

# Mitigating Greenhouse Gas Emissions from Cattle Manure: The Role of Biochar

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## Research scope: Introduction

- Global warming has shown adverse impacts throughout the globe and if current greenhouse gas (GHG) emissions continue without a rapid and sustained reduction, the impacts might increase exponentially.
- Agriculture contributes significantly (10-12%) to the global anthropogenic emitted GHG (Malyan et al., 2021; Tellez et al., 2017).
- Notably, agricultural practices yield nearly seven billion tons of manure each year (Thangarajan et al., 2013), with animal husbandry in the European Union (EU-27) and the UK producing over 1.4 billion tonnes of manure from 2016 to 2019 (Orgiazzi & Briones, 2021).
- More specifically, livestock manure was calculated as contributing 8.9% of total methane and 9% of total nitrous oxide emissions in the EU27 + UK + ISL in 2020 (Secretariat, 2022), showcasing significant environmental impacts from manure management practices.
- Biochar is a carbonaceous material produced by thermal degradation of biomass (wood, manure, leaves, etc.) in an oxygen-limited environment (Stylianou et al., 2020). Biochar is a multifaceted product that has a broad range of environmental applications mainly as sorbent material.
- **SCOPE OF THE STUDY:** In the present study the use of manure derived biochar was investigated for the mitigation of cattle manure emitted gasses.

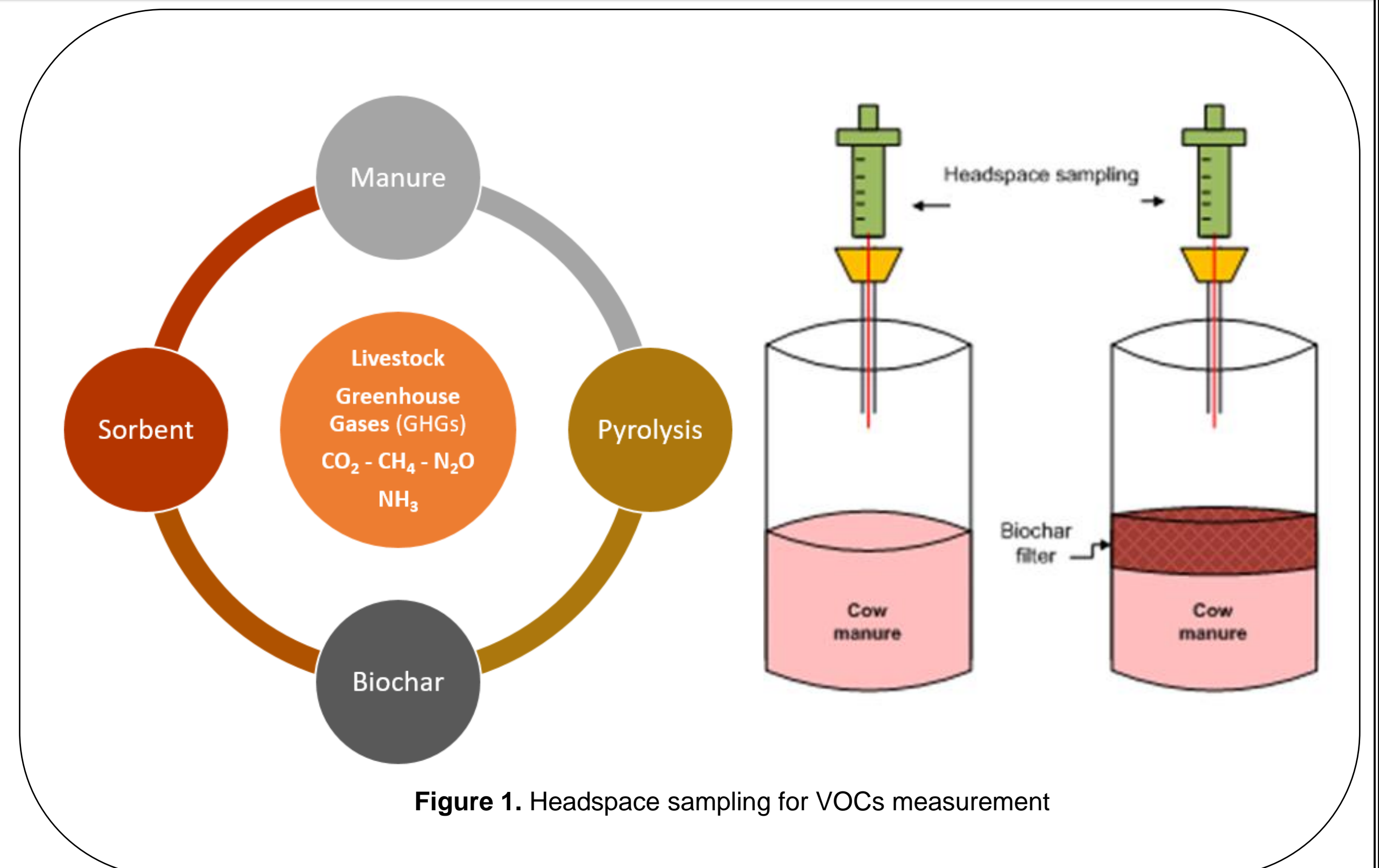


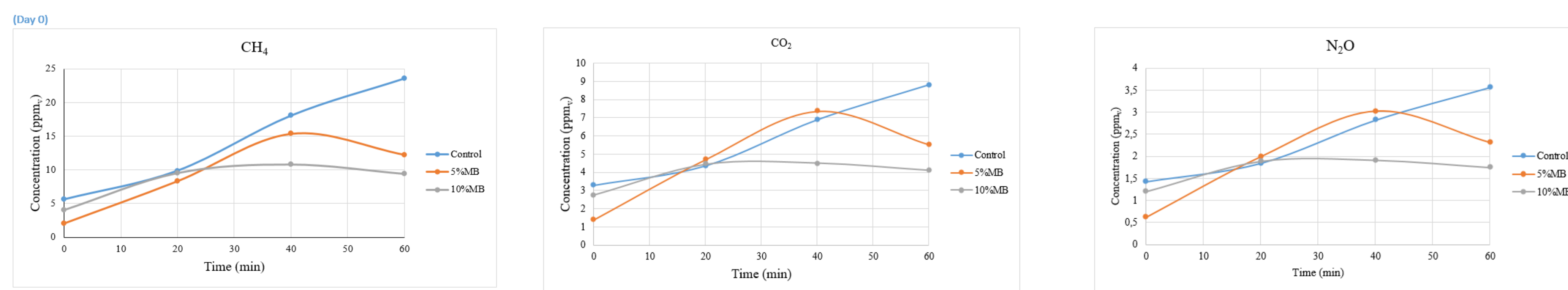
Figure 1. Headspace sampling for VOCs measurement

## THE STUDY: Experimental setup and main methods used

- In the present study the use of manure derived biochar was investigated for the mitigation of cattle manure emitted gasses.
- More specifically, fresh manure was collected from various location from a cattle farm, homogenized and placed in specific in-house made glass reactors (250 mL).
- The reactors were filled with 100 gr manure and a thin surface layer of MB biochar was placed on top of it at 5 and 10 % respectively.
- Air samples were taken at intervals of 0, 20, 40 and 60 minutes across several days (0; 1; 4; 6 and 8 day). Air samples were taken with 20 ml syringes and placed in a pre-vacuumed 20 mL vials.
- Samples were analysed for CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O through Gas Chromatography GC-FID-TCD-ECD (Agilent 8890).
- A portable photoionization gas detector (PID, Dragger Xam 8000, Dräger Safety AG & Co. KGaA, Lübeck, Germany) was used to measure NH<sub>3</sub> emitted from the reactors.

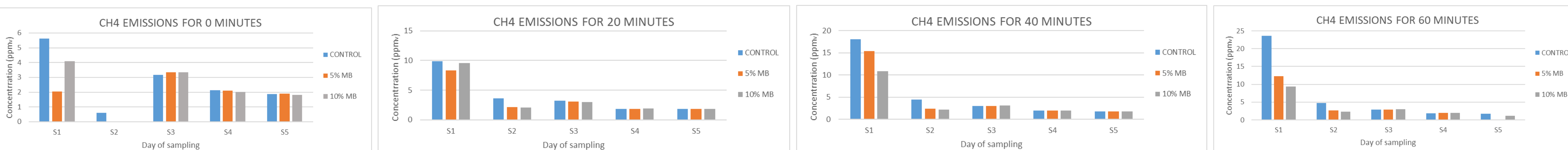


## THE STUDY: Results and Discussion

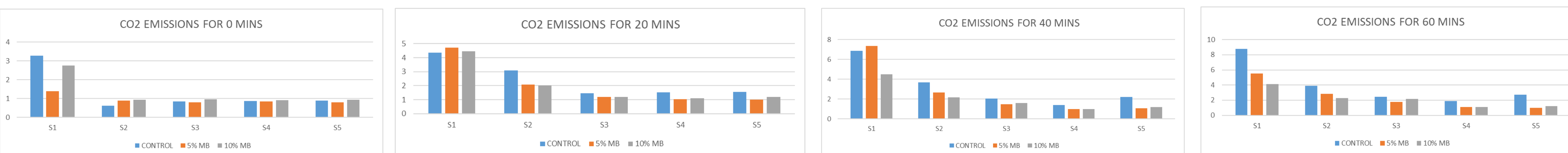


- Overall, GHG emissions were reduced over time.
- Biochar application caused a significant reduction of GHG emissions from dairy cattle manure
- The amount of biochar significantly affected the GHG fluxes and MB 10% was more effective at the initial stages of the experiment

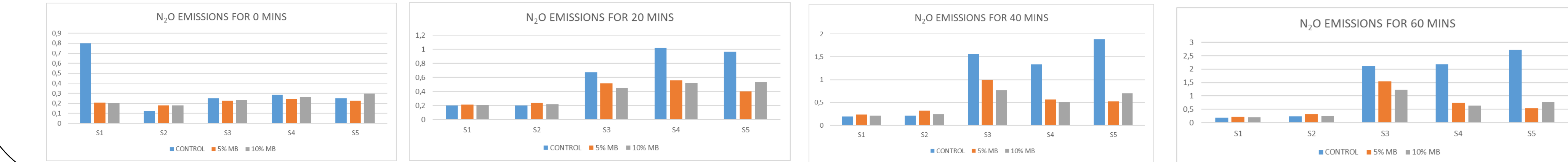
### Methane (CH<sub>4</sub>) emissions



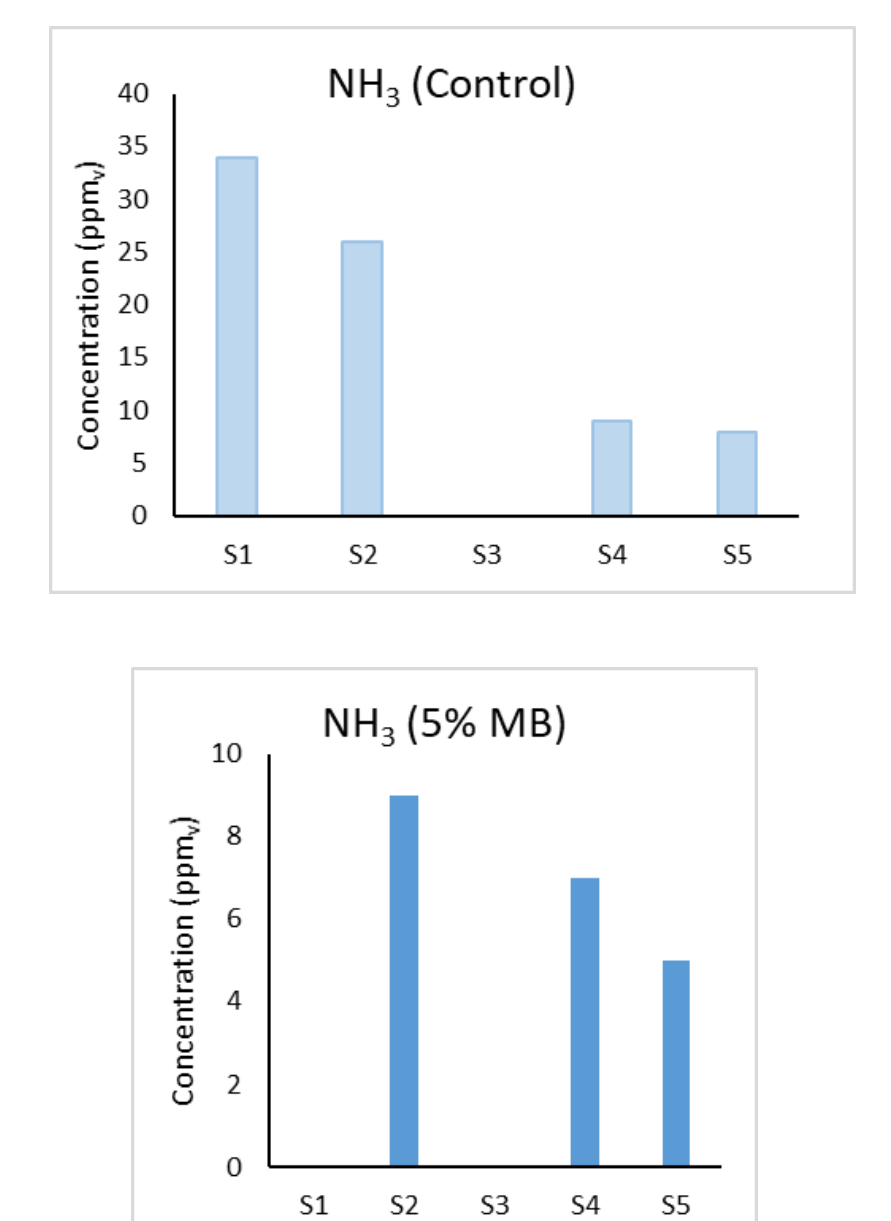
### Carbon dioxide emissions



### Nitrous oxide emissions



### Ammonia emissions



## THE STUDY: Conclusions

- Results showed that emissions for all three GHG are increasing through sampling time (0-60 min).
- The addition of two different concentrations of biochar decreased the emitted GHG only the first day whereas the next period an increase was observed.
- A significant decrease in NH<sub>3</sub> emissions was recorder which should be further investigated with more detailed experiments.

References  
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