FARMERS'PERCEPTION REGARDING USE OF CATTLE MANURE IN THE CROP FIELD

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TO MY

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ABSTRACT

The study was conducted at five villages namely: Bokainagor, Ramgopalpur, Dowhakhola, Shahagonj and Achintapur of Gouripur upazila of Mymensingh district to observe farmers' perception regarding use of manure in crop field. Data were collected from 10 farmers in each village through personal interview using an interview schedule. The farmers had more number of cows (6.68±0.49) followed by bulls (2.58±0.27), bullocks (2.04±0.20) and goats (2.88±0.35). The data also indicated that there was a high level of crop-livestock interaction among the smallholders in the study area. Average 15.41±0.70kg, 16.12±0.39kg and 16.13±1.71kg cowdung produced per cattle per day from small, medium and large size farms, respectively the production of Aman rice (t/ha) was highest in large farm (1.05±0.05) followed by medium (0.98±0.03) and small farm (0.92±0.05). Production of Boro rice (t /ha) also showed similar trends,being highest in large farm (1.58±0.05) followed by medium (1.49±0.03) and small farm (1.37±0.05). Cattle population, distribution and manure output were also described. Options for cattle manure management includes on-farm crop production, off-farm crop production, non-agricultural uses and discharge to the environment.

In correlation study, significant and positive relationship was found in case of total land size between homestead area, fodder area, crop area, homestead forest, uncultivated land and pond. Only pond between homestead area and uncultivated land relationship were non- significant.

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The author *October, 2012*

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CHAPTER 1

INTRODUCTION

Bangladesh is a country of mixed agricultural farms of which crop, livestock, fisheries and homestead forestry are the major components, where crop production accounts for most land use i.e. 14.2 million hectare in Bangladesh (BBS, 2001) and as such is probably the single most powerful influence on environmental quality. Including crop production livestock is an integral part of farming systems in Bangladesh. Only livestock is contributing about 6.5% of gross domestic products (GDP) and 13% of total foreign exchange earnings and it also provides 20% of rural employment (GOB, 1991). Nationally, the contribution of livestock to the agricultural GDP is 9% but can be increased to 14% if the values of the production of draught animal power and manure are included (Devendra *et al.*, 1999). Livestock also contributes 95% of draught power in agriculture, 50% of rural transportation, 10% of organic fertilizer, 20% of fuel and also crushing and threshing of crops and sugarcane (DLS, 1994).

Livestock manure has typically been considered a 'waste products' of livestock production. On average cattle manure contain 4.4 percent nitrogen, 1.1 percent phosphorus and 2.4 percent potassium (Parr *et al.*, 1994). Cowdung save the cost of purchasing chemical fertilizer and also it has a long term residual effect on soil. Environment can be saved by using cowdung in crop field. Khan (2004) reported that compost prepared from cattle manure in Bangladesh contains 1.89, 0.80, 0.88% NPK, respectively where farmyard manure showed NPK as 0.81, 0.53 and 1.10% respectively.

Cowdung also increases the activity of favourable micro-organisms and earth worm into soil. We can maintain ecological balance and biodiversity through reducing the ill effect of chemical fertilizer incorporation into soil for crop production. The crop and other products produced using cowdung are safer for human consumption. Farmyard manure is produced

in the farm from the excreta of farm animals, used as bedding materials, left over materials during feeding and farmstead wastes.

Cattle manure is the raw material used for bio-gas production in Bangladesh. Bio-gas has been gaining worldwide importance and popularity recently, especially with the developing countries, because of its appropriateness in the context of technical, socio-economic and resource endowments of these countries. It was also stated that LGED constructed 980 family bio-gas plant using cattle manure throughout Bangladesh (LGED, 2007). The potentials of bio-gas in Bangladesh (LGED, 2007) are described here: cattle dung available from 22 million cows and buffaloes is nearly 220 million kg. Cowdung of one cattle can produce 0.037 cum of bio-gas i.e. available cattle dung can produce 2.97 x 106 tons cum of gas which is equivalent to 1.52 x 106 litres of kerosene or 3.04 x 106 tons of coal. The residues of bio-gas are used as improved organic fertilizer, for mushroom cultivation, aquaculture, purl cultivation, fish feed and seed fermentation. Abedin *et al.* (2006) also reported about the benefit of bio-gas plant at farmer's level in Bangladesh.

Nutrients in manure are potentially valuable resources for the management of soil fertility. Land application of manure recycles nutrients back to the land. Literature considered the manure nutrients dynamics (Anonymous, 2007) in three stages:

- Manure nutrients are produced in faeces, urine and other agricultural by-products associated with an animal feeding operation. The quantity of nutrients produced varies with livestock type as well as the animal,
- Manure nutrients are lost during manure handling, storage, treatment, and application and
- Manure nutrients become available in the soil for crop uptake or are lost as potential pollutants.

Therefore, the present study was undertaken with following objectives:

i. To explore relationship among farmers land size with livestock population,

ii. To investigate the existing livestock feeding practices in the rural areas,

iii. To find out the crop, livestock and environmental interaction in the rural areas at Gouripur upazila of Mymensingh district and

iv. To find out the use of cattle manure in the crop field and their environmental interactions.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Nutrient content in cattle manure

Govind *et al.* (1978) concluded that a mixture of poultry waste and cowdung in the ratio of 1:3 was best in producing maximum quantity of plankton followed by poultry, goat, cow, pig and horse manures.

Mirza *et al.* (1990) stated that the cowdung treatment of the nursery ponds had significant effect on the water transparency, dissolved oxygen, carbon dioxide and nitrate nitrogen contents.

Parr *et al.* (1994) have shown the nutrient content of cattle manure which were 4.4% nitrogen, 1.1% phosphorus, 2.4% potassium and value ($/MT) of cattle manure was 23.47.

Livestock excretes 70 to over 90% of the N, P, K, Mg and heavy metals taken up in the feed. The excreta, which will furthermore be called solid and liquid manure (Pain and Menzi, 2003), therefore contain a considerable amount of these substances. Furthermore, they contain considerable amounts of organic substance.

Zhang (2003) discussed the manure handling systems and outlined as follows:

- ❖ solid or conventional manure handling
- ❖ slurry manure handling
- ❖ liquid manure handling

- anaerobic lagoon
- removal of suspended solids
- composting
- combinations of the above.

Each system can be broken down into five major components:

- collection
- storage
- processing or treatment
- transport and utilization.

Sainsbury and Sainsbury (1982) discussed farmyard manure as produced in the farm from the excreta of farm animals, bedding used for animals, left over materials during feeding, farmstead wastes. The transportation system of cattle manure from one place to another creates problem in the organic system. High rate of transport charges and inadequate availability of transport like truck and railway stand bottlenecks in the marketing channel.

2.2 Manure in soil and crop

Jahangir and Matin (2004) reported that combined use of manure and chemical fertilizer slightly increased soil p^H and improved the organic matter, N, P, K and S contents of soil.

Rahman (2004) and Islam *et al.* (2006) showed that the application of cowdung significantly increases the yield of carrot per hectare.

2.3 Manure in forage and fodder production and evaluation

Cattle manure is an important and useful organic fertilizer for forage and fodder production in Bangladesh. The effect of farmyard manure on biomass yield and nutrient content of Zamboo fodder was discussed by Khan (2004). Cowdung at different level as a source of N was used by Khan *et al.* (2005) to estimate the yield and nutrient contents of maize forage.

Cattle faeces contains micro-organisms which is useful for the evaluation of feeds and forage for livestock. Jones and Barnes (1996) reported that it may be easier to use faeces of cattle rather than collect rumen liquor from cattle as an inoculum source of *in vitro* digestibility studies of forage specially in developing countries. Akhter and Hossain (1998) also explored that cow faeces was found to be a suitable alternatives to sheep rumen liquor as the source of micro-organisms for *in vitro* digestibility assays of forage.

2.4 Manure in integrated fish farming

Most of the livestock manure is not properly utilized and became waste which causes environmental pollution. If the manure could be applied in fish ponds through integrated fish farming system, fish production could be increased substantially without using any other fertilizer or supplementary feed for fish.

Livestock manure and waste feed particles which enter the food web of a pond ecosystem are utilized in several ways (FAO , 2007).

- ❖ As a source of nutrients required for primary production.
- ❖ As nutrients and organic substrates for heterotrophic microorganisms which in tern may be consumed directly by fish or by invertebrate fish pond organisms.
- ❖ Directly consumed by the fish.

2.5 Impact on environment

Small scale bio energy development in large number in Bangladesh could bring significant environmental benefits (Hossain and Ahammad, 2007), such as-

- ❖ Reduce higher level of deforestation.
- ❖ Reduce net greenhouse gas emissions.
- ❖ Improve air quality and reduce acid deposition.
- ❖ Improve soil quality and reduce erosion.
- ❖ Reduce land filling by adding value to residues.
- ❖ Reduce agricultural chemical runoff.

2.6 Options for manure management

Manure management in livestock production system is of vital importance for sustainable production. Figure 1 provides a conceptual framework for considering possible solutions to the current situation. The figure illustrates five possible options for manure management:

1) direct recycling of manure as a livestock feed ingredient,
2) on-farm recycling of nutrients for crop production,

3) off-farm recycling of nutrients for crop production,

4) export to non-agricultural uses, and

5) discharge to the environment (Richard and Choi, 1999).

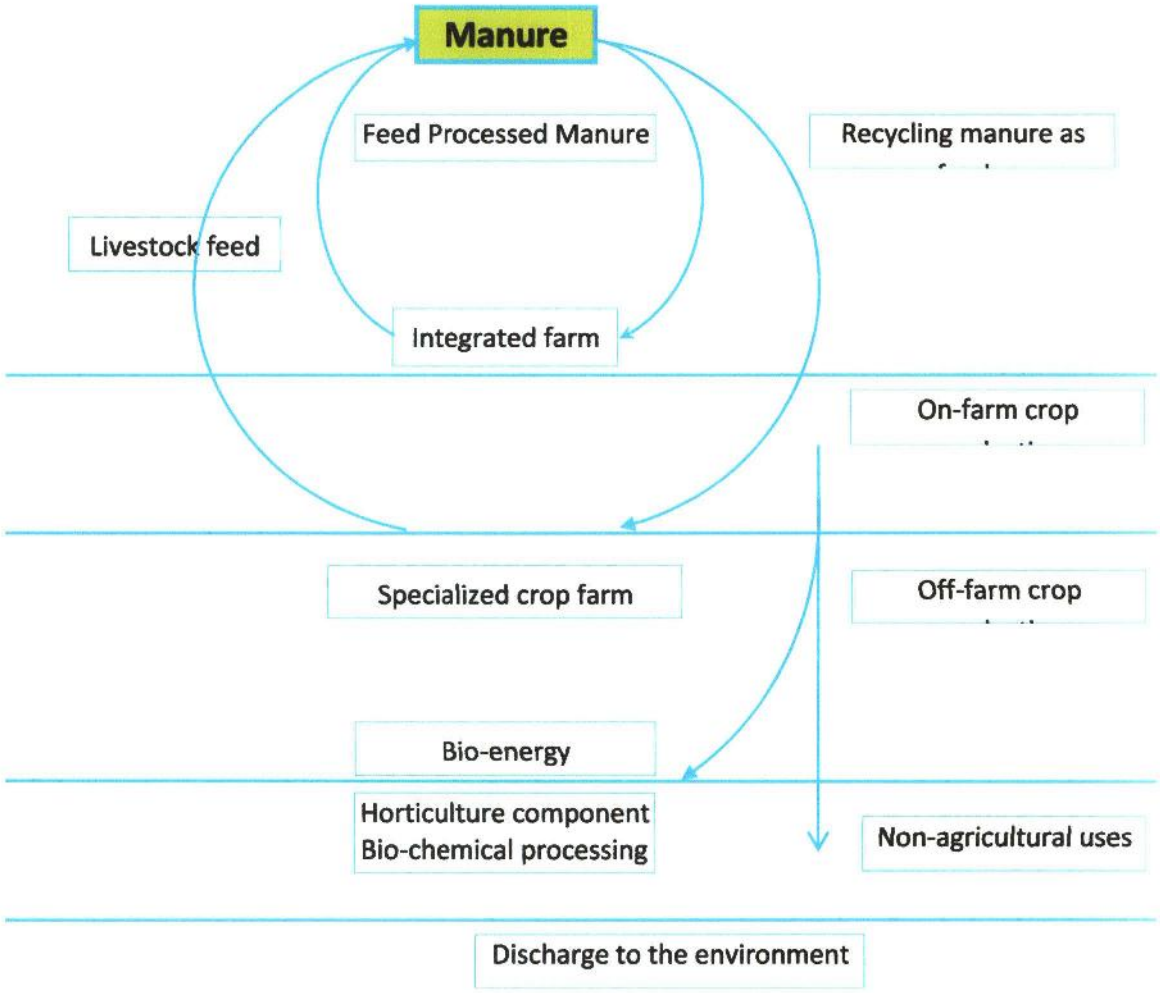

Figure 1: Options for manure management

2.7 Variables related to livestock and environment

Livestock interactions with the environment have been the subject of much discussion and heated debate over the last decade. The World Bank, the European Union and many bilateral donors have sponsored the Livestock Environment and Development (LEAD) initiative and a compilation of 130 publications on CD-ROM concerning livestock, Environment and Development Interactions (FAO, 2003). Bourn *et al.* (2005) emphasizes to increase awareness of livestock-environment interactions at all levels from producer to consumers. (Anonymous,2007) discusses in details the managing livestock manure to protect environmental quality. Livestock producers must be deal with the waste in ways that do not harm the environment (Gillespie, 1983). There is scarce of literature regarding livestock-environment interactions in Bangladesh. Recently, Hossain and Sarwer (2006) reviewed the factors related to livestock and poultry production systems and interactions with the environment in Bangladesh.

2.8 Principles of environmental stewardship

The following principles environmental stewardship will help livestock producers remain viable while protecting the environment's water and air quality (Anonymous, 2007):

- Awareness of environmental risks.
- No point source discharge.
- Balance in the use of nutrients.
- Nutrient plan for land preparation.
- Be a good neighbor.

- Know the rules.
- Expansion without environmental compromise.

2.9 Monitoring environmental variables

It is often impossible to interpret population changes or the distribution of a species unless there has also been a programme of monitoring environmental variables. Most environmental measures can be simply collected manually. The major environmental variables (Sutherland, 2000) are temperature, rainfall, water depth, water flow, water chemistry, evapotranspiration, wind speed, salinity, soil p^H and soil characteristics.

2.10 Organic farming

Rahman (2002) stated that animal husbandry is the central element of organic farming. Appropriate animal production link to the land is basic principles of organic animal husbandry in Bangladesh. Proshika and BRAC are producing organic crop and vegetables for the consumers. Kazi and Kazi Tea Estate are producing organic tea by using cattle manure in northern part of Bangladesh (Figure 2).

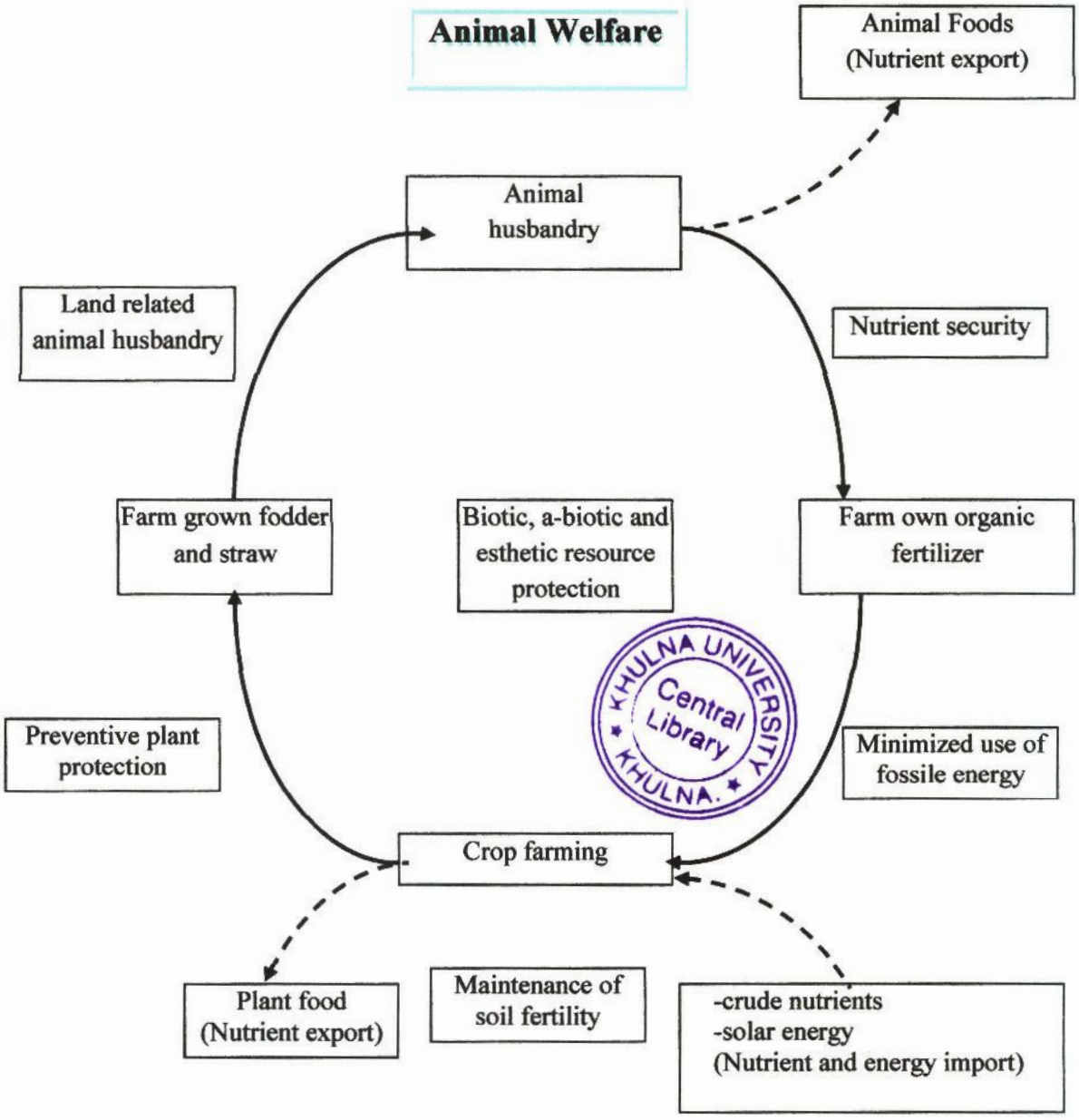

Figure 2: System approach of organic farming

2.11 Environmental consideration

Moore and Gamroth (1993) have shown the procedure for management of dairy manure and strategies for recycling the nutrients to recover fertilizer values and avoid environmental pollution.

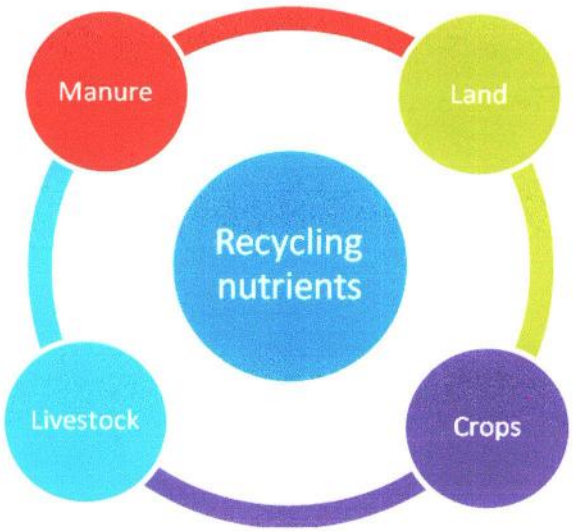

Figure 3: Land application of animal manure recycles nutrients back to the land

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

Materials and methods followed in conducting the present research are described in this chapter.

3.2 The locale of the study

Gauripur is an Upazila of Mymensingh District in the Division of Dhaka, Bangladesh. Gauripur is located at 24.7583° N 90.5750° E . It has 48378 units of house hold and total area 274.07 km². Gauripur has a population of 247945. Males constitute are 50.71% of the population, and females 49.29%. This Upazila's eighteen up population is 125167. Gauripur has an average literacy rate of 26.4% (7+ years). Gauripur has 13 Unions/Wards, 277 Mauzas/Mahallas, and 278 villages. The study was conducted at Gouripur union of the upazila. The selected areas were easily accessible by Van, Tempo, Bi-cycle, Motor-cycle, Bus etc. from the main road. Villages are under agro-ecological zones of the Old Brahmaputra Floodplain sub-region. Only 5 villages such as Bokainagor, Ramgopalpur, Dowhakhola, Shahagonj and Achintapur were selected randomly as area of the study. No study of the same type was conducted in this area before the present one.

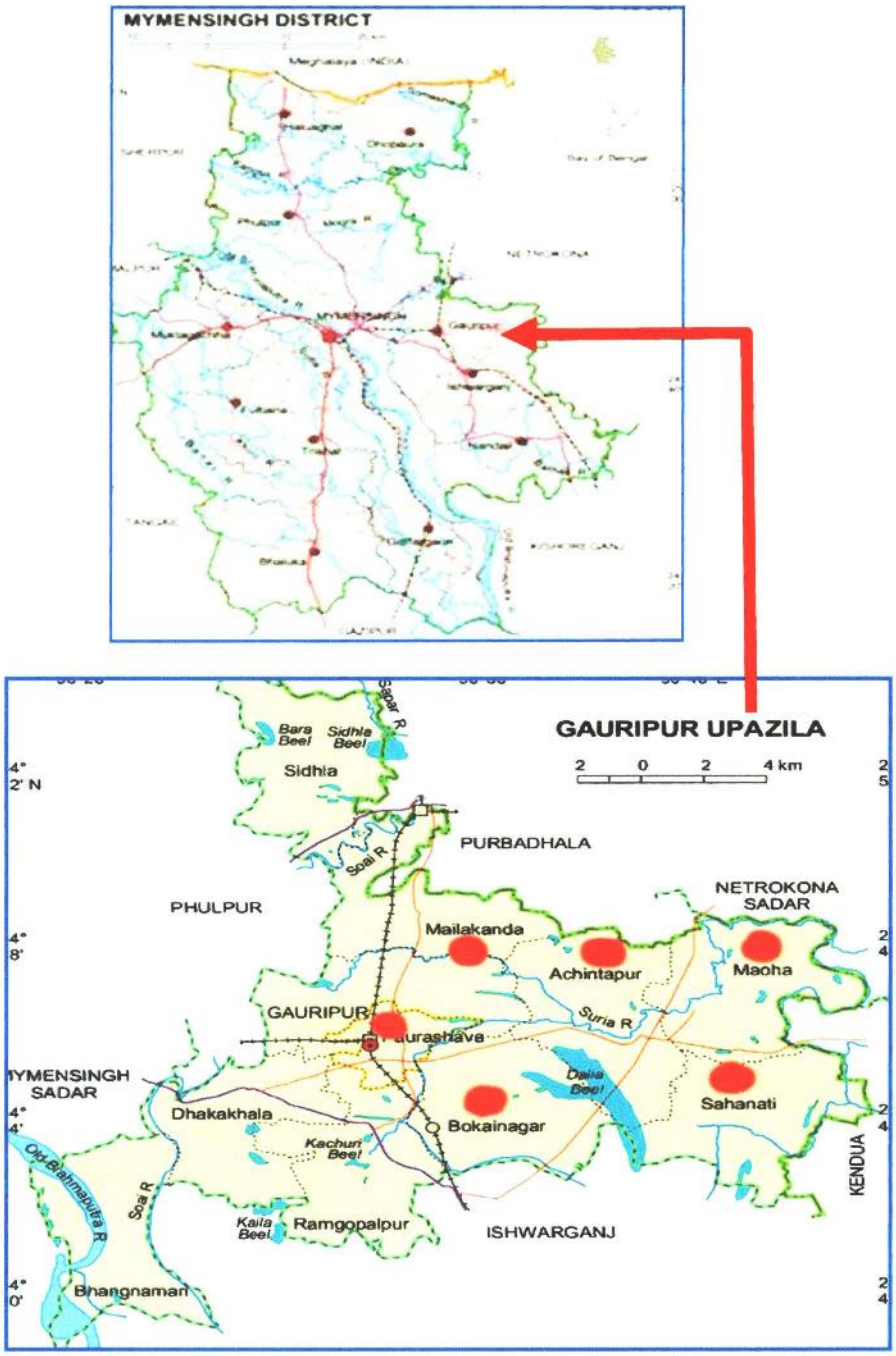

Figure 4: Showing map of Gouripur upazila and different study area of the experiment

3.3 Environmental condition of the study area

Maximum and minimum temperatures were observed in April and January ranged between 32.9°C and 13.2°C in Mymensingh district (BBS, 2004). Summer season continued from April to June and winter lasts from December to February. Rainfall started in May and continued up to September. Total rainfall about 93% of the annual rainfall occurs during the monsoon. The maximum humidity was observed 84% from July to September and the minimum about 74% from January to April (BBS, 2004). The area seems to be less affected by the natural calamities like cyclones but moderately affected by flood, drought, severe rainfall etc. as compared to other districts of the country (BBS, 2004).

3.4 Means of data collection

In order to collect the required information on various aspects of the study, an interview schedule was carefully prepared to satisfy the objectives of the research. Direct questions, open questions and different scales were used to obtained reliable information. The questions were arranged systematically and presented clearly before the respondent. The interview schedule was prepared in Bangla for easy understanding and for the collection of data but given in the thesis in English (Appendix I). This helped the respondents to understand the interview schedule easily and furnish the required information easily and systematically. The draft interview schedule was pretested with ten farmers. The pre-test facilitated the researcher to examine the suitability of various questions in the interview schedule. The interview schedule was finalized after necessary correction, alterations and additions. The interview schedule was then printed in its final form and multiplied for collection of data.

3.5 Procedure of data collection

The researcher collected information through personal interview from the individual respondent at their home and field. An introductory visit was made to the study area to become familiar with the respondent and their social environment. During visit the objectives of the study were explained clearly to most of the respondents. This helped the researcher to have a friendly orientation with the farmers. The researcher also established desired rapport with respondents. Questions were asked systematically and explanations were made whenever it was felt necessary. The information supplied by the respondents was recorded directly on the interview schedule. The information was checked carefully before leaving the study area in order to minimize errors. Data were collected in local unit. These were subsequently converted into appropriate standard units.

No serious problem was faced by the researcher during data collection. Excellent co-operation was received from all respondents during collection of data. The data were collected from randomly selected 50 respondents during the period from 25 May to 26 June, 2010.

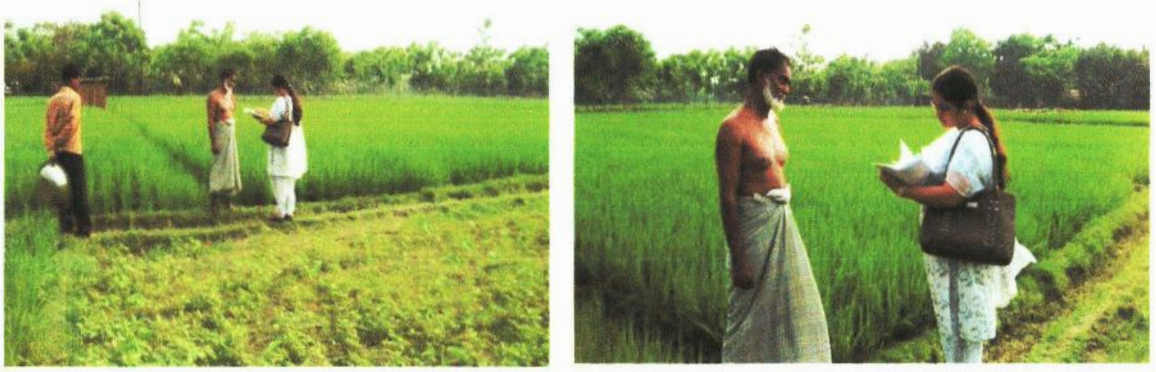

Figure 5: Showing data collection by author from the study area (Gazipur)

3.6 Sampling design of the farmer

The data for this study was collected from five randomly selected villages namely Bokainagor, Ramgopalpur, Dowhakhola, Shahagonj and Achintapur of Gouripur union. Fifty respondents who were involved in crop- livestock integrated production systems were purposively selected from the villages. A reserve list of at least 12 respondents in each village was also made. So that the respondents of this list could be used if any respondents from the original sample would not be available at the time of interview. The distribution of respondents from the selected villages are shown in the Table 3.1.

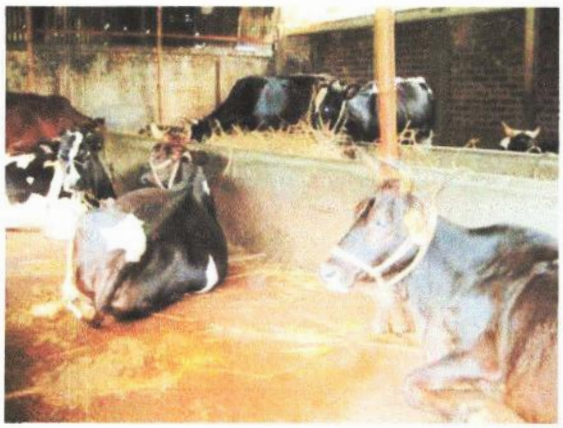

Figure 6: Showing different breeds of cattle and compost pit in study area at Gouripur

Figure 7: Showing rice field in the study area at Gouripur

Table 3.61 Layout of the experiment for the collection of data (n= 50)

Survey village	Number of families	No. of respondents per village
Bokainagor	490	10
Ramgopalpur	650	10
Dowhakhola	675	10
Shahagonj	440	10
Achintapur	550	10

3.7 Tabulation of the data

After completion of field survey all the interview schedules were set for its data tabulation for coding and reduction. All the individual variables of the interview schedules were transferred to a master sheet to facilitate tabulation. Tabulation and cross-tabulation were done on the basis of farmers farm size (ha), number of livestock, number of crops produce per year, availability as per requirement of livestock feed, present status of crops, amount of cowdung production per cattle, sources of livestock, frequency of collection of used cowdung, use of cowdung, rate of yield, manure management cycle, etc.

3.8 Variables and their managements

The selection of variables and their measurements constitute an important task in research. The selection of inappropriate and inconsistent variables may lead to misleading results. The selected environmental variables in this study are as follows: temperature, rainfall and humidity which effect on crops, livestock etc.

The environmental interactions were observed in terms of

1) Temperature + yield
2) Rainfall + yield
3) Humidity + yield

In case of the farmers who used cattle manure in their crop fields.

3.9 Statistical analyses of data

The data were coded, complied, tabulated and analyzed to accomplish the objectives of the study. Qualitative data were converted into quantitative

by means of suitable scoring techniques where ever applicable. Data were presented mostly in the tabular form for widely used and easy to understand. Various statistical measures like numbers, average, percentage distribution, etc. were done in describing the variables using Statistical Package for Social Science (SPSS).

CHAPTER 4

Results and Discussion

4.1 Age of the respondents

Based on their age, the respondents were classified into three categories: "young age" (upto 30 years), "middle age" (31-55 years) and "old age" (above 55 years). The highest proportions (56.00%) were middle aged followed by old (36.00%) and young aged (8.00) (Table 4.1).

Table 4.1 Distribution of the respondents according to their age

Age of the farmer	Frequency	Percent
Young (upto 30 yrs)	4	8.0
Middle (31 to55 yrs)	28	56.0
Old (Above 55 yrs)	18	36.0
Total	50	100.0

4.2 Level of education

Education helps individuals to become conscious of their environment and develop rational insight into many matters of life. Education broadens outlook of individuals and leads them to explore new ideas for better litter management. Thus, it seems that rate of literacy of the respondents in the study area is higher than the national context since 80% of individuals had different kind of formal education. On the basis of literacy level, the respondents were classified into four categories: "Illiterate" (no education), "primary" (0-5), "secondary" (6-10) and "above

secondary" (>10). In the study 20.00% respondents were illiterate, 46.00% had primary, 30.00% had secondary and 4.00% had above secondary level of education (Table 4.2).The literacy rate in this country is 45.3% (BBS, 2004). Thus, it seems that rate of literacy of the respondents in the study area was higher than the national context.

Table 4.2 Distribution of the respondents according to their level of education

Category	Frequency	Percent
Illiterate	10	20.0
Primary	23	46.0
Secondary	15	30.0
Above secondary	2	4.0
Total	50	100.0

4.3 Farm size

Farm size of the respondents ranged from 0.0 to above 3 ha. Respondents were grouped into three categories based on their farm size: "small" (0.21-1.0 ha), "medium" (1.01-3.0 ha) and "large" (above 3.0 ha) (Table 4.3). In this study, highest percentage of farmers belonged to medium category (60%), followed by small (32%) and large farm category (8%).

Table 4.3 Distribution of the respondents according to their farm size

Category	Frequency	Percent
Small (0.21 to 1.0 ha)	16	32.0
Medium (1.01 to 3.0 ha)	30	60.0
Large (Above 3.0 ha)	4	8.0
Total	50	100.0

4.4 Agro based farm area

In the study area different types of agro based farms were observed. Such as homestead area, fodder area, crop area, homes forest, uncultivated land and pond. According to the respondents homestead area (ha) was lowest in small farmers (0.12±0.26) and highest in large farmers (0.30±0.10). The average homestead area of the study area was (0.22±0.02). Homestead area was varied significantly according to land size (Table 4.4.1).

Fodder cultivation area (ha) was lowest in small farmers (0.003±0.003) and highest in large farmers (0.09±0.01).The average fodder cultivated area of the study area was (0.05±0.01). Fodder cultivated area was varied significantly according to farmer's land size ($p<0.05$).

The crop production area (ha) was lowest in small farmers (0.39±0.04) and highest in large farmers (1.60±0.038).The average crop production area of the study was (0.92±0.07). The crop production area was varied significantly according to land size ($p<0.001$).

Homestead forest area (ha) was lowest in small farmers (0.01±0.004) and highest in large farmers (0.15±0.03). The average homestead forest area of the study area was (0.07±0.01). Homestead forest area was varied significantly according to land size ($p<0.001$).

Uncultivated land (ha) was lowest in small farmers (0.007±0.004) and highest in large farmers (0.13±0.04). The average uncultivated land of the study area was (0.02±0.01). Uncultivated land was varied significantly according to land size ($p<0.001$).

Pond area (ha) was lowest in small farmers (0.03±0.01) and highest in large farmers (0.99±0.01). The average pond area of the study area was (0.16±0.06). Pond area was varied significantly according to land size ($p<0.001$).

Table 4.4 Distribution of respondents according to their agro-based farm size area (ha)

Farmer's category	Homestead area (ha)	Fodder production area (ha)	Crop production area (ha)	Homestead forestry (ha)	Uncultivated land (ha)	Pond (ha)
Small (0.21 to 1.0 ha)	0.12±0.26	0.003±0.003	0.39±0.04	0.01±0.004	0.007±0.004	0.03±0.01
Medium (1.01 to 3.0 ha)	0.26±0.02	0.07±0.02	1.11±0.07	0.08±0.01	0.02±0.01	0.13±0.02
Large (Above 3.0 ha)	0.30±0.10	0.09±0.01	1.60±0.38	0.15±0.03	0.13±0.04	0.99±0.74
Average	0.22±0.02	0.05±0.01	0.92±0.07	0.07±0.01	0.02±0.01	0.16±0.06

Table 4.4 Effect of farm size on agro-based farm areas

		Sum of Squares	df	Mean Square	F-value	Significance
Homestead area (ha)	Between Groups	0.24	2	0.12	9.55	***
	Within Groups	0.59	47	0.01		
	Total	0.83	49			
Fodder area (ha)	Between Groups	0.06	2	0.03	3.51	*
	Within Groups	0.40	47	0.01		
	Total	0.46	49			
Crop production area (ha)	Between Groups	7.43	2	3.72	30.35	***
	Within Groups	5.76	47	0.12		
	Total	13.19	49			
Homestead forestry (ha)	Between Groups	0.09	2	0.04	22.52	***
	Within Groups	0.09	47	0.00		
	Total	0.18	49			
Uncultivated land (ha)	Between Groups	0.05	2	0.02	20.69	***
	Within Groups	0.05	47	0.00		
	Total	0.10	49			
Pond (ha)	Between Groups	3.10	2	1.55	10.11	***
	Within Groups	7.21	47	0.15		
	Total	10.31	49			

*P<0.05, ***P<0.001

4.5 Relationship of farm size with livestock population

The number of livestock reared by the farmers in relation to farm size is shown in the Table 4.5.1. The total number of cattle per farm family was highest in medium category of farmer (13.43±1.01) and lowest in small category (7.38±1.28). The average number of cattle per farm family was (11.30±0.86). Effect of farm size on cattle population was significant ($P<0.01$).

The total number of cow per farm family was highest in medium category of farmer (8.07±0.59) and lowest in small category (4.19±0.60). The average number of cow per farm family was (6.68±0.49). Effect of farm size on cow population was significant.

The total number of bull per farm family was highest in medium category of farmer (3.17±0.29) and lowest in small category (1.56±0.45). The average number of bull per farm family was (2.58±0.27). Effect of farm size on bull population was significant ($P<0.05$).

The total number of bullock per farm family was highest in large category of farmer (2.50±0.65) and lowest in small category (1.63±0.34). The average number of bullock per farm family was (2.04±0.20). Effect of farm size on bullock population was non-significant ($P>0.05$).

The total number of goat per farm family was highest in medium category of farmer (3.03±0.46) and lowest in large category (2.50±1.5). The average number of goat per farm family was (2.88±0.35). Effect of farm size on cattle population was non-significant (Table 4.5.2).

Table 4.5.1 Number of livestock in relation to their farm size

Total Land size (ha)	Total no. of cattle/family	No. of cow/ family	No. of bull/ family	No. of bullock/ family	No. of goat/ family
Small (0.21 to 1.0 ha)	7.38±1.28	4.19±0.60	1.56±0.45	1.63±0.34	2.69±0.62
Medium (1.01 to 3.0 ha)	13.43±1.01	8.07±0.59	3.17±0.29	2.20±0.26	3.03±0.46
Large (Above 3.0 ha)	11.00±3.54	6.25±1.93	2.25±1.11	2.50±0.65	2.50±1.5
Average	11.30±0.86	6.68±0.49	2.58±0.27	2.04±0.20	2.88±0.35

Table 4.5.2 Effect of farm size on livestock population

		Sum of Squares	df	Mean Square	F-value	Significance
Total no of cattle/family	Between Groups	383.38	2	191.69	6.26	**
	Within Groups	1439.12	47	30.62		
	Total	1822.50	49			
No .of cow/family	Between Groups	157.83	2	78.91	8.49	***
	Within Groups	437.05	47	9.30		
	Total	594.88	49			
No of bull/family	Between Groups	27.326	2	13.663	4.762	*
	Within Groups	134.854	47	2.869		
	Total	162.180	49			
No of bullock/family	Between Groups	4.370	2	2.185	1.098	NS
	Within Groups	93.550	47	1.990		
	Total	97.920	49			
No of goat/family	Between Groups	1.876	2	0.938	0.144	NS
	Within Groups	305.404	47	6.498		
	Total	307.280	49			

*P<0.05, **P<0.01, ***P<0.001, NS= Non significant

It is important to know the patterns of land use, the number of livestock owned by the farmers and farm size of the farmers when studying crop-livestock environmental interaction in the rural areas. The data also indicated that there was a high level of crop-livestock integration among the small holders in the study area. Begum *et al.* (1996) reported that both the number of cattle and goats increased with the increased of land size.

4.6 Feeding practices

Relationship between farmers land size and types of fodder offered to livestock are shown in Table 4.6.1. Farmer offered green grass, straw, tree leaves, roadside grass, oilcake, bran, molasses and other different types of conventional and unconventional feeds and fodders to their livestock.

Green grass supply per animal per day was highest in large category of farmer (2.81±0.75 kg) and lowest in small farmer (0.13±0.13 kg). Average green grass supply was (1.20±0.22 kg). Mean differences were significant.

Straw supply per animal per day was highest in medium category of farmer (9.91±0.19 kg) and lowest in small farmer (9.29±0.20 kg). Average straw supply was 9.69±0.14kg. Mean differences were non-significant.

Tree leaves supply per animal per day was highest in medium category of farmer (2.52±0.11kg) and lowest in small farmer (1.97±0.22kg). Average tree leaves supply was 2.33±0.10 kg. Mean differences were non significant.

Road side grass supply per animal per day was highest in large category of farmer (2.02±0.29 kg) and lowest in small farmer (1.66±0.18 kg). Average roadside grass supply was 1.90±0.09 kg. Mean differences were non-significant.

Oil cake supply per animal per day was highest in large category of farmer (0.26±0.11kg) and lowest in small farmer (0.19±0.02kg). Average oil cake supply was 0.21±0.02kg. Mean differences were non-significant.

Rice bran supply per animal per day was highest in large category of farmer (2.46±0.37kg) and lowest in small farmer (1.60±0.17kg). Average bran supply was 1.99±0.10kg. Mean differences were significant.

Molasses supply per animal per day was highest in large category of farmer (0.14±0.08kg) and lowest in small farmer (0.04±0.02kg). Average molasses supply was 0.10±0.02 kg. Mean differences were significant.

Table 4.6.1 Relationship between farmers land size and quantity of different types of feed offered to livestock (kg/animal/day) (n=50)

Total Land size (ha)	Green grass(kg/animal/day)	Straw (kg/animal/day)	Tree leaves(kg/animal/day)	Road side grass (kg/animal/day)	Oil cake (kg/animal/day)	Bran (kg/animal/day)	Molasses (kg/animal/day)
Small (0.21 to 1.0 ha)	0.13±0.13	9.29±0.20	1.97±0.22	1.66±0.18	0.19±0.02	1.60±0.17	0.04±0.02
Medium (1.01 to 3.0 ha)	1.55±0.29	9.91±0.19	2.52±0.11	2.01±0.10	0.21±0.02	2.14±0.13	0.13±0.02
Large (Above 3.0 ha)	2.81±0.75	9.59±0.62	2.32±0.20	2.02±0.29	0.26±0.11	2.46±0.37	0.14±0.08
Average	1.20±0.22	9.69±0.14	2.33±0.10	1.90±0.09	0.21±0.02	1.99±0.10	0.10±0.02

Table 4.6.2 Effect of farm size on feed supply to their livestock

		Sum of Squares	df	Mean Square	F	Significance
Green grass	Between Groups	32.339	2	16.170	9.126	***
	Within Groups	83.274	47	1.772		
	Total	115.613	49			
Straw (kg/animal/d)	Between Groups	4.091	2	2.046	2.075	NS
	Within Groups	46.330	47	0.986		
	Total	50.421	49			
Tree leaves(kg/animal/d)	Between Groups	3.137	2	1.569	3.098	NS
	Within Groups	23.795	47	0.506		
	Total	26.933	49			
Road side grass (kg/animal/d)	Between Groups	1.356	2	0.678	1.875	NS
	Within Groups	16.997	47	0.362		
	Total	18.353	49			
Oil cake (kg/animal/d)	Between Groups	0.014	2	0.007	0.425	NS
	Within Groups	0.789	47	0.017		
	Total	0.803	49			
Rice bran (kg/animal/d)	Between Groups	4.021	2	2.010	4.143	*
	Within Groups	22.803	47	.485		
	Total	26.824	49			
Molasses (kg/animal/d)	Between Groups	0.094	2	0.047	4.602	*
	Within Groups	0.480	47	0.010		
	Total	0.575	49			

*P<0.05, ***P<0.001, NS= Non significant

4.7 Farmers land size and use of chemical fertilizer

In the study area farmers used different types of chemical fertilizer such as urea, TSP, MOP and Gypsum. Among the chemical fertilizer only urea used by 100% farmers in their crop field (Table 4.7.1). In the small farm size rate of fertilizer application (kg/ha) were urea as 100.00±3.65, TSP as 36.25±7.950, MOP as 20.62±9.51 and Gypsum as 3.75±2.56. Medium farmer used different fertilizer (kg/ha) at the rate of urea as 100.00±3.41, TSP as 42.50±5.65, MOP as 24.33±6.76 and Gypsum as 1.06±1.03. Large farmer used different fertilizer at the rate of as urea 100.00±1.16, TSP 60.00±7.07, MOP 57.50±20.97 and Gypsum 32.50±11.09. Mean difference of Urea, TSP, MOP used between different category of farmers were non-significant but Gypsum were significant.

Table 4.7.1 Relationship between farmers land size and quantity of chemical fertilizer (kg/ha) used in crop field

Total Land size (ha)	Urea (kg/ha)	TSP (kg/ha)	MOP (kg/ha)	Gypsum (kg/ha)
Small (0.21 to 1.0 ha)	100.00±3.65	36.25±7.95	20.62±9.51	3.75±2.56
Medium (1.01 to 3.0 ha)	100.00±3.41	42.50±5.65	24.33±6.76	1.06±1.03
Large (Above 3.0 ha)	100.00±1.16	60.00±7.07	57.50±20.97	32.50±11.09
Average	100.00±2.40	41.90±4.30	25.80±5.39	4.50±1.77

Table 4.7.2 Effect of chemical fertilizers on their crop field

Fertilizer		Sum of Squares	df	Mean Square	F	Significance
Urea (kg/ha)	Between Groups	0.00	2	0.00	0.00	NS
	Within Groups	14100.00	47	300.00		
	Total	14100.00	49			
TSP (kg/ha)	Between Groups	1832.00	2	916.00	0.99	NS
	Within Groups	43512.50	47	925.80		
	Total	45344.50	49			
MOP (kg/ha)	Between Groups	4512.58	2	2256.29	1.59	NS
	Within Groups	66705.42	47	1419.26		
	Total	71218.00	49			
Gypsum (kg/g)	Between Groups	3488.79	2	1744.40	20.48	***
	Within Groups	3918.03	46	85.18		
	Total	7406.82	48			

***P<0.001, NS= Non significant

4.8 Cereal crop production

Farmers cultivated different types of crop in their crop field. Rice, wheat, maize and vegetables were cultivated in the study area. In the study Aman rice production (t/ha) was highest in large category of farmer (1.05±0.05) and lowest in small farmer (0.92±0.05). Average Aman rice production was 1.00±0.02 t/ha. Mean differences were non-significant.

Boro rice production (t/ha) was highest in large category of farmer (1.58±0.05) and lowest in small farmer (1.37±0.05). Average Boro rice production was 1.46±0.03 t/ha. Mean differences were significant.

Table 4.8.1 Distribution of respondents according to their rice production (t/ha)

Total Land size (ha)	Rice cultivated area (ha)	Time of rice cultivation/year	Aman production (t/ha)	Boro production (t/ha)
Small (0.21 to 1.0 ha)	0.37±0.04	1.94±0.11	0.92±0.05	1.37±0.05
Medium (1.01 to 3.0 ha)	1.18±0.09	2.03±0.11	0.98±0.03	1.49±0.03
Large (Above 3.0 ha)	1.60±0.38	2.00±00	1.05±0.05	1.58±0.05
Average	0.95±0.08	2.00±0.08	1.00±0.02	1.46±0.03

Table 4.8.2 Effect of land size to rice production

		Sum of Squares	df	Mean Square	F	Significance
Rice cultivated areas (ha)	Between Groups	8.517	2	4.258	23.066	***
	Within Groups	8.677	47	0.185		
	Total	17.194	49			
Time of rice cultivation	Between Groups	0.096	2	0.048	0.162	NS
	Within Groups	13.904	47	0.296		
	Total	14.000	49			
Aman production (t/ha)	Between Groups	0.063	2	0.032	1.248	NS
	Within Groups	1.192	47	0.025		
	Total	1.256	49			
Boro production (t/ha)	Between Groups	0.218	2	0.109	3.651	*
	Within Groups	1.403	47	0.030		
	Total	1.621	49			

*P<0.05, ***P<0.001, NS= Non significant

4.9 Cow dung production (kg/animal/day)

In the study area the production of cow dung (kg/animal/day) was highest in large category of farmer (16.13±1.71) and lowest in small farmer (15.41±0.70). Average cowdung production was 15.89±0.34 kg/animal/day. Mean differences were non-significant.

On the other hand, application of highest quantity of cow dung by large category of farmer (0.80±0.08) and lowest in small farmer (0.58±0.04). Average cow dung used was (0.63±0.02) (t/cultivation/ha) Mean differences were non-significant.

Table 4.9.1 Distribution of respondents according to their amount of cow dung production (kg/cattle/day) and application.

Total Land size (ha)	Production of cow dung/animal/day	Cow dung used (t/cultivation/ha)	Price of dung (Tk./kg)
Small (0.21 to 1.0 ha)	15.41±0.70	0.58±0.04	1.30±0.10
Medium (1.01 to 3.0 ha)	16.12±0.39	0.64±0.03	1.15±0.09
Large (Above 3.0 ha)	16.13±1.71	0.80±0.08	1.25±0.25
Average	15.89±0.34	0.63±0.02	1.21±0.06

Table 4.9.2 Effect of cow dung production (kg/cattle/day) and its application

		Sum of Squares	df	Mean Square	F	Signifi cance
Production of cow dung/animal/d	Between Groups	5.506	2	2.753	0.456	NS
	Within Groups	283.639	47	6.035		
	Total	289.145	49			
Cow dung used (cultivation/ha)	Between Groups	0.169	2	0.084	2.992	NS
	Within Groups	1.324	47	0.028		
	Total	1.492	49			
Price of dung (Tk./kg)	Between Groups	0.232	2	0.116	0.561	NS
	Within Groups	9.725	47	0.207		
	Total	9.957	49			

*P<0.05, **P<0.01, ***P<0.001, NS= Non significant

4.10 Distribution of respondents according to cow dung use (t/ha)

The respondents were used cow dung in different purpose like as fertilizer in their crop field or fish pond, fuel, biogas, etc. On the basis of cow dung use the respondents were classified into three categories: Crop field, Crop filed and fuel and multi-purpose. The highest proportions (52.00%) were multi-purpose used, the lowest proportions 12.00% were used in their crop field and 36.00% were used in crop field and fuel.

Table 4.10 Uses of cow dung for different purposes

category	Frequency	Percent
Crop field	6	12.0
Crop filed and fuel	18	36.0
Multi-purpose	26	52.0
Total	50	100.0

4.11 Distribution of respondents according to why they use cow dung in the crop field

The respondents were use cow dung for increase crop production and application of it is cost effective. On the basis of reason of cow dung use farmers were classified into three categories: increase crop production, cost effective and both. The highest proportions (48.00%) were used for increase production and for cost effective, the lowest proportions 12.00% were used for cost effective and 40.00% were used for increase crop production.

Table 4.11 Why use cow dung

category	Frequency	Percent
Increase crop production	20	40.0
Cost effective	6	12.0
Increase production and cost effective	24	48.0
Total	50	100.0

4.12 Distribution of respondents according to their perception of cow dung on environment

According to their perception of cow dung on environment, 90.00% respondents were thought that there was no bad effect on environment for using cow dung as a fertilizer for crop production. On the other hand 10.00% were thought that using cow dung may hazard for carrying and application on their field and it may cause their health problem and air pollution.

Table 4.12 Effect of dung on environment

	Frequency	*Percent*
Positive	45	90.0
Negative	5	10.0
Total	50	100.0

4.13 Correlation co-efficient

There was a positive and significant correlation (0.507) between total land size and homestead area. There was a positive and significant correlation (0.342) between total land size and fodder production area. There was a positive and significant correlation (0.744) between total land size and crop production area. There was a positive and significant correlation (0.491) between total land size and uncultivated land. There was a positive and significant correlation (0.416) between total land size and pond area.

Table 4.13 Correlation co-efficient between different components of total farm areas

	Total Land size (ha)	Homestead area (ha)	Fodder area (ha)	Crop production area (ha)	Homestead forestry (ha)	Uncultivated land (ha)	Pond (ha)
Total Land size (ha)	1	0.507(**)	0.342(*)	0.744(**)	0.699(**)	0.491(**)	0.416**
Homestead area (ha)	0.507(**)	1	0.434(**)	0.507(**)	0.438(**)	0.439(**)	0.034
Fodder area (ha)	0.342(*)	0.434(**)	1	0.200	0.355(*)	0.100	0.188
Crop production area (ha)	0.744(**)	0.507(**)	0.200	1	0.693(**)	0.477(**)	0.088
Homestead forestry (ha)	0.699(**)	0.438(**)	0.355(*)	0.693(**)	1	0.300(*)	0.322*
Uncultivated land (ha)	0.491(**)	0.439(**)	0.100	0.477(**)	0.300(*)	1	0.025
Pond (ha)	0.416(**)	0.034	0.188	0.088	0.322(*)	0.025	

** Significant at 0.01
* Significant at 0.05

CHAPTER 5

SUMMARY AND CONCLUSION

The research was conducted at the five villages of Gouripur Upazila of Mymensingh district namely: Bokainagor, Ramgopalpur, Dowhakhola, Shahagonj and Achintapur. Data were collected from 10 farmers to each village (total farmers 50) through an interview schedule. In the study area the survey was carried out to investigate the multiple uses of cattle manure for environmentally sustainable integrated organic farming in Bangladesh. The information was collected about Gouripur upazila from published literature, internet and personal communication. Cattle population, distribution and manure output was described. Some examples are: to improve soil fertility and crop production, horticulture, forage and fodder production, fish feed in the ponds, domestic and commercial fuel.

Options for cattle manure management includes recycling manure as on farm crop production, off-farm crop production, non-agricultural uses and discharge to the environment. This experiment describes the parameters for sustainable integrated organic farming considering the environmental variables like rainfall, temperature and humidity. The farmers had an average (6.68±0.49) cows per family. They also had average number of bull (2.58±0.27), bullock (2.04±0.20) and goat (2.88±0.35) respectively. The data also indicated that there was high level of crop-livestock integration among the smallholders in the study area. According to the respondents (15.41±0.70)kg, (16.12±0.39)kg and (16.13±1.71)kg cowdung/animal/day came from small, medium and large size farm,

respectively. It was stated that Aman rice productions were (0.92±0.05)t/ha, (0.98±0.03)t/ha and (1.05±0.05)t/ha. Aman rice production and (1.37±0.05), (1.49±0.03) and (1.58±0.05) t/ha Boro rice production came from small, medium and large size farm, respectively. Cattle population, distribution and manure output was also described in the study.

Conclusion

The farmers of the study area are very much interested to use cattle manure (cowdung) in their crop field as it is environmentally friendly.

Recommendation

Recommendation for policy implication

- The results of this study will be helpful for the farmers and researchers to know the multiple use of cattle manure for environmentally sustainable integrated organic farming in Bangladesh.

- The results of sustainable integrated organic farming practices of this study may be useful for others.

- The researchers, planners and policy makers would be benefited in organic farming system development strategies.

Recommendation for further study

- The present study was undertaken in five villages. For detail information further studies should be undertaken in more number of villages with more farmers.

- Agro-ecological and environmental factors need to be considered while studying sustainable integrated organic farming systems.

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APPENDIX-I

M. S. in Agronomy, Agrotechnology Discipline,

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Interview Schedule

On

FARMERS' PERCEPTION REGARDING USE OF CATTLE MANURE IN THE CROP FIELD

Serial No. … … …

1. Name of the farmer:

i. Village … … … … … ii. Union … … … … …

2. Age: … … … … … …

3. Level of education:

i. No education ii. Primary

iii. Secondary iv. Above secondary

4. Farm size: (ha)

a) Homestead area … … … … … … … … … … … … … … ...

b) Area under fodder production … … … … … … … … … … .

c) Area under crop production … … … … … … … … … …

d) Homestead forestry … … … … … … … … … … … … … ..

e) Uncultivated land … … … … … … … … … … … … … …

f) Pond … … … … … … … … … … … … … … … … … … … ... .

5. Present status of livestock (No.):

i. Cow ii. Bull

iii. Bullock iv. Sheep

v. Others

6. Present status of availability as per requirement of livestock feed /cattle /day:

Feed item	Quantities of feed (kg/animal/day)
Green grass	
Straw	
Tree leaves	
Road side grass	
Oil cake	
Rice bran	
Molasses	

7. Inorganic fertilizer used in crop field (kg/ha):

Negative effect of inorganic fertilizers

i. Urea: Yes/No

ii. TSP: Yes/No

iii. MOP: Yes/No

iv. Gypsum: Yes/No

8. Present status of crops (kg/ha):

Cultivated crops	Cultivated land	Time of cultivation	Production per ha (ton)
Aman Rice			
Boro Rice			

9. Amount of cowdung production (kg/cattle/d):

i. Cowdung/cattle/day … … … … … … … … … … … … … …

ii. Amount of cowdung used/farmer/cultivation/ha/ton … … … … … … … …

iii. BDT/kg manure … … … … … … … … … … … … … … ...

10. Use of cowdung:

i. Agriculture,

ii. Fish feed,

iv. For sale,

v. Biogas,

iii. Use as fuel, vi. Others (if any).

11. Used cowdung causes any type of environmental pollution, please answer?

i. Yes

ii. No

iii. I do not know

12. Why do you choose to use cattle manure in your crop field instead of inorganic fertilizers?

i. … … … … … … … … … ii. … … … … … … … … …

iii. … … … … … … … … … iv. … … … … … … … … …

13. Positive and negative effect of cowdung on environment:

i.Positive ii. Negative

18. What is farmers suggestions for better cowdung management system for environmental pollution control:

Thanks for your co-operation