Investigation/application of DX/Innovative Technologies for Impactful Development in Water and Sewage Sector

Final report

DX Solution for water utility sector of Uttarakhand, India

Presented by

Deloitte.
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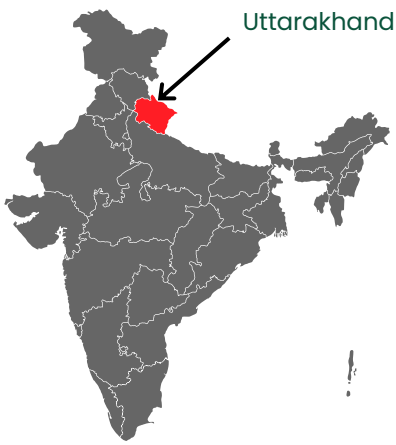
Submitted to

JICA
Japan International Cooperation Agency

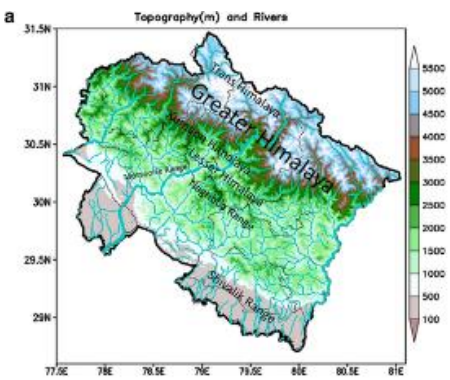
CONTENT

Executive Summary

This project was targeted towards state of Uttarakhand of India. Due to various geographical, infrastructural, climatic, and other factors, access to safe drinking water and sanitation has not been able to reach the entire population. This lack of access is impediment to the development of the state and quality of citizens. Realizing this, Government of Uttarakhand has formulated the "Uttarakhand Vision 2030" and the "Improving Drinking Water Policy for Peri Urban Areas" and is promoting the development of water supply systems with a focus on providing safe and stable drinking water and efficient water resource management in the mountainous and remote areas of the state where development is lagging.



Map of India



Topography of Uttarakhand

Government of Japan and JICA under various policies and strategic initiatives to promote co-operation and support sustainable and inclusive growth are extending expertise and financial support. One of the key components of support is this project in which Deloitte supported JICA in finding innovative solutions from the private sector for use in DX or other methods to solve the needs of Uttarakhand Peyjal Nigam. Leakages at multiple points in the water supply chain are a major cause of water loss in existing infrastructure. This project aimed to find a DX solution to reduce such losses by detecting and/or addressing leaks.

The project is divided into 3 phases:

Phase I :
1. Study and assessment of problems and requirements of Uttarakhand Peyjal Nigam.
2. Design technology map & longlist potential solution providers.

Phase II :
1. Campaign to attract innovative solutions.
2. Execute a pitch contest to assess capability of applicants.
3. Finalize candidate for Pilot project.

Phase III :
1. Execute the pilot.
2. Study results and analyze the effectiveness of technology intervention for the DX project.

At the end of the project, we have curated preliminary monitoring and evaluation findings from collected data, along with learnings from stakeholders engaged in the Pilot activity, which shall be discussed in detail throughout this report. During the implementation of the pilot project, we found that ground and technical support from the executing agency is critical for the success of such programs. Under the guidance and supervision of JICA, technical and ground support from the executing agency and coordination with the technology partner (selected start-up) enabled the successful implementation of this project and allowed us to attain all the following goals:

- A model case of a DX project envisioned by JICA for the support of various state government agencies in India.
- A framework for the selection/recruitment of an innovative technology partner through a consultant to work with the executing agency.
- Successful and measurable impact of the technology implementation on the efficiency of state agencies.

As this project becomes a model case of DX implementation, learnings can be used for planning and implementation of similar projects with peer executing agencies and stakeholders in other geographies/states of India.

<u>We would also like to highlight some key points of this project:</u>

1. **Speedy implementation of the survey and PoC:** Led by the JICA India office, the survey with bidding, screening, pitch, and PoC were carried out in a short time span of 9 months. This expedited the response to development needs of the executing agency and the local population.
2. **Applying the fusion of Japanese and Indian technologies to PoC:** The technology used by selected Technology partner (AUMSAT) utilizes satellite data from Japan's JAXA (Japan Aerospace Exploration Agency) to detect groundwater. This is a technological innovation unique to India, where drought conditions are severe, and will be used to detect water leaks.

3. Agile management based on decision-making by the Executing agency: Important decisions, such as identifying issues and selecting technologies, are made with the implementing agency to promote ownership. During the PoC, the implementing agency suggested shifting the activities beyond leak detection to include repairs, and adjustments were made to provide more effective support.

Background & Purpose

The fundamental objective of this project was to find cost-effective, scalable, and innovative solutions that use digital transformation (DX) or other methods for addressing the needs of the Executing Agency: Department of Drinking Water and Sanitation, Uttarakhand Peyjal Nigam. The solution provided from the private sector can be effectively employed with the assistance of the E/A and JICA.

In 2023, India overtook China to become the world's most populated country and is expected to grow for the next decades with a population growth rate of 0.8% as of 2021 (World Bank, 2023). The continuous growth in population is and shall continue to put strain on the existing water resources and supply. Thus, in addition to developing water sources, there is a need to increase water supply infrastructure and develop efficient water supply systems by rehabilitating aging existing facilities and strengthening operations and maintenance capacity, including reducing the non-revenue water rate (38% as of 2020 (Industrial Automation, 2020)). The Government of India has taken cognizance of this situation and has been promoting the development of waterworks with the goal of providing piped water to all households by 2024. However, as of December 2024, only about 79% of all households in India are connected to the water supply system (Ministry of Jal Shakti, 2024), so the government needs to accelerate its efforts.

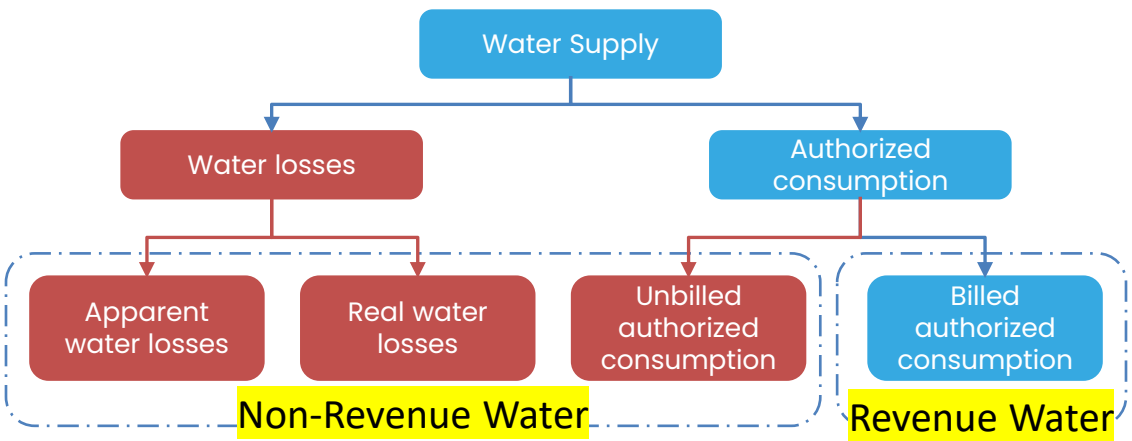
The state of Uttarakhand in India was the primary focus of this project. Eighty-six percent of the landmass of the state is covered by steep terrains of the Himalaya Mountain range (Government of Uttarakhand, 2017). The state is the source of major rivers, including the Ganges, which originates from melting snow in the Himalayas and plays a significant role as a water reservoir for the states located downstream. Nonetheless, 50 urban towns out of 102 urban towns in the state, i.e., more than 50% of all households, are still not connected to the water supply system. Particularly in mountainous and remote rural areas, the number of households without access to sufficient drinking water throughout the year is 18.4%, higher than in urban areas of the state (3.0%) and the Indian average (9.1% in urban areas and 12.4% in rural areas), indicating that securing a stable source of water is an issue (Government of India, 2023).

UKPJN has identified Non-Revenue Water (38%) as a major issue and wanted to find solutions to tackle this challenge. The long-term objectives of such solutions would be to enhance the availability and sustainable management of water and sanitation resources for all. Deloitte Tohmatsu Venture Support team ,comprising of Indian and Japanese members to bridge the cultural and Language gap effectively, provided an approach that delivered the required results to UKPJN and JICA in an efficient manner.

Phase 1 : Need Assessment & Technology mapping

Requirements collection phase - Through hearing interviews of UKPJN & JICA and data gathering framework, Deloitte documented the understanding of NRW in the region.

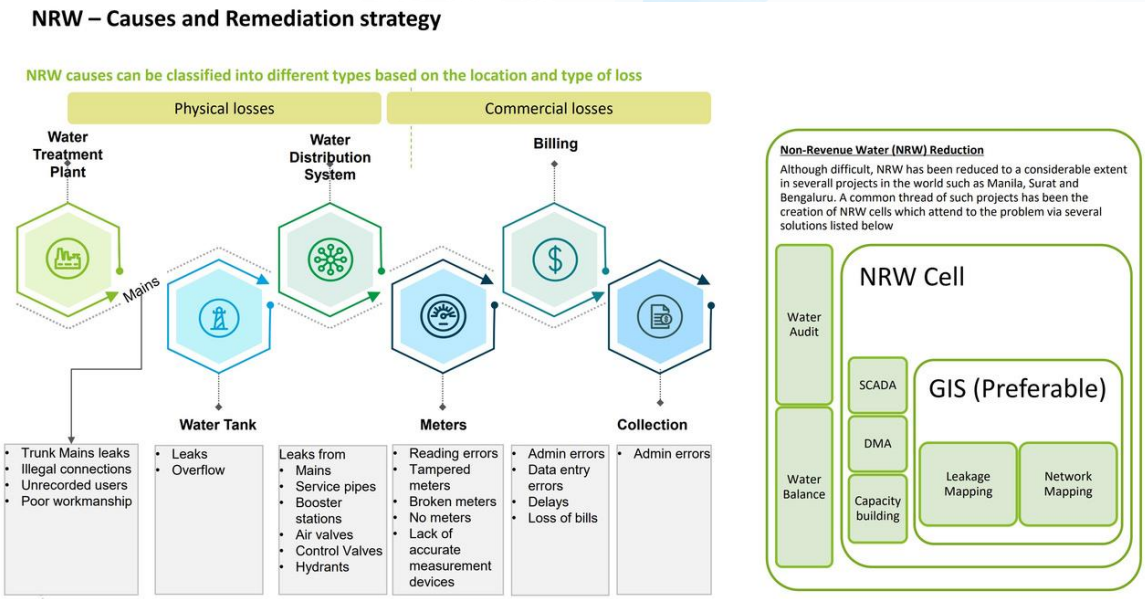
Understanding what is NRW and why is NRW calculation so important :
Non-Revenue Water (NRW) is the extent of water produced which does not earn any utility/ revenue. Difference between total water produced (ex-treatment plant) and total water sold expressed as a percentage of total water produced. So, it is the difference between the quantity of treated water in the distribution system and the quantity of water that is billed to consumers. Reduction of real losses can be used to meet currently unsatisfied demand or to defer future capital expenditures to provide additional supply capacity. Reduction of NRW is desirable not just from a financial standpoint, but also from an environmental benefits point of view.



Non-Revenue water - Our understanding of situation at Uttarakhand

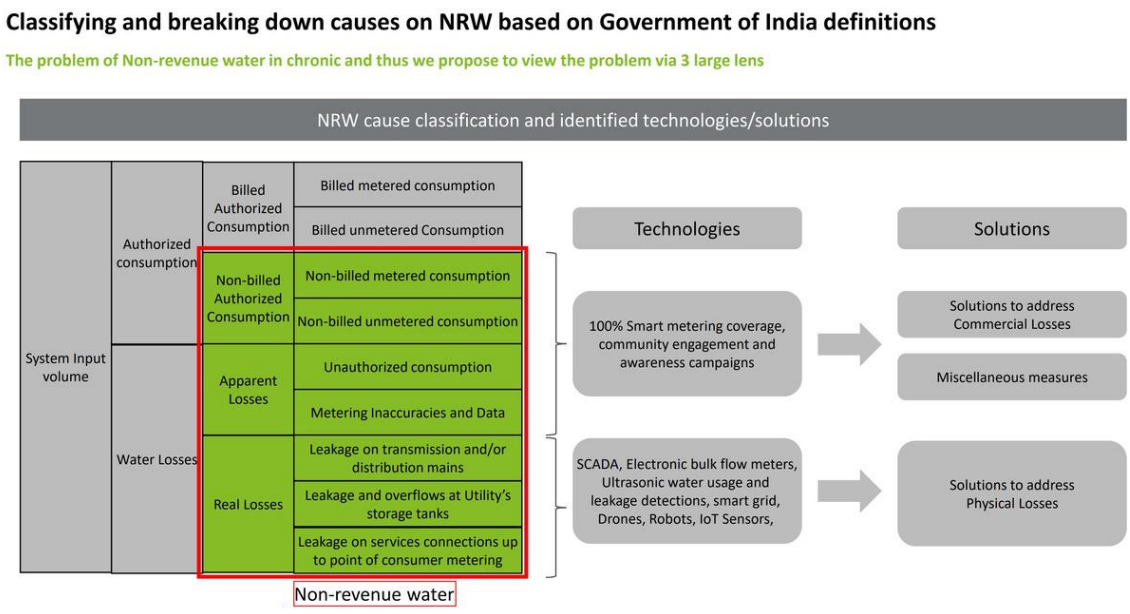
Source : https://www.peakventures.in/non-revenue-water, Ease of Living index MoHUA, Government of India

We also documented general causes and remedies for NRW issues as follows:



NRW - general causes and remedies

Based on the research and discussion with all the stakeholders, we classified and identified technologies and solutions for mitigating non-revenue water, as follows:



NRW cause classification and identification of technology and solutions

Sources : 1. https://www.spml.co.in/Download/Reports/nrw-toolkit-final.pdf

Deloitte identified following problem statements that were required to be solved during the Pilot project.

Initial problem Statement :

EA faces a severe problem with non-revenue water of higher than 38% and would like to seek technologies to bring it down to 20-25% range. EA is open to explore technologies to solve the issue. We have divided solutions into 3 buckets which would mitigate, respectively:

- Commercial losses
- Physical losses, and.
- Miscellaneous measures.

Technology Mapping & finalizing problem statement :

After detailed discussions and deliberations between experts from UKPJN and JICA on timelines, technical pre-requisites, evaluation of technologies/solutions, resources (monetary and human) it was concluded that search of solution would focus on "prevention and detection of leakages." Thus, the problem statement was designed to be **"prevention and reduction of non-revenue water including prevention and detection of leakage"** and invitation was sent to many varied technology providers with mandatory requirements as :

- ☑ Proposed solution must provide a solution that can integrate with existing solutions to improve the capabilities of UKPJN to detect and/or prevent water losses in its existing water supply infrastructure.
- ☑ Proposed solution must provide ways to measure impact of the solution before and after the implementation of the solution.
- ☑ Proposed solution should ideally be scalable and can be implemented in a wider area without disproportionate escalation of costs.

During the discussions, measurable factors during the PoC were also deliberated and finalized as:

- **Detection Accuracy:** The technology solution should accurately detect the presence of leaks in the water supply infrastructure. The accuracy rate, false positives, and false negatives should be measured.
- **Location Precision:** The solution should precisely locate the position of the leak. The accuracy of the location data should be measured.
- **Response Time:** Measure how quickly the system can detect a leak and alert the relevant authorities or take automated action if applicable.
- **Scalability:** Test if the solution can be effectively scaled up to monitor a large water supply network.
- **Integration:** The solution should be able to integrate seamlessly with existing water management systems. Assess the ease and effectiveness of this integration.
- **User Interface and Experience:** Evaluate the usability of the system for end users. This could involve ease of use, clarity of alerts, and simplicity of interpreting data
- **Reliability:** The system should function reliably under different conditions and over extended periods of time. Measure uptime, error rates, and other relevant reliability metrics.
- **Cost-effectiveness:** Evaluate the costs associated with implementing the solution, including equipment, installation, operation, and maintenance costs, against the potential savings from reduced water loss.
- **Impact Assessment:** Measure the potential impact of the solution in terms of water saved, reduction in repair and maintenance costs, and improvement in service delivery.
- **Sustainability:** Evaluate the solution's environmental impact, energy consumption, and long-term sustainability

Phase 2 : Solution Scouting & Pilot design

Under the supervision and guidance of JICA and UKPJN an RFP was designed and circulated to attract applications. The RFP was directly sent to various Venture capital funds, ecosystem players and also to companies, identified through field visits, references and desktop research.

The content of the RFP included:

- Documented problem statement & requirements that need to be met using DX or other solutions.
- Details on the potential opportunity to collaborate with the E/A and JICA for the selected Water supply scheme through a Pilot project.
- High level parameters on which the applicants will be evaluated.
- Details on the estimated cost provided to implement the Pilot project.
- Tentative timeline of the Pilot implementation.

Flyer to attract response to RFP

Selection round 1 : Written evaluation
Evaluation of submitted proposal on technical and financial parameters

With respect to the floated RFP, on 24th July 2024, for attracting technology solution for reducing NRW in Uttarakhand, in total 7 applications were received. Based on initial evaluation of submitted document, 5 companies scored above the threshold of 70 points and thus were shortlisted for phase-2 "Online Pitch session".

Technical Expertise	Applicability of solution to Need of detection of Leakage	Previous Experience in Non-Revenue Water Projects	Scalability of Solution	Long term cost efficiency of solution	Total score
25%	25%	20%	20%	10%	100%

Evaluation criteria

Selection round 2 : Solution Pitch + QnA from panel
Evaluation of submitted proposal on technical and financial parameters

Online Pitch session was organized on 22nd Aug 2024, 13:00 ~ 17:00 IST.

Each of the qualified 5 companies were invited to pitch in front of panel of experts from JICA and UKPJN.

Each company was given 10 mins to pitch & Queries from panel for 20 mins.
Panel of experts:

- UKPJN
- JICA
- Deloitte (also the moderator of the session)

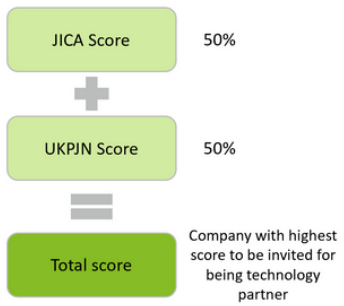
Pitch session to present solution in front of panel of experts from JICA and UKPJN

Pitch session for 5 selected companies will start at 13:00 IST on 22nd Aug (13:00 ~ 17:00 IST is scheduled time)

Start time	End Time	Duration	Activity	Comments
00:00	00:10	10 mins	Pitch by Company	
00:10	00:30	20 Mins	Questions by Panel to Companies	
00:30	00:45	15 Mins	Review, scoring and small break	
Next Company				

Scoring criteria and mechanism

- Each company's pitch and answers to query from panel was evaluated on predetermined technical criteria.



Overview of the Pitch session

Outcome of selection rounds :

After rigorous evaluation and deliberation by the panel, AUMSAT technologies was shortlisted and invited for implementation of Pilot project.

Pilot project activity was planned between October 2024 and December 2024.

The parties relevant to the Pilot activity were 1) JICA & UKPJN 2) Consultant (Deloitte Tohmatsu) and 3) selected Technology Partner (AUMSAT) and the expectations from each of the parties in the Pilot phase was summarized below :

	Strategic Planning	Project scope definition	Resource allocation	Risk assessment and mitigation	Implementation of the Technology and Infrastructure	Monitoring and evaluation	Follow-up and Review
Deloitte	■ Assist the selected company / startup in defining clear objectives and goals for the pilot project. ■ Help align the pilot activity with the long-term vision and business strategy of the selected company / startup	■ Collaborate with the startup to clearly define the scope of the pilot project. ■ In consultation with E/A and JICA establish **S**pecific, **M**easurable, **A**chievable, **R**elevant, and **T**ime-bound (SMART) KPIs and metrics for the pilot.	■ Provide guidance on allocating resources efficiently, including financial, human, and technological resources.	■ Assist and guide Selected company / start-up in identifying potential risks associated with the pilot project.	■ Provide advice on selecting appropriate technologies for the pilot	■ Guide the startup in developing a monitoring and evaluation framework to assess project progress.	■ Assist in analyzing feedback from the pilot and making necessary adjustments to enhance success.
E/A & JICA	■ Feedback and guidance on alignment with expectations from the outcome	■ Approve the boundaries and limits of the scope in consultation with all the stakeholders	■ Provide the selected company / startup identify and secure necessary resources for the pilot.	■ Review with the selected company / startup to develop risk mitigation strategies and contingency plans	■ Offer guidance on setting up the necessary infrastructure and ensuring compatibility with existing systems	■ Review and supervise key performance indicators (KPIs) and metrics for the pilot.	■ Provide feedback about the pilot. ■ Extract learning and record best practices for future pilots or reproduction.
AUMSAT	■ Clearly state company goals, mission and vision and service capabilities	■ Analyse the boundaries and limits of the scope ■ Procide timelines of roll-out of PoC activities	■ Define the external and internal resources required cleary ■ Allocate any internal resources required	■ Capacity and capability acknowledgment. ■ Prepare contingency plan for high-risk scenarios.	■ Design technical compatibility with the existing infrastructure and co-operate with E/A and Deloitte on technical alignment	■ In consultation with E/A and Deloitte negotiate and arrive at mutually agreeable KPIs	■ Share experience about the pilot, the success, failure ■ Discussion with mentor to analyse the root causes and help develop learning outcomes

Roles & Responsibilities

Phase 3 : Pilot Implementation & result verification

Deloitte team along with selected technology partner, Aumsat made a planned 2-day visit to Dehradun to meet UKPJN officials and visited the designated site for pilot activity.

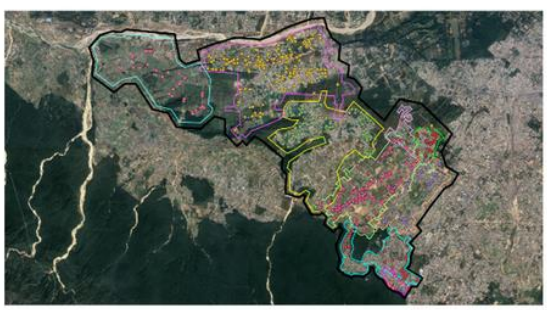
During the 1st day officials from UKPJN gave a detailed overview of the entire project, topography, assets, resources available and made introduction to the executive engineers & contractor of the project who would be providing ground support during the entire exercise.

Following the initial introductory meeting UKPJN also provided detailed tour of the designated site for pilot activity. The tour included visits to Pump houses, housing areas, Over Head tanks etc. This tour helped Aumsat to understand the topography, pipeline network planning and infrastructure, other local issues like consumer requirements and behavior.

Area covered in Pilot project

Mehuwala Cluster Water Supply Scheme" spanning the Mehuwala, Chandrabani and Arcadia regions of Dehradun, Uttarakhand

Sr. No.	Zone	Subzone	Pipeline Length in Kms
1	Arcadia	1	70
2		2	107
3		3	37
4	Chandrabani	1	43
5		2	8
6	Mehuwala	1	10
7		2	13
8		3	61
9		4	33
		Total	382



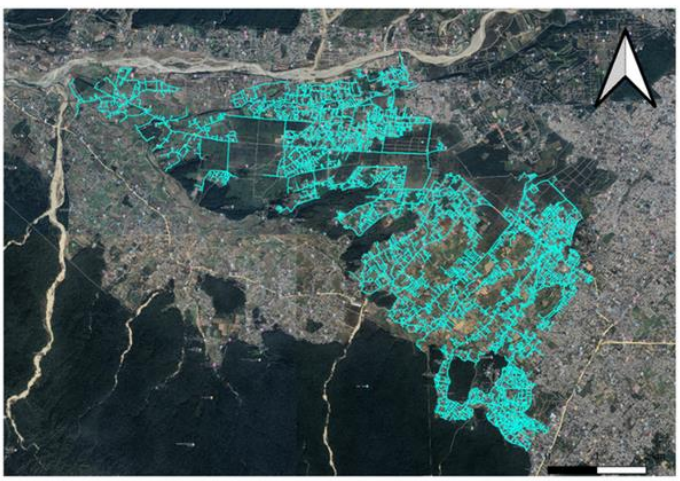
In all party meeting on the 2nd day of the visit, Aumsat provided a detailed view on their learnings from the tour and study of the infrastructure. UKPJN also answered many technical and logistical questions of Aumsat. Based on the discussions following 3 items were agreed upon by all parties:

- ☑ Weekly touchpoint for tracking the progress and mitigation of any foreseeable risks.
- ☑ Framework and mechanism of reporting.
- ☑ Steps for execution of pilot, as described below :

1	Digitalization	• Digitalization of assets (pipeline, overhead tanker, motors, pump station etc) • Curation of digital data on the map for satellite reading
2	Satellite scanning	• Once the assets are accurately mapped, satellite data can be evaluated. • Through satellite imagery, area with water logging can be identified and co-ordinates can be tracked.
3	Ground verification	• Once the assets are accurately mapped, satellite data can be evaluated. • Through satellite imagery, area with water logging can be identified and co-ordinates can be tracked.
4	Reporting to authority	• Co-ordinates of leaks are shared with authorities for tracking and initiation of fixing process
5	Fixing the leakage	• Cause of leak (Poor workmanship, Natural causes, Damage by other activities etc) • Rate and amount of leak is measured and fixed.
6	NRW calculation	• Cross verification of prevented NRW using billing data.

1 Digitalization of assets

UKPJN shared Computer Aided Designs of the entire scheme, which were extraposed to create a digital footprint of the pipelines. However, Over time, due to random repairs, accidents, other construction projects or other reasons, actual location of assets may differ from original plans.
Thus, a thorough digitalization was key for accuracy of the leak detection.



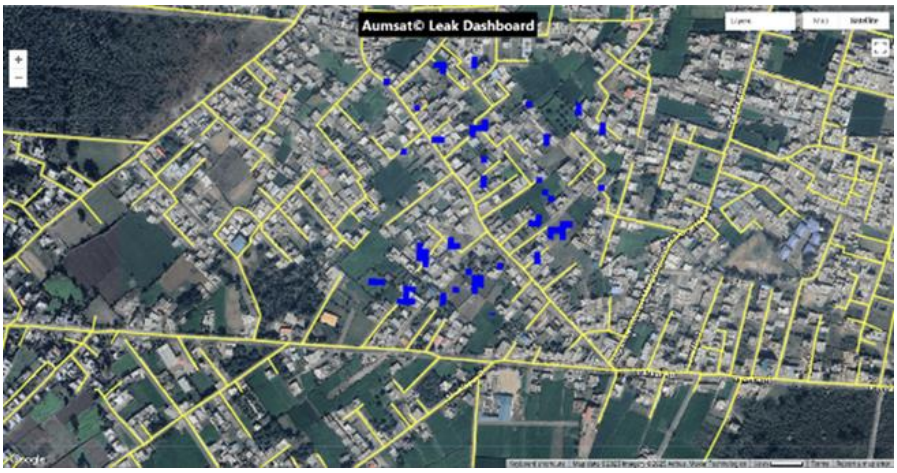
Digital map of pipelines

2 Satellite scanning

Two types of satellite imagery was used to inspect leakage :

1. Optical – uses Imaging spectroscopy to detect surface leakages & quality of water in the leakage.
2. Radar – Uses active radar reflectometry for Subsurface water detection.

Optical Imagery of Arcadia subzone 2 (red dots denote presence of water)



Radar Imagery* of Arcadia subzone 2 (Blue dots denote presence of water)

*Special Note : Radar Imagery was sourced from JAXA (Japan Aerospace Exploration Agency) and AUMSAT used their data analysis to extract results. This is a classic example of India-Japan technological collaboration.

3 Ground verification

Thermal and acoustic leak inspection for verification and validation of leak signatures to avoid any false positive from car washing, water tap, gardening activities etc. Ground verification also increases the accuracy of the data, satellite can predict to accuracy of 3x3 meter, but with ground verification accuracy can be improved to 1x1 meter which makes fixing leakage cost and time effective.

Images of staff performing ground verification

4 Reporting to authority

On verification of leaks through ground investigation, data of 652 leakages with coordinates were shared with UKPJN.

Region	Number of leaks
Arcadia subzone 1	124
Arcadia subzone 2	236
Arcadia subzone 3	34
Chandrabani subzone 1	90
Chandrabani subzone 2	3
Mehuwala subzone 1	12
Mehuwala subzone 2	31
Mehuwala subzone 3	71
Mehuwala subzone 4	51
Total	**652**

To verify the accuracy of the data shared, UKPJN selected 49 leaks to fix.
Upon digging, the co-ordinates were found to be precise and thus satisfactory to prerequisite of pilot activity.

5 Fixing the leakages

Fixing leakages can confirm following :

1. Accuracy of co-ordinates provided.
2. Determine cause of damage/leakage - critical for staff training, future planning etc.
3. Rough estimate of NRW - important metric to evaluate the current understanding & measurement of NRW.

Images of staff fixing the leakages

6 NRW Calculations

Out of 652 leaks, 49 have been fixed under the pilot project.
Based on early data NRW has reduced from 32.10% in Oct 2024 to 29.58% in Dec 2024 – total reduction of 2.52%.

If water saved is calculated based on Dec water supply and NRW reduction of 2.52%, a total of **94,942 Kiloliters of water is saved per month.**

Sl No	Month	Zone	Pumped Discharge(m3)	Water Consumption (m3)	NRW Zone wise (%)
1	October 2024	1	361929.91	222478.18	38.53
		2	209191.28	146954.98	29.75
		3	652682.49	461498.27	29.29
		Total	**1223803.68**	**830931.43**	**32.10**
2	November 2024	1	347325.21	222699.65	35.88
		2	219288.79	152408.36	30.50
		3	600510.95	435323.03	27.51
		Total	**1167124.95**	**810431.04**	**30.56**
3	December 2024	1	341658.03	230776.68	32.45
		2	174013.14	126720.74	27.18
		3	613190.26	437399.38	28.67
		Total	**1128861.43**	**794896.80**	**29.58**

- **Cost savings : Considering the cost of water as INR 11.5 per KL, saving of INR 10,91,833 per month, making it INR 1,31,01,966 per year.**
- Electricity and carbon footprint : Due to water saving, less pumping is required thus not only further reducing the cost but carbon footprint as well leading to less pollution and enhanced environment protection.

Workshop for capacity building

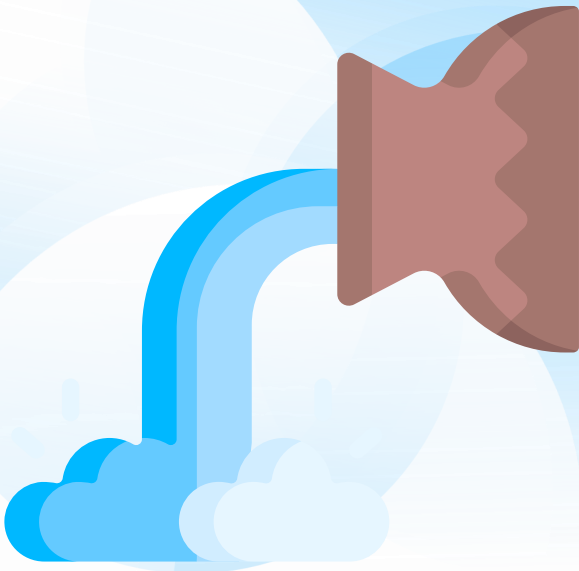
Both Class-room and on-field classes were conducted for staff by technology partner for local capacity building for acoustic data loggers, satellite based leak detection dashboard, GPS data collection, pipeline tracers, thermography techniques for leak verification

Field Workshop



Classroom Workshop





Conclusion

At the end of the pilot project all the required conditions were fulfilled, and outcome of this digital transformation project was found to be exceeding satisfaction.

JICA Side:

1. Model for replicating in other sectors and states.
2. Learning and recommendations for future projects.

UKPJN side:

1. Accuracy of data for fixing of leakages.
2. Minimum hindrance to water supply and disturbance to customers
3. Cost effectiveness and scalability

Thank You
for your attention

Takahisa Ohira
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Anurag Srivastava
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