
NAMAMI GANGE
National Institute of Urban Affairs
WATER & ENVIRONMENT
VERTICAL
INNOVATIONS
IN URBAN RIVER MANAGEMENT

Title
Innovations in Urban River Management

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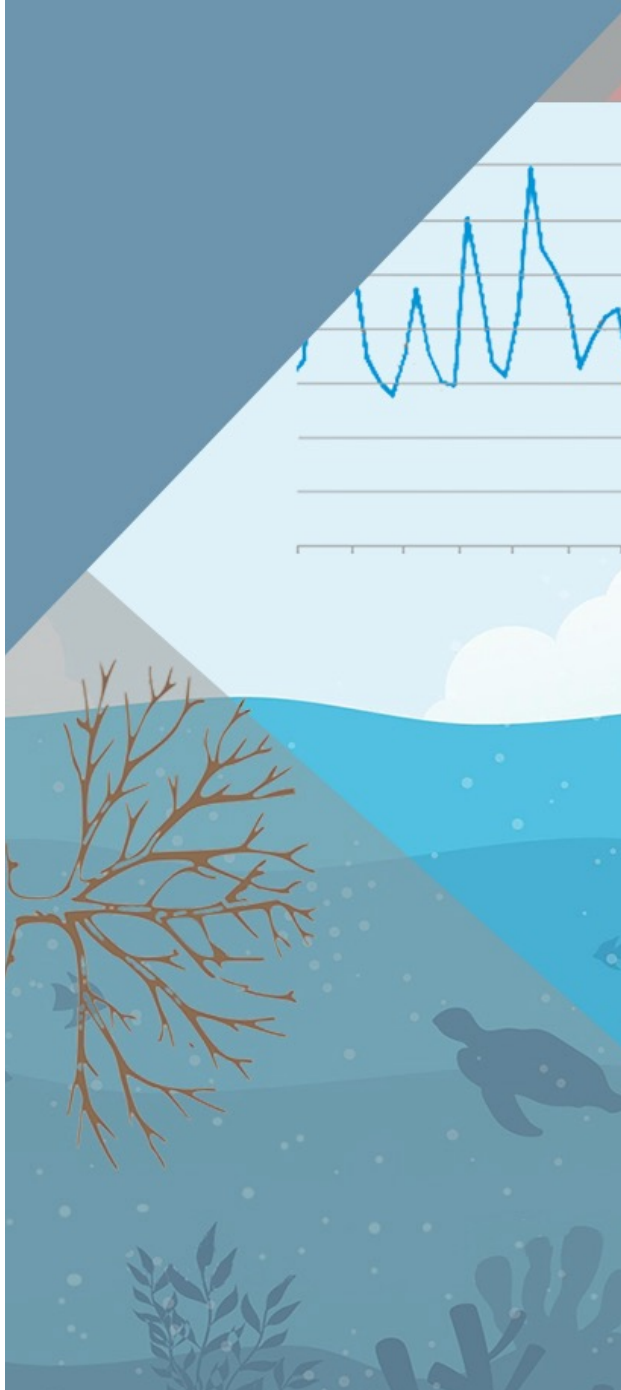
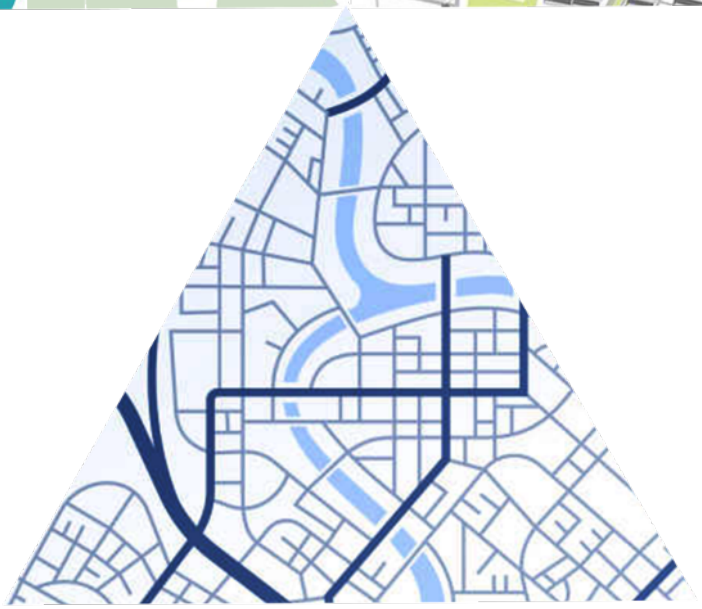




Smart

Network

Drone

Technology

Information Technology

Artificial Intelligence

Community participation

Sensor

Satellite

Contents

Introduction

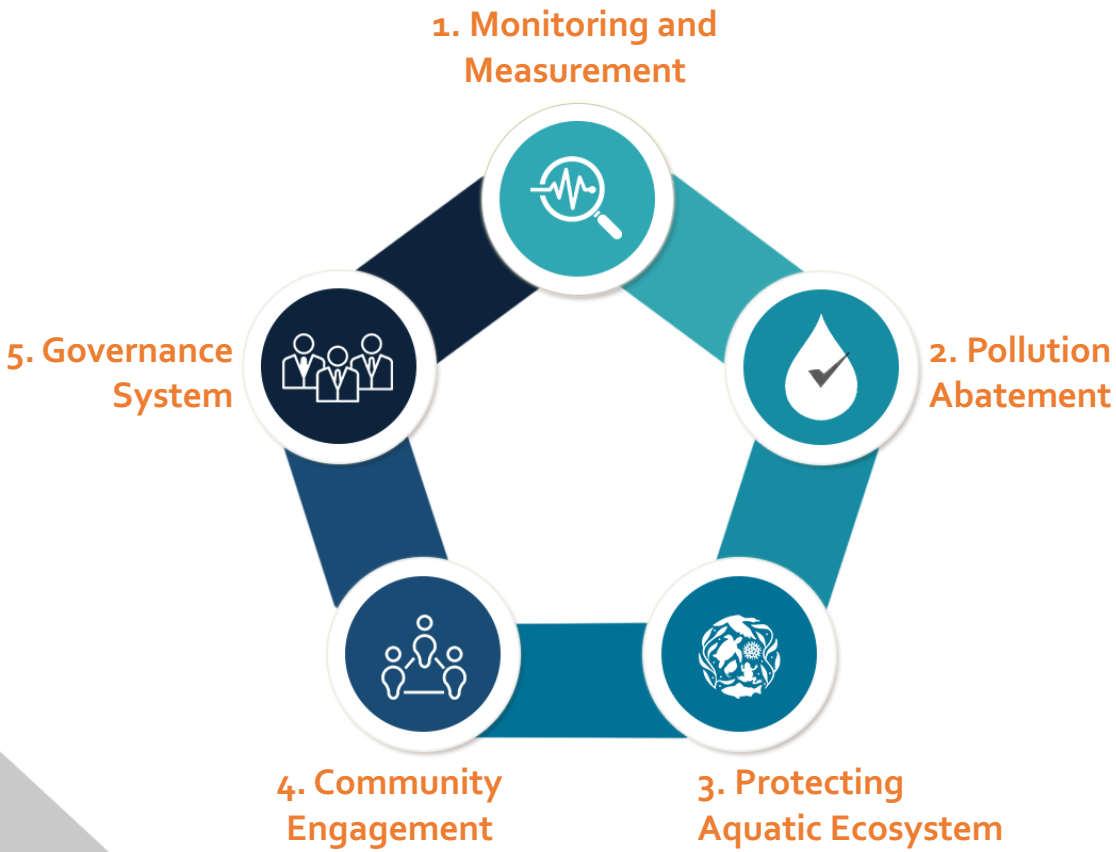
Rivers are an integral part of the urban ecosystems. However due to lack of sufficient management resources, inadequate infrastructure, poor community participation and behavioral concerns, rivers particularly in urban stretches, are facing reduction in flows, pollution, encroachment and loss of flora & fauna. The impact of anthropogenic activities is further reducing the capacity of rivers to deliver the essential ecological services. All this is leading to an overall degradation of the ecosystem.

At our present rate of urbanization, the conventional solutions for river management are proving insufficient to combat the adverse impacts of urban growth on rivers. Innovative solutions for urban river management are thus being employed by cities, in order to respond to these stresses in a timely manner.

With the advancement of knowledge, percolation of information and technology and increasing awareness among citizens, efforts have already been made across the globe to come up with unique and out-of-the-box initiatives. Several such innovative case examples from the domain of *Information & Technology*, *Robotics*, *Artificial Intelligence*, *Geographic Information Systems,* etc. are presented in this knowledge product.

The purpose of this product is to showcase innovations, especially to city governors and administrators, in order to help them identify possible solutions for local issues.

The innovations presented in this document are grouped into five broad categories, based on the themes addressed under urban river management.



Key to read this Document

The innovative case examples covered in this document are elaborated in the following format

The Innovation

Introduction of the components covered in the innovative practice

Issues Addressed

Listing of specific concerns that the innovation addresses

Geography

The place where the innovative practice has been presently adopted

Stage of Innovation

The current stages of progress are indicated for each innovation - Inception, Pilot tested or Upscaled

Innovation Details

Relevant details to describe the innovation

Applicability

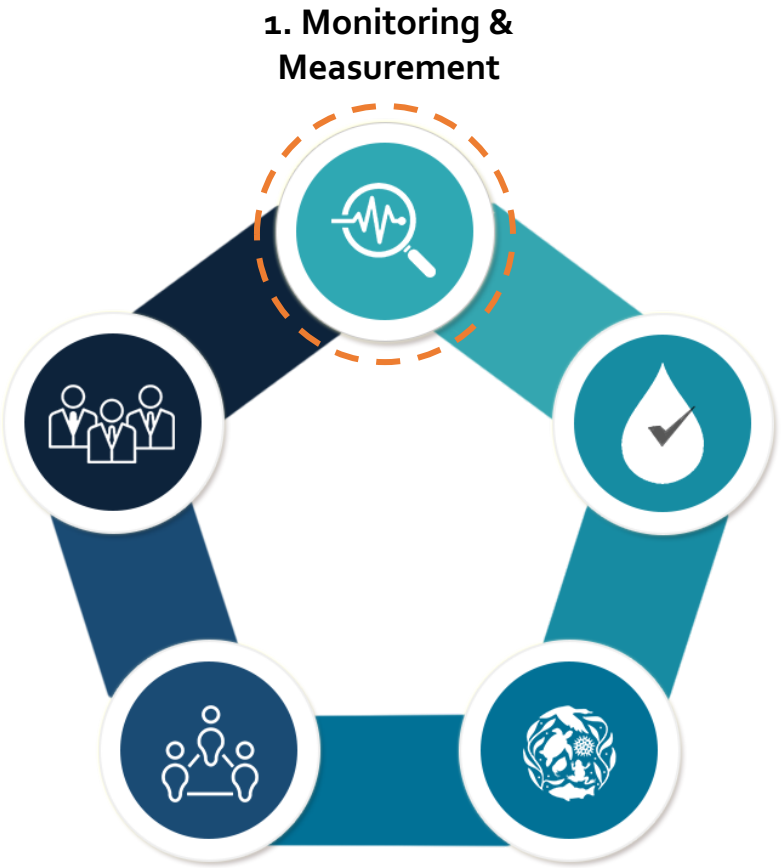
Describes suitable areas of application and potential for implementation

Limitations

The restrictions associated with successful implementation of the innovation

References

The sources of information about the innovation

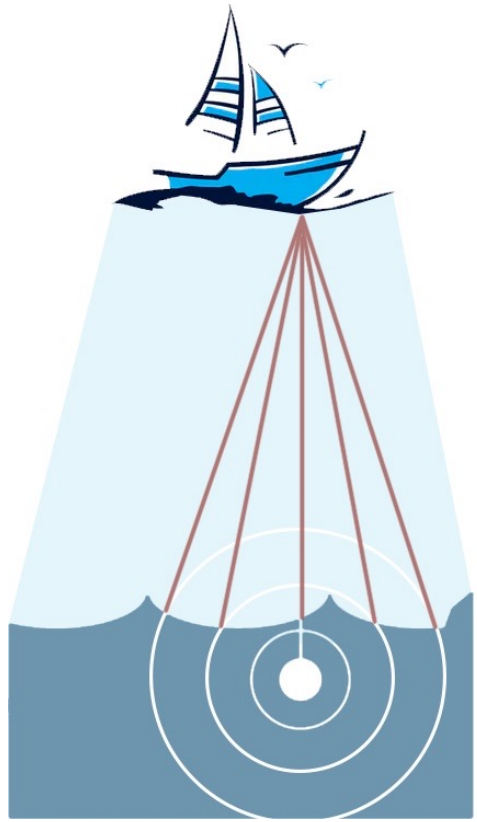

1. Monitoring & Measurement
2. Pollution Abatement
3. Protecting Aquatic Ecosystem
4. Community Engagement
5. Governance System

Monitoring and Measurement

Determining physical aspects like size, shape, depth and flow velocity of inland water bodies (rivers, lakes, ponds, wetlands, etc.) is the first step for planning, designing operations and maintenance of infrastructure for water related activities. While the size and shape of water bodies can be estimated with external observations, measurement of depth (bathymetry) and flow velocity remain quite challenging.

Conventionally, the depth measurements of water bodies are being done through boats equipped with Sonar, which is quite accurate under normal circumstances. Even though remote sensing methods like *Space* and *Airborne Multispectral Imaging*, *Light Detection and Ranging (LIDAR)* have been in use for quite some time for depth measurements, these are unable to penetrate the surface of the water. The submerged bed is traditionally estimated through field surveys and these physical surveys are expensive, time-consuming and cost-intensive.

With advancement of technologies, several innovations are now available for measurements and monitoring. This section covers three of these unique practices.



1.1 *Unmanned Aerial Vehicle/ Drone for Waterbody Measurements*

The Innovation

Combination of Radar, GPS, Sonar attached to a drone for depth and surface velocity measurements of rivers and waterbodies.

Issues Addressed

Conventional approaches of waterbody (rivers, lakes, ponds) depth & water velocity measurement using boats, are time consuming, costly, labour intensive and difficult to conduct in case of inaccessible regions.

Stage of Innovation

Inception stage (*adopted by a group of researchers*)

Geography

Denmark

Innovation Details

- The floating sonar is attached to an Unarmed Aerial Vehicle, for accurately measuring the depth of water bodies.
- The UAV is fitted with radar to measure surface water elevations, GPS for navigation and positioning, and camera to determine the surface water velocity.
- The sonar is suspended from the drone on the surface of the waterbody to measure the bottom profile.

Applicability

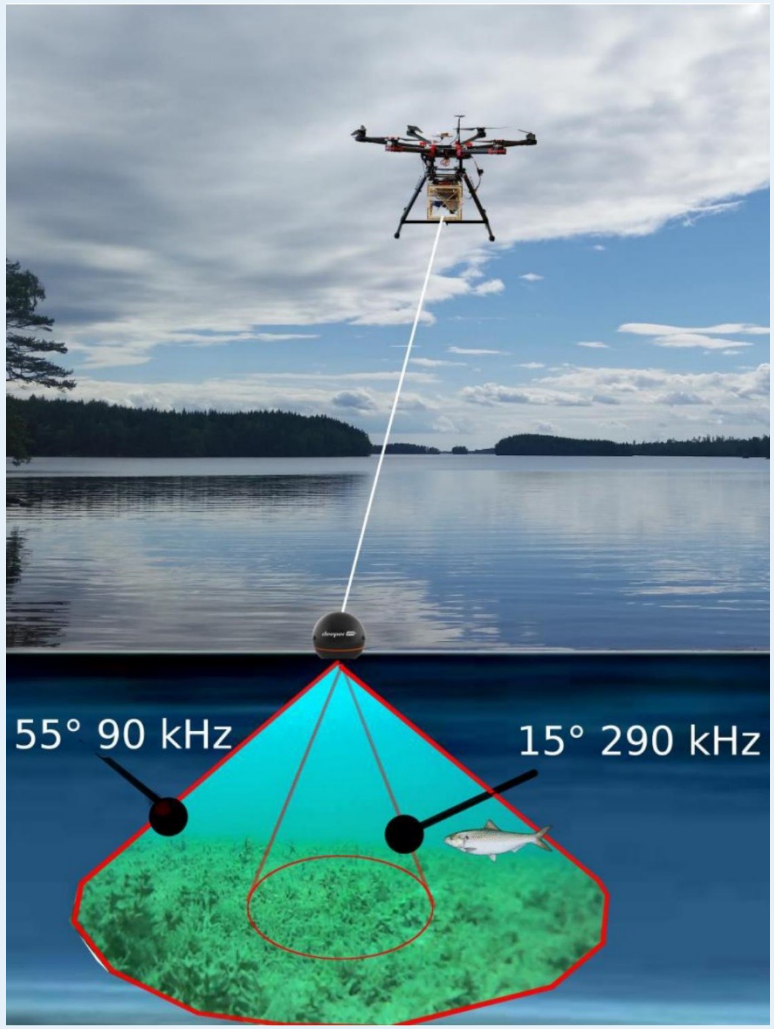
- This method can be adopted to measure the depth of water bodies that are shallow to moderate.
- This method can provide period measurement to know the siltation rate in water bodies, which is a prevalent issue

Limitations

- Requires clear weather conditions, particularly calm winds, for smooth flight of UAV/drones.
- The maximum depth that can be measured with this technique is 35m at present.

References

[1] https://hess.copernicus.org/articles/22/4165/2018/
[2]https://www.sciencedirect.com/science/article/abs/pii/S0022169417301178



Unarmed Aerial Vehicle and tethered sonar

1.2 *Smart Stick for Water Level Measurements*

The Innovation

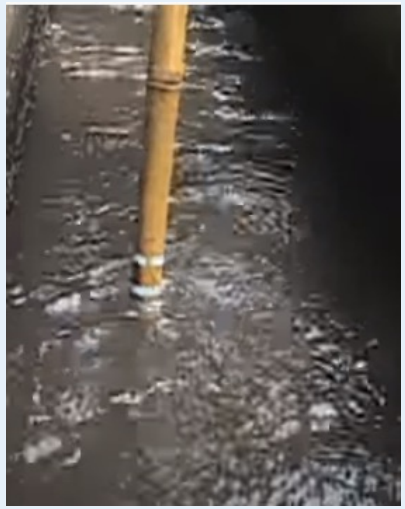
Measurement and digital recording of water level in rivers and urban drains by using smart stick and smartphones.

Issues Addressed

Traditional methods of measuring water levels for natural resources located in far upstream areas are time consuming and labor intensive. Moreover, continuous manual recording of depth is tedious. This results in irregular monitoring for local areas.

Geography

Themi River, Tanzania



Conventional approach
Wooden Staff

Innovative approach
Smart Stick

Stage of Innovation

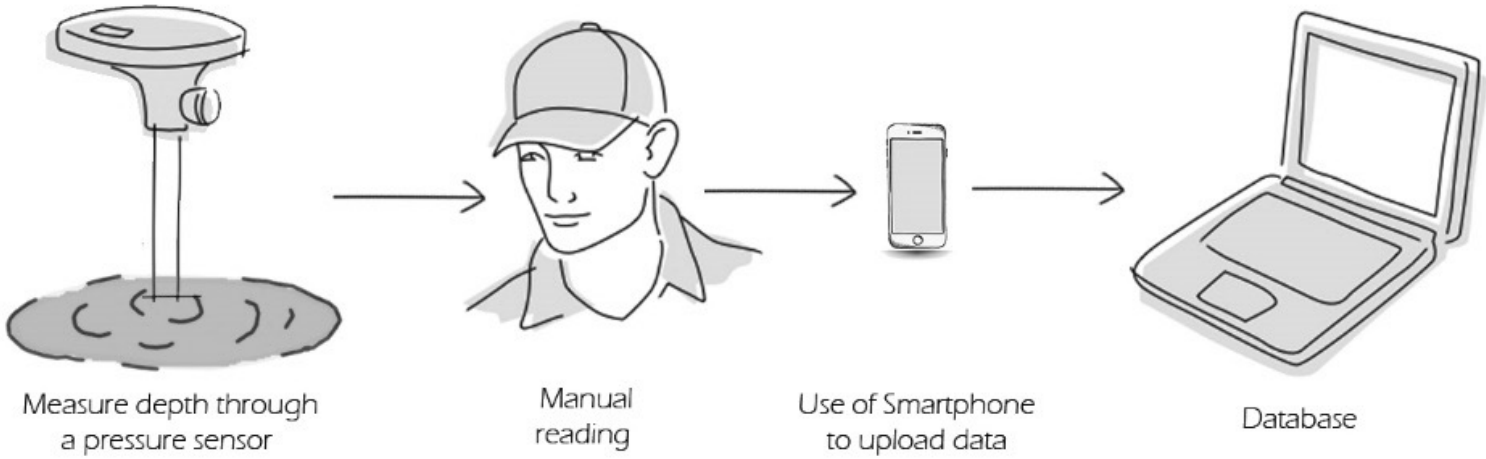
Pilot tested

Innovation Details

- This system measures water depth through a pressure sensor, displays the value and allows the measurements to be uploaded to a database, either manually via SMS or automatically with a dedicated smartphone application.
- It modernizes data collection and transmission process, from the point of measurement to the data management center. It shows the exact and objective readings. It enables to collect, analyze and exchange data, to improve water management.

- The Smart Stick* is a low-cost and high-technology device for measuring water depth and discharge at selected locations.

Water Monitoring Process



Applicability

This innovation is suitable for small irrigation canals, water intakes and shallow water bodies, wetlands and urban drains. Simplicity of this method allows involvement of local communities in data collection, using their smartphones.

Limitations

- The maximum depth of water that can be measured is 100 cm.
- The depth measurement is a manual technique, so it can't be used in inaccessible areas.

References

[1] https://www.imomohub.com/field-scale-water-availability-copy
[2] https://www.youtube.com/watch?v=WUDlVXvGeOI

*developed by iMOMO (Innovative Technologies for Monitoring, Modelling and Managing Water)

1.3 Satellite-based *Remote Sensing for Water Quality Monitoring*

The Innovation

Use of dedicated satellite sensors for water quality monitoring and web-based real-time data transmission.

Issues Addressed

River water quality monitoring is a challenge in some urban areas, especially in inaccessible locations. Moreover, regular monitoring requires extensive resources, time and laboratory infrastructure; while the limited samples based inferences do not represent overall conditions of river health. Remote sensing can provide real-time and rapid analysis of river water quality.

Geography

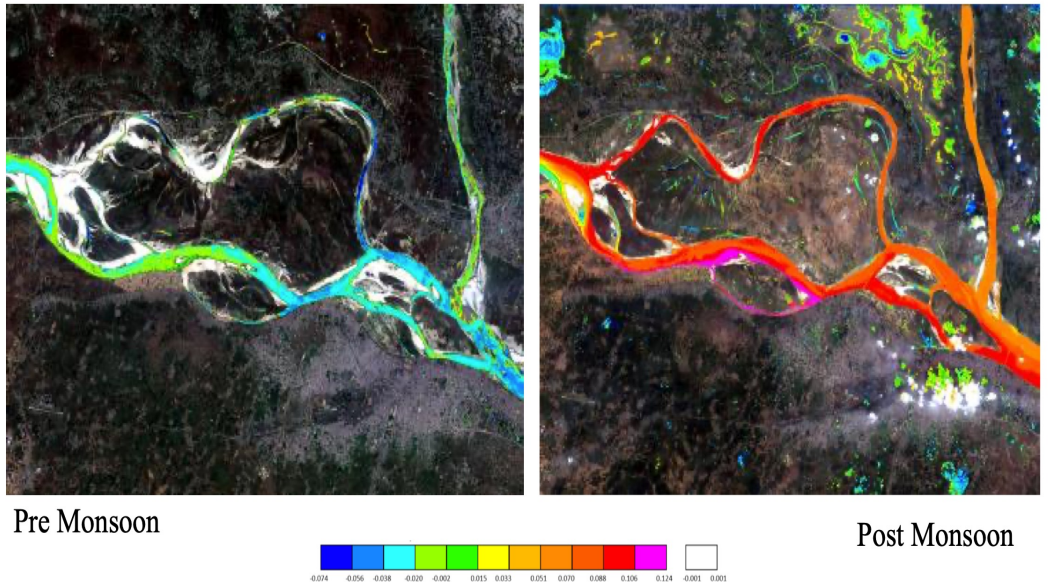
Worldwide

Stage of Innovation

Upscaled

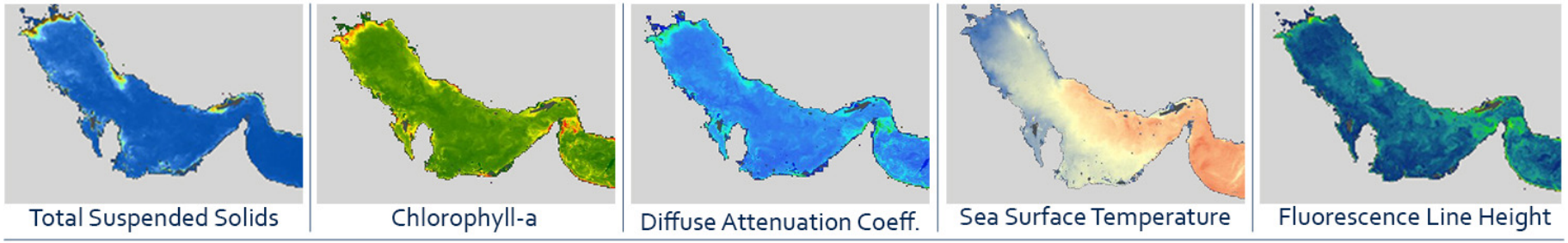
Innovation Details

- Satellites with specific sensors that are used to detect various parameters.
- The solar energy reflected from surface water in specific wave lengths is captured by the sensors on board. This digital information is converted into pictorial format, by means of values attached for specific parameters.
- This data is transmitted to the users, as per the requirement.



Water Turbidity in Ganga River near Patna by ISRO

Common monitoring parameters

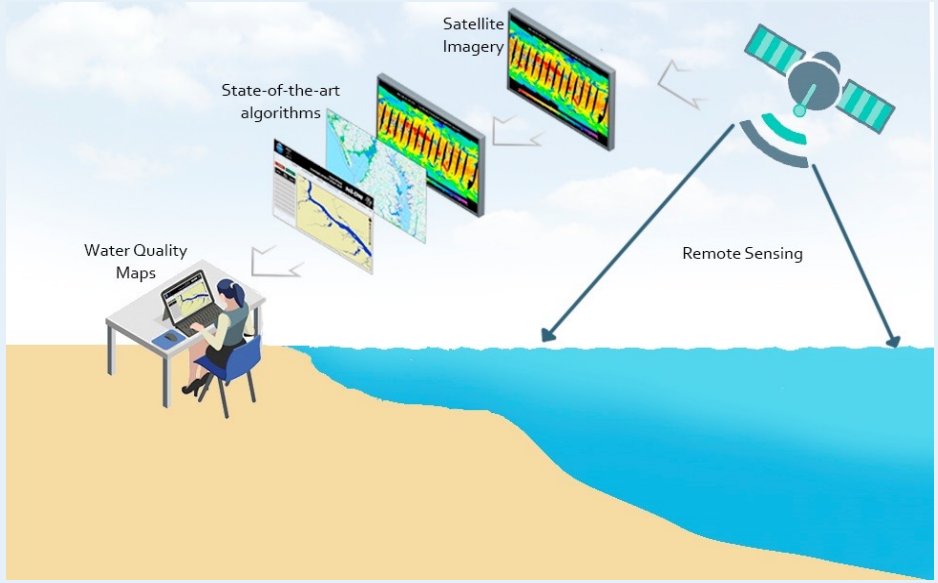


Applicability

- The physical, chemical and biological parameters of urban river stretches can be repeatedly measured, also to map pollution hot spots.
- Advanced warning for harmful algal booms, which can adversely affect bio-diversity, is possible.

Limitations

- The sensors can only pick up surface water character.
- Technical assistance is required for modelling of the data by machine learning and artificial intelligence.
- High-quality maps are not accessible in open domain.



Pictorial representation of the system

References

[1]https://vedas.sac.gov.in/vedas/downloads/ertd/Hydrology_8_11%20August%202017/L_9_Water%20Quality%20From%20Space_Ashwin_Gujrati.pdf
[2] https://www.dhi-gras.com/solutions/water-quality/
[3]https://worldwide.dhigroup.com//media/shared%20content/dhiflyers%20and%20pdf/solution%20flyers/water%20quality%20monitoring%20from%20space%20-%20dhi%20gras%20solution.pdf


1. Monitoring & Measurement
2. Pollution Abatement
3. Protecting Aquatic Ecosystem
4. Community Engagement
5. Governance System

Pollution Abatement

With the rapid urbanization and growing anthropogenic pressure on water resources in urban areas, pollution of water bodies (rivers, ponds, lakes) has become a common scenario.

Some of the common concerns are related to untreated sewage and industrial effluent discharge; disposal of solid waste containing plastic bags, bottles, religious waste, thermocol sheets, etc. into water bodies; overgrowth of weeds and hyacinths; and excessive extraction of water from these reserves effecting their flow and self-cleaning properties. The negligent behaviour of communities towards these natural ecosystems aggravates the problem.

Furthermore, cleaning of waterbodies is often irregular. This pollution load accumulates over time and eventually hinders the biochemical processes, which are essential for survival of the waterbody and its associated aquatic biodiversity.

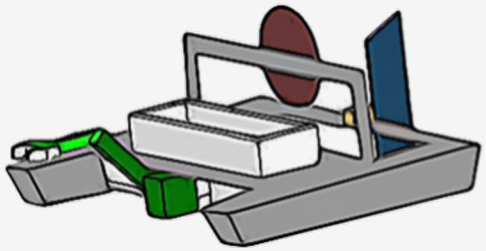
The innovative solutions presented in this section, address the aforementioned issues for protecting urban water bodies.

2.1 *Remotely Operated Robots for Trash Removal from Water Bodies*

The Innovation

Use of remote controlled Robot Tech, hydro powered Water Wheel, or remote-controlled/ sensor-enabled Aqua Drone (also known as Waste Shark) to clean the trash/ solid waste from water bodies

1. Robot Tech



2. Water Wheel

3. Aqua Drone

Issues Addressed

Solid waste floating in the form of trash, litter and garbage; and overgrowth of hyacinth and sea-weed in surface water bodies are being increasingly recognized as difficult challenges to manage. Conventional methods for manual cleaning of water bodies are highly labor intensive, time consuming and also risky.

Geography

1. *Robot Tech* - Yamuna River, New Delhi, India
2. *Water Wheel* - Baltimore, The United States of America
3. *Aqua Drone* - Devon Harbor, England

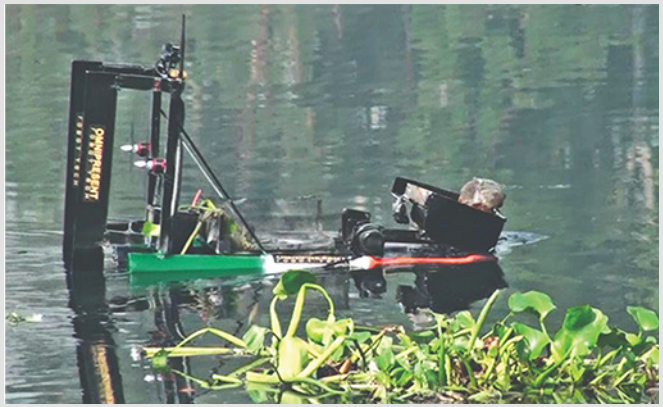
Stage of Innovation

1. *Robot Tech* - Pilot Tested
2. *Water Wheel* - Upscaled
3. *Aqua Drone* - Upscaled

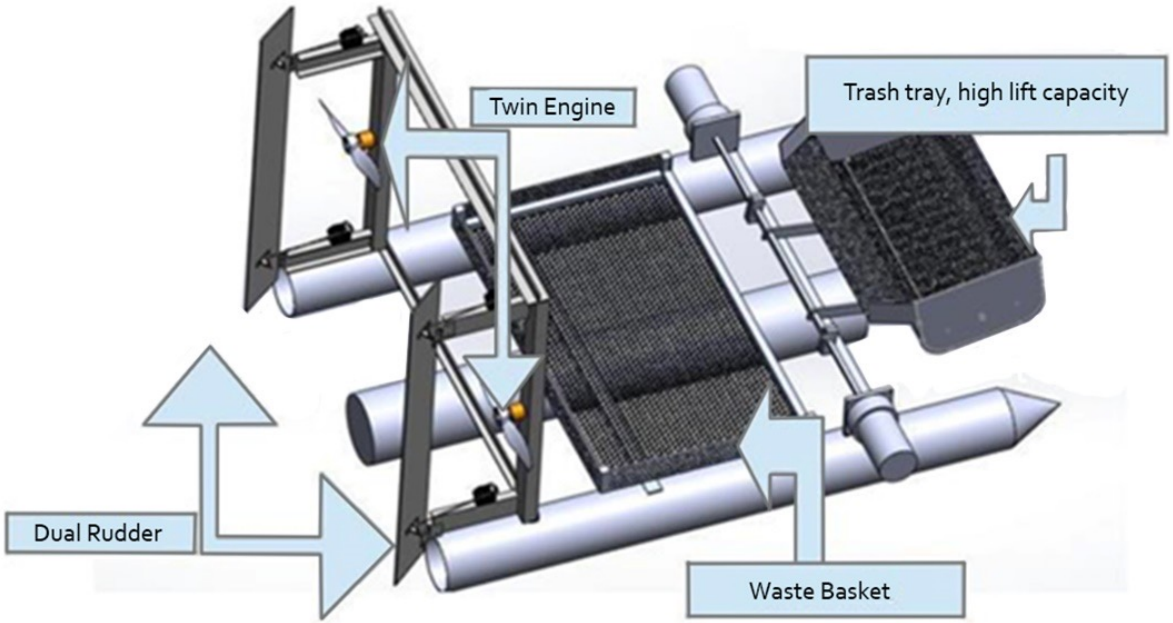
Innovation Details

2.1.1 Robot Tech

- The Robot weighs 15kg and is 1.5x1.2m in size. It is propelled through fan motors fitted at the rear side, and has a working range of 5km with 5m/sec speed.
- It is installed with a GPS system for navigation, Artificial Intelligence (AI) based imaging system to identify trash, and a camera for video imaging of the operation.
- It can be remotely operated from land.



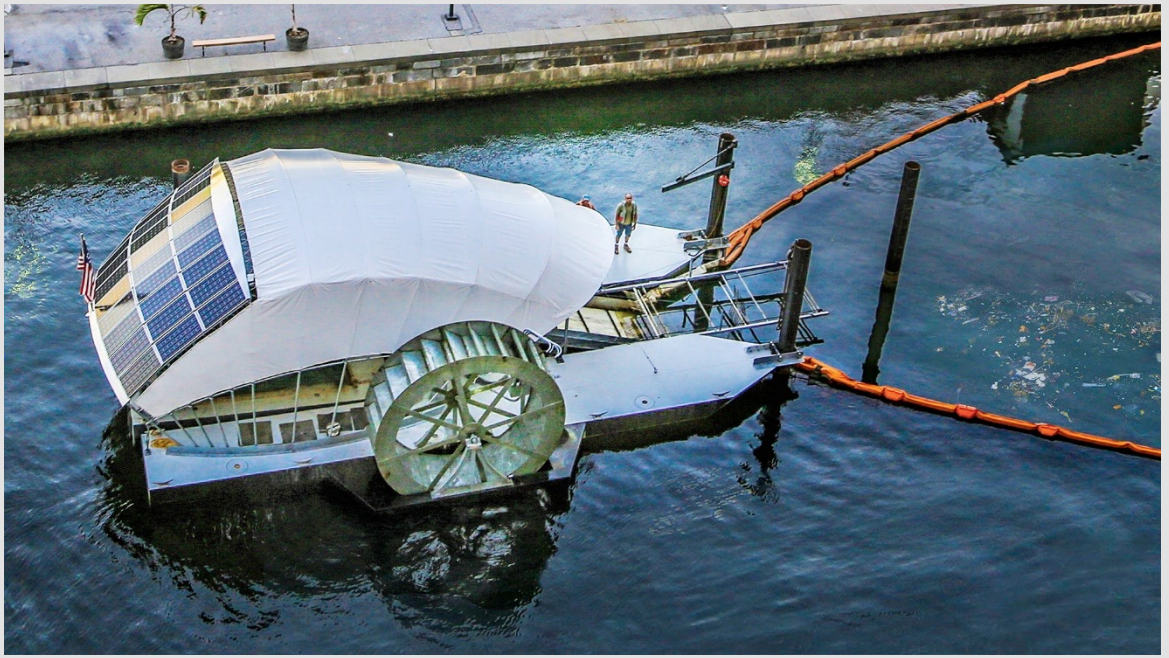
Robot Tech cleaning a water body



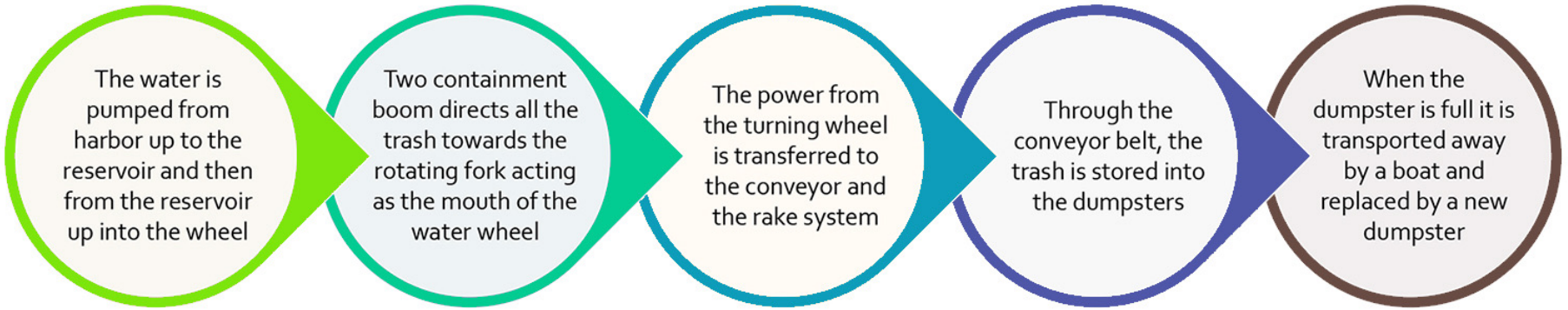
Robot Tech assembly

2.1.2 Water Wheel

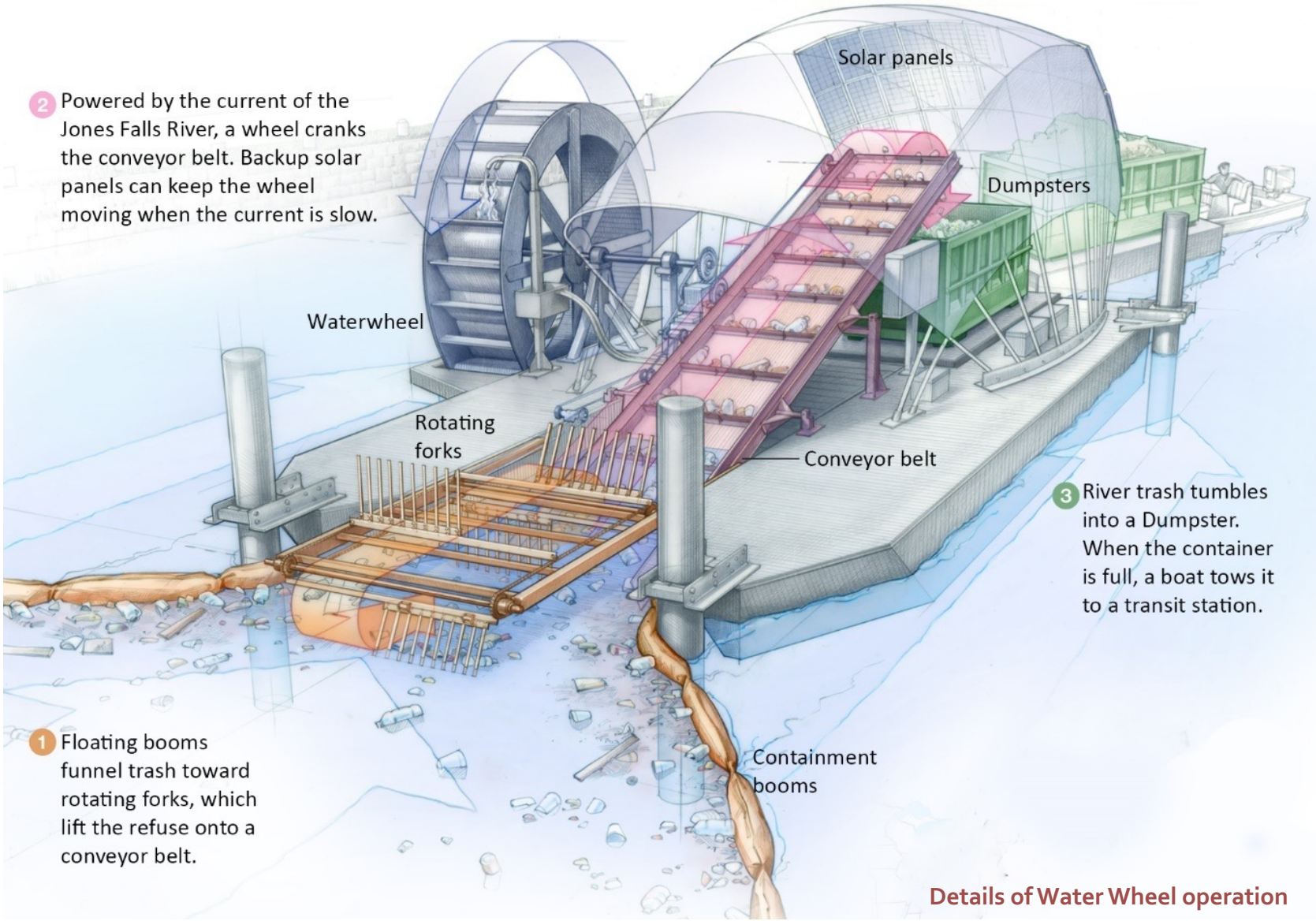
- Generally used after heavy rain or storm, when the river has a strong current flow, which helps to collect the large amounts of waste generated.
- Powered by hydropower and solar panels when there isn't enough current.
- The speed of its giant wheel, 14 feet high, can be controlled via remote monitoring.
- The biggest single-day waste collection using this has been tapped as 17000 kg approx.
- It indicates when the dumpster is full and needs to be replaced.



Water Wheel installed at Devon Harbor



Trash Collection Process



Details of Water Wheel operation

2.1.3 Aqua Drone

- It swims through water to collect trash, preventing collision using LIDAR and ultrasound. It is available as a remote-controlled unit operated by a land-based controller, or a data and sensor-enabled unit.
- While collecting surface waste (like plastic, vegetation and floating debris), it simultaneously measures environmental data such as salinity, depth, chemical makeup, temperature and pH balance through customizable sensors.
- Measuring 1.5 by 1.1 meters, it can swim for 8 hours and carry 60 kg of plastic waste at a time. It can pick up trash close to 1 foot under the surface.

Aqua Drone : trash cleaner and environmental data collector

Applicability

- All the three robots are well suited for all types of water bodies (natural, recreational or commercial), to carry out occasional cleaning or regular maintenance.
- They can also be used for collecting water quality data, by creating predictive models for toxicity, which is dangerous for humans, algal bloom, aquatic species, etc.

Limitations

- Robot Tech innovation is suitable only for small to medium-sized waterbodies. Its battery may not be sufficient for long operation hours and its floating might be difficult in highly clogged water bodies.
- Although the Robot Tech and Aqua Drone seem robust in operation, strong water currents may hinder their operations.
- Single units may not be sufficient to meet the demand. Therefore multiple units might have to be installed by urban local bodies.
- All three innovations can only clean surface water trash.

References

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[2] https://www.youtube.com/watch?v=dBAo-W4EoGk

[3] https://www.wasteshark.com/

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[5] https://www.mrtrashwheel.com/technology/

[6] https://www.nationalgeographic.com/news/2017/02/mr-trash-wheels-professor-trash-wheels-baltimore-harbor-ocean-trash-pickup/

2.2 Cyber Physical Sensor Network System *for Water Quality Monitoring*

The Innovation

High-resolution, instantaneous water quality monitoring and mapping system, that can pinpoint contamination hotspots using automated, geotagged, time-stamped, real-time sensors.

Issues Addressed

The traditional methods of water quality monitoring can't provide live, compiled and comprehensive data. Results for BOD assessment takes about five days. Water quality parameters collected on real-time basis with this method can be used to determine values by machine learning and can be produced instantaneously.

Geography

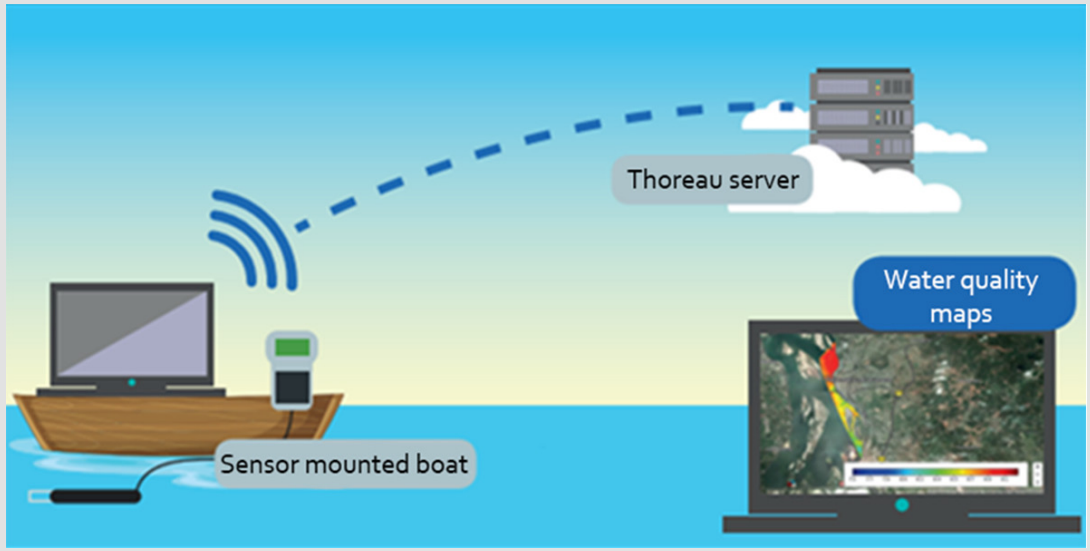
University of Chicago, US and IIT Varanasi (collaborative project)

Stage of Innovation

Inception, Pilot Tested

Innovation Details

- A real time sensor is fitted in a boat, which collects non-stationary data of water quality that is automated, geotagged and time-stamped.
- The data is transmitted to a cloud based server in real-time and associated machine learning programmes generate the real-time pollution hotspot maps.
- It can provide data even for complex pollutants.



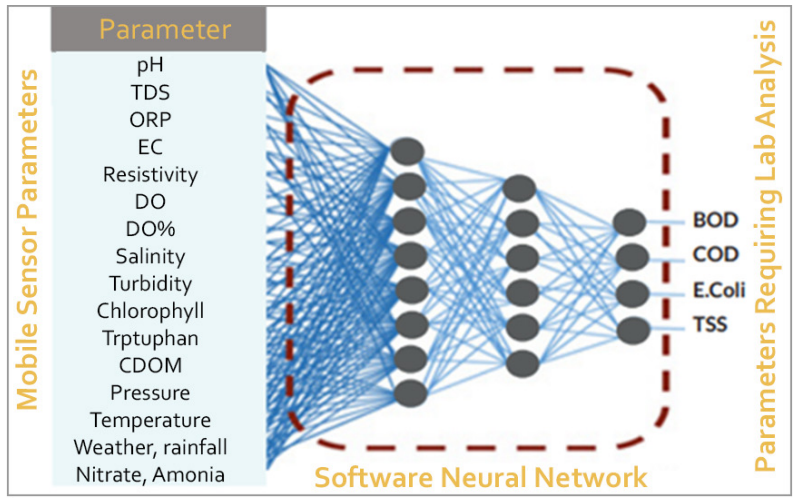
Graphical representation for the innovation

Procedure

A time-stamped and geo-tagged cyber-physical sensors is attached to a boat that goes on a pre-defined route

The sensor probe is immersed in water and handheld meter records the data based on the kind of pollution being monitored: industrial, agricultural, anthropogenic, etc.

Then, the data is downloaded from sensors, filtered and superimposed on geospatial maps to create 2D maps for ease of interpretation and predictive analysis and uploaded onto Thoreau portal.



Real-time application of a neural network to easily available parameters, for predicting complex water quality indicators

Applicability

- Used for water quality mapping of rivers and water bodies.
- Currently 4 rivers and 3 lakes are being monitored by this technique under the pilot being undertaken in India.

Limitations

This technology is currently under development. The real time data processing is costly and requires dedicated servers, cloud based technology and skilled human resources.

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[2] https://www.weforum.org/agenda/2019/10/water-pollution-in-india-data-tech-solution/

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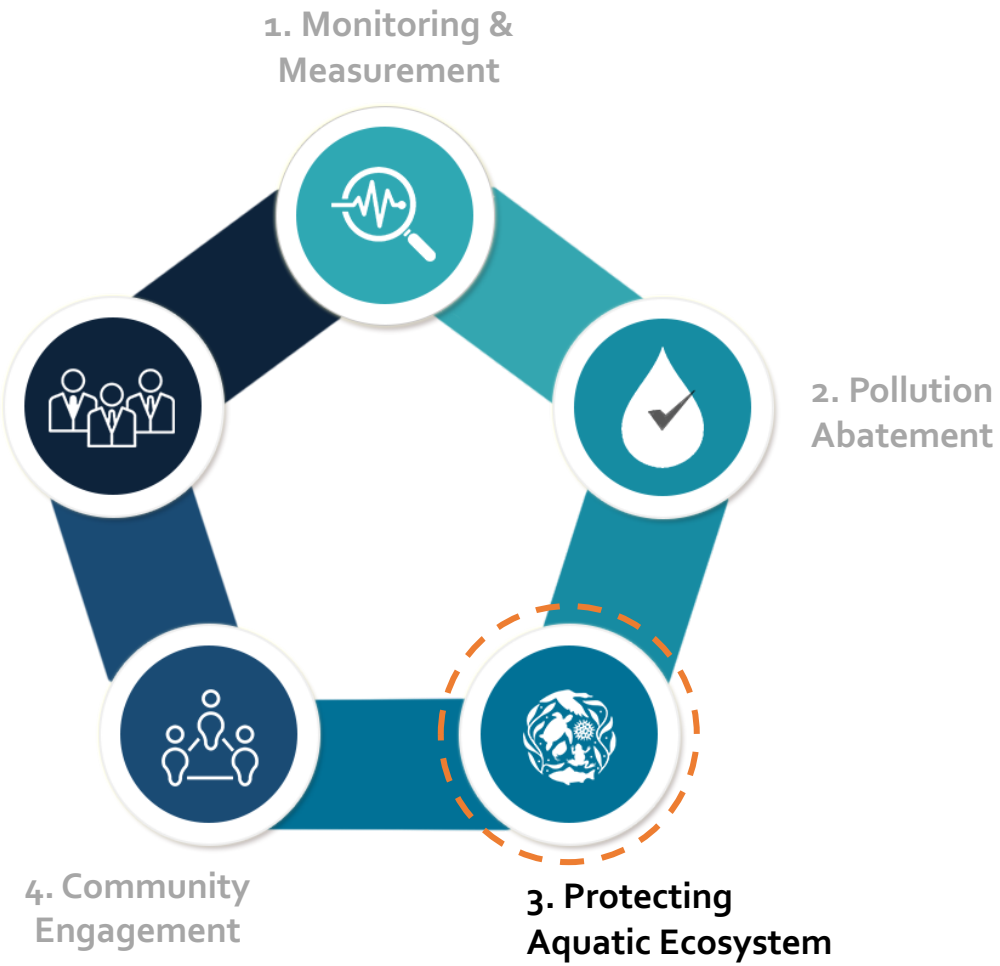
1. Monitoring & Measurement
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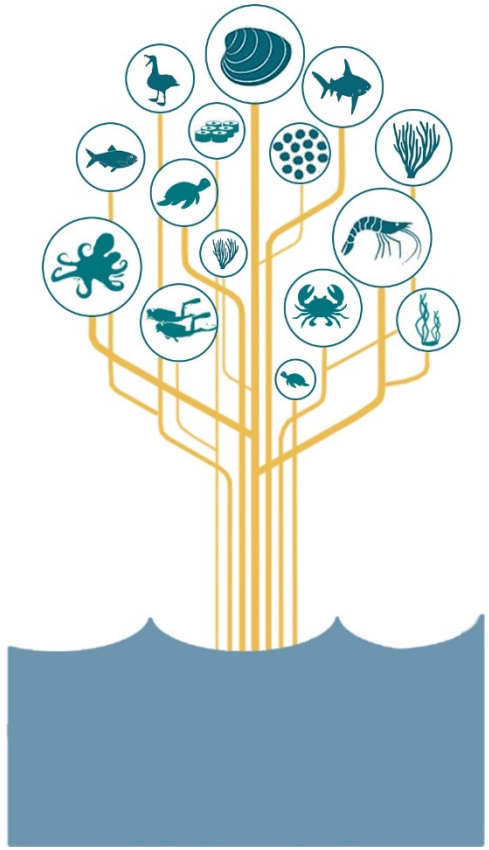
Protecting Aquatic Ecosystem

Freshwater aquatic ecosystems like rivers, lakes, ponds, are important natural resources for aquatic biodiversity to thrive. The aquatic biodiversity encompasses a wide range of species, including plants, micro-organisms, invertebrates, insects, fishes, etc. Due to very fragile nature of the aquatic ecosystems, even minute fluctuations (happening internally or externally) can result in substantial damage and loss of these ecosystems. They are thus ideal for determining the health of any water body.

Water pollution, caused majorly by discharge of untreated sewage & industrial waste into waterbodies, not only affects the water quality and its biological balance, but also hinders the growth and survival of aquatic species. This results in complete alteration of the flora and fauna surviving within these systems. As a result of this, the biodiversity surviving in aquatic ecosystems is facing a severe decline.

This section of innovations highlights various techniques to monitor the aquatic ecosystem and identifies avenues to protect them for maintaining the required natural balance.



3.1 *Bioacoustics for Monitoring Underwater Aquatic Biodiversity*

The Innovation

Bio-acoustics, the study of sounds produced by various species, is used as a tool for monitoring of aquatic system and indicating the river health.

Issues Addressed

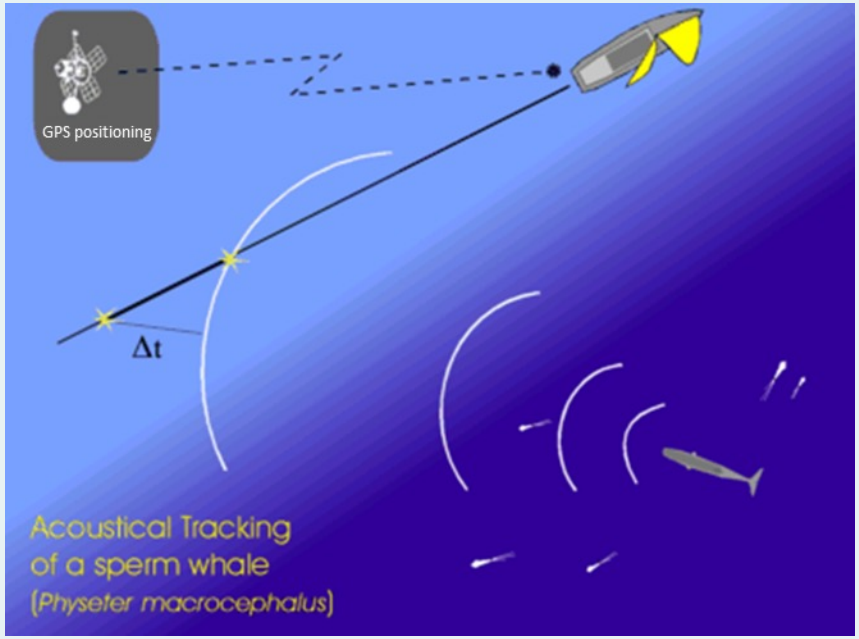
Accurate assessment of the underwater bio-diversity is a challenging and complex process. Traditional field based observations involve direct human intervention. This method is real time and time saving.

Geography

Mediterranean Region, Australia

Stage of Innovation

Upscaled



Bioacoustics: Sound tracking of a sperm whale with a dipole array

Innovation Details

- Underwater Bioacoustics deals with acoustic characteristics of the aquatic environment. It detects the sound waves produced by different organisms and species on the basis of their specific acoustic signals.
- The signals are captured continuously and the sound recording is matched with a library of sound recordings for various species.

The activity of a population of *Micronecta* was monitored acoustically in this Mediterranean pond, with an array of 12 hydrophones submerged in the pond using ropes.

Applicability

Underwater bioacoustics can be used in oceans, rivers or waterbodies to map the bio-diversity and evaluate the ecosystem's health.

Limitations

- In a complex environment, underwater bioacoustics are not sufficient to describe the levels of particle motion.
- Overlapping of sound waves of different species can make it difficult to identify species.
- Identifying and assigning priorities to fish and invertebrate species requires an extensive procedure and specialized knowledge.

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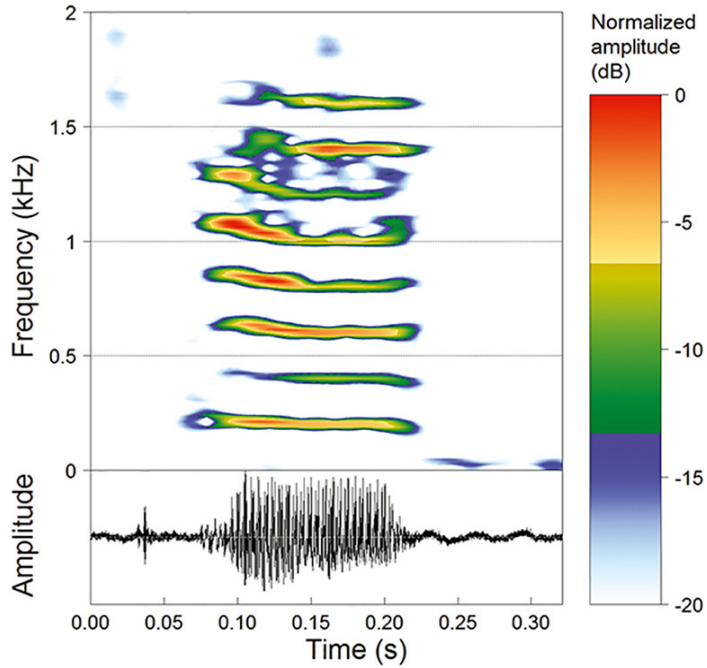
[2]http://www9.unipv.it/cibra/edu_underwaterbioacoustics_uk.htmlution.pdf



Identification of the *Spangled Grunter* (an Australian fish) through Bioacoustics. Its distinctive grunt is captured for identification

3.2 Root Wads Treatment for Protection of River Bank from Erosion

The Innovation

Instead of block stones to protect the river banks, this soft engineering approach strengthens the river banks, helps restoring the natural habitat and protecting the degraded channels.

Issues Addressed

River bank erosion can leave long-term impacts on the river hydrology, ecology and hinder the growth of biodiversity. Most of the traditional solutions involve concretization and channelization, which disturb the natural ecosystem.

Geography

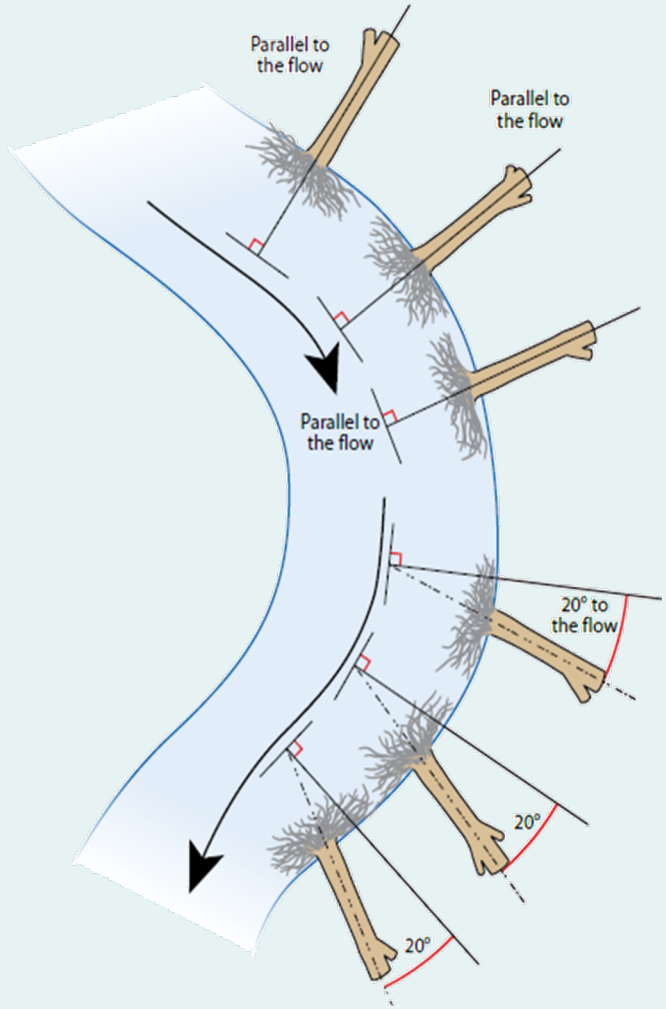
Wales, The United Kingdom

Stage of Innovation

Upscaled

Innovation Details

- A trench is dug considering the flow velocity and river bank angles. The trunks are inserted in the trenches as per height of the cliffs (small to medium) Its Installation is carried out from upstream to downstream. The river bank stabilizes once the trunks are stabilized.
- Avg.0.3 to 0.6m diameter trunks are used which are locally available
- It provides immediate bank protection and allows bankside vegetation to grow naturally.



Plan showing position of root wads

Root wads application

1. Excavation of trench

2.Moving root into position

3. Installing Root Wad

4. Right after installation

Applicability

This system is highly efficient in rivers with low to medium flow of water. This technique can also be used for rivers in rocky areas with high flow, along with a combination of some of the other techniques.

Limitations

- It is an expensive, labor-intensive technique and requires heavy equipment to carry out the procedure.
- The construction can only take place during the dry/ lean season, while also considering the highest water level.

References

[1] https://www.therrc.co.uk/MOT/Final_Versions_%28Secure%29/4.8_Dulais.pdf
[2] https://www.sepa.org.uk/media/219450/bank_protection_guidance.pdf
[3] http://www.adfg.alaska.gov/index.cfm?adfg=streambankprotection.rootwad

3.3 Ultrasonic Wave Technique for controlling Algal Bloom in Waterbodies

The Innovation

Ultrasonic sound waves are generated to moderate the blue-green algal bloom. This solar based technology is environment friendly.

Issues Addressed

Traditional means for controlling water pollution do not specifically address algal bloom, which severely affects the aquatic life and causes nutrient pollution. It also generates a pungent taste and odour in the water, which might remain even after its treatment and processing.

Geography

Poona Dam, Australia

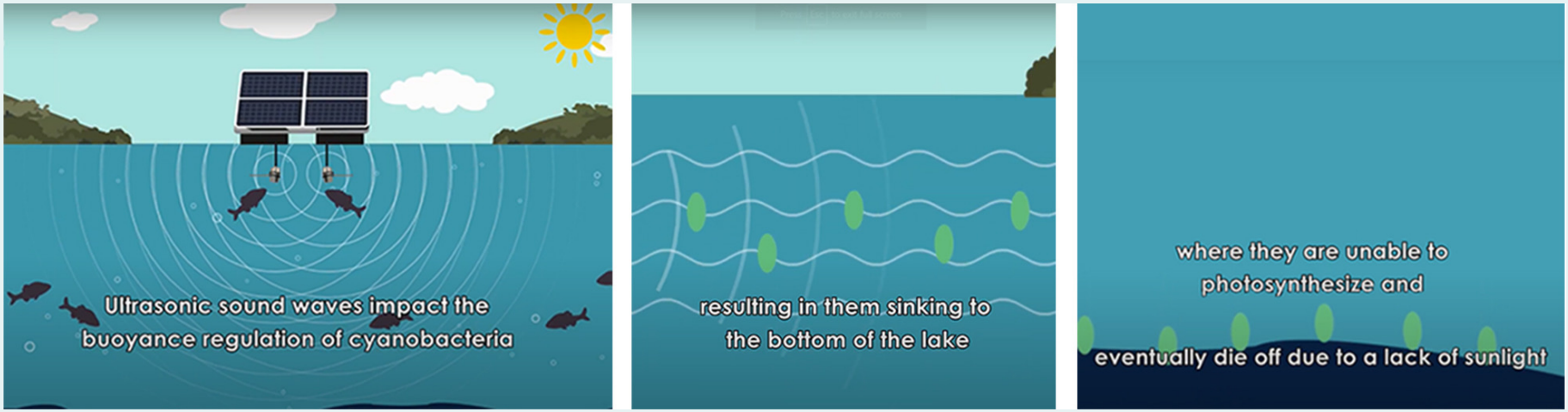
Stage of Innovation

Upscaled

Innovation Details

- Two solar powered units emit ultrasonic sound waves. These waves create sound in the top layer of water, which directly impacts the buoyancy of the algae. Algae cells sink to the bottom, where they are unable to photosynthesize and eventually die due to lack of light.
- This is a sustainable alternative to chemicals for controlling algae growth, without disturbing the aquatic environment.

Application of ultrasonic sound waves technique



Applicability

- This technology can be installed in various types of water bodies such as rivers, dams, ponds, lakes, reservoirs, etc.
- It can clean large water surfaces through the use of several systems.

Limitations

- Some algal bloom is beneficial, since it acts as a good indicator for water quality and land environment. Before installing this instrument, an evaluation for the same needs to be done.
- This technique can't be used efficiently during the monsoon season, since it is operated using solar power.

References

[1] https://www.youtube.com/watch?v=5ypKjmtmH6o
[2] https://www.seqwater.com.au/news/ultrasonic-sound-waves-used-combat-taste-and-odour-drinking-water
[3] https://www.lgsonic.com/ultrasonic-algae-control/


1. Monitoring & Measurement
2. Pollution Abatement
3. Protecting Aquatic Ecosystem
4. Community Engagement
5. Governance System

Community Engagement

Community engagement is an essential process for any development project. Even for river management projects, the local stakeholders better understand the ground level concerns. However in most cases, community consultation is limited to inviting public suggestions on the draft propositions. This dilutes the interaction level and the scope to actively incorporate the community needs.

Urban rivers have an important role in serving the community needs. It is thus key to involve these communities in the entire process of urban river management. Their engagement at inception of the project makes it easier to incorporate their ideas. Moreover, it generates a sense of ownership among the citizens, thus involving them a lot more in the process of protection and conservation of these natural resources.

Community engagement in other processes like water quality monitoring, bio-diversity observations, etc. makes them understand the ecological value of the resource. It also helps in sharing the load of regular monitoring, which is otherwise mostly irregular due to resource constraints.

Examples in this section highlight innovative approaches to engage communities as an active part of different processes associated with river management.

4.1 *River Track to Engage Communities in Flood Management*

The Innovation

Providing real-time water level and flood alerting information with smart tech solutions

Issues Addressed

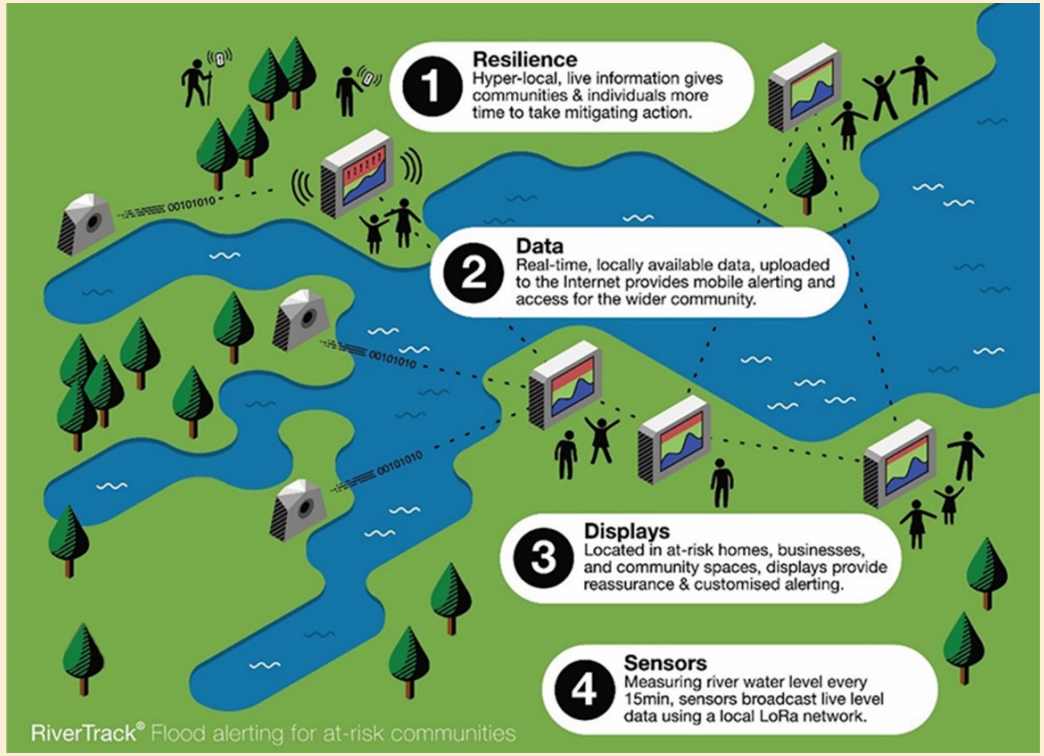
- Events of urban flooding is increasing and incurring life and property damages in cities
- Early warning system for a probable disaster is still a challenge.
- Local real-time monitoring is not feasible in areas using traditional techniques.

Geography

Scotland

Stage of Innovation

Pilot Tested



Innovation Details

- A community controlled flood alerting device, which can provide 24/7 local flood warnings by sending accurate real-time water levels
- High accuracy sensors, with a long battery life, are installed in the river at strategic locations. When water level reaches the sensors (installed at a danger mark), the system sends a flood warning to its users. One outdoor sensor can be paired with many individual and community display devices, requiring no technical expertise to operate. The community is responsible for finalization of a trigger level and installation of a community display for flood warnings.

Technology used in the River Trek warning system

Water level sensors are attached to an agreed point on a stream or river

The system uses an array of low-cost sensors to monitor real-time water level data.

Data is transmitted by licence-free, low power radio frequency either with or without an internet /cellular connection.

Real-time transmitted data is broadcasted to display screens located anywhere in the vicinity.

It provides constant reassurance about the state of current river levels

Applicability

- It can be installed over any type of water body (rivers or large water bodies) to avoid flooding in urban areas.
- It can be used for rivers flowing through multiple cities, where the city upstream can provide an early warning for the downstream areas.

Limitations

There is no provision of database storage, for any future reference.

References

[1] https://media.sepa.org.uk/media-releases/2018/smart-tech-solution-helps-scots-fight-flooding.aspx
[2] https://environment-analyst.com/uk/68108/sepa-to-trial-innovative-flood-warning-system

4.2 School Network for Engaging Students in River Management

The Innovation

Creating awareness among students about the history, ecology, and geography of rivers and engaging them for evaluating the river health.

Issues Addressed

Despite various programs and policies, most rivers are still facing serious issues due to lack of environmental awareness and involvement of local population.

Geography

Chicago River, USA

Stage of Innovation

Upscaled

Innovation Details

- Friends of Chicago River NGO promoted the concept of the Chicago River Schools Network (CSRN) to improve the health of Chicago River by actively engaging school students. The NGO helps teachers to organize workshops, field trips and arrange education material for generating awareness.
- This program is dedicated to engaging students and teachers to improve and protect the Chicago river and its watershed for the benefit of people and wildlife. It integrates education with real environmental issues and provides a nature-education experience.

Applicability

- Students of government or private schools, and colleges or universities can be engaged.
- Organization also partners with community groups, municipalities, government agencies and individuals for identified projects beneficial for the river.

Limitations

- It is usually difficult to manage a sustained financial resource to continue such activities.
- Willingness of heads of schools and colleges to participate in such activities can also act as a barrier.

References

[1] https://www.chicagoriver.org/
[2] https://patch.com/illinois/parkridge/park-ridge-mans-efforts-educate-kids-chicago-river-honored

4.3 Mobilization of Local Communities for River Conservation and Restoration

The Innovation

Formation of local leadership and mobilization of grassroot level communities for involvement in water governance, adopting rainwater harvesting to sustain ecological flows, biodiversity conservation and restoration of the river ecosystems.

Issues Addressed

River habitat degradation, encroachment of flood plains and river pollution are difficult to deal without engagement of local communities.

Geography

State of Rajasthan and states within the Ganga river basin

Stage of Innovation

Upscaled

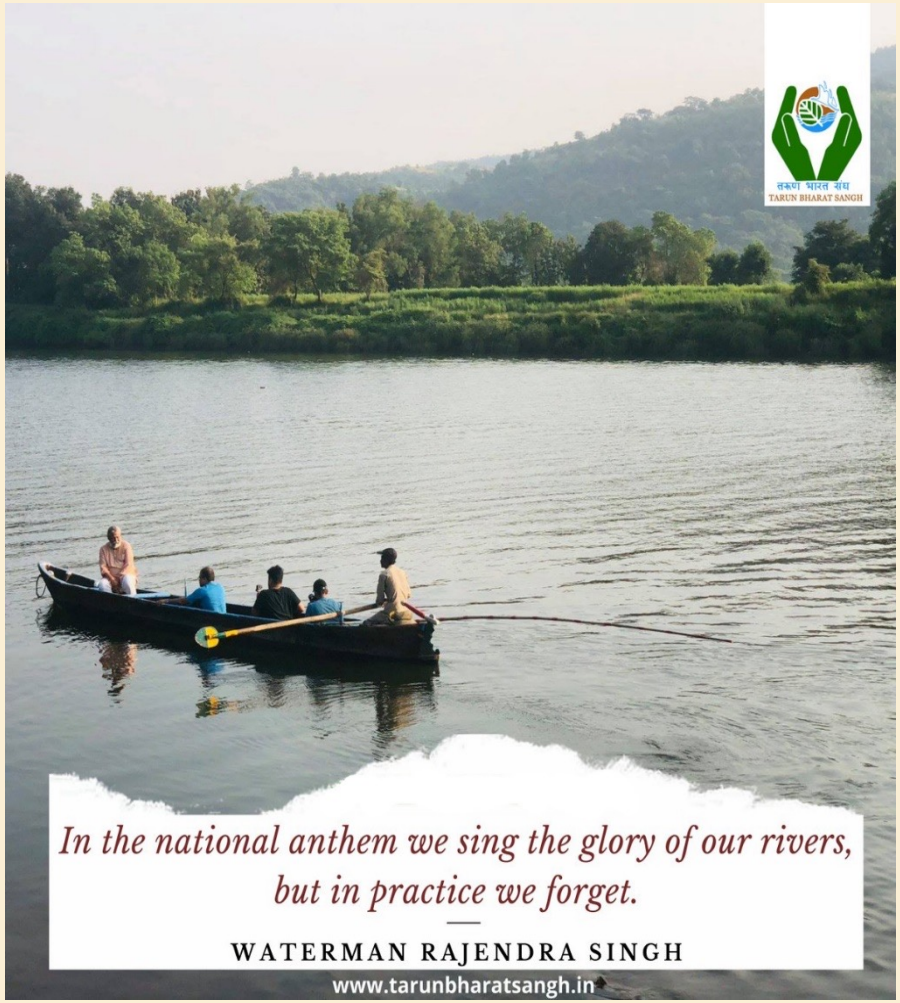
Innovation Details

Ganga Prahari

- A project promoted under the National Mission for Clean Ganga in collaboration with Wildlife Institute of India, involving a cadre of self-motivated volunteers to mobilize local communities at grassroot level.

Rashtriya Jal Biradari (National Water Community)

- Created by the *Tarun Bharat Sangh (TBS)*, Rajasthan to resolve issues concerning water and rivers.



Rashtriya Jal Biradari's activities for river restoration

1

Formation of a special cadre of field activists for river restoration issues

- Selects Field activists from the various river basins through screening process.
- Train them to enhance their capacities.

2

Policy Advocacy for River restoration at State Level

- Capacity building programs for stakeholders on river restoration.
- State level workshops on vital issues .

3

Policy Advocacy for River restoration at National Level

- Organizing national level workshops on issues related to river based policies.
- Regional and national level foot-marches

Applicability

- Ganga Prahari's are spread across five Ganga states.
- *Rashtriya Jal Biradari* has a network all over India, working not only on river-related issues, but also addressing various other types of water-related concerns.

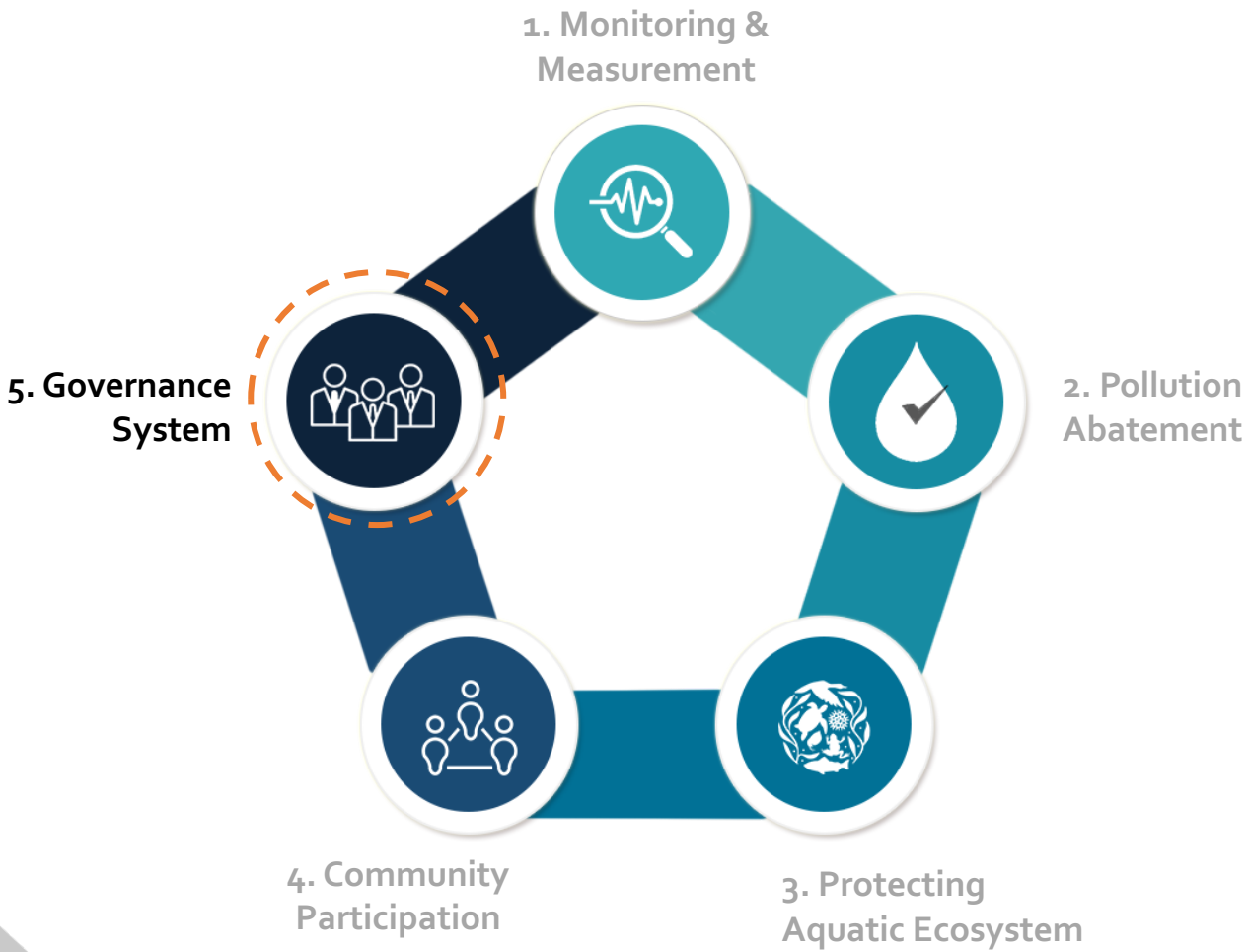
Limitations

- Ganga Prahari's work is limited to villages along the Ganga river.
- *Tarun Bharat Sangh's* efforts are also limited mostly to rural areas, thus leaving limited engagement of communities in the urban Indian context for water-related concerns .

References

[1] https://nmcg.nic.in/wii/prgbggp.aspx
[2] http://tarunbharatsangh.in/rivers-and-generations/#

Ganga Prahari's cleanliness drive In Uttarakhand


1. Monitoring & Measurement
2. Pollution Abatement
3. Protecting Aquatic Ecosystem
4. Community Participation
5. Governance System

Governance System

Governance of river catchment is a complex arrangement, as rivers don't follow any administrative boundaries. Trans-boundary river management usually involves different administrative structures, compliance mechanisms and most importantly multiple stakeholders. Thus coordination between agencies and stakeholders, in a participatory and transparent way, is essential for river governance.

Nowadays water-related conflicts are increasing due to increasing water demand and its scarcity. Issues related to water distribution, pollution control, conservation of river resources, etc. are additional causes for concern. Therefore a robust transparent governance framework is required, where each division and stakeholder has a clearly defined set of roles, responsibilities and benefits.

5.1 *Unique Frameworks for Urban River Management*

The Innovation

Different governance frameworks, namely, the Contemporary River Corridor Management, Collaborative Modelling Approach and International Integrated River Management, which have distinct processes for river management at various scales and hierarchy levels.

Issues Addressed

In the case of river management, there is no pre-defined institutional framework that can be adopted as a standard practice for governance. Also, implementing river management plan remains a challenge due to numerous interests and power structures.

Location

1. Contemporary River Corridor Management - Drava River in Italy, Austria, Slovenia, Croatia, Hungary
2. Collaborative Modelling Approach - Pemali Comal River Basin Territory in Indonesia.
3. International Integrated River Management - Lower Mekong River Basin Governance in Vietnam, Thailand, Laos, Cambodia

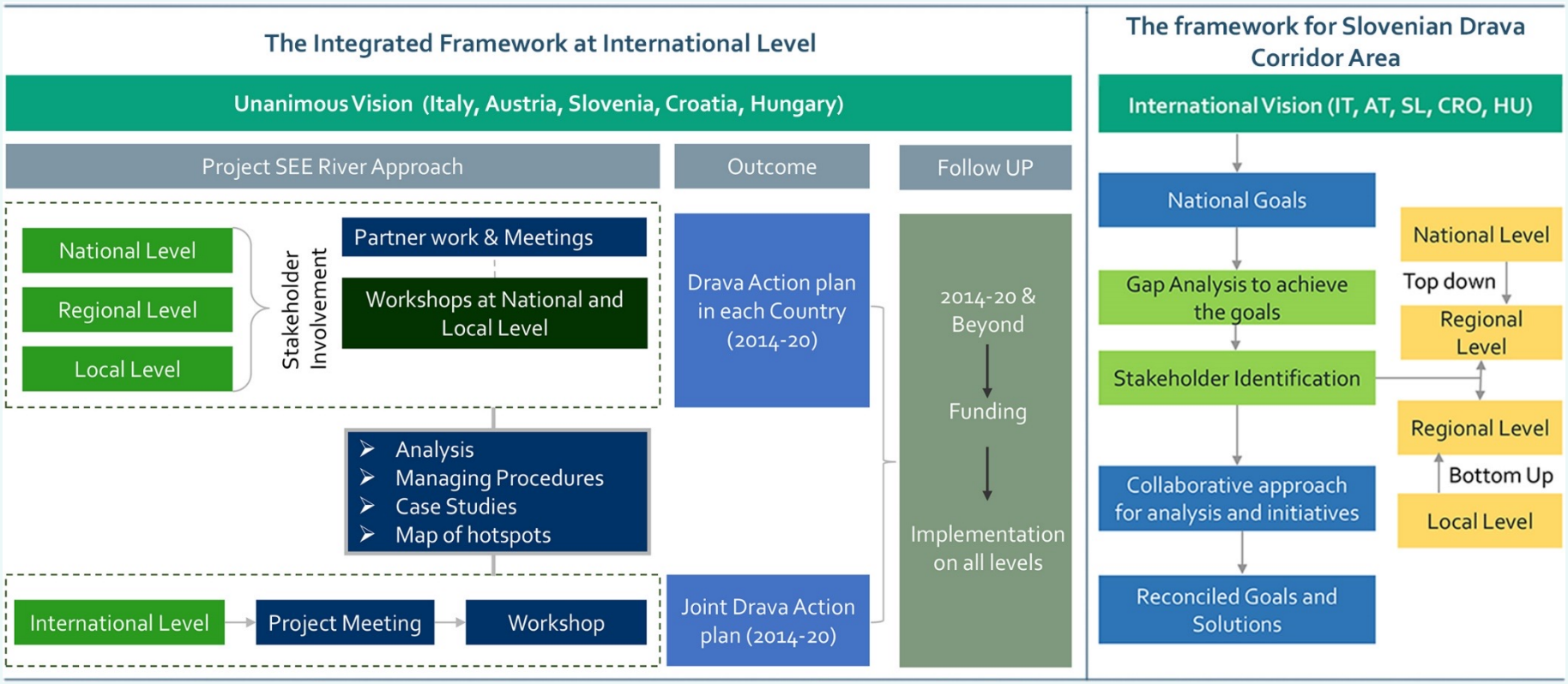
Stage of Innovation

All 3 frameworks are operating successfully

Innovation Details

5.1.1 *Contemporary River Corridor Management (CRCM) - Drava River, Europe*

- It is under the larger umbrella of SEE (South East Europe) River Project, for sustainable integrated management of international river corridors.
- It is a holistic approach to formulate a reconciled River Development Plan, based on cross-sectoral co-operation and stakeholder dialogue for management at local, regional, national and international levels.
- Each participatory country implements the international framework, by following up with their respective goals and methods.

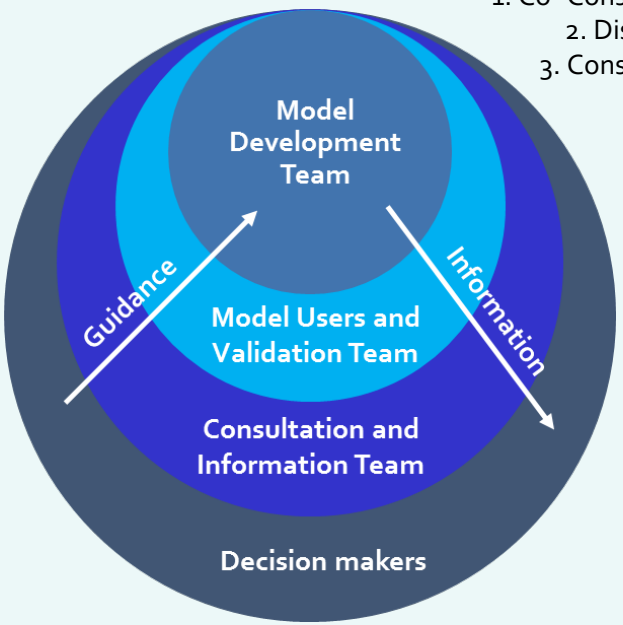


5.1.2 *Collaborative Modelling Approach - Pemali Comal River Basin, Indonesia*

- It is a structured policy solution developed according to the complexity of the problem encountered in the river basin.
- This interactive process provides a step by step procedure for informed planning with key details
- It segregates the level of participation between stakeholders according to the need and level of decision making.

There are three levels of stakeholder participation-

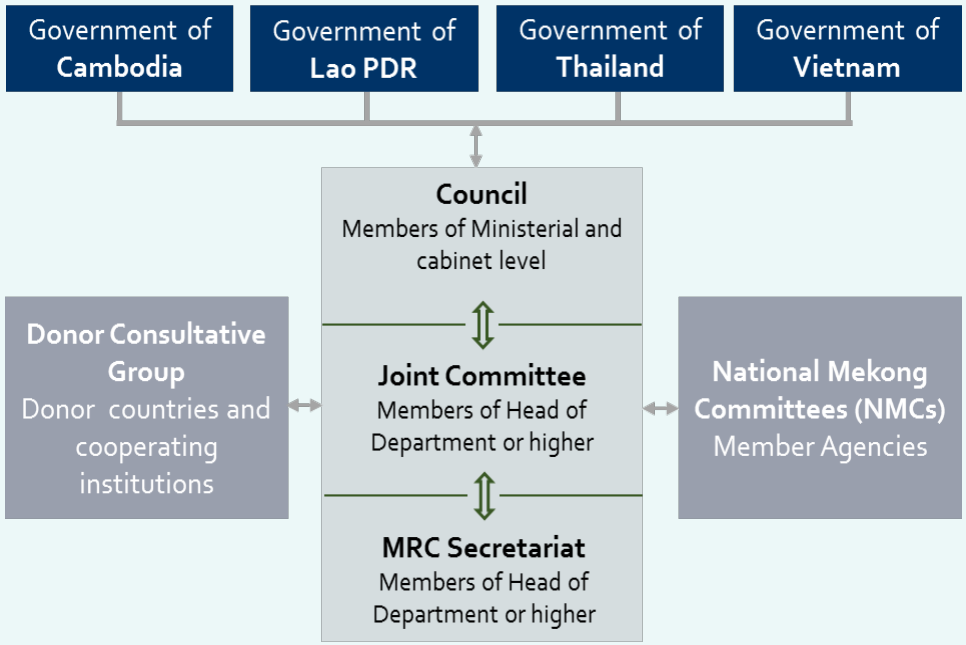
1. Co- Consultation
2. Discussion
3. Consultation



Circles of Influence approach

5.1.3 International Integrated River Management - Lower Mekong River Basin Governance

- The Mekong River Commission (MRC) is an inter-governmental organization working for sustainable development of the river, that manages the lower Mekong river basin and the shared water resources.
- 4 participant countries are developing a joint basin-wide planning process on the basis of an Integrated Water Resources Development Programme. Three interdependent governing bodies comprise the MRC, each assigned a specific role and function.



Mekong River Commission governance structure

Applicability

- These governance structures are developed according to the local problems and context. They can't be replicated everywhere, but can be used as a reference for developing a new river governance framework.
- These systems provide an orderly structure for cooperative governance, to resolve transboundary conflicts.

Limitations

There is scant attention to the social sector in these practices. Community awareness and engagement, which are the most important factors to successfully implement any river management plan, are almost missing in all these systems.

References

[1] https://ris.utwente.nl/ws/portalfiles/portal/59056375/2018_IHE_PHD_THESIS_BASCO_CARRERA_FINAL.pdf

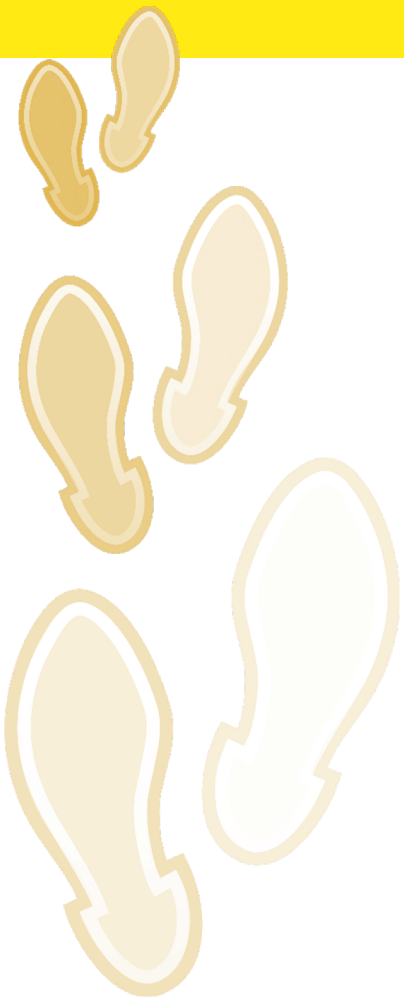
[2] https://www.researchgate.net/publication/327828649_SEE_River_Towards_Contemporary_River_Corridor_Management

[3] https://www.alpine-region.eu/file/1497/download?token=3EvpvmM9

[4] http://www.see-river.net/about-river.html

[5] http://www.mrcmekong.org/

[6]https://iwlearn.net/documents/legal-frameworks/mekong

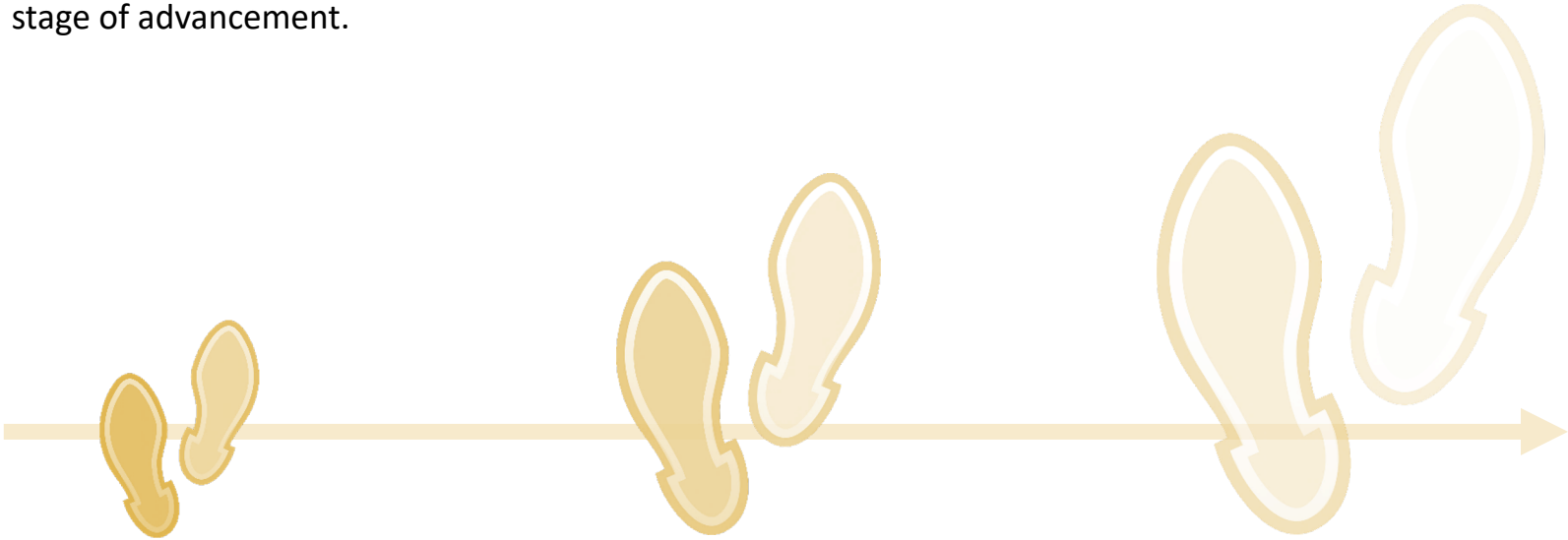


Currently, a lot of work is being done at the national and state level for Urban River Management. However in most cases, application of conventional approaches are found to be time consuming, costly or labor intensive. To meet the requirements, these traditional means need to be complimented with innovative solutions.

Government of India has created momentum to upscale innovations in Urban River Management by identifying technical institutes across the country as innovation labs and incubation centers, in order to conceptualize ideas and foster thinking in this direction. Several efforts are continuously being made to upscale new concepts from experimental stage and bring them into practice. City administrators can directly approach these innovation labs, or engage with academic institutes, business entities, NGOs or community leaders, for finding solutions to their local river needs.

The innovations discussed in this Knowledge Product are presently at different levels of progress. Some innovations are at their inception stage, mostly in the form of institutional or academic researches. These ideas are theoretically proven to work but require further experimentation in live scenarios. While others are at a relatively advanced stage, which have already been tested and are ready to replicated and scaled up.

Following is recommended as a way forward for upscaling these unique concepts, from their present stage of advancement.



Inception

(Interventions listed under this head are at an experimental stage, requiring further research)

These ideas require financial support to further validate the theoretical recommendations. The best possible way forward is to engage any technical/ academic/ research institute to develop these further.

Pilot Tested

(Interventions listed under this head are at a slightly advanced stage, requiring avenues for demonstration)

These ideas require testing grounds. National agencies can coordinate with the ULBs to identify the local river needs and facilitate the application of these tested techniques.

Upscaled

(Interventions under listed this head perform as per the prescribed standards and have already been replicated)

These ideas need to be procured for replications in multiple contexts. ULBs can be incentivized for adopting these techniques under the ongoing missions.

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