EVALUATION OF METHANE EMISSIONS FROM ANIMAL FARMS IN SHKODRA DISTRICT- ALBANIA

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Abstract: *The development of the livestock in our country has a direct impact in economic, social and environmental modifications. Livestock and in particulary Ruminant animals are the principal source of emissions because they produce the most methane per unit of feed consumed. (FAO 2006)*
The present study aims to estimate methane emission inventories from enteric fermentation and manure management for domestic livestock in Albania (Shkodra region), using Tier 1 methane emission factors of IPCC (2006) and regional population of each species of domestic livestock in 17 commune. Total methane emissions from enteric fermentation and manure management for domestic livestock in Shkodra region in Albania in 2009 were estimated to be 3638.16 ton per year, with a carbon dioxide equivalent of 76401.36 ton/year when assuming the global warming potential of methane being 25 times that of carbon dioxide. The majority of methane emission was derived from enteric fermentation (82%). cattle were the largest emitter (87.25% of total emission), followed by sheep and pigs (4%), goats (3%).These results indicate that enteric fermentation of ruminant animals, especially for dairy cattle, is the major area in research for development of mitigation strategies to reduce methane emissions from domestic livestock in Albania.

Key words*: livestock, emission methane, animal waste, dairy cattle, sheep, pigs, potential biogas.*

INTRODUCTION

Animal agriculture is responsible for 8 to 18% of total global greenhouse gas (GHG) emissions (FAO, 2006).

Greenhouse gas emissions from the agricultural sector that are related to animal production comprise CH4 directly emitted from domestic animals, CH4 and N2O emitted from manure and grazed lands, and N2O emitted from soils after application of manure . Methane is a greenhouse gas with a global warming potential more than twenty times that of carbon dioxide (U.S. EPA 2007)

Methane emission by the ruminants is produced during microbial fermentation of feed, especially carbohydrates, in the rumen (anaerobic methanogenesis). This is associated with a loss of 5-14% of the animal feed energy. One liter of CH4 is 0,174 g and represent approximately a lose of energy 9,45 kcal (VERMOREL 2008) It contributes to 16-18% of the total green house gases in the atmosphere (FAO 2006), but the reason of its assuming greater importance is that it has 20 times greater warming potential than carbon dioxide on a gram per gram basis. Production of methane is correlated with feed quality, digestibility, type and size, weight of animal and its production (KIRCHGESSNER ET AL 1994; VERMOREL 1995). Methane is a result of hydrogen sink in the rumen eco-system.

Livestock manures are a source of both direct and indirect losses of nitrous oxide when applied to soil and also a source of methane and nitrous oxide emissions during storage. This is because they contain significant quantities of nitrogen, much of which is in the ammonium form, organic matter and carbon (with different degrees of microbial availability)

and water − three essential factors controlling direct and indirect (e.g. ammonia emissions and nitrate leaching) losses of nitrous oxide and methane emissions. The methane production potential of manure depends on the specific composition of the manure, which in turn depends on the composition and digestibility of the animal diet. The amount of methane produced during decomposition is also influenced by the climate and the manner in which the manure is managed. The manage end system determines key factors that affect methane production, including contact with oxygen, water content, pH, and nutrient availability. Climate factors include temperature and rainfall. Optimal conditions for methane production include an anaerobic, water-based environment, a high level of nutrients for bacterial growth, a neutral pH (close to 7.0), warm temperatures, and a moist climate

In that context, we carry out this first study in Albania, *aiming* to evaluate the potential quantity of methane emission in the atmosphere from the livestock activity according to Albanian farming conditions.

MATERIAL AND METHODS

To realise our study, in evaluation of quantity of methane emission in one year, we choose one of the biggest region, Shkodra region, including 17 communes. According to dates of Statististical yearbook, of MAFCP 2010 we identified as follow:

- Number of farms per commune
- Number of animals according to species/type
- Production level
- Manner or System of waste management

Evaluation of the quantity of Ch_4, is done in two different ways: enteric fermentation from ruminants and from manure management system, according to Guidelines for National Greenhouse Gas Inventories, IPCC 2006, (*Intergovernmental Panel on Climatic Change).* We choose TIER1 method, for both CH4 emissions. it is a very simple method because its easy to application in regional or national level.

Database includes the number of livestock heads, livestock type and emission factors, according to the literature. According to our animal farms conditions, and the level of our livestock develop, manure management systems and our climate conditions, E_F were choose from tab 10.10 and tab. 10.11 (IPCC 2006).

1. Methane enteric emission was accounted based in formula:

$CH_{4\ Enteric} = EF \times N$ *(Equation 10.19 IPCC 2006)*

Where:

$CH_{4\ Enteric}$ = methane emissions from Enteric Fermentation

EF= emission factor for the defined livestock population (kg CH4/head/yr)

N= number of head of livestock species in the country

2. Methane emission from animal waste was calculated using the formula as shown below:

$CH_4 = EF_T \times N_T$ *(Equation 10.22 IPCC 2006)*

Where:

CH_4 Manure = CH_4 emissions from manure management, for a defined population

$EF_{(T)}$ = emission factor for the defined livestock population, kg CH4 head^{-1} yr^{-1}

$N_{(T)}$ = the number of head of livestock species/category T in the country

T = species/category of livestock

3. The quantity of CO2 equivalent, accounted based in formula:.

t CO2 equivalent/year (tonnes) = t CH_4/year X GWPCH_4

Where:

$GWPCH_4$ = Global Warming Potential for CH_4 (t CO_2/CH_4) = 21

4. It was calculated the quantity of potential methane that could be produced in case when the waste in managed under a biogas production system.

The total quantity of animal manure was determinates about different database from literature (ASAE 2003)

Daily potential for biogas generation was calculated using the following equations :

1. Potential Volume of Biogas (Litres/day) = Collectible manure total solids (kg/day) X typical volume of biogas produced per kg total solids (L/kg TS)

2. Potential Volume of Methane (L CH4/day) = Potential Volume of Biogas (L/day) X % Methane in Biogas

3. Weight of Methane produced per day (Kg CH4/day) = Potential Volume of Methane (L CH4/day) X Density of Methane (Kg/L)

RESULTS AND DISCUSSIONS

Shkodra's region is located in North-est of Albania, with ……m^2 area

It includes 17 communes in total 139 villages. Population is aproximately 24500 and the farm's numbers according to the year 2009 is 28866 (MAFCP 2010).

As result of analyzing the livestock development in Shkodra region was prepared the Table 1 which indicates the number of livestock per 17 commune.

Table 1

Number of livestock by category in Shkodra region

N	Commune	Dairy	Sheep	Goats	Poultry	Pig	Horse
∑	17	28370	28710	21410	384900	28610	2446

The quantity potential of emission of enteric methane, in this region, for the year 2010 is represented in tab. 2. ruminants emitted approximately 97.52 % of total CH4 in atmosphere because of ruminal fermentation of their feed.

Table 2

Emission enteric methane from animal livestock in Shkodra region

Livestock Type	Head (no.)	Emission factor (kg CH_4 $head^{-1}$ yr^{-1})	Baseline CH_4 Product t CH_4 /yr	t CO2 equivalent	Contribution to the categori %
Dairy Cows	22580	99	2235.4	46943.4	77.22
Beef steer	5790	58	335.8	7051.8	11.6
Fattering pigs 50 kg	26412	1	26.4	554.4	0.9
Breeding sow	2209	1	2.2	46.2	0.08
Sheep	28710	5	143.6	3015.6	5
Goats	21410	5	107	2247	3.7
Horse	2446	18	44	924	1.5
TOTAL			**2894.4**	**60782.4**	**100**

Table 3 shows calculation data per each category and for the daily quantity of organic waste as well as the waste quantity which are calculated by using addition coefficient method. Small ruminants and horses are managed in extensive systems and most of the cases are grazing in pastures and for this reason their calculation is difficult and this is the reason why

they are not present in the below table 2.

Table 3

Total quantity of waste that could be gathered in Shkodra region

Livestock Type	Head (no.)	Fresh Manure /head (kg/day)[1]	Total Solids (% of fresh manure) [1]	% Collectible[2]	Total manure t/day	Total manure t TS/day
Dairy Cows	22580	35	13	80	632.24	81
Beef steer	5790	25	13	75	108.56	14.1
Fattering pigs 50 kg	26412	3.3	9	90	78.443	7.05
Breeding sow	2209	16	9	95	33.577	3.02
Poultry	384900	0.12	25	70	32.332	8.08
Sheep	28710	3.9	32	45	50.386	16.12
Horse	2446	39	15	60	57.236	8.6

[1] ASAE 2003
[2] Karaj SH. 2007

Methane emission quantity CH_4 is calculated according to the Tier 1 method. It is a simplified method that only requires livestock population data by animal species and climate region or temperature, in combination with IPCC default emission factors, to

estimate emissions. Average yearly air temperature for Shkodra region in our study is calculated 18 ^{o} Celsius. In table 4 shows the methane quantity values which are emissioned by each animal species and the total value.

Table 4

Methane emissions from livestock's manure management by species

Livestock Type	Head (no.)	Emission Faktors kgCH_4 head/yars	Baseline CH_4 Product t CH4 / vit	tCO2 eq	Contribution to the categori %
Dairy Cows	22580	**23**	519.34	10906.14	71.8
Beef steer	5790	**11**	63.69	1337.7	8.7
Fattering pigs 50 kg	26412	**4**	105.65	2118.4	14.6
Breeding sow	2209	**7**	15.46	323.4	2.3
Poultry	384900	**0.02**	7.7	161.7	1.1
Sheep	28710	**0.15**	4.3	90.4	0.6
Goats	21410	**0.17**	3.6	76.4	0.4
Horse	2446	**1.64**	4.01	84.02	0.5
TOTAL			**723.8**	**15098.3**	**100**

Total quantity of CH_4 emission by manure livestock in Shkodra region is approximately 724 ton per year. Emission contributions show that cattle represent 80.5% of the total CH4 emissions, followed by pigs 16.9% ; horses (0.5%), sheeps (0.6%) and poultry (1.1%) goats 0.4 %. But, emission total CH4 in year from livstock in Shkodra region for 2010 is 3638,16 tons. Only, from cattle are emissioned 87,23% or 3174.24 t CH4/yr.

Reduce emissions of harmful gases in the atmosphere coming from economic development of livestock sector today constitute one of the important areas of research. According to many studies and authors one of the most efficient ways is the management of these wastes in an anaerobic process of bio-methane. During this

process, decomposition of their organic matter leads to the formation of biogas wich contains CH_4. Already formed, this gas can be used as renewable energy source.

In the following tables 5 and 6 we have calculated theoretical amount of potential that can be produced from these wastes and have calculated reducing. harmful gas emissions after the implementation of this biotechnology.(only for cattle).

Table 5

Biogas potential that could be produced in Shkodra region

	Head	**Baseline Emission**		**Potential Leakage from Biogaz System**		**Potential net emission Reduction**	
Livestock Type		t CH4	t CO2 ekivalent	t CH4	t CO2 ekivalent	t CH4	t CO2 ekivalent
Cattle	28370	583	12243.8	264	5547	319	6696

Table 6

Calculated Annual Baseline Emissions and Net Emission Reductions from Biogas1

In conclusion, GHG emissions from farming sector are strictly conditioned by cattle population and Biomethanisation of animal waste reduce methane emission about 50%.

CONCLUSIONS

Development of livestock in our country was increased by 17% during the period 2009-2010. As result, this development has increased the amount of organic waste which on 95% of them are not managed. Our study analyzed Shkodra region:

- Total amount of CH_4 emission by livestock in Shkodra region is approximately 3638.16 ton per year.
- Total amount of CH4 from enteric emissions is 2894.4 ton /year or 60782 CO2 equivalent and Ch4 emission from manure management is approximately 723.8 ton /year.

Livestock Type	**HEAD**	**Total Collectible manure TS (kg/d)**	**Typical Volume Biogas Produced (L/kg TS)**	**Potential Volume of Biogas (L/Day)**	**% Methane in Biogas**	**Potential Volume 0f CH4 (LCH_4/day)**	**Kg CH4/ day**	**t CH 4/yr**	**t CO2eq/ yr**
Cattle	28370	95.1	190	18069	60	1084100	726	264	5547
Pig	28621	10.07	310	31217	55	1716900	1150	419	8793
Poultry	384900	8.08	375	3030	57	172700	115.7	42.3	886.2
Sheep	28710	16.12	200	3224	56	180500	121	44.1	927
Goats	21410	10.02	200	2004	52	104200	69.8	25.5	535.5
Horses	2446	8.6	210	1806	60	108400	72.6	26.5	556.5

- CH4 emissions from farming sector are strictly conditioned by cattle population.
- Emission contributions show that cattle represent 87.25% of the total CH4 emissions, followed by pigs 4.14%; sheep (4%), goats 3.06 %, horses (1.33%) and poultry (0.22%).
- Waste management as the main source in the process of bio-methane decreased significantly CH_4 emissions in the atmosphere.
- From the remains of cattle in this region can be produced 583 ton of CH4 per year as part of the biogas when it occupies 55%.
- Bio-methane from bovine waste reduces 50% of the CH_4 emission as well as the CO_2 equivalent.

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