WasteX

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P4G
Pioneering Green Partnerships, Investing in Impact

Business Case Study and Model for WasteX Indonesia

A Full-Stack Biochar Solution to Agricultural Waste Management and Carbon Reduction

2025

Whitepaper: Business Case Study and Model

PT WasteX Technology Indonesia
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1. Background and Problem Analysis

- **Magnitude of the Problem:** Globally, over 3.5 billion tons of agricultural waste are generated annually from crop residues, animal manure, and other organic materials[1]. Much of this waste is either dumped, burned, or sold cheaply, leading to significant environmental and economic inefficiencies. Burning agricultural waste, for example, releases harmful greenhouse gases (GHGs) like CO2 and methane, contributing to climate change.
- **Environmental Impact:** The improper disposal of agricultural waste not only contributes to air pollution but also leads to soil degradation and water contamination. For instance, when agricultural residues are burned, they release particulate matter and toxic gases, which harm human health and ecosystems.
- **Economic Loss:** The underutilization of agricultural waste represents a missed economic opportunity. Instead of being converted into valuable products like biochar, this waste is often treated as a liability. Biochar is a carbon-rich material formed by heating organic materials (feedstock) at high temperatures in an oxygen-limited environment. This heating process, known as pyrolysis, stabilizes the carbon within the feedstock, transforming it into a stable form. Biochar can enhance soil health, improves crop yields, reduces carbon emissions, and generates carbon credits.
- **Carbon Emissions:** Agricultural residues and manure are significant sources of carbon emissions, with over 700 Megatons of CO2e released annually. This makes the agricultural sector a key target for carbon reduction strategies.
- **Regional Focus:** Southeast Asia (SEA) is a particularly relevant region for addressing this problem due to its large agricultural sector, high levels of waste generation and >40% of the region's emissions being generated in the agricultural sector and from land use. However, less than 1% of farming in SEA currently utilizes biochar[2], indicating a massive untapped market. The region's reliance on agriculture for livelihoods and food security makes it a prime candidate for biochar adoption.

[1] World Bank. (2019). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 - source
[2] International Biochar Initiative. (2020). Biochar Market Report: Southeast Asia - source

2. Business Journey

- WasteX's initial business model was supposed to be a facilitation of waste valorization solutions for agricultural producers in Southeast Asia
- We quite quickly realized that biochar is the promising of such solutions so decided to focus on it exclusively for start
- Additionally, we realized two more things: (1) There is no high-performance, affordable biochar equipment in the market, and (2) Prospective clients need a full-stack solution that encompasses all the components (including digital MRV (Monitoring, Reporting, Verification) or certification) and allows them to immediately start earning carbon credits (rather than go through the certification process themselves) – that's how we settled on our current solution and started developing it
- The process included designing and manufacturing our own equipment, developing our software (digital MRV) and obtaining the carbon credits certification – after around 12 months of these efforts we managed to put the whole solution together into a commercial product (first version) and sign our first commercial contract
- Since then, with a >10-strong engineering team, we have invested (and continue investing) in the continuous product development with new versions of the equipment, that come with major improvements, being released every 3-6 months
- We also started developing our own biochar projects in Indonesia in collaboration with local agricultural processing businesses – while most of our revenues still comes from the sale of the solution, our carbon removal impact is mostly driven via these projects
- Along the way, we have faced (and continue facing) challenges including commercial, engineering and operational, among others – with the resolution of each challenge we have progressed forward with better product, happier customers, more effective operations etc.
- Since we joined the P4G Partnership, we also engaged with a few government agencies, and recently we have officially commenced official projects with them promoting biochar via such public-private partnerships

Case study: First partner facility with a corn mill in Pasuruan, Indonesia

In this partnership, the corn mill in Pasuruan, Indonesia provided a space and supply of corn cobs for the biochar production facility. WasteX developed the facility, started operating it, producing and selling biochar, and generating and selling carbon credits. The arrangement has both cost-coverage and profit-sharing mechanisms ensuring the alignment of incentives. Additionally, produced biochar has been largely provided to neighbouring farmers helping them increase the yield by up to 95% while reducing fertilizer use by up to 50%.

Irianto, the mill owner, said the following of the partnership:

"Managing corn cob waste has its challenges. We usually sell it as fuel and planting media, but oftentimes it quickly rots and is hard to sell, especially during peak harvest time. However, by working with WasteX, these corn cobs can be processed into high-value biochar, which is useful as a soil fertility enhancer"

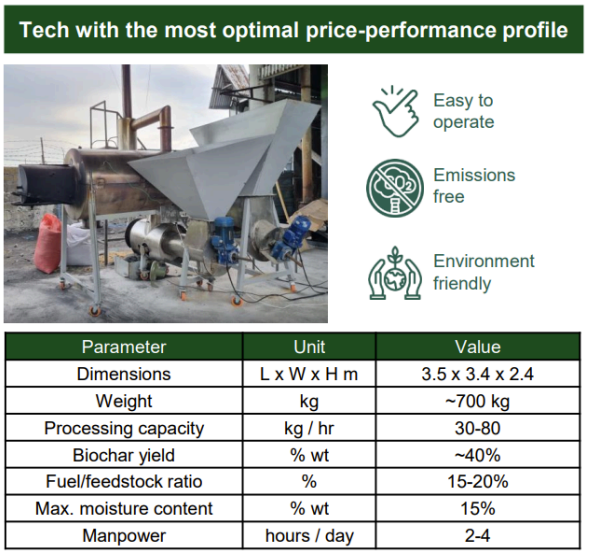
Irianto- Mill Owner & WasteX Partner

3. Solution

- **Full-Stack Biochar Solution:** WasteX offers a full-stack biochar solution consisting of proprietary equipment, digital MRV, carbon credits certification, and support with biochar application for agricultural benefits. In this way, WasteX focuses on value creation for the agricultural producers and farmers inclusive of affordable equipment, agricultural benefits maximization and carbon credits facilitation.
- **Proprietary Equipment:** WasteX has developed a high-tech, small-scale, decentralized biochar production system that is globally unique – no other biochar equipment provider globally combines high-tech with affordability for this capacity as well as combining it with own digital MRV, both of which are certified for carbon credits, while simultaneously facilitating carbon credits for the producers. The equipment is designed to be affordable, efficient, and easy to use, making it accessible to small and mid-sized farmers. It operates in a low-oxygen environment, **converting biomass into biochar** through a process called pyrolysis. The equipment is automated, reducing the need for manual labor and ensuring consistent biochar quality.
- **Agricultural Benefits:** Biochar has been proven to enhance soil health by increasing soil pH, moisture retention, and nutrient availability. WasteX's trials have shown **yield increases of up to 95% in crops like maize**, along with reductions in fertilizer use

by up to 50%. This not only boosts farm productivity but also reduces input costs for farmers[3].

- **Carbon Credits:** WasteX's solution is certified for carbon credits, enabling farmers and businesses to generate additional income through carbon removal. By converting agricultural waste into biochar, WasteX helps sequester carbon in the soil for hundreds of years, making it a permanent carbon removal solution.
- **Digital MRV (Monitoring, Reporting, Verification):** WasteX has developed an Android app that tracks biochar production and application in real-time. This digital MRV system ensures transparency and accountability, making it easier for clients to verify carbon credits and comply with Carbon Standards International (CSI).



Parameter	Unit	Value
Dimensions	L x W x H m	3.5 x 3.4 x 2.4
Weight	kg	~700 kg
Processing capacity	kg / hr	30-80
Biochar yield	% wt	~40%
Fuel/feedstock ratio	%	15-20%
Max. moisture content	% wt	15%
Manpower	hours / day	2-4

Figure 1. WasteX Biochar Equipment Specifications

4. Defined Methodology

- **Decentralized Approach:** WasteX's strategy focuses on small-scale, decentralized biochar production at the point of biomass generation. This approach is particularly effective in regions like Southeast Asia, where agricultural waste is spread across many small farms. By setting up decentralized hubs, WasteX ensures that biochar production is localized and accessible to farmers.
- **Technology Innovation:** WasteX's equipment is designed for modularity, efficiency, and low emissions, with features like separate pyrolysis and burner chambers, gas recycling, and automation.
- **IP Protection:** WasteX has a robust IP strategy, including proprietary PCB (Printed Circuit Board) and firmware to automate biochar production, a patent-pending design, and exclusive carbon credit eligibility tied to its equipment.
- **Scalability:** WasteX business is scalable and reinforcing through a combination of equipment sales and the development of larger-scale partner facilities.

[3] 2024 WasteX latest Agri Benefit : Full Report

5. WasteX Business Model

- **Business Models:**
    1. **Equipment and Services Sale:** Selling biochar equipment and providing implementation support together with carbon credits facilitation and support with biochar application in agriculture.
    2. **Partner Facilities:** Developing and operating larger-scale biochar production facilities in partnership with agricultural mills.

- **Revenue Streams:**
    1. **Equipment and Services Sale:**
        a. Equipment and implementation services sale.
        b. Participation in the profit sharing of carbon credits sale.
    2. **Partner Facilities:**
        a. Biochar sale
        b. Carbon credits sale

- **Marketing / Go-To-Market:**
    1. Digital marketing (content, ads, search, social media etc.)
    2. Own sales workforce
    3. Partnerships

- **Client Segments:**
    1. Agri mills (corn, rice, saw)
    2. Fertilizer and sustainable agriculture producers
    3. Biochar project developers

6. Results

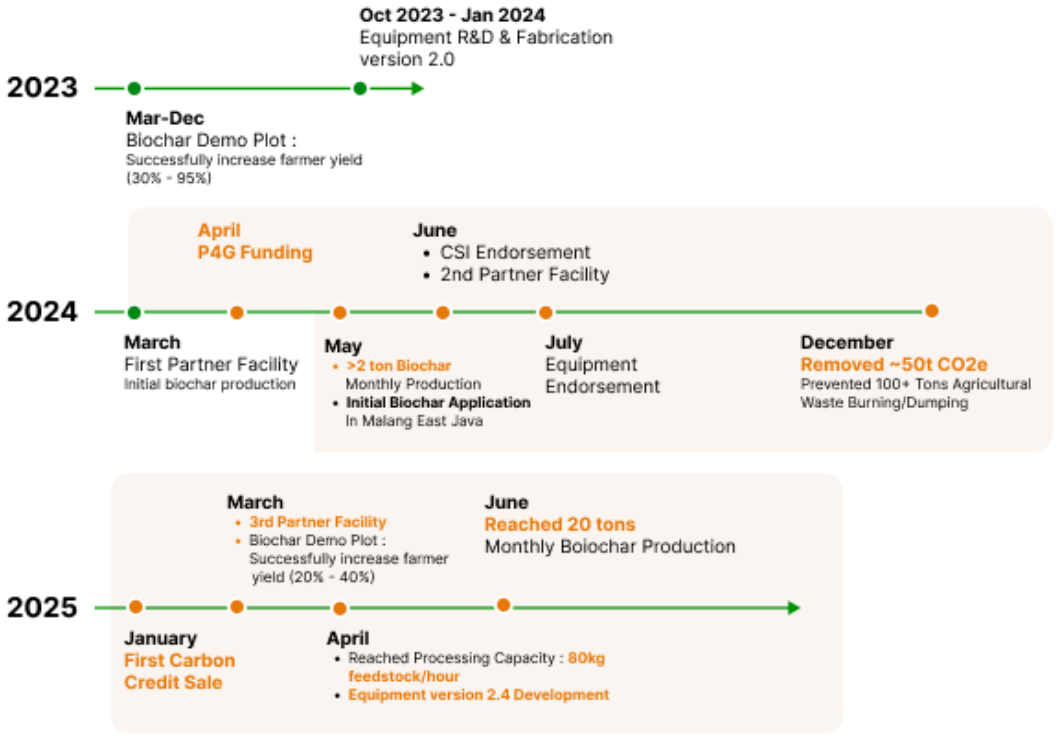


Figure 2. WasteX Biochar Project Timeline and Key Milestones (2023-2025)

1. Monitoring (Tracking Progress and Outputs)

- Quantitative Results:
  - Units Sold and Operational Facilities: WasteX has successfully sold >25 units of its proprietary biochar equipment globally, with 3 operational facilities in Indonesia. These facilities are producing biochar at scale, demonstrating the feasibility and scalability of the solution.
  - Yield Improvements: WasteX's biochar application has led to significant yield increases across multiple crops in the Malang area, East Java

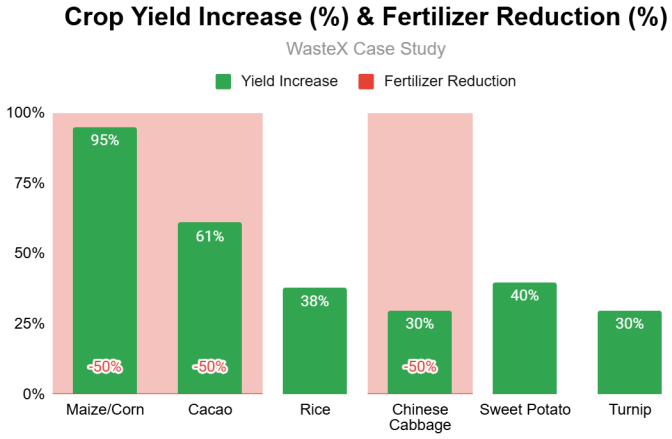


Figure 3. WasteX Results from Biochar Application

- Equipment Production Capacity: WasteX's equipment has achieved a processing capacity of up to 80 kg/hr in April 2025. This capacity is expected to triple in 2026 with an introduction of a larger version of the equipment.
- Biochar Yield: The equipment has a biochar yield of on average 40-45% (depends on the feedstock type).
- Weekly Biochar Production: WasteX's facilities are producing up to 2 tons of biochar per week, resulting in over 20 tons of biochar produced from 3 production sites in June 2025

- Qualitative Results:
  - Customer Feedback: Farmers have reported improved soil health, higher crop yields, and reduced input costs.
  - Carbon Credit Certification: WasteX's equipment and digital MRV system have received full endorsement from the CSI's Global Artisan C-Sink standard, ensuring compliance with international carbon credit regulations.

Case study: Farmers stories and testimonials

*"This is the first time my land has been planted with horticultural crops, and using biochar made from my long beans has resulted in a **yield increase of up to 23%** compared to treatment without biochar, along with a **20% reduction in chemical fertilizer use**. Additionally, the soil has become softer and more friable (previously it was hard)"*

Kodri - Horticulture Farmer in Batang

*"For decades as a horticultural farmer, this is my first time using biochar. I applied 4 tons/ha charged with goat manure fertilizer and **reduced chemical fertilizer by 20%**. The cauliflower treated with biochar grew faster, with larger flowers, roots, and stems. At the first harvest, I got 800 grams per bed compared to just 100 grams without biochar—**a 650% increase**"*

Masmin - Cauliflower Farmer in Grobogan

2. Evaluation (Assessing Outcomes and Impact)

- Economic Impact:
  - WasteX Revenue from Equipment Sales: Around USD 180,000 in 2024 and expected around USD 1 million in 2025.
  - Carbon Credit Income: WasteX and our clients benefit from the carbon credits income (at the price of USD 150 per credit).

    - Financial Benefits for Farmers: WasteX's biochar has been shown to increase yields by up to 95% and reduce fertilizer use by up to 50%, significantly improving financial outcomes for farmers.
- Environmental Impact:
    - Carbon Removal: WasteX's solution has the potential to remove 1-2 tons of CO2e for every ton of biochar produced. In 2024 WasteX removed ~50 ton CO2e.
    - Waste Reduction: By converting agricultural waste into biochar, WasteX reduced the amount of waste that is burned or dumped by more than 100 tons throughout the year 2024, thereby minimizing air pollution and soil degradation.
- Social Impact:
    - Job Creation: WasteX's decentralized approach creates local employment opportunities in rural areas in Indonesia. This includes jobs in equipment operations, biochar production, and agricultural support services.
    - Farmer Empowerment: WasteX's solution empowers small and mid-sized farmers by providing them with affordable technology, agricultural improvements and additional income streams, improving their livelihoods and resilience to climate change.
- Engagement with the Government/Regulatory Bodies
    - Central Government Agency (still confidential): WasteX is participating in a pilot initiative launched by one of the central government agencies of Indonesia to convert novel feedstock type into biochar, exploring its agricultural benefits for horticultural crops such as chili and shallot. In this project, WasteX is collaborating with one NGO. The project is scheduled to run from July to October 2025.
    - Central Government Agency and one of the universities (still confidential): WasteX is contributing to a Climate Smart Agriculture initiative launched by one of the central government agencies of Indonesia in collaboration with one of the universities. In this project, WasteX supplies biochar for field trials with farmers in the Grobogan area of Central Java, where one of WasteX's partner facilities is located. Additionally, as part of the initiative, the university is conducting a series of Forum Group Discussions (FGDs) involving another government agency and other key stakeholders.
- Collaboration with P4G's National Platform: WasteX is currently participating in a Government-to-Government (G2G) capacity-building initiative by the Embassy of Denmark (one of the members of P4G's National Platform), which focuses on reducing food loss and waste (FLW) in rice production and fisheries. As part of this engagement, WasteX is providing insights on biochar production from agricultural residues and exploring its potential role in addressing food system challenges along the rice value chain.

3. Investment

- **Key Levers**:
  - Strong Continued Growth
  - Great Value Creation for Clients
  - Unique Solution and Business Model with Strong Defensibility
  - Strong Team and Execution Capabilities
  - Innovative Technology
  - Proven Environmental and Agricultural Impact
  - Ability to Generate Carbon Credits at Scale
  - Huge Market Opportunity
- **Funding Details:**
  - WasteX has raised almost $1.5 million in equity from private investors. The equity investment has been used to scale operations, develop new facilities, continue developing product, and expand market reach.

4. Financial

Table 1. Comparative Financial Matrix of WasteX Pre- and Post-P4G Funding

Financial Metric	Before P4G Funding	After P4G Funding
Annual Revenue	<$20,000	~$180,000
Gross Profit (%)	<30%	~35%
Equipment Units Sold	<3	~30
Sales Growth YoY	-	10x
Total Investment	<$1m	~$1.8m

5. Impact / ESG

Table 2. WasteX Social and Environmental Impact Metrics

Impact / ESG Metric	Before P4G Funding	After P4G Funding
CO2e Removed	<5 tons	>100 tons
People positively affected	<50	>1,000
Jobs created	0	10
Gender Diversity (% female employees)	<20%	30%

7. Challenges and Solutions

- Challenges:
    - High Initial Costs: Biochar technology is often expensive, making it difficult for many agricultural stakeholders to adopt.
    - Market Awareness: Many farmers and agricultural businesses are unaware of the benefits of biochar, leading to slow adoption.
    - Product Development: Developing hardware-software solution takes considerable time and resources slowing time-to-market with new products.
    - Certification and Regulatory Hurdles: Navigating carbon credit certification and compliance with environmental standards can be complex and time-consuming.
- Solutions:
    - Value Creation for Clients: Despite the solution's cost, focus on generating value for (and communicating it to) the clients including from carbon credits, biochar sales and agricultural benefits. Additionally, help them with financing options.
    - Drive Market Awareness:
        - Digital Marketing and Sales Efforts
        - Collaboration with Government Agencies
        - Training Programs and Demo Plots
    - Invest in Product Development: Continue investing in product development
    - Regulatory Intervention:
        - Carbon Credits Certification and Marketing: Ensure certification for carbon credits for WasteX and our clients, and promoting our carbon credits across global market stakeholders
        - Government Engagement: Engaging with policy makers to incorporate biochar in the government agenda

8. Lessons Learned and Recommendations

- Value Creation for Clients: Focus on clear value creation for your clients and other stakeholders to drive adoption and satisfaction.
- Lean Budget Management: Ensure lean budget management due to delayed product adoption and revenues generation, slow fundraising process etc.
- Growth vs. Product Dev Balance: Ensure the right trade-off between growth and product development
- Partnerships: Collaborate with governments, NGOs, and agricultural corporates to promote the wider product adoption.
- Continuous Innovation: Invest in continuous product innovation and improvement to improve client satisfaction over time, stay competitive in the market, and continue improving product economics and performance.