Documentation on

Stakeholder Consultation on Urban Aquifer Management & Water Governance in Kerala

Athens, TAJ VIVANTA, Thiruvananthapuram, Kerala

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Prepared by

AMRUT, Kerala

Stakeholder Consultation on Aquifer Management & Water Governance in Kerala

April 29th 2024

Organized by

State Mission Management Unit, AMRUT

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1 Programme Schedule

Date : 29th April 2024			**Venue :TAJ VIVANTA, Thiruvananthapuram**
Time		**Programme**	
09:30 AM	10:00 AM	Registration	
10:00 AM	10:45 AM	Welcome, Introduction, and Context of the Meeting	
		Inaugural Address	Dr. V.K Baby IAS(Rtd), Advisor to Government (Water Resources)
10:45 AM	12:00 PM	Experience sharing on Urban Aquifer Management Plan of Thiruvananthapuram	Smt. Mini Chandran, Regional Director, Central Ground Water Board, Kerala Region
12.00 PM	12.15 PM	Refreshments	
12.15 PM	01.00 PM	Presentation on Urban Water Security in Kerala	Shri. Mathews Mullackal, Senior Water Specialist, World Bank Group

01:00 PM	02:00 PM	Panel Discussion	**Aquifer Management & Water Governance** Moderator-Dr. V.K Baby IAS(Rtd), Advisor to Government (Water Resources) Panel 1. Smt. Mini Chandran, Regional Director, CGWB, Kerala Region 2. Shri. Mathews Mullackal, Senior Water Specialist, World Bank Group 3. Rathish, Chief Engineer (Rtd) KWA 4. Dr. Babu Ambat, Executive Director, Centre for Environment and Development, Thiruvananthapuram 5. P. K Kurian, Research Scholar
02:00 PM	02:45 PM	Lunch	
02.45 PM	03.10 PM	Presentation on OECD Principles	Dr. V.K Baby IAS (Rtd), Advisor to Government (Water Resources)
03.10 PM	04.15 PM	Group Discussion on Thematic Areas	Participants
04.15 PM	04.45 PM	Presentation and Conclusion	Group leaders

2 Introduction - Background:

Kerala hailed for its lush biodiversity and distinctive geographical features, grapples with a paradoxical reality: abundant rainfall juxtaposed with challenges of water scarcity and pollution. The state's urbanization, burgeoning population, and the specter of climate change-induced floods and droughts underscore the critical imperative for robust water governance and efficient aquifer management. Recognizing this urgency, stakeholders must converge to navigate these complex water-related issues.

Against this backdrop, this proposed workshop endeavors to delve into the multifaceted dimensions of aquifer management and water governance in Kerala. By examining the intricate interplay between ecological, social, and economic factors, we seek to illuminate pathways toward sustainable development in the realm of water resources.

Our ultimate goal is to discover actionable strategies that can steer Kerala towards a future where water is managed equitably, sustainably, and with resilience. This involves exploring the challenges and opportunities that come with the nexus of aquifer management, water governance, and integrated water resource management. As sustainable solutions, we propose the concept of artificial recharge of aquifers to replenish groundwater levels and ensure long-term water security. In addition, efficient reuse of water can minimize wastage and reduce the burden on existing water resources. We also suggest the implementation of rainwater harvesting tanks to collect and store rainwater for later use. Through dialogue, collaboration, and shared learning, we can work towards a future where Kerala's water needs are met efficiently and sustainably, with a focus on equitable distribution and resilience in the face of climate change.

The Stakeholder Consultation on Aquifer Management and Water Governance in Kerala, orchestrated by the State Mission Management Unit (SMMU) of the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) within the Local Self Government Department, stands as a significant endeavor towards addressing the intricate water challenges prevailing in the state.

This proposed panel discussion and brainstorming session emerged as a culmination of the insights garnered from the stakeholder consultation. It delineates the pivotal role of aquifer management and adherence to the OECD principles of water governance in fostering water security and sustainable development in Kerala. The Stakeholder Consultation on Aquifer Management and Water Governance in Kerala witnessed active participation from a diverse

array of delegates and officials representing various departments and organizations. Their collective engagement underscores the comprehensive and inclusive nature of the discussions held during the consultation. Here are some of the notable participants:

1. Kerala State Pollution Control Board
2. Central Groundwater Board
3. Kerala State Electricity Board Ltd.
4. Irrigation Department
5. Centre for Water Resources Development and Management (CWRDM)
6. Kerala Agricultural University
7. Kerala Rural Water Supply and Sanitation Agency (KRWSA) - Jalanidhi
8. Swachh Bharat Mission (SBM)
9. Kerala State Planning Board
10. Kerala State Council for Science, Technology, and Environment
11. Kerala State Disaster Management Authority (KSDMA)
12. Kerala State Industrial Development Corporation (KSIDC)
13. Directorate of Soil Survey & Soil Conservation
14. National Bank for Agriculture and Rural Development (NABARD)
15. National Centre for Earth Science Studies (NCESS)
16. Department of Environment and Climate Change, Kerala
17. Haritha Kerala Mission
18. Kerala State Remote Sensing and Environment Centre
19. Kerala State Groundwater Department
20. Kerala Water Authority
21. IMPACT
22. Kerala State Land Use Board
23. Kerala Industrial Infrastructure Development Corporation (KINFRA)
24. SMART CITY
25. WASH Institute
26. Urban Local Self-Government Department
27. Kerala State Small Industries Association
28. Kerala State Biodiversity Board
29. UL Technology Solutions

The breadth and depth of participation from such a wide range of stakeholders demonstrate the collaborative spirit and collective commitment towards addressing the multifaceted challenges related to aquifer management and water governance in Kerala. Their contributions and insights have been instrumental in shaping the discussions and charting a path forward towards sustainable water management practices in the state.

3 Inaugural Address

Time: 10:15 AM - 10:45 AM

Shri Rajamanickam IAS Opened the workshop on urban water security, welcomed attendees to the brainstorming session. Among the distinguished guests present were Shri V K Baby IAS (Rtd), Advisor to Government (Water Resources), Smt. Mini Chandran, Regional Director, CGWB, Shri. Mathew Mullackal, Senior Water Specialist, World Bank and Shri. Babu Ambat, Executive Director, Centre for Environment and Development, Thiruvananthapuram along with Shri.Ratish, Chief Engineer (Rtd) KWA.

The session commenced with Shri Rajamanickam IAS' introductory remarks, setting the tone for the discussions ahead, emphasizing the significance of collaborative efforts in addressing urban water security challenges. The attendees were encouraged to actively participate in the forthcoming discussions to formulate effective strategies and solutions. Each participant provided insights into the critical aspects of urban water security, paving the way for a productive exchange of ideas.

Figure 3.1: Inaugural Program: Shri Rajamanickam IAS addressing the audience during the opening ceremony

Dr. V K Baby's emphasis on urban water security underscores the critical need for comprehensive management strategies beyond mere infrastructure development. He stresses the significance of strengthening urban local bodies is vital, incorporating considerations of design flaws in drainage systems to enhance aquifer management. He rightly advocates for scientifically informed political decisions, recognizing the intricate balance between rural and urban water needs. He highlights the advantages of implementing water reuse practices to alleviate demand pressures, aligning with sustainable resource management principles. Dr. VK Baby's emphasis on careful oversight within local governing bodies resonates, urging incremental yet irreversible improvements in capacity building. Initiatives such as those in New Delhi for sewage management serve as examples of effective water resource management practices, illustrating the potential for positive change through concerted efforts at the grassroots level.

Figure 3.2: Dr VK Baby - Addressing Urban Water Security and the necessity for better management over infrastructure development to ensure sustainable water resources

Smt. Mini Chandran emphasized the necessity of conducting detailed surveys and gap analyses to better understand the disparities between water demand and supply. She proposed the implementation of resolutions focusing on the reuse of greywater, suggesting the establishment of a plant dedicated to processing and repurposing greywater for non-potable uses. This initiative aims to decrease freshwater consumption and alleviate the pressure on urban water systems. Following these remarks, the workshop was officially inaugurated, leading into a

brainstorming session to address these critical water management challenges and Shri Rajamanickam IAS concluded the session.

4 Technical Session I - Experience sharing on Urban Aquifer Management Plan of Thiruvananthapuram

Time: 10.45 am – 12.00 pm

Speaker	Smt. Mini Chandran, Regional Director, Central Ground Water Board, Kerala Region

Smt. Mini Chandran presented findings from the implementation of a granularity scale, specifically examining the inorganic constituents in Trivandrum, spanning an area of 215 square kilometers with an annual rainfall of 1700mm. The study primarily investigated the effects of urbanization on the groundwater regime of the Thiruvananthapuram Municipal Corporation. It delved into various aspects of aquifer characteristics, with a focus on sustainability considerations across different seasons, particularly during the summer monsoon. The analysis involved aquifer mapping utilizing thematic layers such as hydrogeology, geomorphology, drainage patterns, drainage density, soil types, slope, and isopach.

The NAQUIM 2.0 toolkit outlines comprehensive deliverables for managing groundwater resources, including assessing aquifer dispositions, monitoring groundwater levels per aquifer, identifying recharge areas crucial for sustaining reserves, refining resource assessment parameters, evaluating groundwater resource quality, identifying subsidence-prone areas, implementing management interventions like delineating safer aquifers, developing artificial recharge plans, implementing additional measures, prioritizing identification of potential aquifers for drinking water supply, ensuring long-term sustainability, and providing recommendations for addressing water logging issues, thereby offering a comprehensive approach to groundwater management.

Based on geophysical survey data, analysis of key well locations, and water quality sampling both before and after the monsoon season, various parameters including basic characteristics and heavy metal content were examined. This data facilitated the creation of a conceptual model detailing aquifer dispositions. This analysis involved identifying aquifer types, formations, depths (both top and bottom of aquifers in meters below ground level), thickness or presence of fractures (in m), range of yield (in m3/h), sustainability (in hr), and aquifer parameters such as transmissivity (in m2/day). Isopach dug

wells and weather thickness were also analyzed, revealing thickness ranges of 10-15 meters in certain areas.

Geophysical studies further informed the assessment, with measurements of apparent resistivity at depths of 10m, 20m, 30m, and 40m. High resistivity values in the northern coastal areas at shallow depths suggested alluvial sand, while low to medium resistivity values in the central and southern regions at deeper depths indicated groundwater potential. Examination of curves, VES type curves, geoelectric resistivity, and TEM pseudo sections collectively contributed to identifying zones with high groundwater potential. Results indicated good groundwater potential in the North and North Eastern areas and medium potential in the Central parts of the urban areas.

Additionally, the reflection coefficient provided insights into the degree of fracturing in the underlying basement, supplementing the interpretation beyond mere resistivity values. Potential aquifers were identified where either the overburden thickness was high or the reflection coefficient was low (<0.8).

Figure 4.1:Smt. Mini Chandran, Regional Director, Central Ground Water Board, on her presentation on Experience sharing on Urban Aquifer Management Plan of Thiruvananthapuram

From the identified groundwater potential zones, detailed aquifer-wise water level data were gathered, encompassing both phreatic and confined aquifers, using hydrographs. The implementation of the Bhujal App, which tracks water levels in bore wells, ensured an impressive water level accuracy of 99%, facilitating the creation of water table fluctuation maps and hydrographs. Analysis revealed that

the phreatic aquifer in the area exhibited a delayed response to rainfall, while deeper aquifers showed a rising trend. Recharge in these aquifers is predominantly controlled by fractures in the bedrock.

Further analysis focused on understanding the response of aquifers to rainfall, using high-frequency data of water level versus rainfall versus time. The characteristics of these hydrographs indicated that recharge typically occurs via preferential flow paths such as extensional fault zones. A strong relationship was observed between the amount of rainfall, groundwater abstraction, and aquifer response. The majority of water storage was found to be in the fractured bedrock, leading to sharp fluctuations in water level. Moreover, if the water table rises rapidly in fractures relative to matrix permeability, the specific yield will be similar to fracture porosity.

This study resulted in the discovery of delineated patterns regarding the response of aquifers to rainfall in recharge areas and long-term groundwater trends. Various factors, such as topography, soil characteristics, recharge rates, aquifer media, and parameters, were considered in the analysis. A significant portion of the area, falling under the 5-10 meters below ground level (mbgl) category, indicated potential for artificial groundwater recharge, especially in the eastern part of the study area. Supplementary data from soil infiltration tests supported these findings, highlighting the delayed response of wells in phreatic aquifers during the rainy season.

The analysis enabled us to pinpoint recharge areas and calculate the total recharge, by utilizing the Tritium Injection method. This involved analyzing the infiltration rate curve at Vizhinjam. Additionally, the study evolved to refine parameters through an annual groundwater resource assessment, taking into account the relatively lesser dependence on surface water supply in Trivandrum. Storativity of the deeper aquifer was refined based on pumping tests, facilitating the assessment of groundwater resources and the identification of provisions for development where groundwater exists. The outcomes revealed substantial groundwater resources, including in-storage in the weathered zone and the fracture aquifer system, suggesting significant potential for sustainable groundwater use and management in the region.

Groundwater quality analysis based on the data revealed predominantly medium to low salinity and sodium hazard levels, with few exceptions exceeding acceptable limits. Principal Component Analysis (PCA) attributed most parameters to geogenic sources, with others linked to external factors like NO3 and K. Contamination sources included leaking sewer drains, stormwater runoff, and localized issues like E-coli contamination.

Recommendations to address contamination included treatment plants, infrastructure repairs, and on-site wastewater treatment. Groundwater quality management interventions proposed defining safer aquifers and implementing water quality indices. While most areas had good drinking water quality, some showed poor quality due to high EC.

An Artificial Recharge Plan was devised with the aim of replenishing groundwater, reducing scarcity, and preventing land subsidence. Complementing this plan, the implementation of a Dug Well Recharge Scheme promised benefits such as reduced scarcity, sustainable management, and environmental conservation. Recommendations encompassed sewage treatment improvements and innovative flood control measures to address waterlogging issues. Efforts toward drinking water sustainability, proposing treatment plants and strategies for water reuse. Integrating a dug well recharge scheme was proposed as a means to enhance overall water security.

In conclusion, a comprehensive water security plan has been crafted, prioritizing source sustainability. Anchored by an Integrated Urban Water Management approach, the plan aims to tackle emerging challenges and overcome spatial disparities in service delivery. It emphasizes the provision of quality service and the implementation of proactive measures to ensure the sustainability of water sources. Immediate actions involve the development of surface water bodies as alternative water sources and the renovation of identified tanks to enhance water availability during monsoons. Maintenance responsibilities for these tanks will be entrusted to local PRI/water user associations.

Looking ahead, the plan proposes the implementation of a dug well recharge scheme covering 100 sq km in peripheral urban areas to address long-term sustainability goals. The plan's findings underscore significant challenges, including coliform contamination, groundwater pollution, and the impact of urbanization on recharge patterns. Geophysical studies have identified potential groundwater zones, particularly in the north and northeastern parts of the study area. These findings, coupled with estimates of extractable groundwater resources, provide a foundation for informed decision-making. Ultimately, the water security plan serves as a roadmap for sustainable water management, emphasizing the integration of short-term actions with long-term strategies to safeguard water resources for present and future generations.

Discussion:

Following the study, the discussion commenced, with Shri. Rajamanickam IAS drew attention to significant changes in land use. Particularly the delineation of recharge areas through town planning. The Muttathara waste plant's Sewage Treatment Plant (STP) was noted for its success in reducing Biological Oxygen Demand (BOD) and promoting water reuse. Smt. Mini Chandran suggested opting for onsite treatment methods. Shri. VK Baby referenced Chennai's utilization of STP water for intake wells, suggesting its feasibility.

Suggestions were made to focus on managing coastal unconfined aquifers, especially in flood-prone areas. Attention was also drawn to shallow aquifers and the inclusion of salinity, emphasizing

sustainable groundwater use and surface water management for overall sustainability. Risk and mitigation assessments, particularly for aquifers with limited capacity, were deemed crucial.

The interdisciplinary approach was stressed for real implementation at the grassroots level, particularly involving local governments in managing groundwater resources and sub-surface water flow. It was suggested that real master plans and project implementation plans should be integrated, emphasizing an interdisciplinary approach.

Figure 4.2: Discussion on Urban Aquifer Management Plan of Thiruvananthapuram

Further discussions revolved around nutrient studies, storm water recharge, distinguishing between drains and sewerage, and addressing nitrate contamination. The importance of stakeholder consultation and participatory methods, as seen in projects like Akkulam and the Karamana report, was highlighted for balanced sewer line implementation and water resource recovery.

Shri Pradeep Kumar CS emphasized the importance of cost-effective wastewater treatment for industries. Shri. Narayanan Namboodiri, stressed the need for effective management of dug wells, especially in shallow aquifers, advocating for lining protection and proper design and implementation. Lastly, discussions touched upon the significance of managing septic tanks, soak pits, storm water, and sewage networks to mitigate bacteria growth and ensure effective water management.

5 Technical Session II - Presentation on Urban Water Security in Kerala

Time: 12.15 am – 01.00 pm

Speaker	Shri. Mathews Mullackal, Senior Water Specialist, World Bank

Water security entails ensuring safe, sufficient, and reliable water, sanitation, and hygiene (WSS) services for human well-being, supporting livelihoods, and driving economic activities across sectors such as agriculture, industry, tourism, and transport. It involves managing water resources sustainably, including both surface and groundwater, to maintain healthy ecosystems and services. Additionally, water security requires building resilience to water-related risks such as droughts, floods, and other climate-induced challenges to safeguard communities and economies. On this regard, Shri. Mathews Mullackal suggested several recommendations on Urban Water Security in Kerala such as Integrated water resource management, Governance and regulation, Reliable, efficient service delivery, Circular economy approach and Community engagement & behavior change.

Figure 5.1: Shri. Mathews Mullackal, Senior Water Specialist, World Bank on his presentation on Urban Water Security in Kerala

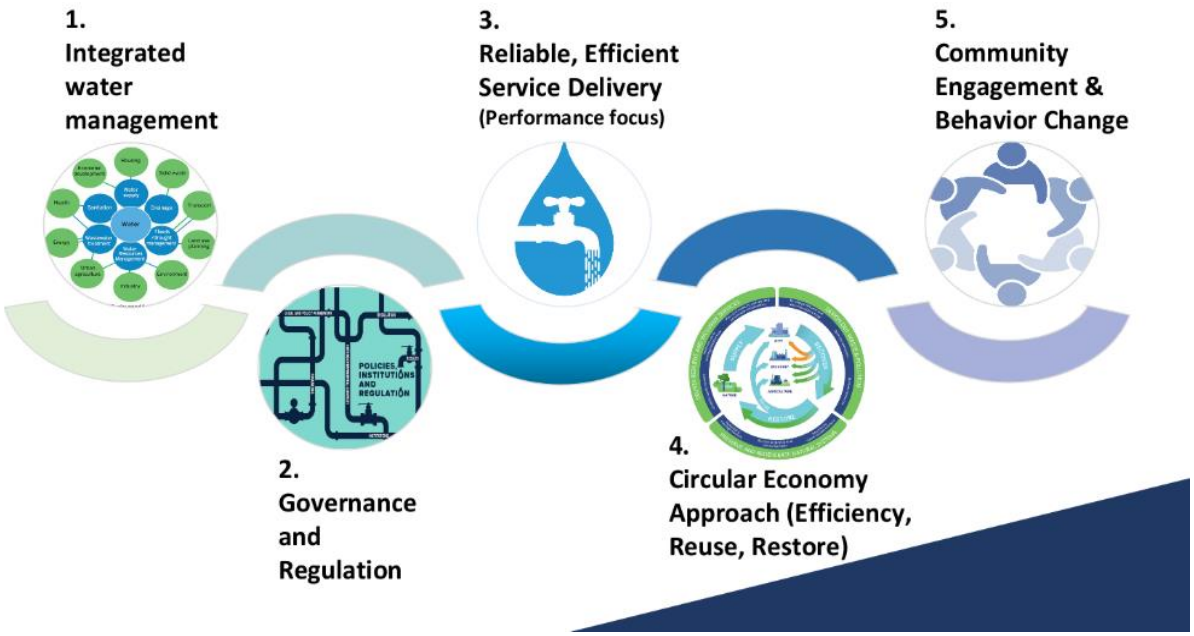

Figure 5.2: Shri. Mathews Mullackal-Urban water security in Kerala -Key Recommendations

Integrated water management at the basin level is essential for sustainable water governance, ensuring the holistic management of water resources across various sectors and stakeholders. Linking urban planning with river basins and upstream/downstream users is imperative to address the water needs of growing urban populations while maintaining the ecological integrity of water basins. This approach enables coordinated decision-making, efficient resource allocation, and the implementation of strategies that promote water security and resilience in both urban and rural areas within the basin.

Prioritizing water governance is crucial, necessitating a policy framework that adopts an integrated approach at the basin level while ensuring efficient service delivery. Institutions involved in water governance must possess sufficient autonomy, clarity of roles, accountability, and capacity to effectively manage water resources. Clear definition and independence of regulatory functions, coupled with transparency, are essential for effective governance. Strengthening regulation and monitoring are imperative for better management of aquifers, ensuring both quantity and quality of water from wells, enhancing rainwater harvesting, managing solid waste, and improving water supply and sanitation (WSS) service delivery.

Improving access to clean water and sanitation facilities requires investment in infrastructure upgrades, better management practices, community involvement, technology integration for efficiency, and stronger regulatory oversight. Capacity building for service providers, enhanced data management, and promoting sustainability practices are also crucial. Monitoring performance through metrics like monthly compliance of water quality, hours of water supply, water pressure, and customer satisfaction

levels are essential. An example of performance-based financing and operations in Uttarakhand was presented during the workshop as a model for achieving these goals.

Adopting a Circular Economy Approach, particularly Water in Circular Economy and Resilience (WICER), is imperative in addressing water sustainability challenges. WICER encompasses more than just reusing water; it entails diversifying water sources, ensuring efficient supply management, and promoting the reuse of wastewater for various purposes. Additionally, WICER focuses on recovering energy and nutrients from water systems, implementing rainwater harvesting and aquifer management practices, and preserving or restoring natural ecosystems. By embracing this holistic approach, communities can enhance water resilience and contribute to a more sustainable water future. Communities can contribute by diversifying water sources, promoting groundwater recharge, implementing greywater filtering and recharge systems, practicing urban farming to reduce water demand, and being willing to pay for quality water services.

Additionally, Urban Local Bodies (ULBs) play a crucial role in supporting community efforts. ULBs can monitor and guide the quality of wells, ensure efficient water supply and sanitation services, facilitate markets for urban farming, provide waste management services, implement Social Behavior Change Communication (SBCC) campaigns, and establish grievance management mechanisms to address community concerns effectively. Collaboration between communities and ULBs is essential for fostering a culture of responsible water use and ensuring sustainable water management practices at the local level.

Discussion:

During the discussions **Shri. Jehamgeer** pointed out the primary focus on the role of Urban Local Bodies (ULBs) as mandated by law. There was emphasis placed on the collection of data regarding greywater and black water for distribution in new lines. Additionally, the discussions explored utilizing rainwater and freshwater desalination for distributing new curves. The Integrated Command and Control Centre for Cities (ICCCA) was highlighted as instrumental in data monitoring, with the involvement of Haritha Karma Sena. It was underscored that the primary need in these endeavors is accurate and comprehensive data. Furthermore, the discussions leaned towards making compulsory the recharging of groundwater, including through dug wells, to address water scarcity and sustainability concerns effectively.

Figure 5.3: Participants engage in a focused discussion on strategies to address water security challenges in Kerala.

In conclusion, **Shri. A G Gopakumar** highlighted the critical need for a comprehensive database to conduct census programs under the National Hydrology Department, stressing the importance of analyzing various water parameters at the grassroots level with support from organizations like Kudumbasree. He underscored the urgency of implementing a water resource database at the grassroots level, proposing coordination of data collection efforts through a centralized portal facilitated by a designated nodal department. Additionally, Gopakumar emphasized the necessity of conducting yield tests for wells and prioritizing their recharging, considering their impact on localities and water intake. Moving forward, the implementation of a centralized portal for data collection and the concerted effort to recharge wells stand as essential steps in addressing pressing water management challenges across various levels.

6 Panel Discussion - Aquifer Management & Water Governance

Time: 1:00 pm - 2:00 pm

Moderator	Dr. V K Baby IAS(Rtd), Advisor to Government (Water Resources)
Panel	1. Smt. Mini Chandran, Regional Director, CGWB 2. Shri. Mathews Mullackal, Senior Water Specialist, World Bank 3. P. K Kurian, Research Scholar 4. Dr. Babu Ambat, Executive Director, Centre for Environment and Development, Thiruvananthapuram 5. Rathish, Chief Engineer(Rtd) KWA

The panel discussion on "Aquifer management and water governance was moderated by Dr. V K Baby IAS(Rtd),Advisor to Government (Water Resources). The panelists were; Smt. Mini Chandran, Regional Director, CGWB, Shri. Mathews Mullackal, Senior Water Specialist, World Bank, P. K Kurian, Dr. Babu Ambat, Executive Director, Centre for Environment and Development, Thiruvananthapuram, and Shri. Rathish, Chief Engineer (Rtd) KWA. More than 60 participants attended the panel discussion.

Dr. V. K. Baby, serving as the moderator, commenced the discussion by providing a brief introduction to the topic. He extended a warm welcome to the panelists and introduced them to the audience. Dr. V.K.Baby outlined the format of the discussion, which would consist of two rounds. Each speaker would be allocated four minutes for discussion in each round. The first round would center on discussing the primary challenges associated with aquifer management, while the second round would address key governance issues and offer recommendations pertinent to aquifer governance.

The panel discussion on challenges of aquifer management and governance, led by **Shri. Rathish,** highlighted critical issues and proposed actionable recommendations. Rathish emphasized the need for a comprehensive approach addressing quantity, quality, and sustainability factors in aquifer management. Key recommendations included implementing efficient waste management systems to preserve water quality, preventing excessive drainage through recharge mechanisms, and promoting artificial groundwater recharging initiatives. Additionally, he suggested decentralized waste management mechanisms, advocating for environmentally friendly building practices, regular monitoring, and integrating databases for better decision-making and proposed exploring the merger of the Kerala Water Authority with the Local Self Government Department to streamline utility services provision. These recommendations aim to address the multifaceted challenges faced in aquifer management and governance, ensuring sustainable water resource management in the region.

Following Shri. Rathish's insightful discussion, **Shri. Mathews Mullackal** further enriched the conversation by emphasizing the critical need to enhance service delivery mechanisms within aquifer management. He prioritized the proper installation of septic tanks and scheduled desludging practices to manage solid waste effectively, highlighting the importance of accountability in service delivery through performance-based monitoring systems. Mathews proposed a series of recommendations to bolster aquifer management efforts, including the establishment of a robust governance system to coordinate different agencies involved, implementation of comprehensive planning and monitoring processes, and development of community-level governance structures for grassroots engagement. Additionally, he emphasized the importance of local-level accountability mechanisms, oversight within local government bodies, and regular monitoring of onsite waste management systems. Mathews also suggested considering decentralized solutions for greywater management and prioritizing water supply quality, stormwater management, and solid waste management to ensure water resource sustainability. His recommendations aim to enhance aquifer management practices, promote effective resource utilization, and foster community involvement in the sustainable management of water resources.

Figure 6: Panel Discussion- Aquifer Management & Water Governance

Following Shri. Mathews Mullackal's discussion, D**r. Babu Ambat** offered additional insights into sustainable service delivery sourced from policy directives. He highlighted the importance of complete storm water recharge and advocated for decentralized storm water drainage systems to mitigate urban runoff's impact on aquifers. Dr. Ambat also emphasized the need for continuous water supply, referencing successful 24x7 water supply initiatives in municipalities and proposing a similar approach for Kerala. He suggested adapting decentralized sewage treatment plants (STPs) to the region's needs

and drew attention to the disparity between Kerala and Orissa in sewage treatment infrastructure, advocating for exploring alternative networking solutions. Additionally, the speaker advocated for a decentralized approach to greywater management and solid waste management. These recommendations complement Shri. Mathews Mullackal's proposals, aiming to enhance aquifer management practices and ensure sustainable water resource utilization in the region.

Following Dr. Babu Ambat's insights into sustainable service delivery for aquifer management, **Shri**. **P K Kurian** provided further recommendations tailored to address challenges specific to Kerala. He proposed breaking the myth of water abundance in the region to promote responsible water use and conservation practices. Additionally, Shri. Kurian emphasized capacity-building initiatives, advocating for the development of "barefoot professionalism" among local communities to enhance their ability to manage water resources efficiently. He also stressed the importance of promoting water literacy to increase public awareness and understanding of water-related issues. Furthermore, Kurian recommended addressing methodological crises within aquifer management practices and prioritizing water quality considerations to safeguard public health and environmental integrity. These recommendations complement Dr. Babu Ambat's proposals, offering a comprehensive strategy for tackling aquifer management challenges in Kerala and promoting sustainable water resource management practices.

Following Shri. PK Kurian's recommendations on addressing aquifer management challenges in Kerala, **Smt. Mini Chandran** provided further insights into a systematic and scientific approach to aquifer management. Chandran emphasized the tritium method for accurate assessment and identified potential issues such as water recharging leading to waterlogging, highlighting the necessity of a robust scientific database. She proposed implementing automated water level measurement systems, strategic storm water management techniques, and identifying recharge areas like paddy fields.

The speaker stressed the importance of balancing manpower and technology for effective aquifer recharge and advocated for studying the quantity and distribution of recharge into the aquifer system. She suggested developing site-specific recharge methods based on scientific data and referred to master plans created by relevant agencies for guidance. Furthermore, the need for collective efforts to prevent further deterioration of water sources and advocated for the revival of water sources to address existing gaps in water availability.

In conclusion, Smt. Mini Chandran reiterated the importance of a systematic and scientific approach to aquifer management and emphasized the need for collaborative efforts to ensure sustainable water resource management in Kerala. Her insights provided valuable contributions to the panel discussion, highlighting actionable strategies for addressing aquifer management challenges and promoting water resource sustainability in the region.

7 Presentation on OECD Principles

Time: 02:45 pm - 03:10 pm

Speaker	Dr.V.K Baby IAS (Rtd), Advisor to Government (Water Resources)
Moderator	Shri. Murali Kochukrishnan, Environmental Expert cum Hydrogeologist, SMMU

The management of water resources is a critical global challenge that requires effective governance frameworks to ensure sustainability, resilience, and equitable access. Recognizing this need, the OECD (Organization for Economic Cooperation and Development) has developed a set of principles for water governance. These principles serve as a comprehensive guide for policymakers, stakeholders, and responsible authorities to navigate the complexities of water management in an increasingly interconnected world.

The OECD principles for water governance encompass a wide range of dimensions, including policy coherence, stakeholder engagement, regulatory frameworks, and capacity building. These principles emphasize the importance of integrated approaches, collaboration across sectors and scales, transparency, and accountability. By adhering to these principles, countries can enhance their capacity to address the multifaceted challenges of water management and foster more resilient and adaptive governance systems.

Principle 1: "Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster coordination across these responsible authorities."

Background and Importance:

This principle underscores the importance of clarity in governance structures to ensure accountability and effective decision-making. Basically it means every stakeholder, every agency, every institution who works in water should be aware of their roles and responsibilities, including policymaking, implementation, operation, and regulation. Authorities can streamline processes and minimize overlaps or gaps in responsibilities. Clear allocation of roles and responsibilities fosters transparency, enhances

accountability, and facilitates coordination among responsible authorities. It ensures that each entity understands its mandate and contributes effectively to achieving water management objectives.

Establishing transparent mechanisms for collaboration, defining clear mandates through legal frameworks or institutional arrangements, and fostering communication channels are essential for effective coordination. Regular review and refinement of governance structures may be necessary to adapt to changing circumstances or emerging challenges.

Principle 2: "Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster coordination between the different scales"

Background and Importance:

This principle emphasizes the importance of subsidiarity that is water should be managed at the lowest appropriate level. Developing integrated basin management frameworks, engaging local communities and stakeholders in decision-making processes, and facilitating multi-level governance mechanisms are critical for effective water management at different scales. Collaboration and coordination between various levels of government, as well as with non-governmental actors, are essential for achieving integrated and adaptive basin governance. It recognizes that water management is inherently linked to local contexts and requires integrated approaches that consider multiple scales of governance.

Managing water at the appropriate scale ensures that interventions are tailored to local needs, priorities, and challenges. It recognizes that water management is inherently linked to local contexts and requires integrated approaches that consider multiple scales of governance.

Principle 3: "Encourage policy coherence through effective cross-sectoral coordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use"

Background and Importance:

Policy coherence ensures that interventions in one sector do not undermine objectives or create unintended consequences in others. It promotes holistic approaches to water management that consider interdependencies and interactions with other sectors such as environment, health, energy, agriculture, industry, spatial planning, and land use. Establishing inter-ministerial coordination mechanisms, conducting policy assessments for coherence, and promoting stakeholder dialogue across sectors are essential for achieving policy coherence. Integrating water considerations into sectoral policies and fostering interdisciplinary approaches facilitate the identification of win-win solutions and the management of trade-offs. It indicates harmonizing of policies. The policies related to water management should have some level of coherence.

Principle 4: "Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties"

Background and Importance:

This principle recognizes that addressing water challenges requires adequate institutional capacity and expertise, because these institutions are the instruments for service delivery. It emphasizes the importance of continuously assessing and enhancing the capacity of responsible authorities to effectively fulfill their roles and responsibilities.

Assessing capacity needs, investing in training and skill development, and fostering knowledge-sharing networks are essential for enhancing the capacity of responsible authorities. Collaborating with academic institutions, research organizations, and international partners can also contribute to capacity building and knowledge exchange.

Principle 5: "Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy"

Background and Importance:

This principle emphasizes the importance of reliable data and information for evidence-based decision-making and policy formulation. It underscores the need for transparent, accessible, and up-to-date data to support informed governance processes.

Developing data management systems, promoting data transparency, and engaging stakeholders in data collection and analysis are essential for ensuring the availability and quality of water-related information. Collaborating with relevant agencies, research institutions, and civil society organizations can facilitate data sharing and strengthen data-driven decision-making processes.

Principle 6: "Ensure that governance arrangements help mobilize water finance and allocate financial resources in an efficient, transparent, and timely manner"

Background and Importance:

This principle highlights the importance of financial resources for supporting water infrastructure, services, and management initiatives. It emphasizes the need for transparent and efficient governance mechanisms to mobilize and allocate financial resources effectively.

Establishing transparent financial mechanisms, exploring innovative financing options, and ensuring equitable distribution of financial resources are essential for effective water finance governance. Engaging with private sector partners, international donors, and financial institutions can also leverage additional funding sources and expertise.

Principle 7: "Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest"

Background and Importance:

This principle emphasizes the importance of regulatory frameworks for safeguarding water resources, protecting public health, and promoting equitable access to water services. It underscores the need for effective implementation and enforcement of regulations to achieve policy objectives.

Strengthening regulatory enforcement mechanisms, enhancing compliance monitoring, and fostering public participation in regulatory processes are essential for sound water management. Investing in regulatory capacity, training enforcement personnel, and promoting stakeholder awareness can support effective implementation of regulatory frameworks.

Principle 8: "Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders"

Background and Importance:

This principle highlights the importance of innovation in governance practices to address emerging water challenges and improve the effectiveness of water management systems. It emphasizes the need for adaptive and forward-thinking approaches to governance.

Encouraging experimentation with new governance approaches, fostering learning networks, and facilitating knowledge exchange promote the adoption and implementation of innovative practices. Creating incentives for innovation, supporting pilot projects, and collaborating with research institutions and private sector partners can accelerate the uptake of innovative governance solutions.

Figure 7.1: Dr VK Baby -Presentation on OECD Principles

Principle 9: "Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making"

Background and Importance:

This principle emphasizes the importance of integrity and transparency in building public trust, enhancing accountability, and reducing corruption risks in water governance. It underscores the need for ethical conduct, accountability mechanisms, and transparent decision-making processes.

Establishing integrity frameworks, promoting transparency in decision-making processes, and strengthening anti-corruption measures are essential for mainstreaming integrity and transparency practices. Building capacity for ethical leadership, conducting integrity assessments, and promoting whistleblower protection can reinforce a culture of integrity and accountability in water governance.

Principle 10: "Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation"

Background and Importance:

This principle underscores the importance of inclusive stakeholder engagement in water governance processes. It recognizes the value of diverse perspectives, local knowledge, and participatory approaches in decision-making and policy formulation.

Establishing participatory platforms, fostering dialogue among diverse stakeholders, and incorporating local knowledge and perspectives into decision-making processes promote meaningful stakeholder engagement. Building trust, providing access to information, and ensuring representation of marginalized groups are essential for inclusive and equitable engagement.

Principle 11: "Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations"

Background and Importance:

This principle emphasizes the need to balance competing demands, allocate resources equitably, and consider long-term sustainability in water governance. It recognizes that trade-offs may arise between different water users, regions, and future generations.

Facilitating negotiation processes, implementing adaptive management strategies, and promoting intergenerational equity considerations enhance the capacity to manage trade-offs in water governance. Integrating economic valuation tools, conducting impact assessments, and fostering collaboration among stakeholders can support informed decision-making and trade-off management.

Principle 12: "Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed"

Background and Importance:

This principle underscores the importance of monitoring and evaluation in ensuring the effectiveness, efficiency, and accountability of water governance systems. It emphasizes the need for evidence-based decision-making, transparency, and continuous improvement.

Establishing monitoring frameworks, conducting periodic evaluations, and communicating findings to stakeholders facilitate adaptive governance processes and policy learning. Incorporating stakeholder feedback, promoting data transparency, and making adjustments based on evaluation results enhance the relevance and impact of water policies and governance arrangements.

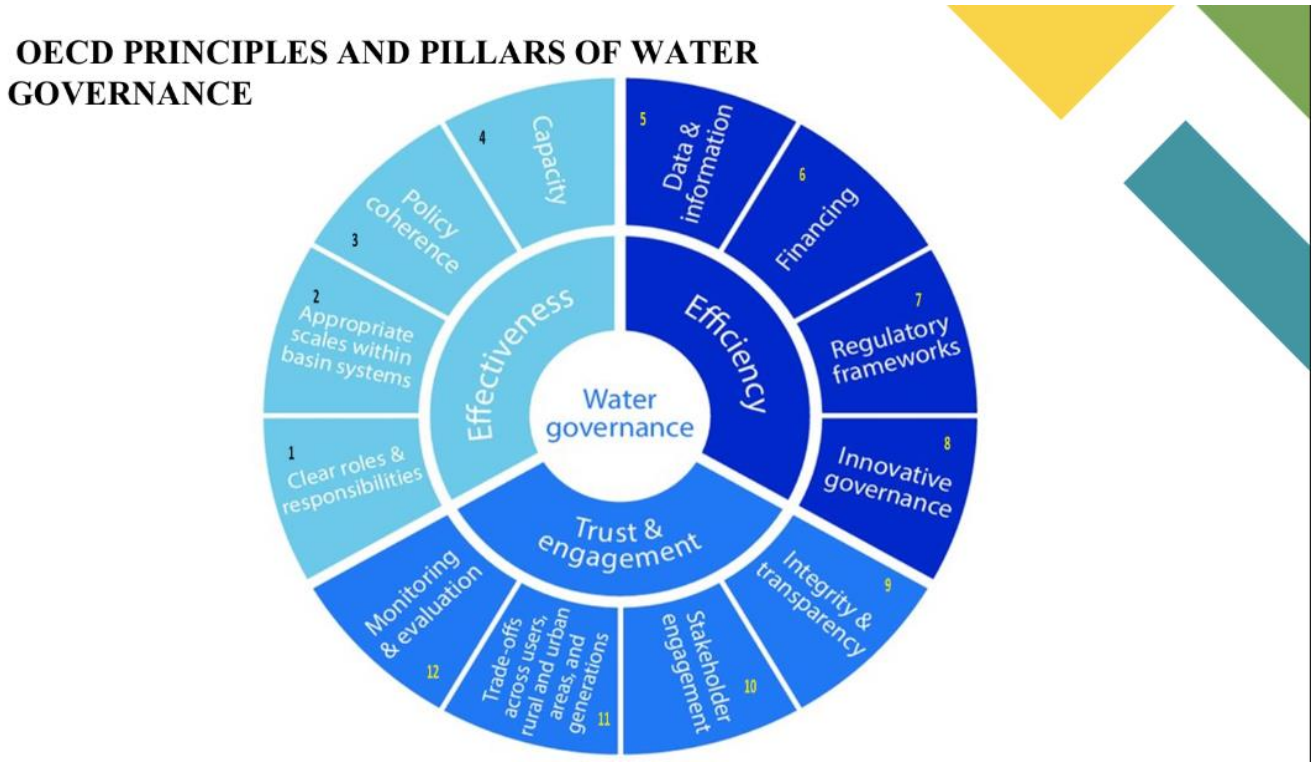

Figure 7.2: OECD Principles and Pillars Of Water Governance

Effective water governance relies on the establishment of robust pillars that encompass effectiveness, trust, engagement, and efficiency. The effectiveness of governance structures is contingent upon several factors, including building capacity, ensuring policy coherence, delineating clear roles and responsibilities, and operating at appropriate scales within basin systems. Trust and engagement are

equally vital, necessitating the navigation of trade-offs across various user groups, including rural and urban communities, and fostering stakeholder engagement through transparent monitoring and evaluation processes. Moreover, integrity and transparency serve as foundational elements in establishing trust within water governance frameworks. Lastly, efficiency is paramount, demanding the integration of comprehensive data and information systems, securing adequate financing mechanisms, implementing adaptive regulatory frameworks, and embracing innovative governance approaches. By fortifying these pillars, water governance can achieve sustainable management practices that safeguard this invaluable resource for current and future generations.

Based on the 12 OECD Principles, Six Themes have been generated by Shri. Murali Kochukrishnan as follows:

1. Urban Water Security and Governance: Surface Water
2. Urban Water Security and Governance: Ground Water
3. Urban Water Security and Governance: Environment and Water Quality Management.
4. Monitoring, Evaluation, and Data Management in the Water Sector.
5. Urban Water Security and Governance Roles of ULB's (Municipalities and Corporation) (AMRUT) cities.
6. Urban Water Security and Governance: Policies and Institutions.

Accordingly, to the above thematic description, like-minded groups are formed with a facilitator/team leader to put forth each group's crucial points of discussion as Key challenges and summary recommendations. The group-wise discussion and suggestive recommendations are detailed below as the next session.

8 Group Discussion

Group 1:- Urban water security and governance: Surface Water

SL NO	Key Challenges	Summary Recommendation
1	Availability of data, quality, and quantity	Use of modern technology to collect and share data. Automated rain and river gauges etc.
2	Allocation of water resources for various purpose , drinking, sanitation , irrigation	Basin level authority and system for implementation projects
3	No coordination between different departments.	Integration of departments
4	Encroachment, land use.	Urban local government to come up with projects.
5	Pollution , abandonment of traditional resources Water regulating structure to arrest salinity intrusion	New project to be proposed.

Group members

1. Team leader:- Shri Mathews Mullackal, Senior Water Specialist, World Bank.
2. Smt. Suja Gracen, SE, Irrigation Dept.
3. Smt. Shalini Pillai, Prof. Kerala Agriculture University.
4. Smt. Menaka M.G, Irrigation Dept.
5. Shri S.K Chandren, Kalliyoor Krishi Bhavana.
6. Shri Alester Vaneryk, AE Alappuzha Municipality.

Figure 8.1: Group Discussion-Group 1

Group 2:- Urban water security and governance: Groundwater

SL NO	Key Challenges	Summary Recommendation
1	Scientific evidence based site identification for aquifer charge	Proper guidance through scientific expert with proper data
2	Increase of imperviousness area	Adapt policy decision for pumping system with monitoring system
3	Soil dipping problems & excessive pumping of groundwater	Proper survey mechanisms
4	Urban wise draft estimation	Data collection from different departments with coordination
5	Unscientific septic tank structure and designs	Proper policy matter to execute through accredited agencies
6	Area wise ground water quality monitoring systems	Area wise ground water quality to be monitored and record in portal, upload with competitive agencies – incentive schemes
7	Identification leaky aquifer system.	Recharge schemes and plans shall implement

Group Members

1. Shri A.G Gopakumar, Superintending Hydrogeologist, Ground Water Dept.
2. Dr. Suresh Francis, Scientist, KSREC
3. Dr. P. Harinarayanan, Senior Principal Scientist, KSCSTE.
4. Smt. Ajina.K, UIWE, CMMU
5. Smt. Sumitha G.K, Project Manager, Impact Kerala, LSGD.
6. Smt. Shruthy M.L , Project Manager, Impact Kerala Ltd.

Figure 8.2: Group Discussion-Group 2

Group 3:- Urban water security and governance: Environment and Water Quality Management.

SL NO	Key Challenges	Summary Recommendation
1	Water Scarcity	➢ Diversify water resources – local sources ➢ Manage consumption ➢ Water conservation at source level – RWH, Dug wells ➢ Circularity ➢ Incentives
2	Water Quality (Eutrophication, DO depletion)	➢ Monitoring & quality check ➢ Treatment system & proper monitoring protocols ➢ Biodiversity conservation ➢ Protection of water sources- no dumping of waste
3	Protest against FSTP/ STP (site and availability)	➢ IEC ➢ Piloting ➢ Aesthetics
4	Data Availability	➢ Centralized ➢ Dashboard

Group Members

1. Dr. Karung Phaisonreng Kom, Assistant Professor, National College, Trichy, Department of Geology.
2. Smt. Er. Pravitha P. K, AEE, Kerala State Pollution Control Board.
3. Dr.C.S Vimal Kumar, Principal Scientific Officer, Kerala State Biodiversity Board
4. Smt. Indu Rajendran, Assistant Manager, KINFRA
5. Smt. Devika H. Devi, Wastewater Specialist, WASH Institute

Figure 8.3: Group Discussion-Group 3

Group 4:- Monitoring, Evaluation and Data Management in Water Sector

SL NO	Key Challenges	Summary Recommendation
1	Absence of updated data on resources infrastructure and assets	Complete reconstruction of data as on current status with regard to resources and assets. Facility to update geotag data regularly
2	Lack of standardized data across sectors and departments	Define standards, policies, procedures format , metadata for the data across sectors and departments
3	Lack of central repository /platform for data	Authorize an appropriate institution for collation and standardization of data – all water related data (eg IKM)
4	Lack of policy and practice on data sharing – resistance to share data	Formulate policy on data sharing – LSGD Data Democracy in creation promotion & Dissemination
5	Lack of resources and capacity for data collection , management	Modernization of work flow to improve resources and capacity for data collection and management

Group Members

1. Team leader: - Shri P.K Kurian Research Scholar
2. Shri Luqman, DMD, Sewerage, SMMU
3. Dr Ratish Menon, Professor, SCMS Kochi
4. Shri Anoop Nair, GM - Commercials
5. Shri Jake Jacob, Chief Commercial Officer, Head GIS practice
6. Smt Jemi Joseph, Specialist, Soil Conservation
7. Smt Sunitha M, AEE, Kollam Municipal Corporation.
8. Shri Sheik Mohammed Shibl FSSM Specialist, WASH Institute

Figure 8.4: Group Discussion-Group 4

Group 5:- Urban Water Security and Governance roles of ULB'S (Municipalities and Corporation. (AMRUT) cities.

SL NO	Key Challenges	Summary Recommendation
1	Lack of skilled staffs	Engagement & provide training to SHGs – Latest Technology WTFH minimum atomization
2	Lack of coordination among stakeholders	Plan project based on watershed & GIS
3	Lack of finance	Storm water management & decentralized regional based sewerage system
4	Lack of proper holistic planning	Baseline study, service level monitoring in addition to project management: RWH, greywater reuse, shallow aquifer for all secondary purpose
5	Lack of Awareness of people	Integration of available funds
6	Lack of Sense of ownership	Ensure community participation through education institutions.
7	Lack of Integrated data	Building the capacity of ULB's officials & the people: model like house surgency
8	Lack of Sanitation	Well designed & maintained distributed database management system
9	Lack of Multi ULB coordination	Formation of committees involving representatives from different ULB's

10	Lack of Political Interventions	➢ Stakeholder consultation during planning stages ➢ Inculcate politicians about the importance of water management ➢ Monitoring & compliance ➢ Climate resilience including technologies like AI

Group Members

1. Shri Narayanan Namboothiri T.V, CE (SR), KWA.
2. Shri Krishna Kumar V.S, Deputy Chief Engineer, KWA.
3. Smt. Ashima Sebastian, UIWE, SMMU.
4. Shri Vijaya Kumar, UIWE, SMMU.
5. Smt. Ashida A.G, UIWE, SMMU.

Figure 8.5:Group Discussion-Group 5

Group 6:- Urban Water Security and Governance: Policies and Institutions.

SL.NO	Key Challenges	Summary Recommendation
1	➢ Source Sustainability 1. Local · Rejuvenation · Contamination of surface and subsurface water 2. External · Non compensatory exploitation	Policy formation for rejuvenation and protection from pollution (role , responsibility and accountability)
2	➢ Involvement of multiple agencies 1. lack of coordination between stakeholders 2. lack of clarity in roles and responsibilities 3. lack of uniform water policy addressing all agencies	Proper coordination between agencies involved (role , responsibility and accountability)
3	Reuse policy of groundwater	Training , Manpower
4	Unavailability of sufficient data for the formulation of policies	The data collected from different departments shall be made available in single portal

Group Members

1. Shri Rahul N., UIWE, CMMU, Trissur.
2. Shri Jahamgir. S, Secretary, Thiruvananthapuram Corporation
3. Shri Subodh S, Joint Director, LSGD.
4. Shri Vivek.V, UIWE, CMMU, Thiruvananthapuram.
5. Shri Muhammad Rafi. P, UIWE, CMMU, Kozhikode.
6. Shri Akhil. T, UIWE, CMMU, Palakkad
7. Shri Kannan.S, UIWE, CMMU, Ernakulum

Figure 8.6: Group Discussion-Group 6

9 Conclusion

The workshop and panel discussion on urban water security and governance yielded invaluable insights and recommendations for addressing the intricate challenges associated with water management in urban areas. Throughout the sessions, experts underscored the imperative need for collaborative, interdisciplinary approaches to ensure the availability, sustainability, and quality of water resources. Discussions ranged from detailed implementation strategies, such as granularity scale studies, to essential topics like aquifer management and water governance principles, illuminating various strategies and initiatives aimed at fostering sustainable water management practices.

Key recommendations emerged, including enhancing waste management systems, advocating for decentralized storm water drainage, capacity building, and fostering stakeholder engagement. The overarching message emphasized the urgency for collective action and innovative solutions to effectively tackle urban water security challenges.

As a vote of thanks, Shri. Luqman, Deputy Mission Director of AMRUT, extended sincere appreciation to all participants, thereby concluding a productive and insightful session.