NAAC GRADE A+

REVA UNIVERSITY
Bengaluru, India

RAINWATER HARVESTING (B22EDO601)

OPEN ELECTIVE- SEMESTER-VI

SCHOOL OF CIVIL ENGINEERING

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Unit -4

- **Advancement and Policies of RWH:** Government policies and schemes for RWH in India, guidelines and regulations (e.g., building codes, municipal policies), Incentives and subsidies for RWH.
- **Smart RWH systems**, Integration with IOT for monitoring and management. Role of RWH in achieving water sustainability, Case Studies in Urban and Industrial.
- https://youtu.be/t2F02T2yNY8

Contents:-

- Government policies and schemes for RWH in India.
- Guidelines and Regulations
- Incentives and Subsidies for RWH
- Smart RWH Systems
- Integration with IOT for monitoring and management
- Role of RWH in achieving water sustainability
- Cases studies for Urban and Industrial

Government policies and schemes in India

- Central Government has formulated National Water Policy 2012 which *inter alia* contains provisions for rainwater harvesting like incentivizing revival of traditional water harvesting structures by States, encouraging rainwater harvesting.

- Water being a State subject, steps for augmentation, conservation and efficient management of water resources are primarily undertaken by the respective State Governments.

- In order to effectively implement the rainwater harvesting across the country, the Government undertakes various activities in the form of special drives, schemes and programmes. Some of the major steps taken by Government of India in this regard are as follows:

1. Jal Shakti Abhiyan-I (JSA-I) was conducted in 2019 in 1,592 blocks out of 2,836 blocks in 256 water stressed districts of the country and was expanded as “Jal Shakti Abhiyan: Catch the Rain” (JSA:CTR) in 2021 with the theme “Catch the Rain Where it Falls When it Falls” to cover all the blocks of all districts (rural as well as urban areas) across the country.

2.Government of India is implementing Atal Bhujal Yojana, a Central Sector Scheme.

3. Watershed Development Component of Pradhan Mantri Krishi Sinchayee Yojana (WDC-PMKSY) has got rainwater harvesting as one of the activities under its Natural Resource Management (NRM) component.

4.The scheme of Surface Minor Irrigation (SMI) and Repair, Renovation & Restoration (RRR) of Water Bodies have multiple objectives like expanding cultivable area under assured irrigation by improvement and restoration of water bodies *inter alia* increasing ground water recharge and revival of lost irrigation potential.

5.Master Plan for Artificial Recharge to Groundwater- 2020 has been prepared by Central Ground Water Board in consultation with States/UTs which is a macro level plan indicating various structures for the different terrain conditions of the country.

6. Central Ground Water Authority (CGWA) while granting No Objection Certificates (NOCs) for ground water abstraction envisages that the proponents shall install roof top rain water harvesting & recharge systems in the project area.

7. Government of India has launched Atal Mission for Rejuvenation and Urban Transformation (AMRUT) in 2015 which focuses on development of basic urban infrastructure especially water supply & access to tap connection to every household in 500 cities.

8. Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) includes water conservation and water harvesting structures as one of the activities under its natural resource management (NRM) component.

9. Model Building Bye Laws (MBBL) 2016 circulated by Ministry of Housing &Urban Affairs include provisions for Rainwater Harvesting and it has been shared with all the States/ UTs. So far, baring Sikkim, Lakshadweep and Mizoram all the States/UTs have adopted the provisions of rainwater harvesting of MBBL-2016.

10. The Mission Amrit Sarovar was launched on National Panchayati Raj Day on 24th April, 2022 as a part of celebration of Azadi ka Amrit Mahotsav with an objective to conserve water for future. The Mission is aimed at developing and rejuvenating 75 water bodies in each district of the country.

GUIDELINES AND REGULATIOS

The laws around rainwater harvesting

- There are Acts that define the law and there are Regulations that enable the authorities to enforce the stipulations of the Acts

- There are two main Acts concerning rainwater harvesting:
  - The Bangalore Mahanagara Palike Building Byelaws (2003)
  - The Bangalore Water and Sewerage Amendment Act(s)…
    - The Bangalore Water and Sewerage Amendment Regulation(s)

- Even if you don't qualify under the law it makes sense!

Do the laws apply to me?

- The BBMP law applies to all properties coming under its jurisdiction; they are required to implement rainwater harvesting as per the BBMP law.

- If you have a BWSSB connection, then you have to comply with the BWSSB Act
  - Currently around 110 villages/areas in Bangalore do not have BWSSB connections and thus penalties cannot be levied on them for non compliance.
  - But if these properties come under BBMP, they need to comply with the BBMP law.

Chronology


BMP Building Byelaws (2003)
Byelaw 32 pertaining to Rainwater Harvesting
BWSSB Amendment Act (2009)
Insertion of Section 72a making RWH compulsory
BWSSB Regulations Amendment (2011)
Inclusion of Regulation 8 Disconnection of water supply
Bangalore Water supply and Sewerage Amendment Regulations (2015)
Introduction of penalties for defaulters

The laws pertaining to RWH

	BBMP Bye-Laws 2003, Bye-Law 32	BWSSB Amendment Act 2009
Eligible properties	Built up area exceeding 100m²/1100 ft² on sital area of 200m²/2150 ft²	Built up area of 1200 ft² and above on sital area of 2400 ft² and above
Capacity of storage structure rooftop		20l per m²/10ft² of roof area
Open well recharge well	Open well should have a minimum depth of 6m/18ft and a minimum dia of 1m/3ft; the borewell should have a pit with 3m/10ft depth and 1m/3ft dia filled with stone aggregate and sand around it	Well should have a minimum depth of 3m/10ft and minimum of dia 0.9m/3ft
Land based rwh storage capacity		Plan for 10L or more per m²/10ft²
Discharge	For roof area of 100m²/1100 ft² you need at least 2 down pipes of minimum 10cm dia	
Penalties	1000 Rs p.a. for every 100m²/1100ft²	Disconnection of water supply (2011 Reg Amdt) and 25% addnl charge for 3mths, 50% additional charge thereafter (residential); 50% addnl charge for 3mths, 100% additional charge thereafter (non residential);

Penalties and Non Compliance

Non compliance: what if I have not implemented rainwater harvesting?

- If you have a BWSSB connection and your property falls under any of the regulations and have not yet implemented rainwater harvesting, the BWSSB can impose a levy of additional water supply and sewerage charges as per the BWSSB Amendment to Regulations (2015).

Penalties imposed by BWSSB for non compliance

- Penalties introduced for residential and non residential defaulters (BWSSB Amendment to Regulations 2015)
  - Residential buildings: additional charges of 25% of total water and sanitary charges will be levied for first 3 months and thereafter 50% of total water and sanitary charges till the RWH is provided
  - Non residential buildings: additional charges of 50% of total water and sanitary charges for first 3 months and thereafter additional charges of 100% of total water and sanitary charges till the RWH is provided

Penalties imposed by BWSSB for non compliance

- Executive Engineers and Assistant Executive Engineers are responsible for levying the additional charges and BWSSB has started implementing this with effect from 30th June 2016.

- As of August 2016, 61,749 properties implemented RWH and 117000 properties have been identified by BWSSB as non compliant and thus additional charges (30 Lakh INR) have been levied against them as per above in last two months.

Annexures – Laws and Regulation

The Bangalore Mahanagara Palike Building Byelaws (2003) Bye-Law 32

- Applicable within BBMP jurisdiction from June 5th 2004 onwards
- Every building with plinth area/built up area *exceeding* $100\,m^2$ *(approx 1100 sq ft.)* and built on a site measuring not less than 200 m^2 $(approx\ 2150\ sq\ ft)$should have rainwater harvesting structures with a minimum total capacity as mentioned in Schedule 12
- Every owner of a concerned property needs to ensure that the rainwater harvesting structure is maintained and is used to store water for non-potable purposes or recharge of groundwater at all times
- The Authority may impose a levy of not exceeding Rs. 1000/- per annum for every 100 m^2 of built up area for the failure of the owner of any building mentioned in the bye-law 32 to provide or to maintain Rain Water Harvesting structures as required under these bye laws.

BBMP Bye-law 32 Schedule XII

- For the efficient discharge of rain water, there shall be at least two rain water pipes of 100 mm dia for a roof area of 100 m^2 $(approx\ 1100\ sq\ ft)$.
- Every property identified under Bye-law 32 needs to provide an open well of a minimum of 1m dia and 6m depth (3 ft dia and 18 ft depth) into which rain water may be channelled and allowed after filtration for removing silt and floating material
- Recharge of ground water may be done through a bore well around which a 1m wide pit may be excavated up to a 3m depth and refilled with stone aggregate and sand

Bangalore Water Supply and Sewerage (Amendment) Act, 2009, Section 72A

- Section 72A included in the Act and in force since August 27, 2009
- "Obligation to provide rain water harvesting Structure"

- *Within 9 months from the date of commencement of this act, i.e. May 2010, every owner or occupier of building with sital area of 2400 ft^2 and above or every owner who propose to build/construct building with sital area of 1200 ft^2 and above should provide for RWH as per regulations mentioned in first section above. Failing which the board may cause such RWH and recover the cost from owner as arrears of land revenue.*

The Bangalore Water Supply and Sewerage (Amendment) Regulations, 2011

- The insertion of new Regulation 8: "Disconnection of water supply"

- Where the owner or occupier of building fails to provide RWH within such date as modified under section 72A of the Act, the water supply connection provided to such building may be disconnected provided that no disconnection should be made unless an opportunity of being heard is given to the affected persons

The Bangalore Water supply and Sewerage (Amendment) Regulations, 2015

- Penalties introduced for residential and non residential defaulters
- Residential buildings: additional charges of 25% of total water and sanitary charges will be levied for first 3 months and thereafter 50% of total water and sanitary charges till the RWH is provided
- Non residential buildings: additional charges of 50% of total water and sanitary charges for first 3 months and thereafter additional charges of 100% of total water and sanitary charges till the RWH is provided

Incentives and subsidies for RWH

- The Government of India, for example, provides financial assistance for the installation of RWH systems. The Surat Municipal Corporation has made RWH mandatory for new buildings with a plot size of >4,000 m^2 and provides up to a 50% (up to Rs. 2,000) subsidy to citizens to encourage rainwater recharging

Role of RWH in achieving water sustainability

- Rainwater harvesting is defined as the collection and storage of rainwater before it is dispersed as surface run-off. Typically, a rainwater harvesting system collects the water running off a roof surface and passes it into a storage vessel.

- It’s a process that is by its nature inherently efficient; simply put, rainwater is a water supply that is used where it is collected.

- The water quality is typically high so it can be used for a wide variety of non-potable (non-drinking) purposes including WC flushing, laundry, garden irrigation and vehicle washing.

Karnataka Council for Technological Upgradation
Government of Karnataka

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RWH

Home

Incentives to MSME Units for adopting Rain Water Harvesting (R.W.H.) Measures

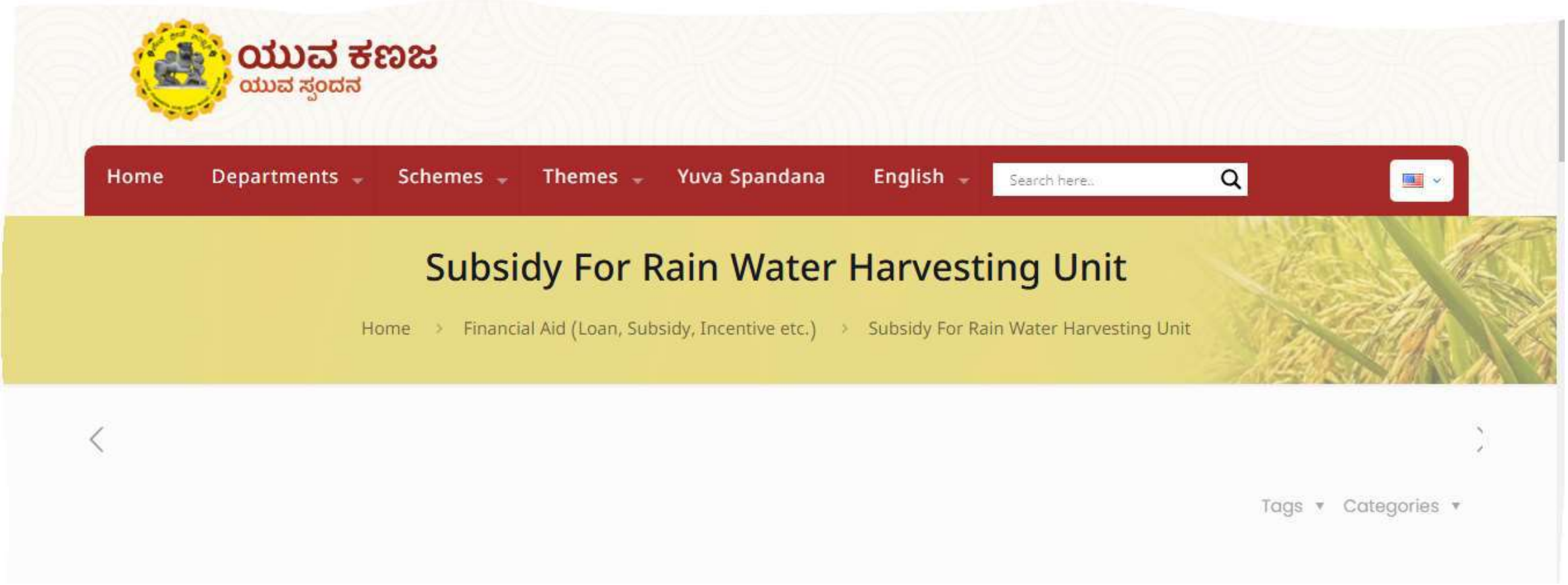
Eligibility:

1. The new / existing Micro, Small & Medium Enterprises who have adopted RWH methods are eligible to claim incentives under this scheme.
2. The scheme provides incentives to expenditure made for procurement of equipments foradopting RWH measures.
3. The scheme shall provide one time incentive/assistance only.

ncentives :

General Category	Special Category
For All Zones 50% of Cost of equipment (Max Rs 2.00 lakh)	For All Zones 75% of Cost of equipment (Max Rs 2.50 lakh)

https://kctu.karnataka.gov.in/25/rwh/en



https://yuvakanaja.in/horticulture-dept/subsidy-for-rain-water-harvesting-unit/

Smart RWH Systems

- **Smart Rainwater Harvesting Systems: An Overview**

Smart rainwater harvesting systems integrate advanced technology, sensors, automation, and data analytics to optimize the collection, storage, and use of rainwater. These systems are designed to increase efficiency, reduce waste, and help in sustainable water management.

Let’s break down the components, functions, and benefits of smart rainwater harvesting systems.

- **Key Components of Smart Rainwater Harvesting Systems**
- **Rainwater Collection**:
  - **Roof Catchment Area**: The primary source of rainwater, typically rooftops, where water is collected through gutters and downspouts.
  - **Gutters and Downpipes**: Channels that direct the rainwater from the roof to the filtration and storage systems.

- **Filtration and Pre-Treatment**:
  - **First Flush Diverter**: This is a device that ensures the first portion of rainwater, which may contain contaminants like dust, leaves, and debris, is diverted and not stored.
  - **Mesh Filters or Screen Filters**: Prevent large particles like leaves, twigs, or dirt from entering the system.
  - **Sediment Filters**: Removes smaller particles to ensure cleaner water enters the storage tanks.

- **Storage**:
  - **Water Tanks or Cisterns**: Stores harvested rainwater for later use. These tanks can be made of various materials such as plastic, concrete, or metal. They can also be above or below ground.
  - **Smart Water Level Sensors**: These sensors help monitor the water levels in the tank in real-time and can trigger alerts or automatic actions (e.g., shutting down or activating pumps).

- **Smart Automation and Control System**:
  - **Flow Meters and Sensors**: Measure the volume of water being collected, filtered, and stored. These provide data on the system's performance.
  - **IoT Connectivity**: The system can be connected to a smartphone or cloud-based platform, where users can monitor and control various aspects of the system remotely. For example, users can track water levels, filter status, and maintenance schedules.
  - **Weather Prediction Integration**: Some systems integrate weather forecasts to optimize collection based on predicted rainfall, which can help in scheduling maintenance or diverting excess water.
  - **Automatic Flush Valves**: Triggered by sensor data, these valves automatically flush out accumulated debris or sediments when the tank reaches a certain level of dirtiness.

•**Water Distribution**:

•**Pumps and Irrigation Systems**: Once the rainwater is collected, a pump system can deliver it for household use (e.g., for washing, landscaping, or toilet flushing) or garden irrigation.

•**Smart Controllers for Irrigation**: For rainwater used in irrigation, smart controllers can adjust watering schedules based on factors such as soil moisture levels, weather forecasts, and water availability.

•**Water Quality Monitoring**:

•**Sensors for pH, Turbidity, and TDS (Total Dissolved Solids)**: These sensors monitor the quality of rainwater, ensuring it is safe for its intended use. Alerts are generated if the water quality falls below the desired standards.

- **Features and Advantages of Smart Rainwater Harvesting Systems**
- **Efficiency and Automation**:
  - Smart systems allow for the automation of various processes, including water collection, filtration, storage, and distribution. For example, water levels can be automatically adjusted based on sensor feedback, ensuring that tanks are not overfilled or underutilized.
  - Automatic flushing systems help maintain the cleanliness of the water without requiring manual intervention.

•**Data-Driven Insights**:

•The integration of IoT and sensors provides real-time data on water usage, tank levels, filtration status, and system performance. Users can access this data through mobile apps or web dashboards, which allows for better management and decision-making.
•Predictive analytics can optimize system operations based on weather forecasts, historical data, and usage patterns, reducing water waste and maximizing savings.

•**Water Conservation**:
•The system helps reduce dependence on municipal or groundwater sources, especially in areas with water scarcity. By collecting rainwater and reusing it for non-potable uses like irrigation or washing, smart systems reduce the overall water demand.
•This process also helps in reducing stormwater runoff, preventing flooding, and decreasing the strain on drainage systems.

•**Cost Savings**:
•Reduced water bills for users who can shift non-potable water needs to rainwater. Over time, the system can pay for itself with savings on water consumption.
•Efficient use of rainwater through automated systems ensures minimal wastage.

Sustainability:
•By capturing and using rainwater, smart systems contribute to environmental sustainability. These systems reduce the need for energy-intensive water treatment and transportation systems.
•Rainwater is often "softer" (low in dissolved minerals like calcium), making it more suitable for use in irrigation and industrial applications.

- **Smart Monitoring and Alerts**:
- With integrated sensors, users can get real-time alerts for maintenance needs (e.g., clogged filters, low water levels, or required system repairs), thus preventing system breakdowns.

- Smart systems can be programmed to alert users when the collected rainwater is suitable for use, or when it might need further treatment (e.g., for potable uses).

- **Types of Smart Rainwater Harvesting Systems**
- **Residential Systems**:
  - Smaller scale systems typically installed for individual homes, with features like automated irrigation, toilet flushing, or washing water. These systems are often designed for ease of installation and maintenance.

- **Commercial and Industrial Systems**:
  - Larger systems capable of handling higher volumes of rainwater. These systems might incorporate more complex filtration and purification processes, as well as automation for large-scale irrigation or industrial applications.

- **Urban Rainwater Management Systems**:
  - These systems are designed for urban environments where large-scale stormwater management is needed. They often integrate with city-wide smart grids or infrastructure, contributing to flood mitigation and overall water conservation efforts.

- **Agricultural Rainwater Systems**:
  - For farms or agricultural use, smart rainwater harvesting can automate irrigation systems, monitor soil moisture, and even apply fertigation (fertilizer and irrigation combined) based on real-time data, optimizing water use in agricultural fields.

- **Challenges and Considerations**
- **Initial Investment**:
  - While the benefits of smart systems are clear, the initial setup can be costly, particularly if high-end sensors, smart controllers, and weather integration features are used. However, long-term savings can offset the initial costs.

- **Maintenance**:
  - Smart systems require periodic maintenance, especially for sensors, filters, and pumps. Automation helps reduce the manual labor required, but the system still needs to be periodically checked to ensure optimal functioning.

▶ **Dependence on Weather**:

•The efficiency of the system relies heavily on rainfall patterns. Areas with irregular or low rainfall might find these systems less effective unless they are augmented by other water sources or technologies.

▶ **Water Quality Issues**:

•Rainwater may require additional treatment if it's intended for potable use. Filtration, UV treatment, and disinfection are often necessary, and smart monitoring systems can help ensure that water meets required standards.

- **Conclusion**
- Smart rainwater harvesting systems are transforming traditional water conservation efforts by leveraging technology to optimize rainwater collection, filtration, storage, and usage. By integrating sensors, IoT, and automation, these systems not only contribute to sustainability but also offer significant cost savings and efficient water management. As water scarcity becomes an increasingly important issue, the role of smart rainwater systems in both residential and commercial applications will likely continue to grow.

Integration with IoT for monitoring and water management

TEAMTWEAKS

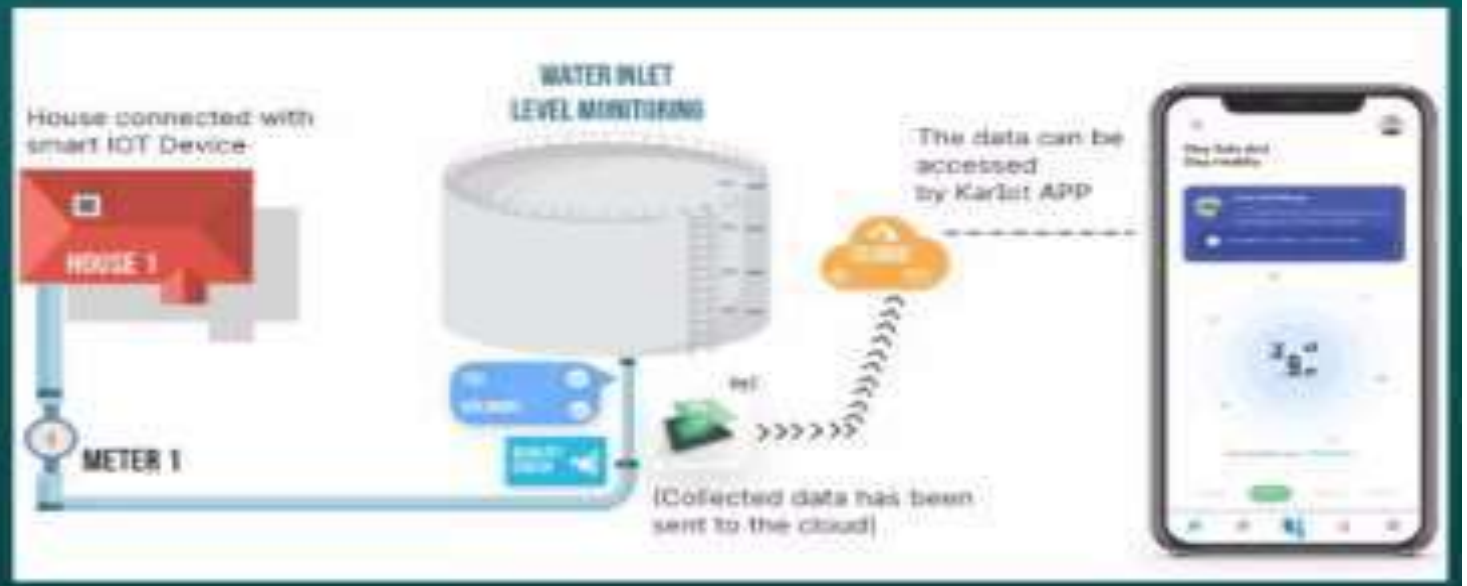
Introduction

IoT has had a significant impact on everyone's lives in this technology age. Smart houses, smart traffic management systems, and other smart infrastructure are present in our cities. IoT is currently heavily used in the water management strategies. It guarantees the precise use of water, protecting our priceless resources and enhancing overall convenience. The majority of nations lack effective resource management. It always causes a shortage of water. According to a recent study, water scarcity would affect 50% of the world's population within the next four years. These facts make it very evident that water will be a valuable resource in the coming years.

An exclusive insight

TEAMTWEAKS

The IoT-integrated smart water management system is currently the greatest method for effectively saving water. The smart IoT water measuring devices are used to measure the water supply in both industrial and commercial settings. A number of sensors, including those for pressure, volume, pH, and turbidity, are mounted throughout the pipelines to collect data and send it to cloud storage. The sensors described above are mostly used to test the water's quality in a specific way.




TEAMTWEAKS
The water is then directed towards the overhead tanks. Here, it is also possible to measure the quantity and quality of the water. It is clearly seen using clever smartphone apps. To conserve water and use it correctly, the government must intervene immediately and offer smart protocols. Saving water is inevitably encouraged if using it is required to earn credit. By starting a water supply, it is also possible to identify any leaks in the system's overall pipes.

Role of IoT in Water Industry

TEAMTWEAKS

- Water Preservation
- Smart Irrigation
- Smart Water Management
- Systematic Smart Water Units

While discussing in detail, most of the houses in our country especially in the southern part, the people have constructed large wells where the water is pumped easily to fulfill our daily needs.

TEAMTWEAKS

Evolution of smart water management for the metropolitan city

Smart showers are known to have a control point at the output source. Today, it is possible to control the entire household's water system. Either a utility company or a relevant government is in charge of the whole water delivery. The monthly bills go to both the household and the industrial sectors. Usually, it is calculated using water metre measurements. The majority of people wonder how smart water metres are introduced. It is merely a typical question and not a major concern; it is not a big hypothetical one. It is simple to create smart water metres by adding sensors to conventional metres. Massive data collections have been analysed by intelligent systems, even when the distance factor is taken into account.

TEAMTWEAKS

Role of IoT in agriculture

According to a statistics report, agriculture uses around 70% of the water that is used globally. This one automatically applies to improving roughly 90% of the Asian nations in the southern region. It is possible to drastically remove by utilising more modern IoT & AI technology. The irrigation procedure often follows an infinite strategy. An enormous plant's water needs are triggered by a number of variables. Practically speaking, it is impossible to quantify every issue. But as of right now, everything has changed and is moving in the right direction.

Conclusion

TEAMTWEAKS

The management of water resources, conservation efforts, and waste prevention have all been made possible by IoT, as is evident from the aforementioned facts. The optimization of automated concerns is what the Internet of Things is all about. IoT had a significant impact across all industries, excluding water management. It plays a crucial part in everything from beehive monitoring systems to smart cities. There is no doubt that everything will be automated in the future, and this is only possible with the help of IoT coupled with its array of sensors. Be prepared to use IoT technology in every industry by making the proper system choice and being wise enough to do so! In search of any IoT project development or other services like app or web development. For your project's launch, you can find top web development companies nearby.

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Case Studies in Urban

- https://www.researchgate.net/publication/299704904_Water_Conservation_in_Urban_Areas_A_Case_Study_of_Rain_Water_Harvesting_Initiative_in_Bangalore_City

- https://www.ijsr.net/archive/v8i5/ART20197767.pdf

Case studies in Industrial

- https://www.mdpi.com/2071-1050/16/11/4657
- https://www.stormsaver.com/case-studies/leisure-case-studies/oru-community-building-
- https://www.stormsaver.com/case-studies

Thank You