Current Journal of Applied Science and Technology

22(2): 1-10, 2017; Article no.CJAST.34675
Previously known as British Journal of Applied Science & Technology
ISSN: 2231-0843, NLM ID: 101664541

Study on Existing Livestock Manure Management Practices in Bangladesh

K. S. Huque[1*], J. S. Khanam[1], S. M. Amanullah[1], N. Huda[1], M. K. Bashar[1], T. Vellinga[2], M. Fielding[3] and K. Hicks[4]

[1]Animal Production Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh.
[2]Wageningen UR, Livestock Research, P.O.Box 338 6700, AH Wageningen, The Netherlands.
[3]Stockholm Environment Institute-Asia, Bangkok, Thailand.
[4]Stockholm Environment Institute at York, Environment Building, University of York, UK.

Authors' contributions

This work was completed by jointly by all authors. The work plan was designed by author KSH. Questionnaire was designed by the SEI and the Wageningen University, data collection was done by authors NH, MKB and JSK. The analysis, calculation and tabulation of data and writing of article were done jointly by authors KSH and JSK. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2017/34675
Editor(s):
(1) S. Sathish, Department of Mechanical Engineering, Annamalai University, India.
Reviewers:
(1) Adjolohoun Sébastien, University of Abomey-Calavi, Benin.
(2) Prakash M Munnoli, S D M College of Engineering and Technology, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/19905

Original Research Article

Received 5th June 2017
Accepted 1st July 2017
Published 6th July 2017

ABSTRACT

Livestock manure conventionally pollutes the environment and it may be turned into wealth through improved management. A survey research was conducted to determine existing manure management systems, their share in manure produced on farm and to quantify the extent of pollution through different systems. The commercial and subsistence farms of the humid and sub-humid areas under irrigated and rainfed regions of Bangladesh were selected for data collection using a pretested questionnaire through individual household visits. The extent of pollution by different system was calculated using IPCC Equation 10.23 and data were statistically analyzed using appropriate computer softwares. About 56.2 to 57.0% manure of large ruminants is kept in solid storage and 37.3 to 43.0% is used as burned fuel. Of the rest 4.80% is used in anaerobic digestion and 1.65% is lost as liquid slurry. The extent of manure used in solid storage was significantly ($p<0.01$) higher in commercial than subsistence farms irrespective of areas. The extent

*Corresponding author: E-mail: kshuque58@gmail.com;

of burned fuel between the two farm types differed and it was significantly ($p<0.05$) higher in the commercial farm of sub-humid area but lower in humid and rainfed area. The methane emission factor of dairy & other cattle (bulls & growing animals), buffalo, small ruminants and poultry was calculated to be 6.77, 6.41, 5.42, 0.203 and 0.024 Kg CH_4/head/year, respectively and the annual emission was estimated to be 62.98, 92.3, 7.97, 5.89 and 7.62 Gg methane, respectively. Farmers` unawareness and their weak capacity and credit problem are the major constrains to improved manure management.

Keywords: Livestock manure; solid store; burned fuel; anaerobic digester; liquid slurry.

1. INTRODUCTION

Livestock manure, feed biomass fed to animals that pass through digestive tract undigested and urine excreted from subsequent tissue metabolism, is conventionally termed as wastes. It pollutes environment through emitting greenhouse gases (GHGs) estimated to be 9.50% of the total of livestock origins [1].

Improved livestock manure management reinforcing the planet pillar of sustainable livestock production [2] may reduce food-feed-fuel competitions. It may support the vision of climate smart agriculture (CSA, FAO) and green growth dynamics also (7th Five Year Plan, Bangladesh). About 26 million large ruminants, 18 million small ruminants and 137 million poultry [3] of Bangladesh, 70% to 82% of which are being raised by landless and small farmers, produce manure largely piled as solids and liquid slurries at a variable concentration per unit land area. The manure of large ruminants is also dried as sticks & cakes for using as cooking biomass depending on their distribution and rearing systems. However, the database of conventional uses of livestock manure and the extent of GHGs emissions are not studied thoroughly considering variations in livestock production systems in different regions of Bangladesh.

The livestock rearing systems have both positive and negative effects on natural resource base, public health, social equity and economic growth [4]. Livestock manure, in addition to production of energy for rural areas via biogas/electricity from anaerobic digestion, improving livelihood, saving fuelwood and reducing methane emissions may build up soil organic matter [5-7] of arable land depleted through gradual increase of crop intensities, if livestock manure based fertilizer is used as a source of soil nutrients [8]. However, the plethoric open solid storages of manure and spread of slurry in the environment reduce air, water and soil quality posing threats to public health and causing socio-economic impacts. It may contain bacterial, viral, protozoal or parasitic pathogens that are significant health hazards to both humans and livestock.

Global concerns of climate pollution changed the perception of livestock manure management very recently. The vision of Climate Smart Agriculture (CSA) along with the gradual transformation of subsistence animal agriculture to input supported systems has been emphasizing the development of market oriented good practices of manure management. This requires research, development and extension works focusing on strategies, systems and techniques that allow maximization of the benefits of manure uses while minimizing its impacts on natural resource and ecosystems. Organizing community based biogas production systems based on livestock manure available to small farmers may be gateways for trapping the socioeconomic benefits of livestock rearing [9]. All the above factors substantiate development of database of livestock manure under different animal rearing system in different regions of Bangladesh, and its present uses by farmers.

Thus, the present research work was undertaken with the following objectives.

i. To examine the present practices of livestock manure management systems based on the type of animals
ii. To determine methane emission factors in the present livestock manure management systems and their impacts on the extent of pollution
iii. To logically derive the major limitations to on farm management of livestock manure

2. MATERIALS AND METHODS

The study was conducted by the Bangladesh Livestock Research Institute (BLRI), Dhaka, in cooperation with the Wageningen University, the Netherlands and the Stockholm Environment Institute, Asia-Centre, Bangkok in the selected district of different livestock production area of Bangladesh characterized as follows.

The mixed farming of Bangladesh consists of irrigated area embraces a broad range of food and cash crops and more than 10 percent of the total value of production comes from non-livestock farming activities; and rainfed area, steep and highlands and sources of more than 90 percent of the value of non-livestock farm production [10].

Depending on the length of growing period (LGP), [10] the irrigated farming area was again divided into humid area, LGP is greater than 270 days, and sub-humid area, LGP is 271-280 days. The LGP does not vary in the rainfed area, as crop growing period is not shortened by flood water. Considering the extent of pollution by the number of animals in a farm two categories of farms were randomly selected viz, i) Commercial (having average per household 15 animals) and ii) subsistence (having average per household 2.0 animals, [3]. The data were collected by the researcher of the BLRI had an orientation on livestock production and manure management. The data were generated through visiting individual farmer`s house and sharing questions of a pre-set questionnaire developed by the University of Wageningen, Netherlands and SEI (Stockholm Environment Institute) -Asia Centre and pre-tested locally before the use at farm levels.

Considering agroecological area (humid, sub-humid & rainfed) total 47, 63 and 10 farmers, respectively, were randomly selected for visiting and sharing their responses on the preset questions. In each area there were subsistence and commercial farmers, and their number, respectively, was 40 & 7 in humid, 45 & 18 in sub-humid and 5 & 5 in rain fed area. The researchers developed an itinerary and visited each farm in different times with the local support of the district livestock office of each district, an administrative area. Out of 23, 32 and 6 total district in three areas 4, 5 and 2 districts, respectively, were randomly selected under the field study. The total farm animals was classified into i) dairy cattle, ii) other cattle (bulls and growing animals), iii) buffalo, iv) goat and sheep and chicken & ducks. The number of farmers of different categories, their land area and number of different types of animals are presented in Table 1.

The data of manure management system of different livestock, the fate of dung and urine, farmer's opinion on major technical, socio-economic and institutional constraints and any source of information regarding LMM available to them were recorded. All the data were inserted in Microsoft excel sheet for calculation of secondary data and any significant differences in methane emission between the two livestock production system was analyzed using SPSS 17.0. The extent of pollution by methane production from different LMM system was calculated using Equation 10.23: $EF_T = (VS_T.365).[B_{o(T)}.\frac{0.67Kg}{m^3}.\sum_{S,k}\frac{MCF_{s,k}}{100}.MS_{(T,S,k)}]$ of the IPCC, where methane emission factor (EF) of LMM was calculated using default values of volatile solid (VS), and maximum methane producing capacity of manure (Bo) specified for different farm animal categories of the Indian sub-continent & methane conversion factor (MCF) for different manure management system at an ambient temperature >26℃. The emission factor (EF) was determined using the data of manure management system (MS) of different animals. Considering the number of different farm animals reported by Bangladesh Economic Review [11], the annual methane emission of different management system of different animals was calculated and reported in gega (Gg) methane emission per year.

3. RESULTS AND DISCUSSION

3.1 General Information of the Respondent Farmers

Table 1 shows the land and farm animal holding characteristics of the selected farmers under the study area. Irrespective of the region selected commercial farmers had a higher land area (1.30 to 2.17 ha) than subsistence farmers (0.004 to 0.13 ha). The range of dairy and other cattle number (bulls and growing animals) varied from 15 to 22 and 9 to 15 per farm, respectively, in commercial farms and 2 to 4 and 1 to 2, respectively, in subsistence farms (Table 1) randomly selected under the survey area. The selected farmers of different regions kept small ruminants (goat, sheep) and poultry (chicken and duck) in addition to their cattle. The average number per farm of small ruminants and poultry irrespective of farm types was reported to be 4 to 20 and 271 to 7000, respectively, in humid area, 3 and 200 to 2236, respectively, in sub-humid area and 1 and 9, respectively in rainfed area. Except a few farmers own 8 buffaloes per farm in sub-humid area, no selected farmer of humid and rainfed areas irrespective of farm types reported any buffalo in their farms. The animal holding characteristics of randomly selected commercial (an average large animal number per farm was 15) and subsistence (an average large animal number per farm was 2) farmers was an imposed factor and may not represent the typical distribution of farm animals in the area. A detailed socioeconomic distribution of farm animals of the country including the study area was reported [12].

Veterinary care and management was not addressed in the present study. In general all the animals in the study area received veterinary support extended by both the public and private sector. The large ruminant animals are sporadically treated with broad spectrum anthelmintics and a few of them are vaccinated against infectious diseases like anthrax, Foot and Mouth Disease etc. Farmers consult veterinary doctors of the public livestock services and in many cases quacks while they face any veterinary health problems of their animals. The small ruminants, on the other hand, receive less veterinary care accept limited vaccination against peste des petites ruminants (PPR) disease. The poultry, especially of commercial strains, are vaccinated against all possible infectious disease according to the vaccination schedule of the private companies, and the rural chicken and ducks are raised traditionally with minimum preventive health care.

3.2 Existing Livestock Manure Management Systems

The manure management system of Bangladesh, as defined by the Inter-governmental Panel on Climate Change [13], may be categorized into i) Solid storage, ii) Liquid slurry, iii) Burned fuel, iv) Anaerobic digester, and v) Without litter, a system practiced only for commercial poultry. The manure produced by dairy or other cattle is mostly kept as solid storage (56.2%) and burned as fuel (37.3%). The rest of the manure of cattle is used for anaerobic digestion (4.80%). A few number of farmer stated that they store bioslurry (1.65%), and, as stated by farmers, in most cases all form of liquid slurry including bioslurry, instead of keeping in confined systems, are practically lost out of ignorance, and in some cases it was kept as open spreads (Table 2). Similarly, about 57.0% buffalo manure was stored as solid storage and the rest 43% was burned as fuel, while the total amount of manure of goat and sheep (100%) was kept as solid storage (Table 2). A major fraction (74.5%) of poultry manure, on the other hand, was without litter and 25.5% was used for anaerobic digestion. The latter fraction of poultry manure was quiet high. Representation of a lesser number of poultry farms without anaerobic digestion system, under the present study, may be one of the causes of showing a higher percentage of anaerobic digestion.

However, composting and vermicomposting is popularly practiced in some selected areas of the country with a major attention to the production of livestock manure based organic fertilizers cost effectively. They are not found in the area of the present study. Capturing methane emitted during the composting and vermicomposting in addition to capturing of methane emitted during the composting of livestock manure may add further value to the systems.

Among three greenhouse gases methane is major one whose warming potentiality is 25 fold higher than $N0_2$ and CO_2 [14]. An estimation shows that livestock are one of the leading causes of worldwide green house effect [15]. The annual methane emission ($KgCH_4$/head/Yr) of the manure produced by different farm animals under different management systems was estimated to be 6.77, 6.41, 5.42, 0.203 and 0.024, of a dairy, other cattle, buffalo, small ruminants and poultry, respectively (Table 2). Considering average distribution of livestock manure, the average emission factor of manure of different animals, respectively, was shown to be 6.0, 2.0, 5.0, 0.20 and 0.02 $KgCH_4$/head/Yr in the warm condition (26℃ to 28℃) of Indian sub-continent region [13].

Table 1. Land and per farm animals under different areas

Attributes	Humid		Sub-humid		Rain fed	
	Subsistence	Commercial	Subsistence	Commercial	Subsistence	Commercial
Av. area of land, ha	0.13	1.30	0.004	2.17	0.004	1.57
Dairy cattle	2.0	22.0	3.0	20.0	4.0	28.0
Other cattle	1.0	9.0	1.0	15.0	2.0	15.0
Buffalo	-	-	8	-	-	-
Goat & sheep	4.0	20.0	3.0	3.0	1.0	-
Chicken & ducks	271	7000	200	2236	9.0	-

Table 2. Manure management system of different farm animals and annual methane emission

Farm animals	Solid storage		Liquid slurry		Burned fuel		Anaerobic digester		Without litter		Total	
	MS, %	CH_4 kg/head/yr	MS, %	CH_4 kg/head/yr	MS, %	CH_4 kg/head/yr	MS, %	CH_4 kg/head/yr	MS, %	CH_4 kg/head/yr	MS, %	CH_4 kg/head/yr
Dairy cattle	56.22	2.322	1.65	0.968	37.33	3.08	4.80	0.40	-	-	100	6.77
Other cattle	56.21	0.96	1.65	4.01	37.32	1.28	4.82	0.16	-	-	100	6.41
Buffalo	57.0	2.16	-	-	43.0	3.26	-	-	-	-	100	5.42
Small ruminants	100	0.203		-	-	-	-	-	-	-	100	0.203
Poultry	-	-	-	-	-	-	25.5	0.006	74.5	0.018	100	0.024

The cattle, buffalo, small ruminants (goat and sheep) and poultry population of Bangladesh was reported to be 23.7, 1.47, 29.02 and 317.7 million in 2015 (Table 3, [11]). The dairy cattle and other cattle number may be calculated to be 9.30 and 14.4 million, respectively, following the ratio reported by [16]. Considering the methane emission of different types of animals (Table 2) the annual methane emission calculated to 62.96, 92.3, 7.97, 5.89 and 7.62 Gg, respectively, of different farm animals described above, and a total annual methane emission of livestock and poultry manure managed in different systems is amounted to be 176.75 Gg of Bangladesh. The findings was supported by [17] who reported that in 1980-83 the total calculated emitted methane from livestock manure management was 80.7 Gg, in 1996 it was 86.64 Gg and 2008-09 it was 99.15 Gg and the trend of methane emission was increasing gradually.The manure of cattle share the highest emission (87.85%) and the rest (12.15%) is shared by other farm animals. It was also stated that methane emission from dairy cattle was much higher than non-dairy animals and it may be due to variation in emission factors. The manure of buffalo, small ruminants and poultry emits 4.51%, 3.33% and 4.31%, respectively (Fig. 1).

3.3 Regional and Farming System Variation in Cattle Manure Management

Crop production system affects manure management systems in both commercial or subsistence production system of livestock (Table 4). The commercial farmers of all the region (humid, sub-humid or rain fed) store a significantly ($p<0.01$) higher proportion of manure (82.8%, 33.5% & 66.1%, respectively) in solid storage than subsistence farmers (53.3%, 26.9% & 41.9%, respectively) and both categories of farmers of humid (82.8% & 53.3%, respectively) or rain fed areas (66.1% & 41.9%, respectively) kept more manure in solid storage compared to those of sub-humid areas. The farmers of both commercial and subsistence system of the sub-humid region use a higher fraction of manure as burned fuel (62.2% & 48.5%, respectively) than that of other areas. A limited access of farmers to cooking biomass due to inundation of major cultivated area by the monsoon flood water of

Table 3. Annual livestock manure CH_4 emission (Gg) from different management system

Farm animals	Number of farm animals millions, [11]	Gg methane emission.Yr^{-1}
Dairy cattle	9.3	62.96
Other cattle	14.4	92.30
Buffalo	1.47	7.97
Small Ruminants	29.02	5.89
Poultry	317.7	7.62
Total		176.75

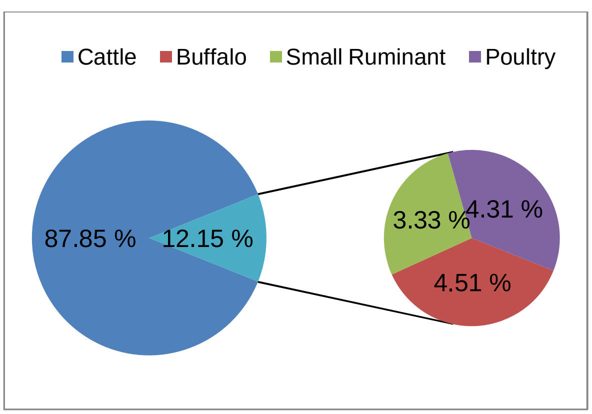

Fig. 1. Percent of Gg methane emission.Yr-1 of farm animals

Table 4. Different management system of cattle manure in different areas of Bangladesh

Manure management system	Humid		Significance		Sub-Humid		Significance		Rain fed		Significance	
	Comm.	**Subsist**	**SE**	**Level**	**Comm.**	**Subsist**	**SE**	**Level**	**Comm.**	**Subsist**	**SE**	**Level**
Solid storage	82.8	53.3	19.4	p<0.01	33.5	26.9	12.1	p<0.01	66.1	41.9	64.6	p<0.01
Liquid slurry	0	9.48	0.85	NS	1.99	6.17	1.3	p<0.05	0	0	-	-
Burned fuel	13.2	29.8	6.77	p<0.05	62.2	48.5	22.4	p<0.01	33.9	35.7	50.8	NS
Anaerobic digestion	4.04	7.38	1.18	p<0.01	2.36	18.4	1.59	p<0.01	0	22.4	-	-

sub-humid region compels them to use cattle manure as burned fuel. The use of anaerobic digestion of cattle manure differed significantly ($p<0.01$) between the commercial and subsistence farmers of humid and sub-humid areas, and it ranged from 4.04% to 7.38% in the former and 2.36% to 18.4% in the latter area. A higher proportion of subsistence farmers (22.4%) of rain fed area (Table 4) was found to use anaerobic digestion system. Selection bias to farmers having biogas system during the survey may have resulted in an inordinate percentage of manure use for anaerobic digestion.

Dietary feed composition, in addition to its effect on enteric methane emission, also affects manure composition that in turn, in addition to its farm management systems, affect the CH_4 emission of manure of farm animals. Fig. 2 shows that commercial dairying had less annual CH_4 emission (6.87 Kg/head) compared to subsistence dairy cattle (8.75 Kg/head). A higher input support, especially, in terms of feeding and nutrition [18] and improved management helped reduction of CH_4 emission from manure of commercial dairying.

3.4 Constrains of Manure Management

Data on the farmers opinion about technical and socio-economical along with institutional constrains of manure management was recorded and they are summarized and presented in Table 5. According to the farmer's opinion the major technical and socio-economical constrains are the lack of manure treatment capacity (52.89%) and unavailability of credits (49.46%). About 87.88% of the respondent farmers stated that they were unaware of improved manure management and 41.31% raised the problem of lacking trading infrastructure. Others supported the problem of absence of easy access to information due to illiteracy (38.02%), regulation (30.58%), and to required equipment and machineries (20.65%).

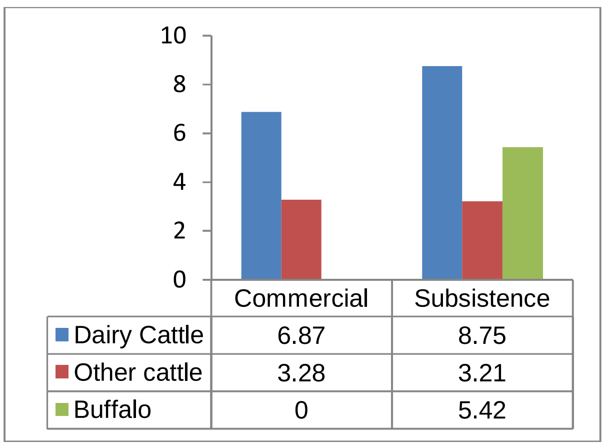

Fig. 2. Kg CH_4 emission/head/Yr by ruminants

Table 5. Identified major constrains of manure management

Technical and socio-economical (% farmers)	
Lack of farm labor	22.3
Lack of manure storage capacity	15.90
Lack of manure treatment capacity	52.89
Lack of manure transport capacity	14.88
Lack of suitable equipment	21.49
Credit problem	49.46
Institutional (% farmers)	
Lack of information	87.88
Lack of access to information due to illiteracy	38.02
Lack of access to loan	38.84
Lack of access to required equipment and machines	20.65
Lack of trading infrastructure	41.31
Lack of regulation	30.58

4. CONCLUSION

Solid storage, liquid slurry, burned fuel, anaerobic digestion and without litter, especially for chicken manure, are the major livestock and poultry manure management system found in Bangladesh, and 56.2% to even 100%, especially in case of small ruminant animals, of the total manure is kept in solid storage, followed burned fuel use of 37.3% to 47.0%. The total annual CH_4 emission from manure is estimated to be 176.75 Gg and emission from cattle manure was estimated to 87.85%. The manure management and the extent of emission varied according to farming system and region of the country. Lack of technical knowledge, credit support, and absence of policy are the major constraint to improved manure management in Bangladesh.

ACKNOWLEDGEMENT

This work was financially supported by the Climate and Clean Air Coalition (CCAC) of the UNEP through a contract agreement between the Stockholm Environment Institute (SEI) and the Bangladesh Livestock Research Institute (BLRI). The authors acknowledge the cooperation extended by the Wageningen University, the Netharlands and the Stockholm Environment Institute, Asia-Centre, Bangkok.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gerber PJ, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, Falcucci A, Tempio G. Tackling climate change through livestock: A global assessment of emission and mitigation opportunities. FAO, Rome; 2013.
2. Bhandari YR, Makkar HPS. Towards implementation of sustainable animal diets: Evidence generation, perspective building and way forward. CAB Reviews: 11 (029); 2016.
3. Bangladesh Bureau of Statistics (BBS). The census of agriculture, structure of agricultural holdings and livestock population, Statistics Division, Ministry of Planning, The Govt. of the People`s republic of Bangladesh; 2008.
4. World Bank. Development Research Group, Policy Research Working Paper 3428; 2009.
5. Islam MS. Soil fertility history, present status and future scenario in Bangladesh. Special Issue on Balanced Fertilization for Increasing and Sustaining Crop Productivity. Bangladesh J. Agric, and Env. 2008;4(SI):129-51.
6. Rahman MM, Yakupitiyage A. Use of fishpond sediment for sustainable aquaculture-agriculture farming. International Journal of Sustainable Development and Planning. 2006;1:192-202.
7. Chongrak P. Organic waste recycling: technology and management. John Wiley & Sons Ltd., Baffins Lane, Chichester, West Sussex PO19 1UD, England. 1996; 412.
8. Draft National Integrated Livestock Manure Management (ILMM) Policy. Ministry of Fisheries and Livestock, The Government of the People's Republic of Bangladesh; 2015.
9. Sarkar SK, Uddin MK. Window of opportunity: An asset based approach to community development in Bangladesh. Journal of Developments in Sustainable Agriculture. 2013;6:1-11 (2011): AFRC, University of Tsukuba, Japan. ISSN: 1880-3016
10. Steinfield H, De Haan C, Blackburn H. Livestock-Environment Interactions. European Commission, Brussels; 1996.
11. Bangladesh Economic Review, Finance Division, Ministry of Finance, the Govt. of the Peoples` Republic of Bangladesh; 2016.
12. Huque KS, Khan MYA. Socio-geographic distribution of livestock and poultry in Bangladesh-a review. Bang. J. Anim. Sci. 2017;46(1):65-81.
13. IPCC. IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HS, Buendia L, Miwa K, Ngara T, Tanabe K. (eds). Published: IGES, Japan. IPCC National Greenhouse Gas Inventories Programme Technical Support Unit, % Institute for Global Environmental Strategies, Kamiyamaguchi, Hayama, Kanagawa, JAPAN, 240-0115. 2006;10.41.
14. Stackhouse KR, Pan Y, Zhao Y, Mitloehner FM. Greenhouse gas and alcohol emissions from feedlot steers and calves.

Journal of Environmental Quality. 2011;40: 899-906.
15. Haan CD, Schillhorn VV, Brandenburg B, Gauthier J, Gall FL, Mearns R, Siméon M. Livestock Development: Implications for Rural Poverty, the Environment, and Global Food Security the World Bank. 2001;96.
16. Huque KS. A performance profile of dairying in Bangladesh- programs, policies and way forwards. Bangladesh Journal of Animal Science. 2011;43(2): 81-105.
17. Jahan S, Azad AK. Estimation of greenhouse gas emission from the livestock sector of Bangladesh. International Journal of Science and Research. 2015;4(1):1148-1155.
18. Huque KS, Chowdhury MM, Das PK, Mandal NA, Ahuja V, Baset MA. Milk Vita – realities and reaching out to dreams of millions; The paper was presented at a regional meeting on Dairy Asia: Towards Sustainability held in Hotel Plaza Athene, Bangkok, Thailand, during 21 to 24 May; 2014.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/19905