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Sustainable Industrial Systems

Biochar from Agricultural Wastes: Sustainability Assessment and the Potential as a Negative Emissions Technology

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Research background

Climate Change Impacts and Urgency

- GHGs emission in 2022 = **54.6 bn t** (68% from CO_2)
- Drives global warming and increase in the frequency of extreme weather events
- Global temperature increase of 3.2 °C by 2100.

Negative Emissions Technologies (NETs) as a Climate Solution

- Emissions reduction efforts are not enough
- NET mechanism: 1) atmospheric GHG removal & 2) permanent storage

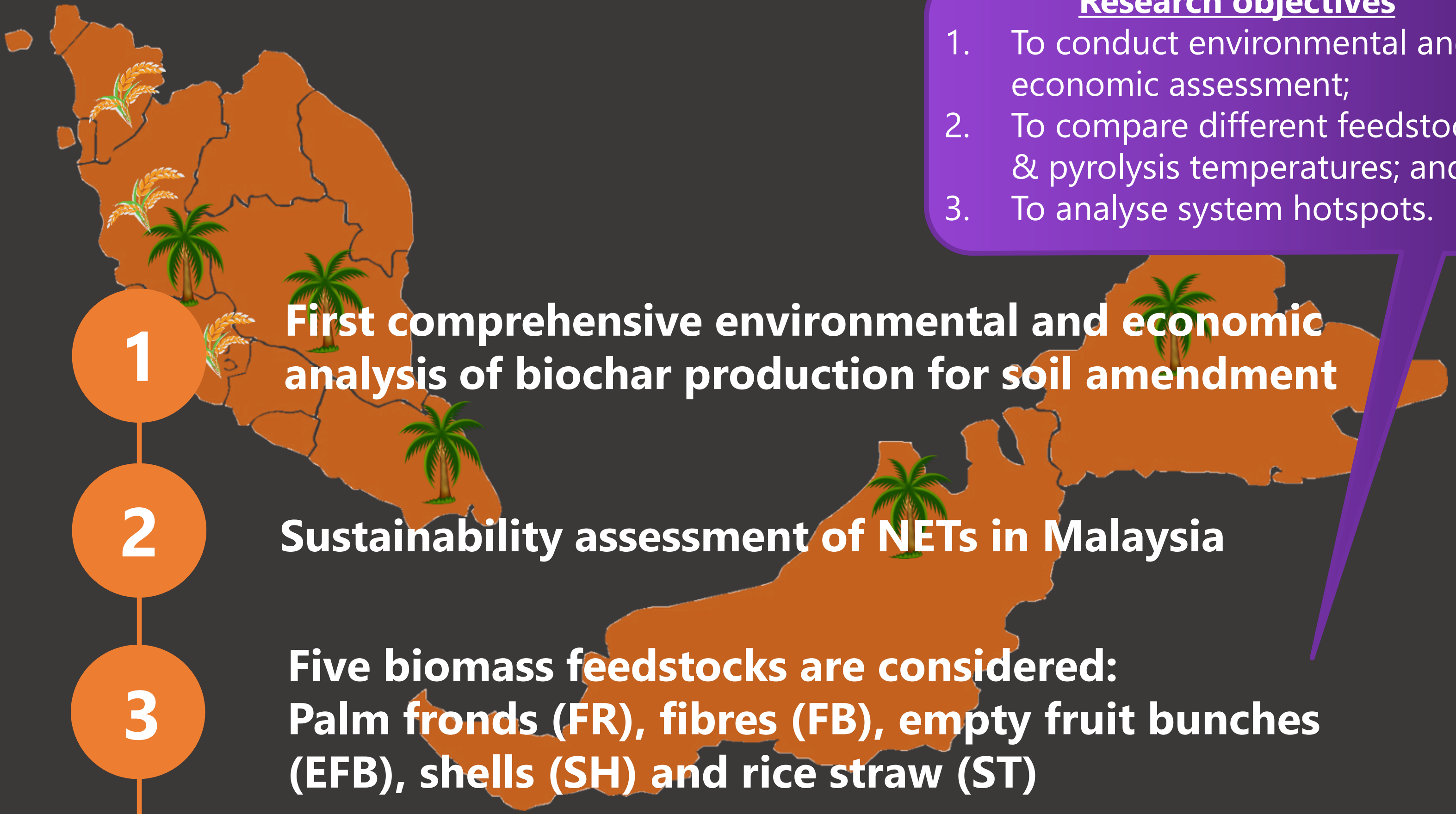
Biochar: Versatility and Developing Country Relevance

- Simple technology
- Can be deployed at any scale
- Abundance of resources

Benefits of biochar application to soil

- Carbon sequestration
- Additional soil benefits
- Waste management solution

Novelty & context



Research objectives

1. To conduct environmental and economic assessment;
2. To compare different feedstocks & pyrolysis temperatures; and
3. To analyse system hotspots.

1 **First comprehensive environmental and economic analysis of biochar production for soil amendment**

2 **Sustainability assessment of NETs in Malaysia**

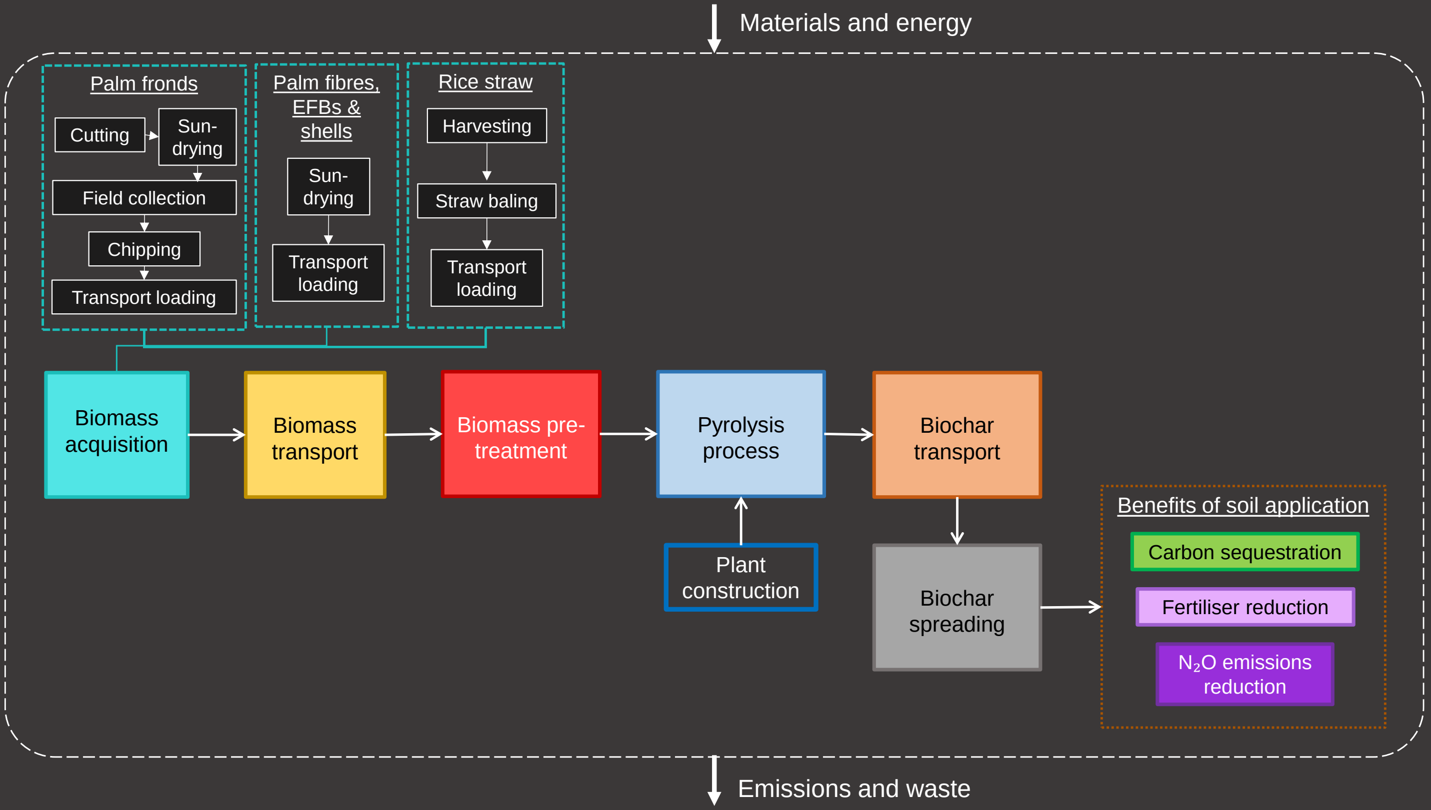
3 **Five biomass feedstocks are considered: Palm fronds (FR), fibres (FB), empty fruit bunches (EFB), shells (SH) and rice straw (ST)**

Methods

1 **Process simulation**

2 **Life Cycle Assessment (LCA)**

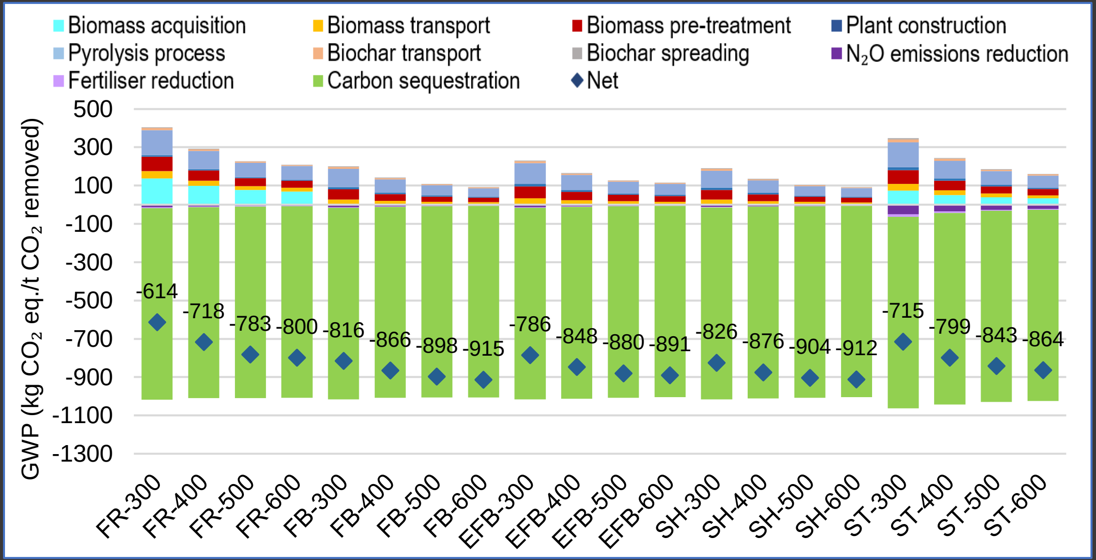
3 **Life Cycle Costing (LCC)**



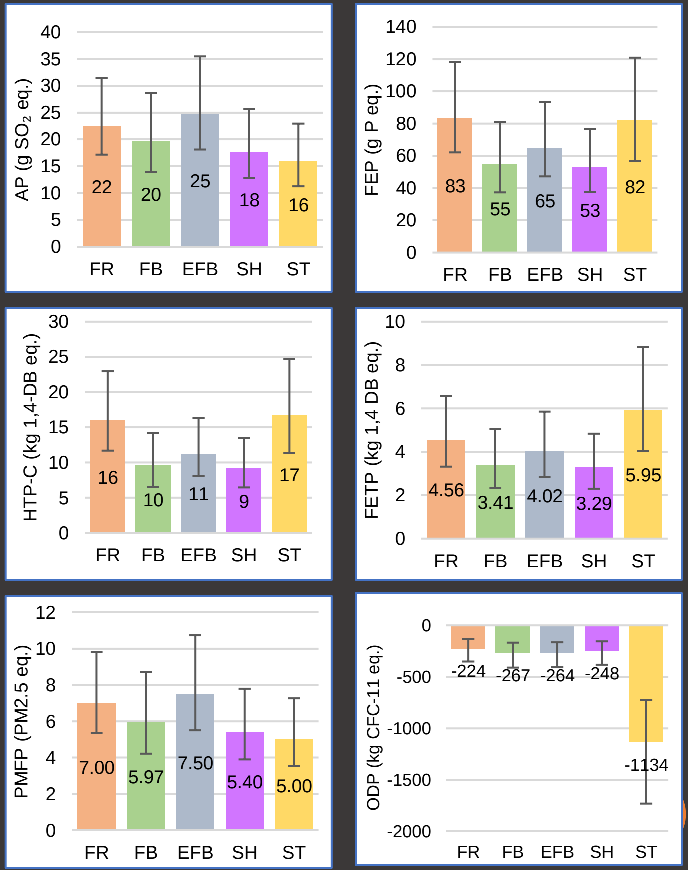
Unit of analysis:
1 t CO_2 removed

Environmental impacts

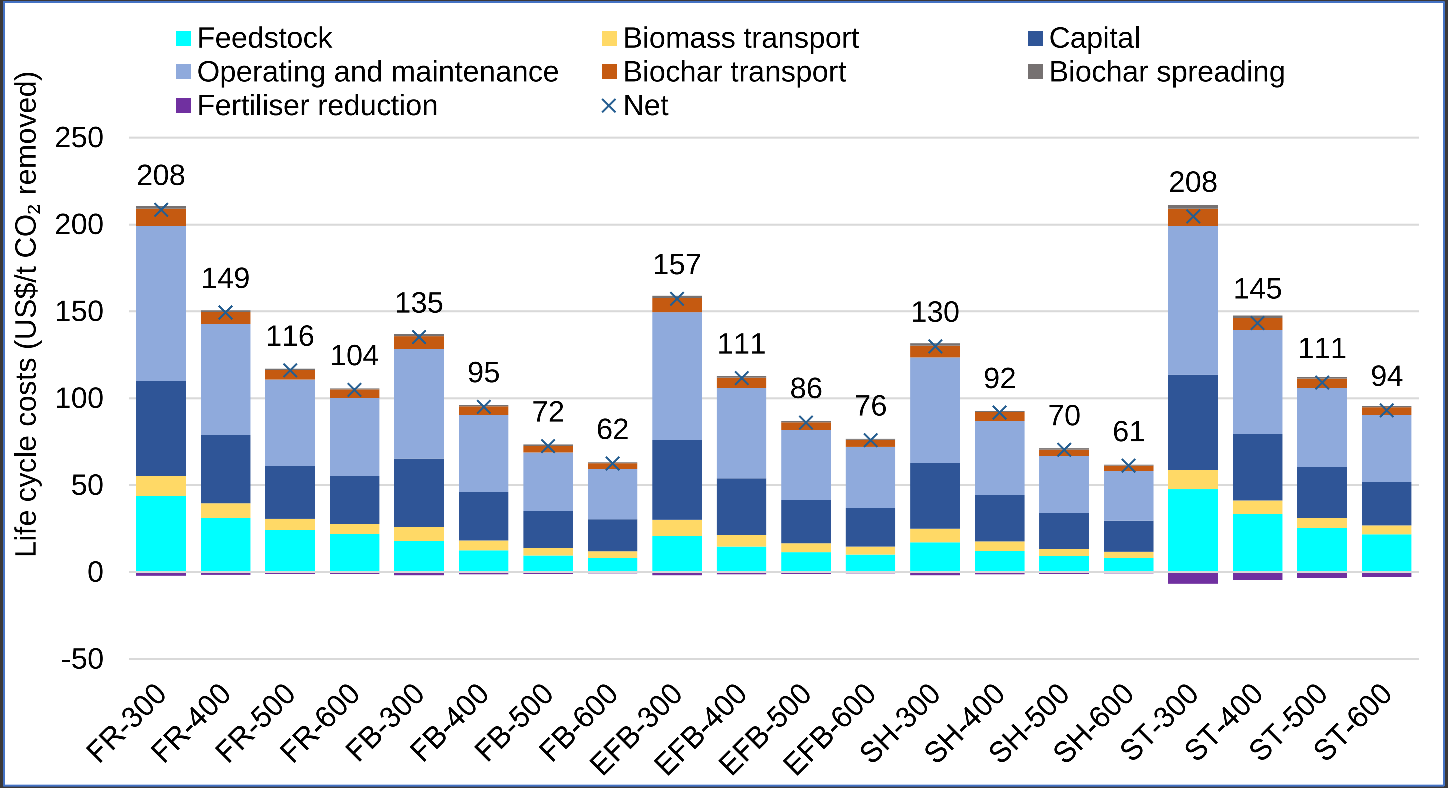
Global warming potential



Other environmental impacts



Life cycle costs



Conclusions & Future Work

Net-negative global warming potential and ozone depletion potential, with cost ranging US$ 61 – 208/t CO_2 removed.

The system with shells performs the best environmentally and economically. Pyrolysis temperature at 600 °C is preferred.

Potential sequestration of 6.01–12.41 Mt CO_2/yr (26-54% national emissions from agricultural sector).

Savings up to 3% in fertiliser import (~ US$ 31 million/yr).

Results will be compared to other NETs to determine the most suitable NETs deployment for Malaysia

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