CROP RESIDUE MANAGEMENT

Crop Residue Management

{A project beyond a project}

Supported by: The Walmart Foundation
Implemented by: S M Sehgal Foundation
2022-2025

Together with the village communities, our proud farmers, and government departments, we made change happen.

North Indian Farm Fires

Every autumn, as paddy is harvested across Punjab, Haryana and Uttar Pradesh, fields are left covered with a dense layer of stubble stretching across millions of acres. With limited time before the next crop is sown, this crop residue are set on fire to clear fields quickly. Thick smoke rises from these farmlands and spreads across the Indo-Gangetic plains. Carried by seasonal north-westerly winds, it travels hundreds of kilometres and reaches Delhi-NCR. There, it worsens air quality, reduces visibility and affects public health.

Over the years, National Green Tribunal and the Supreme Court of India have stepped in, issuing directions to curb stubble burning, enforce penalties, and promote alternative crop residue management practices. What appears to be a simple act of burning is closely tied to farming practices, time pressures and environmental choices.

Stubble burning releases harmful pollutants, including greenhouse gases like carbon dioxide, methane, nitrogen oxides along with fine particulate matter, adding to the toxic haze that settles over large parts of north India.

Breathing this air leads to respiratory illnesses such as bronchitis, and reduced lung capacity. Long-term exposure is linked to cardiovascular disease, neurological disorders and cancer, increasing premature death.

A Conflict

Paddy harvesting practices in Punjab and Haryana have changed rapidly over the past two decades. Once common, manual harvesting requires 2-4 days of labour to clear even a single acre. Today, shrinking labour availability, rising wages and tight agricultural timelines have made this approach difficult to sustain. As a result, farmers increasingly rely on combine harvesters.

A combine harvester performs cutting, threshing and separation in one operation. It can harvest an acre of paddy in about 20 to 25 minutes. Here, speed matters. Farmers aim to harvest quickly and reach the mandi (market) on time. Combine harvesters offer a clear mechanical advantage, allowing crops to harvest efficiently while reducing reliance on scarce labour.

Although combines save time and labour, they leave behind stubble across the field. Removing this residue involves additional cost and time. Under mounting pressure to prepare land for wheat, the next crop, burning the straw, becomes the easiest option for the farmers.

Since most of the farmers are cultivating high yield varieties, generation of biomass has also increased.

India generates approximately 500 million tonnes of crop residues annually

(National Policy for Management of Crop Residue, Ministry of Agriculture, Government of India)

{A Belated Prologue}

Preservation of Subsoil Water

Paddy is a highly water-intensive crop. In Punjab and Haryana, it is largely irrigated using groundwater putting a high pressure on groundwater reserves. Over the years, groundwater extraction has far exceeded natural recharge. Ministry of Jal Shakti has confirmed that Haryana extracts 37% more than extractable groundwater.

To address this crisis, Punjab and Haryana enacted the Preservation of Subsoil Water Act in 2009, in respective states. The law restricts early sowing and transplantation of paddy. Transplantation is allowed only after mid-June, when monsoon rainfall reduces dependence on groundwater, as well as to prevent evapotranspiration during summer heat. The intent was to protect rapidly declining water tables.

This act shifted the cropping calendar. Paddy is a 100-140 days crop. Delayed transplantation leads to delayed harvesting. This leaves farmers with a very short window between cutting paddy and sowing wheat.

A noble policy to save groundwater resulted in unintended burning of crop residue

Solutions & Efforts

If crop residue is not burned, it must find alternative use. One such is to move the stubble away from the field. This approach came to be known as ex-situ crop residue management.

In this process, the paddy straw is cut, gathered, compressed into bales, and transported elsewhere. It is used as an alternative to fossil fuels, converted into pellets or briquettes for energy, incorporated into construction materials, or reused in agriculture as mulch. Seen this way, residue becomes a resource rather than waste.

To support this, the Government of India invested in machinery for cutting, baling and transport, and encouraged rental services through Custom Hiring Centres.

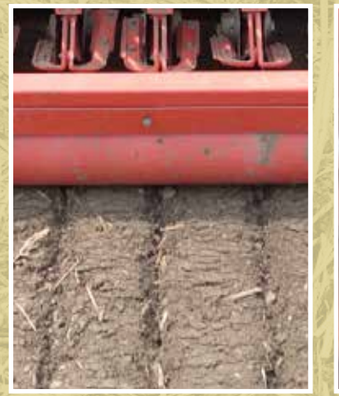
On the ground, the process involves several steps and depends on external factors such as coordination, transport and available buyers within a limited time window. For small farmers, arranging all of this is difficult during the busy harvest season.

Since 2018–19, the Indian government has spent over Rs ₹4,000 crore (Rs 40,000 million) to reduce stubble burning by supporting alternatives to open fires, according to Press Information Bureau. States such as Punjab, Haryana, Uttar Pradesh and Delhi have received funding for crop residue management machinery and services.

The other solution is

Enter Super Seeder, a versatile machine towed behind a tractor, that mixes crop residue right in the field itself. Known as in situ crop residue management, this approach treats paddy straw as part of the land rather than waste to be removed. The arrival of the Super Seeder has transformed stubble-covered fields across the region.

The super seeder
cuts the stubble | mixes with soil | loosens the soil | sows wheat



More importantly, this machine puts crop residue back into the soil, adding organic matter and improving carbon content and moisture retention of soil. What once ended in smoke now returns to the soil, enriching the soil for the next crop cycle. As a four-in-one machine, it is efficient saving time and money too.

in situ solution

A Meaningful Engagement

As conversations around crop residue management deepened, the S M Sehgal Foundation supported by The Walmart Foundation began by asking a simple question: where was the need most urgent. In 2023, Kaithal and Kurukshetra were reported as two of the five hotspot disctrics in Haryana by a Press Information Bureau communique. Critical gram panchayats in these districts were noted from granular data.

Meetings with panchayats helped the project team to move from data to reality, and zero in on clusters of villages where burning was frequent and deeply rooted in practice.

The process began not with machines, but with listening

Conversations centred on finding solutions that would address the issue at hand and suit the scale and resources. In situ crop residue management emerged as a long term fit, especially for improving soil health over time. The state agriculture department was also engaged to vet approaches and align methods on the ground.

The project identified 150 villages across Kaithal and Kurukshetra districts. Working in clusters allowed the team to concentrate efforts, observe change more clearly, and build momentum across neighbouring communities.

“When stubble is burned, the soil suffers first. Then health of local community and environment is affected. Only later the damage reaches beyond. That’s how we began conversations with the farmers.”

- Sanjay Kumar
Assistant Programme Leader, S M Sehgal Foundation, Kurukshetra district

Machines to Farmers

“This year, the yield has been better than last year. Earlier, I used 70 to 80 kilos of DAP (Di-ammonium phosphate). Now, I use only 20 to 30 kgs. The soil is softer, retains more water. Overall, soil quality has improved.”

- Mahema Singh
Manjhla village,
Kaithal district

Mahema Singh from Manjhla village in Kaithal received a Super Seeder from the project, one of the 93 beneficiary farmers who received super seeders from this engagement. These farmers were identified to anchor change within their villages, not just on their own fields.

Selection followed a clear set of principles. Beneficiaries had to be farmers residing in the village and willing to invest in the solution themselves. Each farmer contributed ₹1 lakh (Rs 100,000), while the project supported the larger share of the cost. They were required to own a high-power tractor and agree to rent the Super Seeder to other farmers at existing village rates. Selling the machine was not allowed. Importantly, beneficiaries were chosen by the villagers themselves, ensuring that the initiative was built on local consensus.

Once selected, beneficiaries underwent proper training on operation and maintenance of the Super Seeder. Thereafter, machine performance and the output of each Super Seeder were meticulously monitored every season. Monitoring also included, crop performance, soil fertility and other benefits resulting from the use of the Super Seeder.

Introduction of shared economy is a step closer to circular economy

Everybody Wins

Sushil Kumar of Bhor Saidan village is not a beneficiary of a Super Seeder. He rented one. "*Super Seeder has changed the way wheat is sown and the way fields are managed after harvest. I now spend less money on wheat sowing. The stubble is mixed into the soil, and the field remains soft*," said Sushil.

The impact, according to him, shows up season after seaon. Mixing stubble into the soil has improved field conditions and reduced costs. Wheat yields have increased, while input use has gone down. More importantly, burning has disappeared from his fields altogether. There is no fire now. No smoke. No pollution. No stubble burning.

Sushil's experience reflects a larger story: how one Super Seeder, shared and reaps benefit to the whole community. One farmer invests, others use.This also capture the idea of shared economy. The benefits travel beyond ownership, moving fields to fields. This model focuses on access, more than possession, and change spreads quietly.

Cumulatively, the project managed stubble from 161,103 acres of land in the project area

"First, I used it in my own land, and later on others. During this paddy season, I rented it to 30-40 farmers covering 100-110 acres, and earned around ₹1.5 lakh (Rs 150,000)."

- Gurlal Singh
Bhor Saidan village,
Kurukshetra district

Success of a small farmer is not a linear event

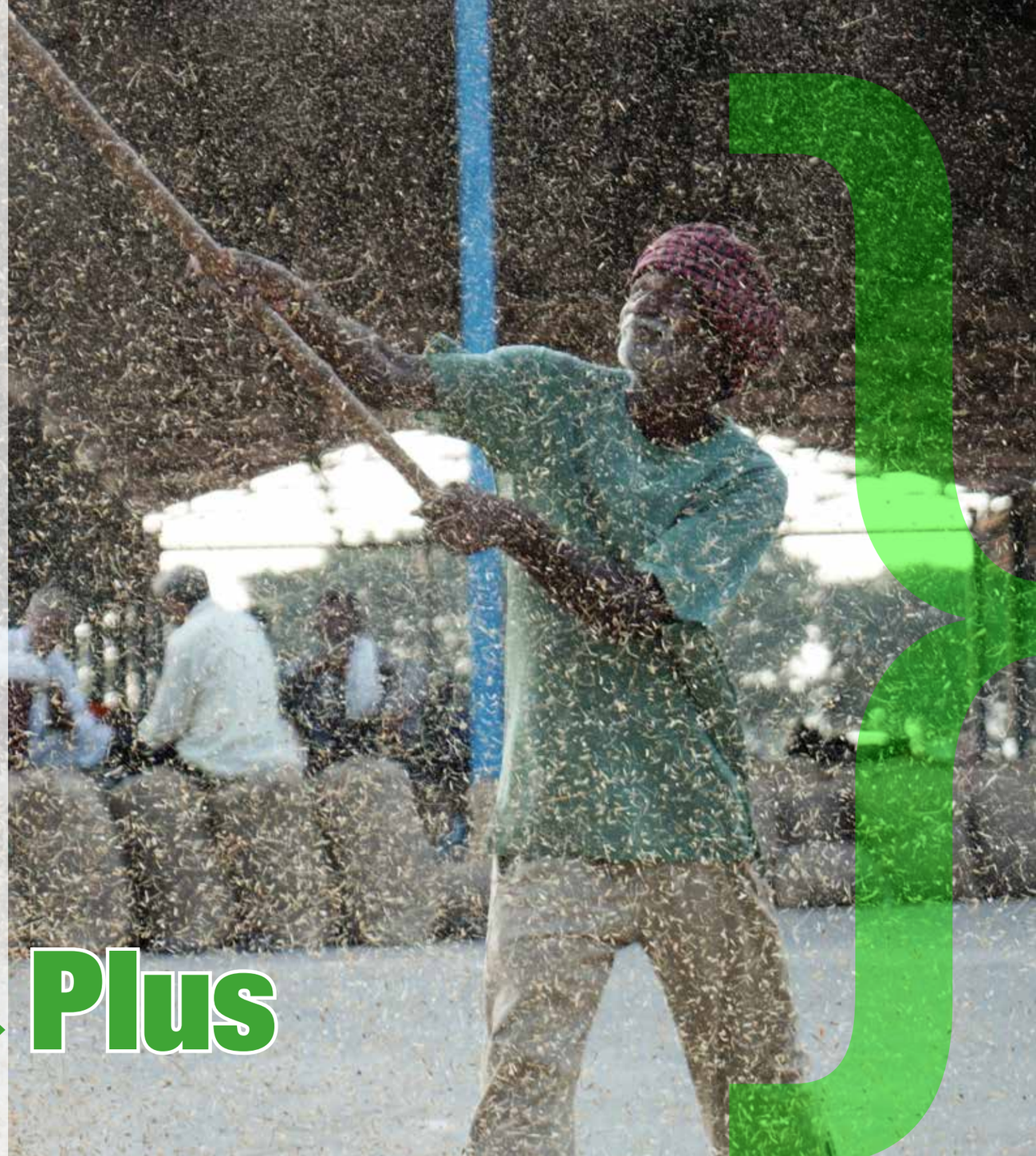
With years of working with small farmers, S M Sehgal Foundation understands the small farmers' success is layered. One solution rarely fixes reality. Therefore, the project did not limit itself to distributing super seeders only.

So the project widened its lens. Soil health became a continuing conversation, not a one-time intervention about what the land needs. Farmers were encouraged to adopt crop diversification, supporting a shift from water-intensive rice towards horticulture.

Change was also social. Women were brought into learning spaces and decision-making. By working on soil, crops, livelihoods and people together, the project has seen a transition from seasonal fires to long-term resilience.

Thus, the project included:

Crop Residue Management › **Plus**



Soil Health Matters

Soil enrichment was an important reason for choosing in-situ crop residue management approach in Haryana. But this understanding was, at first, largely theoretical that the project team wanted to validate and verify. And, soil testing became a regular part of the project, helping track how fields responded to mixing residue into the soil.

If soil health matters, is it not important for farmers to know the condition of their own soil? Making soil health visible to farmers through testing, observation and dialogue became central to the work.

Years of repeated use of fertilisers such as DAP, urea and chemical pesticides have slowly disturbed the natural balance of nutrients in the soil. Often, fertilisers are applied without fully knowing what the soil needs. When crops show stress, the response is usually to add more inputs.

Knowing what lies beneath the surface allows farmers to make informed choices, reduce unnecessary inputs, and treat the soil not as an endless resource, but as a living system that needs care.

The project tested 6,202 samples of soil

Farmers' Field Training

"Whenever you find the plants shorter or yellow, farmers only put in urea and DAP, nothing else. But a crop needs 17 nutrients"

- Prashant Shukla
Project Associate, S M Sehgal Foundation, Kaithal district

Training unfolded in the fields, not in classrooms. During farmers' field training sessions, farmers shared their own problems and experiences from the field. Collectively, they observed the crops, analysed and responded with practical solutions.

Based on soil tests conducted in the area, a set of inputs recommendations, often referred to as Package of Practices (PoP) by farmers, was developed consisting of right amount of micronutrients to suit soil conditions for paddy cultivation. A total of 624 PoPs were prepared and distributed among the farmers. They were encouraged to apply it themselves on half an acre as demonstration plot. In the remaining area, farmers continued with their usual practice as control plot. Everything else, irrigation, labour, and care, remained the same.

The difference was easy to see. Crops grown with recommendations appeared taller, cleaner and stronger. In comparison, plants grown without it were shorter and showed early signs of nutrient stress. Farmers observed that this visible gap could translate into two to three quintals per acre. The field itself became the classroom, offering proof without explanation.

Farmers observed a 10% increase in yield of paddy with recommended inputs

Supporting Horticulture

Convincing farmers to move to horticulture after years and generations of ‘rice-wheat’ routine is a significant task. The project managed to convince Sandeep Kumar of Bhainsi Majra village to do exactly that.

‘Crop diversification’ is an idea to promote ecological sustainability in agriculture. But it can be successful only when it is also economically sustainable. Horticulture, by breaking the ‘rice-wheat’ cycle, not only erases stubble burning, but reduces water use resulting in groundwater conservation, lets the soil regenerate its fertility, and brings in more assured revenue ensuring a long term sustainability for small farmers.

The project encouraged farmers to adopt horticulture as crop diversification, and did hand-holding on pruning, organic practices, soil enrichment through vermicompost, and natural pest management. Intercropping during the early years of orchards provided additional income while trees matured.

Farmers in this region avoid orchards as animals damage them. Knowing local details at times helps a project in a long way. So the project offered to get fencing done for the willing farmers.

“This is the first fruiting of my guava orchard. I have planted around 340 guava plants, and each plant is expected to give about 20 kilograms of fruit. Based on this, I am expecting an income of around ₹2.5–3 lakh (Rs 250,000–300,000) from the orchard.”

- Sandeep Kumar
Bhainsi Majra village
Kurukshetra district

Aligning ecology and economy for better lives

Participating Women

“I have grown peach, chillies, cluster beans, brinjal, pumpkin, bottle gourd, lady finger, turmeric, cowpeas, guava, ridge gourd, bitter gourd, lemons. All without spraying any chemicals.”

- Balwinder Kaur
Lander Peerzada village
Kaithal district

In Manjhla village, Paramjeet Kaur, Mahema’s wife, stands ankle-deep in water, transplanting paddy alongside her husband. Later managing household responsibilties, caring for children and tending to livestock. Like many rural women, her work moves seamlessly from field to home, yet she is rarely part of decision making conversations within the household or the community.

Recognising this gap, Sehgal Foundation began organising Women’s Leadership Schools alongside crop residue management initiatives. Village women gathered to learn about soil health, nutrition and sustainable farmimg practices. Women were also encouraged to grow kitchen gardens, and produce nutrition-rich food at home.

A total of 1,700 sessions were designed to feel familiar and engaging. Games like snakes and ladders turned learning into play, helping explain food choices, soil health, and seasons. As confidence grew, participation followed. Women began to recognise the value of their experience and found their voices shaping decisions at home and in the community, making the change permanent.

Farmers associated with the Crop Residue Management Project in Kaithal and Kurukhestra can now cultivate rice without fear of pollution, ill health, degrading soil and penalty. They do not burn stubble any more.

In fact, they are enriching their soil and learned a few more practical lessons to reduce cost as well as grow more.

Those who want to diversify, have also found ways to do that.

19,518+ farmers from
150 villages participated in the project

The project distributed 93 super seeders
161,103+ acres covered cumulatively over three seasons

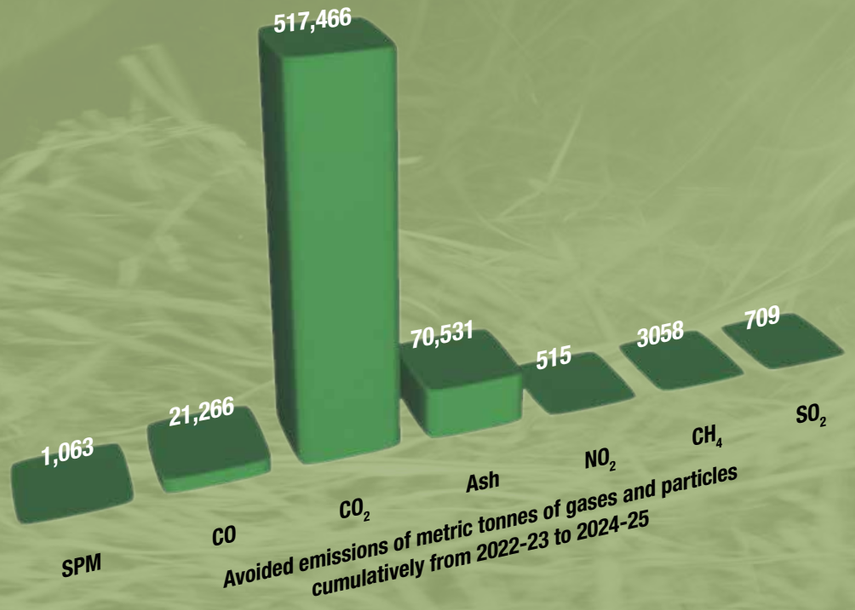
After testing 6,202 soil samples,
demonstration of paddy with better inputs took place
in 1,921 acres resulting in 10% increase in yield

Good Agricultural Practices
adopted by 34,854 farmers

Farmers' Climate Action

The story of stubble burning often did cast farmers in a negative light in discussions on Delhi-NCR air pollution. Initially, the farmers were helpless. This project turned the narrative into a different reality. By not burning crop residue, farmers not only reduced air pollution, but contributed to climate action by preventing greenhouse gas emissions.

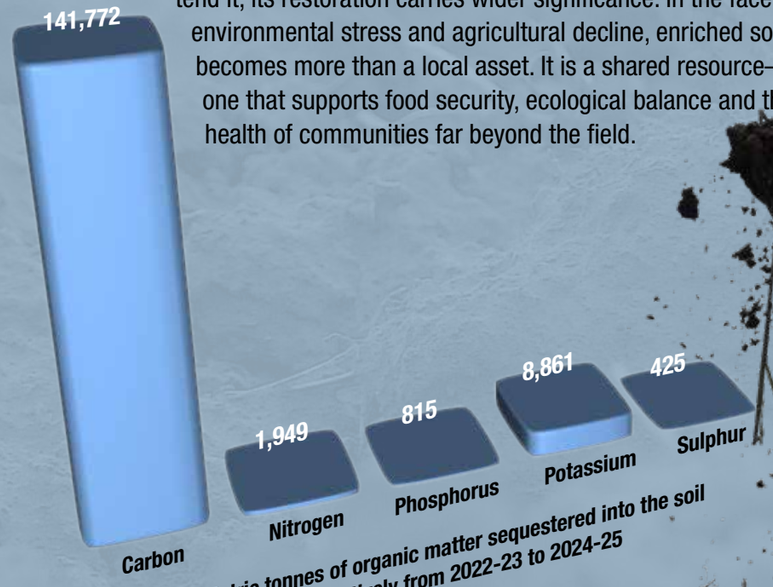
Monitoring by S M Sehgal Foundation indicates that farmers in the project area avoided nearly 0.517 million metric tonnes of carbon dioxide emissions cumulatively, a contribution towards global climate mitigation.



Farmers harvest nutrients

The decision to manage crop residue through in-situ methods and the use of the Super Seeder was guided by a simple principle: return organic matter to the soil. Over three years, farmers have observed tangible changes. The need for chemical fertilisers has declined. The soil feels softer, retains moisture better, and crop yields have improved.

Project monitoring has also revealed the scale of this transformation. By avoiding burning and incorporating residue into the soil, fields in the project area have cumulatively sequestered about 0.14 million metric tonnes of carbon over three years. While the soil belongs to the farmers who tend it, its restoration carries wider significance. In the face of environmental stress and agricultural decline, enriched soil becomes more than a local asset. It is a shared resource—one that supports food security, ecological balance and the health of communities far beyond the field.



SEHGAL FOUNDATION

S M Sehgal Foundation is a leading rural development organization with a mission to strengthen community-led development initiatives to achieve positive social, economic, and environmental change across rural India.

The key program areas include Water Management, Agriculture Development, Local Participation and Sustainability, and Transform Lives one school at a time. These programs are supported by rural research and technology innovation and outreach for development.

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Walmart.org represents the philanthropic efforts of Walmart and the Walmart Foundation. By focusing on where the business has unique strengths, Walmart.org works to tackle key social and environmental issues and collaborate with others to spark long-lasting systemic change.

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