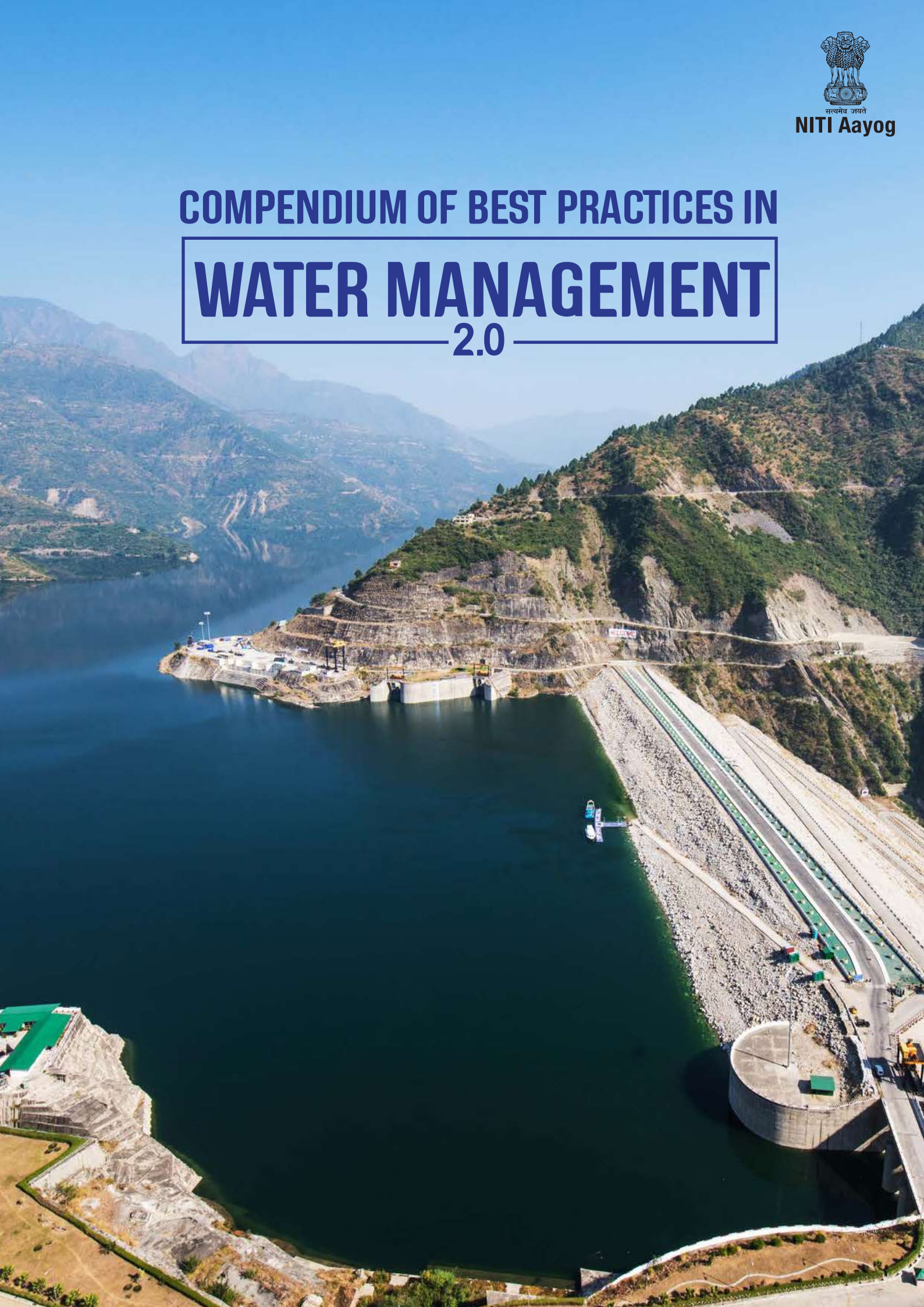
सत्यमेव जयते
NITI Aayog

COMPENDIUM OF BEST PRACTICES IN

WATER MANAGEMENT 2.0



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SEPTEMBER 2021

COMPENDIUM OF BEST PRACTICES IN WATER MANAGEMENT - 2.0

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3rd August, 2021

MESSAGE

Water and its sustainable management are of immense importance in all walks of human life and have substantial reliance on the existence and sustenance of life on earth. As it is evident, water is the pivotal resource for all kinds of development activities and also plays vital role in health, food security and livelihood. Accelerated pace of consumerism coupled with climate change have adversely impacted the water sector leading to drying up and contamination of fresh water sources.

In India, the annual available water after evapotranspiration is 1999 Billion Cubic Metres (BCM), out of which the utilizable water potential of the country is estimated to be 1122 BCM. We are the largest groundwater user in the world, with an estimated usage of around 251 BCM per year, more than a quarter of the global total. With more than 60% of irrigated agriculture and 85% of drinking water supplies dependent on it, groundwater is a vital resource for rural areas in India. Reliance of urban and industrial water supplies on groundwater is also becoming increasingly significant.

Access to clean and safe drinking water forms the integral part of right to life enshrined in the Constitution and the Government of India is committed to provide functional household tap connection to every household by 2024 under Jal Jeevan Mission. This is also a part of the Sustainable Development Goal-6, ensuring access to water and sanitation for all. Nevertheless, there is an acute stress on freshwater availability as it is projected that the per capita water availability will dip to around 1400 cum in 2025 and further down to 1250 cum by 2050.

Water management is the way out to facilitate the multifaceted development of the country and to ensure the wellbeing of its citizens. However, this responsibility needs to be shared between the states, NGOs, civil society organizations and citizens. Through this compendium, NITI Aayog endeavours to acknowledge all unique and ingenious efforts which could combat water scarcity and boost water management successfully.

I hope the best practices depicted in this compendium encourage everyone to think innovatively towards sustainable water management practices in India.

(Rajiv Kumar)

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एक कदम स्वच्छता की ओर

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MESSAGE

Significance of water for existence of all sort of life is well known and its judicious management is the key to sustainable future. India has a very rich and long experience of treating water as a valuable resource, and its conservation and management were always placed at a higher pedestal. Harnessing of water for agriculture and irrigation helped India to overcome famine, food scarcity and widespread hunger of 1960s and turned the country from severe food shortage to a food surplus nation. Sadly, the use of water became indiscriminate and gradually turned to over-exploitation due to excessive use and unsustainable practices. As a result, water is getting over-exploited and the stress on water resources is rising. There is a common belief in the society that water is an absolutely free and never-ending resource and its management is the responsibility of State, but the fact is, water is a limited public good and its conservation is best done with the active involvement of all stakeholders.

There are good number of success stories of water conservation and efficient water management from different parts of the country and most of them are replicable and can be easily upscaled. The challenging task of fighting water scarcity and promoting sustainable use of water was taken up by groups of citizens, civil society organisations, urban and rural local bodies, NGOs and private entrepreneurs. The transformational impacts of such initiatives are tremendous at local levels because of the active involvement of beneficiaries throughout the phases of planning, implementation and operation & maintenance. Moreover, the activities are customized to suit the local needs taking into account all geographic, social and economic peculiarities.

Through this exercise of compiling the best practices, NITI Aayog intends to serve the objective of maintaining repository of research on good governance and best practices in sustainable and equitable development as well as help their dissemination to stakeholders. I am optimistic that the compendium will emerge as a reference source to the policy makers, decision makers and many more who aspire to contribute towards water conservation efforts for the well-being of the nation.

August 19, 2021

(Ramesh Chand)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

अमिताभ कांत
Amitabh Kant
मुख्य कार्यकारी अधिकारी
Chief Executive Officer

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Preface

Promoting and disembarking sustainable economic growth is paramount in India's transition towards five Trillion dollar economy. Water is one such vital resource in this endeavour. As per the UN report on Water and Jobs, it has been estimated that half of the world's workforce i.e., about 1.5 billion people are dependent and employed in one of the eight water and natural resources dependent industries. Yet, the world is suffering from the water crisis, and millions of lives and livelihoods are under threat. Moreover, this situation has also been aggravated by changing climatic trends, frequent natural disasters and sudden quake of pandemics. The Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC) while assessing hydrological impacts of climate change also projected that global warming can have huge implications on water resources.

This calls for urgent and comprehensive water management approach to conserve and use every drop of water through pro-active engagement of all stakeholders. Through the stalwart missions of Jal Jeevan Mission, Swachh Bharat Abhiyaan etc. India has strived to augment the infrastructure for piped water supply while strengthening solid and liquid waste management systems. States, NGOs, and civil society organizations have undertaken several unique efforts that are worth sharing and replicating in the rest of the nation.

The Compendium of Best Practices is an exceptional collection of various unique and effective strategies applied in water management across different geographies in the country. Most of these areas were highly water scarce and belongs to economically weaker strata of the society. The compendium comprises of success stories from versatile fields such as Groundwater Management, Watershed Management, Climate Change impact mitigation, Agriculture etc. Since we are witnessing erratic rainfall pattern and heavy downpours these days, and expecting this trend to be continued or even worsened, it is highly essential to go for water conservation practices suitable to the local conditions.

Through this compendium, NITI Aayog has tried to bring the best practices to the fore which shall serve as an inspiration and guide for those who aspire to conserve water for better future.

(Amitabh Kant)

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Foreword

National vision of development and self-reliance is invariably associated with water security of the country and its realization is only possible through the active engagement of all stakeholders. Further, the importance of conserving and managing water accentuates rapidly on account of the persistent issues of resource scarcity, climate change impacts and adverse anthropogenic factors. Through the "Compendium of Best Practices in Water Management 2.0", NITI Aayog seeks to disseminate best practices in the area of water conservation and management. The first edition of the compendium was published in 2018 and was well received. The second edition discusses groundwater conservation, increasing water-use efficiency, flood management, climate change control and technological advancement in the water sector.

Crucial to this exercise was the contribution of a number of people. I would like to acknowledge the continuous support and guidance provided by Dr. Rajiv Kumar, Hon'ble Vice Chairman, NITI Aayog, Prof. Ramesh Chand, Hon'ble Member, NITI Aayog and Mr. Amitabh Kant, CEO, NITI Aayog.

I would also like to acknowledge the efforts of Dr. Fawzia Tarannum, Assistant Professor, TERI School of Advanced Studies and her team in preparing this report.

I appreciate the efforts put in by Mr. Arunlal K., Associate; Dr. Namrata Singh Panwar, Consultant; Ms. Aakanksha Sharma, Ms. Arunima Chandra and Ms. Priyanka Anand, Young Professionals working under Water & Land Resources vertical of NITI Aayog in coordinating with various states, NGOs, and civil society organizations for compiling and designing this document.

Equally noteworthy is the commendable job done by various state governments, NGOs, and civil society organizations in innovating such practices and sharing it with us for further dissemination.

Management and conservation of water are our combined responsibilities. In the spirit of cooperative and competitive federalism, which are main pillars of NITI Aayog, we will keep on encouraging states and other organizations in endeavor that result in the overall development of the nation.

19th Aug 2021

(Avinash Mishra)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

EXECUTIVE SUMMARY

Increasing urbanization and changing climatic trends exert immense pressure on water resources. In a country where 51% of rural households do not have access to individual piped water and about a billion people live with water scarcity for at least one part of the year, water management plays an undisputedly critical role. In addition to this, water—being a multifaceted resource and supplied by various sources for different purposes—needs to be managed at different levels of consumption by different stakeholders.

Several individuals, organizations and government departments have come up with successful water management solutions. Giving due importance to such innovations and successful practices on the field, NITI Aayog, as an yearly exercise, collects and lists down some water conservation and management practices that can be replicated in other regions. The current edition of the compendium lists out best practices on the following themes: agriculture; groundwater management; watershed development; water infrastructure; and climate risk and resilience.

The compendium gives prime importance to the role of the community in water management. Considering the bottom-up approach of planning, it encourages states and non-profit organizations to highlight the practices of participatory governance. Water management has always been seen as part and parcel of the rural community in the country. Therefore, prominence of renovation and rejuvenation of the traditional water bodies can also be witnessed in the document.

Furthermore, water conservation has the potential to support and enhance livelihoods. Construction of water conservation structures not only creates jobs in rural areas but also enhances the natural resource base to support the prime livelihood option of a community. The compendium tries to capture this complex relationship between water and livelihood patterns.

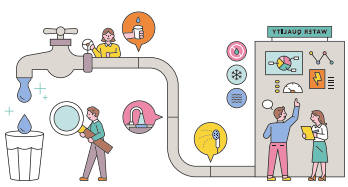
Finally, the integration of technology with water management is the need of the hour.

CONTENTS

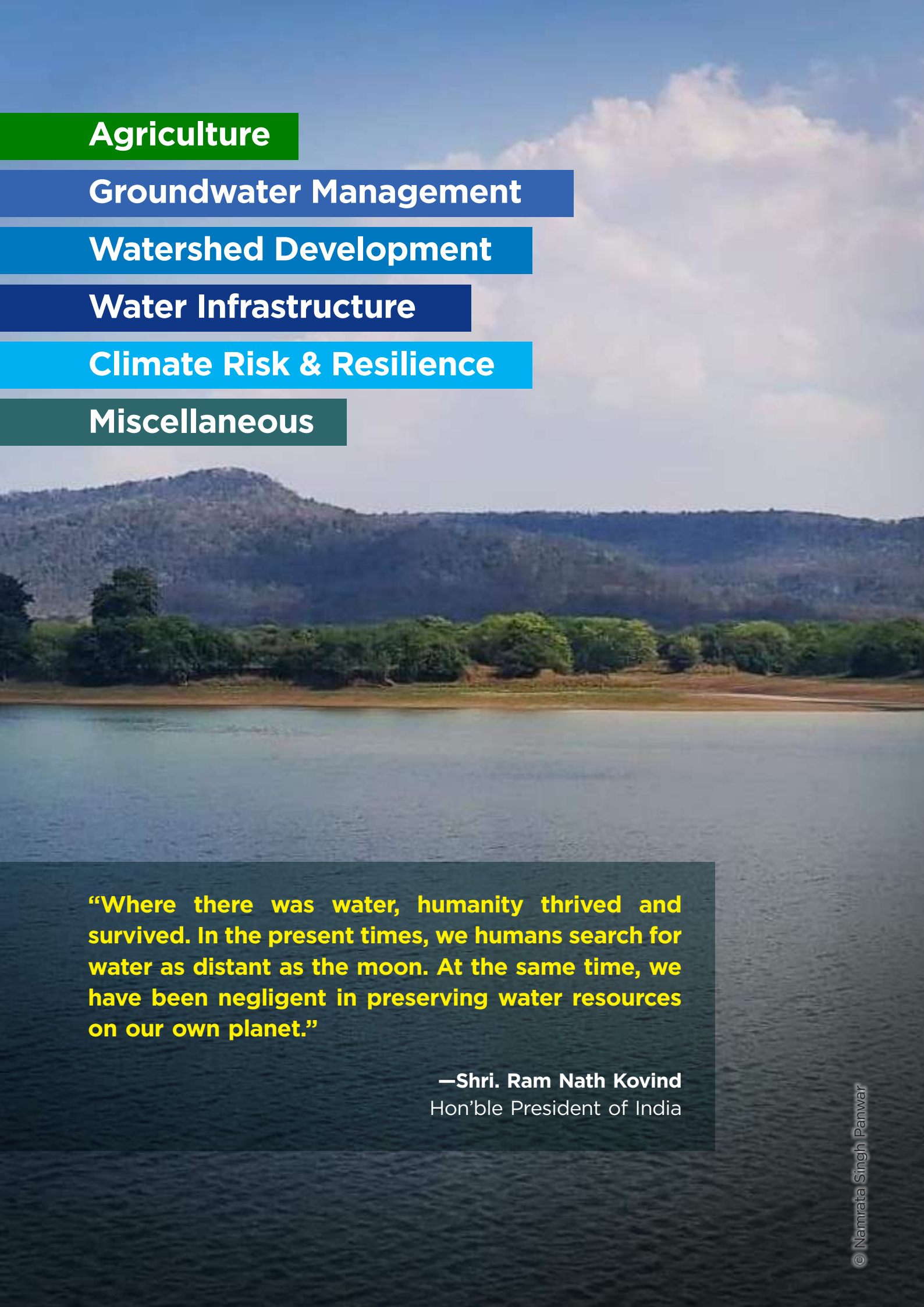
LIST OF ABBREVIATIONS

CFW	Cash for Work
WUA	Water User Association
GDGS	Gaalmukt Dharan and Gaalyukt Shivar
CSR	Corporate Social Responsibility
CEC	Centre for Environmental Concerns
SWAR	System of Water for Agriculture Rejuvenation
NGO	Non-Governmental Organization
PRADAN	Professional Assistance for Development Action
SST	Srinivasan Service Trust
CRP	Community Resource Person
HSM	Hub and Spoke Model
ADP	Area Development Programme
WMC	Water Management Committee
BPL	Below Poverty Line
INRM	Integrated Natural Resource Management
CSO	Civil Society Organization
GIS	Geographic Information System
LDPE	Low-density polyethylene
HDPE	High-density polyethylene
WTP	Water Treatment Plants

STP	Sewage Treatment Plants
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solids
PPM	Parts Per Million
MCM	Million Cubic Metre
DTP	Dibrugarh Town Protection
FREMAA	Flood and River Erosion Management Agency of Assam
SSD	Sub Surface Dam
TMC	Thousand Million Cubic
ID	Irrigable Dry
ERP	Enterprise Resource Planning
PLC	Programmable Logic Controller
RWA	Resident Welfare Associations
OAP	Old Age Pensioner
NTFP	Non Timber Forest Produce
MDM	Mid-day Meal
APWRIMS	Andhra Pradesh Water Resources Information and Management System
LI	Lift Irrigation
MWRRA	Maharashtra Water Resources Regulatory Authority
VDC	Village Development Committee
SHG	Self Help Group
SRI	System of Rice Intensification
SSA	Samagra Shiksha Abhiyan
CRP	Community Resource Person
NABARD	National Bank for Agriculture and Rural Development
IDE	International Development Enterprise
ACWADAM	Advanced Center for Water Resources Development and Management
SST	Srinivasan Service Trust
PGWM	Participatory Groundwater Management
CHIRAG	Central Himalayan Rural Action Group



O&M	Operation and Maintenance
SCI	System of Crop Intensification
PSI	People's Science Institute
NREGS	National Rural Employment Guarantee Scheme
WASSAN	Watershed Support Services and Activities Network
WET	Water Entitlement Transfer
WRC	Wastewater Reuse Certificates
IOT	Internet of Things
RWH	Rain water harvesting
ITI	Industrial Training Institutes


Agriculture
Groundwater Management
Watershed Development
Water Infrastructure
Climate Risk & Resilience
Miscellaneous
"Where there was water, humanity thrived and survived. In the present times, we humans search for water as distant as the moon. At the same time, we have been negligent in preserving water resources on our own planet."
—Shri. Ram Nath Kovind
Hon'ble President of India
© Namrata Singh Panwar

AGRICULTURE

1. Vidarbha Farmers Livelihood Project – World Vision India
2. Participatory Irrigation Management in Uttar Pradesh – Tarapur Alpika Committee
3. Drought Proofing in Maharashtra – Soil and Water Conservation Department, Government of Maharashtra
4. Low-Cost Irrigation in Andhra Pradesh – Centre for Environment Concerns
5. Irrigation Support and Farm Ponds - PRADAN

VIDARBHA FARMERS LIVELIHOOD PROJECT

Place of Implementation: Yavatmal District, Vidarbha Region, Maharashtra

Agency: World Vision India

Year of Implementation: 2007

Background

Initially started in five villages, 10 more were added to the project in 2009 following its success. The Yavatmal block holds the dubious record of the maximum number of farmers' suicides in India. The main reason was rising indebtedness among farmers. With the interventions taken under the watershed management project between 2007 and 2016 helped farmers to have alternate livelihood options while strengthening agriculture.

Objectives

Sustaining farmers' livelihoods through integrated watershed management and conservation of natural resources.

Interventions

The following activities were performed in the three phases:

- Cash for work through implementation of soil and water conservation.
- Support for irrigation, agricultural inputs, and intercultural operations.
- Income-generating activities and capacity building of the community.
- Infrastructural support in schools and for educational and vocational trainings.
- Distribution of seeds.
- Deepening of wells and farm ponds, distribution of horticultural plants, smokeless stoves, and the construction of toilets.

Outcomes

- Many farmers are now practising soil and moisture conservation in the operational villages.
- With the rise of rainwater harvesting on farmlands to enhance the groundwater table, farmers now have access to improved irrigation facilities. Women Self-Help Group (SHG) members have been empowered through sensitization, exposure and trainings.
- Increase in surface water (stream) flow and soil water retention.
- Improved productivity.
- Change in asset base and living conditions.
- Change in outflow of produce from watershed villages.

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Sunken Pond

Gabion Structure

Nala Diversion

PARTICIPATORY IRRIGATION MANAGEMENT IN UTTAR PRADESH

© Tarapur Alpika Samiti

Place of Implementation: Tarapur, Amethi, Uttar Pradesh

Agency: Tarapur Alpika Committee (Water User Association [WUA])

Year of Implementation: 2009

Background

Post the enforcement of the Uttar Pradesh Participatory Irrigation Management Act, 2009, WUAs started managing the irrigation of agricultural fields.

Objective

To produce more crop per drop using judicious water irrigation practices.

Interventions

- Discussion with farmers, by the WUA, led to a gradual reduction of malpractices such as illegal water-lifting and canal formation.
- Monetary contributions by farmers for silt removal from canals.
- Under MGNREGA, widening of service roads along canals was done.
- In collaboration with the Uttar Pradesh groundwater department, canals were created to improve irrigation

Outcomes

- Irrigation area increased from 123 ha in 2011 to 386 ha to date.
- The problem of tail feeding was solved through water provision.
- Silt removal, canal cutting and cleaning resulted in improved water provision.
- Reduction of malpractices of illicit irrigation, water-lifting and canal formation.
- Sale of silt is a revenue-generation avenue.

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DROUGHT PROOFING IN MAHARASHTRA

Place of Implementation: Maharashtra

Agency: Soil and Water Conservation Department, Government of Maharashtra

Year of Implementation: 2017

Background

Maharashtra has the greatest number of dams and waterbodies in India. However, every year many villages in the state are hit by drought—with varied levels of severity—due to an insufficient and irregular rainfall pattern and poor rainwater harvesting of waterbodies due to silt deposit. Removal of silt, from these waterbodies, helps in restoring the water storage capacity and improves the percolation potential, which in turn recharges groundwater. Also, the silt removed from these waterbodies can be used to improve soil fertility.

Objectives

The Government of Maharashtra rolled out the "Gaalmukt Dharan and Gaalyukt Shivar" (GDGS) scheme, under which waterbodies were de-silted using excavating machines. The resultant silt was given to farmers free of cost.

Interventions

- Farmers can cart the silt from the waterbodies to their respective farms at their own expense. The government pays for the fuel required for running the excavating machines.
- The excavating equipment can be hired through community contribution or through sources such as CSR and philanthropic funding.
- GDGS leverages about 10–15% of the total project cost through government support (for fuel supply); another 10–15% through philanthropic funding sources; and the remaining 70–80% is borne by the farmers to cart away the silt.

Outcomes

- So far, 5270 waterbodies have been de-silted, resulting in the excavation of about 32.3 million m3 of silt.
- This has benefitted more than 4,600 villages and over 6.5 million villagers.
- Removal of silt has increased the water-storage capacity of waterbodies to the tune of about 32,300 thousand m3, which is equivalent to the supply of about 3.2 million water tankers. The excavated silt has been spread across more than 54,000 acres of farmland.
- This has helped increase farm productivity by two to four times, which has further resulted in improvement in agricultural incomes by 50% to 100%. The scheme has actively helped in making villages drought-resilient.

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LOW COST IRRIGATION IN ANDHRA PRADESH

Place of Implementation: Anantpur District, Andhra Pradesh

Agency: Centre for Environment Concerns (CEC)

Year of Implementation: 2011

Background

Anantpur district is one of the driest regions of Andhra Pradesh. With lack of water harvesting and irrigation facilities, the region was considered as 'desert' in the region.

Objective

Produce more crop per drop using judicious water irrigation practices.

Intervention

- A unique sub-surface, plant-root-zone-measured moisture system called System of Water for Agriculture Rejuvenation (SWAR) was introduced. SWAR shifts irrigation from the surface to measure the moisture at the plant root zone. The root zone also serves as an ecosystem to foster microorganisms, besides rationing plant water requirements.
- The system involves storing water in overhead tanks and sending it through a small diameter pipe to a customized locally made clay pot, which is buried near the root area. The clay pot contains micro-tubes that transmit water through a sand pouch, to prevent the roots from invading the pipes and the pot. The slow oozing out of water provides moisture for a prolonged period, the level of which is calculated based on the soil type, plant species and their age.

Outcomes

- Compared to drip irrigation, SWAR uses only one third of the water, with zero wastage. The irrigation architecture and its wide capillary spread suits low rainfall and low water availability and heat-wave-prone areas. The system is also suitable for massive tree plantation programmes.
- In 2015, this technique was also used to grow vegetables and flowers. This produced immediate results in terms of both soil and plant health and farmers' incomes. For vegetables and fruits, where close planting was done, it was discovered that one eighth of the water suffices, compared to drip irrigation.
- In 2017, SWAR was piloted under the Ministry of Rural Development and GIZ Environmental Benefit Project in MGNREGS, Andhra Pradesh. It was successfully scaled up in 2018 with the involvement of government agencies, institutions, NGOs, and farmers.

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Measuring moisture to plan irrigation schedule

IRRIGATION SUPPORT AND FARM PONDS

Place of Implementation:
Bhanupratappur Block, Uttar Bastar Kanker District

Agency: Gram panchayat, with facilitation by Professional Assistance for Development Action (PRADAN)

Year of Implementation: 2018

Background
South Chhattisgarh, including Uttar Bastar Kanker district, is plagued with low water availability and uncertain rainfall, which results in low agricultural productivity. Climatic variability disproportionately affects smallholder farmers and makes their livelihoods even more unpredictable. In this respect, water conservation and land development projects, along with the creation of small water harvesting structures, proved to be a boon.

Objectives
- The major objective was to make gram panchayats water sufficient and poverty-free while increasing the water-harvesting capacity of the village.
- Ensuring participatory planning and educating women on watershed management.

Interventions
Involvement and active participation of village organizations and SHG members.
- Training and exposure visits.
- Livelihood-focused planning and preparation of resource and social maps.
- Linking communities with government schemes

Outcomes
- Farm ponds were made deeper than usual to conserve more rainwater and to ensure its availability for a longer duration.
- Changes in cropping pattern led to increased incomes.
- Higher yield and improved production of paddy.
- Emergence of fishery as a new livelihood activity, due to availability of sufficient water in farm ponds.
- Better yield in the lowlands due to water storage and seepage.
- Increased confidence of community members on farm ponds for irrigation
- Vegetable farming using trellis proved profitable and many farmers now plan to grow more vegetables using water stored in the farm ponds.

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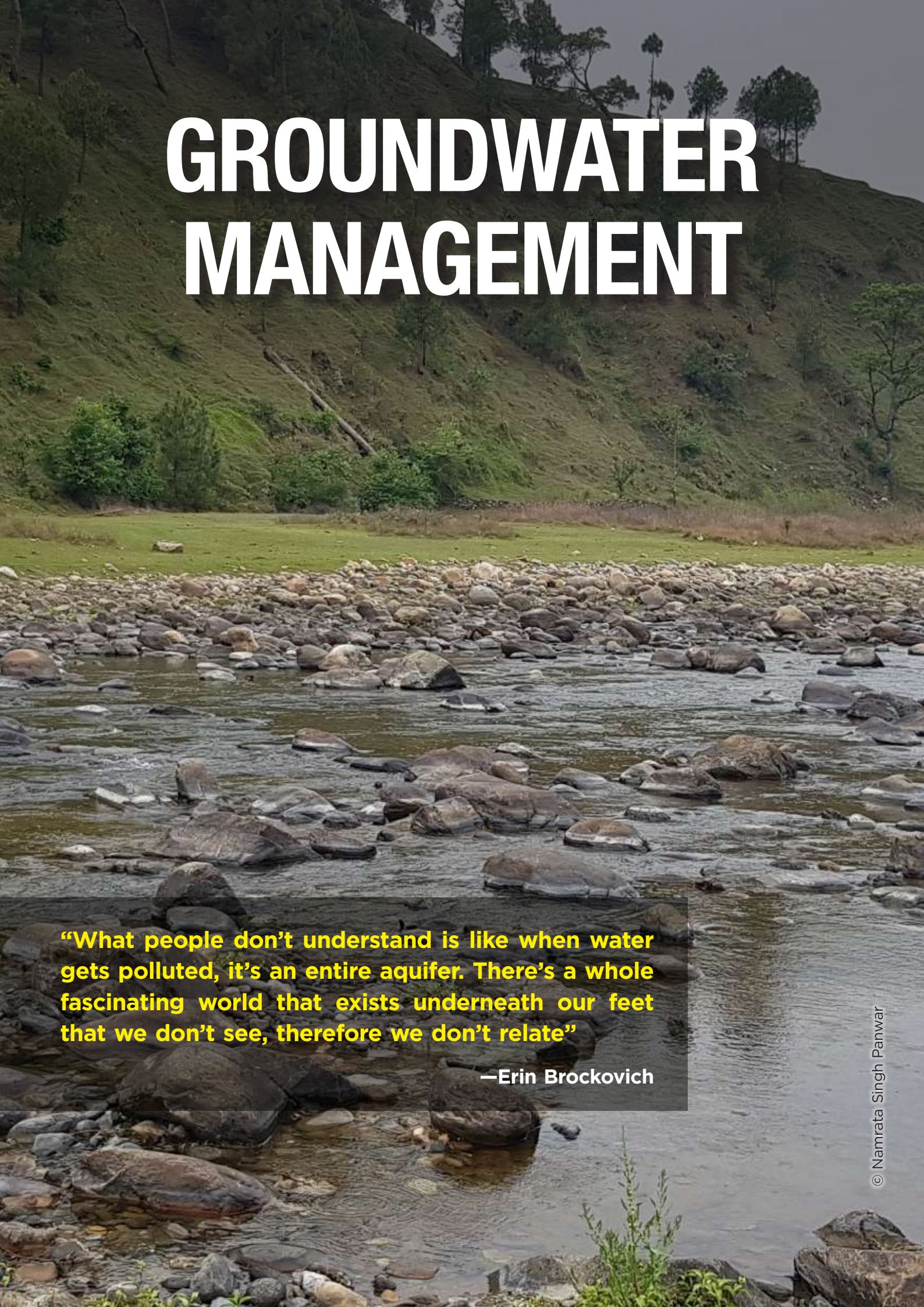
Community members participating in meeting

GROUNDWATER MANAGEMENT



"What people don't understand is like when water gets polluted, it's an entire aquifer. There's a whole fascinating world that exists underneath our feet that we don't see, therefore we don't relate"

—Erin Brockovich

1. Aquifer Based Groundwater Management – *ACWADAM, SST and Arghyam*
2. Community led Springshed Management – *CHIRAG, ACWADAM and Arghyam*
3. Participatory Springshed Management – *PSI, ACWADAM, Arghyam*
4. Water Security and Participatory Groundwater Management – *Samerth, Arghyam*
5. Springs Wetlands and Groundwater Connect in the Nilgiris – *Keystone Foundation*
6. Adaptation to Climate Change through Participatory Springshed Development – *PSI and Department of Land Resources, Nagaland*
7. Bore-Well Pooling by Farmers to Address Water Security – *WASSAN, Arghyam*

AQUIFER BASED GROUNDWATER MANAGEMENT

Place of Implementation: Gadakwadi Village, Khed Tehsil, Pune District, Maharashtra

Agency: Advanced Centre for Water Resources Development and Management (ACWADAM), Srinivasan Service Trust (SST) and Arghyam Trust

Year of Implementation: 2015–16

Background

Gadakwadi village faces severe water crisis in the summers, rendering agriculture unviable and forcing people to migrate in search of work. The people of Gadakwadi embarked on a participatory groundwater management journey with the Advanced Centre for Water Resources Development and Management, and Srinivasan Service Trust.

Objectives

To enable water security, enhance groundwater recharge, promote the efficient use of water through farmers' groups and develop a water-security plan for the village.

Interventions

- Awareness generation and sensitization of the community on groundwater management.
- Primary data such as water level and quality, rainfall, socio-hydrological data, etc., collected through community resource persons.

Mahila Sarpanch with the village infographics

- The ACWADAM team, along with the community, prepared a groundwater management plan for the village, which was presented in the gram sabha.
- The ACWADAM team also tried convergence with various government programmes such as the Jalyukta Shivar, Jalswarajya II, etc.

Outcomes

- The community accepted the following recommendations given under the groundwater management plan:
  - Ban on drilling of borewells in the village
  - Selection of groundwater recharge sites based on hydrogeological study
  - Protocols for drinking water security
  - Efficient use of water through the use of drips and sprinklers
  - Crop planning based on water availability
- Water conservation structures helped enhance the recharging capability of aquifers.
- From being tanker-fed, the village became completely tanker-free in 2017–18.
- A significant change in the cropping pattern and income of the community was observed.

Shramadaan activities in the village

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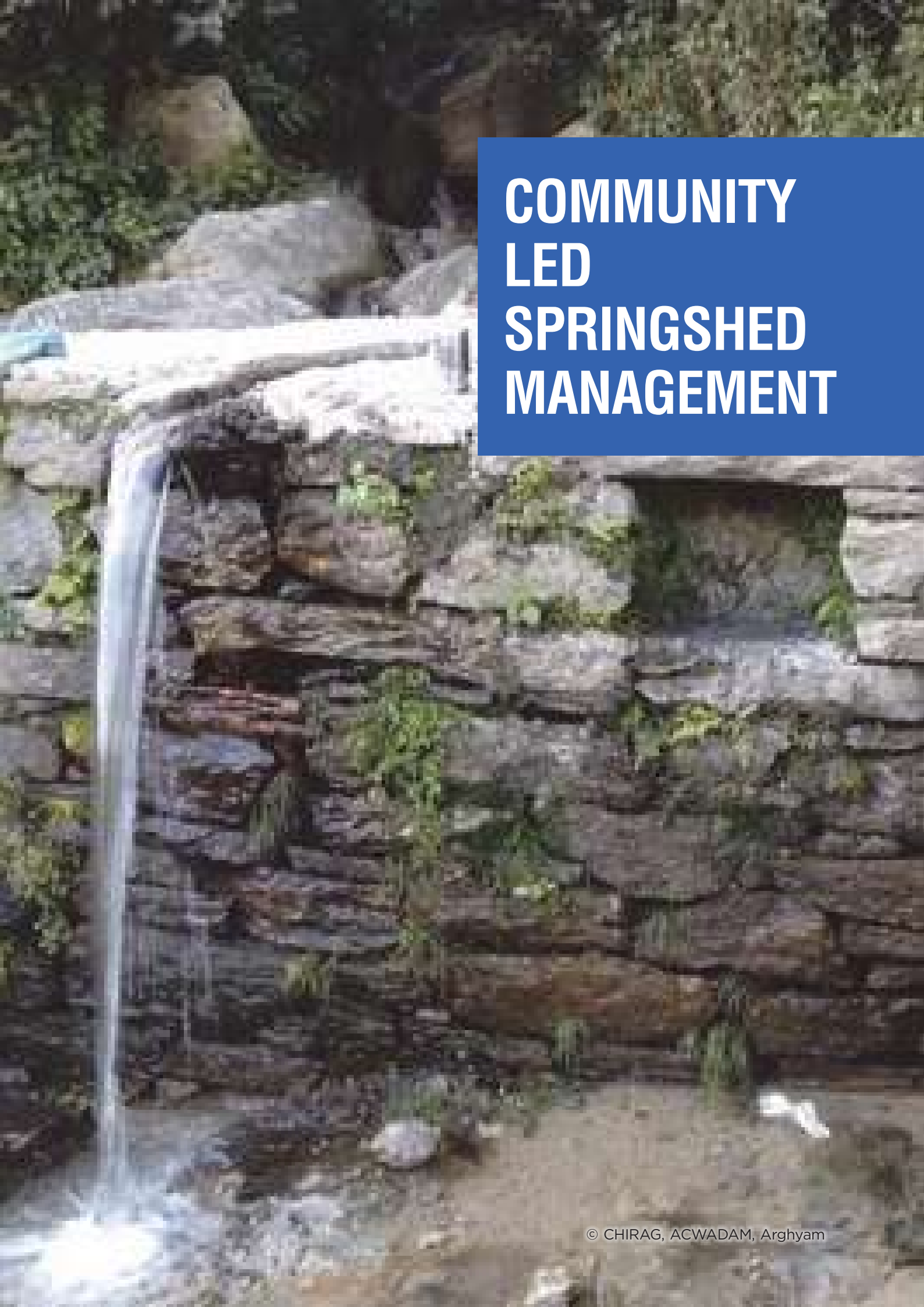

COMMUNITY LED SPRINGSHED MANAGEMENT

Place of Implementation: Kumaon Region, Uttarakhand

Agency: Central Himalayan Rural Action Group (CHIRAG), ACWADAM, Arghyam

Year of Implementation: 2013–17

Background

Traditionally, Uttarakhand has been water secure due to the existence of several springs and small streams in the state. These springs are of special importance for the local communities as people are dependent on them for a variety of needs. However, fluctuations in weather patterns over time have led to a significant decline in spring flows. Perennial springs have turned seasonal and in some unfortunate instances dried up completely. Changes in land use patterns and improper sanitation have also contributed to the deteriorating quality of spring water.

CHIRAG implemented a participatory groundwater management (PGWM) approach for springshed management in the Kumaon region, with support of Arghyam.

Objectives

To revive and protect springs, thereby ensuring water security in two villages, Kulgarh and Basgaon.

Interventions

- Community mobilization and awareness
- Hydrogeological mapping
- Hardware intervention
- Promoting efficient water use through protocols and conflict resolution

Outcomes

- With the intervention, Spring water was available even in the lean season despite low rainfall, indicating better revival of springs
- The creation of Jal Samitis has empowered women and developed a core group of women leaders, with the ability to conduct trainings.
- The community enforces protocols, takes up Operation & Maintenance of structures, monitors and evaluates the status of springs regularly.

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Jal Samiti Members-Kulgarh Village

PARTICIPATORY SPRINGSHED MANAGEMENT

Place of Implementation: Thanakkasoga Gram Panchayat, Himachal Pradesh

Agency: People's Science Institute, ACWADAM, Arghyam

Year of Implementation: 2012

Background

Lives and livelihoods of people in the Indian Himalayan Region are mostly dependent on springs and streams, instead of on big rivers. However, of late most of these perennial springs and streams are becoming seasonal or have dried up, leading to severe drinking water shortages. The discharge of springs and baoris has reduced due to mostly anthropogenic factors. Moreover, spring water also gets contaminated with the infiltration of pathogens.

Objectives

- Demonstrate an approach of community-centric spring rejuvenation, using the principles of common pool resources and PGWM in the Himalayan region.
- Build a community understanding of aquifers and basic hydrogeology; and demonstrate an equitable and sustainable water-sharing mechanism at the village level.
- Create a pool of trained resource persons at the village level, with knowledge on groundwater hydrogeology and PGWM principles.
- Establish governance and institutional mechanisms in the village to embed principles of equity, equality and common pool resources.

Interventions

- Awareness and capacity-building efforts were undertaken to identify the problem faced by the community and the willingness to resolve it.
- A hydrogeological mapping of the area was done to identify the recharge area of the critical springs more accurately.
- A water budget for the village was designed based on the estimated amount available for use and demanded by the community.
- For demand management, protocols were established in the village to ensure the sustained impact of the interventions. Some of the protocols included recharge area protection, social fencing, crop-water analysis-based farming, crop diversification, etc.

Outcomes

- Enhanced spring discharge led to a more equitable water-sharing system amongst the communities, and increased the availability of water for irrigation. Villagers were motivated to try out the SCI (System of Crop Intensification) technique of farming for crops, such as maize and wheat.
- The protection of the vadose zone and plantation helped in improving filtration, thereby reducing faecal coliform contamination.
- Due to capacity building, water sharing from the two baoris has become a norm. It was observed that the discharge in the baori increased.

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WATER SECURITY AND PARTICIPATORY GROUNDWATER MANAGEMENT

Place of Implementation: Kutch District, Gujarat

Agency: Samerth, Arghyam

Year of Implementation: 2001

Background

The Kutch region in Gujarat has been experiencing a steady decline in the groundwater level. This, along with salinity and persistent droughts, has made the region extremely water-stressed. Traditionally, local communities relied on talabs (ponds) and wells, along with dependence on rainfall, to meet their water requirements. Recently, the village grew heavily dependent on the Narmada to meet their growing demands. However, the frequency of the water supplied through the Narmada was insufficient and unreliable.

Objectives

Arghyam supported Samerth in designing and implementing the participatory groundwater management framework in the region.

Interventions

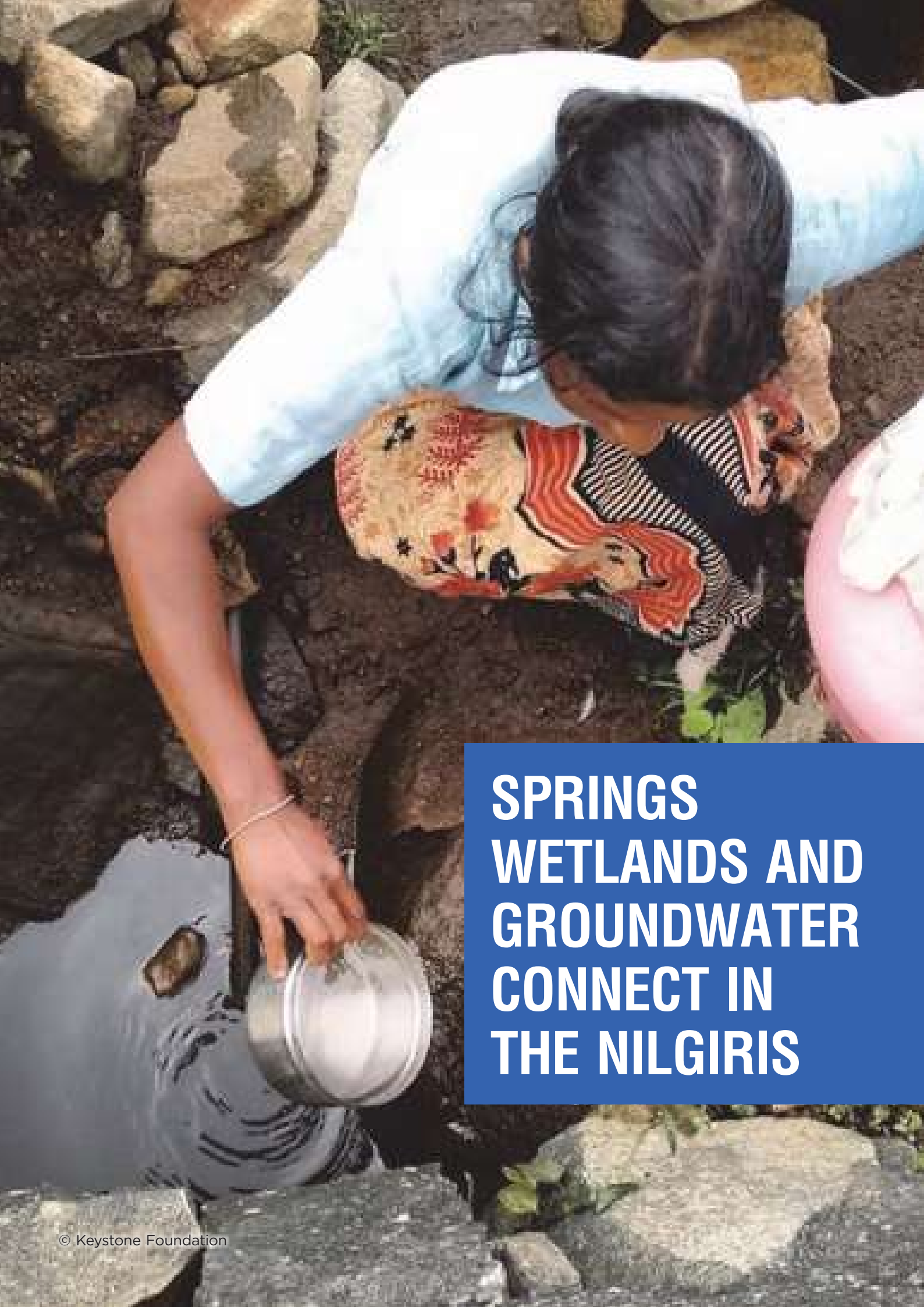
- Community resource persons (or jal doots) were identified to anchor the initiative in villages and for conducting a baseline survey for parameters such as socio-economic, demographics, geology and water sources.
- Based on the survey, a water security plan was designed.
- The trends in water levels and quality are regularly monitored and discussed with the community.
- Activities such as de-silting of existing ponds, building storage wells and check dams, assigning recharge zones in alluvial areas, and reviving old ponds are done by the community, with the support of Samerth. NREGS is leveraged to incentivize community members to contribute their labour for these activities.

Outcomes

- The project has ensured security of drinking water in the region. Also, efficient management of water now ensures its sufficient availability throughout the year. The villages are longer dependent on tankers.
- With Samerth's intervention, the Koli community renovated two nearby talabs, which were also connected to the Narmada.
- The drudgery of water collection has now been reduced to 3–4 hours per day, giving women sufficient time for other activities.

For further details contact:

E-mail: info@arghyam.org



SPRINGS WETLANDS AND GROUNDWATER CONNECT IN THE NILGIRIS

Place of Implementation: Happy Valley

Agency: Keystone Foundation

Year of Implementation: 2006

Background

The Nilgiris are known for their significant biological and cultural diversity. The region relies heavily on state water supply systems and on a network of springs and wells in the discharge areas. However, issues of falling water levels and wells running dry have become common in the region. Water quality tests revealed coliform presence across the Coonoor area. To protect these spring sources, it is important to understand their behaviour, identify and conserve them.

Objectives

To revive and conserve springs and for springshed management in the region.

Interventions

- Community involvement and convergence: wetlands that were the primary source of drinking water and were under threat were identified.
- A nursery was raised and saplings planted with the participation of the community, panchayat and a local school.

Outcomes

- The springs that used to dry up in the summers has now become perennial. A small shola forest has ensured sustained water levels in the wells.
- The community has responded positively to the intervention and is happy with the water availability in its springs and wells even during the lean season.

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ADAPTATION TO CLIMATE CHANGE THROUGH PARTICIPATORY SPRINGSHED DEVELOPMENT

Place of Implementation: 11 districts of Nagaland

Agency: People's Science Institute (PSI), Dehradun, and Department of Land Resources, Nagaland

Year of Implementation: 2016

Background

There has been a drastic decline in groundwater availability, leading to reduced discharge of water in spring sheds across the Himalayas. A user association came up in 2016, along with the Department of Land Resources, Nagaland, to restore and regenerate springs.

Objectives

- Regeneration of 11 springs (1 spring each in 11 districts) based on local hydrogeology.
- Involvement of local communities, especially women, in planning and recharge works, maintaining and sharing of water sources.
- Knowledge dissemination and communication to ensure sustainability of the programme.

Interventions

- Spring inventory: A recce visit to 50 water-scarce villages was undertaken by the Department of Land Resources to collect baseline information. This was followed by the preparation of an inventory of springs.
- Capacity Building and Trainings: Focused on identification of springs, discharge measurements, estimation of water demand and supply gaps, and hydrogeological studies.
- Criteria for selection of springs and treatment measures.

Outcomes

- Increased spring discharge during the lean season in 10 out of the 11 pilots were carried out.
- Reduced demand and supply gap: The spring discharge increased from 3 (litres per minute) lpm in January 2017 (pre-implementation period) to 5 lpm in June 2018 (post implementation).

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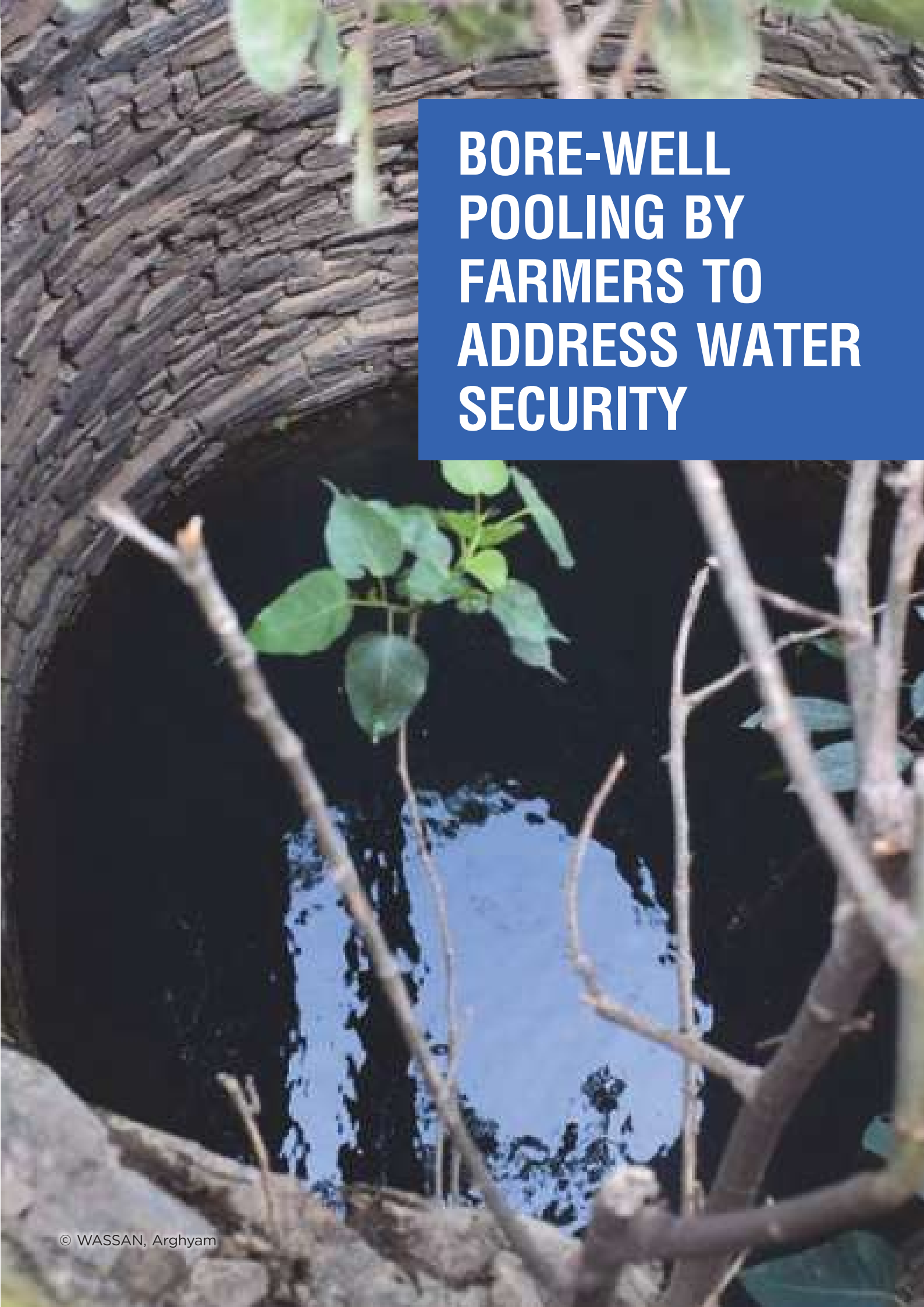
Monitoring of discharge and water quality



BORE-WELL POOLING BY FARMERS TO ADDRESS WATER SECURITY

Place of Implementation: Andhra Pradesh and Telangana

Agency: WASSAN (Watershed Support Services and Activities Network), Arghyam

Year of Implementation: 2011–13

Background

Andhra Pradesh suffers from water scarcity as the permissible level for drawing groundwater is 40%, but the state draws about 58%. Changes in rainfall distribution have led to frequent crop losses in low rainfall areas of the state. To combat this, WASSAN and Arghyam engaged with farmers in three districts of Telangana and Andhra Pradesh to create a sustainable model for resource sharing and groundwater management.

Objectives

To bring the farmers together through a system of voluntary compliance and by using a shared network of borewell pooling.

Interventions

- Identifying farmers with borewells and creating a collective of well-owners and non-owners.
- Hydrogeology training, establishment of norms and capacity building to map borewells, aquifers and rainfed areas.
- Groundwater-sharing norms devised, along with a system for their maintenance and enforcement.
- Promotion of soil conversation practices, including crop-residue management, green manure compositing, and drip and micro-irrigation systems.
- Borewell network designed by mapping agricultural land and connecting borewells.

Outcomes

- Reduced pumping time
- Improved water availability
- Increased crop productivity
- Rise in groundwater levels
- Assured livelihoods and reduced migration

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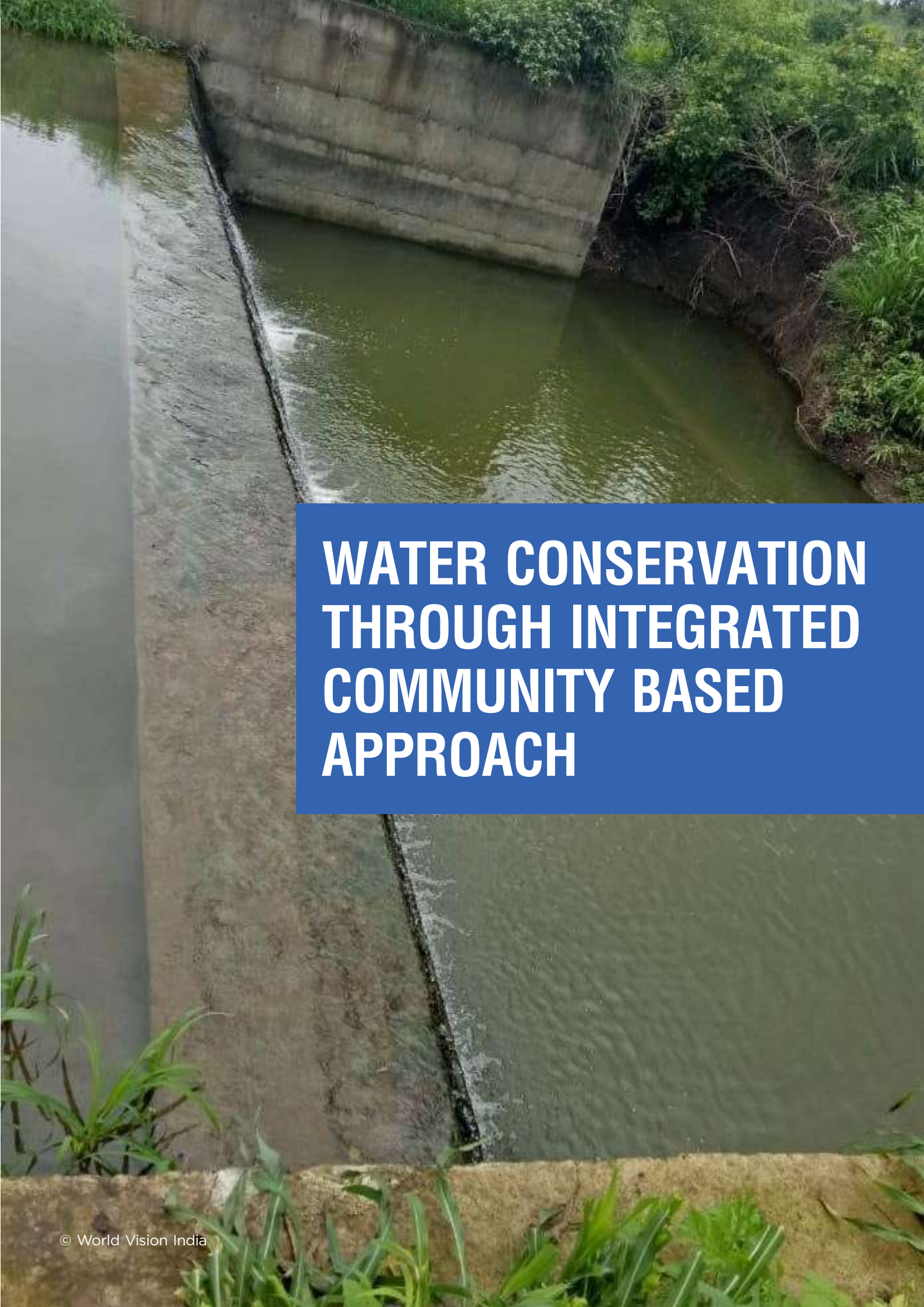
WATERSHED DEVELOPMENT

"Now that we have learnt to fly the air like birds, swim under water like fish, we lack one thing – to learn to live on earth like human beings."

—G. Bernard Shaw

1. Water Conservation through Integrated Community Based Approach – *World Vision India*
2. Multi-Layered Water Management in River Sub-Basin through with Integrated Development Approach – *Haritika*
3. Community Approach to Water Conservation - *PRADAN*
4. Convergence of Water Management & Farm-Based Livelihood – *PRADAN*
5. Use of Solar Energy for Decentralized Watershed Development – *Watershed Management Department, Uttarakhand*
6. Rejuvenation of Khentawas and Mojamabad Pond: *GuruJal Society*
7. Revival of Waterbodies in Bundelkhand: *Sarvodaya Adarsh Jal Gram Swaraj Abhiyaan Samiti, Jakhni, Uttar Pradesh*
8. Rajokri Pond Rejuvenation: *Delhi Jal Board*



WATER CONSERVATION THROUGH INTEGRATED COMMUNITY BASED APPROACH

Place of Implementation: Andhra Pradesh, Bihar, Chhattisgarh, Maharashtra, Odisha

Agency: World Vision India

Year of Implementation: 2015

Background

An integrated community-based approach was undertaken to improve access to safe water for drinking, handwashing and toilet use. This was done by deepening ponds, rehabilitating wells and other water sources, and improving water sources at the household level through an innovative hub-and-spoke model (introduced in 2018).

Objectives

To provide universal access to safe water sources at the community and household levels in nine Area Development Programmes across four states in 48 ponds/open wells.

Interventions

- Deepening and rejuvenation of waterbodies through de-silting and deepening, strengthening of embankments, pitching of revetments with boulders, retrenching of drains, planting trees on embankments, providing open well platforms, covering open wells, etc.
- The hub-and-spoke model involves identifying the best local source of water and distributing water as close to the household premises as possible through solar and electrical submersible pumps.
- Water is stored in overhead tanks to supply to the community later.
- The community is educated and trained on WASH skills to assist in income generation; the model is sustained through WMC.

Indicator	Numbers
# taps installed from water supply in communities	364
# of households benefitted	4356
# women benefitted	4356
# men benefitted	4792
# children under 5 – girls	2940
# children under 5 – boys	2983

Outcomes

- Increased availability of water for irrigation and access to safe water for drinking, handwashing, and toilet use at the household level.
- Improved sanitation and hygiene, and reduction in the number of diarrheal incidences.

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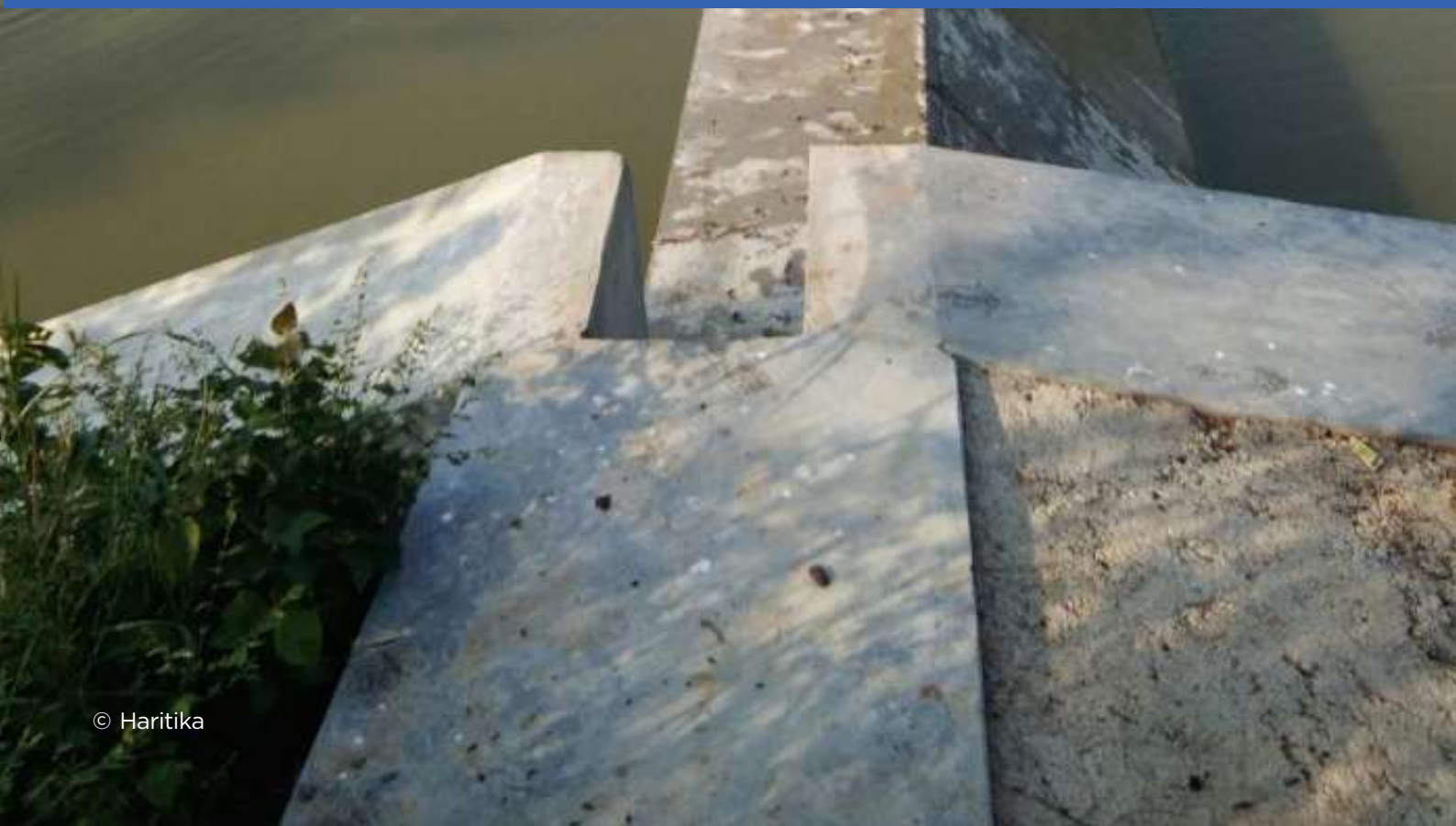
MULTI-LAYERED WATER MANAGEMENT IN RIVER SUB-BASINS WITH INTEGRATED DEVELOPMENT APPROACH



Place of Implementation: Bijawar Block, Chhatarpur District, Madhya Pradesh, and Jaitpur Block, Mahoba District, Uttar Pradesh

Agency: Haritika

Year of Implementation: 2010–18

Background

To combat droughts, food and water crises, Haritika proposed a project for implementation in 12 villages of the Bijawar block on Banne river basin, and 14 villages of the Jaitpur block on Karpia river basin, under the support of the Coca-Cola Foundation between 2010–18.

Objectives

- To augment groundwater and increase the productivity of dry lands through water conservation.
- To empower women in the decision-making process.
- To bring about significant improvement in the quality of life of rural families by adopting an integrated development approach.

Interventions

- Construction of check dams and stop dams for restraining the water flow.
- Ensuring a participatory approach and community mobilization by forming village water user committees and training them.

Outcomes

- In the Bijawar block, water conservation structures, with storage capacity of up to 2,981,576,460 litres, have been constructed.
- In the villages of Jaitpur block, water conservation structures, with storage capacity of up to 472,931,000 litres, have been built.
- Increased groundwater levels.
- Area under rabi cultivation increased approximately by 36%.
- Reduced migration and improvement in the health standards of the villagers.

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CONVERGENCE OF WATER MANAGEMENT & FARM-BASED LIVELIHOOD

Place of Implementation: Chhindbharri Village, Dhamtari District, Chhattisgarh

Agency: PRADAN

Year of Implementation: 2009

Background

Chhindbharri village is near Madamsilli dam, around 30 km from Dhamtari. Predominantly, a village for Poor and marginal farmers largely depends on agricultural labor activities for livelihood and source of income wherein only small number of people depends on other livelihood options such as NTFP collection and trading.

Objectives

To enhance the productivity of resources (land and water) by following the integrated natural resource management (INRM) approach through the convergence of various government programmes.

Interventions

- Development of irrigation facilities
- Provision of agriculture implements and other inputs.
- Infrastructure developed to harvest 56,380 m3 of rainwater in the fields of 31 families.
- Soil erosion checked in 91 acres of land of 31 families and an additional 40 acres covered by irrigation.
- Social mapping, resource mapping, transect visit, finalization of plan and activity mapping and documentation.
- Harvesting rainwater and soil and water conservation:
- Farm pond and seepage tanks in convergence with MGNREGA; land husbandry, plantations and irrigation system in convergence with the Department of Agriculture and NABARD.

Outcomes

- Participatory planning and monitoring enhanced the confidence of the community.
- Farmers and SHG members can now access government schemes from 15 departments.
- The village saw a huge increase in the production of vegetables, fish and poultry. Families are earning an additional income of Rs. 40,000 per annum through vegetable cultivation.
- Enhancement of agriculture income—more than 60% of the families earn an income of Rs. 15,000 and above.
- Distress migration stopped.

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COMMUNITY APPROACH TO WATER CONSERVATION

Place of Implementation: Masulpani Gram Panchayat, Narharpur Block, Uttar Bastar Kanker district

Agency: Gram Panchayat, with PRADAN as facilitating agency

Year of Implementation: 2018

Background

Masulpani Gram Panchayat has evolved as a model, because of intensive work done under MGNREGA for water conservation. Also, the continuous involvement of community members has ensured high quality output. The panchayat is under a high-impact mega-watershed project, a joint initiative by the Chhattisgarh government and civil society organizations, to treat 694,500 acres of land in 26 blocks of 13 districts in the state.

Objectives

To generate livelihood opportunities within villages throughout the year, through MGNREGA and farm-based activities, and to convert the village from being water deficit to water sufficient.

Interventions

- Construction of 250 water harvesting structures under MGNREGA.
- MGNREGA planning done in a participatory manner, with a focus on land use pattern and water requirement for the same.
- Capacity building of women SHGs through training on the technical aspects of watershed planning.
- Identification of Community Resource Persons (CRPs) in the village with technical knowhow of various structures under MGNREGA.
- Water budgeting taken on as the base for planning of structures.
- Integration of GIS tools and maps while planning for the treatment of drainage lines
- Employment generation in the village.
- Preparation of detailed plans—with dimensions and GIS coordinates—for all the structures, and their submission to the MGNREGA cell at the block.

Outcomes

- Over 50% of the families saw an increase in their incomes by 30–40%.
- Regular employment generation in the village led to a reduction in migration.
- Creation of a village-based cadre that is technically sound in watershed principles.
- Opening of allied agricultural livelihood options, such as fisheries, goat and bird rearing.

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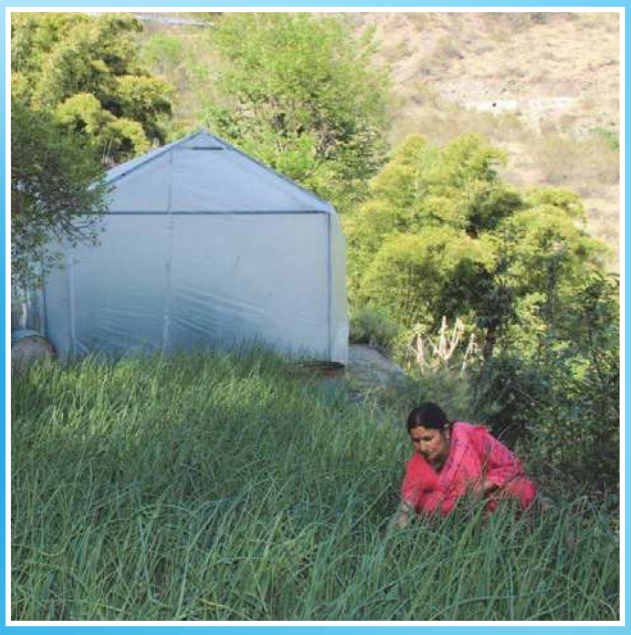
SHG women participating in discussions



USE OF SOLAR ENERGY FOR DECENTRALIZED WATERSHED DEVELOPMENT

Place of Implementation: Almora, Dehradun, and Pauri Garhwal

Agency: Watershed Management Directorate, Uttarakhand

Year of Implementation: 2014

Background

Ladholi village in Almora district is a case in point for building climate resilience. As the farming was not considered to be very fruitful with barren lands and lack of irrigation facilities, villagers used to migrate to towns more sustainable income.

Objectives

To overcome the situation of water availability for irrigation, discussions with farmers led to the idea of impounding water from the river flowing down stream (through construction of check dam and collection in sedimentation tank) and using solar energy to pump water to the overhead tank in the village situated at an elevation of 180 metres and to the agriculture fields up-stream.

Interventions

- An irrigation tank with capacity of up to 15,000 litres was constructed by the villagers.
- Scientists and technicians from Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, provided on-farm training to villagers on how to dig the LDPE tanks.
- Through project support, 10 solar panels with 3000-watt capacity were established and 21 LDPE tanks (each with capacity of 15000-18000 cubic litres) were connected through HDPE pipes from the overhead irrigation tank.
- An underground sedimentation tank was constructed along the river and a submersible pump of 3.2 HP was installed, which could be operated through solar power generated from the 10 panels.
- Nearly 4,35,000 litres of water can be harnessed in all the tanks, enough to water the crops.
- Similarly, six solar panels, with a capacity of 300 watt each, along with a pump and controller, were installed at Dharkot, Dehradun. Through them, a 20,000-litre-capacity irrigation tank could be filled.
- In Kagthun Gram Panchyat, Pauri Garhwal district, 9 ha plantation, along with the 1200 contour trenches and 500 recharge pits, were dug up to improve the water regime in the catchment area of the natural water source.

Outcomes

- The farmers in the project villages now have the capacity for irrigating 50.80 ha gross rainfed area. These farmers have shifted to the cultivation of cash crops and vegetables. This has increased their incomes substantially and improved the standard of living.
- A considerable increase in the water level at the source situated in the lower end of the village was observed.
- Reverse migration has been reduced.
- Solar energy is a much more convenient and cheaper alternative to diesel. It is also climate resilient and leaves a low carbon footprint.

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REJUVENATION OF KHENTAWAS AND MOJAMABAD PONDS

Place of Implementation: Khentawas and Mojamabad Villages, Gurugram, Haryana

Agency: GuruJal Society, Gurugram

Year of Implementation: 2019

Background

Several traditional waterbodies in Gurugram, which were once used to collect rainwater from catchment areas, now gather wastewater along with rainwater due to urbanization and poor infrastructure. As a result of this, there are fewer number of clean water sources, the ecology of ponds has been destroyed, groundwater has been polluted—all of which have further exacerbated water scarcity in Gurugram.

Objective

Treatment of the accumulated wastewater in the pond, which can be further used for irrigation, horticulture, construction of infrastructure and other purposes, which would reduce reliance on groundwater, replenish water table and improve the biodiversity of the area.

Intervention

- Dewatering of ponds to increase the recharge capacity.
- Cleaning of peripheral areas of ponds and levelling of landscape for setting up wastewater treatment plants (WTPs). Aggregates and natural filter media were laid down in the constructed WTPs.
- The WTPs/STPs use phytorid technology, which is a kind of subsurface flow in which water is applied to beds filled with gravel and stones.
- Creation of biodiversity zones at project sites to prevent the ponds from future encroachment.
- Creation of pathways and recreational areas.
- Various technologies have been implemented in the 13 project sites and 17 more are in the pipeline.

Outcomes

- Treated water from ponds is used in biodiversity zones.
- BOD level of 23 mg/L reduces to 10 mg/L, with the help of the Waste Treatment Plants, thereby improving the quality of water, which can be used for agriculture and horticulture, as well as other activities.
- The phytorid technology has five stages, which can be adapted at low cost in several other regions.

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REVIVAL OF WATER BODIES IN BUNDELKHAND

Place of Implementation: Jakhni, Banda, Bundelkhand Region, Uttar Pradesh

Agency: Sarvodaya Adarsh Jal Gram Swaraj Abhiyaan Samiti, Jakhni

Year of Implementation: 2007

Background

Located in infamous region of Bundelkand, Jakhni village was facing water scarcity for a long time.

Objectives

To revive waterbodies through traditional water conservation techniques, improve agricultural productivity, and reduce migration.

Interventions

- Intensive plantation of trees on the ridges of agricultural fields
- Construction of farm ponds
- Raising of farm bunds
- A rainwater harvesting committee formed: Sarvodaya Adarsh Jal Gram Abhiyaan Samiti.
- Trenching around wells and plantations

Outcomes

- Jakhni was declared a model 'jalgram' (water village) by NITI Aayog. Over 1000 other villages have also been proposed to be developed as jalgrams.
- Summers are less harsh in Jakhni now compared to the other surrounding areas of drought-prone Bundelkhand.
- Ponds and wells remain full throughout the year.
- Soil remains fertile as mineral and salts do not wash away.
- There has been noted increase in the groundwater level.
- Exponential rise in agricultural produce—a formerly dry village now grows a highly water intensive crop such as Basmati rice.
- There has been noted increase in crop diversification.
- Incoming migration observed with increase in livelihood opportunities.

Takeaways

- Jakhni farmers undertook the entire work without any external funding, machinery, or resources.
- Village water-budgeting modelled around the collection and storage of rainwater within the boundaries of Jakhni and consequently utilizing it for economic development.

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RAJOKRI POND REJUVENATION

Place of Implementation: Rajokri Village, Delhi

Agency: Delhi Jal Board

Year of Implementation: 2018

Background

Rajokri village is located on the outskirts of Delhi. Earlier, the wastewater from the village was directly discharged into the Rajokri pond, which led to its deterioration. This resulted in several other problems such as the breeding of mosquitoes, sinking of sewage, etc. In 2018, Delhi Jal Board decided to rejuvenate the pond

Objectives

To convert the turbid pond fed by sewage into a clean waterbody for recharging the groundwater and providing a recreational spot for the villagers.

Interventions

- Construction of artificial wetlands, floating wetlands, grassland, rain gardens, parks, chhath ghat, amphitheatre, and gravel walkways.
- Construction of Sewage Treatment Plant, with capacity of 600 kilolitres per day
- Scientific wetland systems with active biodigesters technology used.
- Interception of drains, from which sewage is fed into an underground sedimentation tank equipped with biodigester. This coupled with filtration through aggregated stones reduce the BOD levels to half. Solar pumps push the water to an artificial wetland, where it passes through 2.5 deep gravel lined with water treating plants such as Umbrella and Canna Indica which absorb toxins. The effluent then passes through three terrace gardens. It then gently passes from the slope of the grassland to the pond. A solar power-enabled pump installed in the middle of the pond recirculates the water.
- Carbon/sand filters and floating rafters to be installed.

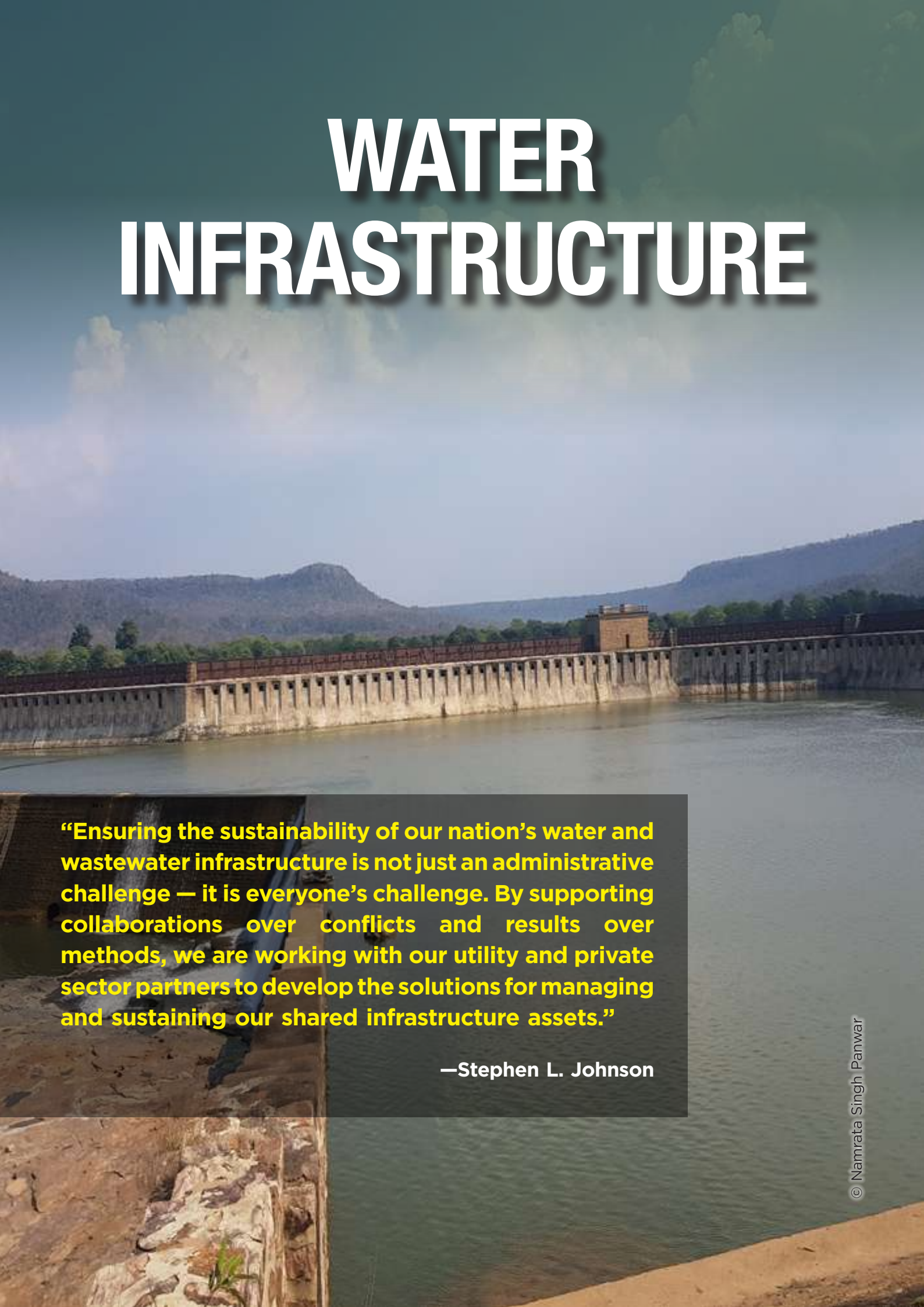
Outcomes

- As much as 9500 sq. metres of area redeveloped, with a 2000 sq. metre waterbody. Sewage is now treated before being discharged into the pond.
- Chhath ghat serves as a public space.
- Migratory birds have been spotted in the area surrounding the pond.
- Treated wastewater is used to recharge the pond.

For further details contact:

Delhi Jal Board

WATER INFRASTRUCTURE

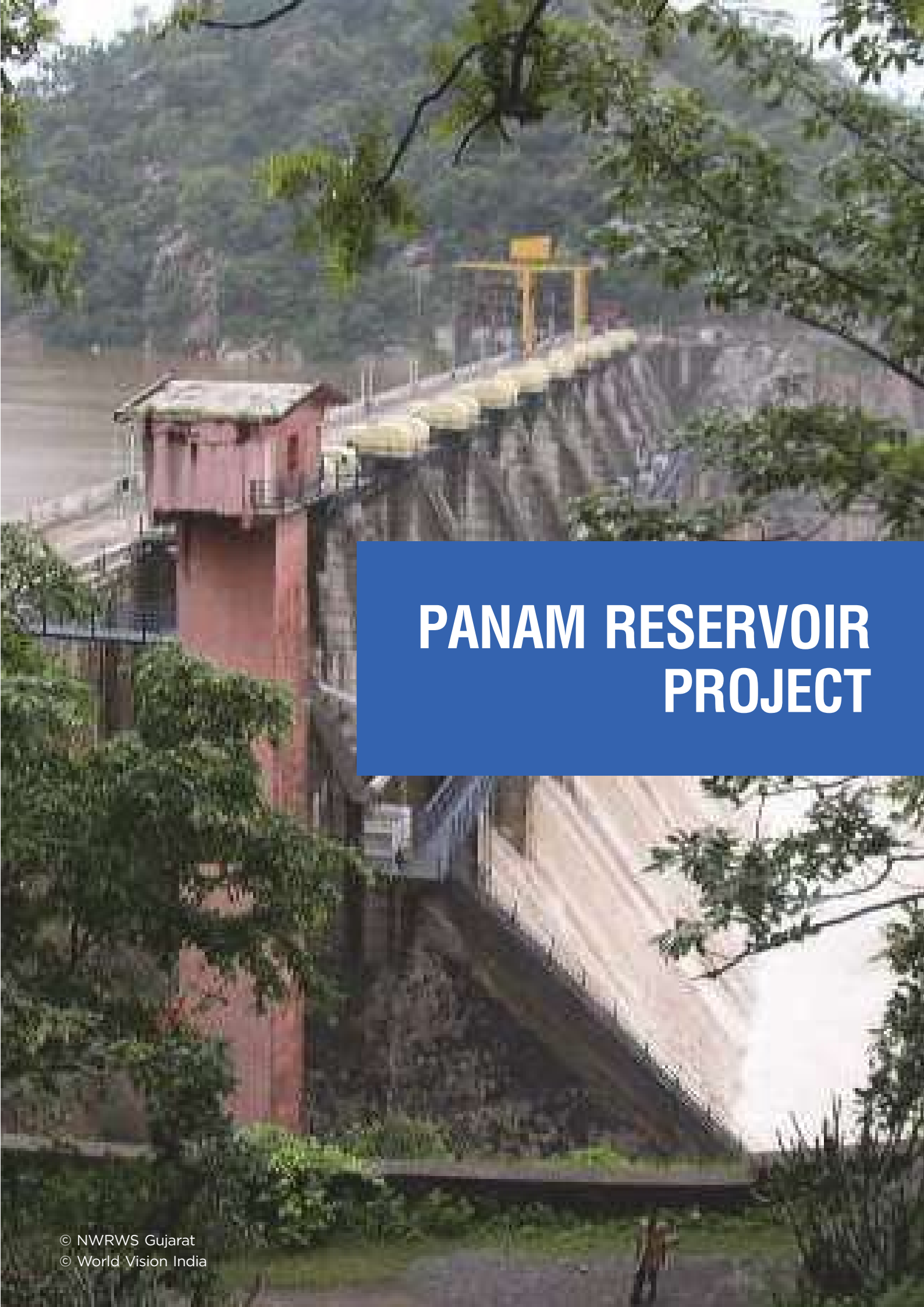


"Ensuring the sustainability of our nation's water and wastewater infrastructure is not just an administrative challenge — it is everyone's challenge. By supporting collaborations over conflicts and results over methods, we are working with our utility and private sector partners to develop the solutions for managing and sustaining our shared infrastructure assets."

—Stephen L. Johnson

© Water Resources Department, Andhra Pradesh

1. Panam Reservoir Project – *Government of Gujarat*
2. Installation of Solar PV Panel with Net Metering System – *Tubewell Division, Dehradun*
3. Upgradation of Dibrugarh Town Protection Dyke – *Water Resources Department, Assam*
4. Construction of Sub-Surface Dams With "Z" Sheet Piling Technology – *Water Resources Department, Andhra Pradesh*
5. Palasbari Sub-Project under Assam Integrated River Erosion Risk Management – *Water Resources Department, Assam*
6. Hub-&-Spokes Model to Affordable Potable Water beyond the Piped Urban Areas – *Piramal Sarvajal*
7. Construction of Revetment, Geo Bags Apron along the Brahmaputra River – *Water Resources Department, Assam*
8. Rohini Dam System of Irrigation in Bundelkhand – *Irrigation Department, Lalitpur, Uttar Pradesh & Water Users Association*
9. Pirul Leaves Check Dam in Uttarakhand – *Forest Department, Uttarakhand*
10. Redefining Urban Water Space using FBTec® - *DEWATS – Nixie Engineers Pvt. Ltd.*
11. Reducing Domestic Water Wastage in Gurugram – *Gurujal Society*



PANAM RESERVOIR PROJECT

Place of Implementation: Gujarat

Agency: Government of Gujarat

Year of Implementation: NA

Background

The Panam project has 510 MCM of water allocation for 32,800 hectare of command area as per the original plan. Panam is a part of the Mahi River basin, which is shared by the states of Rajasthan, Madhya Pradesh, and Gujarat.

Objectives

To provide water for irrigation, apart from flood protection, fisheries, and hydropower generation.

Interventions

- To ensure higher efficiency of the canal distribution network, vulnerable stretches were identified using advanced technologies such as tomography.
- Canals were restored using materials like geo-synthetics so that seepage losses could be minimized.
- To provide permeability of the surface and shear and bending resistance to the lining, welded wire mesh was used as reinforcement in the concrete lining.
- Tunnel on the initial stretch of the Panam high level canal demand management was also properly implemented through participatory irrigation management and rotational water supply in the canal system.
- A 30-km-long, high level canal was constructed, having some initial stretch in the form of a tunnel, and made functional recently for a nearby area deprived of water.

Outcomes

- With all such efforts, the net result was that the entire command area of 32,800 hectare was served with only 300 MCM of water, and 210 MCM of water was saved.
- Conserve the water while allowing better distribution of water resource

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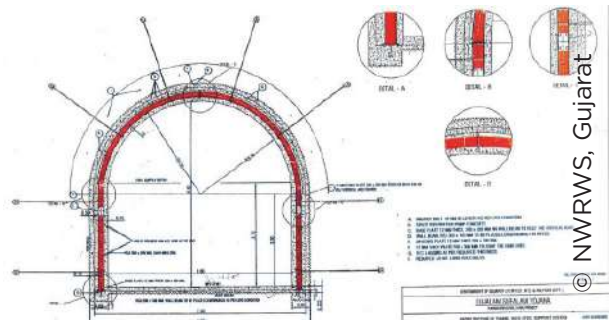
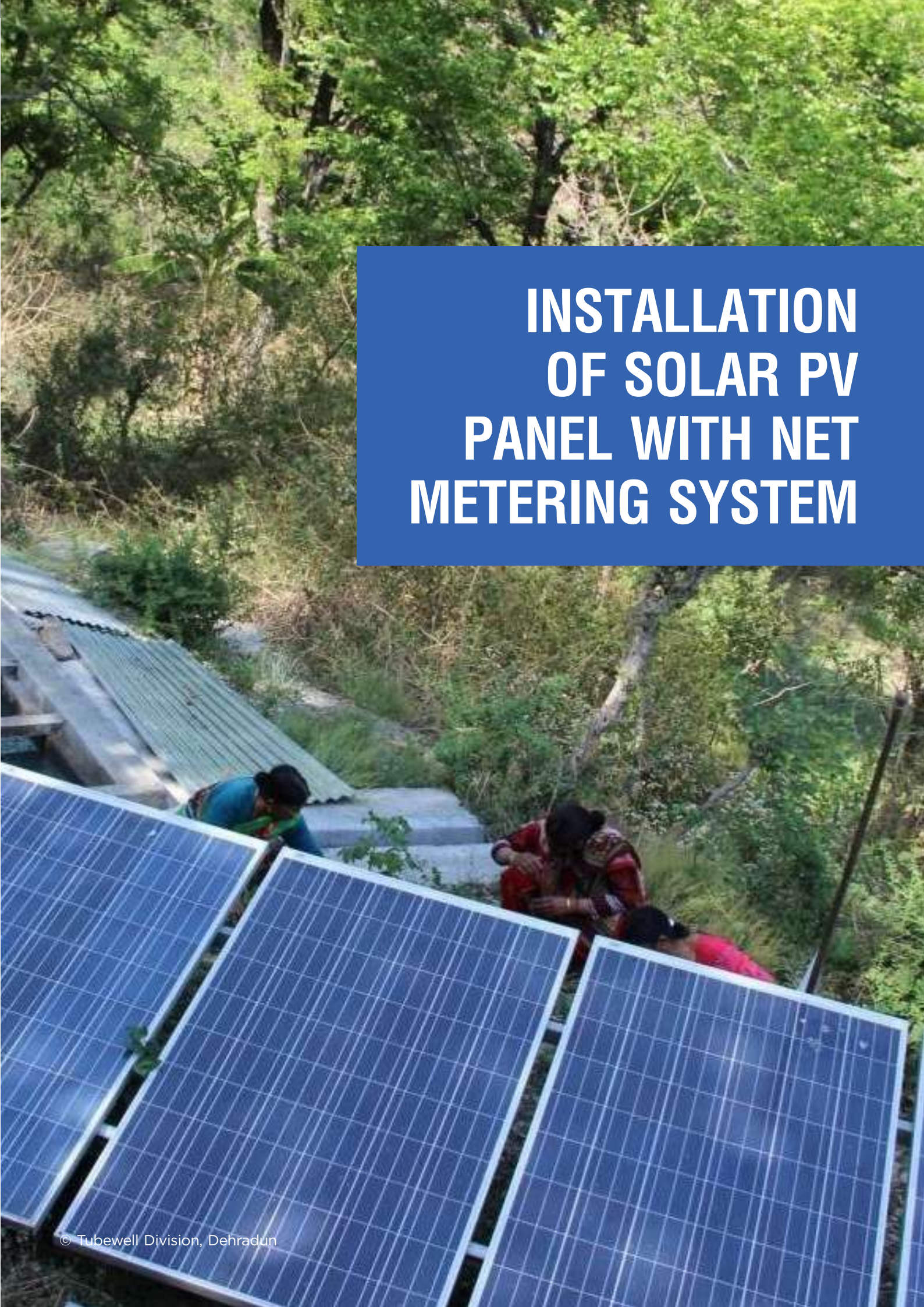


Tunnel in the Initial Stretch of Panam High Level Canal

INSTALLATION OF SOLAR PV PANEL WITH NET METERING SYSTEM



Place of Implementation: Nakraunda, Dehradun, Uttarakhand

Agency: Tubewell Division, Dehradun

Year of Implementation: 2018

Background

To reduce the cost of running tubewells and to promote clean energy, the Tubewell Division in Dehradun initiated the installation of solar panels for energy production.

Objectives

To save the operation costs of tubewells by solar power generation.

Interventions

Installed solar PV panels in 200 m2 area, with a net metering system connected to 11 KV electric line.

Outcomes

- Generation of an average 55 units per day
- Generation of green energy
- Saving operation costs of tubewells i.e., Rs 92,345 per year per tubewell.

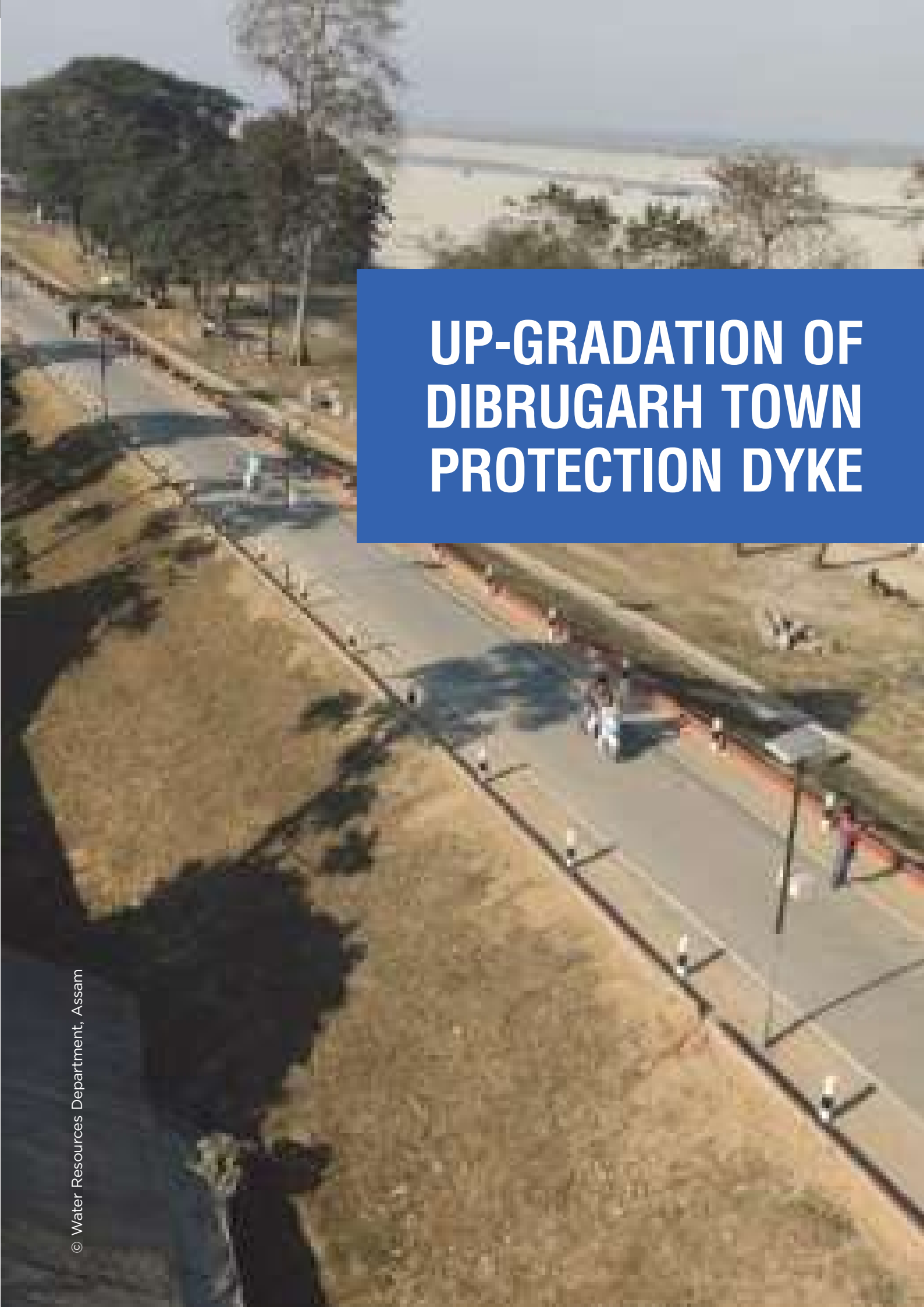
For further details contact:

Executive Engineer, Tubewell Division

E-mail: cemechanical2016@gmail.com

Phone No: 91-9412608030

Solar panels used for power generation



UP-GRADATION OF DIBRUGARH TOWN PROTECTION DYKE

Place of Implementation: Dibrugarh, Assam

Agency: Water Resources Department, Assam, and FREMAA as Special Purpose Vehicle

Year of Implementation: 2013

Background

The old embankment constructed in Dibrugarh after the massive earthquake of 1952 was susceptible to breach and overtopping at certain reaches. This necessitated its upgradation, which was started in 2013 and successfully completed by 2017.

Objectives

To raise the height and strengthen the Dibrugarh Town Protection Dyke, the lifeline of the town, to provide a higher level of water proofing and protection from overtopping.

Interventions

Upgradation of the dyke with earthwork, including the construction of a toe wall at the most critical sections where land constraints are maximum, construction of open drain at toe wall section, construction stairs at different locations and construction of a black topping road over the DTP Dyke from Maijan to Mohanaghat.

Outcomes

- Increased protection of life and property from floods.
- The dyke has evolved to be a major walking zone.
- Antisocial activities across the dyke has been checked and curbed.
- The dyke has added vibrancy to the urban landscape of Dibrugarh with its open spaces, walkways, and adjacent gardens.

For further details contact:

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Walking Path built on the Dyke

CONSTRUCTION OF SUB-SURFACE DAMS WITH "Z" SHEET PILING TECHNOLOGY

Place of Implementation: Y.S.R. District, Andhra Pradesh

Implementation Agency: Water Resources Department, Andhra Pradesh

Year of Implementation: 2017

Background

Owing to Kapada district's complex geology, the rate of water infiltration into the ground is not very beneficial to restore groundwater. Despite constructing numerous water-harvesting structures, the groundwater table is rapidly declining. The situation demands the recharging of freshwater zones, in declining water table areas, with artificial means to maintain the groundwater table at optimum levels.

Objectives

The district administration, after examining different options, decided to construct Sub -Surface Dams by using innovative, low-cost technology. The government's intention is to increase the water table up to 3 metres during the monsoons and 8 metres during the summers.

Interventions

As a pilot model project, the construction of sub-surface dams, with an innovative concept of "Z" sheet piling technology, was taken up at six locations on the Papagni.

Outcomes

- The surface water runoff got percolated to the sand layers and also in the adjoining alluvium along the river thereby increasing the water table.
- By construction of sub surface dams with Rs.26.36 Crores covering 4 Mandals in six locations, OAP have been arrested for which 7,795 Acres of Paddy irrigated through Ground Water for which 16,563 MTs of Paddy produced, which costs Rs.25.67 Crores in a year. About 8,000 Acres of area comes under irrigation in subsequent years.
- Paddy has been stabilized in these mandals during the Kharif season and unclear.
- The water level in agriculture borewells have been augmented. The sustainability of borewells have been increased.
- The increased water level has facilitated the functioning of centrifugal pumps, which is an indication of shallow water levels, particularly in and around Sugali Tanda SSD.

For further details contact:

District Magistrate, YSR District

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Construction of Sub Surface dam through Z sheet piling

PALASBARI SUB-PROJECT UNDER ASSAM INTEGRATED RIVER EROSION RISK MANAGEMENT INVESTMENT PROGRAM

Place of Implementation: Palasbari, Kamrup District, Assam

Agency: Water Resources Department, Assam, and FREMAA as Special Purpose Vehicle

Year of Implementation: 2013

Background

The project was envisioned as the Brahmaputra River front development venture at Palasbari town. It aimed at the rejuvenation of the town and its development as a nodal tourist centre.

Objective

To construct flood and erosion control mitigation structures based on the latest technologies with cost-effective and sustainable structural and non-structural measures.

Interventions

The following were constructed:

- The length of embankment cum black topped road–5.02 km.
- Length of Bank revetment with loose boulder for a thickness of 0.60 mover geo-textile fabric sheet–4.90 Km.
- Toe-key at lowest water level with boulder filled in wire netting cages for thickness 0.9m for the entire reach.
- Top Key along anchorage at bank level of size 4.0m x 0.6m over geo fabric sheet.

Outcomes

- This road cum embankment also acts as an alternative route linking many interior villages. It has also evolved to be a major walking zone.
- The Brahmaputra dyke at Palasbari is a major tourist attraction; it is also a picnic spot.

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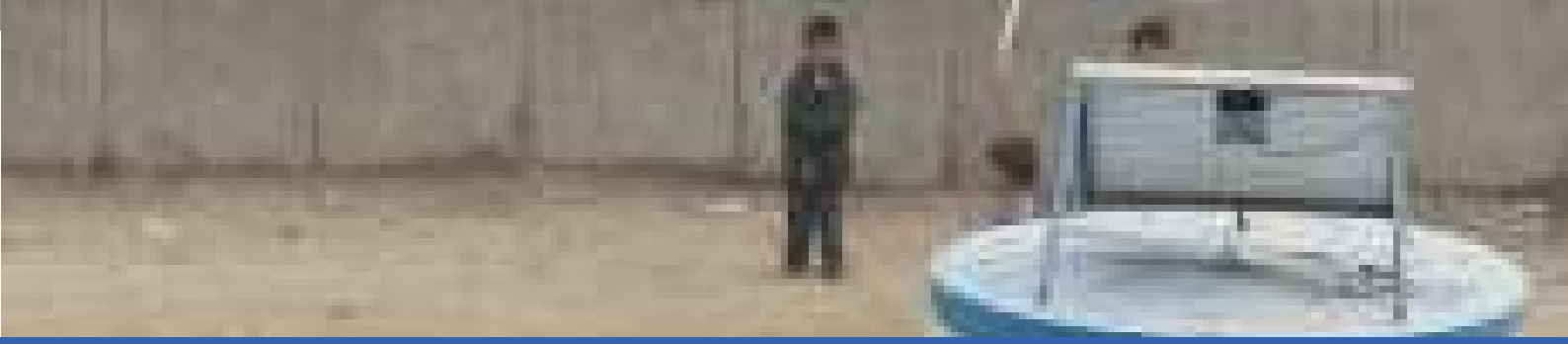
Embankment cum Black Topped Road



HUB-&-SPOKES MODEL TO AFFORDABLE POTABLE WATER BEYOND THE PIPED URBAN AREAS

Place of Implementation: Bhubaneswar, Delhi, Laxmangarh, Pune

Agency: Piramal Sarvajal

Year of Implementation: 2013

Background

Piramal Sarvajal has devised a hub-and-spoke model of safe water delivery to various resettlement colonies and slums across the country. This comprises locally installed remote-sensing enabled, state-of-the-art water purification plants for in-situ purification of raw water and a network of automated water vending units for distribution of drinking water.

Objectives

To create reliable access to 24x7 safe drinking water services to underserved areas of urban centres in a decentralized manner.

Interventions

- Centralized water purification system at the community level and dispensing units, where water is transferred through a no-touch transfer mechanism.
- A Programmable Logic Controller (PLC)-based remote tracking device, called the Soochak controller, is installed on the purification plant to track the quality and volume of water, monitor the plant's operational status and capture vital machine health parameters to provide preventive maintenance.
- SEMS is an online Enterprise Resource Planning (ERP) tool, developed in-house by a team of software experts, which captures and processes data sent across by all the water purification and dispensing units.

Outcomes

- To date, Piramal Sarvajal serves around 6 lakh people daily. Specifically in urban areas, it serves over 50,000 people daily through 148 touchpoints.
- Real-time monitoring of water quality and consumption pattern.
- Increased efficiency in water distribution system.
- Time-saving and better health outcomes for beneficiaries.

For further details contact:

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Hubs and Spokes Model

CONSTRUCTION OF REVETMENT, GEO BAGS APRON ALONG THE BRAHMAPUTRA RIVER

Real Time Monitoring of Water Quality

Place of Implementation: Mothola, Assam

Agency: Water Resources Department, Assam, and FREMAA as Special Purpose Vehicle

Year of Implementation: 2013

Background

The Mothola-Oakland dyke had been suffering from continuous erosion by the Brahmaputra and required immediate protection. Therefore, to tackle the situation, protection works with geo-bags apron and CC block revetment were proposed.

Objectives

To ensure the safety of life and security of property of the people of Dibrugarh and adjoining areas.

Interventions

Geo-bags apron and CC block revetment at eroded reaches were used for 2.4 km. This gave a new lease of life to the dyke.

Outcomes

- The Mothola-Oakland Bank Protection Work has provided safety to about 25,000 ha of land.
- It also protects several public and private properties.
- It has also evolved as a tourist attraction.

For further details contact:

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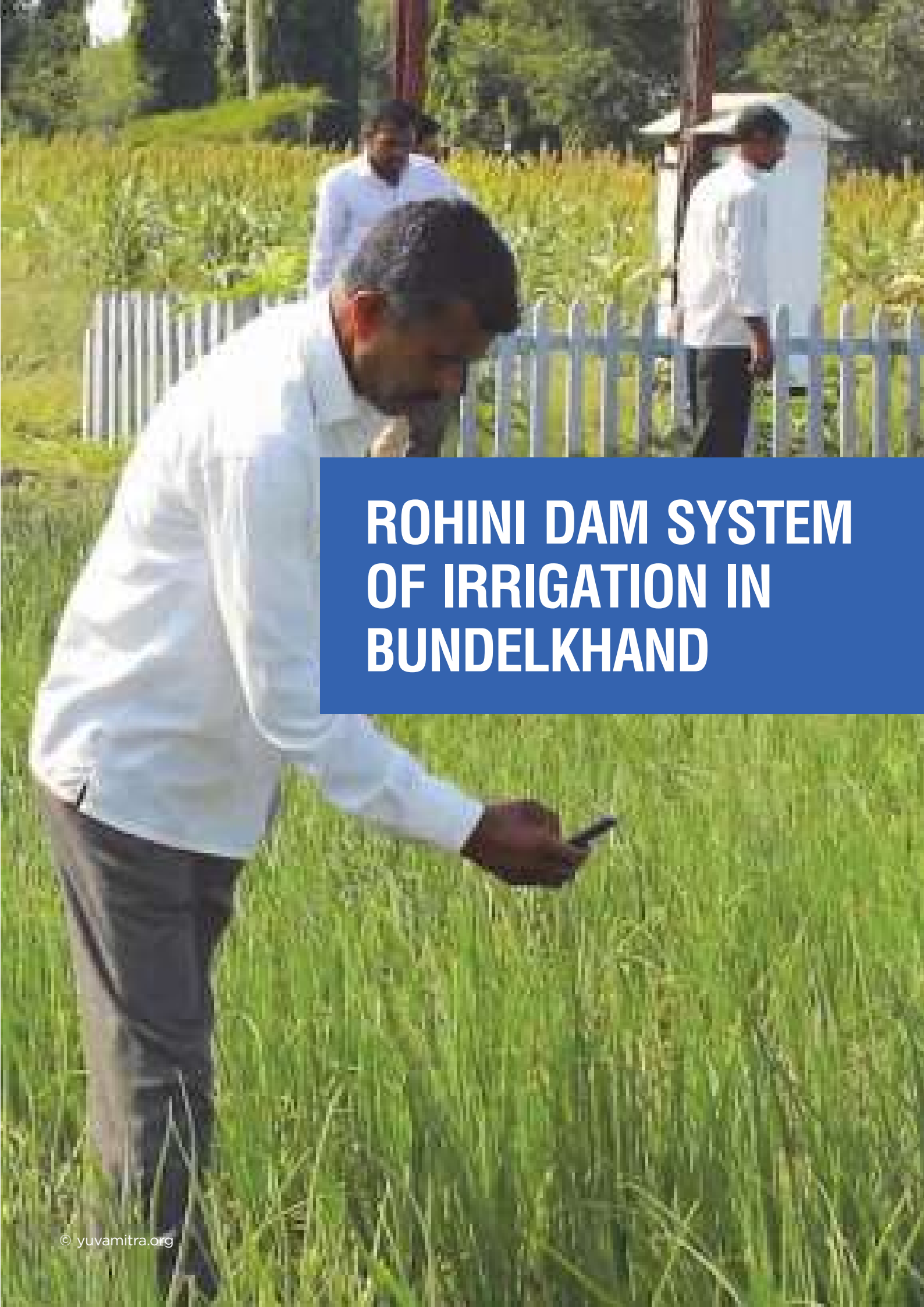
Use of CC block revetment on dyke



ROHINI DAM SYSTEM OF IRRIGATION IN BUNDELKHAND

Place of Implementation: Lalitpur, Bundelkhand, Uttar Pradesh

Agency: Irrigation Department of Lalitpur, Uttar Pradesh, and Water User Association

Year of Implementation: 2016

Background

The Uttar Pradesh Participatory Irrigation Management Act, 2009, has been implemented in the Rohini Dam of I.D. Lalitpur of Bundelkhand region (UPWSRP) for Water User Association (WUA) on Chhaprauni Minor, Tisgana Minor, Chauka Minor and Garauli Minor which has been formed in October, 2016. The system was handed over to the respective WUA on 24 February 2018

Objectives

To save water and increase the area of irrigation in Lalitpur.

Interventions

- Water User Associations (WUAs) distribute water from the tail end of canals.
- Training to the WUA members
- Rehabilitation of minor outlets
- A management committee supervises the activities.

Outcomes

- Irrigation was completed seven days before the date mentioned in the roaster.
- 1.13 TMC water was saved.
- No dispute in canal operation.
- Tails of Chauka and Garauli minors were fed after 27 years.
- Farmers now able to water the crops 4 times in a year as compared to two times in a year.

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Handing over Garauli Minor to WUA in the presence of World Bank Team

© ISO, UP

WUA meetings to make joint rosters


© Amar Ujala

PIRUL LEAVES CHECK DAM IN UTTARAKHAND


© Forest Department, Uttarakhand

Place of Implementation: Almora, Ranikhet, Someshwar, Dwarahat in Uttarakhand

Implementation Agency: Forest Department of Uttarakhand

Year of Implementation: 2014

Background

Under the Kosi River Rejuvenation Project, rainwater conservation-related works are being done in different recharge zones. These works include the construction of check dams to store the surface run-off.

Objectives

Groundwater recharging through rainwater harvesting.

Interventions

- Creation of check dams using pirul leaves. This was mainly done in first order streams.
- Pirul leaves are woven with iron wires.
- After this, three quintals of pirul are filled in the net, which is firmly tied with a rope of coconut.
- Plants like Jatropha, Sinwali are used in the drains
- Nearly 2000 such check dams were made.

Outcomes

- These check dams are stronger and less expensive than their cement counterparts.
- Plantation around the dam provides protection from damage and soil erosion.
- These dams are effective for big drains and can absorb the flowing debris.
- Nearly 1,00,605 trees have been planted in 105.50 hectares of land.

For further details contact:

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REDEFINING URBAN WATER SPACE USING FBTEC® – DEWATS

Place of Implementation: Sangamner, Maharashtra

Agency: Nixie Engineers Private Limited

Year of Implementation: 2007

Background

Over the years, improper wastewater treatment and discharge from residential areas contaminated the surface in Sangamner. It led to the breeding of mosquitoes and other insects, and deterioration of the soil. Also, the wastewater coming from different points would drain into a common drainage system.

Objectives

After conducting a survey, Nixie Engineers found that the wastewater could be efficiently recycled through decentralization at the source by installing FBTec®, a trademark registered technology developed in Singapore, in line with UN guidelines.

Interventions

- FBTec® were installed.

Outcomes

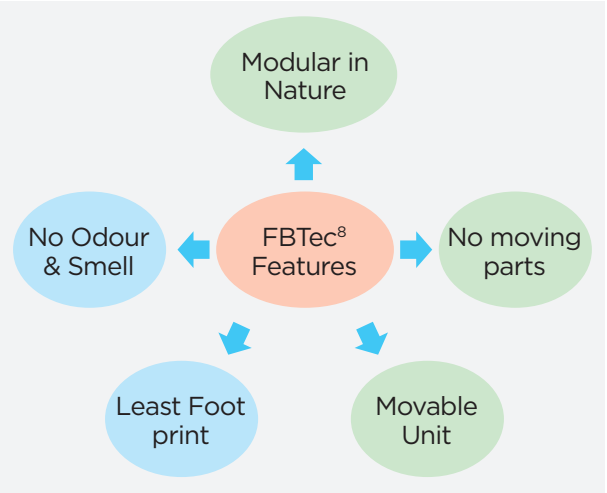
- About 20,000 litres of wastewater is recycled every day. The recycled water is reused for sanitation, gardening, etc.
- It is a step towards ensuring a swachh Bharat.

For further details contact:

Mr Lalit Bajare

E-mail: lalitbajare@nixiewater.com

Phone No.: +91-020 2543 5800



REDUCING DOMESTIC WATER WASTAGE IN GURUGRAM

Place of Implementation: Gurugram, Haryana

Agency: GuruJal Society, Gurugram

Year of Implementation: 2019

Background

Residential societies have an important role to play in water conservation—by reducing their daily consumption of water, fixing leakages and infrastructure-related issues, discouraging the plantation of ornamental plants and encouraging the plantation of native trees and plants.

Use of aerators is one of the few water-conservation measures that could be retrofitted into existing infrastructure. This step reduces water consumption at any tap by 40%, without any difference to the user.

Objective

Leak-proofing of campuses, public spaces and institutions, and installation of aerators in resident welfare associations (RWA).

Intervention

- Identifying all possible sources of water leakages and fixing them.
- Providing innovative, cost-effective design solutions.
- Assisting institutions in drawing up water budgets.
- Checks done on rainwater harvesting structures in 572 government schools. The survey revealed that only 128 schools had functional rainwater harvesting structures. However, at full capacity, nearly 304 ML/year can be saved.
- Education of RWA members regarding the importance of installing aerators in kitchens or washbasins to reduce water consumption by 3–4 L/minute.

Outcomes

- Installation of 8500 aerators in 15 RWAs of Gurugram saves approximately 230 kilolitres/day.

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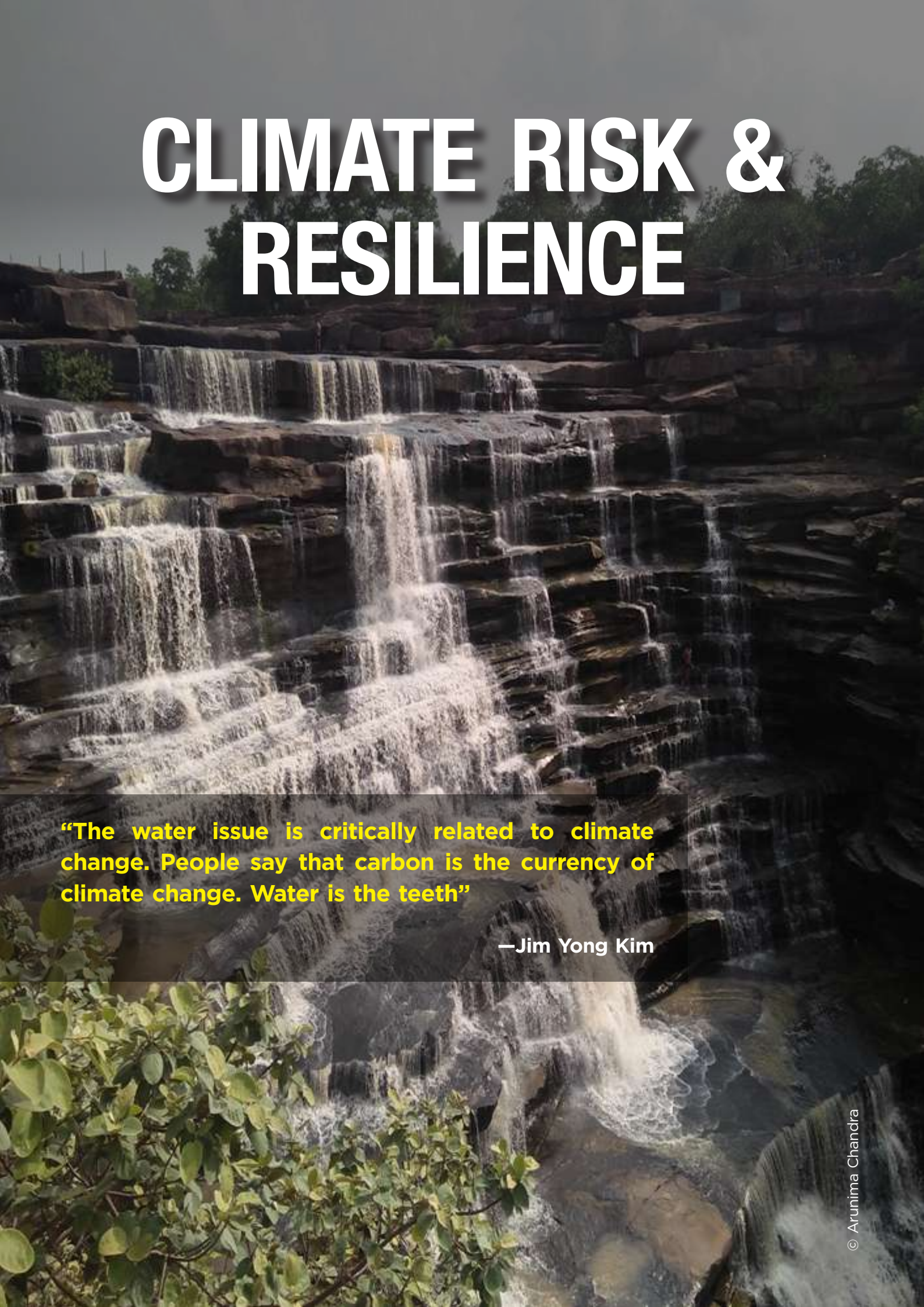
Phone No.: 91–124–233100

CLIMATE RISK & RESILIENCE



"The water issue is critically related to climate change. People say that carbon is the currency of climate change. Water is the teeth"

—Jim Yong Kim

1. Flood Livelihood Restoration – *Udyama*
2. Risk Reduction and Livelihood Promotion – *Udyama*
3. Sustainable Livelihood & Fair Climate Initiative – *Udyama*

FLOOD LIVELIHOOD RESTORATION

Place of Implementation: Balenga Gram Panchayat of Kosagumuda Block in Nabarangpur District

Agency: UDYAMA

Year of Implementation: 2011

Background

The region was prone to flash floods. From Koshagumuda Block, Balenga was one of Panchayats which was worst affected by the devastating flood. Nearly 90% of the standing crops and 70% of houses were damaged by the flash flood. Importantly, one of the most backward districts of Odisha, Nabarangpur is also plagued by flash floods, which is one of the major causes for sluggish growth and poverty in the region.

Objectives

To restore livelihoods, address food and nutrition security and build community institutions.

Interventions

- Formation of Village Development Committee
- Formation of Self Help Groups
- Formation of Farmers' Club
- Community pond renovation
- Sand reclamation from individual agricultural land
- Kharif paddy seeds
- Training on SRI rabi seeds
- Grain bank
- Seed bank
- Farmers' training
- SHGs' training
- Income-generating support
- Pisciculture programme

Outcomes

- Institution strengthening
- Land-based livelihood promotion
- Capacity building
- Leveraging resources

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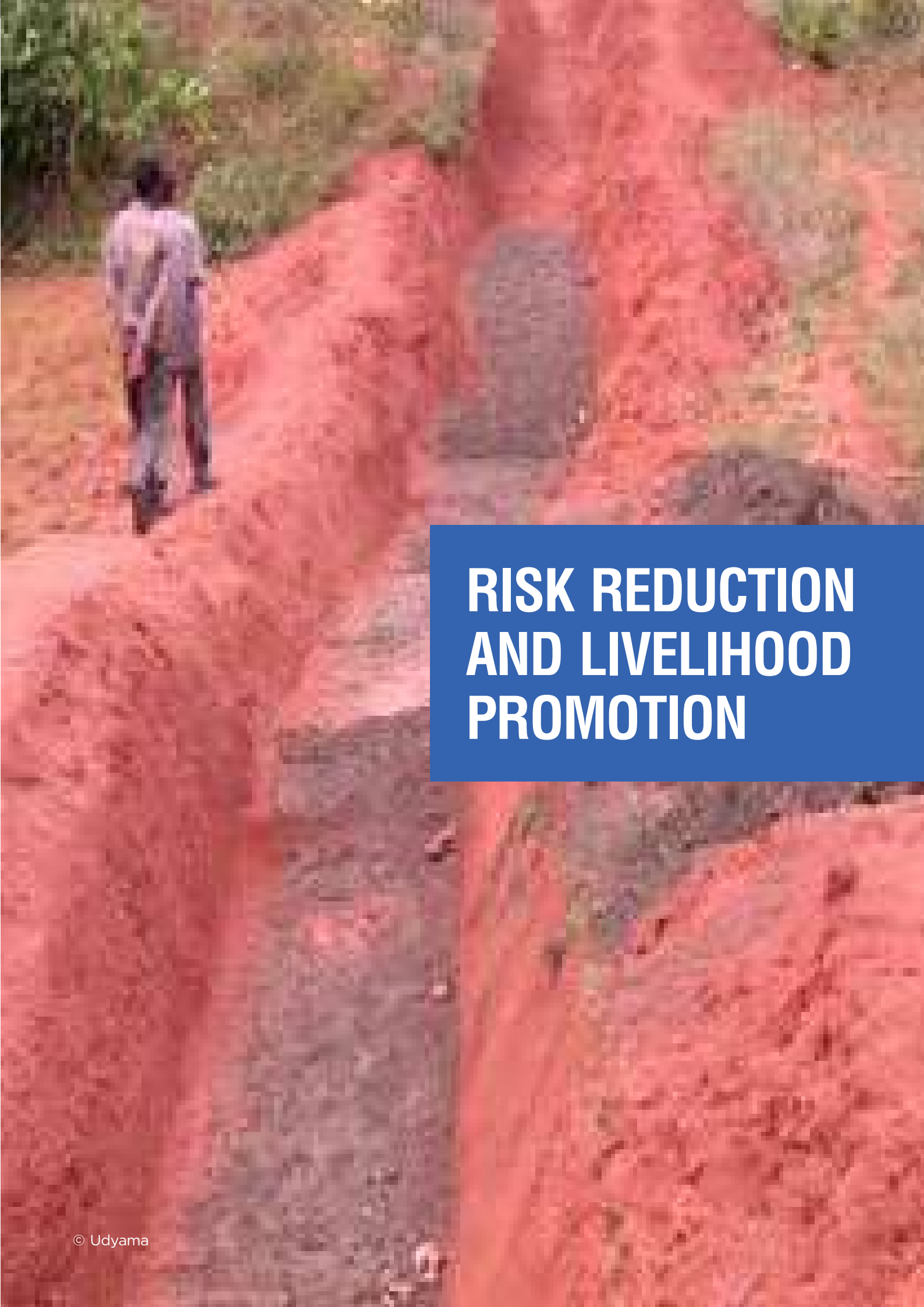
Sand Reclamation

Community Tank Renovation



RISK REDUCTION AND LIVELIHOOD PROMOTION

Place of Implementation: Western Odisha

Agency: Sramika Shakti Sangha, Anchalik Jana Seva Anustan, Bolangir Gramodyog Samitee, Agency for Social Action, UDYAMA, Samaja Pragati Sahayog

Year of Implementation: 2006

Background

The area prone to floods was vulnerable to hunger, starvation, child sale and women trafficking leading to rampant social, mental and physical abuse. This has also led to skewed land distribution, low productivity high debt traps/credits, livelihood displacement and more

Objectives

To generate sustainable livelihood practices based on existing natural resources, to significantly reduce distress migration.

Interventions

- Drought-resistant varieties of crops promoted based on land classification.
- The growth of cereals, pulses, vegetables requiring less water prioritised.
- Animal Husbandry as the better option for crop diversity and appropriate land management was also promoted.
- Promotion of crop insurance as a part of drought proofing plan.

Outcomes

- Diverse livelihood options explored and income-generation activities scaled up.
- Revival of growth of drought-resistant crops to cover risks of crop failure.
- Micro water harvesting structures provides protective irrigation to 20 acres of agricultural land during critical periods.
- Watertable in wells has risen, along with availability of water for longer durations.
- Women's groups and VDC play an important role.
- Emergence of 485 SHGs engaged in livelihood-strengthening activities.

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SUSTAINABLE LIVELIHOOD & FAIR CLIMATE INITIATIVES

Place of Implementation: Nayagarh and Bolangir Districts, Odisha

Agency: UDYAMA

Year of Implementation: 2014

Background

Erratic weather conditions put at risk crop output, production and yield, which contribute to the growing distress among the rainfed farmers, thereby resulting in distress migration.

Objectives

Various community-based institutions, such as VDCs, SHGs and user groups, have either been newly formed or revamped in the districts' villages.

Interventions

- Institutional development: exposure visit, promotion of CRP, village development and assessment plan, nutrition.
- Sustainable agriculture: training on sustainable agriculture, seed support, framer filed school, nutrition garden, organic farming practices, compost pit, grain bank
- Value addition and marketing: leaf plate processing, inland fish cultivation, ultra poor women support.
- Biodiversity conservation: forest conservation and plantation.
- Sanitation: training and campaign
- Soil and water conservation: rainwater management, dug well/ sallow ponds, water harvesting structures, land development and gully control.
- Life skills training: market-led vocational training.
- Green energy: energy audit, biogas, biomass training, solar dryer, solar home lighting system, integrated energy centre, fuel efficient stove, treadle pump.

Outcomes

- As many as 28 VDCs and SHGs were instituted, which are now fucntioning regularly.
- Convergence with mainstream programmes initiated such as NABARD and Odisha Renewable Energy Development Agency.
- Demonstration of Green Energy
- Integrated cropping, integration of farmers clubs in to intensive farming, appropriate technology on soils and water conservation demonstrated
- Building platform for producers' organization at community level to accelerate farm products in a business model
- International Development Enterprise (IDE) is collaborate in both the district on technical support on Agricultural planning and demonstration
- Several community assets created , institution created with good partnership
- The process of community resilience has opened a new vista to work further on micro-initiatives in harmony with local culture, nature, environment with. It would be brought under agro-ecological tourism on revenue model

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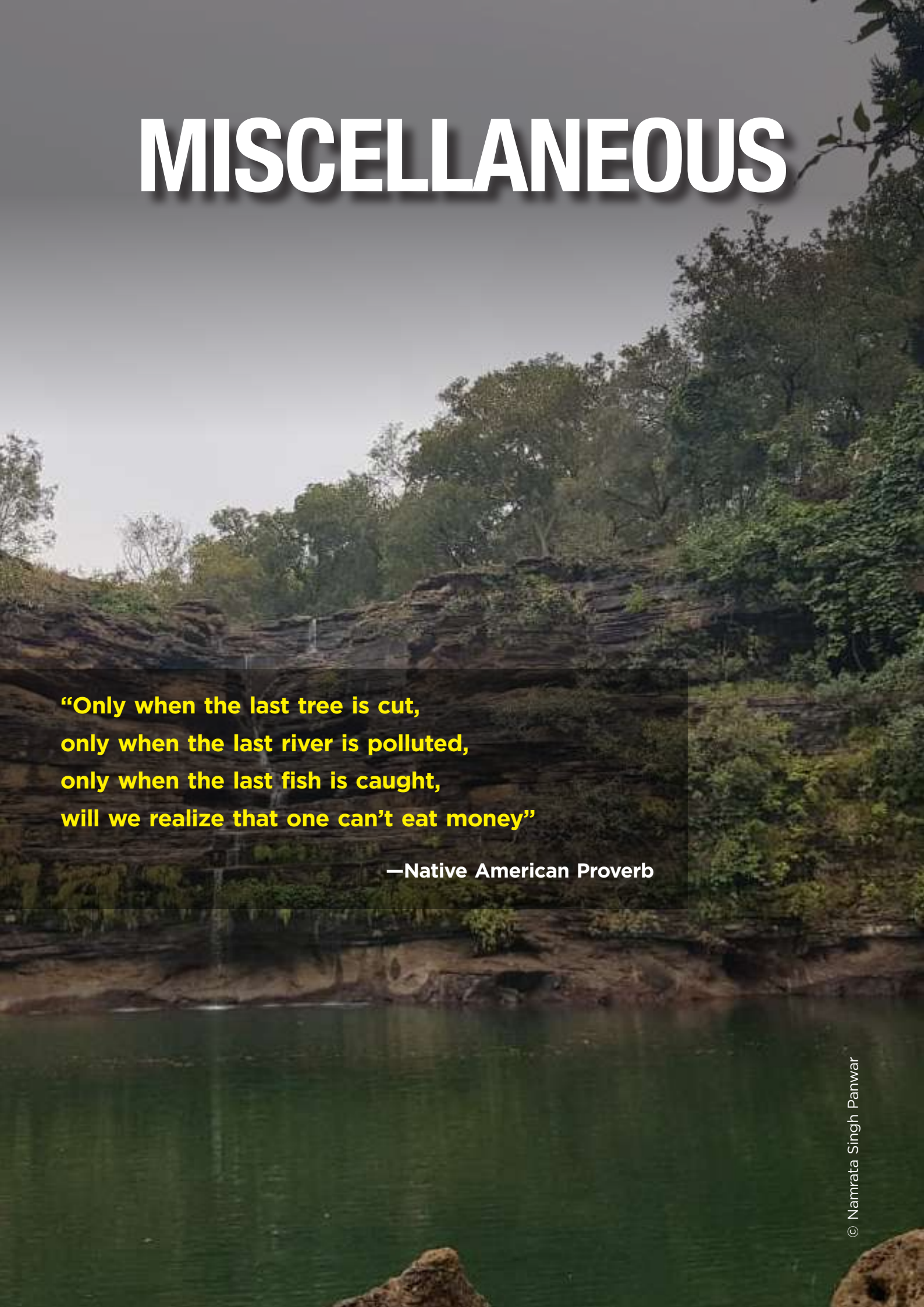
MISCELLANEOUS



"Only when the last tree is cut,
only when the last river is polluted,
only when the last fish is caught,
will we realize that one can't eat money"

—Native American Proverb

1. Making Gurugram ‘Water Conscious’ through Community Mobilization – *GuruJal Society*
2. Andhra Pradesh Water Resources Information and Management System – *Government of Andhra Pradesh & Vassar Labs*
3. Wastewater Reuse Certificates and Water Entitlement Transfer Trading – *Maharashtra Water Resources Regulatory Authority*
4. Gurugram District Enforcement Drive – *GuruJal Society*

MAKING GURUGRAM 'WATER CONSCIOUS' THROUGH COMMUNITY MOBILIZATION

Place of Implementation: Gurugram, Haryana

Agency: GuruJal Society, Gurugram

Year of Implementation: 2019

Background

Community sensitization and behavioural changes are at the centre of water conservation.

Objectives

Connect with all stakeholders to gauge the current level of understanding of water-related issues—what water means for different people, create awareness on the availability of water and water quality, and communicate measures to be incorporated—to promote the judicious use of water.

Intervention

- Krishi Vigyan Kendra Mela: Interacting with farmers and conducting workshops on water conservation measures. Workshops in 50 Gram panchayat centres organized to promote drip and micro irrigation. Promotion of organic farming and introduction of community radios to allow the spread of information easily and readily.
- Connect the Drop: A planned module to sensitize various stakeholders to make Gurugram a water-conscious district. Community meetings are an essential tool to reduce possible resistance amongst locals and educate them on proper measures for water conservation. Jal Sansad, a mock parliamentary structure, comprising school students representing and holding the posts of the Indian Cabinet. Each post is designed to address water issues in schools. This is an ongoing process in currently 42 schools with 1,050 students. The annual Jal Pe Charcha trains over 100 volunteers through a four-hour-long session, to enable them to spread awareness in their respective localities. The Jal Sabha campaign ran in 133 gram panchayats, with the participation of 3,165 women, men and school students. It raised awareness on various practices of water conservation.

Outcome

- Krishi Vigyan Kendra Mela led to the conversion of 150 dried tubewells into recharge pits.
- After community mobilisation efforts and activities in villages, people stopped throwing solid waste in waterbodies; a vehicle would come to the village daily and collect the solid waste.
- Communities in certain villages grew active and volunteered their services in the restoration of their village's waterbodies.
- Workshops for community mobilization organized in 319 different locations, with 12,892 participants. As many as 156 schools have conducted workshops for their teachers, principals and students.

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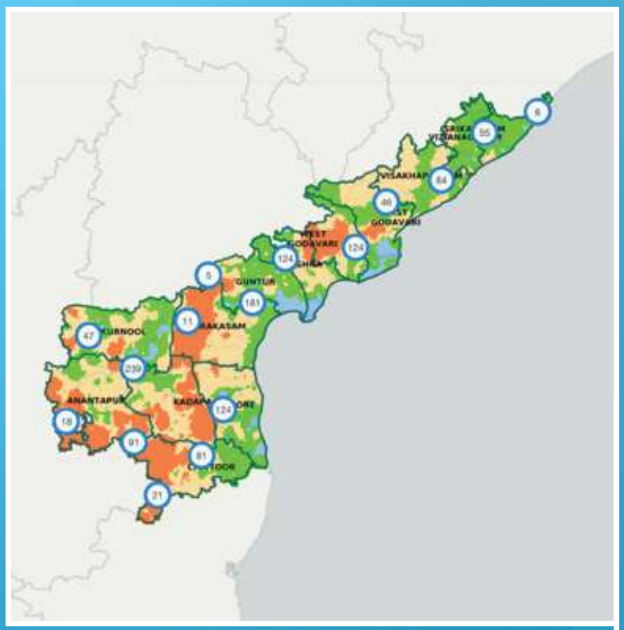
ANDHRA PRADESH WATER RESOURCES INFORMATION AND MANAGEMENT SYSTEM



Place of Implementation: Andhra Pradesh

Agency: Water Resources Department, Government of Andhra Pradesh, with Vassar Labs

Year of Implementation: 2017

Background

APWRIMS is a smart water solution platform, targeting the overarching objective of sustainable water management in the state. The idea is to have one authoritative system for all water supply, demand and environmental factors, with a vision of making water related data accessible transparently on near real-time basis to different stakeholder through an online GIS/MIS web-portal as well as seamlessly available through mobile, tablets et

Objectives

To implement the state's vision of taking a data-driven and scientific approach towards drought-proofing the state and providing water security to all.

Interventions

To ingest all kinds of data related to water resources in the state and bring in the latest technologies, such as sensors, satellites, AI and ML, to reduce human interventions. The APWRIMS collects data from 1,254 piezometers on real-time basis across 13 districts of the state and correlates the information with all 15,00,000 borewells used for agricultural purposes in the state. Soil moisture data is also collected from over 900 locations across the state. The platform has data related to more than 100 reservoirs, over 40,000 Minor Irrigation tanks, 15 lakh agriculture borewells and more than 10 lakh water conservation structures.

Outcomes

- APWRIMS is benefiting more than 60% of the population that is agriculture dependent in the state either directly or indirectly.
- Crop-planning activities resulted in an increase of about 1.85 lakh ha of horticulture crops.
- Groundwater levels improved by 2 meters across the state, despite receiving 14% less rainfall.
- Helped to optimize inter-basin transfer of water, which provided the critical and necessary water to the entire Krishna Delta region, impacting 1.1 million acres.
- Due to interventions, about 4,540 farmers benefitted; groundnut farmers increased their yield by 23%.
- Saved 970 MW hour of energy for pumping groundwater for irrigation purpose, which costs about Rs 4,850 million.
- Stabilizing an ayacut of 7.11 lakh acres
- Lift scheme management: After the revival of the LI schemes, the ayacut irrigated is increased substantially from 3.81 lakh acres to 6.15 lakh acres.

For further details contact:

Vassar Labs

E-mail: amit@vassarlabs.com

Phone: 91 – 8897701243

WASTEWATER REUSE CERTIFICATES AND WATER ENTITLEMENT TRANSFER TRADING

© MWRRA

Place of Implementation: Maharashtra

Agency: Maharashtra Water Resource Regulatory Authority

Year of Implementation: 2019

Background

Maharashtra Water Resources Regulatory Authority (MWRRA) is entrusted with the responsibility to determine the criteria, regulate and enforce the distribution of entitlements for the various categories of use and the distribution of entitlements, within each category of use, to establish a water tariff system for levying water charges on various categories of water users with a view to establishing a stable and self-sustainable management of service delivery to such users and provide clearances to water sector projects.

Objectives

- To encourage wastewater recycling and reuse in water-guzzling industrial and urban centres, which go beyond the stipulated water reuse targets mentioned in the State Water Policy.
- Creation of a transparent water accounting process.

Interventions

Launch of the Draft Maharashtra Water Resources Regulatory Authority Water Entitlement Transfer (WET) and Wastewater Reuse Certificates (WRC) Platform Regulations, 2019. The Regulations are yet to be notified for implementation.

Outcomes

- A benign policy to encourage wastewater recycling and reuse for industrial and urban centres that consume more water than what has been stipulated in the State Water Policy.
- Creation of a transparent water accounting process, with the use of IOT metering at the water consumption, reuse and environmental discharge points.
- Creation of immutable distributed ledger-based repository of wastewater reuse certificates created through a crowd-sourcing/ hackathon process involving practitioners and academia.
- Involvement of industry bodies, stakeholders, and IT experts, with knowhow in wastewater reuse processes to create a knowledge base for possible replication in other states.

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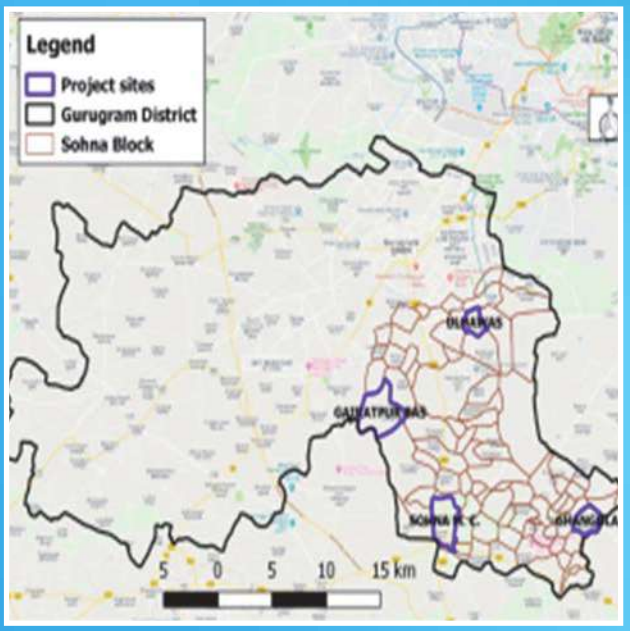

GURUGRAM DISTRICT ENFORCEMENT DRIVE

Place of Implementation: Gurugram, Haryana

Agency: GuruJal Society, Gurugram

Year of Implementation: 2019

Background

Several pieces of legislation and by-laws have laid down mechanisms for taking care of different aspects of our ecosystem. In Haryana, the Haryana Pond and Wastewater Management Authority Act, 2018, directs the constitution of a District Consultation and Monitoring Committee, or a District Pond and Wastewater Management Authority. Similarly, according to the Biodiversity Act, 2002, and its Rules, biodiversity management committees are to function at the district, sub-division, block, and panchayat levels. However, effective and regular enforcement of statutory provisions are sometimes limited. In this light, the GuruJal Society initiated a drive to gauge the difference that the implementation of existing provisions and mechanisms can make.

Objective

To map out the entire district, conduct due diligence, pin illegal water activities and non-functional rainwater harvesting systems and strict enforcement of statutory and non-statutory provisions to prevent water wastage and improve water management practices.

Intervention

- As many as 57 different teams comprising volunteers, government officers, police personnel and engineers were involved in the drive.
- Training over 100 police personnel and 10 plumbing apprentices of Industrial Training Institutes (ITIs) prior to the enforcement drive to check the functionality of rainwater harvesting structures.
- Launch of a helpline to report water issues, receive feedback and suggestions.
- Increase inter-departmental coordination and revive defunct committees formed under the statutes.

Outcomes

- A total of 290 illegal borewells/tube wells were sealed.
- Currently, there are 320 identified sites that require active intervention from various departments for water conservation and restoration of traditional waterbodies across the district.
- As many as 520 government schools have been identified across the district where functionality checks of RWH structures have been identified and through department coordination, the non-functional/ semi-functional RWH structures are being repaired.
- Through coordination, mandates of various departments are being aligned and forces are being used to empower the local community with the formation of committees.
- Development of standard operating procedures for better water management practices in the district that can easily translate to block-level implementation.

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NUTS & BOLTS: KEY TAKEAWAYS FROM COMPENDIUM

A number of community organizations, along with participation from local and state governments, in India has adopted water conservation practices over the years, which have immensely benefitted farmers and resulted in optimal allocation of water resources. A brief description of some of these best practices has been provided below:

Agriculture

1. Water User Associations, Tarapur, Uttar Pradesh, have played an important role in improving irrigation practices by spreading awareness among farmers. This also helped in curbing incidences of illegal water lifting in the area. Also, under MGNREGA, service roads along canals were widened and farmers were engaged in the process of removal of silt from these canals. This helped in improving water distribution efficiency.

   Participatory irrigation management and convergence of schemes are effectively implemented here, with active beneficiary involvement and financial contribution. This ensures efficient last mile service delivery and enhances the civic sense for maintenance of minor canals.

2. A unique, sub-surface plant root zone measured moisture system/irrigation technology called System of Water for Agriculture Rejuvenation (SWAR) was introduced in Anantpur district of Andhra Pradesh. SWAR shifts irrigation from surface to measure moisture at the plant root zone and uses only one-third amount of water compared to drip irrigation, leading to zero wastage. This technology is a prime example of low cost irrigation and can be emulated in other regions of India.

   This is a scalable model across the country, particularly in areas where water is scarcely available. In addition to the significant saving in irrigation water, this could be further developed to precision farming by combining with fertigation. Improved crop yield, better soil health and use of only the required quantity of fertilizers make this method very attractive.

3. The problem of low water availability in South Chhattisgarh was addressed through participatory planning, involvement of village organizations and self-help groups in the construction of small water harvesting structures and in spreading awareness about different types of cropping systems.

   Farmers were encouraged to actively engage in planning and exploring options for additional income-generating activities such as fisheries. Beneficiaries gained confidence by successfully practicing a scientific cropping pattern and water conservation measures. This shows how capacity building and knowledge dissemination among locals can put an end to irrigation woes in an area.

4. The Government of Maharashtra rolled out "Gaalmukt Dharan and Gaalyukt Shivar" (GDGS) scheme, under which waterbodies were de-silted using excavating machines. This is a programme where the cost is borne jointly by the government, farmers and trusts. This is a prime example where money is pooled in from different sources and a common goal is achieved. The scheme can be replicated in other regions to prevent droughts.

   This initiative has several benefits, such as increased water storage, improved fertility by way of depositing silt, and community participation. Farmers can recover the financial contribution made for desilting by way of improved crop yield and assured irrigation.

5. Yavatmal District, Vidarbha Region, Maharashtra, holds the record of the maximum number of farmer suicides in India. To reduce the pressures of debt on farmers, three phases of developmental interventions were carried out in the area between 2007 and 2016.
   - Cash for Work (CFW) through implementation of soil and water conservation.
   - Support for irrigation, agricultural inputs, intercultural operations.
   - Other works such as the deepening of wells and farm ponds, distribution of horticulture plants, smokeless stoves, and construction of toilets.

   There has been an increase in the number of farmers practicing soil and moisture conservation. This model can be adopted in areas that are severely drought hit and economically backward.

Groundwater Management

6. The problem of water scarcity in Gadakwadi village of Pune district in Maharashtra was addressed by sensitizing the local community on groundwater management. Primary data on water levels, rainfall, water quality and other socio-hydrological data, etc., was collected by community resource persons in the village. Accordingly, a number of recommendations was made, such as a ban on drilling of borewells, crop planning on the basis of availability of water and the efficient use of water through drips and sprinklers.

   Scientifically backed recommendations and their due acceptance by the community made a significant difference to the water availability of the area by making it self-sufficient, which was once tanker-fed. In addition to hydro-geological benefits, individuals also benefited through increased incomes.

7. A participatory approach for springshed management in Uttarakhand, Himachal Pradesh, Nagaland and the Nilgiris led to the revival of springs and natural streams in these regions and assured a continuous supply of water to locals. This shows how the involvement of people in groundwater management can go a long way in the preservation of natural aquifers. Conservation of springs and springshed management are crucial in groundwater management. Activities such as the preparation of an inventory of springs, training and knowledge dissemination, afforestation measures, hydro-geological mapping, demand management, protection of recharge area and water budgeting can contribute heavily to springshed management.

8. A shared network of borewell-pooling among farmers was introduced in Andhra Pradesh and Telangana to address the problems of inadequate access to critical irrigation water, uncertainties in agriculture, and seasonal migration. This is a good example of how resource-sharing can be used to accomplish a common goal of groundwater management.

   This also led to energy and water saving through reduced pumping time. Moreover, by sharing groundwater equitably, it also

conveyed the message of public trust doctrine on water resources.

Watershed development

9. An integrated community-based approach was used to improve access to safe water for drinking, handwashing and toilet use by deepening of ponds, rehabilitation of wells and other water sources in communities, and improvement of water sources at the household level through a hub-and-spoke model (introduced in 2018) in the states of Andhra Pradesh, Bihar, Chhattisgarh, Maharashtra, Odisha. The hub-and-spoke should be replicated in areas that don't have access to water at all.

   This model has successfully integrated source rejuvenation, drinking water access to people away from the source through pipelines, solar energy and improved sanitation. Water management committees also play a crucial role here. Since the rejuvenated waterbodies are now transcends to drinking water source, it could be expected that its continued maintenance and conservation will be handled by the community with priority.

10. Village water user committees were formed in the states of Madhya Pradesh and Uttar Pradesh to prevent food and water crises. Members of these committees were involved in the construction of check dams and water conservation structures and trained about their responsibilities for management of these assets, thus entailing a participatory approach. This shows how collective work by locals can boost irrigation prospects in an area.

    Construction of check dams, with storage of around 3 to 4 million cubic metres, enhanced the groundwater level, increased the cultivated area and reduced migration.

11. Irrigation woes in Chhindharri village, Chhattisgarh, were addressed through the efficient management of natural resources such as land and water. Farm ponds and seepage tanks were constructed in line with the MGNREGA programme and focus was laid on plantations and irrigation systems. This shows how increased productivity of land and water resources can promote the growth of the beneficiary community.

    An approach of integrated natural resource management was practiced through the convergence of relevant schemes, with the active involvement of the beneficiary community. As a result, income of farmers increased by 60%, distress migration stopped and the confidence of the community was boosted. This is an ideal example that can be replicated in areas where natural resources are poorly managed and experience social distress.

12. Masulpani Gram Panchayat in Chhattisgarh evolved as a model for nearby villages because of the intensive work done under MGNREGA. Water harvesting structures were constructed by involving community members and importance was given to capacity building. The gram panchayat is also under the high impact mega watershed project—a joint initiative of the Chhattisgarh government and various civil society organizations. This is an example of how the MGNREGA programme has been effective in addressing water crises in the area.

    The right blend of community involvement, women's participation, dissemination of knowledge on water conservation structures, use of GIS tools and maps, and utilization of MGNREGA funds helped in regular employment generation and in the creation of a village-based cadre technically sound in water management principles. Such practices make the initiative sustainable and result oriented.

13. Solar energy has been used to boost irrigation prospects in three districts of Uttarakhand: Almora, Dehradun and Pauri Garhwal. The river was impounded by constructing check dams and water was collected in sedimentation tank. This was pumped to an overhead tank situated at an elevation of 180 metres and to upstream agriculture fields powered by solar panels.

    This shows how two natural resources—water and solar energy—were harnessed to address agrarian distress without leaving any carbon footprint. Use of renewable sources of energy should be promoted in suitable areas to reduce costs and prevent pollution.

14. Wastewater treatment plants were set up to treat wastewater in Khentawas and Mojamabad villages in Gurgaon. Several traditional waterbodies in Gurugram collect rainwater, along with wastewater, thereby reducing the sources of clean water. Wastewater treatment plants have been successful in improving the water quality in the area.

    Use of Phytorid beds for wastewater treatment is a low cost method that could be replicated to generate clean water from wastewater. The treated water is filled in ponds to undergo natural attenuation, which thereby reduces the BOD/COD/TSS levels to produce clean water that percolates into the ground. Water-scarce areas can adopt this technique; the creation of biodiversity zones around the ponds can also prevent encroachment.

15. Traditional water conservation techniques were used to revive waterbodies in Jakhni village, UP. The following works were done by farmers without any external funding, machinery, or resources: intensive plantation of trees on the ridges of agricultural fields; construction of farm ponds; raising of farm bunds; and trenching around wells and plantations.

    Jakhni was also declared a model 'Jalgram' by NITI Aayog. This is an epitome of social mobilization and rainwater harvesting at the community level, and has already been planned to be replicated in 1030 more villages.

16. Rajokri is a village located on the outskirts of Delhi. The wastewater from the village was directly discharged into the Rajokri pond, resulting in its deterioration and other problems such as mosquito breeding, sinking of sewage, etc. Scientific Wetland Systems with Active Biodigestors technology was used to clean the pond, along with the installation of sewage treatment plants. Sewage is now treated before being discharged into the pond. Similar technology is used for treating wastewater in other areas.

    This is a scalable model for waterbodies polluted by untreated sewerage discharge and thus causing serious hazard to the aquatic system and environment. The area around the Rajokri pond was transformed into a public place and even migratory birds were spotted there.

17. A participatory approach was adopted to address irrigation woes in Kutch district, Gujarat. Community resource persons were identified and activities such as de-silting of existing ponds, construction of storage wells and check dams and revival of old ponds were carried out to promote groundwater management in the area with the help of Arghyam.

    This endeavour shows how awareness in the local community can go a long way in boosting irrigation prospects of an area.

Water Infrastructure

18. Solar panels were installed to run tubewells to reduce operational costs and promote clean energy in Dehradun. Dependance on thermal sources should be reduced and use of renewable energy sources should be increased.

This practice can bring down the input cost on irrigation and agriculture where groundwater irrigation is dominant.

19. Piramal Sarvajal devised a hub-and-spoke model of safe water delivery at various resettlement colonies and slums across the country. This project comprises locally installed remote-sensing enabled, state-of-the-art water purification plants for in-situ purification of raw water and a network of automated water vending units or water ATMs installed for distribution of drinking water to the beyond-the-pipe communities in urban areas in Bhubhaneswar, Pune and Delhi. This model can be replicated to provide water supply to far-off regions.

    Use of technology in ensuring clean water supply is a laudable initiative and can be replicated. It will improve service delivery efficiency and ensure better health outcome for beneficiaries.

20. The Mothola-Oakland dyke in Assam was suffering from scour and severe continuous erosion by the Brahmaputra for several years and required immediate protection from further erosion. Accordingly, protection works with geo-bags apron and CC block revetment were proposed to secure life and property of inhabitants of Dibrugarh town and adjoining areas.

    This intervention saved Dibrugarh and adjoining areas from the dangers of flooding. The damage caused by the flood would have been manifold compared to the expenses incurred for the maintenance work.

21. Under the Kosi River Rejuvenation project in Uttarakhand, rainwater conservation-related works, such as the construction of check dams, were undertaken to store surface run-off. Check dams were constructed using pirul leaves, which were woven into iron wires. Apart from this, plantation around the dams was done to prevent chances of damage and to reduce soil erosion.

    This shows wise use of locally sourced materials for water and soil conservation. The trees planted in the vicinity of the drain supplements the outcomes. This practice could be replicated where such natural materials are available and the area around the drain is relatively devoid of trees.

22. Improper wastewater treatment and discharge from residential area have contaminated the surface in Sangamner town in Maharashtra. Wastewater was recovered by decentralization at the source by installing FBTec®—a trademark technology developed in Singapore with a focus on DEWAT (decentralized wastewater treatment systems) in line with UN guidelines. The technology has been successful in recycling wastewater and can be replicated in other parts of the country.

    Decentralization of wastewater treatment is ideal where drains and sewers are not well connected. Moreover, it can facilitate reuse and recycle at the point of generation itself.

23. GuruJal Society identified all possible sources of water leakages in Gurugram. Rainwater harvesting structure functionality checks were done at government schools and societies. Also, the RWA members were educated about the installation of aerators in kitchens and washbasins to reduce water consumption. Similar work can be done in other metropolitan cities to reduce water wastage.

    Prevention of leakages, rainwater harvesting, use of aerators and water budgeting at the institution level are proven water-saving methods. However, these are not practiced widely due to lack of awareness on the quantum of water saved. Here, measures are widely implemented at the community level and the estimated the quantum of savings. This case study could be motivating

to similar communities to adopt and practice.

24. Sub-surface dams with "Z" sheet technology have been constructed to arrest decline in the groundwater table in Kadapa district, Andhra Pradesh.

    This method is devoid of all impacts a conventional checkdam or weir causes to a river system. Sub-surface flow will be slowed down and percolated to join ground water table. Similar technology can be used to recharge freshwater zones in other regions of India which is faster and causes very less damage to the ecosystem during construction.

Climate-Risk Resilience

25. Climate change has wreaked havoc on farmers in Western Odisha in the form of unexpected droughts and floods. Accordingly , the following measures were introduced:

    - Drought-resistant varieties were promoted based on land classification.
    - Low water requirement cereals, pulses and vegetable were prioritized.
    - Selective varieties, such as fruit-root-shoot, were promoted.
    - Sustainable Agriculture: Training on Sustainable Agriculture, Seed Support, Framer Filed School, Nutrition Garden, Organic Farming Practices, Compost Pit, Grain Bank
    - Soil and Water Conservation: Rain Water Management, Dug Well/ Sallow Pond, Water Harvesting Structure, Land Development and Gully Control

    Climate change poses unprecedented threats to agriculture. Erratic rainfall affects the growth and yield of crops. To tackle the situation, it is essential to develop drought- and flood-resistant crops, promote biodiversity conservation and strengthen institutions. Though the practice can't be replicated as such in everywhere else, it could be implemented with modifications to suit local conditions.

Miscellaneous

26. A number of measures are being made to make Gurugram water conscious through community mobilization and behavioural change programmes.

    - Krishi vigyan kendra melas are organized to interact with farmers and conduct workshops on water conservation measures.
    - Connect the Drop is a planned module to sensitize various stakeholders to make Gurugram a water-conscious district.
    - The annual Jal Pe Charcha trains over 100 volunteers through a four-hour-long session to enable them to spread awareness in their respective localities.
    - The Jal Sabha campaign ran in 133 gram panchayats; as many as 3,165 women, men and school students participated. It raised awareness on various practices of water conservation.
    - An enforcement drive was also conducted in Gurugram to spread awareness on water preservation.

    These are good examples of how citizens are educated on water conservation. Similar initiatives can be undertaken in other communities in collaboration with government/non-government organizations.

27. APWRIMS is a smart water solution platform to achieve the objective of sustainable water management in Andhra pradesh and to have a single authoritative system for all water supply, demand and environmental factors, with a vision of making water related data accessible transparently on near

real-time basis to different stakeholders through an online GIS/MIS web-portal as well as through mobile and tablets. This is a good initiative towards data-driven and scientific approach for drought proofing and can be replicated in other States as well.

Lack of information or rather, information scattered across the system is a major hindrance to water resource managers and policymakers. APWRIMS provides all relevant information on a unified dashboard. This can be implemented in every state and could be clubbed at the national level in due course.

28. Wastewater reuse certificate and water entitlement transfer trading, Maharashtra (Maharashtra Water Resources Regulatory Authority) has put forward the idea of creating a transparent water accounting process and published the draft Maharashtra Water Resources Regulatory Authority Water Entitlement Transfer (WET) and Wastewater Reuse Certificates (WRC) Platform Regulations, 2019. It is intended to create an immutable repository of water entitlement and wastewater reuse certificates with the help of IOT metering at the points of consumption, reuse and discharge.

    As per the draft policy, water entitlements to every user will be updated in the system, with permission for transfer of entitlements. Further, a tradable water reuse certificate is issued to users. The idea of a common repository of entitlements and tradable water reuse certificates can be practiced anywhere, which will help bring in more accountability in water consumption and recycle/reuse. Going further, the tradability could be extended to avail incentive/subsidy in power/water tariffs.

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