CHAPTER I:

INTRODUCTION

The animal agriculture of Bangladesh has 26.21 million large ruminants, 17.59 million small ruminants and 137.23 million poultry (Agricultural Census, 2008), with about 70.0% to 82.0% of them being raised by landless and small farmers. Farm animals annually produce about 151.3 million tons of fresh manure, of which 3.08 million tons/year is produced under structured market dairy of Bangladesh (Draft National Integrated Livestock Manure Management Policy, 2015)

Livestock manure is a valuable source of nutrients for crop production, but can also pose a public health hazard and have negative environmental impacts. (Gunilla *et al.* 2017)

When managed properly, livestock manure is a valuable fertilizer that may contribute to enhanced food security by improving soils and increasing crop yields (Rufino *et al.*, 2006). However, mismanagement of livestock manure, including improper handling, storage and disposal, can instead pose a sanitary hazard and cause excessive greenhouse gas emissions and eutrophication (Gerba and Smith, 2005; Jongbloed and Lenis, 1998).

Untreated livestock manure may also contain a wide range of zoonotic pathogens that can cause disease in humans (Carrique-Mas and Bryant, 2013; Yugo and Meng, 2013). These pathogens are mostly spread by food and water that have been contaminated with manure. The risk of transmission to humans may be enhanced by certain consumption habits, such as source of drinking water and consumption of raw or undercooked food, or by the lack of sanitary precautions, including proper hand washing (Lam *et al.*, 2015; Gerba and Smith, 2005). Additional health problems may arise if manure containing antimicrobials or antimicrobial-resistant bacteria ends up in the environment, as they may contribute to the emergence of antimicrobial resistance (Heuer *et al.*, 2011; Venglovsky *et al.*, 2009). Implementation of proper management practices for livestock.

Manure storage and land application tends to produce odour, greenhouse gases, microbes, and particulate matter, which can negatively impact the environment and human health. Concerns

about potential dairy waste pollution of the environment have focused mainly on water, and the potential impacts of nitrogen, phosphorous, and turbidity (suspended solids). However, contemporary issues associated with potential pollution impacts of livestock operations now include microbial pathogens, gaseous emissions (such as ammonia), and odors (odorants). Increased awareness of zoonoses (pathogenic microbes of animal origin) in cattle wastes is now recognized as a public health concern, especially because of the occurrence of waterborne disease outbreaks apparently caused by fecal contamination of manure origin (for example, in Walkerton, Ontario, in 2000) (Sobsey, 2006). Identification and characterization of zoonotic animal pathogens is one of the key steps in reducing potential human exposures via water and other routes (foods, air and soil).

Airborne and waterborne microorganisms and microbial by-products from intensive livestock and manure management systems are a potential health risk to workers, farm personnel and individuals in nearby communities. Various bacteria, viruses, and protozoa exist in apparently healthy animals, but upon transmission to humans these pathogens can cause illness and even death. Exposure of humans to these disease-causing pathogens of animal origin can occur via occupational exposure, water, food, air or soil. Some of the important pathways for pathogen transmission to humans are shown in (Figure 1).

The fecal wastes and other wastes (such as respiratory secretions, urine, and aborted fetus, dead animal) of various agricultural (livestock) animals often contain high concentrations of human and animal pathogens (disease-causing microorganisms) (Strauch and Ballarini, 1994).

Concentrations of some pathogens occur at levels of millions to billions per gram of wet weight feces or millions per ml of urine. Per capita fecal production by agricultural animals such as cattle and swine exceeds that of humans. Furthermore, the trend for production facilities to harbor thousands to tens of thousands of animals in relatively small spaces results in the generation of very large quantities of concentrated fecal and other wastes that must be effectively managed to minimize environmental and public health risks.

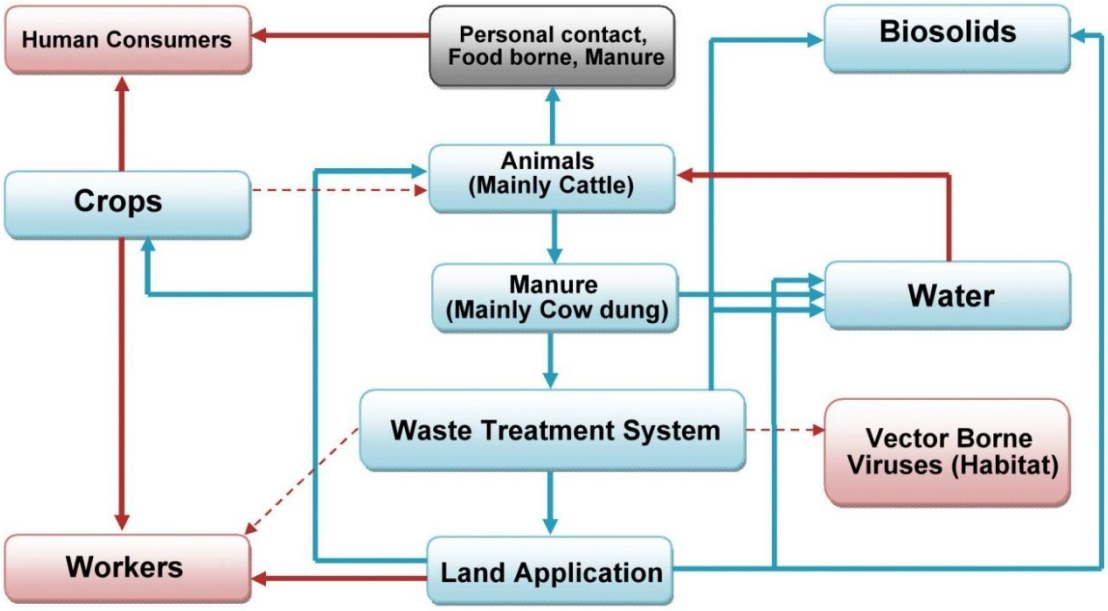

Figure 1. Sources and transmission pathways of pathogens to humans from animal agriculture

Manure on farms is usually stored for property stabilization and to meet fertilizable timing. Manure storage systems generally fall into three categories: stockpile, tank, and lagoon. Stockpiles consist of heaps of solid manure above ground, whereas tanks and lagoons contain mainly liquid manure and semi-solid manure. Tanks are built vessels or rooms above ground or underground, and lagoons are natural or artificial underground pits.

When manure is stored, microorganisms in manure decompose the organic matter and release a number of pollutants. The greatest proportion of air pollution emissions from manure management takes place during manure storage because it is concentrated and continuous, putting farm workers at high risk (Siduo, 2011). Factors influencing manure storage emissions include animal species, storage system structures, and local environment. Specifically, the original nutrient content, ambient temperature, and aeration conditions directly determine the digestion of the organic matter and thus the final emissions. Similar to manure storage, soil microorganisms along with manure microorganisms continue the decomposition process after land application.

Soil conditions and local weather will additionally influence the micro-environment and therefore the decomposition processes (Siduo, 2011). Emissions from manure application are released gradually for months and will eventually disperse. Hence the impact on community health basically results from manure land application.

Table 1: Potential presence of organisms in manure and illness caused by them in humans

Name	Type	Illness in human
Escherichia coli	Bacteria	Some can cause bloody diarrhoea, some cause severe anemia or kidney failure that can lead to death. Infection is causes by coming into contact with the feces of human or animals. This can happen by drinking water contaminated by feces.
Campylobacter	Bacteria	Produce diarrhoea and systemic illness. This organism spread through water sources contaminated with infected animal or human feces.
Salmonella	Bacteria	It is a common bacterial disease that affects the intestinal tract. Symptoms consisted of diarrhoea, fever and abdominal cramps. Humans become infected most frequently through contaminated water or food.
Leptospira	Bacteria	Causes leptospirosis characterized by high fever, may develop kidney or liver failure, respiratory failure, meningitis, or even death. It is often transmitted by animal urine or soil containing animal urine coming into contacts with break in skin, eyes, mouth or nose.
Listeria	Bacteria	Causes listeriosis characterized by fever and chills, headache, upset stomach and vomiting, most likely to affect pregnant women and unborn babies
Shigella	Bacteria	Intestinal disease characterized by diarrhoea, which is often bloody. Shigella can be passed through direct contact with the bacteria in the feces
Cryptosporidium	Parasite	Produce watery diarrhoea, life-threatening to peoples with poor immune system
Hepatitis A	Virus	It's a viral liver disease that can cause mild to severe illness. Hepatitis A infection risk is associated with lack of safe water and poor sanitation
Rotavirus	Virus	Rotavirus causes gastroenteritis. Symptoms include severe diarrhoea, vomiting, fever, and dehydration. Rotavirus infection is spread through contamination of hands, objects, food or water with infected feces.

Nipah virus	Virus	It's a newly emerging zoonotic disease causes severe illness in both animal and human. Fruit bats are the natural host and pig is the intermediate host. It causes asymptomatic infection to acute respiratory syndrome and fatal encephalitis.

Oneill and Phillips (1992) reported nearly 200 compounds emitted from animal manure management, 9 with volatile organic compounds (VOCs), ammonia (NH3), hydrogen sulphide (H2S) and particulate matter (PM) being those most relevant for potential human health impacts.

Animal pathogens posing potential risks to animal and possibly human health include a variety of bacteria, viruses and parasites (Table 1), such as *Escherichia coli*, Salmonella (Davies *et al.* 1997), Leptospira, Listeria, Hepatitis A, Rotavirus, Avian Influenza. Some of these pathogens, such as the ones just mentioned, are endemic in commercial livestock and are difficult to eradicate from both the animals and their production facilities. Because these pathogens are so widely prevalent in animals, they are often present in fresh animal manure and other animal wastes. Therefore, the pathogens in animal manure and other wastes pose potential risks to human and animal health both on and off animal agriculture production facilities if the wastes are not adequately treated and contained (Graczyk *et al.,* 2000).

Cattle manure and other animal waste management technologies must be capable of reducing and containing these pathogens in order to prevent or minimize human and animal exposures to them that would pose health risks (Cole *et al.,* 1999; Darwin and Yukifumi, 1998).
Considering the above facts the present study was undertaken to full fill the following objectives:

(1) To detect the types of pathogen present in the livestock manure.
(2) To assess the economic condition of the farm located in the study area.
(3) To identify the existing waste management system and their impacts in public health mainly farm personnel.

CHAPTER II:

MATERIALS AND METHODS

Livestock rearing usually involves collection of data from individual farmers. There are various methods of data collection for livestock research. Selection of a particular method depends on many considerations. The present study was performed by the collection of data through a questionnaire, because it was considered to have some advantages over other methods.

2.1 Steps of study:

There are several methods of data collection of which survey method is one of them. The word "survey" refers to a method of study in which an overall picture of a given universe is obtained by a systematic collection of all available data on the subject **(Efferson, 1963).** The survey method for the present study involved the following steps:

2.2 Selection of study area:

Selection of study area is an important step for the study to achieve the objectives. The present study was conducted in three Upazilla of viz, Begumgonj (Noakhali), Anowara (Chittagong) and Sitakunda (Chittagong).

2.3 Duration of the study:

The study on cattle waste and the impacts of waste management practices on public health were conducted actually from April 2017 to August 2017.

2.4 Selection of sample and sampling procedure:

Larger the sample size, greater is likely to be the extent of accuracy and usefulness of the results. But in reality, inclusion of all farms was not possible due to time and resource constraints. So the selection of representative sample was one of the crucial aspects for the study. Purposive sampling technique was used for selecting the sample. In total 30 cattle farms are selected from three Upazilla under Chittagong and Noakhali district.

2.5 Source of population:

Cattle farms were selected according to their managemental system, farming system and waste management system and also having at least 3 cattle were considered to be the study of population.

2.6 Preparation of questionnaire and Pre-testing:

Before starting final data collection draft schedule were prepared keeping the objectives in mind and pre-tested to avoid post survey inconsistencies, if any. A few schedules where the pre-tested in the study area in order to ensure the appropriateness of the contents. After pre-testing, some parts of the draft schedule were improved, rearranged and modified in the light of the actual experience gained from the field and then the final schedule was developed. The questions of the study schedule included the following information:

a) General information of the farm owner such as, farm personnel composition, literacy level, occupational status, government registration of the farm etc.

b) Information on socio-economic status of the farm, farm composition, floor type, rearing and managemental system of the farm, position of the drain, passage of animal waste, manure storage systems, waste material disposal, any chance of food, water contamination, occurring any skin, respiratory and digestive disease in farm personnel and others farming problems.

2.7 Methods of data collection:

Reliable data are directly related to the success and validity of the study. Keeping this in mind all of the data were collected by the researcher himself. To obtain the reasonable and accurate data, the researcher visited several times in the study area. Data were collected by personal interview through farm to farm visit. During data collection the objectives of the study were clearly explained to the respondents so that they could respond freely. Questions were asked systematically and explanation was given wherever necessary. Farmers usually did not keep records of their day to day transactions of farm activities. It was therefore; very difficult to collect actual data and the researcher had to rely on the memory of the farmers. To overcome this problem, of course, all possible efforts were made by the researcher himself to ensure the collection of reasonably accurate data on recall basis.

2 (a): Diganto Dairy farm, Begumgonj Upazila

2 (b): Hasan Dairy farm, Sitakhunda Upazila

2 (c): Miraz dairy farm, Sitakunda Upazila

2 (d): Ma Dairy farm, Anowara Upazila

Figure 2: Data collection from farm owner by personnel interview through farm to farm visit

2.8. Statistical analysis:

After collection of data from the selected farmers from upazilla were organized, structured and analyzed by using tabular method. Collected data were analyzed using descriptive statistical tools such as mean, standard deviation and percentage where appropriate. Data also analyzed by using simple descriptive statistical tools and techniques by using SPSS (Statistical Package for the Social Sciences) and Microsoft Excel program.

Chapter III

RESULTS AND DISCUSSION

3.1. Economic condition of the farm:

The farms are divided into four groups according to their animal population and also assessed their economic condition by this. Out of 30 dairy farm, 3.3% dairy farmers are ultra poor having only 1-2 cattle, 23.3% are poor having 4-5 cattle, 43.3% are moderate having more than 10 cattle and 30% are standard having more than 50 cattle in their farms**.** (Figure 4)

3.2. Farm characteristics:

Of the 30 dairy farm, about 23% of the farm, female was responsible for taking care of the cattle, while men were responsible in 65% of the households and 17% reported shared responsibility between men and women.

3.3. Manure management system:

Cattle manure was collected manually from the farms by farm personnel. The majority (64%) of the farms was cleaned by using hand shovel (Figure: 3 A) more than twice a day, and 76% reported that they disinfected the floor regularly. The most common time for disinfection was morning, noon and evening. About 36% of the farm owner dumped their cattle manure, while 36% used it as fertilizer for rice or vegetable production and 14% sold it or gave it away (Figure 6) The practice of dumping the manure was more common in households with a lower socio-economic position. Around 14% of the farmer responded that they stored manure for a period of time, before it was used, sold or dumped (Figure 6). Of these, the majority stored the manure for more than 2 weeks.

Farmers that used the manure for crop or vegetable production often stored it during the dry season and used it as a fertilizer at the start of the rainy season.

Table 2: Distribution of respondents according to their education level, drainage system of the farm, passage of animal waste, waste material disposal, chance of water and food contamination, use of any disinfectant, biogas plant, use of any gloves during handling cow dung

Parameters	Categories	No of respondent (n=20)	% respondent (n=30)
Education level	Low educated (1-5 class)	6	20
	Medium (6-9 class)	13	43
	Higher (10-11 class)	11	37
Drainage system of the farm	Standard	1	3
	Good	9	30
	Moderate	11	36
	Nothing	9	30
Passage of animal waste	Fast, well slopped and connected to central outlet	6	20
	Slow passage, not well connected to outlet	17	56
	Other	7	23
Waste material disposal	Water tank	4	13
	Open place	5	17
	Cultivable land	20	67
	Pond	1	5
Chance of water contamination	Yes	9	30
	No	21	70
Chance of food contamination	Yes	10	33
	No	20	67
Frequency of the cleaning of the floor	Once daily	6	20
	More than once daily	19	64
	Every alternate day	2	6
	When necessary (10/12 times daily)	3	10
Use of any disinfectant	Yes	20	67
	No	10	33
Do you know human can get infection from farm waste	Yes	9	30
	No	21	70
Biogas plant	Yes	9	30
	No	21	70
Use of any gloves during handling cow dung	Yes	0	0
	No	30	100

3.4. Occurrence of disease to farm personnel:

More than 70% of the farmers responded that they did not think diseases could be transmitted between animals and humans. The study revealed that, 56% of farm personnel were affected with skin problem, 4.9% were affected with respiratory problem and 15% were affected with gastrointestinal problem. Skin problem mainly Eczema, fungal infections were common and most of them thought that, it's a natural infection and it would not be harmful. This finding is the agreement with the earlier study of Gunilla *et al.* (2017) who reported 47% farm personnel were affected with skin problem in Cambodia. Respiratory problems were coughing, sneezing which transmitted through inhalation form farm manure. And gastro-intestinal problems were transmitted due to unhygienic condition of the farm personnel and not used to wash their hands with soap and water after handling animals or manure.

Table 3: Disease affected from farm manure in the study area

Diseases	**No of affected persons in farms (N=122)**	**Percentage**
Skin problem	69	56
Respiratory problem	6	4.9
Gastrointestinal problem	19	15
Total	94	77

Image Gallery

Figure 3: A) Manure Management system in dairy farm (using small hand Shovel and bark of tree) B) Pond contamination through cow dung from manure C) Water collection from contaminated pond D) Unhygienic manure disposal E) Some skin problem in hand and leg of farm personnel.

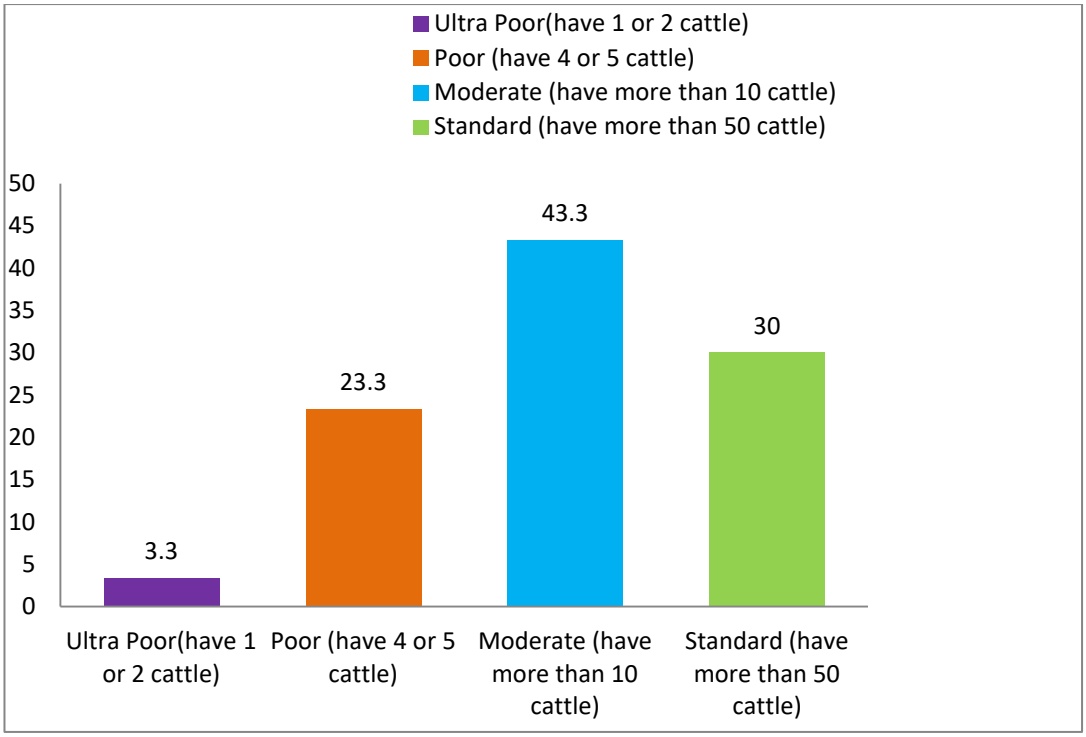

Figure 4: Economic condition of the farm

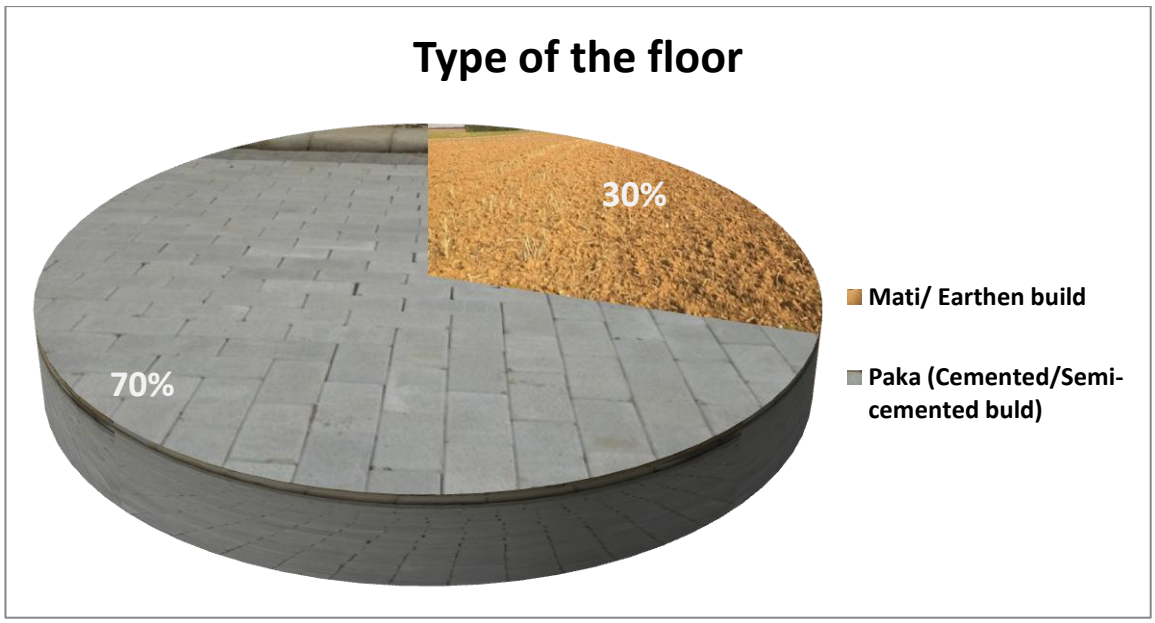

Figure 5: Floor type of selected dairy farms

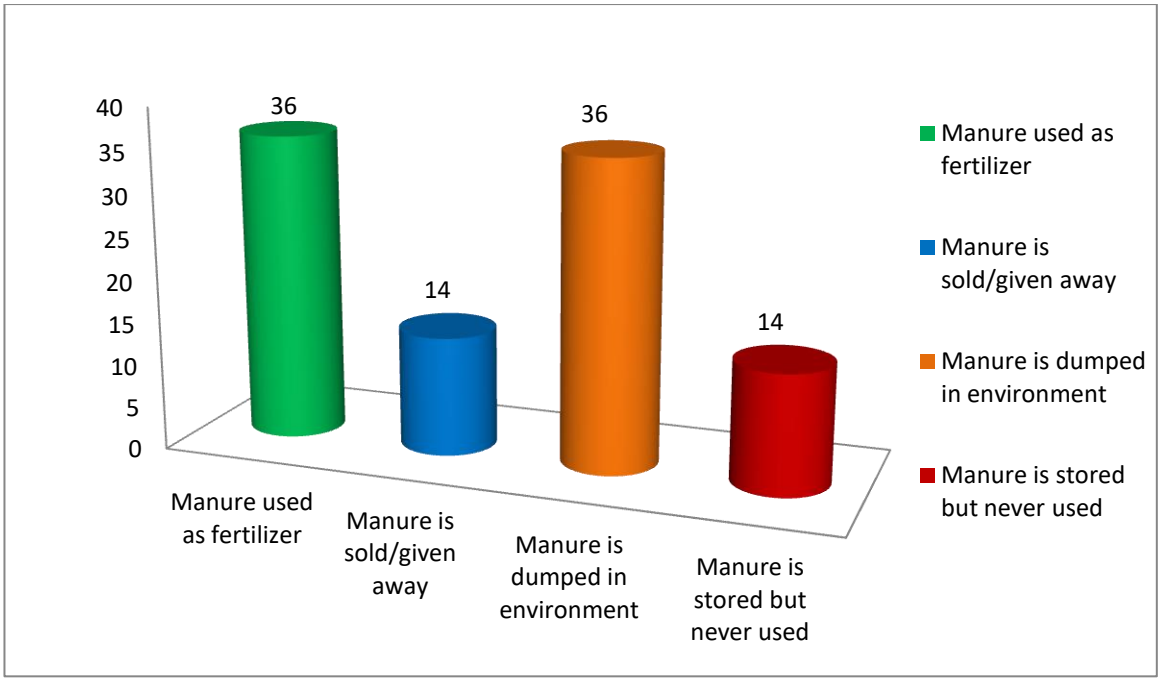

Figure 6: Management percentage of cattle manure by livestock personnel

CHAPTER V:

LIMITATION OF THE PRESENT STUDY

Farm personnel and owners were not equally co-operative and friendly. They sometimes tried to escape in the middle of the interviews.

Moreover, even, interviews were not always the right person who involved with waste management and farming system of the farm. Variable measurements were dependent on reporting of the farmer in most of the cases that recall or incorrect information could have gathered on the way.

As some variable were measured from retrospective information asking to farmers, this could not have corrected or real situation.

No studies on community health impacts from manure management in Bangladesh have been published. The gap in research on community exposures deserves attention, since many Bangladeshis' live on or near livestock farms.

CHAPTER VI:

CONCLUSION

According to the study it was clear that there was significant variation from farm to farm in relation to economic condition, waste management system and occurring of disease to farm personnel. The study revealed that, 56% of farm personnel were affected with skin problem, 4.9% were affected with respiratory problem and 15% were affected with gastrointestinal problem. And 70% respondents responded that, they did not think diseases could be transmitted between animals and humans through farm manure. Furthermore, nearly half of the households (46%) responded that they did not wash their hands with soap and water after handling animals or manure. The evidence suggests that livestock manure is contributing to the problem. Lack of technical knowledge, credit support, and absence of policy are the major constraint to improved manure management in Bangladesh. So it is a crucial need to save the environment as well as our society from the livestock manure.

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APPENDIX

QUESTIONNAIRE FOR DATA COLLECTION

- Name of the farm:……..
- Owner name: …… Contact no: ……
- Address of the farm: ……
- Village:……Thana:……..……
  District:…….....
- Education status: : 1) ☐ Low educated (1-5 class) 2) ☐ Medium (6-9 class) 3) ☐ Higher (10-11 class)
- Type of farm: 1) ☐ Cattle 2) ☐ Sheep 3) ☐ Goat 4) ☐ Mixed
- Number of person worked in the farm:
  - ❖ Total manpower:
  - ❖ Male:
  - ❖ Female:
- Economic condition of the farm owner:
  1) ☐ Ultra poor (have 1 or 2 cattle)
  2) ☐ Poor (have 4 or 5 cattle)
  3) ☐ Moderate (have more than 10 cattle)
  3) ☐ Standard (have more than 50 cattle)
- Govt. registration: 1) ☐ Yes 2) ☐ No 3) ☐ Applied If yes Reg. No:……..……
- Receive training on farming: 1) ☐ Yes 2) ☐ No
  If yes, give details (Name of the Training, Organization, Days):…….
- Current population of cattle at farm:……
- Farm composition (for cattle farm):
  - ❖ Total adult female:
  - ❖ Milking cow:
  - ❖ Pregnant cow:
  - ❖ Total heifer:
  - ❖ Pre-pubertal:
  - ❖ Pubertal:
- Floor type: 1) ☐ Paka (Cemented/Semi-cemented) 2) ☐ Mati (Earthen)

- Drainage system of the farm: 1) ☐ Standard 2) ☐ Good 3) ☐ Moderate 4) ☐ Nothing
- Position of the drain: 1) ☐ Back of the stall/house 2) ☐Between animal rows (middle) 3) ☐ Other……
- Distance of drainage system from the farm: ……
- Manure storage systems: 1) ☐ Stockpile 2) ☐Tank 3) ☐ Lagoon
- Manure management system: 1) ☐ Used as Fertilizer 2) ☐ Sold/Given away 3) ☐ Dumped in environment 4) ☐ Stored but never used
- Passage of animal waste:
    1. ☐Fast, well slopped and connected to central outlet
    2. ☐Slow passage, not well connected to outlet
    3. ☐Other……
- Is there any pit at the farm?: 1) ☐ Yes 2) ☐ No
- If yes, Pit made of 1) ☐ Soil 2) ☐ Bricks
- If no, where the waste material throughout:
  1) ☐ Water tank 2) ☐ Open place 3) ☐ Cultivable land 4) ☐ Pond
- If open place, Is there any chance of water contamination: 1) ☐ Yes 2) ☐ No
- Is there any chance of food contamination: 1) ☐ Yes 2) ☐ No
- Do you use the contaminated pond for bathing, cleaning of utensils?
  1) ☐ Yes 2) ☐ No
- Is there any linkage with the drainage pit? 1) ☐ Yes 2) ☐ No
- Frequency of the cleaning of the floor:
    1.☐ Once daily
    2.☐ Every alternate day
    3.☐ More than once daily
    4.☐ When necessary
- Do you use any disinfectant for cleaning?
  1) ☐ Yes (Frequent) 2) ☐ Yes (Infrequent/Sometimes) 3) ☐ Not at all
- Disposal methods of carcass/placenta: 1) ☐ Burial 2) ☐ Throwing to nearby field 3) ☐ Left on ground 4) ☐ Offer to dog/cat
- Do you use any biogas plant: 1) ☐ Yes 2) ☐ No
- Do you use any gloves during handling cow dung? 1) ☐ Yes 2) ☐ No

- If no, then what types of precautions did you take?

  ……

  ……

- Do you know human can get infection from farm waste ? 1) ☐ Yes 2) ☐ No
- Did you infect any type of skin disease? 1) ☐ Yes 2) ☐ No
- If yes, what it was?.....
- Did you infect any type of respiratory disease? 1) ☐ Yes 2) ☐ No
- If yes, what it was?.....
- Did you infect any type of gastrointestinal disorder? 1) ☐ Yes 2) ☐ No
- If yes, what it was?.....

Thank you very much for your cooperation

Name of the interviewee.....

Date.....

Signature.....

Name of the interviewer.....

Date: ……

Signature ……

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The Author

December, 2017

BIOGRAPHY

Mishuk Shaha, Son of Mr. Anukul Saha and Mrs. Sumita Saha. He is an interned veterinary doctor under the faculty of Veterinary Medicine (FVM) in Chittagong Veterinary and Animal Sciences University (CVASU). He passed his Secondary School Certificate (SSC) Examination in 2008 followed by Higher Secondary Certificate (HSC) Examination in 2010 from Chittagong board. In future he would like to do Research work about public health, Zoonotic diseases and animal welfare those take public health significance in the world regarding one health constitution.