



# World Water **2020** Challenge

## Program Book

Date **November 20, 2020**

Venue **Online / Live Stream on KIWW website**



Ministry of Environment



KOREA  
WATER FORUM

KOREA WATER FORUM  
KWF



## BACKGROUND

The World Water Challenge was created as a special program of the Science and Technology Process in the 7th World Water Forum to identify imminent water problems that the world is facing and to find feasible solutions keeping in mind implementation, the core value of the 7th World Water Forum. The program aims to present science, technology and policy that are applicable to the real world and come up with the optimal solutions to defined water challenges. Attracting great attention in the 1st edition in 2015 at the 7th World Water Forum, the program has become one of the symbolic platforms of implementation which has been followed up in the Korea International Water Week over 5 years.

This year, the 6th edition of the World Water Challenge is expected to serve its role as an important platform to share the not only innovative scientific/technological methods but also policy towards solving the pre-identified water problems around the world. Particularly, given the current global circumstance in which the world is suffering from COVID-19 pandemic, WWCH 2020 will be held as a virtual event, dealing with the special topic "Water and Health" along with 5 Main Topics to demonstrate a pathway to not only overcoming the current pandemic but also achieving the Sustainable Development Goals.

The best solution out of 9 selected solutions to the 6 water challenges will be decided through the final presentation and winners will be awarded with cash prize and an opportunity to be invited to the WWCH Showcase during the KIWW 2021 and/or the WWF9 to share their solutions with the experts from all around the world.

## OBJECTIVES

- to share appropriate and innovative ideas and know-hows based on science, technology and policy that are applicable to the real world by linking problem owners with solution providers
- to raise the world's awareness on the water issues as well as the importance of the role of science, technology and applicable policy in solving the water challenges
- to provide a networking opportunity among participants from the water-related corporations and organizations to create a business opportunity and make an inroad into the global market by presenting those innovative solutions

## OVERVIEW

- **Date & Time** November 20, 2020 / 16:00 - 20:00 (KST / GMT+9)
- **Venue** Online / Live Stream will be available on KIWW website.
- **Host/Organizer** Ministry of Environment, Rep. of Korea / Korea Water Forum

## PARTICIPATION

The session is free and open to all.

## Session Schedule

Time	Contents
16:00~16:10	Opening & Welcoming Remarks
16:10~16:15	<b>Invited Talk : A Water Kiosk at School</b> (Video Presentation) Mr. Venuste Kubwimana Secretary General, International Transformation Foundation, Rwanda <i>* The winner of the World Water Challenge 2019</i>
16:15~16:20	Introduction of World Water Challenge 2020 Final Round (Chairman of Evaluation Committee)
<b>Challenge 1 Scale-up of WASH for Public Health</b>	
16:20~16:30	<b>Solution 1 An Innovative Toilet System for Low-income Countries for Covid-19 and SDG 6</b> Mr. Janith Madubasha Dissanayake Waterfirst Laboratory, Seoul National University, Republic of Korea
16:30~16:40	<b>Solution 2 Resource Circulation Sanitation Showcase to Provide Sustainable Sanitation in Remote Areas</b> Dr. Shervin Hashemi Institute for Environmental Research, Yonsei University, Republic of Korea
16:40~16:50	<b>Solution 3 Engaging Public, Private, and Civil Society Groups in WASH Through Women-Led Output Based Aid (WOBA)</b> Mr. Khouankeo Ardphasouk Thrive Net-Works/ East Meets West Foundation, Lao PDR.
16:50~17:20	Q&A and Discussion
17:20~17:30	Coffee / Tea Break
<b>Challenge 2 Energy Efficiency in Sewage, Waste water, and Sea Water Recycling and Reuse</b>	
17:30~17:40	<b>Solution 4 Gravit'eau: a mobile handwashing station with automatic water recycling</b> Mr. Tom Fitzpatrick Terre des Hommes, UK
17:40~17:50	<b>Solution 5 Seawater cooling for photovoltaic solar power greenhouses and agriculture</b> Mr. Volker Korrman IrrigationNets.com, Germany
17:50~18:10	Q&A and Discussion
<b>Challenge 3 ICBM, ICT based Water Management</b>	
18:10~18:20	<b>Solution 6 Intelligent Water Leak Management Platform Service</b> Prof. Dr. Young-June Choi WI.Plat Co.,Ltd., Republic of Korea
<b>Challenge 4 'Smart' Solutions for Water Management : Definition and Case of 'Smart Solutions' by Region, Sector, and Target</b>	
18:20~18:30	<b>Solution 7 SMART Tech in support of Low Tech for Pumping Water Uphill</b> Mr. Auke Idzenga Alternative Indigenous Development Foundation, Inc., Philippines
18:30~18:50	Q&A and Discussion
18:50~19:00	Coffee / Tea Break
<b>Challenge 5 Nature-based Solutions for Ecological Recovery and Reinstatement of Natural Process of Rivers</b>	
19:00~19:10	<b>Solution 8 Restoration Hydro™: A watershed approach to standard modular new hydropower</b> Ms. Gia Schneider Natel Energy and Restoration Hydro™, Natel Energy Inc., USA
<b>Challenge 6 Ecological Urban Water Cycle in Adaptation of Climate Change</b>	
19:10~19:20	<b>Solution 9 Extraction of Water from Air at Zero Energy Expenditure to Mitigate Water and Energy Crisis in India</b> Dr. Senthil Kumar Sadasivam Geobiotechnology Laboratory, National College (Autonomous), India
19:20~19:40	Q&A and Discussion
19:40~19:45	Closing Remarks
19:45~20:00	Group Photo & Notification of Award Ceremony & Closing
20:00~20:40	Break
20:40~22:00	<b>Final Evaluation Meeting</b>



# World Water Challenge 2020

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  - [Solution 2] Resource Circulation Sanitation Showcase to Provide Sustainable Sanitation in Remote Areas
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## Invited Talk

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### A water kiosk at school

The Winner of the WWCH 2019

**Venuste Kubwimana**  
Secretary General, International Transformation Foundation



## Invited Talk

### A water kiosk at school

Venuste Kubwimana

Inspired by personal experiences growing up in communities, where school-going children walk long distances to secure water for their families before/ after going to school causing absenteeism resulting to school drop-outs.

In 2013 International Transformation Foundation (ITF) members worked together on research project about sustainable clean drinking water system. One of the main insights gained is that all communities wish to improve their water system. Some communities do not have a working water system at all, prompting school-going children and women to walk very long distances to secure water from neighboring communities' wells/ rivers. The problem with current water projects in Kenya's communities are:

- 1) the water system with the technical components to get groundwater to the tap and the paying system that describes what to pay for, how to maintain the system and how the business is set up; the social system.

A Water Kiosk at School is a (primary) school-based and students-managed business selling clean tap water to community residents at an affordable price. It consists of financing a community school to set up on-site water kiosk with sustainable products for the students to transport tap water from school to their homes. It is both an educational and profitable business teaching the students business and entrepreneurial skills, and generating much-needed income for schools. It provides practical education bridging the gap between school and work. And contribute to further development of the community with a school which is able to support itself.

A water kiosk at school is characterised by the following environment friendly products:

1. **Water Saving Tap Station** - Our water stations not only provide clean drinking water but also saves water. No water is wasted with our auto-stop tap!
2. **DRIP TAPS For Hand Washing Facilities** - We build toilets and hand washing sinks to prevent waterborne illnesses to spread. Drip taps technology reduces 90% of water usage!
3. **Water Bottles** - We provide refillable water bottles for the children to drink from made of BPA-free plastic.
4. **Jerry Carry Karts** - reduce the physical injury from constant lifting and carrying heavy loads of water on heads of the children.

Setup at a school located in a rural community with no working tap water system. where it will be the main

source of clean water for all households, not only by providing them clean tap water, improved sanitation and health but also its social business model that develop communities' solidarity, developing local education and an entrepreneurial spirit.

To date, we have:

- Built 12 water kiosks at 12 schools in Kenya and Rwanda consequently
- 6557 school children no longer have to absent themselves from school to secure water for their families.
- 120358 people have access to clean tap water at affordable price within their communities.

By financing a school to set up the kiosk, within 36 months, the school earns enough money from selling water to community residents at affordable price and are able to repay the set-up cost which is then redeployed to an additional school/community.

# World Water 2020 Challenge

# World Water 2020 Challenge

## Main Focus 1 Water and Health Special Topic in 2020

### Challenge 1

#### Scale-up of WASH for Public Health

### Solution

#### **An Innovative Toilet System for Low-income Countries for Covid-19 and SDG 6**

**Janith Madubasha Dissanayake**  
Waterfirst Laboratory, Seoul National University

#### **Resource Circulation Sanitation Showcase to Provide Sustainable Sanitation in Remote Areas**

**Shervin Hashemi**  
Institute for Environmental Research, Yonsei University

#### **Engaging Public, Private, and Civil Society Groups in WASH Through Women-Led Output Based Aid (WOBA)**

**Khouankeo Ardphasouk**  
Thrive Net-Works/East Meets West Foundation



## Solution 1

### An Innovative Toilet System for Low-income Countries for Covid-19 and SDG 6

Janith Madubasha Dissanayake

Lack of access to safe water and proper sanitation are two major problems in the world. With the onset of Covid-19, demand for safe water and proper sanitary facilities have increased, plunging the developing world into a crisis. Due to financial constraints and lack of resources, it is hard for these countries to provide facilities that could not only cater to the sanitary needs but also to hygienic requirements demanded by Covid-19 situation. In this context, our team has come up with an integrated solution to use a cost-effective rainwater harvesting system (RWHS) as a water supply, Urine-Diverting Dry Toilet (UDDT) system as a zero water sanitary toilet and foot pump powered hand washing system. In RWHS in developing countries, a first-flush and a filter is not available. So, by designing the inlet/outlet configurations of the storage tank, our team has come up with a tank design that could minimize sediment re-suspension (By nearly 50%) and maximize residence time of a conservative pollutant. Published journal article regarding tank design is attached to the submission. A two-tank system is provided as a contingency and for better sediment removal. A foot pump powered hand washing system is provided to control the handwashing water demand by 50-60% while saving energy. This combination would ensure a reliable, cost effective solution for developing countries with water scarcity.

A UDDT is provided to further reduce the water demand. UDDT will separate the feces and urine which could then be treated to make fertilizer. For the feces, our team has investigated the possibility of onsite treatment of source separated feces. For on-site feces treatment from UDDT a larger retention time is needed resulting in larger tanks which create substantial initial cost. To overcome these problems, our team members have developed a method to treat human feces, called vermicomposting with saw dust as a catalyst. During vermicomposting process, organic matter in human feces was decomposed to humus by earthworm and microorganisms. And the treatment time of vermicomposting is reduced by adding sawdust (ratio of feces and sawdust = 1:0.5 (v/v)) which can increase the microbial activity helping earthworms decompose faster. After 3-4 months of treatment, the product will include earthworm biomass and soil conditioner (worm cast). The biomass can be used as food for animals or aquatic animals (i.e. chicken, pig, fish). The results of the study with respect to E-coli reduction and volatile soil reduction are provided as an attachment. This technology is not only rapid, zero waste, and energy saving, but also effective in recycling nutrient and organics. This could create additional job opportunities in fertilizer manufacture that could generate additional revenue for the community.

## Solution 2

### Resource Circulation Sanitation Showcase to Provide Sustainable Sanitation in Remote Areas

Shervin Hashemi

Sanitation is a global challenge. In particular, rural and remote communities, which their economic development is heavily related to agriculture, are generally facing a lack of access to appropriate sanitation. Consequently, the sixth sustainable development goal (SDG6) is aiming sustainable access to adequate sanitation for all. Meanwhile, during the years 2018 to 2019, the United Nations has emphasized developing nature-based solutions (NBS) to provide sustainable access to water and sanitation for all, leaving no one behind. In 2018, the World Health Organization (WHO) published guidelines on sanitation and health systems.

Using common flush type toilets cannot be a sustainable solution for remote and rural areas. They consume a high amount of water, require complicated infrastructure, and produce wastes.

Accordingly, an innovative sanitation system named as "Resource Circulated Sanitation (RCS)" has been developed, and supported with a scaled-up showcase project objecting to investigate the technical efficiency and sustainability of the system for offering public hygiene services in a remote area.

The system includes a dry toilet seat, urine reactor, feces reactor, and rainwater harvesting system to provide water for sanitary purposes. The toilet seat efficiently separates urine from feces, storing them in their reactors. Urine is stored in a tank-in-series reactor, while feces, along with other hygienic materials, such as biodegradable toilet papers, are led into a batch reactor including sawdust for the composting process. The reactors are well-designed based on the estimated amount of usage and retention time of 10 to 15 days.

The nature-based treatment process includes adding a microflora, containing nitrifying microorganisms, to urine and feces reactors. The nitrification process gives benefits for reducing the stabilization time for urine and enhancing the biodegradation of feces.

This treatment also shows efficiency in increasing the fertilizing potential of urine by modifying its nitrogen profile. Moreover, pH reduction as a result of nitrification led to reducing ammonia losses as gas along with odor production. Furthermore, this method was useful in the efficient removal of fecal indicators.

Water for sanitation purposes is provided through a rainwater harvesting system. The produced greywater is treated onsite to be used for irrigation purposes. A trained management committee sustains the operation and maintenance of the system.

The treated wastes showed higher agronomic productivity comparing to a locally available commercial fertilizer through cultivating white radish.

The system is sustainable due to its efficiency in reducing water and energy consumption, along with recycling



### Solution 3

urine and feces to be utilized as fertilizer. The benefits acquired by fertilizer production, water-saving, and higher agricultural productivity are substantial, indicating the potentials for improving the economy of the community, where the system is implemented.

This system meets the recommendations of WHO guidelines, does not need complicated infrastructure, and provides NBS for sanitation problems, make it suitable for remote areas. No direct contact with sanitary wastes makes the system safe, preventing the spread of infections like COVID19. Consequently, it can be considered as a step ahead toward SDGs 1, 2, and 6.

## Engaging Public, Private, and Civil Society Groups in WASH Through Women-Led Output Based Aid (WOBA)

Khouankeo Ardphasouk

Lao PDR has made significant progress in its water, sanitation, and hygiene (WASH) sector in recent years. In 2017, piped water supply access increased by 63.25% respectively.<sup>1</sup> However, increasing piped water system access continues to be a challenge in rural areas, where 80% of the population live.<sup>2</sup> A 2017 Joint Monitoring Report (JMP) shows that 40.05% of rural areas have access to piped water supply system, compared to 82.86% in urban areas. Even among the rural poor, the situation varies depending on their location (i.e. no road access). For instance, 65.5% of the rural population with road access use improved sources of drinking water, compared to only 42% without road access.

Lao PDR set up the Strategic Framework for Rural WASH by 2030 to achieve 60% coverage in safely managed WASH services, and 40% in basic service by 2030. The costing provided for the overall strategy amounts to 525 million USD for the 12 years period from 2018-2030, to be funded by Government and its donor partners.

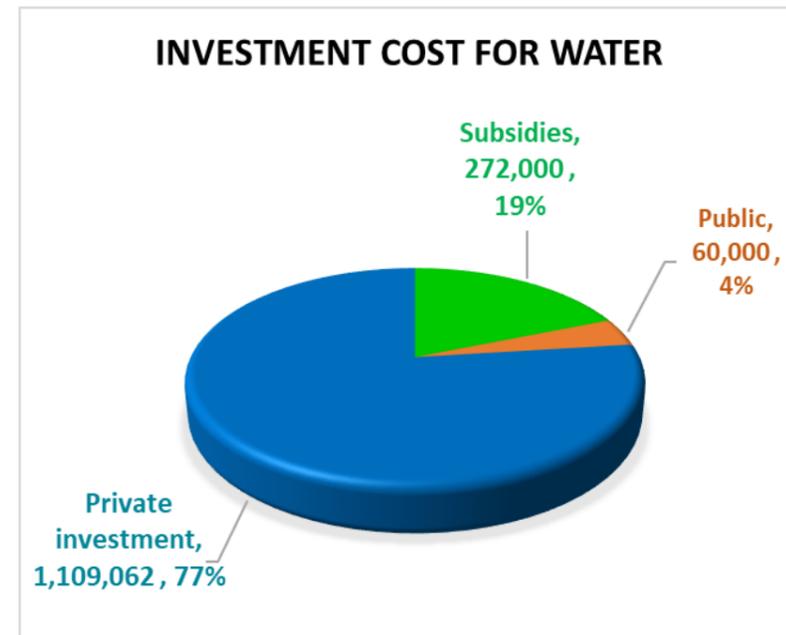
In Laos, the national budget allocated for water supply and sanitation is far below what is required. There is a public financing gap of US\$34 million a year while the Private sector participation in the WASH sector is also limited. Ideally, private water operators can bring additional capacity, technical expertise, and financing to assist the government. However, fragmented supply chains caused by geographic isolation, lack of awareness among enterprises on the potential market demand for sanitation, and inadequate business skills among existing private enterprises prevent them from fulfilling this.

East Meets West's 'Engaging Public, Private, and Civil Society Groups in WASH Through Women-Led Output Based Aid (WOBA)' solution addresses the gaps in the Lao WASH sector and increases WASH coverage and health in small towns. Through this approach, we mobilize approximately 75% of each water system costs from the private sector with only 20% from donor funds and 5% from the Laos Government. ***This innovative financing approach matches every donor dollar 3 to 1.*** In addition to the tremendous financial leverage of our solution, we have also reduced implementation times by 30% or more. All this while reaching rural, poor, and 'GESI' households (i.e. poor households facing gender inequality and social exclusion barriers). We leverage our strong partnerships with national and sub-national government entities, which is the core of our WASH programing in Southeast Asia. We create meaningful gender empowerment outcomes by systematically engaging women as change agents in the sector and decision-makers in the household.

1. WHO and UNICEF Joint Monitoring Programme Data. (2017).

2. Lao PDR, UNICEF (2012-2014). Evaluation of the Water, Sanitation, and Hygiene (WASH) Programme within the UNICEF Country Programme of Cooperation Between the Government of Lao PDR and UNICEF.

# World Water Challenge 2020



## Main Focus 2 Resource Recovery from Water and Wastewater System

### Challenge 2

**Energy Efficiency in Sewage, Waste water, and Sea Water Recycling and Reuse**

### Solution

**Gravit'eau: A Mobile Handwashing Station with Automatic Water Recycling**

**Tom Fitzpatrick**  
Terre des Hommes UK

**Seawater Cooling for Photovoltaic Solar Power Greenhouses and Agriculture**

**Volker Kormann**  
IrrigationNets.com



## Solution 4

### Gravit'eau: a mobile handwashing station with automatic water recycling

Tom Fitzpatrick

Water is scarce in most crisis zones. When water is limited, it tends to be first allocated for drinking and cooking (Brown et al., 2012, ELRHA HIF, 2016). Sanitation and handwashing are often relegated to secondary considerations in these settings.

This is despite the importance of proper handwashing in fragile settings, especially for young children. Proper handwashing with soap helps control the spread of disease significantly, lowering the incidence of diarrhoea and pneumonia among young children by 50%, and limiting the risk of epidemics like cholera, which causes 21,000-143,000 deaths worldwide yearly (WHO).

Handwashing is also a vital way to lessen the spread of COVID-19. 43% of healthcare facilities globally lack hand hygiene at the point of care where doctors and nurses are treating patients, and only 55% of healthcare facilities in least-developed countries have a basic water service. To curb the spread of coronavirus in these countries, that must change.

As a response to this evidence, humanitarian organisations distribute soap in emergencies as a part of their routine measures. However, water shortages in emergencies can adversely affect handwashing. Hand hygiene facilities, when available at all, require daily refilling of water containers, and this process is very costly. For example, Tdh's operations in Iraq show that the shipping of water to IDP camps costs £11 per cubic metre of water.

As a result, toilets with functional hand hygiene facilities remain an exception rather than a norm in many humanitarian settings, including camps, urban shelters, health facilities and schools. Even where handwashing systems exist with recycled water, the quality and provision are low, and there is a risk of people drinking water that contains soap.

*Tdh has co-invented a mobile handwashing station with automatic water recycling system to deal with water shortages, potentially saving thousands of lives if scaled. Gravit'eau safely reduces water use to 5 ml/handwash without chemicals or electricity, and only needs refilling every 2-4 weeks.* The Gravit'eau handwashing system recycles water, reducing the actual water use to just 5 ml/handwash. Using biological gravity-driven membrane filtration, the system does not require backflushing, cleaning of membrane elements, or external supplies like chemicals or electricity.

The system:

- Has high water use efficiency: 5 ml per hand wash, compared to 0.5-1l in conventional handwashing stations.
- Doesn't need regular drainage, water supply connection or refills (only every 2-4 weeks)
- Water is dedicated to handwashing and can't be easily used for other purposes
- Water is free of microbial contamination; with reduced risk of hand recontamination or mixing with soap
- Is designed for children and can be used in child-friendly spaces/ schools.
- Can be produced locally and easily adapted to different scales and available containers.
- The filter does not require any maintenance, complex cleaning or replacement for 5-8 years of operation

# World Water Challenge 2020



## Solution 5

### Seawater cooling for photovoltaic solar power greenhouses and agriculture

Volker Korrman

IrrigationNets is an solution which, if widely implemented, can slow down climate change and secure the drinking water supply.

With IrrigationNets, we evaporate salt-free very large quantities of seawater or salted groundwater and thus generate many millions of cubic meters of cold humid air. If broadly applied, by using this cold, moist air, we cool photovoltaic solar power plants in greenhouse style (1 km), promote agriculture in drought areas (5 km) and green entire deserts within a radius of 250 km, and can therefore reduce CO<sub>2</sub> emissions by several billion tons.

All farmers in drought areas need water! What's the point of cold, damp air?

With the very large quantities of salt-free, cold and humid air, we create almost greenhouse-like conditions in open field cultivation, but without expensive greenhouses. Instead, we consume very large amounts of unlimited seawater or salinated groundwater and allow much of this moisture to spread throughout the country. The farmer has the greatest benefit from the moisture and cooling in the immediate vicinity and therefore bears the costs of the system.

In principle, this technique is already proven. Consider that even with the same amounts of rain, farmers near the sea are known to have fewer drought problems as their plants benefit greatly from the cold, moist sea air. With our plants, we can strengthen this well-known effect and achieve the same effect in areas inland, if salty groundwater is present. For example, we experience this effect near Hannover, in the Algerian desert, in Jordan, Northern Kenya, Ethiopia, Chile, Bolivia and Paraguay.

## Main Focus 3

# Smart Water Technologies

### Challenge 3

#### ICBM, ICT based Water Management

### Solution

#### Intelligent Water Leak Management Platform Service

Young-June Choi  
WI.Plant Co.,Ltd.

### Challenge 4

#### 'Smart' Solutions for Water Management : Definition and Case of 'Smart Solutions' by Region, Sector, and Target

### Solution

#### SMART Tech in support of Low Tech for Pumping Water Uphill

Auke Idzenga  
Alternative Indigenous Development Foundation, Inc. (AIDFI)



## Solution 6

### Intelligent Water Leak Management Platform Service

Young-June Choi

#### *Production vs. Supply*

The water sector faces unprecedented challenges including COVID-19 pandemic (WASH), climate crisis (drought and flood), and social changes (aging population, urbanization, and population growth).

It is merely a symptomatic therapy to build new WTP's (Water Treatment Plant) to meet water demand even with low efficiency of water supply system. If water leak in the supply system can be effectively reduced, the additional WTP's may not be necessary. Arithmetically, we can reduce water production as much as the efficiency of water supply is increased.

NRW (Non-revenue Water) management can be one of the best solutions to solve the problems that the water sector is facing, i.e., increasing water demand. The first and main stage of NRW management is water leak management.

#### *Smart vs. Appropriately Smart*

A smart system cannot be 'smart' when the system is expensive and cannot create the customer's value sustainably.

The existing water leak management technologies are costly and time-consuming as they require a bundle of separated software systems, expert-driven engineering, and expensive hardware devices.

WI.Plat proposes an 'intelligent water leak management' system to address the challenge with wide spectrum of solution technology, which is appropriate for the local water supplier to apply the solution for the city.

The system is composed of three sub-systems, i.e., the hardware system (Sonic M1 and Sonic M2), the mobile application (NELOW App), and the cloud system (NELOW Web).

WI.Plat's solution can save cost through three approaches. The software system integrates the separated software systems into a simple system, the NELOW Web and App. The expert-driven engineering work is replaced by big data analytics and AI algorithms. WI.Plat has developed the water leak detecting devices by itself.

The solution of WI.Plat is wide spanning from 'the fully automated system' to 'the system working with the local staffs' as well as flexible. WI.Plat proposes the 'appropriately smart' water leak management system, not

only 'smart' one.

#### *Sustainable and Feasible*

A smart system is sometimes not sustainable as the solution is too 'smart' for the local suppliers to sustain the system. WI.Plat's solution is sustainable as the 'appropriately smart' system can reduce water production, energy, and other resources required. In addition, it is technically sustainable as the local supplier can operate the system by themselves using WI.Plat's NELOW app and cloud system.

It is feasible as any water supplier can make benefit from the system by choosing the appropriate structure and components considering their financial and technical capability.

The feasibility of the solution was verified through a couple of pilot projects carried out in the cities in Korea and oversea countries.

#### *Water for All*

As we witnessed through the COVID-19 pandemic, the viruses could spread all over the world within weeks. It's just a matter of time that the disaster or pain of people in the other side of the world becomes mine. WI.Plat can achieve the final goal of 'Water for All' by helping the local people solve the problem effectively and sustainably.

## Solution 7

### SMART Tech in support of Low Tech for Pumping Water Uphill

Auke Idzenga

**Water problems:** the water problem tackled by AIDFI is found in hundreds of thousands waterless upland communities and farms in the world where there are free flowing sources but where people must bring it up manually.

**Solution:** in the absence of (affordable) power sources, the best sustainable solution once the source is free flowing, is the hydraulic ram pump which utilizes the energy contained in falling water. A ram pump can lift water to high elevations and without pollution. The AIDFI ram pump model is a crossbreed between expensive commercial and inferior DIY models and is based on local available materials, spare parts, knowledge and skills.

**Typical Village Set Up:** a source far below the village or farms like a spring, stream or river is being tapped and water is diverted to a catchment to which a ram pump(s) is/are attached through drive pipes. The ram pump is protected against natural and human elements and through delivery pipes bringing up the water over a usual 80-100 meters height difference and to a ferro cement reservoir at the highest point from where the water is distributed to strategically placed public tap stands, each serving a cluster of mostly 10 households. Water consumption increases up to ten times.

**Holistic Approach:** when AIDFI started in 1990 with ram pumps, the technology was largely unknown but with marketing and sales the number of ram pump projects increased and spreading in the Philippines. With experiences gained on the ground and the realization that the social part of the water systems were equally important than the technical part, the approach of implementing projects started to become holistic (setting up of water associations, training of members and local technicians, participation of members in the projects, etc). It involves social and technical teams.

**Benefits:** the 24/7 water delivery changes the lives of villagers and farmers. For villagers it saves time and money for fetching, lessens health issues (skin and water borne diseases, better nutrition, and improved sanitation), makes doing laundry easy and provides opportunities for water related livelihood. For farmers it helps them survive crops, add a crop cycle, or help in diversification.

**Expansion:** over the years in some 580 villages and farms ram pump systems were installed, benefitting some 270,000 people. This was observed by the Coca Cola Foundation and the Department of Agriculture with whom we have now been partnering since 2012. Then, some AIDFI ram pumps ended up in 15 countries.

**Management Issues:** AIDFI observed issues in the operation of the water projects and discovered that that

non-functioning systems had management rather than technical challenges. After an evaluation of 100 sites we gathered hard facts backing our earlier observations. There were two main issues: unequal distribution of water leading to non-payment of fees by members and the lack of budget for on the ground monitoring.

**SMART solutions:** for these challenges we started developing SMART solutions two years ago: a monitoring app on a mobile phone which provides AIDFI or donors with monthly information about the water projects like volume delivered, fees collected and, repairs and maintenance undertaken. The other solution was a water kiosk releasing 20 liters of water for a 1-peso coin. This evolved from a solar powered (with too many sensitive electronics) to a robust mechanical coin mechanism, which is operation and maintenance friendly. This results in fair distribution and a 3-4 times higher collection and more sustainable management of the projects.

**Technology Transfer:** like AIDFI has done already to four countries, it is willing to share this holistic ram program (incl. manufacturing) and its extensive experiences to other countries.



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**Main Focus 4**  
**Ecosystem and Water**

**Challenge 5**

**Nature-based Solutions for Ecological Recovery and Reinstatement of Natural Process of Rivers**

**Solution**

**Restoration Hydro™: A Watershed Approach to Standard Modular New Hydropower**

**Gia Schneider**

Natel Energy and Restoration Hydro™, Natel Energy Inc.

**Challenge 6**

**Ecological Urban Water Cycle in Adaptation of Climate Change**

**Solution**

**Extraction of Water from Air at Zero Energy Expenditure to Mitigate Water and Energy Crisis in India**

**Senthil Kumar Sadasivam**

Geobiotechnology Laboratory, National College (Autonomous), India



## Solution 8

### Restoration Hydro™: A watershed approach to standard modular new hydropower

Gia Schneider

Globally, hydropower produces 16.6% of power supplies and 76% of renewable energy (RE) [1]. As a flexible, baseload resource, hydropower directly complements intermittent RE resources like wind and solar, and is thus central to climate change mitigation and grid decarbonization efforts at global scales. When harnessed responsibly, hydropower enables climate change adaptation by enhancing systemic resilience to increasingly unstable hydrological cycles, improving both water and food security, and reducing risks to more frequent floods and droughts.

Global estimates of untapped, economically exploitable hydropower potential range from 6,000 to 18,000 TWh annually [2]. New hydropower projects are therefore certain to play an important role in our energy mix for the foreseeable future. Yet, the construction and operation of conventional hydropower projects can have devastating impacts on ecosystems at the local, national and even regional scales. Countless watersheds, rivers and wetland ecosystems have been degraded or destroyed as a direct result of hydropower, depriving millions of people - especially the vulnerable and disadvantaged - from a vast array of life-sustaining ecosystem services and exacerbating poverty [3].

Must the development of hydropower resources that can help mitigate climate change come at the expense of riverine and watershed ecosystems and the wellbeing of the people whose lives and livelihoods these ecosystems underpin?

Natel Energy (Natel), a US-based, woman-led energy+water development and innovation company, believes the answer to this question is a clear and resounding “no”. With USD 1 million in financial support from the U.S. Department of Energy, Natel is collaborating with a consortium of thought leaders in ecosystem restoration - engineers, academicians and scientists - to transform hydropower through a resilience-enhancing infrastructure development framework called Restoration Hydro.

To achieve this, Restoration Hydro (RH)[4] incorporates the principles of nature-based engineering and biomimicry to strategically deploy complementary combinations of permanent, semi-permanent and ephemeral low-head structures - both natural and engineered - that harness natural geomorphological and hydrological processes at the landscape-scale to: 1) restore degraded rivers and watersheds’ natural ecological function; 2) enhance hydrological connectivity; and 3) generate co-benefits that include increased groundwater recharge, improved sediment transport and management, and improved water security and quality.

RH projects build upon proven river and watershed restoration engineering techniques by integrating hydropower turbines into these low-head structures using evolving civil works concepts and innovative

hydropower turbines that facilitate safe fish and smoother sediment passage. Powering these low-head structures creates a directly monetizable layer of economic value in the form of flexible, reliable renewable energy on top of the already high-value water, environmental and recreational benefits of river restoration.

Natel’s aim is to create a virtuous, self-reinforcing cycle whereby RH projects support the scaling of river restoration investments, creating a water-energy-carbon multiplier effect that: 1) improves the resilience of landscapes and downstream population centers to emerging hydrological regimes; 2) creates a reliable, distributed energy resource that facilitates the integration of intermittent RE resources into grids and enhances grid resilience; and 3) supports climate change mitigation and adaptation through grid decarbonization and river restoration respectively.



## Solution 9

### Extraction of Water from Air at Zero Energy Expenditure to Mitigate Water and Energy Crisis in India

Senthil Kumar Sadasivam

The national water policy of the Government of India, proclaims that “Water is already a scarce resource, will become scarcer” and that “non-conventional methods of sourcing and utilization of water need to be practiced”. One such non-conventional and renewable source of water is the moisture in the atmosphere. Harvesting this water with special equipment could cost high energy. However, an Air-conditioner (AC) machine harvests this water from atmosphere without having us to pay for extraction. Countries like India with tropical climate can capture the AC condensate water (ACW) for reuse. Collection, treatment and reuse of ACW from corporate (commercial) building can trim down the demand of potable water and save a substantial amount of energy in the urban sector. Water and energy are interdependent, so reuse of ACW will also save substantial amount of energy. Thus, the regulated use of this free and green energy is an opportunity to step towards sustainability in urban environments. Energy saved can be quantified in terms of carbon footprint. It is estimated that for each kWh production an approximate  $6.8 \times 10^{-4}$  metric tons of CO<sub>2</sub> is produced. That is for every million gallons of water delivered in the country, 1.3 metric tons of CO<sub>2</sub> is produced. A corporate building that is installed with 350 tonnage capacity of AC will produce an average of 3.7 liters of condensate per minute. Using the condensate on-site would save the city 2,192 kWh and 1.15 metric tons of CO<sub>2</sub> production per year. Thus besides mitigating water-energy-crisis, ACW also breaks amplification-loop-humidity’s contribution to global warming and vice-versa. To prove this concept, a yearlong study was carried out in a corporate building at Chennai city, India. Results revealed that a 16 ton capacity AC machine installed in that building could condense an average of 110 litres of water from the air in 9 hours of operation per day, which was more than 20% of the daily drinking water requirement of that building. Upon various treatment regime tested, a combination of ozonation + activated carbon + UV proved to be efficient in the treatment of ACW as per Indian Standard: 10500 (2012) drinking water specifications. Considering the cost of recurring and non-recurring expenses in collection and custom designed treatment of ACW, the payback period was less than one year. Statistics reveal that 28 million tons of AC machines available across the country are continuously in operation for about 8 hours a day, and then an extra water of about 145.6 million liters/day is wasted through sewer which is the daily drinking water requirement of 45.5 million adults. Thus results reveal that regulated reuse of ACW will improve the performance of buildings by reducing consumption of energy, water and create a sustainable urban environment and extend the ability of India’s infrastructure to meet the needs of future development. Further, the objective of the present work is to develop “Zero-Extract Corporate”, a designation for which corporates will collect ACW and reuse it for drinking/other purposes thereby reducing their water extraction to almost ‘NIL’ from conventional water resources. The present work is to assist government in identifying least-cost policies on a range of environmental issues related to water, including mitigation of climate change, suggesting guidelines to a policy called “Zero-Extract Corporates” for corporate buildings, with a

regulatory framework recognizing ACW as a part of the National Water Patrimony. The overall intent of the work is to evaluate ACW collection potential and to apply tools/techniques in generalizations that can be made regarding where ACW collection and reuse would be recommended or perhaps even mandated. Implementation of ACW collection and regulated reuse in the corporate sector would be a wake-up call to harvest water from a renewable and a non-conventional water resource and will help us stave-off water shortages looming throughout India and any tropical countries.



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