

Nature+ Circular BioEconomy - India

AN OVERVIEW

The Nature-Positive Solutions for Shifting Agrifood Systems to More Resilient and Sustainable Pathways (NATURE+) initiative, part of CGIAR's research portfolio, drives science and innovation to transition food, land, and water systems onto more resilient and sustainable pathways amidst the climate crisis. Under its Work Package 4 (Recycle), led by the International Water Management Institute (IWMI), the initiative explores the potential of agri-livestock waste as a cornerstone of the circular bioeconomy. By leveraging this renewable biomass, the project focuses on producing bio inputs for agriculture and green fuels, fostering sustainable agriculture, energy security, and livelihood generation and reducing environmental impacts.

In India, the initiative is implemented by the BAIF Development Research Foundation, targeting clusters in Akole and Shahada, Maharashtra, to demonstrate how sustainable recycling of agricultural residues can transform organic waste into valuable resources. These efforts showcase cost-effective and eco-friendly solutions that address global waste management challenges while promoting a shift toward a circular economy. This brochure highlights the innovative models and significant outcomes of the Nature Positive Solutions project in India.

Nature+ Solutions

NATURE+ is one of the research initiatives in CGIAR's research portfolio that delivers science and innovation to transform food, land, and water systems in a climate crisis. The initiative aims to re-imagine, co-create, and implement nature-positive solutions-based agrifood systems that equitably support food and livelihoods on the ground while simultaneously ensuring that agriculture is a net positive contributor to nature.

Focus countries: Burkina Faso, Colombia, India, Kenya, Vietnam

Clusters in India: Akole cluster in Ahmednagar, Igatpuri Nashik, Shahada cluster Nandurbar, Maharashtra state

Work Packages (WPs)

WP 1 Conserve: Developing nature-positive solutions for conservation of interlinked agrobiodiversity, water, and soil systems.

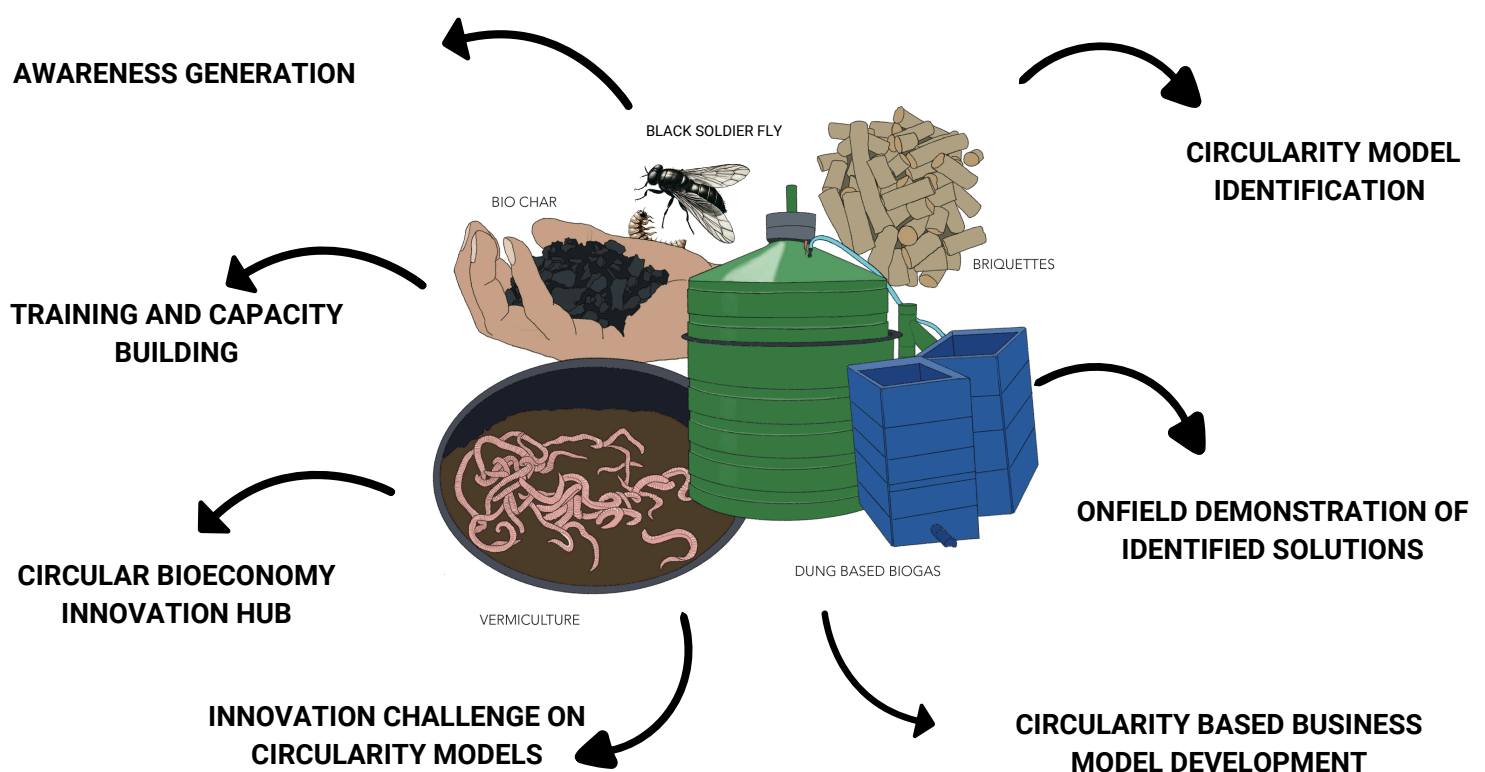
WP 2 Manage: Managing biodiversity and other natural resources in a sustainable, nature-positive way.

WP 3 Restore: Promoting nature-positive solutions as cost-efficiency models for community land restoration.

WP 4 Recycle: Educating a wide range of stakeholders on nature-positive solutions for a circular economy approach to rural waste management.

WP 5 Engage: Engaging key actors in creating an enabling environment for nature-positive solutions.

CIRCULAR BIOECONOMY MODEL, INDIA



Training & Capacity Building



The Nature+ Initiative, under Work Package 4 (Recycle), conducted **7 targeted training programs** for the participants from the Igatpuri, Akole, and Shahada clusters. The sessions introduced them to sustainable waste management technologies, including IRESA Biogas Units, Bio-PROM Production, Vermicomposting, Biochar Production, and Black Soldier Fly (BSF) Larvae-Based Waste Management. Participants received both theoretical knowledge and hands-on training at BAIF Central Research Station and Vigyan Ashram (Pabal).



Over **400+ participants** benefited from the program. Farmers got exposure to existing circularity solutions which was further upscaled through various field level initiatives.

3 Training modules on Biochar, Composting and Biogas prepared in local language for the adoption of circularity solutions at the field level



Thematic Area	Type of Training (Hands-on/Class/Both)	Total Training Hours	Target Wastes	Primary Reason for Beneficiary Choice	Location	No. of Participants
Circularity Solutions	Hands-on training and classroom sessions	16 hrs	Agriculture residue and livestock waste	Livestock farmers	BAIF CRS, Urulikanchan	72
Black Soldier Fly Larva	Hands-on training and classroom sessions	6 hrs	Food and livestock waste	Participants having poultry and fisheries	Vigyan Ashram, Pabal	48
Biochar Production	Hands-on training	6 hrs	Agriculture residue	Cotton farmers and FPO members	Bangra village, Nandurbar	23
Household-level Biogas (IRESA)	Hands-on training	2 hrs	Livestock waste	Livestock farmers with at least 4 animals	Households in Akole cluster	54
School Biogas for Food Waste	Exposure to technology	2 hrs	Food waste	Students of the Tribal Residential School	Ashram School, Shendi	300+
Biochar Production	Hands on training	6 hrs	Agriculture residue	Cotton farmers	Sambalapani, Shahada	35





CIRCULAR BIO-ECONOMY INNOVATION CHALLENGE, 2024



Sudhanshu Gupta and Atharva Musale
from the Institute of Chemical Technology
presenting their model

The Innovation Challenge, hosted in collaboration with the International Water Management Institute (IWMI), aimed to encourage young innovators to present their ideas around the concept of circularity and gain exposure to evolving technologies boot camp. The first prize of ₹50,000 was awarded to Sudhanshu Gupta and Atharva Musale from the Institute of Chemical Technology in Matunga, Mumbai, for their project titled **Increasing Biogas Purity**, which focuses on enhancing methane yield using an algae-based system. The other notable projects included:

- **LEAF KRAFT:** This initiative aims to create biodegradable materials from natural resources.
- **Hai Fame:** A tech platform designed for food waste donation.
- **GreenMinds:** This project offers AI and IoT solutions for managing agricultural waste.
- **F(R)EED:** Focused on producing chemical-free fish feed from organic kitchen waste.

The participants also engaged in a Boot Camp Experience, which provided hands-on learning about circular economy practices, including biochar processing and the development of household biogas units.



One day boot camp conducted at **BAIF Central Research Station** for exposure on various circularity solutions and to **Venture Center** for introducing participants to potential incubation opportunities

Circularity model identified and feasibility study

In the initial phase, five circularity-based models were identified, each designed to enhance sustainable waste management and resource utilization. These models were evaluated for their technical, financial, and social feasibility to determine their potential for implementation.

- **Black Soldier Fly (BSF) Larvae Aided Wet Garbage Management System:** Focused on converting biodegradable municipal solid waste into high-protein feed for poultry and fish, this model was deemed highly feasible and involved training participants in waste bioconversion techniques.
- **Community Biogas Unit:** Designed to utilize livestock waste for biogas production, this model faced challenges related to dung availability and operational costs, resulting in a lower feasibility ranking.
- **School-Level Biogas Unit:** Utilizing food waste from the school environment, this model was highly feasible and supported in providing a sustainable energy source for the tribal school and ensured the awareness generation in students and staffs of the school.
- **Household-Level Biogas Unit:** Targeting individual livestock farmers, this model also received a high feasibility ranking and focused on converting livestock waste into biogas and organic fertiliser for household use.
- **Biochar Unit:** This model aimed to convert agricultural residues into biochar, providing benefits to local farmers. It was considered moderately feasible



Business Model	Waste stream	End-product	Feasibility Ranking
Black Soldier Fly Larvae Aided Wet Garbage Management System	Biodegradable Municipal Solid Waste (MSW)	Compost and BSFL	highly feasible
Community Biogas Unit	Livestock Waste (LW)	Biogas and Organic fertiliser	least feasible
Biochar Unit	Agro/ Plant Waste (AW)	Biochar	moderately feasible
School Biogas	Food waste	Biogas and slurry	highly feasible
Household level biogas unit	Livestock Waste (LW)	Biogas and organic fertiliser	highly feasible

The three circular models—Household-Level Biogas Units, School-Level Biogas Unit, and Biochar Production Unit—were chosen after a comprehensive feasibility assessment that examined key factors including technical viability, resource availability, community acceptance, and environmental impact.

Models established at field location



HOUSEHOLD-LEVEL BIOGAS UNITS

IRESA MODEL

The **IRESA** (*Integrated Renewable Energy and Sustainable Agriculture*) approach focuses simultaneously on the optimal use of existing resources for sustainable energy generation for cooking as well as value-added organic manure production for soil fertility.

Reduces dependence on firewood and LPG, improving household air quality and mitigating deforestation.



Produces gas equivalent to 12 LPG cylinders per year or can replace 2.65 tons of firewood. Production of drip-enabled filtered slurry (about 10,000 litres/year), vermi compost (2 ton/ year) and Enhances soil fertility with organic slurry, promoting sustainable agriculture.

Implemented in the Akole cluster, benefiting 10 households and contributing to resource efficiency, household sustainability, and environmental conservation.

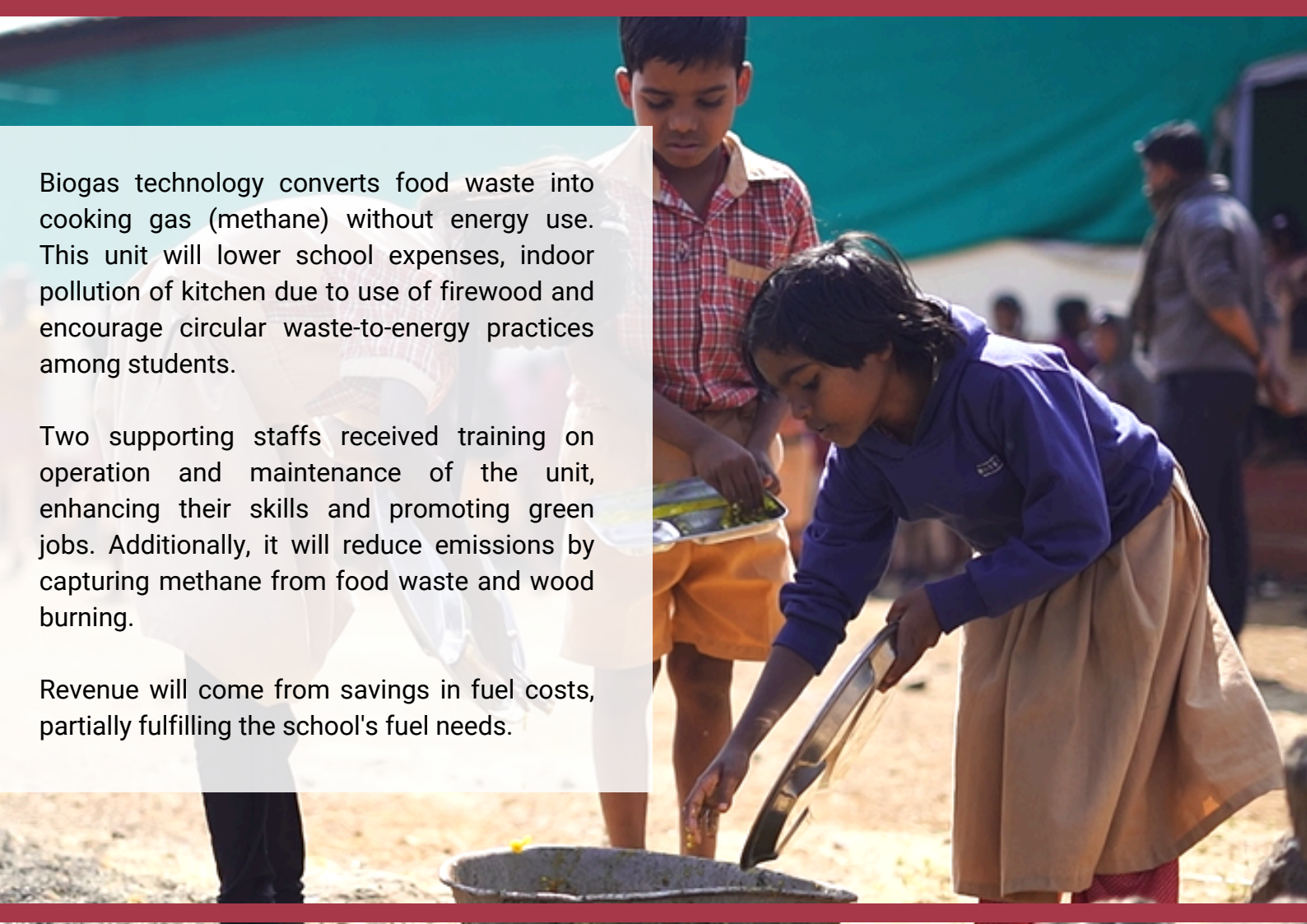
200+ units established through convergence with existing projects in Igatpuri and Shahada Cluster

A young girl with dark hair in two braids, wearing a red and white checkered school uniform with a yellow vest and a blue lanyard, stands with her arms crossed next to a green biogas unit. The unit has a logo that reads "VAAYU - Generation for Generations".

SCHOOL BIOGAS UNIT, AKOLE

The Food Waste biogas unit is established and handed over to an **Adivasi Unnati Seva Mandal Rajur-run Aided Primary and Secondary Ashram School**, Shendi, Akole, to utilize food waste generated in the school's kitchen to produce biogas, thereby reducing the school's dependence on firewood and LPG.

The unit is designed to process 30 kg of food waste per day, which will compensate for 12 cylinders of LPG per year.

Two children in school uniforms are shown. A girl in a blue long-sleeved shirt and a tan skirt is pouring food waste from a metal plate into a large, dark, circular biogas unit. A boy in a red and white checkered shirt stands behind her, also looking down at the unit. The background shows a green tarp and other people in the distance.

Biogas technology converts food waste into cooking gas (methane) without energy use. This unit will lower school expenses, indoor pollution of kitchen due to use of firewood and encourage circular waste-to-energy practices among students.

Two supporting staffs received training on operation and maintenance of the unit, enhancing their skills and promoting green jobs. Additionally, it will reduce emissions by capturing methane from food waste and wood burning.

Revenue will come from savings in fuel costs, partially fulfilling the school's fuel needs.

BIOCHAR PRODUCTION UNIT

The production of biochar, using locally available crop residues as raw materials, offers an innovative solution to transform agricultural waste into a valuable end product.

In Shahada, burning cotton stalks causes air pollution and loss of organic matter. The biochar unit offers an eco-friendly solution by repurposing these residues. Biochar can be effectively utilized by farmers to enhance soil quality, increase soil organic carbon levels, and ultimately improve crop yields.



This initiative tackles environmental issues by reducing open-burning, lowering air pollution and greenhouse gas emissions, and addressing soil degradation

32 farmers were trained in unit installation, biochar production, biochar application and sale and sustainable residue management in Sabalapani village, Shahada cluster, improving soil health and rural livelihoods.

The unit will be managed by the **Kanikansara Farmer Producer Company Limited, Shahada.**

CIRCULAR BIO ECONOMY- INNOVATION HUB (CBE-IH), INDIA

- CBE-IH was Inaugurated on 14th of December, 2023, at ICAR National Institute of Abiotic Stress Management, Baramati
- A stakeholder meeting for the Innovation Hub was held on 15th December with the participation of 11 stakeholder



Round table discussion and stakeholder onboarding workshop

- Round table discussion was conducted on 20th December 2024 at the BAIF Head Office, Pune.
- The workshop aimed to engage stakeholders to discuss scaling up activities under the Circular Bio-Economy Innovation Hub (CBE-IH) and to onboard them onto the platform for joint action.
- A total of 32 participants attended the workshop, representing 14 organizations working on themes related to circularity.



Research and Academic Institutes	Financial Institutions	Upscaling Partners / Incubation centres	Private sector enterprises and Startups
<ul style="list-style-type: none"> • CTARA, IIT Bombay • VNIT, Nagpur • SSS-NIBE, Punjab • Symbiosis Centre for Waste Resource Management • Centre for Sustainable Development • Science and Technology Park, SPPU 	<ul style="list-style-type: none"> • NABARD, Pune • Rangde, Bangalore 	<ul style="list-style-type: none"> • Venture Centre, Pune • RuTAG, IIT Bombay • Vigyaan Ashram • STARS Forum • World Resources Institute (WRI) • Indian Network on Ethics and Climate Change (INECC) • Ekonnnect Knowledge Foundation 	<ul style="list-style-type: none"> • Biofuel Circle Pvt. Ltd. • Craste • Kisan Biogas • Vaayu Biogas • Samuchit Enviro Tech



CIRCULAR BIO ECONOMY- INNOVATION HUB SECRETARIATE

- To support capacity building and the scaling up of circularity models, a secretariat for the Innovation Hub has been established at the BAIF Central Research Station (CRS).
- The initiative aims to expand the scope of existing circularity models and develop new models for demonstration and training purposes.
- As part of the project, new units such as a Biochar unit, a 10-Drum organic input production unit, and an exhibition-cum-training facility have been established at CRS.
- The center will serve as a hub for facilitating training and capacity-building activities on various circularity models.



OUTCOMES

- **400+** participants trained
- **3 circularity models** established at field locations
- Circular BioEconomy **Innovation Hub established** for India
- **3 training modules in local language** prepared for local needs
- **1 Innovation Challenge** conducted on circularity models
- **10+ potential partners** onboarded to (CBE-IH)

WAYFORWARD

- Develop and introduce solutions focusing on women, youth and Indigenous communities
- Training modules tailored to specific locations
- Building upon innovation hub platforms through stakeholders and like-minded agencies for scouting innovative solutions and policy advocacy
- Building awareness on potential funding partners for upscale of circularity models
- Develop Innovation Hub secretariat for circularity-based knowledge exchange
- Promotion of circularity-based business models as a solution for Nature+ Approach & Scaling up of circularity innovations through identified partners

IMPACT AREA



Environmental Sustainability: ensure environmental sustainability through adoption of circularity solutions.



Climate Change Mitigation: Lowers emissions by reduction in use of conventional fuels and residue burning



Economic Development: Creates opportunities by turning waste into valuable products, reducing fuel costs, and promoting rural entrepreneurship.



Community Well-being: Improves health and hygiene through better waste management and reduced indoor air pollution.



Employment Generation: Creates green jobs for rural women and youth by creating an ecosystem that facilitate circularity based value addition and entrepreneurship

FOR FURTHER DETAILS VISIT: cbeihindia.com



BAIF Development Research Foundation
BAIF Bhavan, Dr. Manibhai Desai Nagar, Warje, Pune - 411058
Phone: +91-20-25231661-9 | +91-8625081661
E-mail: baif@baif.org.in