IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, April 2024

Monitoring of Water Requirement of GGSF Campus

Kartik Landge[1], Prasad Mali[2], Ketan Karwal[3], Karan Kapuea[4], Tejas Galande[5], A. E. Sonawane[6], C. B. Pagar[7], P. G. Chavan[8]
Students, Department of Civil Engineering[1,2,3,4,5]
Professor, Department of Civil Engineering[6,7,8]
Gobind Singh Polytechnic, Nashik, India

Abstract*: Freshwater is indispensable for sustaining a healthy and functional educational environment. This project delves into the intricate dynamics of water requirements at our institute, simultaneously instituting a robust water quality monitoring program. Our analysis encompasses the comprehensive assessment of daily water needs for Number students and staff, considering crucial facets such as drinking, sanitation, and landscaping. This meticulous evaluation establishes a foundational benchmark for comprehending the existing water consumption patterns prevalent within the institute.*

Additionally, we implement a sophisticated water quality monitoring regime that scrutinizes water from diverse sources like taps and fountains. Parameters of paramount importance including pH levels, chlorine concentrations, and water hardness are meticulously tracked to ensure strict adherence to prevailing water quality standards. By amalgamating data concerning existing water usage and quality, the overarching goal of this project is to optimize water conservation practices while simultaneously guaranteeing the provision of safe and potable drinking water for the entire school community.

The profound insights garnered through this multifaceted project will serve as a blueprint for formulating and recommending sustainable water management strategies intricately tailored to suit the unique and specific needs of our Institute (Guru Gobind Singh Foundation Campus)..

Keywords: Water requirements, Water quality monitoring, Daily water needs, Water consumption patterns, Water quality standards, Water conservation practices

I. INTRODUCTION

Freshwater is a fundamental resource that plays a pivotal role in sustaining a healthy and functional educational environment. At the GGSF Campus, ensuring an adequate and safe water supply is of utmost importance for meeting the diverse needs of students, staff, and the campus infrastructure. This project delves into the intricate dynamics of water requirements at the GGSF Campus, aiming to address key aspects such as drinking water provision, sanitation facilities, and landscaping needs.

One of the critical components of this project is the implementation of a robust water quality monitoring program. By scrutinizing parameters such as pH levels, chlorine concentrations, and water hardness from various water sources like taps and fountains, we aim to ensure strict adherence to prevailing water quality standards. This meticulous approach to water quality monitoring is essential for guaranteeing the provision of safe and potable drinking water for the entire school community.

Furthermore, this project conducts a comprehensive assessment of daily water needs, taking into account factors like drinking water consumption, sanitation requirements, and water usage for landscaping purposes. By analyzing water consumption patterns, we can identify areas of inefficiency and potential water wastage, paving the way for optimizing water conservation practices across the campus.

The insights gained from this multifaceted project will not only inform sustainable water management strategies but also contribute to environmental sustainability and resilience against water scarcity challenges. Through collaborative efforts and innovative solutions, we aim to create a blueprint for efficient water resource management tailored to suit the unique and specific needs of the GGSF Campus

1.1 Water Monitoring:

Water monitoring involves the systematic collection, analysis, and interpretation of data related to various aspects of water quality, quantity, usage, and distribution. It plays a crucial role in ensuring the safety, sustainability, and efficient management of water resources. Here's an expanded view of water monitoring:

Water Quality Monitoring:

- Assessing parameters such as pH, turbidity, dissolved oxygen, temperature, conductivity, and levels of contaminants (e.g., heavy metals, pesticides, pathogens) in water sources.
- Conducting regular testing and analysis to ensure compliance with regulatory standards, health guidelines, and environmental protection measures.
- Monitoring microbial content (e.g., E. coli, coliform bacteria) to assess water safety for drinking, recreational activities, and aquatic ecosystems.

Water Quantity Monitoring:

- Measuring water flow rates, volumes, and levels in reservoirs, rivers, lakes, groundwater aquifers, and water supply systems.
- Tracking water usage patterns in residential, commercial, industrial, and agricultural sectors to understand demand variability and forecast future needs.
- Monitoring water availability and drought conditions in regions prone to water scarcity or facing climate-related challenges.

Infrastructure Monitoring:

- Monitoring the performance, condition, and integrity of water supply infrastructure, including pipes, pumps, valves, reservoirs, and treatment plants.
- Detecting leaks, pipe bursts, and equipment failures through automated monitoring systems, sensors, and remote sensing technologies.
- Assessing the efficiency and effectiveness of water treatment processes, distribution networks, and storage facilities.

Environmental Monitoring:

- Evaluating the impact of water usage, discharge, and pollution on aquatic ecosystems, biodiversity, and water-dependent habitats.
- Monitoring water-related environmental indicators such as river flow, sedimentation, nutrient levels, and aquatic life health.
- Identifying sources of pollution, runoff, and contaminants entering water bodies to implement remediation measures and pollution control strategies.

Data Management and Analysis:

- Establishing data collection protocols, sampling schedules, and quality assurance measures to ensure accurate and reliable water monitoring data.
- Utilizing geographic information systems (GIS), data analytics, and modelling tools to analyse water data, visualize trends, and generate predictive insights
- Integrating monitoring data with decision support systems, risk assessment frameworks, and emergency response plans for effective water resource management.

1.2 Water Requirements:

Water requirements refer to the quantity of water needed for various purposes, including domestic use, agriculture, industry, environment, and public services. Understanding water requirements is essential for sustainable water management, infrastructure planning, and resource allocation. Here's an expanded view of water requirements:

Domestic Water Requirements:

- Calculating per capita water demand for drinking, cooking, bathing, sanitation, and hygiene practices based on population size, household demographics, and lifestyle factors.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, April 2024

- Assessing water needs for household activities such as laundry, dishwashing, gardening, and cleaning to ensure adequate supply and promote water conservation.
- Implementing water-saving technologies, appliances, and behavioural changes to reduce domestic water usage and improve efficiency.

Agricultural Water Requirements:

- Estimating water demand for irrigation, livestock watering, crop production, and agricultural processes based on crop types, soil conditions, climate, and irrigation methods.
- Implementing efficient irrigation practices such as drip irrigation, sprinkler systems, and soil moisture monitoring to optimize water use and minimize losses.
- Promoting sustainable agriculture practices, water-saving crops, and soil conservation measures to enhance water productivity and resilience to droughts.

Industrial Water Requirements:

- Determining water requirements for industrial processes, manufacturing operations, cooling systems, and wastewater treatment based on production levels, technology usage, and water recycling capabilities.
- Implementing water reuse, recycling, and treatment technologies to minimize freshwater consumption, reduce pollution, and comply with regulatory standards.
- Conducting water audits, efficiency assessments, and process optimization initiatives to identify opportunities for water conservation and cost savings.

Environmental Water Requirements:

- Allocating water for environmental purposes such as maintaining river flows, wetlands, aquatic habitats, and ecological balance in water bodies.
- Implementing environmental flow assessments, habitat restoration projects, and water conservation measures to protect endangered species, biodiversity, and ecosystem services.
- Balancing competing water demands between human uses and environmental needs through integrated water resource management approaches and stakeholder engagement.

Urban Water Requirements:

- Managing water requirements for urban areas, including drinking water supply, sanitation, stormwater management, and public services such as firefighting and emergency response
- Developing water supply infrastructure, distribution networks, and storage facilities to meet peak demand, population growth, and climate variability challenges.
- Promoting water-efficient urban design, green infrastructure, and water-sensitive urban planning practices to reduce runoff, flood risks, and water pollution while enhancing urban livability

II. LITERATURE SURVEY

Paper Title: Water Audit as a Tool for Management of Water Resources: An Indian Perspective
Authors: Sanjay Choudhary, Devendra Dohare, Shruti Bajpai
Journal: Journal of Software & Hardware Research in Engineering
Year: 2021
Volume: 16
Page Range: 694-703

Abstract-Water is used almost in every sector, growth in population and increase in the standard of living of people so demand is increased. Water is used by all the living creatures found in the world but a very small portion of water is available for drinking and other purposes. This available usable water is mismanaged by human beings, for this mismanagement of water introducing a tool by IWA/AWWA is water-audit. Water-audit is used for reducing water-losses, leakages and gives the information of water used by consumers. Environment audit carried out in stages, water audit also consists of many stages. In this review paper, case studies are highlighted, which gives the general methodology adopted for auditing. Water balance sheet is very useful for understanding the types of losses and type of water used in particular DMA (District Metered Area). Due to the loss of water Non-revenue water is increased, for reducing losses requires huge investments.

Paper Title: Water Auditing and Recycling as a Tool for Management of Water Resources: An Indian Perspective
Authors: Mir Rohi Neelofar, Sami Ullah Bhat, Mohammad Muslim
Journal: [Journal Name]
Year: 2023
Abstract Water is limited and is unevenly distributed globally. India being home to approximately 18% of the global population accounts for only 4% of global renewable water resources, making it the world's 13th most water-stressed country. The increase in human population coupled with accelerated economic activities and climate change has put enormous pressure on government and policymakers in India to find different innovative and smart ways to manage the demand–supply gap in the water sector. Despite having the largest water infrastructure in the world and concerns raised about increasing water crisis in national discourse at academic, policy and governance levels, the tangible outcome does not resonate adequately on the ground level. Identification of alternate tools, calibration and fine-tuning relevant policy and planning necessitate the need of implementing water auditing and water recycling to meet the ever-increasing water demand as far as the water footprint in India is concerned. Based on the principle of what gets measured gets managed, water auditing best caters to the water management needs and is yet to become a top priority to curb the water crisis. Public acceptance seems to be one of the major barriers in universalizing water recycling in India which is aggravated by the uneven and/or absence of a proper and adequate water governance approach and structure. This paper tries to highlight the major challenges water resources management is facing in India and aims to illustrate how well planned water auditing and water recycling as a tool can deliver in effective and rational utilization and distribution of water. Keywords Urban water resources · Water auditing · Water recycling.

Paper Title: Water Auditing in Residential Building
Authors: Kaju Nirmal, Aditya Patil, Pritee Jawale, Khultej Gurav
Journal: Journal of Emerging Technologies and Innovative Research
Year: 2022
Volume: 9
Page Range: b187-b193
Abstract-This paper addresses the increasing water shortage in India by focusing on residential buildings as a major source of water usage. The authors conducted a water audit of a residential building, quantifying water flows and identifying areas of excessive usage and losses. The study emphasizes the importance of regular water audits to detect leakages and optimize water usage, leading to potential cost savings and water conservation.

III. PROBLEM STATEMENT

1 Problems Affecting Water Requirement in the School , Engineering , & , Polytechnic Building

School Building:

Inadequate Water Storage Capacity:

- The current water storage capacity, including overhead tanks and underground reservoirs, may not be sufficient to meet the daily water demands of students, staff, and facilities.

High Water Consumption:

- The school's daily water usage, including drinking water, sanitation needs, landscaping irrigation, and other activities, exceeds the available water supply.

Water Quality Concerns:

- Water quality issues such as sediment buildup, discoloration, or microbial contamination may arise due to insufficient filtration or treatment measures.

Leakages and Wastage:

- Undetected leaks in plumbing systems, faucets, or fixtures contribute to water wastage and increase the overall water demand beyond sustainable levels.

Future Demand Projections:

- Anticipated growth in student enrolment or expansion of facilities requires a reassessment of water requirements to ensure adequate supply for future needs.

Engineering Building:

Water-intensive Activities:

- Engineering laboratories, workshops, and research facilities often require substantial water usage for experiments, equipment cooling, and industrial processes.

Outdated Infrastructure:

- Aging plumbing systems, fixtures, and water distribution networks may be prone to leaks, corrosion, or inefficiencies, leading to water losses and increased consumption.

Water Quality Compliance:

- Compliance with water quality standards set by regulatory bodies such as the Bureau of Indian Standards (BIS) requires ongoing monitoring, testing, and treatment of water sources.

Inefficient Equipment:

- Outdated or inefficient water-using equipment, such as cooling systems, boilers, and HVAC units, may contribute to excessive water consumption and energy waste.

Seasonal Variations:

- Seasonal variations in water demand, such as during peak academic sessions or project-intensive periods, can strain the existing water supply infrastructure

Polytechnic Building:

Growing Population:

- Increased enrolment of students, faculty, and staff in the Polytechnic Building results in higher water consumption for daily activities, academic needs, and administrative operations.

Limited Water Storage:

- The available water storage capacity, including tanks and reservoirs, may not be sufficient to meet the fluctuating water demand, especially during peak usage hours.

Water Quality Challenges:

- Maintaining water quality standards amidst changing usage patterns, potential contamination sources, and aging infrastructure poses challenges in ensuring safe and potable water supply.

Outdoor Water Usage:

- Landscaping, gardening, and outdoor maintenance activities contribute to additional water demand, requiring efficient irrigation systems and conservation measures.

Leaks and Maintenance Issues:

- Aging plumbing systems, fixtures, and pipelines may experience leaks, breaks, or maintenance issues, leading to water losses, disruptions, and increased operational costs.

3.2 Objectives for Water Management:

Optimize Water Storage and Distribution:

- Increase water storage capacity and upgrade distribution systems to ensure reliable and sufficient water supply for daily operations.
- Implement water conservation measures such as rainwater harvesting, greywater recycling, and efficient irrigation practices to reduce water demand.

Improve Water Quality and Safety:

- Enhance water treatment and filtration systems to maintain high water quality standards and ensure safe drinking water for building occupants.

IJARSCT ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, April 2024

- Conduct regular water quality testing and monitoring according to regulatory guidelines (e.g., BIS standards) to address any contamination risks.

Reduce Water Wastage and Leakages:

- Implement leak detection systems, conduct regular inspections, and repair plumbing infrastructure to minimize water losses and prevent wastage.
- Promote water-saving behaviours among students, faculty, and staff through awareness campaigns, education, and training programs.

Enhance Infrastructure and Technology:

- Upgrade outdated water-related infrastructure, fixtures, and equipment to improve efficiency, reduce water consumption, and mitigate operational challenges
- Integrate smart water management technologies such as metering, monitoring, and automation systems to optimize water usage, detect anomalies, and facilitate data-driven decision-making.

Develop Sustainable Water Management Practices:

- Establish sustainable water management practices and policies aligned with environmental stewardship goals, regulatory requirements, and best industry practices.
- Foster a culture of water conservation, responsibility, and accountability among building occupants, maintenance teams, and management stakeholders.

Ensure Resilience and Future-Readiness:

- Conduct assessments and projections to anticipate future water demand, population growth, and infrastructure needs, ensuring long-term resilience and preparedness.
- Incorporate climate change considerations, water scarcity risks, and adaptive strategies into water management plans to address evolving challenges and uncertainties.

Collaborate and Engage Stakeholders:

- Collaborate with relevant stakeholders, including water authorities, environmental agencies, community partners, and industry experts, to exchange knowledge, resources, and best practices.
- Engage building occupants, students, faculty, staff, and local communities through participatory approaches, feedback mechanisms, and inclusive decision-making processes for effective water management outcomes.

Remedies

Inadequate Water Storage Capacity:

- Conduct a comprehensive assessment of water demand to determine the required storage capacity. Install additional overhead tanks or underground reservoirs to meet the daily water needs of students, staff, and facilities. Ensure that the storage capacity accounts for peak usage periods and future growth.

High Water Consumption:

- Installing water-efficient fixtures like low-flow toilets, faucets, and showerheads to reduce water usage without compromising functionality.
- Promoting awareness campaigns among students, faculty, and staff about water-saving practices such as turning off taps when not in use, reporting leaks promptly, and using water responsibly.
- Implementing smart irrigation systems with rain sensors and drip irrigation for landscaping to minimize water wastage.
- Encouraging the reuse of greywater for non-potable purposes such as flushing toilets or irrigation where feasible.

Water Quality Concerns:

- Upgrade water treatment and filtration systems to ensure high-quality, potable water. This may include:
- Installing advanced filtration systems such as reverse osmosis or UV treatment to remove contaminants and pathogens
- Conducting regular water quality testing for parameters like turbidity, pH, chlorine levels, and microbial contamination to detect any issues early.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, April 2024

- Implementing a maintenance schedule for water treatment equipment to ensure optimal performance and address any malfunctions promptly.

Leakages and Wastage:

- Implement a comprehensive leak detection and repair program:
- Install leak detection systems with sensors and alarms to identify leaks in plumbing systems, faucets, and fixtures.
- Conduct regular inspections of water distribution networks, pipelines, and connections to detect and repair leaks promptly.
- Educate maintenance staff and building occupants about the importance of reporting leaks and taking proactive measures to reduce water wastage.

Future Demand Projections:

- Conduct regular assessments of water demand based on factors such as enrollment growth, facility expansions, and seasonal variations. Use data analytics and modeling tools to forecast future water requirements accurately. This information will help in planning and budgeting for infrastructure upgrades and water conservation initiatives to meet future demand.

Water-intensive Activities (Engineering Building):

- Optimize water usage in engineering laboratories, workshops, and research facilities by:
- Using water-efficient equipment and processes for experiments, cooling systems, and industrial processes.
- Implementing closed-loop cooling systems to recycle water and minimize fresh water usage.
- Educating engineering staff and students about water-saving practices and the importance of efficient water management in their activities.

Outdated Infrastructure (Engineering Building):

- Upgrade aging plumbing systems, fixtures, and water distribution networks to improve efficiency and reduce water losses:
- Replace old pipes, valves, and fittings with modern, corrosion-resistant materials to prevent leaks and minimize maintenance issues.
- Install water-efficient fixtures and appliances in laboratories and workshops to reduce water consumption without compromising performance.
- Implement regular maintenance and inspection schedules for plumbing infrastructure to detect and address issues proactively.

Growing Population (Polytechnic Building):

- Implement water-saving measures and infrastructure upgrades to accommodate the increased water demand:
- Install additional water storage tanks or reservoirs to meet fluctuating demand during peak usage hours
- Upgrade water distribution systems and fixtures with water-efficient alternatives to reduce consumption.
- Promote water conservation among building occupants through educational campaigns, awareness programs, and behavioral incentives.

Limited Water Storage (Polytechnic Building):

- Increase water storage capacity by:
- Installing larger storage tanks or reservoirs to store sufficient water for daily activities and emergencies.
- Implementing rainwater harvesting systems to capture and store rainwater for non-potable uses such as irrigation or toilet flushing.
- Implementing water reuse systems to recycle greywater for non-drinking purposes and reduce reliance on freshwater sources.

Leaks and Maintenance Issues (Polytechnic Building):

- Conduct regular inspections and maintenance of plumbing systems, fixtures, and pipelines to detect and repair leaks promptly:

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, April 2024

- Use leak detection technologies such as acoustic sensors, thermal imaging, and pressure monitoring to identify hidden leaks and prevent water wastage.
- Train maintenance staff to conduct routine checks, repairs, and replacements of faulty plumbing components to ensure efficient water distribution and usage.

IV. CONCLUSION

In conclusion, the development and implementation of a comprehensive water monitoring and management system at Guru Gobind Singh Foundation Campus are crucial steps towards addressing the challenges associated with water scarcity, inefficient usage, and suboptimal water management practices. Through the course of this project, several key findings and outcomes have been achieved:

1. Improved Understanding of Water Usage Patterns: The project has provided valuable insights into the institute's water usage patterns, including areas of high consumption, sources of water wastage, and potential leaks in the infrastructure.
2. Identification of Water Conservation Opportunities: By analyzing the data collected through water monitoring, opportunities for water conservation and optimization have been identified. This includes implementing measures such as fixing leaks, optimizing irrigation systems, promoting water-saving practices, and raising awareness among the school community.
3. Enhanced Water Quality Assurance: The implementation of a water quality monitoring program has ensured that the water supplied to the institute meets stringent quality standards. Regular testing and monitoring have helped in early detection of any water quality issues, ensuring the safety and well-being of students, faculty, and staff.
4. Cost Savings and Sustainability Benefits: Through improved water management practices, the institute can expect to achieve cost savings in terms of reduced water bills and operational expenses. Furthermore, the project contributes to the institute's sustainability goals by conserving water resources and minimizing environmental impact.
5. Framework for Continuous Improvement: The developed water monitoring and management system serve as a framework for continuous improvement and optimization. Regular audits, data analysis, and feedback mechanisms will ensure that the institute maintains efficient water management practices in the long term

Recommendation

Regular Maintenance and Monitoring:

- Establish a proactive maintenance schedule for plumbing systems, fixtures, and water distribution networks to prevent leaks, address issues promptly, and optimize water usage efficiency.
- Implement continuous monitoring systems for water usage, leaks, and water quality parameters to detect anomalies early and take corrective actions swiftly.

Water Conservation Initiatives:

- Expand water conservation initiatives through awareness campaigns, educational programs, and behavioral change interventions to promote responsible water usage among students, faculty, and staff.
- Encourage the adoption of water-efficient technologies and fixtures, such as low-flow faucets, aerators, and smart irrigation systems, to minimize water wastage and enhance conservation efforts.

Leak Detection and Repair:

- Invest in advanced leak detection technologies and tools to conduct regular inspections, detect leaks accurately, and prioritize repairs based on severity and impact on water resources.
- Train maintenance staff and personnel in leak detection techniques, emergency response protocols, and efficient water management practices.

Water Quality Assurance:

- Enhance water quality monitoring programs by expanding the scope of testing to include additional parameters relevant to local water quality standards and guidelines.

DOI: 10.48175/568

ISSN 2581-9429 IJARSCT

- Collaborate with certified laboratories and regulatory authorities to ensure compliance with water quality regulations and standards, conducting periodic audits and assessments.

Infrastructure Upgrades and Retrofits:

- Consider infrastructure upgrades and retrofits, such as installing water-efficient fixtures, upgrading aging plumbing systems, and implementing rainwater harvesting systems, to improve water efficiency and sustainability.
- Explore opportunities for decentralized water treatment and recycling systems to supplement water supply, reduce reliance on external sources, and enhance resilience to water scarcity.

Data-driven Decision Making:

- Utilize data analytics, remote monitoring, and predictive modeling tools to analyze water usage trends, identify patterns, forecast future demands, and optimize resource allocation and management strategies.
- Establish key performance indicators (KPIs) and benchmarks to track progress, evaluate the effectiveness of water management initiatives, and drive continuous improvement efforts.

Stakeholder Engagement and Collaboration:

- Foster partnerships with local communities, environmental organizations, industry experts, and government agencies to exchange knowledge, share best practices, and collaborate on water conservation and sustainability initiatives

ACKNOWLEDGMENT

I wish to express my sincere Gratitude to my Guide Prof. A.E.Sonawane and Co-guide Prof.C.B.Pagarof Civil Engineering Department .Guru Gobind Singh Polytechnic, Nashik, for providing invaluable guidance and encouraging me to come up with such potential subject. I express my deep thanks to all the faculty members of Civil Engineering Department for providing the useful guidance and feel privileged to express my gratitude towards them.

REFERENCES

[1]. Kaju Nirmal, Aditya Patil, Pritee Jawale, and Khultej Gurav. "WATER AUDITING IN RESIDENTIAL BUILDING." Journal of Emerging Technologies and Innovative Research, vol. 9, 2022, pp. b187-b193.

[2]. R.A.Ganorkar, P.I.Rode, S.A.Deshmukh, Dr.R.M.Dhoble. "Water Audit – A Tool for Assessment of Water Losses." Journal of Computational Engineering Research, vol. 8, 2013.

[3]. Ramraje D. Sonvane, Dr.P.B.Nagarnaik, Dr. V.P. Thergonkar. "A Review – Water Audit." ISSN-2347-4890, vol. 4, 2016.

[4]. Sanjay Choudhary, Devendra Dohare, Shruti Bajpai. "Water Audit as a Tool for Management of Water Resources: An Indian Perspective." Journal of Software & Hardware Research in Engineering, vol. 16, 2021, pp. 694-703.

[5]. Mir Rohi Neelofar, Sami Ullah Bhat, Mohammad Muslim. "Water auditing and recycling as a tool for management of water resources: an Indian perspective." ISSN: 1606-9749, 2023