ICRISAT DEVELOPMENT CENTER

IMPACT

Stories of scale-up in agri-science

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Photo: TN Murthy , BISLD

ICRISAT scientists and locals of Mentapally walk past a wastewater treatment plant in the village. The wetland was constructed as part of a CSR initiative of REC Limited.

Inside

When wastewater ceased to be 'waste'

Soaring coconut trees on Ravi Sagar's five-hectare fruit plantation stand in stark contrast to Mentapally's semi-arid landscape. This south Indian village in Telangana receives less than 600 mm annual rainfall but ideal conditions for farming persist on Mr Sagar's farm, thanks to a community wastewater treatment unit.

Before the wastewater treatment unit's construction in 2017 as part of a watershed project by REC Limited, a Government of India enterprise, Mr Sagar's farm produced less than half the fruit it now yields. Low yields brought inadequate income at a relatively higher cost, compounded by use of chemical fertilizers. The farmer was quick to realize the profit potential a constructed wetland (CW) held for his farm; nutrient-rich water and biomass could potentially double his yield and income.

Mr Sagar became one of the first patrons of the wastewater unit. Mango yields on his farm touched 5 tons per season against 2.5 tons before the project began. Mr Sagar now makes an income of ₹ 500, 000, twice as much as he did earlier.

Domestic wastewater treatment plant

Farmers in rainfed ecosystems often use untreated wastewater to cultivate crops, vegetable and fruit to lower fertilizer spend as wastewater is nutrient-rich.

Wastewater treatment units are wetlands constructed with a filter bed made of sand/gravel. They are vegetated with wetland plants like *Cana indica* and *Typha latifolia*. The plants remove pollutants in the water through their roots.

Besides increasing water availability, CWs can provide additional income for villages during construction, operation and maintenance of the units. The revenue generated through treated wastewater and the biomass can aid economic sustainability of these engineered ecosystems.

The biomass can also be used to prepare organic fertilizer. Mr Sagar trims the *Cana indica* at the REC unit twice a month to collect about two truckloads of biomass which is then blended with woody wastes, cow dung, curd, and with the aid of worms for vermicomposting, results in about 1.5 tons of compost.

Several decentralized wastewater treatment units have been set up by ICRISAT in partnership with government and non-government organizations. With 87% efficiency in pathogen removal, decentralized wastewater treatment units reduce health risks and provide water security to smallholder farmers. The Mentapally watershed is a CSR initiative of REC Limited.

Mentapally farmer Ravi Sagar

Improved water availability and agronomy

Mr Sagar now grows 25 fruit species and is among a handful of farmers cultivating coconut in the area. This has been possible due to improved water availability in the farm pond, percolation and borewell recharge pits constructed during the project.

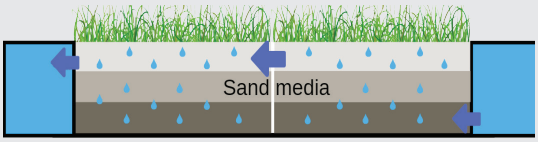
Apart from mangoes, the farmer also has cashew trees, sapodilla (sapota), sweet lime, pomegranate, jackfruit, orange, lime and other fruits. He recently purchased sheep, goat and poultry to help diversify the farm.

To compensate for increased utilization of organic material in his farm's soil, Glyricidia saplings were planted to help fix nitrogen and increase organic content. Mr Sagar also began mulching the soil with paddy straw to conserve moisture.

Urban India generates 62,000 MLD wasterwater

23,000 MLD gets treated

If adequately treated, domestic wastewater is a sustainable source for food production.



Decentralized wastewater treatment units reduce health risks and provide water security to smallholder farmers.

Constructed wetlands also help farmers produce biomass for vermicomposting.

> The number of fruit species and the quantity harvested has increased after the watershed project and wastewater treatment plant. I can now solely address the demand of a niche market of fruits that are not cultivated in this region.
>
> ***– Ravi Sagar***

Director General's message

Dr Peter S Carberry
Director General, ICRISAT

It is imperative for research to provide farmers with information and technologies that can minimize risks inherent in dryland agriculture. This motivation defines the impact that ICRISAT seeks from its research in the semi-arid tropics, home to over a third of the world's population.

ICRISAT works with partners across the globe and, for nearly half a century, our partnerships have delivered significant impacts in Asia and Africa.

My hope for IMPACT is that it will narrate the stories of our partnership approach and become a conduit for proven science. I hope that stories of impact herein are replicated to realize impacts at the scale needed to ensure the drylands deliver sustainable agriculture leading to livelihood prosperity for communities that face changing climate, growing population and the opportunities of markets.

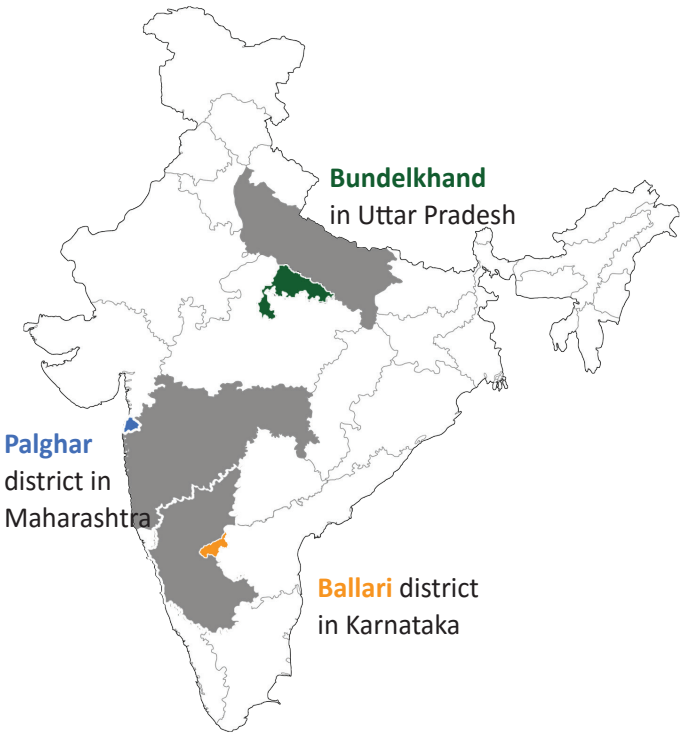
Greetings from IDC

I am delighted to introduce IMPACT, the quarterly newsletter of ICRISAT Development Center (IDC). At IDC, we use agricultural technologies to transform lives in rural India, the impact we strive for. Along the way, we often refine the 'Science of Delivery' of impactful technologies, inching closer to the 'Science of Discovery', a standardized process in the present day.

Through IMPACT we will endeavor to keep our donors and partners abreast of IDC's efforts across the country. While we will be bringing stories from the field demonstrating how science has been translated into successful interventions, we will also be candidly sharing learnings when our work yields the unexpected.

In this inaugural issue, we share with you a significant ripple effect of the efforts made in the parched lands of Bundelkhand region through the CSR initiatives of Coca-Cola. To transform the agricultural landscape in seven districts of Uttar Pradesh in the region, the State Government has come forward to invest in doubling farmers' incomes through science-backed interventions. We will share more about this project in the coming issues.

We are also proud to showcase the impact created by robust CSR partnerships with JSW Foundation and REC Limited in the states of Karnataka, Maharashtra and Telangana. I am sure IMPACT will prove a valuable read, but I am also certain your feedback can make it better.



I look forward to hearing from you. Happy reading.

Dr Sreenath Dixit
Head, ICRISAT Development Center (IDC)
Asia Program

Restoring faith in farming in Ballari, Karnataka

Water shortage forced farmer Thimappa to abandon agriculture and work a labor-intensive job in an industrial production unit to provide for his family. Two years after he quit farming, a JSW-ICRISAT watershed project helped him return to it.

Chikantapur village in Ballari district of India's Karnataka State is semi-arid with mean annual rainfall not exceeding 500 mm. The village relies on rainfall and ground water for agriculture. Mr Thimappa worked his 2.8 ha land for many years but the income from his farm was insufficient and varied significantly, depending on rainfall. He left his land fallow and took up the factory job earning ₹6,000 (less than USD 100) a month.

After initiation of the project 'Improving Rural Livelihoods through Integrated Watershed Management in Ballari', Mr Thimappa was directed by a local NGO and ICRISAT to dig a farm pond in his field. A check dam was also built nearby. These interventions helped recharge groundwater and facilitated the installation of two borewells on the farmer's field. Subsequently, he took up farming full-time and expanded agricultural activity by taking 2.40 ha on lease. The project ensured water availability even in drought years.

Mr Thimappa now grows chilies on 1.20 ha and earns a net income of ₹1,50,000 (USD 2000). From another 1.20 ha, he harvests 3 tons of maize and earns ₹20,000 (USD 285). Cotton and pigeonpea earned Mr Thimappa ₹60,000 (USD 860). With increased water availability, he has been able to allocate 0.40 ha for growing vegetables.

Impact in Joga

Mrs Sharada from Joga village helps her husband, a dryland farmer, on the farm. She is also a member of a women's self-help group called Vaishnavi. Under the JSW-ICRISAT initiative, members of the group ventured into a small-scale poultry business. Alongside 10 other members, Sharada received 10 chicks of Giriraja, a country hen breed. Members of the group were also provided financial support to build poultry units in their houses and to buy more local bird breeds.

The venture turned profitable for Sharada when she began selling eggs for ₹15 each. Despite her price being thrice the market retail price, Sharada managed to build a loyal customer base. She says growing health consciousness in the region is driving the demand for eggs of country birds.

"Eggs from country birds are highly nutritious and are produced organically through natural feeds. These attributes of the eggs earn a premium," she said.

Mr Honurappa, a Joga farmer, not only improved the yield from his irrigated land but also put wasteland to use. Nine check dams and two nala bunds were constructed as part of the watershed initiative. Mr Honurappa then dug a farm pond, ensuring ground water availability well into summer.

Mr Honurappa began using micronutrients including zinc sulfate, gypsum and borax. The brinjal yield on his farm jumped to 2.5 ton. As many as 400 saplings of KPM Drumstick variety distributed free were grown on 0.30 ha of wasteland. In four months, the farmer started selling the vegetable to profit ₹28,000 (USD 400) from his wasteland.

> "My borewell now gushes water out, ensuring availability for most of the year. I have also been able to diversify agriculture with profitable activities like growing vegetable."
>
> *– Thimappa*

Impact across crops in Doddanthapura

Though versatile in his crop choices, water shortage undercut Doddanthapura farmer Basappa's income owing to the use of just 60% of the land.

After initiation of watershed activities in the village, Basappa dug a farm pond which, aided by the check dam built as part of the project, brought water to his borewell. He was also advised to use micronutrients after soil testing revealed deficiencies.

Photo: A V Seshadri | ICRISAT

Mr Basappa now grows chilies, cotton and groundnut. Groundnut yield jumped to 1.4 ton per 0.40 ha from about 1 ton earlier. His income from cotton saw a 25% increase owing to a commensurate yield rise. Chilies yield registered a similar increase.

Wasteland turnaround in Kodalu

For years, Mrs Mokshamma's 5.2 ha farmland in Kodalu village was left barren due to non-availability of water. Profiting from the wasteland was not the farmer's priority until the JSW-ICRISAT watershed project began.

> "A few years ago, I would not have entertained the thought of cultivating my land as I feared any investment was too risky. With assured water supply after the watershed project, I can earn a living from farming."
>
> *– Mokshamma*

Soon, groundwater level increased after a check dam, nala bund and farm pond were constructed. Emboldened by the water supply, Mokshamma decided to take a big plunge into agriculture.

She took out a loan of ₹30 lakh to cultivate pomegranate. Her first harvest after reviving the land saw her reap 10 tons per 0.40 ha. Now, three years later, Mokshamma has repaid her debt and is looking forward to profit from her farm.

Outcomes

45,000 m^3
Net storage capacity

100,000 m^3
Effective rainwater storage capacity

10-30%
Productivity enhancement interventions improved yields

131%
Land under irrigation increased

31%
Increased employment opportunities in agriculture reduced migration

Building climate resilience through watershed management helps farmers reap profits

A story of many firsts in a remote Indian village

For Krushna Arjun Thorat, a farmer in the Indian state of Maharashtra, poor yield from his farm was unexplainable despite multiple efforts to increase it. That his farm's shallow soil lacked fertility only became apparent after he began working with a JSW-ICRISAT project.

During rainy season in 2015, the non-governmental organization Rural Communes introduced the project 'Improving climate resilience of tribal farmers in Palghar district of Maharashtra through integrated watershed management' in Chambharshet, where Mr Thorat lives. As part of project activities, demonstrations of finger millet, groundnut and pigeonpea cultivation were conducted. The importance of micronutrients and ways to apply them to the soil was also conveyed through workshops. Impressed, Mr Thorat went to work on his field. He agreed to have his farm turned into a crop demonstration plot.

Rural Communes staff educated Mr Thorat about pearl millet variety ICTP 8203 (Dhanashakti), known to have a good taste, high yield and is high on nutrients, mainly iron. Mr Thorat prepared land by applying gypsum, zinc sulfate and boron with guidance from field staff. He took up line sowing, an operation he had not performed in the past. He realized that line sowing helped save seed and reduce cost. He carefully performed weeding and inter-culture operations while following advice of the field staff for urea application.

During a Farmers' Day event conducted in his village, scores of farmers visited Mr Thorat's field. They asked him about the crop and for the seed. From just 0.05 ha land, he was able to produce 45 kg of pearl millet.

Mr Thorat has saved some seed for sale during rainy season. In his house, millet is used for preparing *Bhakri*, which is a hit in the farmer's neighborhood.

> "The project helped us understand that some of our farming practices needed correction to maximize yields."
>
> *– Krushna Arjun Thorat*

Improving climate resilience of tribal farmers in Palghar district of Maharashtra through integrated watershed management

Partners:

- JSW Foundation
- Rural Communes
- Government of Maharashtra

Project objectives:

- To bridge the yield gaps on smallholder farmer fields through increased sustainable productivity by 50% in five years in target villages.
- To enhance water availability and its use efficiency for diversifying livelihood systems through an integrated water resource management approach.
- To develop the capacity of farmers in the region for improving rural livelihoods through knowledge sharing and dissemination strategy.

Farmer Krushna Arjun Thorat displays his pearl millet harvest.

Masons help farmers harvest rains in Bundelkhand

Doubling farmers' income in Bundelkhand:

Partners:

- Government of Uttar Pradesh

Project objectives

- Enhancing water availability across seven districts
- Introduction of new varieties of wheat, chickpea and mustard
- New agronomic techniques like laser land levelling and zero till method of sowing to be introduced.

How important are masons in agriculture? If the success of ICRISAT's watershed efforts in Bundelkhand region is an indication, skilled masons are crucial in helping farmers double their incomes.

The 'Doubling farmers' income in Bundelkhand' project aims to develop 5,000 ha in each of the region's seven districts. Water harvesting works which were initiated earlier are now being scaled up, increasing the demand for skilled manpower. To meet the demand, skill enhancement training programs are being conducted for masons.

Two masons from each district have been chosen for work at a pilot site of the project in Jhansi, while being supervised by Mr Ram Prakash Kumar, the lead mason, and the ICAR- Central Agroforestry Research Institute (CAFRI) team led by Principal Scientist Dr Ramesh Singh.

This month, 15 masons were trained in excavation, reducing the width of the foundation, placing iron bars, constructing various components of rainwater harvesting system (RWHS), avoiding preferential flow in varied situations and material quality. After training, they will be deputed to their districts to construct water harvesting structures in consultation with the CAFRI and ICRISAT teams.

Rainwater harvesting through check dams, farm ponds, check walls and well recharge systems increase water availability and irrigated land, ensuring good crop growth. It is often seen that these structures, when built in the best of ways, continue to function efficiently long after their intended lifetimes.

Dr Ramesh Singh of CAFRI and Dr Kaushal Garg of ICRISAT, contributed to this story.

Instances where such structures lasted less than 8 years, it was learnt that poor foundation, absence of cutoff and toe walls, short extension wall and use of sub-standed material were some reasons for failure.

As part of ICRISAT and ICAR-CAFRI – led projects in Bundelkhand region, low-cost robust designs for rainwater harvesting structures were developed and tested during 2012 -2016 in Parasai-Sindh watershed, Jhansi.

ICAR-CAFRI also worked in Garkundar-Dabar watershed of Tikamgarh district, Madhya Pradesh, where many water harvesting structures were constructed in 2006 and 2007; these structures did not require maintenance for 14 years after construction despite witnessing heavy floods. During the implementation of these watershed projects, only a few masons could learn and develop the skills necessary for constructing strong rainwater harvesting structures.

Construction of checkdam in Rajapur village. After completion (below).

Photos: Anil Singh, ICRISAT

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NITI Aayog recognition for Parasai-Sindh watershed management

A check dam in Parasai-Sindh watershed in Jhansi, Uttar Pradesh.

Parasai-Sindh watershed has added another feather to its cap. The National Institution for Transforming India (NITI Aayog) recognized the project as among the best water practices in India.

"Local community in the water scarce Parasai-Sindh region of Jhansi, Uttar Pradesh increased groundwater level by 2-5 meters and made 100 acres of land cultivable by constructing check dams, farm ponds and renovating existing structures in 8 locations," a recent Facebook post from NITI Aayog reads.

Parasai-Sindh watershed covers the villages Parasai, Chatpur, and Bachauni in Babina block of Jhansi. A CSR initiative, it was jointly developed by ICRISAT and ICAR-CAFRI with community involvement between 2012 and 2016, and with support from Coca-Cola India Foundation as a CSR. Nearly 125,000 m^3 storage capacity was created by renovating traditional water tanks and constructing check dams on village streams. More than 250,000 m^3 runoff was annually harvested, raising groundwater by 2-5 meters.

Partners:

- Coca-Cola India Foundation
- ICAR-National Research Centre for Agroforestry

Project outcomes:

- Enhanced water availability in target villages through rainwater harvesting and recharging of wells
- Enhanced water use efficiency and agricultural productivity through improved management of land and water resources
- Established a site of learning within five years of project inception
- Transformed villages from a degraded to productive stage.

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