Jurnal Peternakan Vol 7 No 1 Februari 2010 (1 - 6) ISSN 1829 - 8729

AN OVERVIEW OF THE METHANE EMISSION FROM RUMINANT IN JAMBI PROVINCE, INDONESIA

M. AFDAL[1,2] AND T.T. POY[2]

[1] *Faculty of Animal Husbandry Jambi University Kampus Mandalo Darat Jambi 36361 Indonesia*

[2] *Department of Animal Science, Faculty of Agriculture Universiti Putra Malaysia Selangor Darul Ehsan 43300 Malaysia*

ABSTRAK

Emisi gas metan terdiri dari 37% dari total emisi gas rumah kaca dimana sumber utama emisi enterik dari sapi dan domba. Metan adalah salah satu gas rumah kaca (GRK) utama di samping uap air, karbondioksida dan nitrogen oksida. Dibandingkan dengan CO_2, metan adalah suatu GRK penting dimana konsentrasinya di atmosfir lebih dua kali lipat semenjak era pre-industri. Kajian ini memberi gambaran sebuah studi kasus mengenai penilaian emisi gas dan kredit karbon dari ternak ruminansia di Provinsi Jambi Indonesia. Data merupakan data sekunder meliputi luas daerah, jumlah ternak ruminansia dan kebijakan tentang rencana ke depan Provinsi Jambi. Jumlah emisi metan dari sapi, kerbau dan kambing adalah 47.83 dan 34,54 ton perhari pada tahun 2002 dan 2006 dan total emisi CO_2 dari sapi, kerbau dan kambing 131,5 dan 94,96 ton perhari pada tahun 2002 dan 2006. Diperkirakan bahwa pada tahun 2015 Provinsi Jambi dapat menghasilkan dari ternak kira-kira untuk 69.118 rumah dengan asumsi keperluan listrik 900 watt per-rumah.

INTRODUCTION

Jambi Province is an area situated in the central part of Sumatra Island. Geographically is located between 00 45' to 20 45' Latitude South and 101⁰ 10' to 104⁰ 55' Longitude East. Jambi Province is separated by Riau Province in the north, Malacca strait in the east, West Sumatra in the west and South Sumatra in the south. The width of Jambi Province is 53.534 km2 that consists of.

Kerinci Regency	4.200 Km^2	(7.86%)
Bungo Tebo Regency	3.500 Km^2	(25.26%)
Sarolangun Bangko Regency	4.200 Km^2	(26.57%)
Batang Hari Regency	11.130 Km^2	(20.83%)
Tanjung Jabung Regency	10.200 Km^2	(19.09%)
The Municipality of Jambi	205 Km^2	(0.39%)

The agricultural and forestry sector is the main emitter of GHG in this area. A study was done by Prasetyo *et al* (1998) to estimate GHG emission using remote sensing and geographical information system in Jambi. Unfortunately there was not discussion concerning the gas emission from animal. In fact, the emission of GHG also builds up from animal. Machmüller and Clark (2006) reported that methane emissions comprise 37% of total GHG emissions whereas enteric emissions from cow and sheep are the main source.

1. Methane

Methane, the simplest alkanes, is a chemical compound with the molecular formula of CH_4. It is the primary constituent of natural gas. Methane's bond angles are 109.5 degrees. Oxidation of one molecule of methane in the presence of oxygen releases one molecule of CO_2 and two molecules of water:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

The main sources of anthropogenic methane is from agriculture, waste and energy sector. In agricultural sector, the methane comes from moss soil, paddy field,

landfills, enteric fermentation from ruminant, manure and waste. In New Zealand, for example, the enteric emission from ruminant especially cow and sheep is around 37% (Machmüller and Clark, 2006). Corinair (1990) reported that the methane emission in European Union is 30% and 15% from enteric fermentation and livestock manure respectively.

2. Methane Emission and Global Warming

Methane is one of the main GHG beside water steam, carbon dioxide and nitrous-oxide. These gases will absorb the infra red radiation and therefore cause the atmosphere warming which is called GHG effect. Methane, chlorofluoro-carbons (CFCs), nitrous-oxide and ozone (O_3), all together influence around 3% of the global GHG effect. Although the contribution of the four GHG is relatively small compared to H_2O (67%) and CO_2 (30%) but the acceleration rate of their concentration in the atmosphere significantly increases the GHG effect in last century (Lelieveld and Crutzen, 1993). Apart from this the four, GHG is also more reactive than H_2O and CO_2 (Bouwman, 1990). Compared to the carbon dioxide, methane is an important greenhouse gas whose concentration in the atmosphere has more than doubled since pre-industrial time.

3. Methane and Carbon Credit

Carbon credit is a hot issue in the programme of reducing of global warming now a day. Carbon credit arranges a role to mitigate the emission effect of green house gas in the industrial basis by capping of the total annual emission and letting the market to give financial value of gas emission through trading. Principally carbon dioxide caused the enhancement of the global warming that affect to climate changing. Carbon credit is a project to diminish the carbon dioxide emission through the program of clean development mechanism by using new energy.

The emerging of the carbon credit concept is as an outcome of the need for controlling the increase of earth temperature. The Intergovernmental Panel on Climate Change (IPCC) (2001) has studied that:

> *Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low green house gas product, technologies and processes. Such policies could include economic instruments, government funding and regulation.*

A system for carbon trading is one of the policy mechanisms shown to be environmentally effective in the industrial sector, on condition that there are reasonable levels of predictability over the initial allocation mechanism and long term price. The formalization of this mechanism was done by an international agreement among more than 170 countries in the Kyoto Protocol, and the market mechanism followed the subsequent Marrakesh Accords (United nation framework convention on climate change (UNFCCC)

Carbon credit is a sequestration of the carbon to the earth. Sequestering of carbon will contribute an opportunity to develop the agricultural production plus benefit the environment. Soil carbon will strengthen the organic matter content of soil thus the establishment of carbon credit will have potential to landowner, farmer and the environment. The points for example no-till and reduced-till farming, cropland retirement, reduce equipment use, reforestation, and livestock manure management practices have the potential to create carbon credits.

MATERIAL AND METHOD

The study was presented a case study concerning assessment of methane emission and the carbon credit from ruminant animal in Jambi Province, Indonesia. This study was a literature study and all data were collected from some sources in Jambi Province. Data were the secondary data including land wide, number of ruminant animal and a policy about future plan of Jambi Province.

Calculation of methane, carbon dioxide, faeces and power produced

Based on this data livestock population in Jambi, it was foreseen the methane emission and carbon credit in this area. The CH_4 emission produced from cow, buffalo, goat and sheep was calculated based on an assumption of the average of methane emission calculated by Machmüller and Clark (2006). They reported that the CH_4 emission produced from female cow, male cow, female sheep and male sheep was 308, 144, 36 and 24 g/day respectively. The CH_4 emission produced from cow, buffalo was assumed as those produced from New Zealand cow and the CH_4 emission produced from goat and sheep was assumed as those produced from New Zealand sheep.

The CO_2 produced from the animal was stochiometrically calculated as one mol of methane would synthesize one mol of carbon dioxide and as comparison to one weight unit of methane would produce 2.75 weight unit of carbon dioxide (see chemical reacyion). Therefore one ton of methane will be equal to 2.75 ton of CO_2.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Calculation of faeces produced from animal and power generated was calculated according Agoyyoga (2007). It may be computed that each head of cow would produce 1.41 kg of faeces per day and generate 0.038 kw per day of electric power.

RESULTS AND DISCUSSION

1. Methane Production

Table 1 shows the animal number, methane and carbon dioxide produced from 2002 through 2006. These data only shows the population of cow, buffalo and goat while there is no available data concerning other animals.

In general the total number of animal species in Jambi Province decreased from 2002 through 2006 except goat. This might be due to that animal production system in this area was still in traditional system. Farmers did not raise their animal full time while their main job is in crop, or rubber plant. Animal just left in the field in the morning and collected in the afternoon without paying attention any feed, production, reproduction health etc. As a result Jambi Province is always deficit in animal population.

In fact the need of animal for meat in Jambi Province increases from time to time. Base on the observation in Muara Bulian animal market, the only one animal market in Jambi Province, it could be seen the increase of animals imported from neighbour area like Lampung and South Sumatra. On the other hand, there is no valid data of imported animal at this market. The government of Jambi Province realized the case of animal deficit and has already made a plan for future development of animal especially for cow population. According to the road map of the animal development especially cow, this province would be a surplus area of cow production in year 2015. It would be foreseen that the number of cow population in that year would be 1.637 million (Anonymous, 2008).

Table 1 Cows population and Methane Emission in Jambi Province

Year	Animal number			Methane produced* (ton/day)			CO_2 Produced** (ton/day)
	Male	Female	Total	Male	Female	Total	
Cow							
2006	11.816	106.344	118.160	3,64	15,31	18,95	52,12
2005	29.011	84.667	113.678	8,94	12,19	21,13	58,10
2004	67.302	80.615	147.917	20,73	11,61	32,34	88,93
2003	66.359	79.486	145.845	20,44	11,45	31,89	87,68
2002	64.428	77.172	141.600	19,84	11,11	30,96	85,13
Buffalo							
2006	17.212	47.212	64.424	5,30	6,80	12,10	33,28
2005	17.594	55.236	72.830	5,42	7,95	13,37	36,78
2004	19.425	48.734	68.159	5,98	7,02	13,00	35,75
2003	19.994	50.160	70.154	6,16	7,22	13,38	36,80
2002	19.868	49.845	69.713	6,12	7,18	13,30	36,57
Goat							
2006	13.799	124.189	137.988	0,50	2,98	3,48	9,56
2005	29.914	95.003	124.917	1,08	2,28	3,36	9,23
2004	45.403	86.966	132.369	1,64	2,09	3,72	10,24
2003	45.514	83.349	128.863	1,64	2,00	3,64	10,01
2002	43.491	83.305	126.796	1,57	2,00	3,57	9,80

* Calculated as assumption result from New Zealand ruminant (Machmüller and Clark, 2006)

** Calculated as the stochiometry calculation

In relation to the methane and CO_2, the emission of methane and CO_2 in Jambi Province also decreases as the decrease of animal number. Cow was the main sources of methane emission compared to buffalo and goat. The total emission of methane from cow, buffalo and goat was 47.83 and 34.54 ton per day in 2002 and 2006 respectively and the total emission of CO_2 from cow, buffalo and goat was 131.5 and 94.96 ton per day in 2002 and 2006 respectively (see Table 1). It might be a good sound for reducing of GHG emission. The distribution of the methane emissions follows largely the livestock number allocation to production systems used in this study. Most of the emissions come, and will continue to come, from ruminants in mixed livestock systems.

Back to the road map of the development of cow population in Jambi Province, the population of cow in this area in 2015 would be 1.637 million head. If one cow produced 200 g methane per day it could be predicted the methane and CO_2 produced of 327.4 and 900.35 ton per day respectively.

Increase of animal number will also have a potency to increase the GHG emission that affect to the global warming. In contras development of animal farm will also create the animal pasture that catches CO_2 emission to the earth. This will also reduce the effect of GHG emission that diminishes the global warming. Unfortunately it is needed the study concerning this matter.

2. Power Produced From Faeces

Faeces produced from ruminant animal conversely has other effect as a source of biogas that might be used as electric power and other uses. Table 2 shows the estimation of faeces produced,

power generated and number of houses got power. Faeces produced from animal is a good potency of energy but it is not used until now yet. Base on the study done by Agoyyoga (2007) studied in Lampung that a number of 18,000 cows will produce approximately 25,400 kg of faeces and the biogas produced from manure can generate around 0.68 MW per day of electrical power. It may be calculated that each head of cow will produce 1.41 kg of faeces per day and generate 0,038 kw per day of electric power. It might be calculated that faeces produced in Jambi might power more than 8.000 houses since 2002. It might be imagined that in year 2015 Jambi Province could have power energy from animal around 69,118 houses. It is based on the assumption of 900 w per house.

Table 2. Estimation of Faeces Produced, Power Generated and Number of House Powered in Jambi Province

Year	Number of ruminant	Faeces (ton)	Power (Mw)	Number of House
2006	196.383	276,90	7,46	8.292
2005	199.000	280,59	7,56	8.402
2004	229.313	323,33	8,71	9.682
2003	228.885	322,73	8,70	9.664
2002	223.993	315,83	8,51	9.458

* Calculated as assumption of a study by Agoyyoga (2007)

It is a good source of power energy to substitute or assist the lack of electric power in this area as mainly the electric power is still imported from West Sumatra. Nevertheless all number shown could not completely be applied yet as the livestock production system was the small holder farmer and most animals were not distributed evenly. It had to be prepared some pools for collecting faeces before going to the reactor. Then this might be required a group of farmer to prepare a reactor for processing of faeces. It is especially suitable to be applied in the country side.

CONCLUSION

It might be concluded that ruminant animal has potency as GHG emission like methane and CO_2 from their enteric fermentation. However it might also have potency of biogas that can generate and be applied in the country side that is plenty of animals.

REFERENCES

Agoyyoga, 2007. Berbisnis dengan proyek konservasi. http://amaliaonearth.com/2007/11/21/berbisnis-dengan-proyek-konservasi/ (Downloaded 12 September 2009.

Bouwman AF. 1990. Exchange of greenhouse gases between terrestrial ecosystems and the atmosphere. In Bouwman AF (Ed.), Soils and the Greenhouse Effects. John Wiley & Sons, Chichester, New York, Brisbane, Toronto, Singapore. pp. 61-127.

IPCC, 2001. Climate change 2001: the scientific basis. Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Lelieveld J, and Crutzen PJ. 1993. Methane emissions into the atmosphere, an overview. In Van Amstel AR (Ed.), Methane and Nitrous Oxide, Methods in National Emissions Inventories and Options for Control. Proc. Intern. IPCC Workshop. Netherlands, 3-5 February 1993, pp.17-25.

L B Prasetyo, G Saito, K Okamoto, H Tsuruta, I Shigehiro, U Shingo, U Rosalina1, D Murdiyarso, A Widayati. (1998). Spatial database Development for green house gas emission Estimation using remote sensing and GIS. ACRS (Asian conference of remote sensing. http://www.gisdevelopment.net/aars/acrs/1998/ts12/ts12009pf.htm (downloaded 21-03-08).

Machmüller, A and H. Clark. (2006). First results of a meta-analysis of the methane emission data of New Zealand ruminants. International Congress Series 1293 : 54 -57