



Terms of Reference

DEVELOPMENT AND DEMONSTRATION OF BIOCHAR GASIFICATION KILN WITH INTEGRATED HEAT TRANSFER FOR AGRICULTURAL DRYING

Project: Circular Economy Cocoa - From Bean To Bar

Budget line: 6.2.1.2 | Date: 27.03.2025

1. BACKGROUND

HELVETAS is an independent development organization based in Switzerland with affiliated organizations in Germany and the United States. Helvetas has been active in Vietnam since 1995, working in various areas typically Agriculture, Biodiversity Conservation, Forestry, Eco-Tourism, and Rural Economy.

Under the European Union's SWITCH-Asia programme, HELVETAS is implementing the project “Circular Economy Cocoa: From Bean to Bar,” which aims to develop circular economy solutions within the cocoa and agri-food sectors. This project, which began in 2022, is active in 6-7 cocoa-growing provinces across the Central Highlands and Mekong Delta of Vietnam.

In cocoa bean pre-processing, local producers face challenges in implementing their drying process efficiently and sustainably. While solar drying systems are utilized in some regions, their effectiveness decreases substantially during cloudy or rainy periods, necessitating alternative heat sources. Concurrently, traditional drying methods that rely on biomass combustion generate high emissions and produce inconsistent drying conditions.

To enhance energy efficiency and minimize environmental impact, HELVETAS seeks service providers to develop and demonstrate a **biochar gasification kiln with an integrated heat transfer system** using for cocoa bean’s drying. This system aims to provide a **more sustainable and effective drying solution** for cocoa producers by utilizing locally available agricultural wastes such as brushwoods, cocoa leaves, cocoa shells, macadamia shells, rice straw, and rice husks as feedstock. Additionally, the biochar produced after gasification can be used for soil amendment, creating a circular solution that enhances both energy efficiency and agricultural sustainability.

A pilot project was implemented with Trong Duc Cocoa Company in 2024, demonstrating significant heat generation with minimal emissions while contributing to waste reduction. Building on this success, further demonstration activities are planned to validate and optimize the technology for broader application.

2. OBJECTIVES

The overall objective is to develop, demonstrate and promote sustainable drying solutions of cocoa beans at the farm level using biochar gasification technology, optimize drying efficiency while minimizing environmental impact.

Specific objectives include:

- Design and develop a biochar gasification kiln with an integrated heat transfer system compatible with existing agricultural drying facilities in Ben Tre and Dak Lak provinces.
- Install and demonstrate the systems' performance at two pilot sites using locally available agricultural wastes as feedstock.

- Evaluate the system's efficiency and feasibility for wider adoption in agricultural drying.

3. SCOPE OF WORK

The demonstration will be implemented at two cocoa pre-processing units in Ben Tre and Dak Lak provinces. The consultant will be responsible for:

3.1. Design and Development

- Design 02 separated biochar gasification kiln systems compatible with local conditions as follows:
 - **For Ben Tre (Chau Thanh district):** Integration of a biochar gasification kiln into an existing solar drying facility that currently uses solar energy to heat stones. The system should be designed to combine both heat sources (solar and biochar gasification) efficiently.
 - **For Dak Lak (Ea Kar district):** Integration of biochar gasification kiln into an existing conventional drying facility.
- Prepare demonstration plans and procure necessary equipment and materials.

3.2. Demonstration

- Installation and Testing: Install the biochar gasification systems at both demonstration sites, and conduct performance testing under different operational conditions and optimize systems for maximum efficiency and minimal emissions.
- Training: Develop training materials and user manuals tailored to each site's configuration. Conduct necessary training sessions for relevant stakeholders at the demonstration sites.
- Reporting: Prepare a comprehensive report summarizing all results, lessons learned, and recommendations for scaling up and replicating the technology.

4. DELIVERABLES

- Engineering design package, including technology description, technical specifications, and user manuals for two biochar gasification systems.
- Two customized biochar gasification kilns: one integrated with a solar drying facility in Ben Tre and one with a conventional drying facility in Dak Lak.
- On-site training for local operators at both locations with comprehensive training materials.
- Final report and PPT presentation summarizing system performance, key findings, and recommendations for technology scaling and application.

5. REQUIRED QUALIFICATIONS

For Individual Experts/Expert Team

- Advanced degree (PhD/Master's) in Mechanical Engineering, Energy Systems Engineering, Agricultural Engineering, Environmental Technology or related fields.
- At least 10 years of experience in renewable energy or agricultural technology.
- Proven track record in designing and implementing similar projects.
- Strong expertise in heat transfer systems and agricultural drying technologies.
- Experience with hybrid energy systems, particularly solar thermal integration.
- Ability to deliver high-quality technical solutions within deadlines.
- Excellent communication skills and knowledge transfer skills.

For Consulting Firms:

- Legally registered in engineering, energy, or agricultural technology consulting.
- Minimum 5 years of experience in renewable energy, agricultural technology, and energy efficiency consulting.
- Expertise in biochar gasification, heat transfer technology, hybrid energy systems, and agricultural waste valorization.
- Proven success in implementing similar projects.
- Technical capacity to design and integrate hybrid energy systems.
- Strong project management and knowledge transfer capabilities.

6. SUGGEST TIMELINE

The consultancy is expected to be completed within 2 months, starting from mid-April 2025, with the following indicative timeline:

- Week 1-2: Assessment and design phase for both sites
- Week 3-5: Procurement and installation
- Week 6-7: Testing and optimization
- Week 8: Training, documentation, and final reporting.

7. TECHNICAL & FINANCIAL PROPOSALS

- Technical Proposal: Company profile, team composition, historical records, approach and methodology, available technologies, detailed workplan with timeline, quality assurance procedures, and other supporting documents.
- Financial Proposal: Provide a breakdown of costs including the number of working days, consultant rates, budget justification, field travel expenses, and any additional costs. All costs should comply with EU Cost Norms.

For each biochar gasification system, applicants must submit a separate Technical and Financial Proposal.

8. SUBMISSION

Interested candidates should submit their Technical and Financial Proposals to Helvetas Vietnam at diep.dinh@helvetas.org and helvetas.vietnam@helvetas.org by **April 11, 2025**.