2021 World Water Challenge

Program Book

Ministry of Environment

KOREA WATER FORUM

World Water Challenge 2021

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 7 years.

This year, the 7th 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 2021 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 2022 and/or the WWF10 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** December 3, 2021 / 16:30 - 20:00 (KST / GMT+9)
- **Venue** Online / Live Stream will be available on Youtube and the websites (KWF, KIWW)
- **Host/Organizer** Ministry of Environment, Rep. of Korea / Korea Water Forum
- **Participation** The session is free and open to all

Session Schedule

TIME	CONTENTS
16:30 - 16:40	Opening & Welcoming Remarks
16:40 - 16:45	**Invited Talk** : Extraction of Water from Air at Zero Energy Expenditure to Mitigate Water and Energy Crisis in India (Video Presentation) Dr. Senthil Kumar Sadasivam, National College, India * The winner of the WWCH 2020
16:45 - 16:50	Introduction of World Water Challenge 2021 Final Round (Chairman of Evaluation Committee)
	CHALLENGE 1 / Scale-up of WASH for Public Health
16:50 - 17:00	[Solution 1] ECO-MITRA: The Integrated Smart Public Washroom Solution Aditya Tomar, Sukriti Social Foundation, India
17:00 - 17:10	Q&A and Discussion
	CHALLENGE 2 / Integrated Management of Diversified Water Resources
17:10 - 17:20	[Solution 2] GreenOtter - Energy-independent, hands-free portable, ultimate WASH station Edouard Pevzner, ALEX DEUTSCH TECHNOLOGIES, Israel
17:20 - 17:30	Q&A and Discussion
	CHALLENGE 3 / Innovating Financing for Local Water Solutions
17:30 - 17:40	[Solution 3] Solving Scarce and Contaminated Water Problems with the Village Drill and Community Funded Financing Mike Anderson, WHOlives, Inc., USA
17:40 - 17:50	Q&A and Discussion
17:50 - 18:00	Coffee / Tea Break
	CHALLENGE 4 / Energy Efficiency in Sewage, Waste water, and Sea Water Recycling and Reuse
18:00 - 18:10	[Solution 4] Zero Liquid Discharge Desalination with Ultralow Energy: Spontaneous 'Catch-and-Retain' Salts Kwon Gibum, University of Kansas, USA
18:10 - 18:20	Q&A and Discussion
	CHALLENGE 5 / NEXUS for Efficient Utilization of Limited Water Resources and Energy Recovery
18:20 - 18:30	[Solution 5] E-fields Ivan Pavić, Orchestra Fields, Croatia
18:30 - 18:40	Q&A and Discussion
	CHALLENGE 6 / Flood Prevention and Management for Sustainable Water Cycle and Urban Regeneration
18:40 - 18:50	[Solution 6] SLAMDAM: Water-Filled Flood Barrier Omar Saleh, Zephyr Consulting, Netherlands
18:50 - 19:00	Q&A and Discussion
19:00 - 19:10	Coffee / Tea Break
19:10 - 19:20	[Solution 7] Piloting Innovative Flash Flood Early Warning System in Mountainous Regions of China Xiaolei Zhang, China Institute of Water Resources and Hydropower Research, China
19:20 - 19:30	Q&A and Discussion
	CHALLENGE 7 / The Depletion and Pollution of Water Caused by Climate Change
19:30 - 19:40	[Solution 8] Transforming lives and drylands with sand dams and clean water Dwain Lucktung, Excellent Development, UK
19:40 - 19:50	Q&A and Discussion
	CHALLENGE 8 / 'Smart' Solutions for Water Management : Definition and Case of 'Smart Solutions' by Region, Sector, and Target
19:50 - 20:00	[Solution 9] Cocoon Planting Technology for Reduced Water Consumption in Agriculture in Dry Areas in Palestine Islam Niroukh, UAWC, Palestine
20:00 - 20:10	Q&A and Discussion
20:10 - 20:15	Closing Remarks
20:15 - 20:30	Group Photo & Notification of Award Ceremony & Closing

Contents

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Invited Talk

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

The Winner of the WWCH 2020

- Senthil Kumar Sadasivam, National College, India

Invited Talk

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

- Senthil Kumar Sadasivam, National College, India

Water scarcity becomes a topic of importance worldwide due to the accelerating population leading to intensified human activities consequently affecting both water quality and quantity. The problem is exacerbated and becomes a grave concern as a direct impact of global climate change. Especially, the Indian urban water scenario is suffering from inadequate levels of service due to increase in demand-supply gap. Surface water sources failed to meet the rising demand while groundwater reserves are being tapped often to unsustainable levels. Therefore, there is clearly an urgent need for action. On the other hand, the world is warming, incomes are rising, and one result is a booming market for air conditioning.

An estimate projects that residential and commercial air conditioning worldwide consumes at least one trillion kilowatt-hours of electricity annually. Water and energy are interdependent, referred to as "water energy nexus". To extract water, we need energy and to generate the energy, we need water. Facing the twin crisis, first, India needs to seek for other sustainable, renewable, non-conventional water resources which can transform water crisis from a curse to a blessing.

The solution we have identified is, as a non-conventional and renewable resource of pure water, the moisture content in the atmosphere which is still untapped. It is obvious that an air-conditioner harvests this water from the atmosphere without having us pay for extraction. Despite the fact that AC consumes more energy, cooling systems produce water as a by-product, which can be recovered and put to good use.

From our experiments, by collecting and reusing the AC condensate water, we have saved a substantial amount of energy (free/green energy) and it has been utilized to trim down carbon emission (a substantial amount on per day basis) which resulted in the reduction of carbon footprint. Thus, besides mitigating water and energy-crisis, it also broke the amplification-loop-humidity's contribution to global warming and vice-versa.

Of course, there is no rocket science involved in this work or no new technology or no new scientific invention involved. Nonetheless, the idea of collecting AC condensate water and reusing it for drinking after appropriate treatment is an attempt to bridge the demand-supply gap which has widened to a greater extent in this decade, especially in the urban water scenario of developing countries especially in India.

Through our work, we extracted a total of 434,762 litres of water from the air via AC machines (105 tons) which in turn reduced the energy consumption of 28.984 kW/h power towards the extraction and purification of above-

said quantity of water from natural resource. Further, it has also reduced the CO2 emission by 25.216 kg CO2 kW/h. It is also estimated that the direct cost saving on the procurement/ production of the aforementioned quantum of water from conventional natural resources amounts to INR. 652,143/- (Approx 9,000 USD).

From the experience and visibility that we gained through the World Water Challenge 2020, we are now working on the conversion of the AC condensate water into Pure Distilled Water or High Pure Water for laboratory and industrial purposes. This facilitates in saving almost 70 times (70X) of natural water wasted in the conventional process of producing distilled water. Also it saves energy and cuts CO2 emissions by 10X folds when compared to that of treating AC condensate water for potable purposes.

We acknowledge DST-WTI (Govt. of India) for having funded this project and the Ministry of Environment, South Korea and Korean Water Forum for having recognized our work as the BEST SOLUTION in the WWCH 2020. The prize money received in the WWCH 2020 has supported us for in the attempts of creating a more feasible and socially impactful idea.

World Water Challenge 2021

Main Focus 1

Water and Health

Challenge 1

Scale-up of WASH for Public Health

Solution 1

ECO-MITRA: The Integrated Smart Public Washroom Solution

- Aditya Tomar, Sukriti Social Foundation, India

Solution 1

ECO-MITRA: The Integrated Smart Public Washroom Solution

- Aditya Tomar, Sukriti Social Foundation, India

Hygiene, Sanitation and Water go hand in hand with each other. Poor sanitation facilities cost India over $100 Billion USD every year and trillions to this world.
Consider a village with a field as a common defecation ground. What could go wrong?

- Feces come in contact with crops, food and humans. Bacteria and worms lead to diseases.
- Chronic illnesses prevent the body from absorbing nutrients. Malnutrition follows.
- Sick mothers give birth to children prone to sickness. Loss of human resource in economic

Do the math. Do the biology. And you end up with something terribly, terribly saddening. A tale of disease and death; but this time not from the imagination of an eccentric novelist, rather, from the lens of 1 in every 2 Indians.

If these facts didn't blow up your mind, nothing else would. Most under-privileged women in India, walk a distance which is more than 54 basketball courts or 15 football stadiums to find a place to defecate and if they are lucky, they find one but what they find, is in terrible state and many other times they have to wait for sun to go down so that they could defecate in open with least possible compromise with their dignity.

Therefore, designing a toilet which caters to these needs, upon which the solution to this bigger problem of sanitation hinges, is crucial to seeing positive results in this arena. The importance of something as small as a well-functioning toilet in the larger scheme of this challenge cannot be overstated.
Being engineers we started listing down all the problems with the conventional toilet systems and how our ideal community toilet should look like. We concluded there are three major technological challenges that we had to solve

- Maintenance problem
- uninterrupted water supply
- a system to deal with waste

Because most of the places in India or any developing country in general do not have a sewage infrastructure.
We wanted to design a toilet that can solve the sanitation crisis in the country. A toilet which will prevent trillions of $ in GDP losses to the world. A toilet that will ensure that women and girls no longer need to travel far and wide to find a place to relieve themselves.

After graduating from the college, we officially registered ourselves in the form of a not-for-profit company- SUKRITI and set on a mission to spread a million smiles by transforming sanitation and water sector through

sustainable technical interventions.

To address this problem, we went on a mission to design a toilet which

- depends very little on manual intervention for maintenance
- is automated for self-cleaning and self-maintenance
- consumes 90% less fresh water by means of innovative electronic algorithms and reuse of water
- Treats and reuses the waste on-site
- Works on renewable energy.
- Is robust enough to handle public usage

The entire solution is designed to make it self-sustainable in terms of water needs, energy requirements and maintenance to create maximum impact.

World Water Challenge 2021

Main Focus 2

Efficient Water Management

Challenge 2

Integrated Management of Diversified Water Resources

Solution 2

GreenOtter- Energy-independent, hands-free portable, ultimate WASH station

- Edouard Pevzner, ALEX DEUTSCH TECHNOLOGIES, Israel

Challenge 3

Innovating Financing for Local Water Resources

Solution 3

Solving Scarce and Contaminated Water Problems with the Village Drill and Community Funded Financing

- Mike Anderson, WHOlives, Inc., USA

Solution 2

GreenOtter- Energy-independent, hands-free portable, ultimate WASH station

- Edouard Pevzner, ALEX DEUTSCH TECHNOLOGIES, Israel

GreenOtter system (US patent-pending technology) has been specially designed for the challenging humanitarian routine and emergency domain, taking into account unsafe, hard-to-reach population' characteristics and environment.
Few specific factors, related to vulnerable groups have been considered before and during the R&D process:

- Lack of energy and logistic infrastructure.
- Increasing pollution range in local water resources, from microbiological to chemical.
- Degradation (growing salinity level) of the groundwater reservoirs.
- Low/No technical expertise.
- High population displacement level.
- Seasonal variability of available water sources.

GreenOtter is the first energy-independent, lightweight (16 kg only), hands-free portable water purification and hands disinfection station that can turn any contaminated water source on the land (including brackish water) into drinking water right away. Simply by rotating a manual handle, it can purify up to 2 liters of pure water per minute (120 liters per hour) with no need for a battery or electrical source.

Based on the ultimate Reverse Osmosis technology, it can deal with any type of water contamination (brackish water, bacteria, cysts, viruses, organic and inorganic chemicals, pesticides, herbicides...) including cases of water supply sabotage. The water purification structure of the system includes three pre-treatment stages, three Reverse Osmosis membranes, and a post-treatment stage. The system monitors water quality for the inlet and outlet.

The system's hydraulically activated, energy-independent, eco-friendly (with no disposables) hands-disinfection Ozonator add-on sterilizes ANY pollution on the user's hands. Ozone is generated from the air on-site, therefore no transportation or storage is required. It leaves no telltale taste or odor.

The system was designed to be operated and supported with locally available resources, by users with no technical skills and in any environment. The water purification components of the system were developed to be cleaned and refilled by the local population itself with locally available natural materials, ensuring sustainability and the mission. Specially developed pre-filters backwash and membranes flushing maintenance processes make GreenOtter cheap in terms of maintenance and cost-effective in the long run.

The ergonomic hands-free backpack design ensures comfortable carrying by all – men and women.
In 2020 and 2021 GreenOtter has been successfully piloted and run within the vulnerable rural communities in Angola, Nigeria, Chad and Palestinian Autonomy.
The project has also educated thousands of people on the WASH principles (especially during the COVID pandemic).

In the wake of feedback received from the fields, GreenOtter has been modified and customized to meet the vulnerable population's particular needs in conflict/disaster zones.
Due to heavy chemical contamination of the local water sources from pirate mines, the company has developed a patent-pending technology of Cyanide treatment.
Independent certified international laboratories and the Israeli National Water Company (Mekorot) tested the system's water purification capabilities on biological/chemical contamination.
In January 2020, the system has been supported by the Chief Scientist Office in the Israeli Innovation Authority.

Solution 3

Solving Scarce and Contaminated Water Problems with the Village Drill and Community Funded Financing

- Mike Anderson, WHOlives, Inc., USA

We invented and have brought to market the human powered Village Drill. The Village Drill is the most cost effective and easily operated drilling machine designed to quickly drill deep-water boreholes up to 90 plus meters in nearly all substrates. To see the drill in action, go to https://villagedrill.com/.
The development challenge we are solving is delivering clean water to rural communities, and providing a no interest loan so communities have ownership of their wells. More than 70% of rural populations in developing countries live off improved roads. They are difficult to reach.

One of the biggest challenges the world faces in developing sustainable water systems is the inability of traditional methods, such as big rig trucks, to reach remote locations where the need is usually the greatest. The Village Drill is robust, portable, and best of all is human powered. The Village Drill was intelligently designed with simplicity in mind. A powerful machine with few moving parts means that the Village Drill needs very limited maintenance and local individuals can learn and operate the machine with minimal experience. This makes the Village Drill the only viable tool that can be locally purchased that delivers deep clean water wells at a price point that is affordable by nearly every village or community.

Our innovative Village Drill was developed in 2010-2011. Since then, it has gone through 4 major upgrades to become the amazing machine we have today. To date we have delivered over 110 drills to 36 countries around the world and have drilled over 7,500 hundred boreholes with this disruptive technology. The Village Drill has been vigorously tested and has proven to be the leader in sustainable borehole drilling.
Because local ownership and self-reliance is so important to our success and solving the world's scarce and contaminated water issues, we have also developed the "Community Funded Well Program" that allows villages and communities to pay for their own wells without NGO or Government assistance.

The Community Funded Well Program works hand in glove with the Village Drill technology but is less viable with other drilling methods where the cost of a well from a large drill rig is much higher, or the well runs dry because the other systems could not reach the aquifers.
Since September 1, 2021, we have 8 Community Funded Well programs in place in Uganda and Kenya. These communities are provided a subsidy and an interest free loan to help them purchase their well. Loans are repaid each month in small amounts for a 12 month period. Continued testing this entrepreneurial model and community funded loan program is the focus of this project.

World Water Challenge 2021

Main Focus 3

Resource Recovery from Water and Wastewater System

Challenge 4

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

Solution 4

Zero Liquid Discharge Desalination with Ultralow Energy: Spontaneous 'Catch-and-Retain' Salts

- Kwon Gibum, University of Kansas, USA

Challenge 5

NEXUS for Efficient Utilization of Limited Water Resources and Energy Recovery

Solution 5

E-fields

- Ivan Pavić, Orchestra Fields, Croatia

Solution 4

Zero Liquid Discharge Desalination with Ultralow Energy: Spontaneous 'Catch-and-Retain' Salts

- Kwon Gibum, University of Kansas, USA

Herein, we propose an ambitious 'thinking out of the box' approach to fabricate a zero liquid discharge (ZLD) system that enables desalination of both high and low salinity water with very high water recovery efficiency (>90%) using ultralow energy at an inexpensive cost. The proposed idea is built upon a strong foundation of our zwitterionic gel (zwitter- means 'hybrid' in German) that can catch-and-retain the salts from feed water without needing any external interventions (patented). Upon physical compression, the gel can release desalted water in less than 1 minute and become ready for reuse. When the gel is saturated with salts, it can be readily regenerated by submerging in water with a lower pH level (e.g., pH = 2.0).

The proposed ZLD desalination system can directly tackle the challenge of 'Energy Efficiency in Sewage, Wastewater, and Sea Water Recycling and Reuse' in two ways. Firstly, our system can tremendously reduce energy consumption and lower the cost of desalination by utilizing a thermodynamically favorable desalting mechanism at ambient conditions. This is in striking contrast to the current desalination technologies (e.g., reverse osmosis (RO), forward osmosis (FO), membrane distillation (MD)) that often suffer from the need for high operating pressure or temperature. Secondly, our system can reduce the energy consumption by eliminating additional post-treatment steps to treat concentrated brines which typically consumes approximately 30-50% of the total energy of conventional desalination process. This is possible because it produces neither liquid brine nor solid disposal after the operation.

We firmly believe that the proposed desalination technology has the potential to revolutionize the desalination industry by enabling the ZLD systems more economically viable and technically feasible. Ultimately, it can change the landscape of the ZLD desalination technologies by providing new design principles for the operation and materials.

Solution 5

E-fields

- Ivan Pavić, Orchestra Fields, Croatia

Our solution, e-fields, is electrified, rail-based, automated, unmanned, metered, connected, optimized, sustainably powered and power grid responsive agriculture crop field. It aims to decarbonize and digitalize irrigation and cultivation making agriculture water and energy efficient and profitable for small family farmers. It makes agriculture attractive to younger generations thus fostering repopulation and generational renewal of rural areas.

The approach is multidisciplinary as it consists of advanced precise irrigation and cultivation technique, renewable solar generation simultaneous with agriculture land use, rain harvesting and groundwater pumping, water and energy storage, extreme weather protection, water and energy production for community use etc.

The main investment part is to build the appropriate mechanical, pipeline, electrical and ICT infrastructure on the crop field. The first gain when installing our solution is that all the subsystems are using the same infrastructure and therefore share the investment cost. The same mechanical structure is used to hold lateral railways, solar panels, piping, electrical and ICT cables, and other equipment.

The second gain is that all the subsystems are subjected to the same optimization function maximizing the total benefit. Based on the weather, soil, crops, equipment current measurements and future predictions the system sets the optimal PV angles (different for electricity production, for rain harvesting, crop shading and shielding), agricultural equipment schedules (e-tractor, e-irrigator), pumping schedules, electricity and water grid injections. The solution is modular and can be tailored for specific needs of each farmer or community.

The primary beneficiaries are the small farmers in developing rural areas such as sub-Saharan Africa where there is an abundance of solar radiation, variable rainfall and extreme weather conditions. Of course, there are no restrictions to install and operate the e-fields in any other region in the world.
The proposed solution primarily impacts small farmers as it eases their daily operation, cuts the costs, provides irrigation and protection, increases crop yield, however it all boils down to the increase of the profitability of their business.

With e-fields, the local community gets more financially secured habitants, but it also gets new sources of electricity and water. Globally the proposed solution mitigates issues such as water and food scarcity, greenhouse gas emission, underdeveloped electrical grid, insufficient arable land, low farmer returns.

World Water Challenge 2021

Main Focus 4

Water and Natural Disasters

Challenge 6

Flood Prevention and Management for Sustainable Water Cycle and Urban Regeneration

Solution 6

SLAMDAM: Water-Filled Flood Barrier

- Omar Saleh, Zephyr Consulting, Netherlands

Solution 7

Piloting Innovative Flash Flood Early Warning System in Mountainous Regions of China

- Xiaolei Zhang, China Institute of Water Resources and Hydropower Research, China

Challenge 7

The Depletion and Pollution of Water Caused by Climate Change

Solution 8

Transforming lives and drylands with sand dams and clean water

- Dwain Lucktung, Excellent Development, UK

Solution 6

SLAMDAM: Water-Filled Flood Barrier

- Omar Saleh, Zephyr Consulting, Netherlands

Flood problems

The IPCC report of 2021[1] states that earth is getting a warmer climate leading to intensified and more frequent flooding. Costs of flooding continue to rise dramatically worldwide. An article by the World Resources Institute (WRI)[2] anticipates the following impacts:

- By 2030, 15 million people and $177 billion in urban property will be impacted annually by coastal flooding and 132 million people and $535 billion in urban property due to riverine flooding.
- The number of people exposed to riverine flood risk is expected to more than double globally by 2030 from 65 million to 132 million people — and to triple by 2050.
- Betsy Otto, Director of WRI's Global Water Program, states that: "Floods are a threat multiplier that could worsen the public health and economic impacts we're seeing from COVID-19".

Floods tend to discriminate along generational and gender lines and other elements of discrimination such as race and poverty. Furthermore, flooding hinders countries in achieving their Sustainable Development Goals (SDGs).

Almost all countries are insufficiently resilient to floods, this is caused by:

- A lack of governmental finance and institutional capacity.
- A limited availability of and access to adequate flood related data.
- Inadequate spatial planning.
- A lack of effective flood resilient measures.

Flood Preventive Solution called SLAMDAM

The SLAMDAM-technology is an innovative and low-cost technological solution to enhance resilience against floods. SLAMDAM is a mobile emergency water-filled barrier, which can be deployed easily as soon as there is a threat of flooding.

SLAMDAM's unique construction and materials ensure an exceptionally flexible solution for the emergency dam/water retention market. The product is made out of EPDM, which is a synthetic rubber with unique properties

1) Source: IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

2) Source: https://www.wri.org/news/release-new-data-shows-millions-people-trillions-property-risk-flooding-infrastructure

in heat, ozone and weather resistance. This allows for the product to be used for 70+ years as an effective flood defense system.
SLAMDAM is designed in such manner that the surface contact area is maximized, resulting in maximum friction force with the ground surface. The unique concave shape of the SLAMDAM secures stability and reliability. The concave shape and the maximum friction force ensure that the SLAMDAM will 'stay' on its place and is therefore robust and reliable.

SLAMDAM contributes to sustainable development by:

- Decreasing gender inequality as well as inequality of other vulnerable groups. Vulnerable groups are disproportionally impacted by flooding and SLAMDAM protects them from such events.
- Improving access to healthcare and education by effectively safeguarding people, facilities and critical infrastructure from floods.
- Decreasing hunger and improve economy by effectively protecting businesses, agriculture and livestock from floods. It can also be used to store water to be repurposed for it to be used as drinking water or for agricultural land.

Solution 7

Piloting Innovative Flash Flood Early Warning System in Mountainous Regions of China

- Xiaolei Zhang, China Institute of Water Resources and Hydropower Research, China

Global climate change has great impact on runoff, triggering more frequent water-related extreme events in recent years. Flash floods, typically occurring in mountainous areas, causes approximately 70% of total global mortality. The sudden onset of intense storms account for many of these casualties. Managing this problem is difficult because systematic monitoring network for local and short-duration intense precipitation are lacking, warning times are shorter, populations are more dispersed, and information delivery are more difficult and expensive.

To mitigate flash flood disasters, the Chinese government has invested about 5416.8 million dollars to implement national flash flood disaster prevention projects from 2010. Initially, non-structural measure systems were established including strengthening the monitoring and early warning system and enhancing the preparedness and emergency response capacity, especially at county level. Remarkable disaster prevention benefits have been achieved, especially in reducing casualties. However, it has also been realized that current flash flood disaster management capabilities in China are still incompatible with its socio-economic development level and there is an urgent need for local residents to improve their living and production conditions. The established monitoring and early warning systems need to be continuously improved.

The main objectives and tasks of the solution are to develop innovative technologies in flash flood monitoring and early warning system as well as community-based systems in flood risk management in mountainous river basins in China in order to improve the coverage, accuracy and timeliness of flash flood early warning messages and to enhance the emergency response capacities of local communities, including:

(i) public awareness and knowledge about flash flood risk;

(ii) monitoring and data acquisition;

(iii) forecasting and warning;

(iv) information dissemination and communication;

(v) community-based local response capacity toward disaster evacuating;

(vi) local flash flood disaster resilience and (vii) sustainability of whole early warning system and community-based flash flood disaster prevention ability.

In this solution, aiming at the accurate warning of flash flood disaster and the construction of grass-roots capacity system, the innovative technologies of flash flood disaster monitoring and early warning could strike a balance among sustainability in technology, economy, policy and law, which can realize the harmonious development of human-water-ecology and maintain the sustainable operation of the whole ecosystem.
The popularization and application will help to improve the flood risk management and enhance emergency response capacities in riverine villages along the Yangtze River Economic Belt (YREB) and other regions in the world.

Solution 8

Transforming lives and drylands with sand dams and clean water

- Dwain Lucktung, Excellent Development, UK

Since 2002, Excellent Development has supported rural dryland communities to build over 1,000 rainwater harvesting sand dams; enabling over 1 million people to access clean water for life. These projects (usually coupled with climate-smart agriculture training) give communities the kick-start to work their way out of poverty and transform their lives and land.

The challenge:

Drylands are arid regions covering 40% of the world's land surface, supporting 50% of the world's livestock, accounting for over half of all farmland, and are major wildlife habitats. However, whilst important and vast, drylands are also tough places to live, with water and food scarcity an everyday issue for millions of people.

Drylands support 74% of the world's poor; most living in rural areas. Here, the search for water traps millions of people in water poverty. Women and children (who typically carry the responsibility) can spend 6-12 hours each day trailing across parched scrubland to collect water, often from dirty, unsafe sources. During drought periods, the journey takes even longer.

Rainfall in drylands is erratic and, when it does rain, downpours run off bone-dry land, disappearing into oceans, taking valuable fertile soil with it. In addition, environmental degradation and deforestation is being exacerbated by climate change, with estimations that this could lead to a reduction of global food production by up to 12% (resulting in world food prices increasing) over the next 25 years.

According to a 2019 Intergovernmental Panel on Climate Change report, "soil erosion is a major form of desertification occurring in dryland areas across the world, with negative effects on dryland ecosystems." The report also highlighted numerous soil conservation measures that can help reduce soil erosion, including soil management, reforestation activities, erosion control measures, and improved irrigation techniques (all methods that Excellent implement with partners).

The UN predicts that by 2025, 1.8 billion people will be living in regions with absolute water scarcity, and two-thirds of the world's population could be under stress conditions. As the world's population swells to over 7 billion, so does the pressure on dryland resources; and conflicts over already limited natural resources (including water) will only intensify.
Excellent Development works with in-country partners in dryland countries to support vulnerable communities to

implement sustainable water and food solutions suited to their environment.

This usually involves climate-smart agricultural training alongside the construction of sand dams - reinforced concrete walls built across seasonal riverbeds. During rainy seasons, rainwater is captured and stored within sand (that builds up behind the sand dam wall), protecting the water from evaporation and contamination: https://www.excellentdevelopment.com/what-is-a-sand-dam

Sand dams can store up to 40 million litres of water, naturally replenishing every rainy season. The water meets WHO standards for drinking water, and is easily extractable via pipework connected to hand-pumps and taps, with one sand dam providing enough year-round water for over 1,000 people.

Sand dams enable dryland communities to overcome water shortages and adapt to climate change by ensuring year-round water, even during droughts, and restoring degraded lands through raising the water table.

World Water Challenge 2021

Main Focus 5

Smart Water Technologies

Challenge 8

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

Solution 9

Cocoon Planting Technology for Reduced Water Consumption in Agriculture in Dry Areas in Palestine

- Islam Niroukh, UAWC, Palestine

Solution 9

Cocoon Planting Technology for Reduced Water Consumption in Agriculture in Dry Areas in Palestine

- Islam Niroukh, UAWC, Palestine

Problem and solution

Environmental degradation is one of the "greatest environmental challenges of our time," according to the United Nations. Often caused by human industry and agriculture, environmental degradation is when lush land turns to desert. A total of 2 billion hectares of the earth's land is degraded, which is an area larger than all of South America. The most straightforward solution to degraded land is reforestation, but when soil is dry and crusty, the survival rate for seedlings is dismal.

The water crisis in Palestine is caused not only by the area's aridity and current agricultural practices. A difficult situation has been made worse by Israeli occupation policies and practices, which prevent Palestinians from controlling their own water resources. Palestinian water demand in the West Bank and Gaza Strip has been increasing steadily over recent decades. However, Palestinians have been unable to maintain existing water resources or develop new ones, due to Israeli restrictions on Palestinian access and control of water infrastructure in the West Bank.

Palestine suffers from severe water shortages due to the Israeli occupation and restrictions on natural water resources, as well as high aridity and limited rainfall in several parts of the country. Agriculture is the largest consumer of water, accounting for more than 62 per cent of total use. The amount of water currently used for irrigation is about 141 million cubic metres per year (MCM/yr) to irrigate around 200,000 dunam (1 dunam is about 0.1 hectare), of which 55MCM/yr is used in the West Bank and 86MCM/yr in the Gaza Strip.

In this context, the agricultural use of the COCOON technology in Palestine is very applicable. The Cocoon technology is sustainable, scalable and low-cost solution for growing trees and seedlings in dry and degraded soils without irrigation.

In addition, the one-off irrigation of seedlings makes the technology valuable to Palestinian farmers who do not have regular access to their land due to Israeli restrictions (for example, land located behind the separation wall).

The Cocoon is designed to support a seedling through its critical first year. By providing water and shelter while stimulating the seedling to produce a healthy and deep root structure, tapping into the sub-surface water supply. The result is independent, healthy trees not reliant on external irrigation that can survive in harsh conditions. This

simple invention contributes to:

1. Protects seedlings from harsh arid climates
2. Reduces the amount of water plants need to thrive–and boosts their survival rate by as much as 80%.
3. Needs 25 liters of water only at planting.
- 100% biodegradable practices.

Union of Agricultural Work committees - UAWC through this project, will pilot the cocoon technology in 2 communities, contributing to enforcing the Palestinian's sovereignty on their land and adapting with the challenges of climatic change by implementing appropriate agricultural techniques for Palestinian reality. UAWC will contribute with 50 Cocoons for 50 famers living in conflict affected and arid areas in Palestine.

MEMO

2021 World Water Challenge