Veterinary Integrative Sciences 2024; 22(2): 405 - 418 DOI; 10.12982/VIS.2024.029

Faculty of Veterinary Medicine
Chiang Mai University

Vet Integr Sci

Veterinary Integrative Sciences

ISSN; 2629-9968 (online)

Website; www.vet.cmu.ac.th/cmvj

Research article

A preliminary report of integrating sheep farming in combination with adopting biogas technology in organic rice farming systems in upland areas in Indonesia

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Abstract

This study aims to understand the preliminary results of integrating sheep farming in combination with adopting biogas technology in organic rice farming (ORF) systems in upland areas. The research was conducted in upland areas in Grabag Subdistrict Magelang Regency, Central Java Province (UPL1) and Kertasari Subdistrict, Tasikmalaya Regency, West Java Province (UPL2), Indonesia. At each upland area, a demo plot with a 17 m^3 digester has been established, and 120 sheep were introduced. A combination of sheep and beef cattle manure was used as a biogas substrate. The soil sample of one and three-year conversion of ORF was collected, and macro and micro minerals were analyzed. The biogas quality was analyzed, including dry matter (DM), nitrogen (N), carbon (C) and nitrogen-ammonia (N-NH_3). The greenhouse (GHG) emissions, including methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O), were measured. The results indicated that C-organic content at three-year conversions of ORF in UPL1 was much lower (P<0.05) than the one-year conversion. The average CH_4, CO_2, and N_2O contents in UPL1 were 661, 477.3, and 0.16 mg/m^2/day, respectively. The average CH_4, CO_2, and N_2O contents in UPL2 were 3328, 3038 and 2.42 mg/m^2/day, respectively. In UPL1, the proportion of CH_4 was 52.5 %, CO_2 was 47.4 %, and N_2O was 0.01 % while the proportion of CH_4 was 57.9 %, CO_2 was 42.0 %, and N_2O was 0.01 % in UPL2. To conclude, integrating sheep farming in combination with adopting biogas technology in the ORF system improves manure management and provides organic fertilizer, which subsequently reduces the use of artificial fertilizer and avoids GHG emissions.

Keywords: Anaerobic digestion, Sheep manure, Organic rice farming, Upland areas

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Funding; The research is part of the UPLAND project, Indonesian Ministry of Agriculture. The UPLAND project is a comprehensive upland agricultural activity, from on-farm to off-farm development. The project is funded by International Fund Agriculture Development (IFAD) and Islamic Development Bank (IDB). For further information, please visit https://upland.psp.pertanian.go.id/#googtrans(en|en)

Article history; *received manuscript: 31 March 2023*
revised manuscript: 22 August 2023
accepted manuscript: 25 September 2023
published online: 24 October 2023
Academic editor: *Nguyen Trong Ngu*

INTRODUCTION

The intensive rice production system, e.g., increasing cropping intensity and high use of inorganic fertilizer, has frequently been adopted to increase rice production. In Indonesia, the rice production system takes the most significant portion of inorganic fertilizer compared to other agriculture systems. The use of inorganic fertilizer has soured three times higher over 30 years, from 2.57 tons in 1980 to 7.66 tons in 2010, and during this time, the annual production has increased by up to 34% (Figure 1). However, the yield production has remained stable or declined slightly over the last ten years during 2011-2020 (Figure 1), with the annual production ranging from 5.0 to 5.4 tons per hectare. As the staple food for many Asian countries, including Indonesia, rice is essential in the Indonesian national food security system. The Indonesian national statistic recorded that the rice area was 10.41 million ha, with a total production of 54.4 million tons in 2021 (National Statistic Bureau, 2021).

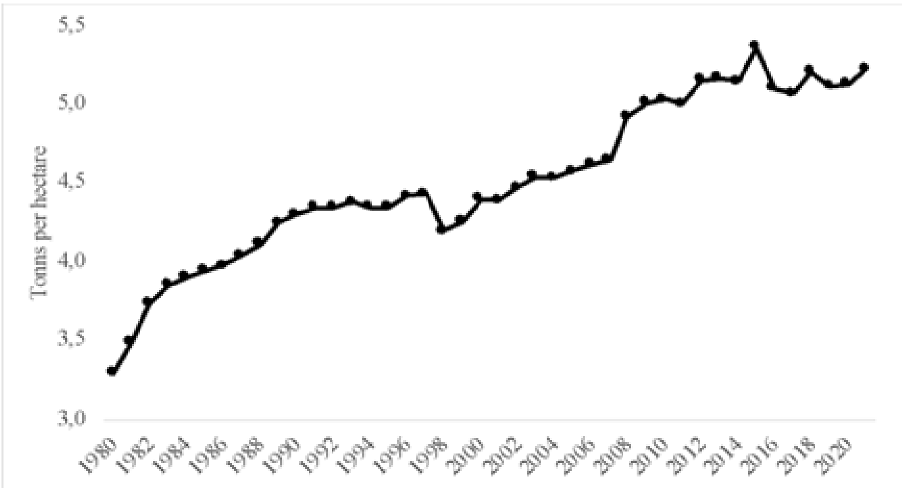

Figure 1 Yield of rice production in Indonesia (1980-2020)(FAOSTAT, 2022).

Steady rice productivity has been indicated as a significant problem in the Indonesian national rice production system. Altough in 2021 rice production was sufficient to meet the demand, the increase in population should be noticed to improve production. The imbalance of nutrients, low soil organic carbon (SOC), and climate changes are reasons that might have a negative impact on steady rice production. Increasing inorganic fertilizer use is not an appealing option to raise production because higher-cost subsidies must be allocated. In addition, inorganic fertilizers stimulate environmental issues such as greenhouse gas (GHG) emissions and nutrient leaching (Arunrat et al., 2018; Park et al., 2023). GHG, including nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2), are emitted along rice production systems. The current practice of rice cultivation generates CH_4 emissions because the flooded soils in the rice field create an anaerobic environment. The CH_4 emissions in the rice field are mainly produced by methanogens, which convert the acetic acid into CH_4 in an anaerobic state (Conrad et al., 2002). High carbon content and low decomposition rate of the biomass in anaerobic conditions create CH_4 (Mboyerwa et al., 2022). The rice field is the second CH_4 emissions contributor after the enteric fermentation from livestock, contributing to 22% of global anthropogenic activities (Smith et al., 2014).

Organic Rice Farming (ORF) has been proposed as an option to address those aforementioned challenges and simultaneously reduce environmental impacts from rice field cultivation. In Indonesia, ORF was developed in 1980, and Java Island was the first ORF center. To date, there have been positive ORF results such as increased revenue/cost (R/C), low-cost production, and less pest and disease damage compared to conventional rice farming (CRF) (Oyama et al., 2017). The adoption of the ORF system has become more popular, mainly due to the higher price offered for organic products in the markets. Rice production is dominated in Java Island, with significant production in East Java, Central Java, and West Java Provinces. The ORF can be found in many upland areas in this central production region.

However, in the ORF system in upland areas, the supply of organic fertilizer is an issue. The supply of organic fertilizer mainly relies on rice straw and the compost product from livestock manure or the purchased organic fertilizer. Hence, the integration of livestock production, i.e., sheep farming in combination with biodigester installation, is expected to provide more organic fertilizer for the ORF. To what extent the effects of this integration are unknown. Hence, this research aims to understand the preliminary results of integrating sheep farming in combination with adopting biogas technology in ORF systems in upland areas.

MATERIALS AND METHODS

Experimental design and data collection

The research was conducted in upland areas at Grabag Subdistrict Magelang Regency, Central Java Province, and Kertasari Subdistrict, Tasikmalaya Regency, West Java Province, Indonesia, from August to December 2022. The ORF and livestock such as sheep and beef cattle are commonly found in this area. The rice farmers in this study are part of the upland project from the Ministry of Agriculture, Indonesia. We first established a biodigester at each demo plot in the upland areas. Following this, we analyzed soil, feed, and manure samples. We finally estimate the GHG emissions from the established biodigester.

Biodigester installation and sheep manure system

In the current study, we first established a 17 m^3 fixed dome biodigester. The biodigester installed in the demo plot area belongs to the farmer group. The land was flat and had a minimum size of 5m x10m to install the biodigester. The biodigester was made from fiber materials, and we followed the Indonesian National Standard (2011) of the biodigester materials and their installment (SNI 7639-2011) (Figure 2).

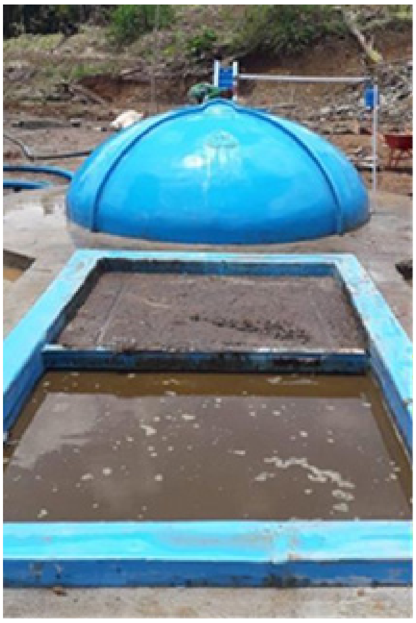

Figure 2 Biodigester system at demo plot (UPLAND PROJECT ©)

Materials such as concrete/bricks, plastics, reinforced fiber, and metals have been used to construct biogas digesters worldwide. Cement and fiber materials are officially recognized as biogas construction materials in Indonesia. We also installed the desulfurized, aiming to absorb the hydrogen sulfide, and the water trap aiming to trap the water vapor. The presence of hydrogen sulfide and water trap can affect the flame from the biodigester. To fill the biodigester and to provide the organic fertilizer to the ORF, we introduced 120 sheep at each demo plot, in which manure from the sheep will be used as the substrate for the biodigester. At Grabag Subdistrict Magelang Regency, Central Java Province, all the sheep were fed with grass and compound feed in the stable. Meanwhile, at Kertasari Subdistrict, Tasikmalaya Regency, West Java Province, all the sheep were fed with the grass, silage, and compound feed in the stable. Assuming each sheep produces 2 kg of feces, we expect to have a minimum of 240 kg daily as the substrate. As the sheep grow, we expect more feces for the substrate. Instead, we expect to receive more manure from the other neighboring beef and sheep farmers close to the demo plot to reduce environmental impacts from livestock production. We did a pre-treatment process for the sheep manure before entering the digester. In this process, all collected sheep feces from the stable are stored in a temporary inlet for two days and are mixed with water to break the lignin complexes defiant to anaerobic digestion (AD). After the biodigester construction, we filled the inlet of the biodigester using the substrate from beef cattle manure (85 %) and sheep manure (15 %). The use of beef cattle manure at the beginning of the installation of biodigester was to stimulate gas production. Therefore, beef cattle manure was collected from the neighboring beef farmers of the demo plot.

The AD in the digester produces two main products: the biodigester gas and the bio-slurry. The gas produced from the biodigester will be used for energy sources at the stable, e.g., cooking and lighting. Bio-slurry is rich in available nutrients such as nitrogen (N), ammonium (NH_4), and carbon (C) and is essential as the organic source for the ORF. The bio-slurry will be delivered to the ORF close to the demo plot.

Greenhouse gas emissions analysis

To get an estimate of GHG, including CH_4, N_2O, and CO_2 from the biodigester, we collected the gas using a closed chamber (Minamikawa et al., 2015). In this approach, the gas was collected between 09.45-11.00 am with intervals of 15, 30, 45, 60, and 75 minutes after the chamber was deployed. The chamber was made from a transparent, break-resistant acrylic material of 40 x 20 x 30 cm. A hose was connected from the biodigester to the chamber to flow the gas. In addition, the chamber was completed with a fan to ensure the gas within the chamber was mixed homogeneously, and the temperature in the chamber was measured. The gas within the chamber was sucked using a syringe and flowed into a 10 ml vacuum bottle. In our study, we collected the gas for four consecutive days. The gas was analyzed using gas chromatography at the Agriculture Environment Research Institute.

Feed and manure samples

We collected feed samples from feed at the demo plot, and the analysis of dry matter (DM), N, and C was performed. Moreover, we also collected the manure samples from the sheep feces at the demo plot and conducted an analysis of the DM, N, and C content. All the feed and manure samples were analyzed at the Faculty of Animal Science, IPB University, Indonesia. The samples of feed or manure were dried at 105 °C until constant weight to determine the DM. The N was determined using a Kjeldahl method, and the C-organic was determined using a Walkley & Black method.

Soil sample

We collected soil samples from the rice fields close to the demo plots. The selected rice fields are expected to receive bio-slurry as the organic fertilizer. Understanding the effects of bio-slurry application on the changes in soil characteristics of rice fields will take some time. Hence, the current study reported the initial information on the soil condition at the rice fields that will receive the bio-slurry. The results are essential to understand the soil changes once the bio-slurry is continuously applied. We collected soil samples from one- and three-year conversion rice fields to understand the soil characteristics after conversion from the conventional to ORF system. In the Grabag subdistrict (UPL1), we collected four soil samples from four rice fields in three villages. In UPL1, the collected sample of one-year conversion included a rice field area in Tlogomulyo and Rukun Tani, and three-year conversions, included a rice field area in Tlogomulyo mand Sidodadi. In Kertasari subdistrict, Tasikmalaya Regency (UPL2), we collected four soil samples from four rice field areas in two villages. In UPL2, the collected sample of one-year conversion includes two rice field areas in Cihamerang, and three-year conversion includes two rice field areas in Ciperut. The difference in soil sampling is due to the distance from the demo plot. The average size of the sampled rice field ranged from 319 to 1,050 m^2.

The soil sample was collected using a hand auger from each rice field with a 0-30 cm depth from three random spots, and we composited the collected soil. The soil analysis included the pH, C- organic, N-total, P, macro minerals (Ca, Mg, K, Na) and micro minerals (Fe, Zn, Mn), and cation exchange capacity (CEC). The pH was measured according to the Indonesian National Standard (2002) method for soil pH measurement (SNI 03-6787-2002). C- organic was measured using a Walkley & Black method, and N-total was determined using a Kjeldahl method. The P analysis was conducted using a Bray method. The macro and micro minerals and CEC were detected using the Atomic Absorption Spectrophotometer. All the analysis was conducted at the soil science laboratory, IPB University, Indonesia.

Data analysis

The results from gas chromatography were used to estimate the N_2O and CH_4 fluxes by using the following equations (Minamikawa et al., 2015):

$$Flux_{N_2O} = \frac{\Delta C}{\Delta t} \times \frac{V}{A} \times \rho \times \frac{273}{273 + T}$$

$$Flux_{CH_4} = \frac{\Delta C}{\Delta t} \times \frac{V}{A} \times \rho \times \frac{273}{273 + T}$$

In which the $\Delta C/\Delta t$ is the changes of gas concentration over time (ppb-N_2O or ppm-CH_4 minute-1), V is chamber volume (m^3), A is chamber area (footprint; m^2), ρ is gas density (1.977 kg m^{-3} for N_2O and 0.717 kg m^{-3} for CH_4 at 0 °C), and T is the mean air temperature inside the chamber (°C). The amount of $\Delta C/\Delta t$ equal the slope of the regression line between gas concentration (ppb or ppm) and time (minute). We reported the daily fluxes of GHG emissions and the proportion of each gas, i.e., CH_4, N_2O, and CO_2 from UPL1 and UPL2. The feed and manure content of UPL1 and UPL2 were descriptively described. As we would like to understand the nutrient changes due to the conversion of conventional to organic rice, we compared the C, N, P, macro, and micro minerals content of the soil at UPL1 and UPL2 in the soils using a t-test.

RESULTS

The quality of biogas production depends on the input's materials, i.e., the feces. Feces concentration from sheep manure used in this study is shown in Table 1.

Table 1 shows that the sheep manure in UPL1 has higher DM and lower N and C content. The C/N ratio in UPL1 ratio was higher than in UPL2. The feces concentration was linked to the feed concentration. Table 2 shows the feed concentration from the sheep at the demo plot.

Table 1 Dry matter, nitrogen, and carbon content of fresh sheep manure in demo plot.

	UPL1	UPL2
DM (g/100 g)	369	279
N (g/100 g)	14	23
N-NH3 (g/100 g)	0.054	0.046
C (g/100 g)	297	338
C/N	21:1	14:1

DM (dry matter), N (nitrogen), C (Carbon), UPL1 (Grabag subdistrict, Magelang Regency, Central Java), UPL2 (Kertasari subdistrict, TasikmalayaRegency, West Java).

From Table 2, the quality of concentrate met the quality of concentrate according to the Indonesian National Standard (2019) (SNI 8819-2019), in which the water content of the concentrate was below 150 g/100 g with a minimum protein content of 100 g/100 g. In UPL2, the silage was fed to the animals, leading to more feed being given to the animals.

Table 2 Dry matter, nitrogen, crude protein, and carbon content of feed in demo plot.

Feed types	DM (g/100 g)	N (g/100 g)	CP (g/100 g)	C (g/100 g)
		UPL1		
Grass	229	29	181	251
Concentrate	864	37	231	223
		UPL2		
Grass	15.3	24	150	354
Concentrate	857	38	237	334
Silage	17.3	1.8	11.2	324

DM (dry matter), N (nitrogen), CP (crude protein), C (Carbon), UPL1 (Grabag subdistrict, Magelang Regency, Central Java), UPL2 (Kertasari subdistrict, Tasikmalaya Regency, West Java)

Table 3 shows methane, carbon dioxide, and nitrous oxide fluxes from 17 m^3 biodigester capacity in demo plots over four days of observation. Table 3 shows the CH_4 fluxes in UPL1 range from 505 to 972 mg/m^2/day, which was 765 to 5,950 mg/m^2/day in UPL2. The CO_2 fluxes in UPL1 range from 336 to 679 mg/m^2/day and 652 to 5,365 mg/m^2/day in UPL2. The N_2O fluxes range from -0.5 to 0.8 mg/m^2/day in UPL1 and -0.5 to 4.6 mg/m^2/day in UPL2. We compare the average GHG from biodigesters in both demo plots (Figure 3). The overall average shows that the GHG was much higher in UPL2 than in UPL1. The average CH_4 in UPL1 was 661 mg/m^2/day, CO_2 was 477 mg/m^2/day, and N_2O was 0.16 mg/m^2/day. The average CH 4 in UPL2 was 3,327 mg/m^2/day, CO_2 was 3,037 mg/m^2/day, and N_2O was 2.4 mg/m^2/day.

Table 3 Methane, carbon dioxide, and nitrous oxide fluxes from biodigester in demo plots over four days observation.

	Observation days	CH_4 (mg/m^2/day)	CO_2 (mg/m^2/day)	N_2O (mg/m^2/day)
UPL1	1	972	679	-0.5
	2	628	336	0.1
	3	538	420	0.2
	4	505	473	0.8
UPL2	1	5,950	5,365	4.6
	2	5,683	5,284	3.8
	3	913	847	1.8
	4	764	652	-0.5

UPL1 (Grabag subdistrict, Magelang Regency, Central Java), UPL2 (Kertasari subdistrict, Tasikmalaya Regency, West Java)

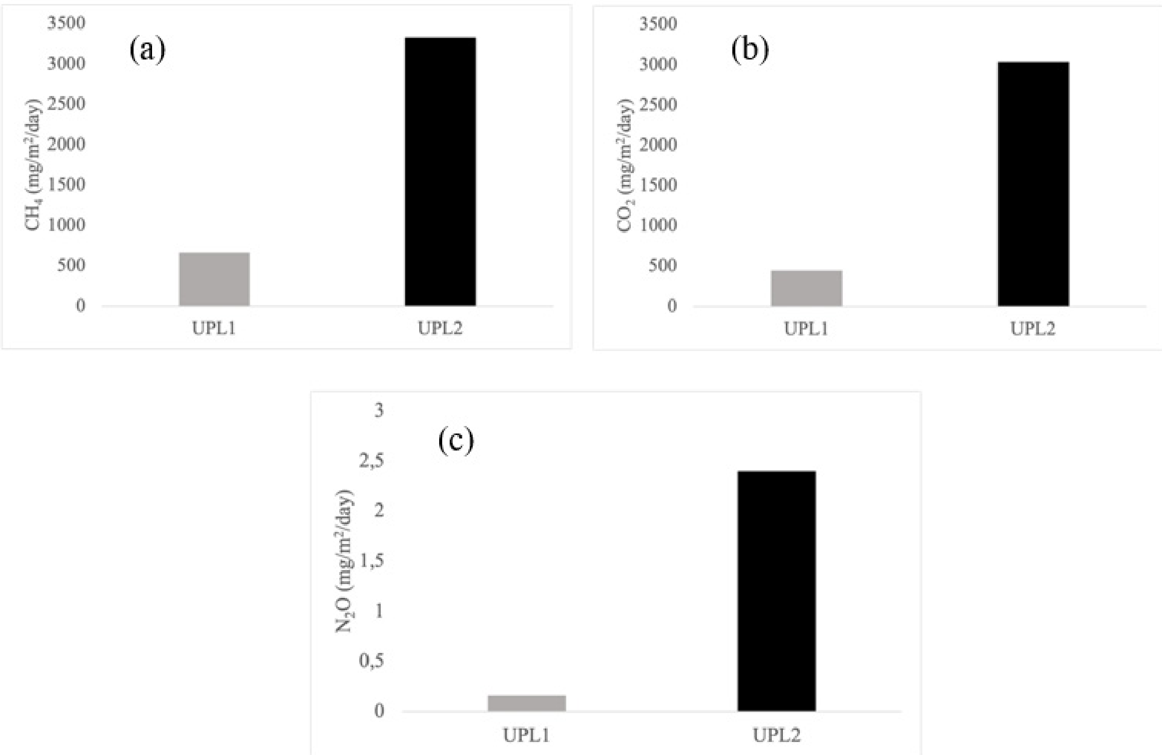

Figure 3 Average of methane (a), carbon dioxide (b) and nitrous oxide (c) from biodigester in demo plot. UPL1 (Grabag subdistrict, Magelang Regency, Central Java), UPL2 (Kertasari subdistrict, Tasikmalaya Regency, West Java).

In AD, the CH_4 and CO_2 determine the combustion from the biodigester. Figure 4 shows the proportion of CH_4 and CO_2 in both demo plots. In UPL1, the proportion of CH_4 was 52.5 %, CO_2 was 47.4 % and N_2O was 0.01 %. In UPL2, the proportion of CH_4 was 57.9 %, CO_2 was 42.0 % and N_2O was 0.01 %.

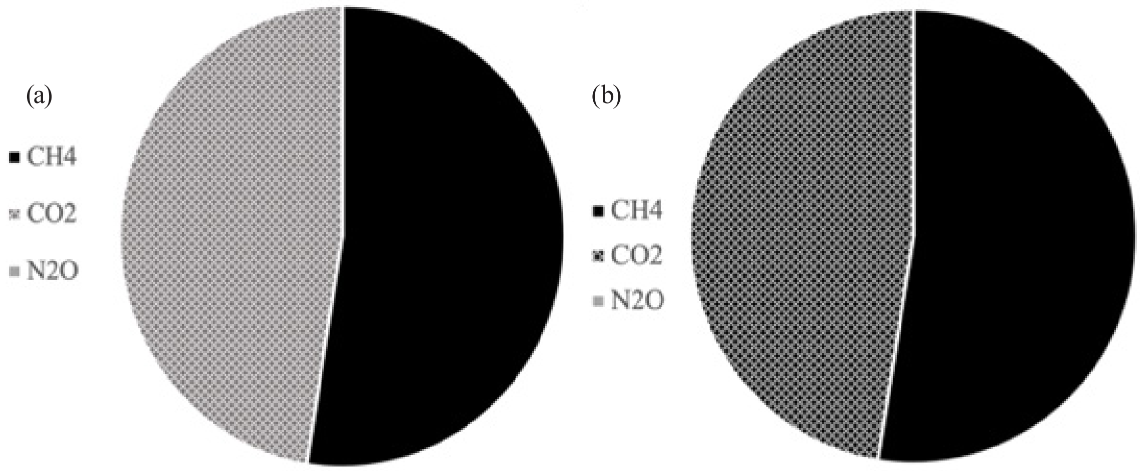

Figure 4 Proportion of methane, carbon dioxide and nitrous oxide from biodigester in demo plot in UPL1 (a) and UPL2 (b)

Table 4 shows that the SOC and Ca content in the rice field at UPL1 differed significantly between one and three-year conversions ($P<0.05$). The SOC and Ca of the three-year conversion were lower than the one-year conversion. Likewise, the SOC and Ca of the three-year conversion were lower than the one-year conversion. However, the others soil parameters content between one and three-year of conversion at UPL2 did not differ significantly.

Table 4 The average soil parameters content in one and three-year conversion at Grabag subdistrict, Magelang Regency, Central Java (UPL1) and Kertasari subdistrict, Tasikmalaya Regency, West Java (UPL2).

Parameters	UPL1		UPL2	
	One-year	Three-year	One-year	Three-year
SOC (%)	3.64±0.15[a]	2.41±0.23[b]	0.81±0.06	1.17±0.11
N (%)	0.33±0.01	0.23±0.04	0.15±0.01	0.16±0.02
P (ppm)	6.68±3.21	9.24±0.99	21.80±0.20	43.60±7.92
pH	5.82± 0.47	6.13±0.04	6.25±0.19	6.56±0.08
Ca	8.05±0.17[b]	10.37±0.63[a]	7.81±3.75	35.01±17.57
Mg	2.80±0.08	3.18±0.88	3.20±1.45	6.05±0.31
K	0.83±0.21	0.35±0.007	0.13±0.01	0.33±0.14
Na	0.46±0.08	0.35±0.007	0.18±0.02	0.24±0.07
CEC	32.35±0.80	30.49±1.76	20.40±7.26	36.42±12.51
Fe	759.00±158.30	645.50±103.90	110.30±67.45	74.95±3.32
Cu	5.91±0.37	8.72±2.15	1.90±0.42	2.70±0.42
Zn	4.55±0.14	4.46±1.08	7.40±1.13	5.50±0.28

* Means within row with different superscripts are significantly different t-test (α=0.05).

DISCUSSION

In this study, we aim to understand the preliminary results of integrating sheep farming in combination with adopting biogas technology in ORF systems in the upland areas. The upland areas are vital to support rice production in Indonesia. Integrating sheep farming with biogas technology in the ORF system is expected to reduce environmental impacts by improving manure management at sheep farms and reducing inorganic fertilizer use at the rice field.

We first constructed the biodigester and introduced sheep farming at the demo plots. Different materials of biodigester have been used widely, and environmental and economic aspects have been assessed (Obileke et al., 2022). In the current study, the fiber materials were used due to better technical performances of biogas production and economically viable for the farmer groups. The biogas technology provides energy and produces digestate, which contains microbial biomass, metabolic compounds, and complex organic structures and can be used as an organic fertilizer (Bonten et al., 2014; González et al., 2021; Kebede et al., 2023). The use of digestate as organic fertilizer for the rice field has been shown in the study of Hu et al. (2021). They demonstrated that coupled digestate and straw application could maintain rice production and have potential positive rice environmental effects. To what extent the effects of this integration on rice production, soil characteristics, and GHG in the upland areas are not discussed in this current study because understanding the overall effects will need some time. Hence, we first report the preliminary results and provide essential information when the digestate is applied to the rice field.

We further analyzed the nutrient content in sheep manure, which subsequently be used as the substrate for the biodigester. In our study, the C/N was much higher than in the study of González et al. (2021), and the lower N content in both demo plots could explain this. Low N content could lead to low ammonia levels in the biodigester. The study of Nasir et al. (2012) reported that a high accumulation of ammonia had caused negative interactions with volatile fatty acids, adversely affecting the digester microflora and the CH4 yield. In UPL2, the C and N content of sheep manure were higher than in UPL1, which the animals' feed could explain the findings. In UPL 2, adding silage to the diet causes higher C and N content. The relationship between feed and manure content is clear (Velthof et al., 2000; Yan et al., 2006; Al Zahra et al., 2020).

The GHG from the biodigester was measured, and we discovered that the CH_4 fluxes in UPL1 were lower than the CH_4 fluxes in UPL2. In addition, manure composition at UPL1 will likely affect the CH_4 fluxes. However, to what extent the relationship between manure composition and CH_4 fluxes is beyond the scope of the current study and provides room for further studies. During our data collection, we discovered that farmers' knowledge of UPL1 still needs to be improved, as they did not continuously feed the biodigester with the substrate. The lack of awareness or limited information on biogas technology was also a challenge in adopting biogas for smallholder farmers in Zambia (Kalinda, 2019).

In addition, the nutrient content of manure in UPL2 was also higher than in UPL1. We compared our findings with other studies, and we discovered that the CH_4 fluxes in UPL2 (converted into $g/m^2/h$; $0.138\ g/m^2/h$) were higher compared to the study of (Zeng et al., 2020) in which they measured the CH4 at the outlet of 8 m^3 biogas filled with the pig manure (0.083 $g/m^2/h$). However, in UPL1, the CH_4 rates were lower than in the study of (Zeng et al., 2020) (i.e., 0.02 $g/m^2/h$). Moreover, the effects of beef manure addition at the start of biogas installation could affect the gas production in both demo plots. However, we cannot measure the beef manure content as it was collected from various beef manure neighbor farmers around the demo plots. Therefore, the effect of adding beef manure on CH_4 fluxes is challenging to explain at the field level. The proportion of GHG in both demo plots was compared, and we found that the proportion of GHG was comparable. CH_4 was the dominant gas compared to other gasses (i.e., CO_2 and N_2O). During AD, the N_2O, the most potent GHG, was very low and often neglected. However, N_2O could arise during storage due to the nitrification process, which needs to be noticed. In our study, the proportion of CH_4 (52.5% in UPL1 and 57.9% in UPL2) was lower than in the study of (Achinas et al., 2018), which showed the CH_4 proportion from the combination of sheep and cattle manure was 61%. Moreover, the CH_4 proportion from sheep manure only was 54%, and this was 65% in the previous studies (Zeng et al., 2020; Alma'atah et al., 2021).

SOC reflects soil quality in sustainable agricultural production (Yu et al., 2022). In the Grabag subdistrict, Magelang Regency, Central Java, the soil was Andosol, and in the Kertasari subdistrict, Tasikmalaya Regency, West Java, the soil was Latosol. A study by Supriyadi et al. (2018) indicates lower SOC in the Indonesian non-organic compared to the organic rice system. In this study, the lower SOC content in three-year conversion than to C content in one-year in UPL1 indicates soil extraction in the rice field in a longer ORF, implying the importance of continuous organic fertilizer supply for the rice field soil (Alma'atah et al., 2021).

CONCLUSIONS

The study shows the preliminary results of integrating sheep farming in combination with adopting biogas technology in ORF systems in upland areas. The feed composition and its content link to the manure composition used as the substrate for AD. The substrate for AD affects the GHG production from biodigester in which CH_4 in UPL1 was lower than in UPL2. The low production of N_2O during AD could be neglected, but the rising of N_2O due to storage must be noticed, showing the importance of storage systems of the digestate for N_2O production. To conclude, the strategy to integrate sheep farming in combination with adopting biogas technology in the ORF system in upland areas improve manure management at sheep farming, provides a potential organic fertilizer supply which subsequently will increase the SOC quality at the ORF, reduce the use of artificial fertilizer and avoid greenhouse gas emissions from both sheep farming and ORF systems. Providing knowledge to fill the biodigester with manure continuously and applying the digestate to the rice field is essential in this integration system. Therefore, the strategy is relevant to improve the sustainability of Indonesia's ORF system in the upland areas.

AUTHOR CONTRIBUTIONS

The research is part of the UPLAND project, Indonesian Ministry of Agriculture. The UPLAND project is a comprehensive upland agricultural activity, from on-farm to off-farm development. The project is funded by International Fund for Agriculture Development (IFAD) and Islamic Development Bank (IDB). For further information, please visit https://upland.psp.pertanian.go.id/#googtrans(en|en)

AUTHOR CONTRIBUTIONS

Windi Al Zahra; Conceptualization and design of the experiment, investigation, manuscript preparation, editing, and finalization.
Renita Sari; Conceptualization and design of the experiment, investigation, and supervision.
Rezha Wahyu Pratama; Investigation and data collection.
Mustaghfirin; Conceptualization and design of the experiment, investigation, and data collection.
Rahmadan Khairul Huda; Investizgation and data collection.
Imam Mujahidin Fahmid; Conceptualization and supervision.
Farakka Sari; Conceptualization and supervision.
Ivan Mangaratua Siburian; Conceptualization and supervision.
Wahyudi; Conceptualization and supervision.

CONFLICT OF INTEREST

Authors declare no conflict of interest in this study.

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How to cite this article;
Windi Al Zahra, Renita Sari, Rezha Wahyu Pratama, Mustaghfirin, Rahmadan Khairul Huda, Imam Mujahidin Fahmid, Farakka Sari, Ivan Mangaratua Siburian, Wahyudi 2024. A preliminary report of integrating sheep farming in combination with adopting biogas technology in organic rice farming systems in upland areas in Indonesia. Veterinary Integrative Sciences. 2024; 22(1): 405 - 418