasing the threats to public health and escalating eco-anxiety (New Indian Express, 2024). Thus water scarcity is a serious psychological stressor particularly when it is systemic and chronic.

In these situations, eco-anxiety stems from a deeper feeling of systemic collapse—the concern that the ecosystem is deteriorating beyond human control—rather than just personal inconvenience. The daily stress of managing limited resources in Coimbatore, particularly in lower-income neighbourhoods, becomes a psychosocial burden. Due to their increased caring responsibilities, disruption of their schooling, and physiological fragility, children, women, and the elderly are disproportionately affected (Searle & Gow, 2010).

An NGO in Coimbatore called Siruthuli has used public awareness of the water problem to organise extensive community initiatives, like as desilting tanks, constructing recharge wells, and promoting rainwater harvesting (Siruthuli, 2023). These grassroots initiatives serve as an example of how, with the help of local knowledge systems and participatory platforms, communities under environmental stress may progress towards proactive climate adaptation.

Moreover Ford and King's (2015) research highlights psychological factors like risk perception, emotional investment, and collective efficacy as mediators between awareness and action in climate adaptation readiness frameworks. Therefore, even if it is distressing eco-anxiety induced by water scarcity may provide a crucial emotional signal for changing behaviour and policy. Eco-anxiety can be understood as a functional reaction to environmental hazard, driving people and institutions towards sustainable, adaptable futures and make them ready for changing climate adaptation. With this objective the present research concentrates on the level of ecoanxiety among the participant with their climate adaptation readiness and the various proactive behaviours being adopted and how far technological adaptation is being used.

OBJECTIVES

The primary objectives of this study are as follows:

- To explore the contribution of water scarcity on eco-anxiety among the population residing in High- Risk Water Zones
- To identify the relationship between eco-anxiety and climate adaptation readiness in populations living in high-risk water zones
- To examine the proactive behaviours adapted as a part of climate adaptation readiness by the populations living in high-risk water zones
- To identify and analyse the role of cutting-edge technology in climate adaptation readiness in high-risk water zones and how that help to be prepared for climate change without water scarcity.
- To provide insights into policy approaches such as including mental health support, behaviour change strategies, and advanced technologies to address eco-anxiety and promote climate resilience in high-risk water zones

LITERATURE REVIEW

The Noyyal River in Coimbatore is heavily polluted due to domestic and industrial waste disposal, causing groundwater degradation (Priya et al., 2011). Unscientific agricultural practices have led to the degradation of water quality, making it unfit for various uses (Priya et al., 2011). Population growth, and urbanization have increased water demand, resulting in an imbalance between supply and demand (Liu & Zhao, 2020).Climate change has also altered precipitation patterns, reducing rainfall and decreasing groundwater recharge, further exacerbating water scarcity. Addressing these issues is crucial for addressing water scarcity in the 21st century.("Scarcity of water in the twenty-first century: problems and potential remedies", 2023)

Eco-anxiety is a feeling of helplessness, fear, and worry linked to environmental deterioration, particularly in urban areas with water scarcity (Boluda-Verdu and Senent-Valero, 2022). Women and children are particularly susceptible, as they often bear the primary responsibility for securing water (Rothschild and Haase, 2023). This lived reality can lead to psychosomatic symptoms, increased domestic conflict, and reduced quality of life. Water scarcity impact impacts sleep patterns and academic performance in younger population (Mondal, Kar, and Bagchi, 2024) and in India water scarcity leads to emotional fatigue and cognitive disengagement along with eco-anxiety as a symptom of environmental degradation (Bhaskaran and Muralidharan, 2025)

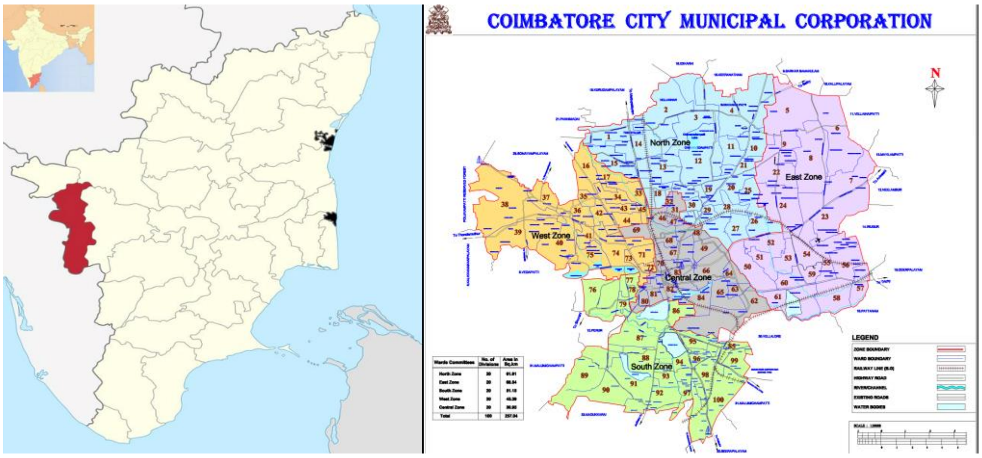
It's interesting to note that not all research views eco-anxiety as entirely negative. According to Betro' (2024), psychological discomfort may motivate local adaptation efforts provided it is recognised and encouraged. This highlights the possibility of converting eco-anxiety into eco-hope and positive climate action. This is consistent with previous research by Ojala (2012), which found that emotionally invested communities are more likely to be adaptable and supportive of sustainable practices. Hickman (2024) view eco-anxiety as a reasonable reaction to actual dangers. She contends that coping strategies including awareness, collaborative action, and mindfulness aid people in moving from anxiety to agency.

DATA AND METHODS

The Study Area

Coimbatore city is located in the western part of Tamil Nadu, India, and is administratively divided into five zones: North, South, East, West, and Central (Figure 1). The Central Zone, heavily urbanized and densely populated, experiences acute water stress due to high demand and limited recharge zones. The North and East Zones, including industrial areas, face water scarcity due to over-extraction of groundwater and limited surface water supply. The South and West Zones, with green cover and lower population density, have better groundwater recharge rates but are still vulnerable to seasonal shortages.

Figure 1



Regional setting and five zones of Coimbatore city (source: CCMC)

DATA COLLECTION AND DATA ANALYSIS

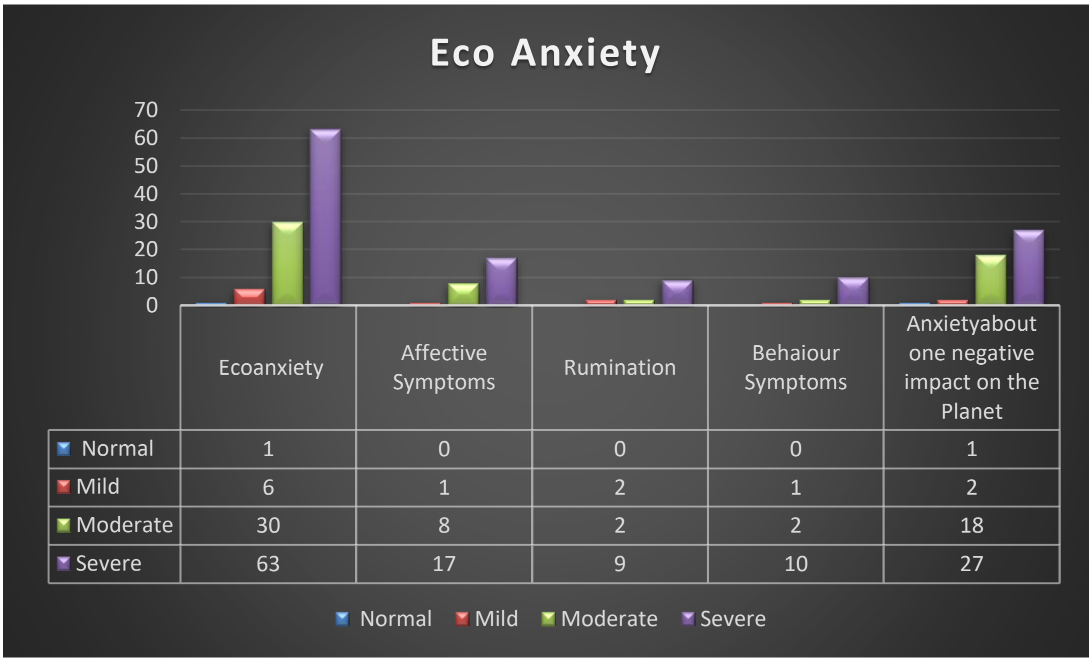
Across the five zones, a purposive sample of 100 participants from diverse socioeconomic backgrounds was selected to assess levels of eco-anxiety related to water scarcity using the Hogg Eco-Anxiety Scale (HEAS-13), developed by Teaghan Hogg, Samantha Stanley, and Léan O'Brien. To further explore dimensions of climate adaptation readiness, including the coping mechanisms and strategies adopted by the population, a qualitative approach was also incorporated. Primary data were collected through in-depth interviews, conducted either directly or via telephone, allowing participants to share their experiences, adaptation behaviours, and personal strategies in a detailed and open manner. This mixed-method approach enriched the study by capturing both quantitative levels of eco-anxiety and the nuanced, lived realities of individuals navigating climate-related water stress.

The interview guide was carefully crafted in alignment with the study's research objectives and key themes emerging from the literature review. It was structured to encourage participants to share detailed narratives about their experiences with eco-anxiety stemming from water scarcity and climate change, as well as their readiness for climate adaptation, strategies employed, and coping mechanisms. Through the use of probing questions, participants were prompted to reflect on their emotional responses, adaptive behaviours, and how these proactive efforts contribute to sustainability within high-risk water zones.

The quantitatively collected data on eco-anxiety were analysed and statistically correlated to explore its relationship with climate adaptation readiness. Simultaneously, the qualitative interview data underwent thematic analysis to uncover patterns, themes, and deeper insights within the participants' narratives. The analysis began with researchers immersing themselves in the interview transcripts to gain a comprehensive understanding of the content. This was followed by a systematic coding process, where segments of data were labelled according to key themes such as eco-anxiety, components of climate adaptation readiness, lived experiences, and adaptation strategies implemented with or without advanced technologies. These initial codes were then grouped into broader themes that reflected participants' coping mechanisms and adaptive behaviours in response to water scarcity and climate stress. The emerging themes were carefully reviewed and refined to ensure clarity and coherence, capturing the nuanced realities of individuals in high-risk water zones. Finally, the themes were interpreted in relation to the study's objectives and broader theoretical frameworks, offering valuable insights into how eco-anxiety influences adaptation readiness and how communities utilize both traditional and technological approaches to enhance resilience in high risk water zones.

RESULTS AND DISCUSSION

Figure 2

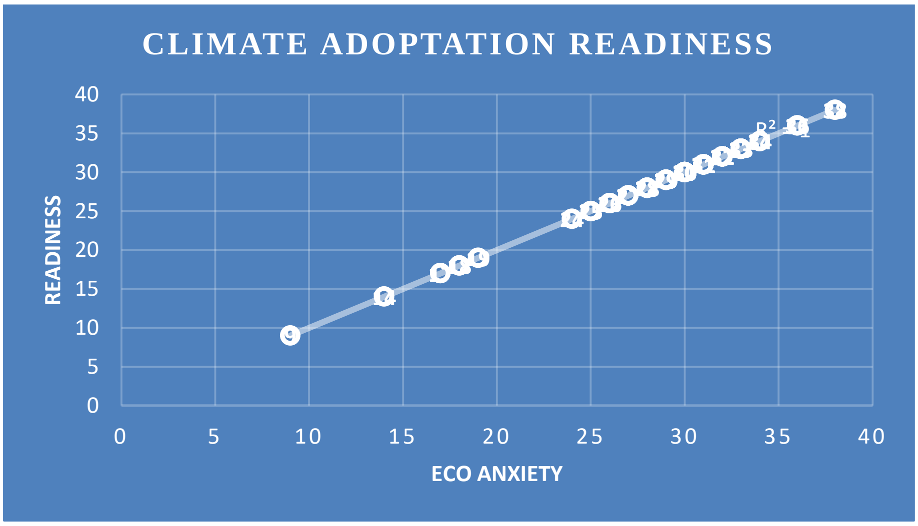


	Ecoanxiety	Affective Symptoms	Rumination	Behaiour Symptoms	Anxietyabout one negative impact on the Planet
Normal	1	0	0	0	1
Mild	6	1	2	1	2
Moderate	30	8	2	2	18
Severe	63	17	9	10	27

Level of Eco- anxiety across various dimensions due to Water Scarcity

The graph in Figure 2 illustrates the contribution of water scarcity on eco-anxiety among the population residing in High- Risk Water Zones across the level of Normal, Mild, Moderate and Severe. It also depicts the distribution over the dimensions of Eco- anxiety relating to its Affective Symptoms, Rumination, Behaviour Symptoms and Anxiety about ones negative impact on the planet. In all the dimensions of Eco – anxiety a Severe level is being observed among the majority of participants which pay the attention towards climate adaptation readiness.

Figure 3



The scatter plot diagram on figure 3 illustrates the relationship between Eco-Anxiety (x-axis) and Readiness (y-axis) based on empirical data. The data shows a positive correlation between eco-anxiety and climate adaptation readiness, with individuals reporting higher levels of anxiety indicating increased readiness to adapt to climate change. According to the regression line, or line of best fit, there appears to be a linear link between eco-anxiety and readiness scores. The data offers support to the hypothesis that eco-anxiety could encourage adaptive behaviour rather than act as a barrier. People may be more inclined to take preparatory actions if they are worried or distressed about the impact of climate change, particularly when it comes to water scarcity. Individuals who score higher in eco-anxiety Instead of being immobilised are becoming more proactive, informed, and responsive to climate adaptation strategies—especially in high-risk zones like Coimbatore.

Table 1

Method of Readiness Adaptation	**% of participants Adopting or ready to Adopt such methods**
Blue-Green Infrastructure	72
Urban Water Infrastructure	66
Governmental and Institutional Support	55

Sustainable Agricultural Water Use	40
Technological Innovations in Water Governance	52

Through a five-phase thematic process familiarization, coding, theme generation, theme reviewing, defining/naming themes, and reporting six dominant themes were constructed to understand how Coimbatore is adapting to water scarcity through tangible, local interventions. Each theme includes relevant sub-themes derived from real-life strategies and Table 1 depicts the percentage of population adopting and believe in such adaptation to overcome Water scarcity.

Sub Theme1: Blue-Green Infrastructure:

Coimbatore residents has actively embraced blue–green infrastructure approaches to restore its ecological balance and enhance urban water resilience. By integrating natural systems into city planning, these initiatives improve water quality, reduce water scarcity and support biodiversity.

Adopted Method	**Methodology and Usage**
Modular Rooftop RWH and Storage Tanks for both Industrial & Domestic purpose.	Modular rooftop rainwater harvesting systems with filters and above-ground storage tanks are available from regional vendors like Vikas Pumps. Rainwater collected is either channelled into recharge pits to replenish groundwater or retained for everyday non-potable uses (cleaning, irrigation).
Integrated Collection and Recharge Structures	In certain residences, rainwater from the courtyard and rooftop is directed through pipes into deep recharge pits that are linked to subterranean aquifers. Nearly half of the houses in Chettipalayam hamlet followed this style, which was widely observed and reduced water scarcity especially in summer.
Percolation Tanks for Groundwater Replenishment	Near dwellings, specialised percolation tanks have been built. These walled trenches reduce runoff for better penetration. In order to maximise recharging during periods of high rainfall, these are frequently combined with rooftop systems.
Residential & School-Based Recharge Shafts and Campus-Level RWH	Artificial RWH shafts that are excavated 100–300 feet deep and effectively drain rainfall directly into subterranean strata are now a feature of Coimbatore's government schools.Rainwater runoff from sidewalks and roads is directed into recharge pits that are connected to decommissioned borewells at various Coimbatore college campus , efficiently collecting monsoon flow and supplying aquifers. Furthermore, rooftop systems collect rainfall and store it in geo-membrane tanks and sump pumps. The treated water is then used for flushing, cleaning, and gardening.

Bioswales and Permeable Paving	Although Coimbatore has not yet implemented specific home bioswale programs, the Corporation's pond-side green cover projects and the Avinashi elevated corridor greening are examples of municipal initiatives that demonstrate the strategic use of blue-green infrastructure.
Green Roofs and Vertical Gardens	BuildScape, a Coimbatore-based firm, installs green roof systems on residential terraces, (Vadavalli, Mr. Narayanaswamy's residence) reducing indoor temperatures by 0.2-0.4°C, adding insulation, and enhancing biodiversity. Terrace vegetable gardens are adopted by homeowners in Coimbatore, offering local cooling, fresh organic produce, and stress reduction. Vertical living walls, pre-grown with plant media and drip-irrigation systems, serve as natural insulation, improve air quality, and are ideal for compact urban homes. These eco-friendly solutions contribute to a more sustainable and eco-friendly lifestyle.
Mini Urban Forests / Miyawaki Patches	Mini urban forests or Miyawaki patches in Coimbatore are a growing trend in the city, showcasing native saplings planted in close proximity to parks, lake edges, or housing society grounds. These patches offer biodiversity enhancement, microclimate regulation, rainwater infiltration, and psychological well-being.. These initiatives proved climate adaptation readiness and aesthetics in urban areas.
Greywater Recycling Systems	Coimbatore's gated communities and apartment complexes are implementing greywater recycling systems to conserve water, reduce municipal dependency, and promote sustainability. The case of Mount Rain Drops Apartments installed an STP-based system in 2018, treating 80,000L of wastewater daily. The treated water is reused in toilets and gardening, with plans to upgrade and potentially sell surplus water to nearby industries.This on-site greywater systems reduces freshwater consumption by up to 35-50%.

Sub Theme2: ***Urban Water Infrastructure:***

The foundation of Coimbatore's reaction to increasing water demand and climate-induced variability is its urban water infrastructure. Rapid urbanisation has put strain on the city's traditional supply networks, necessitating robust substitutes. Increasing efficiency, lowering losses, and guaranteeing fair access across various socioeconomic zones are the goals of strategic investments in supply augmentation, monitoring technology, and decentralised storage systems. Coimbatore's initiatives show how a developing city may sustainably manage its long-term water needs by combining technology with natural methods.

Adopted Method	Methodology and Usage
Smart Metering	Deployment of GIS-based smart meters to monitor household consumption and detect leakages.
Water Source Augmentation	Coimbatore Pillur-III project delivering an additional 270,000 m³/day under a privatized contract.
Stormwater Management	Desilting of 250 km of stormwater drains and coordinated UGD implementation in Kurichi.
Lake Rejuvenation	Ecological restoration of lakes like Singanallur including bunding and biodiversity zones.
Rainwater Harvesting	Mandating rooftop rainwater systems in all new and retrofitted buildings to recharge aquifers.

Sub Theme3: Governmental and Institutional Support

Strategic governmental policies and robust institutional frameworks have strengthened Coimbatore's ability to adapt effectively to climate change. In addition to facilitating the coordination of infrastructure and funding, these policies also facilitate cross-sectoral cooperation, such as alliances with international organisations and non-governmental groups.

Adopted Method	Methodology and Usage
Smart Water Monitoring (IoT + SCADA)	Chenan Nagar's smart water network uses IoT and SCADA for real-time leak detection, reducing non-revenue water by 30-50%, and entire Coimbatore water network has been GIS mapped with support from SUEZ India to detect losses and optimize supply zones.
Sewage Reuse for Non-Potable Applications	Decentralized sewage treatment plants recycle wastewater for non-drinking reuse and aquifer recharge at Vellakinaru Pond and also with STPs supporting wetland revival at Ukkadam, Narasampathy, and Selvachinthamani.
Infrastructure Expansion for Equitable Water Distribution	Five new 30,000L overhead water tanks are being built in each city zone to mitigate storage-related shortages, while the 24x7 Water Supply Scheme (funded via AMRUT and World Bank) aims to connect 80% of Coimbatore households by late 2025.Refurbishing old borewells as recharge shafts in over 100 locations before monsoons are also being laid.
RWH Policy Mandate	The Tamil Nadu Urban Local Bodies Act mandates rainwater harvesting systems in all buildings. Coimbatore City Municipal Corporation has constructed over 1,000 RWH structures, implemented Mobile apps to track RWH system health, promoting increased aquifer recharge and reduced water tanker dependency.
Waterbody Restoration and Groundwater Recharge	Lakes Sanganallur, Ukkadam, Periyakulam, and Valankulam are being desilted and revived in partnership with Siruthuli - Coimbatore’s lead NGO and Smart City Corporation, causing groundwater levels to rise up to 13.9 meters.

Sub Theme 4: Sustainable Agricultural Water Use

Farmers in Coimbatore's peri-urban zones have increasingly adopted multiple methods, often with government or NGO support. These help in optimize irrigation timing and reduce water wastage. Watershed-based conservation structures such as bunds, trenches, and check-dams are being implemented to capture rainwater and boost soil moisture retention.

Adopted Method	Methodology and Usage
Rainwater Harvesting and Groundwater Recharge	Farmers in the outskirts of Coimbatore, such as Chettipalayam, Thondamuthur, and Perur, actively use farm-level rainwater harvesting structures: Deep recharge shafts and percolation pits capture rainwater from fields and roofed animal sheds.
Precision Irrigation (Drip and Sprinkler Systems)	With the support by TNAU's Precision Farming Development Centre in Coimbatore farmers are utilizing drip irrigation and fertigation for crops like banana, tomato, guava, and vegetable, reducing water use by 30-50% and improving yield.Some use greenhouse farming with automated drip controls and soil moisture sensors, minimizing water waste.
Crop Diversification and Agroforestry	Farmers in Salaiyur are transitioning from high-water-demand crops to millets, pulses, amla, and banana, enhancing soil cover and income security through agroforestry-based farming. Tamil Nadu IAMWARM scheme promotes smart irrigation tech adoption in Coimbatore blocks
Smart Irrigation Tools	Use of IoT-based soil moisture sensors to guide watering schedules and prevent overuse.
Wastewater for Irrigation	Use of treated effluent from local STPs to irrigate non-edible crops during dry spells.

Sub Theme 5: Technological Innovations in Water Governance

The integration of technology into water governance has allowed Coimbatore to transition toward more efficient, transparent, and responsive management systems. These innovations focus on real-time monitoring, data-driven decision-making, and predictive modeling for sustainable urban water planning.

Adopted Method	Methodology and Usage
Smart Metering and Flow Controls	Deployment of GIS-based smart meters to monitor household consumption and detect leakages. Coimbatore Municipal Corporation issued a tender for bulk flow meters and SCADA (Supervisory Control and Data Acquisition) systems in new wards, including electromagnetic valves and district metering areas. The system includes automatic consumption data for leak detection and equitable billing. The Corporation has also partnered with SUEZ India to map pipelines, tanks, and consumer networks, enhancing infrastructure monitoring and leak detection.

IoT-Enabled 24/7 Smart Water Networks	In Cheran Nagar, Kavundampalayam, the city piloted Tamil Nadu's first IoT-based water supply system, developed by PSG College and Smint TIQ, divides local supply into metered zones, tracks consumption, ensures equal flow per household, and allows remote shut-off and leak detection.
Groundwater Simulation Models	Researchers in Coimbatore have used MODFLOW and MT3DMS for pollutant transport simulations, focusing on the Noyyal River basin. Human-influenced water quality was modelled in urban tank systems, identifying pathways of leachate infiltration.
Decision-Support Platforms	Data-driven dashboards and planning systems for city officials to allocate resources effectively.

Conclusion

The current study of high risk water zones of Coimbatore provides a powerful lens through which the intersection of water scarcity, eco-anxiety, and climate adaptation readiness can be understood. As urban water challenges intensify due to over-extraction, erratic monsoons, and infrastructural inadequacies, they not only disrupt physical access to resources but also leave profound psychological imprints on vulnerable populations. This study demonstrates that, when used constructively, eco-anxiety can actually stimulate adaptive behaviours rather than paralyse them. The transformative power of emotional engagement with environmental crises is shown by the positive link found between eco-anxiety and climate adaption readiness, as demonstrated by both quantitative and qualitative data. Coimbatore residents are adopting traditional and technological solutions like rainwater harvesting and IoT-enabled metering to mitigate water stress and foster resilience. Institutional policies and grassroots efforts demonstrate the importance of local knowledge and community engagement in sustainable urban transformation.
In conclusion, the study of high-risk water zone like Coimbatore is a prime example of how an integrated, data-driven, and emotionally-informed approach to water administration may enable both institutions and communities to confront climate uncertainties. Understanding eco-anxiety as a warning sign and a source of inspiration could be crucial in influencing systemic policy changes and sustainable futures in addition to individual behaviour.

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Author Contributions

Seethalakshmy Anantharaman: conceptualization, formal analysis, writing the original draft, data collection, software, methodology. **S. N. Suresh**: formal analysis, writing review, investigation, software, and methodology.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was reviewed and approved by the Institutional Ethics Committee of Rathinam College of Arts and Science, Coimbatore. All procedures followed the ethical standards of the institution. Participants were recruited from five high-risk water zones in Coimbatore through purposive sampling. Prior to participation, each individual was informed of the study's objectives, voluntary nature, confidentiality measures, and their right to withdraw at any point. Written informed consent was obtained for survey participation and verbal informed consent was secured for telephonic and in-depth interviews. All data were anonymized and handled with strict confidentiality.

DATA AVAILABILITY STATEMENT

The datasets analysed during the current study are not publicly available. The data are made available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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