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# Compendium

## Best Practices on Water and Agricultural Sustainability

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सत्यमेव जयते

कृषि एवं किसान कल्याण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& FARMER WELFARE
GOVERNMENT OF INDIA

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# प्राक्कथन

अत्यंत हर्ष के साथ मैं आप सभी को सेंटर्स फॉर इंटरनेशनल प्रोजेक्ट्स ट्रस्ट (सीआईपीटी) द्वारा प्रकाशित "कम्पेंडियम: बेस्ट प्रैक्टिसेज़ ऑन वॉटर एंड एग्रीकल्चरल सस्टेनेबिलिटी" (अनुवादित नाम- "सार-संग्रहः जल व कृषि से जुड़ी सर्वोत्तम प्रथाएं") से परिचित कराना चाहता हूँ। यह भारत के विभिन्न क्षेत्रों से चुनी हुई जल और कृषि सम्बंधित सफल दृष्टांतों का उत्कृष्ट संकलन है।

यद्यपि पिछले कुछ दशकों में भारत में कृषि क्षेत्र में हुई बहुआयामी उन्नति विदित है, जलवायु परिवर्तन के कारण किसानों की आजीविका से जुड़ी समस्याएँ इस समय हमारे लिए अहम् हैं। जलवायु परिवर्तन के प्रभाव जल व खाद्य आपूर्ति, कृषि उत्पादन, संसाधन प्रबंधन तथा किसानों की प्रतिरोधक क्षमता पर साफ देखे जा सकता है। इस स्थिति में कम लागत वाले, कृषक-अनुकूल समाधान खोजना अतिआवश्यक हो जाता है जिनसे बदलती जलवायु के प्रभावों से लड़ने के लिए किसानों को सशक्त किया जा सके।

इस कम्पेंडियम में विभिन्न कृषि-जलवायु क्षेत्रों (जैसे थार रेगिस्तान, झारखण्ड, लेह का पहाड़ी क्षेत्र आदि) के कृषक समुदायों के लिए प्रमुख समाधानों का विवरण है। इन विवरणों से मिली सीख छोटे व् निर्बल किसानों के लिए सतत जीवीकोपार्जन में लाभप्रद हो सकती है, जिससे उनके जीवन में सम्पन्नता संभव हो सके.

मैं सीआईपीटी को इस दिशा में काम करने के लिए और इस कम्पेंडियम को प्रकाशित करने के लिए शुभकामनाएं देता हूँ, व आशा करता हूँ कि यह सभी शिक्षाविदों, शोधकर्ताओं, नीतिगणों तथा सबसे महत्त्वपूर्ण, खेतों में काम करने वाले किसानों के लिए उपयोगी साबित होगा.

शुभकामनाएं,

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# MESSAGE

Agriculture continues to remain the predominant sector of Indian economy as still majority of the workforce is dependent on it for their livelihood. In the recent past, climate change is creating multidimensional effects on water, agriculture and livelihood nexus, which in itself is a complex issue. Exploring sustainable options in the form of technologies and practices will help in ensuring resilience and achieve long term sustainability of natural resources and agricultural growth.

Despite considerable gap between development of more effective solutions and the current needs, sufficient amount of work has been undertaken for sustainability across various regions and agro climatic zones in India. The present compendium of best practices is a step towards identifying, compiling, and sharing evidence based best practices having been or being implemented in the country. Lessons drawn from these practices will help in identifying and scaling up of sustainable interventions in the domains of agriculture, water conservation, energy and extension. This document will benefit the policy makers, researchers, civil society organizations, programme practitioners, cooperative societies and a large number of end-users.

Compendium of Best Practices covers 32 success stories from 19 states involving local NGOs, universities, corporate foundations, donor agencies and research organisations. An important aspect of these case studies is the importance given to engagement with community based organisations and farmers in knowledge building, sensitisations and adoption of models and practices.

This compendium is expected to create multiple ripples of change. I am sure that readers of this compendium will find it useful in promoting and adopting more suitable options for water, agriculture and livelihood sustainability

With best wishes,

**Dr Kamal Vatta**
Director, Centers for International Projects Trust
New Delhi

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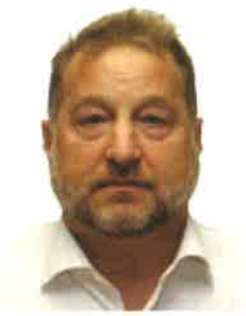
# MESSAGE



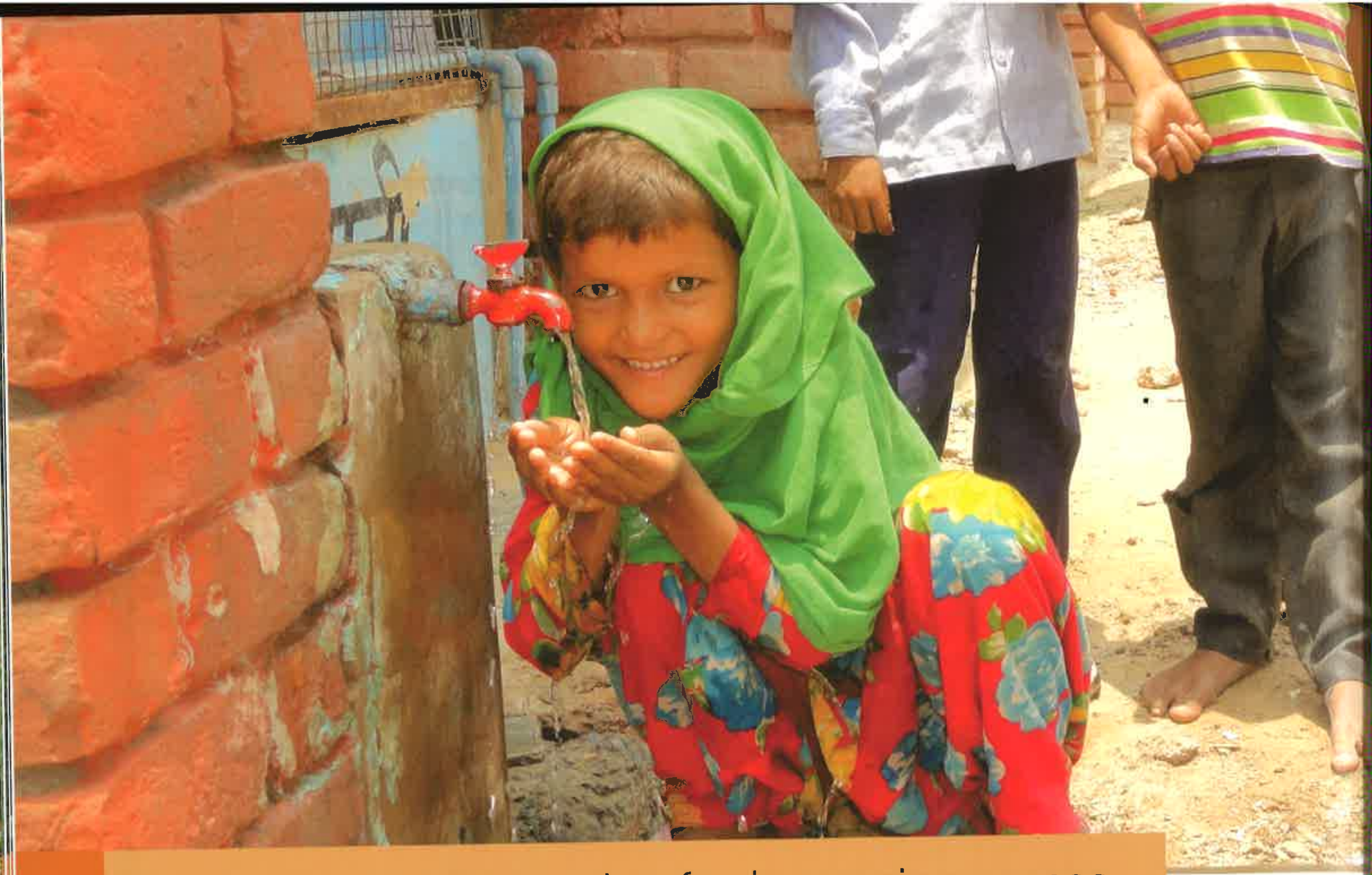
India is one of the fastest growing economies in the world. Agriculture is one of the most important sectors of the Indian economy, contributing 17% to the country's GDP and employing more than 50% of the total workforce. India has witnessed impressive achievements in agriculture, post – green revolution, which has helped in achieving self – sufficiency in food and economically uplifting millions of rural families.

However, sustainability of the agriculture sector has become a major challenge due to a growing population, over – exploitation of resources, extreme weather events, and an absence of profitability. In order to maximize profits and maintain food security, emphasis has been on enhancing agricultural productivity, leading to overexploitation of groundwater and increased power consumption in the sector. Water, energy and agriculture are intricably linked and the pressure on any one sector puts pressure on the others. This phenomenon strongly suggests a need to identify sustainable solutions to the water – food – energy nexus of challenges. It is equally important to share these solutions throughout the community of policy, development and technical practitioners for mutual learning.

I congratulate CIPT for documenting and compiling these successful accounts, "Compendium of Best Practices", in the area of water and agricultural sustainability, as experiences in different parts of India. An important aspect of the compendium is the significance of the various ecosystems in the country, each with its unique set of challenges, demanding unique solutions, but with many overlapping opportunities for learning and application.

Such a beneficial compilation will be highly beneficial as a learning tool for widespread adoption, will lay important groundwork for all working in this very important sector, the water – food – energy nexus, so critical to a sustainable future in resource management.

**Michael Satin**
Director, Clean Energy and Environment Office
USAID/India



# Roof rainwater harvesting for increasing access to potable water

A community managed system for rainwater harvesting in saline region of Haryana

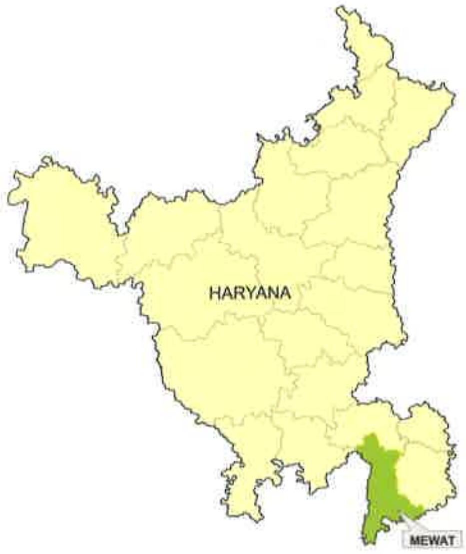
## BACKGROUND

Increased salinity is an important reason for deteriorating water quality. Salinity is caused by a relatively high concentration of dissolved salts in the water. Increased demand for groundwater has led to overexploitation and depletion of ground water tables. Depletion affects the flow (both direction and velocity) of groundwater, which may in turn cause polluted water from surrounding areas to flow into the freshwater aquifer. In coastal areas, it causes intrusion of sea water into the freshwater aquifer increasing groundwater salinity levels thus making it un-fit for drinking purposes.

Mewat district in Haryana, is one such area, badly affected by salinity. To address the intrusion of dissolved salts, this project aimed to develop and demonstrate a technology-based solution to create a localised source of freshwater in saline groundwater villages. The project duration was from August 2012 to August 2015.

## STAKEHOLDERS

The project was funded by Department of Science and Technology (DST), Government of India. Beneficiaries of the intervention included students, teachers and other staff members of government schools.




## APPROACH AND METHODOLOGY

The first phase of the project included an assessment of available water technologies and the development of a model of roof rainwater harvesting as a source of potable water. Based on the results of this assessment, an innovative roof rainwater harvesting system was developed and tested in the project area. Several factors specific to the region and local constraints led to the need to innovate. These included:

- High dependence on groundwater;
- Short rainy season of 31 days with a low average annual rainfall of 594 mm;
- Shallow groundwater table with high levels of salinity;
- Non-availability of reliable grid electrical supply;
- Inability to afford alternatives such as reverse osmosis; and,
- Difficulty in operation and maintenance of high-end technology.

### Tapping rain potential

Rainwater is one of the primary sources of freshwater. Particularly in areas with saline groundwater it is the only source of potable water also but its avaialbility is limited due to seasonality of rains. Due to this fact, roof rainwater harvesting emerged as the most preferred method during the priliminary assessment done as part of the project.

Existing water harvesting models have limitations such as high costs and spreading and mixing of fresh harvested rainwater. Though roof rainwater harvesting (RWH) is widely acknowledged as an effective solution to address water scarcity, the need was felt for a model more suitable to saline groundwater areas. Unlike surface water sources or storage of harvested rainwater, the rainwater is stored in the aquifer under the ground. It is not subjected to loss due to evaporation. It is also not limited by storage tank capacity. This means that the harvested water can also provide an essential basis of water security for potable uses during low-rainfall years.

In the new model, depth of the recharge wells was increased to make them lower than the groundwater table. With it, a desired freshwater pocket is created by pushing away and replacing the existing saline groundwater. The harvested freshwater remain in a consolidated mass due to the pressure exerted by surrounding saline groundwater. The harvested water from this pocket can be extracted through a pump without the usual problem of mixing with surrounding saline groundwater. This model was tested in a government school in Untka village and in three government schools in Nagina and Nuh blocks of Mewat. The systems have been functional for over two years.

## CASE STUDY: Provisioning for sweet water in schools

In Untka village, groundwater is highly saline, with total dissolved solids (TDS) at 5,980 mg/l. The government school in this village catered to 297 students without any source of water. Its daily requirement of water for drinking and midday meal cooking was estimated to be 750 liters and the total annual water demand is 150,000 liters for 200 working days per year.

In 2013, a roof rainwater harvesting system was put in place to recharge the aquifer with rain water using the model described. The financial resources given by the DST, Government of India, enabled setting up a RWH unit to capture rainwater over a roof area of 638 square meters. The average annual rainfall of 594 mm translated into an annual harvest of 3.2 lakh liters of water, considering a run off factor of 0.85.

Since July 2013, the school has used recharged water that is made safe for drinking by filtering through a bio sand filter so as to reduce the risk of biological contamination. The salinity of water pumped from the freshwater pool is below 100 mg/l (the permissible levels of TDS), and is made available year-round. The present water harvesting capacity surpassed the total water needs of the school.

## RESULTS AND OUTCOMES

The major component of the intervention was the design, test, and demonstration of a viable RWH model for exploiting harvested rainwater. Some of the key direct impacts observed included:

- Reduced girl school dropout rate
- Improved sanitation and hygiene conditions in schools
- Regular cooking of midday meals

The model omits the need for construction ofexpensive storage structures. The cost involved in the construction, operation, and maintenance of this model is comparatively lesser than other methods of water treatment, such as reverse osmosis.

By helping to make rainwater potable, this model reduces the demand for transported freshwater from the already overstressed sources lying outside this saline area. It also saves the distribution losses, energy and transportation costs, and their footprint on the environment.

Says Mohammad Musaraf, Untkaschool, Mewat. "Earlier, we were dependent on irregular and unclean tanker supply for drinking water. We used to go back home to drink water and not come back." Informs an excited Vajika Nazia, Malab school, Mewat, "We learned about a new scientific concept and water conservation model that works on our school premises."

### Sustainability and scale up

The experience at Untka school and demonstrations proved the model to be highly affordable for replication. The model is appropriate for regions with saline groundwater, including semi-arid areas and coastal areas with seawater ingress.This model can also be adapted for deeper saline aquifers and seawater intrusion-affected areas.

By
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