Hedgerow Systems and Livestock in Philippine Grasslands: GHG Emissions

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Introduction Hedgerow systems are widely adopted in the smallholder farms in the sloping grassland areas of Claveria, Mindanao, Philippines. The system is effective in addressing soil erosion problems and in conserving the topsoil. *Gmelina arborea* and *Eucalyptus deglupta* are two fast-growing timber species that are planted in hedgerow systems while maize is planted in the alley areas in between the hedgerows. Livestock holdings are widespread in Claveria, with 74% of the households having livestock. Cattle and carabao are the most common livestock in smallholder farms providing draught power for land preparation and transportation. In hedgerow systems, fodder tree leaves and crop residues are fed to livestock, while animal manure is added to the soil. Thus, these systems may serve as both a source and sink of methane and nitrogen oxides, depending on the management practices and component trees and crops of the system. This study aims to estimate methane emissions from livestock holdings and nitrogen oxide emissions through fertilization, tree litterfall and decomposition, maize residue incorporation and livestock manure from *G. arborea* and *E. deglupta* hedgerow systems.

Materials and methods Experimental plots were established in 1 and 7-yr old *E. deglupta*- and *G. arborea*-hedgerow systems with maize planted in the alley areas. The treatments are different combinations of tree species, tree age, and tree spacing. Inorganic N and P fertilizer, and maize crop residues were applied in the maize crop. Maize biomass, grain yield, tree litterfall and leaf litter decomposition were measured. A survey of 300 households in Claveria was conducted to gather information on livestock holding and management.

Results The major sources of N inputs in the different hedgerow systems are the maize crop residues (FCR) and synthetic nitrogen fertilizer (FSN) (Fig.1). Other sources include animal manure (FAW) and tree leaf litter. Since the average animal holding is quite small, nitrogen input from animal waste is small. Direct soil N_2O emissions from the plots range from 2.11 to 5.17 kg N $ha^{-1}yr^{-1}$. Direct soil N_2O emissions from 1-year old hedgerow systems are significantly higher than emissions from 7-year old hedgerow system. Local values for N excretion from cattle and carabao were 12.3 kg and 14.2 kg, respectively; much lower than the default values of 40 kg for both non-dairy cattle and carabao given by IPCC (1997). Enteric fermentation of cattle and carabao (11,352 kg and 3,410 kg, respectively) and swine manure management (2,786 kg) were the main sources of CH_4 emissions from livestock holdings in 300 Claveria households (Table 1).

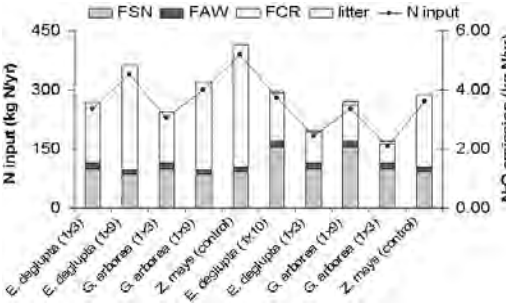

Figure 1 Nitrogen inputs and N_2O emissions in *E. deglupta* and *G. arborea* hedgerow systems

Table 1 Methane (CH4) emissions from enteric fermentation and manure management per animal type

Livestock Type	Number of animals	CH_4 emission (kg)			
		EF	Enteric Fermentation	EF	Manure Management
Non-dairy cattle	258	44	11,352	2	516
Carabao	62	55	3,410	3	186
Goat	46	5	230	0.22	10.12
Swine	398	1.5	597	7	2,786
Poultry	1252	-	-	0.023	28.8
Total			15,589		3,526.92

Conclusions In tree-based hedgerow systems, crop residue incorporation and fertilizer application are the major sources of nitrogen inputs. Direct soil N_2O emissions from the plots range from 2.11 to 5.17 (kg N yr^{-1}) with significant N_2O emissions in 1-year old hedgerow systems than 7-year old hedgerow system. Use of local values for N excretion factors will reduce uncertainties in the estimates of N excretion from animal manure. Enteric fermentation of cattle and carabao and swine manure management were the main sources of CH_4 emissions from livestock holdings in 300 Claveria households.

Reference

IPCC. (1997). The Revised 1996 Guidelines for National Greenhouse Gas Inventories (Workbook and Reference Manuals). Intergovernmental Panel on climate Change. OECD. Paris, France.