WELFARE ASSESSMENT OF BLACK BENGAL GOAT IN SMALL SCALE FARMING SYSTEM

Shahid Newas Nisan

Roll No: 0120/01

Registration No: 809

Session: 2020-2021

A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Physiology

Department of Physiology, Biochemistry and Pharmacology
Faculty of Veterinary Medicine
Chattogram Veterinary and Animal Sciences University
Chattogram-4225, Bangladesh

June 2022

Dedicated

to

my parents

Authorization page

I hereby declare that I am the sole author of the thesis. I also authorize the Chattogram Veterinary and Animal Sciences University (CVASU) to lend this thesis to other institutions or individuals for the purpose of scholarly research. I further authorize the CVASU to reproduce the thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I, the undersigned, and author of this work, declare that the **electronic copy** of this thesis provided to the CVASU Library, is an accurate copy of the print thesis submitted, within the limits of the technology available.

…………………………..

Shahid Newas Nisan
June 2022

WELFARE ASSESSMENT OF BLACK BENGAL GOAT IN SMALL SCALE FARMING SYSTEM

Shahid Newas Nisan

Roll No: 0120/01

Registration No: 809

Session: 2020-2021

This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects and that all revisions required by the thesis examination committee have been made.

<table>
<tr><td>_____
Prof. Dr. Mohammad Rashedul Alam
(Supervisor)</td><td>_____
Dr. Md Ridoan Pasha
(Co-supervisor)</td></tr>
</table>

_____
Prof. Dr. S. K. M. Azizul Islam
(Chairperson of the Examination Committee)

Department of Physiology, Biochemistry and Pharmacology
Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Chattogram, Bangladesh- 4225

June 2022

Acknowledgments

Table of Contents

List of the table

List of the figure

List of abbreviations and symbols used

Abbreviations	Elaborations
AWIN	Animal Welfare Indicators
BCS	Body Condition Score
BBG	Black Bengal Goat
BDT	Bangladeshi Tk
CVASU	Chattogram Veterinary and Animal Sciences University
Dept.	Department
DLS	Department for Livestock Services
FDMN	Forcibly Displaced Myanmar Nationals
NGO	Non-Government Organization
PPR	Peste des Petits Ruminants
SDGs	Sustainable Development Goals
Sq. cm.	Square Centimeter
%	Percentage
$\leq$	Less than or equal to
$\geq$	Greater than or equal to
$>$	Greater than
$<$	Lesser than

Summary

Bangladesh Government has given special emphasis and adopted a national program on Black Bengal goats for poor farmers to reduce poverty by targeting the Sustainable Development Goals (SDGs). Through goat rearing, it can possible to improve the livelihood of the poor people and the country can achieve sustainable development goals. Welfare is an important aspect that affects the health and productivity of goats. Consistent with the rising quality of life and awareness among the Bangladeshi population, interest in goat welfare is just emerging. However, scientific studies on the welfare of Black Bengal goats are scarce in Bangladesh. Therefore, a study was conducted on small-scale Black Bengal goat farms for assessing the welfare of Black Bengal goat goats.

A total of 539 no of goats were studied within 200 goat farms in Chattogram and Cox's Bazar districts. A structured questionnaire was deployed to interview and record the socio-demographic characteristics, knowledge, and opinions of farmers regarding small-scale goat farming. Among 200 farmers, 13% were male and the female farmer was 87%. Farmer's age was within thirty years in 34% of farms, and above thirty in 66% of farms. In terms of perception, 88.5% of the farmers agreed that the demand for goats is high, 77% of farmers said goat farming was easy and 76.5% of farmers said huge support was provided from the family members for goat farming. Most of the farmers (90%) reared their goats in a semi-intensive system. Most of the goat houses were built in the perch method. As, neither sufficient grazing land nor spare land is available for growing fodder, the main feed items of goats were roadside grass, tree leaves, and kitchen wastes, and wheat bran was the main concentrated feed source. Most of the goats died of Peste des petits ruminants (PPR) (20.8%) followed by diarrhea (16.6%) and respiratory problem (11.8%). Quack (64.5%), and pharmacy owners (17%) mostly treated diseased animals. 15% of farmers could access support from veterinary hospitals. In terms of health management, 66.5% of farmers do regular deworming and 60% of the farmers vaccinated their goats against major diseases like PPR. Other farmers did not take any curative or preventive measures. It was found that trained farmers had a significantly higher tendency to vaccinate and regularly deworm the goats than the non-trained ($p \leq 0.05$). The farmers of Cox's Bazar had a significantly higher tendency to have the training and thus better vaccination and regular deworming operation than the farmers of Chattogram ($p \leq 0.05$). During

castration, animal welfare was badly violated. Most of the farmers did not follow proper procedures. Castration was mostly performed by family members (58.6%), followed by quack (22.9%), and neighbors (8%). Only 5.7% of male animals were castrated in veterinary hospitals. In addition, during castration any person except in veterinary hospitals did not give local anesthesia. In individual animal observation (N=539), hair coat was rough in 12%, mucus membrane was pale in about 15%, and udder abnormalities were found in 8.2% of goats. The feces condition of the goats was found to be significantly loose in the goats who were provided pond water (p≤0.05). Grunting sound was auscultated and was significantly higher in goats reared in a house with perch less than three feet (p≤0.05). Hoof overgrowth was seen to be higher in male goats than in female goats (p≤0.05). About 23% of goats were found to be cold-stressed during this study. In terms of goat behavior and interaction, 90.5% of goats showed friendly behavior with other goats, and 95.4% and 69.4% of goats showed a positive approach to the owners and observers, respectively. In all cases, female goats showed a more positive approach than the male (p≤0.05). In terms of malicious behavior, goats were the victim of malicious behavior by a family member, neighbors, and other people in 3%, 8%, and 6% of farms, respectively (N=200). This study showed that there was a lack of knowledge and training in goat farming among the farmers and hence, the goats are facing various health and management issues, which compromised their welfare of goats. Hope that the findings of this study will assist farmers and different organizations to take proper measures to improve the welfare of the Black Bengal goat, especially in the small scale farming system. Further studies can be taken in hand to investigate more and analyze the possible effect on welfare by intervention in management.

Keywords: Black Bengal Goat, Health, Management, Small-scale farms, Welfare.

Chapter I: Introduction

Goat (*Capra hircus*) is one of the smallest domestic ruminants, which are reared for the production of milk, meat, wool, and leather (Morand-Fehr et al., 2004). Goats play a significant role in the livelihoods of smallholder farmers in Bangladesh as they serve as assets in times of need (Akhter et al., 2006). The goat is the best alternative source of income and milk for the rural poor who cannot afford to maintain a cow or a buffalo. Goat is known as 'poor man's cow. Goats can efficiently survive on available shrubs and trees in an unfavorable environment. In Bangladesh, 41% of farm incomes come from goats in some parts of Bangladesh (PKSF, 2014). Goat rearing has distinct economic and managerial advantages over other livestock species because of its less initial investment requirement, low input requirement, higher prolificacy, early sexual maturity, and ease in marketing. Most of the goats (90%) in the country are Black Bengal (Amin et al., 2001), reputed for high prolificacy, high fertility, early sexual maturity, adaptability to hot humid conditions and superior quality meat and skin (Devendra and Burns, 1983; Husain et al., 1996, 1998; Amin et al., 2001). Besides, Bangladesh government has given utmost importance to infrastructure development as well as human resource development and livestock development. It will strengthen peace and end all forms of inequality, including hunger and poverty. Ending all forms of poverty, including extreme poverty and end of hunger, food security and improved nutrition are the prerequisites for sustainable development.

To alleviate the poverty of the poorest people in Bangladesh and integrate them into the mainstream of economic development goat rearing can play a significant role. About 80% of our population is employed in agriculture and livestock farming. About 20% of people are involved in the livestock sector for their livelihood. Ultra-poor in Bangladesh raise goats as a secondary source of income. (Sarker and Islam, 2011). In order to combat poverty by focusing on the Sustainable Development Goals (SDGs), the Bangladeshi government has also given special emphasis on and implemented a national program on Black Bengal goats for underprivileged farmers. In spite of the potential for good economic returns from goat rearing, the income of goat farmers is minimal. The productivity of goats under the prevailing traditional production system is low mainly because of feed scarcity and lack of adoption of improved technologies and management practices. Goats suffer from emaciation and unsatisfactory product

performance due to malnutrition, diseases, and the un-consciousness of the farmer (Shaikat et al., 2013). Higher goat mortality is a result of improper care and generally bad husbandry methods in the current production system. In rural areas, the high mortality rate of kids is regarded as the most important constraint in goat production (Kashem et al., 2011).

Animal welfare is a relatively new concern that is beginning to attract professional attention as a new scientific discipline in Bangladesh. In recent years a domestic research and teaching program has been gradually developed to address animal welfare (Alam, 2008). Not only due to regulatory obligations but also because of its impact on productivity, animal welfare is becoming increasingly important in the animal production business. There is no doubt that animal welfare has been receiving growing recognition in the veterinary field. Good animal welfare is a prerequisite for high-quality and sound farm animal production. Providing environmental and management conditions that favor animal welfare are not only expected by consumers and the general people but are also related to achieving system-appropriate levels of performance and profitability. Animal welfare assessment is thus one of the pillars of productive, efficient, and sustainable production systems (Mattiello et at., 2008). One way to assess animal welfare is through indicators. One way to assess animal welfare is through indicators. Farm animal welfare measures can be divided into behavioral, physiological, health (Broom and Fraser, 2007). Knowledge of animal physiology, animal behavior, and animal needs based on the five freedoms is paramount in assessing as well as enforcing animal welfare. These freedoms, which represent ideal states rather than actual standards for animal welfares are a) freedom from Hunger and thirst. b) freedom from discomfort. c) freedom from pain, injury, or disease. d) freedom to express normal behavior. e) freedom from fear and distress. (FAWC, 1993).

Animal-based indicators are increasingly preferred to resource-based indicators because they are more closely related to the welfare of animals and help to measure the actual state of the animal. Most methods for a welfare assessment include animal-related parameters, such as behavior, body condition score (BCS), body cleanliness, lameness, skin lesions, injuries, and on-farm conditions such as evaluating the housing system and drainage facilities (Webster, 2005). The physical environment, resources available to the animals, and management practices of the farm can affect the welfare

of animals that adjust to these inputs with behavioral and physiological responses. An environment that allows for the free movement of the animal without risk of disease or injury is paramount (FAWC, 1993). Where animals suffer from pain, disease or distress due to the absence of harmony between the animals and the production system, the production system is not sustainable. Studies have shown that it is possible to increase productivity and ensure animal welfare, being each society responsible for defining how animals are raised (Mcinerney, 2004), and the demand for products that assure the welfare of livestock has increased in recent years (Battini et al., 2014).

As animal welfare is very new domain in Bangladesh, very few studies have been performed in different species. However, as per knowledge, very few studies have been performed to investigate the welfare of goats specially the goats at small-scale farming system in Bangladesh. In that connection, this study was initiated aiming to assess the welfare and associated conditions of Black Bengal goats at small-scale farms. The objectives of the study were-

1. To assess the welfare and health condition of Black Bengal goats in small scale farming system
2. To investigate the human-goat interaction and relationship
3. To explore the effect of the management system on goat health and welfare

Chapter II: Review of Literature

2.1. Goat

Domesticated about 10,000 years ago goats were probably the first ruminant livestock species (Mason, 1951; Zeder and Hesse, 2000; Hatziminaoglou et al., 2004). Goat (*Capra hircus*) is one of the smallest domestic ruminants, which are reared for the production of milk, meat, wool, and leather particularly in arid, semitropical, or mountainous countries (Morand-Fehr et al., 2004).

Taxonomical classification of goat:

Kingdom:	Animalia
Phylum:	Chordata
Sub-Phylum:	Vertebrata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Genus:	*Capra*
Species:	*Capra hircus*

2.2. Black Bengal Goat (BBG)

Most of the goats (90%) in the country are Black Bengal (Amin et al., 2001), reputed for high prolificacy, high fertility, early sexual maturity, adaptability to hot humid conditions and superior quality meat and skin (Devendra and Burns, 1983; Husain et al., 1996, 1998; Amin et al., 2001). It has soft, glossy short hair. However, white stripe on black, brown, solid white, black with white patches or brown with white or brown with black found respectively 13%, 5%, 4%, 9% (Chowdhury et al., 2002). The legs are short with a straight back and a beard has in both sexes. The horns of males are bent backward, while those of females are straight or upward and thinner than those of males. The mature body weight of male goat is about 25-30 kg and female goat is 20-25 kg. The Black Bengal goat is a breed of goat found throughout Bangladesh, West Bengal, Bihar, Assam, and Odisha. Phenotypically they are dwarf, so it takes less space than the other livestock and its demand for food is low (Hasan et al., 2014).

2.3. Goat population and demography

Goat farming is concentrated in Asia with 58.2% of the world goat population, followed by Africa with 36.1% and finally in the regions of America and Europe, with respectively 3.4% and 1.5% (Djebli et al., 2020). In Bangladesh, the goat population is about 26.77millions (DLS, 2021-2022). Approximately 65% of the households are connected with goat farming either as a primary or secondary occupation. For small-scale farmers, the goat is a desirable stock animal due to its ease of handling, independence, and ability to live freely. It also has modest food needs, good climatic tolerance, and an efficient way to convert scarce resources into meat, milk, and hides (Balicka- Ramisz, 1999). Currently, it has been also observed that commercial medium and large-scale goat farming increasing to meet the local demand as rural goat keeping are decreasing in trend. At present goat farming has become a profitable business due to high demand of goat meat (chevon) in local market with high price.

2.4. Goat rearing systems around the world

Goat herds are maintained under a variety of conditions, mainly in small scale farming systems (Vacca et al., 2009). Goats are the major livestock raised by poor farmers in a semi-intensive technique without any supplements (Islam et al., 2009). The management strategy combines scavenging and tethering, with either no or minimal inputs for reproduction, nutrition, and medical care. It is worth mentioning that goat production system in tropical countries includes extensive, semi-intensive, tethering, intensive and integration into crop. Semi-intensive rearing represents in between extensive and intensive rearing system, and largely depends on the availability of grazing land (Choudhury et al., 2012).

2.4.1. Extensive rearing system

Goats are raised frequently in large production systems and are common mostly in marginal areas. It is regarded to be highly rustic creatures (Sevi et al., 2009). It is a method of grazing, goat in the open field or entire pasture land and leaving them for the whole season. In this rearing method the cost of feeding is low. More than 80 per cent population of goats are reared under extensive system. In this method whole grasses can't be grazed efficiently. Therefore, we can preferably practice the rotational grazing method. This system includes transhumance, free range, pasture and range grazing management. It is based on low resource use and a low level of productivity. Mostly

farmers let goat graze on common property resources, hills, mountain, forests and wasteland (Shivakumara and Kiran, 2019). This is the cheapest system and practiced over all parts of India where grazing land is available. Nomadic tribes also practice this. Advantages of this system are that it is cheap and provides the production and disposal process simultaneously. The disadvantages are mainly that the animals raised on the system are poor producers besides having poor genetic capabilities, and are exposed to continuous stress.

2.4.2. Semi-intensive rearing system

This system is widely practiced by small and marginal farmers and village poor. Goat herds are mostly kept in small-scale farming systems under semi-intensive farming conditions. When a crop has been harvested, the goats are left to graze or browse on the crop residue. Additionally, sometimes farmers keep their goats in systemic stall-feeding and feed them with tree leaves, natural grasses, and kitchen scraps during unfavorable weather circumstances (Haque et al., 2013). The advantages of this system include reduced wasteful behavior, improved growth rates, simpler management, and potential increases in crop yields due to the increased fertility of the land caused by these animals' droppings and urine. Goat keepers keep herds of goats which they take to other farmers' fields when a crop has been cut. The farmers pay them in cash or kind for the manure and urine they drop in the field while grazing. Tethering is a modified version of this approach in which the goat is restrained by a rope that is 2-3 meters long and has the other end being tied to a tree or post. The goat grazes and browses in the area accessible through the length of the rope. This system is popular with farmers who keep only a few goats. It permits utilization of grass, fodder and bushes in a limited area, keeps a control on the animal, and saves labor.

2.4.3. Intensive rearing system

Goats are confined in specialized houses. This housing system is expensive to construct and may only recommended in commercial settings with high output. This system requires labor and proper knowledge of production. Feed and water are brought to the animal. This system offers the greatest protection for the animals from both predators and environmental conditions. In this system, farmer control goat feeding, housing,

breeding etc. According to Islam et al., (2009), few farmers (7.3%) used intensive system of goat rearing.

2.5. Goat farming practices in Bangladesh

In Bangladesh, goats are generally reared through subsistence, smallholder, and small-scale commercial operations. More importantly, above 98% of Black Bengal goats are being managed in the traditional village system of the country (Husain et al., 1998). About 75.6% farmers kept goat at night in the goat house management system is a combination of both tethering and scavenging with or little inputs for breeding, feeding & health care (Saadullah and Hossain, 2000). In subsistence condition farmers rear 2-5 goats with or without other large ruminants along with other agricultural operation or other non-agricultural professions. In this case, women and children rear animals. In rural area, about 73.20% goat is reared under low input production system (only natural grass and tree leaves) and the rest (26.80%) are supported by the medium inputs (natural grass+ some concentrate). About 6.20%, 8.10% and 12.5% of goats supported by medium inputs are reared in the subsistence, smallholder and small-scale-commercial operations, respectively (Mia, 2011). In recent times, the medium scale (20-25 does) and large intensive/semi-intensive farms (≥ 100 does). Also gaining popularity as a result of the need for and financial success from goat farming, private entrepreneurs are stepping up to engage in this industry. It is also common to see rooftop small-scale farms in some urban and semi-urban areas that are growing in popularity.

2.6. Goat housing system

About 75.6% farmers kept goat at night in the goat house and 78% goat raisers took winter care to manage cold stress. All (100%) goat farmers took bath of their goats in the summer season but only 4.9% farmers took bath of their goats daily in the summer season (Pattamarakha et al., 1997). Housing for goat rearing depends on the rearing system. In rural areas, where landless farmers and women raise the majority of the goats, separate shelter is not usually provided for the goats. Goats are housed in a part of their living house or kitchen or houses used for other large ruminant or storing of goods. In peri urban area, houses are prepared with bamboo and galvanized tin. In this system farmers cultivate some grasses in their own land or rented land. Commercial intensive and semi-intensive farms houses are made with concrete structure where

different type of facilities necessary for goat rearing are present. They have own lands for grassing and cultivation of grasses. This type of housing present in different government owned farms, research institute, universities and in some commercial private farms. Macha is one kind of good management practice for goat rearing that holds floor level up to the earth. According to Islam et al., (2018), very few farmers who raise goats (15.33%) in Sylhet have installed this technology in their goat shed. It resulted, frequent disease occurrence in the farm. Furthermore, due to the lack of proper house designing planning, failed to maintain adequate ventilation to the shed, though it is very important for goat comfort.

2.7. Seasonality trend of goat production

In Bangladesh, goats are raised throughout the year. As a browser, goat feed is more available during April to October. A report on the availability of different tree leaves and shrubs round the year in Bangladesh indicates that some of the fodders and tree leaves are not available for feeding goats during January, February, March and again November and December (Hossain, 2006). These facts undoubtedly affect production of goats particularly during winter season. Supplementation of concentrate feed for goats is important during winter season.

2.8. Socio-economic value of goat rearing

Livestock is an integral sector of agricultural economy of Bangladesh performing multidimensional functions such as provision of food, nutrition, income, savings, draft power, manure, transport, social and cultural functions (Tareque and Choudhury, 2010). Goats are valued for their contribution in the national economy of Bangladesh due to: (i) meat (chevon) for human consumption (ii) skin for earning foreign currency irrespective of type of goat (iii) increase of income and poverty reduction for ultra-poor (iv) employment generation in rural areas and (v) cash income for empowerment of women. It provided social security to farmers as it can be sold as and when there is urgent need for cash. Goats are deeply embedded in almost all-over Bangladeshi culture and are considered as true friends to the rural poor. It is considered as the poor man's cow (Kashem et al., 2011), reared in semi intensive system by rural farmers, especially the poor women or children as an integral part of the farming system. Goats are a significant genetic resource that are raised all over the world for their milk, meat, and

fibers. Goat meat is widely acceptable in our country and has a good market share, but its milk has only a very small market share and has been consumed more as a medicine than as food (Son, 1999). Goat milk and its products are preferred for their health and nutritional benefits, including greater digestibility and lipid metabolism, in addition to their taste, compared to cow milk (Haenlein, 2004).

Livestock is considered to be an efficient tool for poverty reduction throughout the world. The magnitude of contribution of the livestock sector to the GDP is 2.6% in Bangladesh and 80% rural people rear indigenous animals. Small ruminants especially goat is very important in rural economy and nutrition and has the potentially using it as a tool for poverty reduction in Bangladesh (Ershaduzzaman et al., 2007). Bangladesh Government has also given special emphasis and adopted a national program on Black Bengal goats for poor farmers to reduce poverty with targeting the Sustainable Development Goals (SDGs). Considering the possibilities, a participatory approach in rearing goat as a small scale subsistent family enterprise has been promoted by the government and various non-government organizations with the credit and input support since 1980's in this country (Islam et al., 1992). The Black Bengal goat is a good meat-producing animal but it produces very little milk usually 250 ml per day. In Bangladesh, goat produces about 130000 and 1312000 MT meat and milk, respectively per year (FAO, 2004). These poor productions of both milk and meat are due to their poor genetic makeup and improper nutrition and management. The interaction of genetics and nutrition is important and nutrition does not increase the production beyond the genetic potentialities but can help to express the maximum potentiality. The nutritional status and management system of Black Bengal goat is very poor due to shortage of feeds and fodder both in quality and quantity.

2.9. Religious aspects of goat rearing

Animals are considered very important components of the agriculture economy and used as the source of meat and milk supply to mankind. Here in agricultural economy perspective the persuasion of goat rearing is discussed. Goats played a significant religious and socio-economic role to rural communities. They are sacrificed on special occasions such as annual Hindi festivals (example Dasai) to appease local deities and during social occasions example, new year and weddings. In hadith, goats are mentioned as (blessing) barakah. In this research work it has been substantiated that its

breeding, meat and milk are the sources of that particular barakah. Moreover, goat is the source of increase in the farm income and is the best source to widen the national economy and according to the teachings of Islam, it is a rewardable and sacred profession. Goat is the one sort of halal meat among the pet animals, which meat has low quantity of fats and its milk is very much meritorious. Similarly, this research work elaborates that Muhammad (S.A.W) has declared the goat rearing is the better source to increase family income. Thus, goat farming may be adopted not only to increase the family income but also to provide the society some sort of good quality meat and milk. Moreover, the prophets have grazed the goats, which increase the importance of goat rearing as in Hadith. Abu Horara (RA) said the prophet (S.A.W) said that all the prophets sent by Allah have grazed the goats. Sahaba (RA) (the companions of the prophet of Islam) asked you too? He said yes, I used to graze goats for Makah peoples for some wages (Rahman et al., 2012).

2.10. Goat behavior

Animal nutrition, reproduction, and diseases have been the subject of considerable research; however, the development of efficient management techniques that optimize production and high standards of animal welfare requires a better understanding of the mechanisms of goat behaviour (Bouissou, 1980). Behaviour is one of the most important early indicators of the welfare of an individual and its adaptation to its environment and reflects the immediate response to the interaction between the animal and its environment (Metz and Wierenga, 1997). Behavior can be an indicator of good or poor welfare in any animal. Farm animal behavior research is relevant and necessary for animal production enterprises to be carried out effectively and economically (Broom and Fraser, 2007).

2.10.1. Grazing behavior

A goat will often choose to browse on shrubby herbage, while a sheep or cow will graze on pasture plants. Sheep, goats or cattle on sparse pasture often have to use much energy searching for plant material that is worth harvesting. They may have to travel long distances and remember where suitable patches of pasture are to be found.

2.10.2. Grooming behavior

Goats lick and thereby clean every part of their bodies that they can reach. To groom inaccessible parts they often rub parts of their bodies against trees and fences and use their tails to keep off flies and brush their skins. The value of grooming is seen in that it helps to remove mud, faces, urine and parasites and thus greatly reduces the risk of disease.

2.10.3. Attacking behavior

These animals use their heads in threat displays where the head is worked into the ground and the earth is loosened. Butting male goats is a very well known behaviour problem. It would appear that the habit occurs most often in animals confined by themselves and that have previously experienced some degree of socialization through close human contact. In some instances, the behavior is directed at physical structures such as doors or gates (Broom and Fraser, 2007).

2.11. Importance of animal welfare

Good animal welfare is a prerequisite for high-quality and sound farm animal production. Providing environmental and management conditions that favour animal welfare is not only expected by consumers and the general public, but is also related to achieving system-appropriate levels of performance and profitability. Animal welfare assessment is thus one of the pillars of productive, efficient and sustainable production systems (Mattiello et at., 2008). Animal welfare is an essential element of modern animal production. Primarily, animal welfare is grounded on ethical concerns that derive from the fact that animals are sentient beings, i.e., able to suffer and experience emotions (Neindre, 2017). Under the pressure of consumers, and in reaction to the industrialization of agriculture and more recent sanitary crises, transparency of the food production processes has developed, resulting in a better traceability of the products. The consumers' demand for livestock products that are produced with consideration of animals' needs is also increasing (Bartussek, 1999). Studies have shown that, it is possible to increase productivity and ensure animal welfare, being each society responsible for defining how animals are raised (Mcinerney, 2004), and the demand for products that assure welfare of livestock has increased in recent years (Battini et al., 2014). However, to harness this potential, the productivity and profitability of existing

goat production system needs to be improved substantially. Raising animals humanely can use less feed, fuel and water than intensive farming, reducing costs and pollution. For many years, the Five Freedoms (FAWC, 1993) have provided a useful framework to identify the welfare problems of farm animals. These freedoms, which represent ideal states rather than actual standards for animal welfares are:

- Freedom from hunger and thirst.

  By ready access to fresh water and diet to maintain health and vigor.

- Freedom from discomfort.

  By providing an appropriate environment including shelter and a comfortable resting area.

- Freedom from pain, injury or disease.

  By prevention or rapid diagnosis and treatment.

- Freedom to express normal behavior.

  By providing sufficient space, proper facilities and company of the animal's own kind.

- Freedom from fear and distress.

  By ensuring conditions and treatment which avoid mental suffering.

Improving animal welfare may have additional benefits. As many welfare problems have a detrimental effect on production, improving the welfare of farm animals very often has positive effects on performance. In addition, improving animal welfare is one of the strategies that may contribute to reduce the use of antimicrobials in farm (EMA, 2017) and hence may have long-term benefits for human health.

2.12. Animal welfare and productivity

Animals have several physiological, mental and behavioral needs that influence their welfare. Technical and physical solutions to the animal's living conditions play a prominent role in addressing these needs. For example, if an animal is not able to express and fulfil its needs due to barn or pen construction, or feeding regime, impaired welfare will lead to suffering. It is known that there is a connection between stress and welfare, and that stress can be a consequence of compromised welfare (Veissier and Boissy, 2007). Stress is a situation where an animal cannot adapt to stimuli and situations in its surroundings, such as challenges concerning social environment, housing conditions and feeding (Einarsson et al. 1996; Arey and Edwards 1998),

without major hormonal or behavioral adjustments. Long-term stress has an impact on reproduction hormones and their function, especially during ovulation, heat and early pregnancy. The quality of stockman ship contributes to both farm animal welfare and productivity. Welfare, at least on a minimum level, is a precondition for productivity. Deficiencies in welfare can affect not only daily weight gain of fattening pigs and the milk yield of dairy cows but also reproductive. Milk yield is higher on farms where the stockpersons are motivated and happy in their work), and where they perceive it important to treat the animals as individuals and address them by name (Bertenshaw and Rowlinson, 2009). In addition, poor handling of cows has been associated with lower milk yield (Hemsworth et al., 2000; Waiblinger et al., 2002). The fear of humans is also negatively associated with the reproductive performance of a sow. For example; the number of negative physical interactions is strongly related to litter size.

2.13. Body condition scoring (BCS)

In BCS evaluation, feeling the amount of muscling and fat deposition over and around the vertebrae in the loin region of the goats were regarded. While a scale with 1–5 points was applied in the study, half or quarter scores were also used when needed. Scores were recorded as follows (Cimen and Topcu, 2013):

- BCS 1: Spinous processes (SP) are sharp and prominent. Loin eye muscle is shallow with no fat cover.
- BCS 2: Loin eye muscle has little fat cover but is full.
- BCS 3: SP are smooth and rounded, and one can feel individual processes with pressure, loin eye muscle is full with some fat cover.
- BCS 4: SP can be detected only with pressure as a hard line, traverse processes cannot be felt and loin eye muscle is full with a thick fat cover.
- BCS 5: It is impossible to detect SP, and the loin eye muscle is very full with thick fat cover.

2.14. Factors of welfare reduction in goats

Welfare of sheep and goats have developed slowly, due to some of their physiological peculiarities and their prevalent extensive production system. In fact, since sheep and goats are considered very rustic animals, their ability to cope with prohibitive environmental conditions and inadequate management practices, without harming their

welfare and productive performance, has been often overrated. In addition, the diffusion of extensive breeding of these species has led to the belief that sheep and goats did not need any welfare assessment. This was because generally the highest standard of livestock wellbeing, associated with minimal behavioral restriction and man's intervention in the biological cycle of the animal, is attributed to the extensive production system. Finally, sheep and goats are mostly spread throughout internal and marginal areas, where farmers are still anchored to traditional production systems and are not receptive to updated breeding techniques, especially to those without an immediate economic and tangible impact. Climatic extremes and seasonal fluctuations in herbage amount and quality are discussed as important causes of the reduction of well-being in extensive production systems, which can impair production efficiency of grazing animals and dramatically affect the welfare and health status of sheep and goats. Space allowance and structures of sheep and goat houses are described as the main potential sources of discomfort for housed flocks, together with inadequate control of micro-environment, and inappropriate milking procedures and human-animal interactions. Recent studies on the impact of high ambient temperature, different ventilation regimes, high stocking densities, reduced airspace and poor litter management on behavior, immune and endocrine response, and on performance of sheep and goats are discussed. Confined rearing is usually characterized by high stocking density and prolonged feces accumulation in sheep and goat houses. Therefore, adequate space allowance, careful litter management and scrupulous monitoring of the micro-climatic factors (in terms of temperature, relative humidity and air quality) are crucial aspects in sheep and goat housing (Sevi et al., 2009).

2.15. Assessment of goat welfare

Three different views compete in developing an assessment of animal welfare. The first puts the emphasis on the biological functioning, high level of health, production efficiency, and correlated traits. The second view emphasizes affective states of animals such as pain, suffering and other feelings and emotions. The third view holds that animals should be allowed to lead reasonably natural lives by carrying out their normal behavior in a reasonably natural environment, free from undue restraints. Welfare indicators divided by principles and criteria: The welfare indicators for goats are listed according to WQ® principles and criteria (Battini et al., 2015).

Freedoms	Welfare Criteria	Welfare indicators
Good Feeding	Appropriate nutrition	• Body Condition Score • Hair coat condition • Queuing at feeding
	Absence of prolonged thirst	• Queuing at drinking
Good Housing	Comfort around resting	• Bedding
	Thermal comfort	• Thermal stress
	Ease of movement	• Kneeling at the feeding rack
Good Health	Absence of injuries	• Severe lameness
	Absence of disease	• Abscesses Body Condition • Score Fecal soiling • Hair coat condition • Nasal discharge Oblivion • Ocular discharge • Overgrown claws • Udder asymmetry • Absence of pain and pain induce • Improper castration
Appropriate behavior	Expression of social behavior	• Queuing at drinking • Queuing at feeding
	Expression of other behaviors	• Oblivion • Latency to the first contact test

2.16. Goat diseases

The goat rearing inherently incurs different diseases which intern reduces profitability of farming by treatment costs, reducing productivity and by mortality. Black Bengal is vulnerable to rain water and water logging conditions. Different types of diseases both infectious and non-infectious are significant problems in goat rearing in our country. Although, large and medium scale intensive and semi-intensive commercial goat farm use regular vaccination against PPR, they generally not faced the problem of PPR. However, in rural areas, PPR causes heavy economic losses in every year especially in

rainy seasons and decreases the productive performances of goats. The prevalence of PPR disease was higher in Black Bengal goat (54.93%) than in Jamunapari goat (31.78%) (Islam et al., 2012). In the rural areas high mortality rate of kids are regarded as the most important constraint in goat production. Among various factors affecting kid mortality during the pre-weaning period, birth weight was the most important. Mortality rate decreases with the increase of birth weight. High level of kid mortality represents a significant barrier to increase productivity in goat rearing and reduce the efficiency of production in all types of goat production enterprises (Sherman, 1987). Major causes of kid's mortality are in PPR (25%), pneumonia (21.15%), diarrhea (17.31%), and the invasion of predator (23.08%) (Kashem et al., 2011). But in intensive and semi intensive system of commercial goat farming, major causes of kid mortality are infectious (63%) followed by predators (10%), mechanical (4%) and congenital (1%) and among infectious causes the prevalence of different diseases are diarrhoea, pneumonia, bloat & enterotoxaemia, ecthyma and others like, 30%, 27%, 23%, 17% and 2%, respectively (Ershaduzzaman et al., 2007). A great damage caused by infectious diseases and creates nutritional deficiency and disturbances in fertility. It has been reported that about 10% animals die annually because of diseases (Ali et al., 2011). Wounds due to dog bite in different livestock species are one of the most common types of traumatic injuries. Most cases are commonly occurring in domestic animals like cattle, sheep and goats even in dogs and cats. Female and younger animals are the frequent victims of dog bite. Islam et al., (2016) reported that, the proportionate prevalence were found higher in goats (25.7%) irrespective of study placements. Hind leg (28-50%) and hindquarter (13-34%) of all species were found as the most vulnerable body part for dog bite. Contrarily, adult and male dogs are reported to be bitten by other dogs Nutritional deficiency of kids, especially due to pre and postnatal maternal nutritional deficiency, cause relatively low birth weight, slow growth rate and insufficient milk production by does were identified as the major constraints directly associated with higher kid mortality (Husain, 1993). Season and type of births, birth weight and parity have significant effect on kid mortality (Acharya, 1988). Viral diseases like PPR, goat pox, contagious ecthyma and viral pneumonia, and bacterial diseases such as enterotoxaemia, tetanus, brucellosis, mastitis and metritis, mycotic diseases like ringworm infection, and rickettial infections like conjunctivitis are common causes for goat mortality in rural areas. Gastro-intestinal nematodiasis, fascioliasis and tapeworm causes less mortality but cause severe depression in the

growth and reproductive rate of the BBGs. (Husain, 1993). Lack of proper care and overall faulty husbandry practices are responsible for higher goat mortality in the prevailing production system (Husain et al., 1995). The survival rate and average growth potential are two factors for increasing meat production. In the rural areas high mortality rate of kids are regarded as the most important constraint in goat production. Among various factors affecting kid mortality during the pre-weaning period, birth weight was the most important. Mortality rate decreases with the increase of birth weight (Husain, 1993). High level of kid mortality represents a significant barrier to increase productivity in goat rearing and reduce the efficiency of production in all types of goat production enterprises (Sherman, 1987).

2.16.1. Parasitic disease
The productivity of this small ruminant is hampered by several factors amongst, which is ectoparasitism (James-Rugu and Iwuala, 2000).). Both external and internal parasites make goats suffer, cause loss to the farmers (Rahman and Mondal, 1985). Different skin diseases along with myiasis are commonly seen and dangerous for goats (Rashid et al., 1994). Nooruddin et al., (1987) reported higher prevalence of skin disease (26.80%) in Black Bengal goats under rural condition of Bangladesh. Huq and Mollah, (1969) reported that the prevalence of lice on sheep and goats in Mymensingh and Dhaka were found 36.20% in goats. The losses due to parasites can be categorized into (i) those affecting the productivity of an individual animal and (ii) those influencing herd productivity. The first category includes mortality, lower market value (slaughter house condemnations), reduction in body weight gain, reduced wool and milk yield, reduced draught power, reduced dung output (for fuel and fertilizer) and reduced efficiency in food conversion. The second category includes the reduced productive life span of animals, the disturbance of the genetic selection effort and the possibility of immunosuppression and increased susceptibility to diseases (Nari and Hansen, 1999). The occurrence of ectoparasites in goats is frequently reported in Bangladesh but is seldom quantified. Among ectoparasites, ticks have been recognized as the notorious threat due to severe irritation, allergy and toxicosis (Niyonzema and kittz, 1986). On the other hand, lice and flea are also found to be influential on animal health and production. Heavy louse infestations may cause pruritus, alopecia, excoriation and self-wounding. Regarding flea, although blood meal size is small, repeated feedings and high infestation can cause significant blood loss, and heavy infestations may cause fatal

iron-deficiency anemia in very young animals (Wall and Shearer, 1997). In rural areas where co-habitation between animals and humans is common, the potential of human infection by some of the ectoparasite borne pathogens are high (Adu, 1980). Despite these grave consequences, the magnitude and epidemiology of ectoparasite infestation in goats has been have been partially documented in Bangladesh by a number of authors (Samad, 2000; Rahman and Mondal, 1985).

2.17. Veterinary services

The health care and veterinary services are inadequate that also causes a considerable constraints for sustainable goat production in the country. Department for Livestock Services (DLS) is the main actor to provide health care services to the farmers through Upazilla Livestock Office and hospital. Nevertheless, the work force is not sufficient to cover almost 0.7 million animals in about 200 villages of each Upazilla (National livestock development policy, 2007). The DLS has mostly engaged with treatment of sick animals, while preventive care has been grossly neglected. Consequently, epidemics like PPR and other diseases often kill goats and impose huge losses for farmers. The quality and quantity of different vaccines produced and delivered by the DLS at present are not adequate. Commercial vaccines are available but these are costly and its efficacy and sustainable goat farming in Bangladesh quality are not checked by DLS. Lack of ambulatory services also leads to limitation of veterinary services only around the upazilla headquarters. On the other hand, quarantine is not visible neither in the ports nor in the country. These results occurrence of transboundary movement of diseases and spread within the country. Moreover, unorganized animal slaughter and in adequate veterinary inspection in slaughter house and live animal market lead to spread of infection from one area to another area. Thus, it is important to adopt better management and preventive intervention to reduce the adult and kids mortality in Bangladesh to improve goat production as well as living status of goat farmers.

2.18. Castration of goat

Castration is an important management practice for sheep and goat farmers to maintain control of their breeding program and successfully carry out breed improvement. Castration involves cutting blood supply to the testes by either crushing the blood vessels, cutting, vaccinating and/or elevating temperature of the testes. There are three

commonly used methods of castration for goats: these are i) Burdizzo method, ii) banding or elastrator method and iii) surgical method. Generally, method of castration is selected considering the age of animal and size of the testicle (Nsoso et al., 2004). Castration becomes more difficult and painful with age and the chances of complications increase. Castration increasing slaughter weight that influence the distribution of lean meat, fat and bone in the carcass, may provide suitable approaches for improving goat meat qualitatively and quantitatively (Webb et al., 2005).

2.19. Human-goat relationship

Human–animal relationship is an example of inter species relationship. Most relationships that people maintain with animals are with domesticated animals. Domestication is the process by which a population of animals becomes adapted to man and to the captive environment by some combination of genetic changes occurring over generations and by environmentally induced developmental events reoccurring during each generation (Price, 1984). Domesticated animals have many functions in human societies. They are used for food and clothing production, for transportation and draught power, for religion, for sport, amusement, recreation and betting, for warfare, hunting, tracing and protection, for assisting disabled, shepherds and lumberman, for obtaining social status and social support, for nature conservation and for research.

In all functions, Farm animals have undergone the process of domestication, a continuing genetic process aimed at modifying the animal's behavior, anatomy and physiology to suit humanity's specific needs (Siegel, 1993). Farm animals prefer to keep a distance to unfamiliar persons. Inexperienced people do not know how to react to an animal and do not know how an animal reacts to their presence and behavior. Unfamiliar people may have experience with (certain) animals, but the animal they would like to interact with does not know them. This may result in aggressive or unexpected behavior of the animal. Humans and animals are in regular and at times close contact in modern intensive farming systems. The quality of human-animal interactions can have a profound impact on the productivity and welfare of farm animals. Interactions by humans may be neutral, positive or negative in nature. Regular pleasant contact with humans may result in desirable alterations in the physiology, behavior, health and productivity of farm animals.

On the contrary, animals that are subjected to aversive human contact were highly fearful of humans and their growth and reproductive performance could be compromised. Farm animals are particularly sensitive to human stimulation that occurs early in life, while many systems of the animals are still developing. This may have long-lasting impact and could possibly modify their genetic potential. The question as to how human contact can have a positive impact on responses to stressors, and productivity is not well understood (Zulkifli, 2013).

As herding animals, goats need to establish some sort of social relationship and, as in many other herding species; they can develop strong bonds with humans (Anderson et al., 2004). Gentling is a form of positive physical attention that serves to calm the animal and increases the affinity for a healthy animal–human bond, which in turn can have a positive effect on body weight, behavior, quality and amount of milk produced, and the overall health of the animal (Hemsworth. et al., 2000). As herding animals, goats need to establish some sort of social relationship and, as in many other herding species; they can develop strong bonds with humans (Anderson et al., 2004). Gentling is a form of positive physical attention that serves to calm the animal and increases the affinity for a healthy animal–human bond, which in turn can have a positive effect on body weight, behavior, quality and amount of milk produced, and the overall health of the animal (Hemsworth et al., 2000). Research on various livestock species has shown that gentled animals have shorter avoidance distances (Neindre et al., 1996). Boivin and Braastad, (1996) observed that gentled kids were calmer; more easily approached by humans and, when isolated, were less frightened than were non-gentled kids. In Italy, Mattiello et al., (2008) observed shorter avoidance distances in goats that were reared in small old farms than in large modern farms. That difference might have been due to the closer relationships between the farmer and each individual goat on the small farm, which was possible because of the smaller number of animals on these farms. Furthermore, the old farms had a very low level of mechanization and, consequently, every operation had to be performed manually by the farmers, which frequently brought them in close contact with the animals. Habituation to humans by goats caused by frequent manipulation of the goats during daily activities might have played a role in improving the quality of the human–animal relationships. In a study of dairy goats, Jackson and Hackett, (2007) found a significant increase in heart girth (a correlate of body weight) in dairy goats after a short gentling treatment (only 10 min/day for 24 days); however, gentling did not have a significant effect on milk quality (fat and

protein concentrations). Lyons et al. (1988) found that goats exhibited marked individual differences in their attitude towards humans. Behavioral and pituitary–adrenal responses provide a means of distinguishing between bold and timid kid goats; however, a goat's experience can influence the attitude of a goat towards humans. The importance of early contact with humans and gentling treatments on the establishment of the human–animal bond has been studied in many ungulate species, and positive, early contact can improve this relationship and result in tamer animals, which exhibit less fear and, therefore, are easier to handle (Hemsworth and Coleman, 1998). In goats, a taming effect was evident when hand-reared and dam-reared kids were compared and dam-reared goats exhibited greater avoidance distances from humans and were more fearful than were human-reared goats, although these behavioral differences were not accompanied by significant differences in heart rate. Neindre et al., (1996) found that young animals that were not exposed to human handling were more fearful and sometimes aggressive towards its caretaker. Lyons et al. (1988) concluded that genetic factors and early postnatal environments are responsible for individual temperament, including its attitude towards humans, which largely persists throughout the lifetime of the animal. Lyons, (1989) observed that adult dairy goats that had been dam-reared were more reactive to novel stimuli and exhibited higher levels of milk ejection impairment (greater residual milk volumes) than did human-reared goats. Hand-reared kids handled gently for 2 weeks from the age of 1 week (immediately after weaning) were tamer than hand-reared kids gentled in the same manner from the age of 6 weeks. To facilitate handling practices, increase production, and improve animal welfare, we recommend positive daily contact between the stockperson and the goats, starting when the animals are very young.

Chapter III: Materials and Methods

3.1. Study area

The study areas were peri-urban. It was conducted in two sub-districts of Chattogram named Hathazari, Fatikchari, and two sub-districts of Cox's Bazar named Ukhiya, and Teknaf. Hathazari is located at 22.5083°N and 91.8083°E. It has 52,594 households and a total area of 251.28 km2. The main river is Halda. It is surrounded by Fatikchhari upazila on the north, Panchlaish Thana and Chandgaon thana on the south, Raozan upazila on the east, and Sitakunda Upazila on the west. Fatikchari is located at 22.6840°N and 91.7893°E. It is one of the largest Upazilas in Bangladesh. It is a fertile valley between the Sitakunda hills and the hills of the Chittagong hill tracts. Ukhia is located at 21.2833°N and 92.1000°E. It has 19,189 households and a total area of 261.8 km2. There is the world's largest refugee camp located. Teknaf is located at 20.8667°N and 92.3000°E. It has 23,675 households and a total area of 388.68 km2. The tidal range at the Teknaf coastal area is strongly influenced by the Naaf river estuary. The area has a warm tropical climate and sufficient rainfall to enable it to support a wide biological diversity.
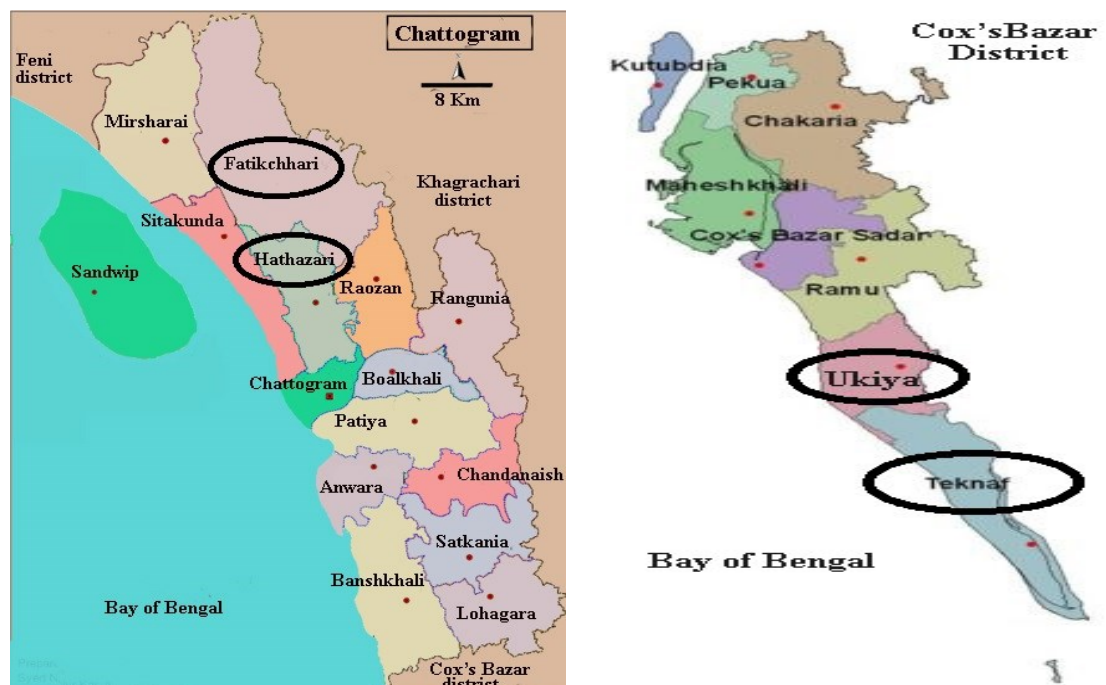
Fig. 3.1: Map of Chattogram and Cox's Bazar districts

3.2. Study duration

The study was conducted for a period of fifteen months; starting from January 2021 to March 2022.

3.3. Selection of farms

A total of two hundred small-scale goat farms were visited randomly where goats were generally reared in the small scale farming system. Out of two hundred households, 50,50,84,16 households were located in Ukhiya, Teknaf, Hathazari and Fatikchari sub-districts, respectively.

Table. 3.1. Geographical distribution of studied households and goats

District Name	Sub-district name	No of Household	No of goats
Chattogram	Hathazari	84	235
	Fatikchari	16	75
Total		**100**	**310**
Cox's Bazar	Ukhiya	50	116
	Teknaf	50	113
Total		**100**	**229**
Grand Total		**200**	**539**

3.4. Development of a questionnaire

For the development of the questionnaire, sufficient number of published reports and literature related to goat farming, and welfare—both from developed and developing countries—were collected and studied before preparing the record sheet. A preliminary questionnaire was prepared and trialed at some goat farms. The questionnaire was then corrected and modified before the starting of the actual data collection. The farms present in the piloting were not included in the main survey. Farmers were interviewed on their own premises, and immediately before the interview, the verbal consent of the respondent was taken. The questionnaire was mainly oriented in two parts, the first part for farming conditions and the second for individual animal measurements.

3.5. Data collection

In this study, there were three methods used to gather farm data. These were- 1) direct observation, 2) interview of the farmers, and 3) records kept by the farmers. The observer performed direct observation of the condition of farm and goats. In addition, an interview method was followed to collect information from the respondents to fulfill the objectives of this study. Data was collected from respondents in a one-to-one interview method. To minimize errors, repeated visits were made to collect data and in the case of any omission or contradiction, the farmers were revisited to obtain the correct information.

3.5.1. General information

The general information of the farmers such as the name, gender, age, and educational qualification of the farmer were recorded. The socio-economic characteristics of the farmers are important factors influencing production planning and decision-making. In the socio-economic section, farmers' experience, training, the purpose of rearing of goats were noted. The present number of goats, previous income from goat sale, number of goats brought last year, the number of animals died and the reasons of mortality were also recorded to understand the in-depth of farmers experience, knowledge and their effect on goat welfare and production. In terms of health care and management, data were collected on preventive measures like deworming and vaccination, availability of treatment and health care support provider. A special focus was given on the castration, as it is an important matter of animal welfare. The method of castration in male animal, medication, and care after castration were recorded.

3.5.2. Perception of the farmers

To reveal the farmers' perceptions on various aspects of goat farming seven statements were included in the questionnaire. The perceptions were graded in five categories: 1) strongly agree, 2) agree, 3) neutral, 4) disagree, 5) strongly disagree. Farmers were asked upon seven statements below:

1. Goat farming is easy
2. Demand of goat is high
3. Goats are reared as insurance
4. Feed cost is high
5. Neighbors give huge support in goat farming

6. Family members give huge support in goat farming
7. Goat farming is profitable

Farmers' perception was directly recorded under those categories in the questionnaire.

3.5.3. Assessment of welfare of goat

The welfare of animal is closely related to the five freedoms of animal welfare. The welfare of goats at these small-scale farms were assessed upon these five freedoms (Mattiello et at., 2008). The five freedoms can be assessed by investigating the housing condition, feeding strategy, health status of goats, and human-animal-relationships (HARs). These welfare parameters were assessed by farm observation and individual animal observation and recorded in the questionnaire.

3.5.3.1. Farm parameters

In terms of farm, the housing of goat, the feeds and feeding of goat were observed and recorded by direct interview. Goats can be subjected to malicious behavior by human. The farmers were also asked whether their goats had been exposed to any such episode.

3.5.3.1.1. Traits related to goat housing

The goat perch (Macha) and the adjacent environment were inspected directly to collect the information regarding the housing. Materials used in housing, height of the roof (in the middle from the floor), height of the wall, floor material, height of floor from the soil, presence open space in the wall and their type, presence of ceiling, stocking density at the shed were observed and recorded in the data sheet. The temperature and humidity within and outside of the shed was recorded using a hygrometer. Observation and interview were performed to record the provision of dedicated space for mother and newborn, and dedicated bedding material for the dam and newborns. The data on cleaning time and frequency of the shed were collected by direct question to the farmers.

3.5.3.1.2. Type of feed offered and feeding patterns

To explore the welfare related to feeds and feeding, various sorts of questions were asked along with the direct observation. The farmers were asked regarding the source of water and concentrate feed supplied to the goat. They were also asked whether they provide different rationing for different sex or age group. In terms of observation, the

condition of the feeder and drinkers, the number of feeders, queuing in feeding and drinking were observed and recorded. Both interview and observation were performed to record whether the farmers feed kitchen waste and rice gruel to the goats and vitamin-mineral supplements were added. Regarding the feeding of the kid whether the colostrum is fed to the kid and available colostrum was found from the dam were recorded after interviewing the farmers.

3.5.3.1.3. Roughage supply and grazing management
The farmers were asked regarding the time of grazing and the age from when the grazing was started. They were also asked regarding the other roughage supply and how did they manage it.

3.5.3.1.4. Malicious behavior and cruelty to goat
To investigate the malicious behavior, the famers were asked whether their goats were susceptible to misbehavior by either any one of the family members or by the neighbor or by any other people. After collection of that information, it was documented in the questionnaire.

3.5.3.2. Individual animal data
From each of the studied farms, every animal was examined one by one to record the information related to welfare of animal. These included general information like age, sex, castrated or not, body condition score, ectoparasite & its type, hair coat condition mucous membrane, eye abnormality, dehydration (%), nasal discharge, coughing intensity, skin injury, alopecia, respiratory sound, mortality, udder abnormality, mastitis, hoof overgrowth, lameness, feces condition, dag Score, heat stress (panting) etc.

3.5.3.2.1. Goat health
Various health parameters were observed and investigated in the goats in the studied farms. The conditions are described below. Most of these health parameters were graded and assessed as followed by Battini et al., (2015).

3.5.3.2.1.1. Body condition score (BCS)

BCS was visually assessed by standing at the rear of the goat. Each of the goat was checked in this manner. For scoring the body condition, special focus was given in the rump region of the goat. The scoring was from one to five.

Table. 3.2. Body condition score of goats

Score	Description
1	• Emaciated and weak animal, the backbone is highly visible and forms a continuous ridge. The flank is hollow. Ribs are clearly visible.
	• The spinous process of the lumbar vertebrae can be grasped easily between the thumb and forefinger; the spinous process is rough, prominent, and distinct giving a saw-tooth appearance. Very little muscle and no fat can be felt between the skin and bone.
	• The hand can easily grasp the transverse process of the lumbar vertebrae which is very prominent.
	• Sternal fat can be easily grasped between thumb and fingers and moved from side to side.
2	• Slightly raw-boned animal, the backbone is still visible with a continuous ridge. Some ribs can be seen and there is a small amount of fat cover. Ribs are still felt.
	• The spinous process of the lumbar vertebrae is evident and can still be grasped between the thumb and forefinger; however, a muscle mass can be felt between the skin and bone.
	• The hand can grasp the transverse process but the outline of the transverse process is difficult to see.
	• Sternal fat is wider and thicker but can still be grasped and lifted by the thumb and forefinger.
3	• The backbone is not prominent. Ribs are barely discernible; an even layer of fat covers them.
	• The spinous process of the lumbar vertebrae cannot be easily grasped because the tissue layer covering the vertebrae is thick.
	• The outline of the transverse process of the lumbar vertebrae is slightly discernible.

	• Sternal fat is wide and thick.
4	• The backbone cannot be seen. Ribs are not seen.
	• It is impossible to grasp the spinous process of the lumbar vertebrae, which is wrapped in a thick layer of muscle and fat. The spinous process forms a continuous line.
	• The outline of the transverse process of the lumbar vertebrae is no longer discernible.
	• Sternal fat is difficult to grasp because of its width and depth.
5	• The backbone is buried in fat. Ribs are not visible.
	• The thickness of the muscle and fat is so great that reference marks on the spinous process are lost.
	• The thickness of the muscle and fat is so great that reference marks on the transverse process are also lost.
	• The sternal fat now extends and covers the sternum, joining fat covering cartilage and ribs. It cannot be grasped.

Villaquiran et al., (2004)

3.5.3.2.1.2. Condition of hair coat

The hair coat was visually assessed. It was assessed considering the whole body, except the head and legs below the joints (anatomical knees and elbows). The hair coat was graded as shiny or rough.

Table. 3.3. Grading of hair condition

Grade	Description
Shiny	The hair coat is shiny, has a sheen, homogenous, and adheres to the body.
Rough	The hair coat is matted or rough or scurfy on the body

Battini et al., (2015)

3.5.3.2.1.3. Eye abnormality and ocular discharge

It was visually assessed by the assessor observing the goat from the front. The appearance of the eyes can vary from just wet hair in the lateral canthus of the eye to copious purulent discharge running down the face. Discharge may be watery or thick, transparent or whitish.

3.5.3.2.1.4. Dehydration (%)

In the present study, dehydration was measured by visual inspection and skin fold test. The loose skin of the neck was grasped and a gentle pull outside of the body. Then the grasp was loosened. After that the skin would go to its normal place. The time between the loosening of the grasp and normalization of the skin was recorded.

Table. 3.4. Dehydration scoring

Percent of dehydration	Description
5%	Skinfold remains in folds for 4-5 seconds
7%	Skinfold remains in folds for 6-7 seconds
10%	Skinfold remains in folds for more than 7 seconds

3.5.3.2.1.5. Respiratory signs

The goats were observed to check the presence of nasal discharge and if present the color of the discharge was observed. Nasal discharge was visually assessed by observing the goat from the front. Discharges to be considered should be white or yellowish (mucous or purulent). Serous discharge (transparent and watery-like) should not be considered for this assessment. Nasal discharge is observed around the nostrils or hanging from the nose. Coughing intensity was also observed. The respiratory sound was auscultated using stethoscope.

3.5.3.2.1.6. Mucous membrane

The mucous membrane was observed visually for checking the mucous membrane the conjunctival mucous membrane in the eye was checked. The mucous membrane was categorized as either pink or pale.

3.5.3.2.1.7. Hoof overgrowth

All the hooves of the goats were checked. The presence or absence of overgrown claws were visually assessed. A claw is considered to be overgrown when it exceeds the normal length and/or width leading to a loss of the common triangular profile.

3.5.3.2.1.8. Lameness

Lameness is a behavior that is expressed due to the presence of pain in the feet. To assess this, all the goats lying down were forced to stand and walk at least a few steps. If a goat does not stand up and it is impossible to determine whether this is caused by

some claw or limb injury or disease (e.g., the claws or limbs do not show any visible sign of injury and are not swollen and with high temperature) it was not recorded as lameness. If a goat expressed regular gait, then the goat was graded as non-lame or normal. If the goats were seen to have irregular gait, goose walking (stretched limbs) and presence of arched rump, then the goat was marked as lame.

3.5.3.2.1.9. Dag Score
The Dag score is the marker of cleanliness and the digestive health of the goats. For Dag scoring, the goats were visually assessed from the rear. The observer checked for the presence of fecal soiling observing the area around the anus under and on both sides of the tail.

3.5.3.2.1.10. Presence of ectoparasites
The presence of ectoparasites was investigated by observing through the hair coat especially near the base of ear, tail and medial side of stifle and elbow joint. If the presence of ectoparasites was found, the type of ectoparasite (tick/flea/lice) were recorded.

3.5.3.2.1.11. Alopecia
The hair coat was observed in the body of goat to check the presence of alopecia and if present, the location, severity of loss of hair were noted. The goat would be recorded as positive if the alopecia had a patch of more than 4 sq. cm. and the number of patches was counted.

3.5.3.2.1.12. Udder abnormality
Udder abnormality was visually assessed by the assessor at the rear of the goat. Each female goat was evaluated by positioning caudally to the animal to have a full view of the udder region. The goats were kept standing. Asymmetric udders were those in which one half of the udder was at least 33% larger than the other half (excluding the teats). Mastitis was examined by physical appearance, palpation, and history.

3.5.3.2.1.13. Injury in the body
Any broken skin, abscess, or ulceration (fresh or in the process of healing, i.e., crust) were observed in the body of goats. Regions that were observed for skin lesions

included the head or neck, and the rump or thigh. Fully re-epithelialized tissue was excluded.

3.5.3.2.1.14. Goat in cold stress (huddling/shivering)
It was measured by focusing on hair coat on the back, postures, and movement of the body. Goats suffering from cold frequently had bristling hair on their backs (horripilation) and, in severe cold stress occasions, they shivered and may assumed a posture with arched back and head lowered. Animals involved in agonistic interactions were not included, as they frequently raise the hair on their backs.

3.5.3.2.1.15. Goat in heat stress (panting)
Heat stress was measured by focusing on the respiration of the goats. Goats suffering from heat stress frequently had an accelerated respiration rate with open-mouth and excessive salivation. Animals with abnormal respiration sounds (e.g. rales, wheezes, stertor, or stridor) and coughing were not included as they may be suffering from a respiratory disease not related to heat stress.

3.5.3.2.1. Goat behavior and human goat interaction
The behavior of goats was visually assessed from outside the pen. An oblivious goat generally tries to isolate itself from the group, standing (sometimes lying) immobile for a long time, frequently facing the wall or other parts of the housing structure, sometimes with ears down. As to behavior, it is apathetic, inattentive, absent, depressed, unaffected by external stimuli, and shows no interactions with its conspecifics during the whole observation period. During this period goat's aggressive, agitated, alert, bored, content, curiousness, fear, liveliness frustration, fearfulness, irritated, relaxed, sociable, suffering, etc. behavior was observed. To assess the goats' interactions with human, every goat was observed one by one. During this period goat's aggressive, curiousness, fearfulness, sociability, attacking, etc. behavior towards the owners and observers were observed.

Table 3.5. Behavioral ethogram of goats

Goat's behavior	Indication	Descriptions
Social interaction	Show	Animal engages in interactions with other that may involve locomotion, climbing, manipulating objects, or other activities that show a relationship between two or more interacting animals
	Withdrawal	Animal comes in contact with another animal while engaging in solitary behavior.
	Aggressive to other	Animals engage in physical conflict with another animal in its environment.
Accepting the owner's approach		Goat's approach is a slow, gentle, calm manner to the owner.
Accepting the observer's approach		Goats approach is a slow, gentle, calm manner for the observer.

3.6. Data analysis

Data that were collected had been stored into MS Excel (Microsoft office Excel-2007, USA). Descriptive analysis was performed by STATA 14.2 (STATA Corporation, Texas, USA) to find out the association between a categorical explanatory variable with outcome and then chi-square ($\chi2$) test was done for evaluation of inter-relationships among variables . An association was considered as significant if $p \leq 0.05$.

Fig. 3.2. Interview of the farmer and filling up of the questionnaire

Fig. 3.3. Measuring of perch height from floor and ground level

Fig. 3.4. Recording of the feeder condition

Fig. 3.5. Kitchen waste then offered to the goat

Fig. 3.6 and 3.7. Housing condition of goat in various perching system

Picture Gallery

| Fig. 3.8. Visual inspection of the mucous membrane | Fig. 3.9. Observing the goat during tethered grazing |

| Fig. 3.10. Feeding behavior of goat was observed | Fig. 3.11. Recording of feeding management and frequency of feeding |

Fig. 3.12 and 3.13. Recording of human-goat interaction

Picture Gallery

Chapter IV: Results

4.1. General demographic information

A total of 200 small-scale goat farms were studied and 539 goats were assessed for the collection of data. The average number of goats per household was 2.7. Table 4.1. Shows that male farmer was 13% and female farmer was 87%. Farmer's age was below or equal to thirty at 34% and above thirty at 66% households, respectively. The mean age of the farmers was 35.5 years. The educational qualification of the farmers had a wide distribution; 18% farmers had no institutional knowledge, whereas 55% had below primary and 17% had above primary level of education. Most of the farmers were rearing goats in semi-intensive systems (90%) and others rear them in an intensive system (10%). Most of the farmers (95%) were rearing goats for more than one year. In terms of training, 67% of farmers got the training on goat rearing from NGOs and the department of livestock services.

Table 4.1. General demographic information of the studied small-scale farms (N=200)

Variable	Category	Frequency (%)
Data collection Season	Summer	35 (17.5)
	Rainy	20 (10)
	Winter	145 (72.5)
Farmer's gender	Male	26 (13)
	Female	174 (87)
Farmer's age	≤ 30 years	68(34)
	> 30 years	132(66)
Educational Qualification	No institutional knowledge	36 (18)
	≤ Primary	110 (55)
	> Primary	54 (27)
Rearing system	Intensive	20 (10)
	Semi-intensive	190 (90)
Year of farming	≤ 1 year	10 (5)
	> 1 year	190 (95)

Other species	Poultry	160 (80)
	Cattle	80 (40)
Training on goat rearing	Yes	134(67)
	No	66(33)

Table: 4.2. Shows that, farmer's purpose of the farming was primary income source, hobby, and sunnah in 47%, 45%, and 6% farms, respectively. Farmers' annual income from goat rearing was below or equal to ten thousand in 56% farms.

Table. 4.2. Purpose and economic outcome of goat farming (N=200)

Variable	Category	Frequency (%)
Purpose of the farming	Primary income source	174 (87)
	Secondary income	4 (2)
	Hobby	10 (5)
	Sunnah	12 (6)
Annual income from goat farming	$\leq$ 10000 BDT	112 (56)
	> 10000 BDT	88 (44)

Figure 4.1. Shows farmers' perceptions of goat rearing. Out of 200 farmers, 140 farmers agreed that goat farming was easy, 177 farmer's opinion was that goat demand was high, 113 farmers were rearing goats as insurance, 131 farmers strongly agreed on that feed cost was high, 104 farmers agreed that they got huge support from their family members, and 164 farmers were agreed on goat farming was profitable.
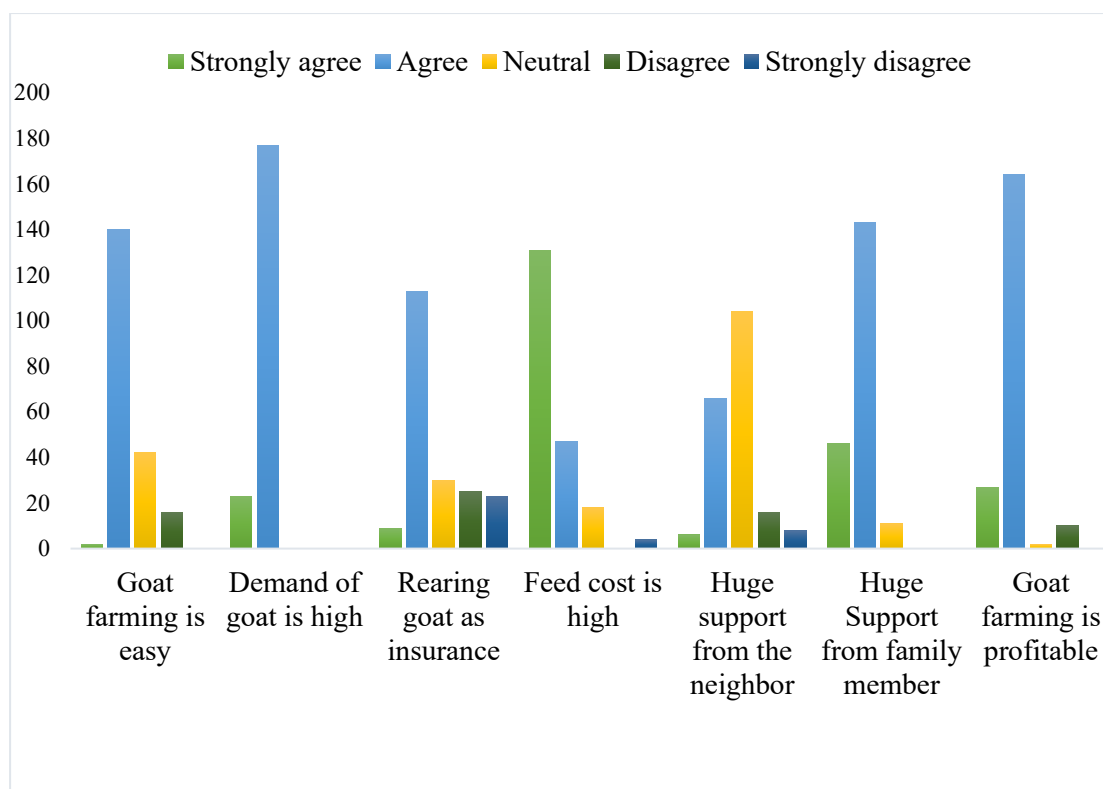
Figure. 4.1: Overview of farmer's perceptions of goat farming, demand, feed cost, support from family and neighbors, and profitability of goat rearing (N=200).

According to FAWC (1993), five freedoms is paramount in assessing farm animal welfare. These freedoms are- a) Freedom from Hunger and thirst, b) Freedom from discomfort, c) Freedom from pain, injury, or disease, d) Freedom to express normal behavior, e) Freedom from fear and distress. Welfare indictors are listed according to welfare criteria. All the welfare criteria were examined under four principles. These were- a) good feeding, b) good housing, c) good health, and d) appropriate behavior. Under these principles, study data are presented below.

4.2. Goat feeding

Table 4.3 shows that, feeder condition was found to be dirty in 58% farms. Feeder cleaning agent was water, soap, detergent, sand in 40%, 34.5%, 20%, and 5% of farms, respectively. Queuing at a feeder was found in 36% of farms. In terms of water supply, 20% of farmers did not provide additional water to their goats. Major drinking water source were pond and tube well in 11% and 69% of farms. Generally, the goats were fed the mixture contains wheat bran, pea husk, rice polish, broken rice, boiled rice, kitchen vegetable waste, and common salt as concentrate feed. Most of the farmers

used to provide solely wheat bran in 58% of farms. Rice gruel fed to goat in 44% of farms. Goats ate grass by grazing on pasture 35%, and in 15% farms, grass was provided by cut and carry method. The rest 50% of the farms provide the grass by both methods. During grazing, 45.5% of the farms let their goat moved freely, whereas 26.5% farms tether their goats, and the rest of the farms use both ways depending on the situation. Most of the farmers sent the kid for grazing at one month of age (67.9%).

Table. 4.3. Feeding practice in the studied small-scale goat farms (N=200)

Variables	Category	Frequency (%)
Condition of feeder	Dirty	116 (58)
	Clean	84 (42)
Feeder cleaning agent	Water	80 (40)
	Soap	69 (34.5)
	Detergent	40 (20)
	Sand	11 (5.5)
Queuing at feeding	Yes	72 (36)
	No	128 (64)
Water source	No drinking	40 (20)
	Pond	22 (11)
	Tube well	138 (69)
Drinking frequency	One time	60 (30)
	Two times	74 (37)
	More than three times	20 (10)
	No drinking water provided	46 (23)
Composition of concentrate feed	Wheat bran 100%	116 (58)
	Mixer concentrated feed	50 (25)
	No concentrate	34 (17)
Provision of kitchen waste in feed	Yes	188 (94)
	No	12 (6)
Feeding of rice gruel	Yes	88 (44)
	No	112 (56)
Roughage supply	By grazing	70 (35)

	Cut and carry	30 (15)
	Both	100 (50)
Types of grazing	Free-roaming	99 (45.5)
	Tied	53 (26.5)
	Both	48 (24)
Age of the kids sent for grazing	Before one month	110 (77.4)
	At or after two months	32 (22.5)
Provide dam colostrum to newborn	Yes	184 (92)
	No	16 (8)
Milk source for kids	Only Dam milk	188 (94)
	Extra milk with dam milk	12 (6)

4.3. Goat housing

Table 4.4 shows the overall information on goat housing. It shows that the most of the farmers (97%) use tin as the roof. The floor was made of wood in 45.5% farms followed by bamboo 20.5%, tree bark 19%, and soil 15%. The walls of the goat house were absent in 3% of houses. In 2% of goat houses, maggot was found. In 15% houses, the goats were housed in the floor same as the ground level. The rest of the houses were built in the perch method where floor height was below three feet in 25% of farms. In terms of cleaning, 10% farmers did not clean floor at least once in a week. Only 5% of farms had separate space for dams & newborns.

Table. 4.4. Housing management and conditions in the goat shed (N=200)

Variables	Category	Frequency (%)
Roof material	Tin	194 (97)
	Other	6 (3)
Floor material	Bamboo	41 (20.5)
	Tree bark	38 (19)
	Wood	91 (45.5)
	Soil	30 (15)
Wall material	Absent	6 (3)
	Bamboo	58 (27)
	Concrete	22 (11)

	Plastic	10 (5)
	Wood	11 (5.5)
	Tree bark	46 (23)
	Tin	47 (23.5)
Use of jute bag on the open space of the wall	Yes	158 (79)
	No	42 (21)
Use of tarpaulin on the open space of the wall	Yes	72 (36)
	No	128 (64)
Maggot in the shed	Present	4 (2)
	Absent	196 (98)
Gap in floor	< 0.5 inch	145 (72.25)
	≥ 0.5 inch	15 (7.5)
	No gap	40 (20)
Cleaning of floor (At least once/week)	Yes	180 (90)
	No	20 (10)
Cleaning of the shed fortnightly	Yes	184 (92)
	No	16 (8)
Floor height from the ground	> 3 feet	150 (75)
	< 3 feet	50(25)
Separate space for mother and newborn	Present	10 (5)
	Absent	190 (95)

4.4. Health management of goat

Goat health is closely related to its welfare. Table 4.5 shows that only 59.5% of the farmers vaccinated their goats against major diseases like PPR whereas 66.5% of farmers dewormed their goats. Diseased animals were mostly treated by quack in 64.5% farms and pharmacists in 17% farms, followed by veterinary hospitals, neighbors and family members in 15%, 6%, and 4.5% of farms, respectively.

Table. 4.5. Management of goat health in the studied farms (N=200)

Variables	Category	Frequency (%)
PPR vaccination	Done	119 (59.5)
	Not done	81 (40.5)

Deworming	Performed	133 (66.5)
	Not performed	67 (33.5)
Goat treated by	Family member	9 (4.5)
	Neighbor	12 (6)
	Pharmacy owner	34 (17)
	Veterinary hospital	30 (15)
	Quack	115 (64.5)

Table 4.6 shows that, goats body condition score (BCS) was 2, 3, 4 respectively 7.79%, 78.8% and 13.4% of the studied goats. Hair coat were rough in 11.7% of goats. Most of the goats died of PPR (20.8%) whereas diarrhea was accountable for 16.6% cases. Eye abnormalities were moderately found in 5.4% of goats. Dehydration was found to be 5% in 28.9% of goats. Overall dehydration was found in 29.7% of goats. Nasal Discharge was clear in 16.5% of goats. In auscultation, respiratory sound was found to be grunting in 4.9% goats. The mucous membrane found to be pale in 14.8% goats. Hoof overgrowth and lameness were present in 16.5% and 1.86% of goats, respectively. Ecto-parasite was present at 2.97% of goats and alopecia was found in 1.86% of goats.

Table. 4.6. Overview of the health status of goats (N=539).

Variables	Category	Frequency (%)
Sex	Male	127 (23.5)
	Female	412 (76.5)
BCS	2	42 (7.79)
(Body Condition Score)	3	425 (78.85)
	4	72 (13.5)
Hair coat	Shiny	474 (87.94)
	Rough	63 (11.69)
	Matted	2 (0.37)
Cause of death of goat	Respiratory problem	17 (11.8)
(N=$\sum$ Dead)	Diarrhea	24 (16.6)
	Acidosis	12 (8.3)
	Post labor	7 (4.8)
	Castration complication	3 (2)

	PPR	30 (20.8)
	Dog bite	12 (8.35)
	Other	12 (8.7)
Dehydration	Absent	381 (70.7)
	5%	156 (28.9)
	7%	2 (0.37)
Coughing intensity	Absent	485 (89.98)
	Sporadic	50 (9.28)
	Mild	1 (0.19)
	Continuous	3 (0.56)
Respiratory sound	Normal	513 (95.18)
	Grunting	26 (4.9)
Mucous membrane	Pink	456 (84.60)
	Pale	80 (14.8)
	Cyanotic	3 (0.48)
Hoof overgrowth	Present	89 (16.51)
	Absent	450 (83.49)
Lameness	Present	10 (1.86)
	Absent	529 (98.14)
Dag Score	No soiling	512 (94.99)
	Very light soiling	27 (5.01)
Ecto-parasite	Present	16 (2.97)
	Absent	523 (97.03)
Alopecia	Presence of patch > 4 sq. cm.	10 (1.86)
	Absent	529 (98.27)
Udder abnormalities	Normal udder	491 (91.78)
	One udder is 33% smaller than the other	40 (7.48)
	Swelling of mammary tissue	4 (0.75)
	Severe skin lesion in > 12.5% of udder area	2 (.01)

Mastitis	Absent	531(99.44)
	Present in one teat	3 (0.56)
Feces condition	Diarrheic	10 (1.86)
	Normal	528 (96.2)
	Loose	33 (6.13)
Injury in leg/neck	No	522 (96.84)
	Healed (scar)	10 (1.8)
	Skin and s/c tissues are seen	7 (1.4)
Cold stress	Present	113 (22.9)
	Absent	416 (77.1)

4.4.1. Castration and its management

Table. 4.7. Shows that most of the goat were castrated by quack/pharmacists (22.9%) and rest were by family members (6%), neighbors (8%), veterinary hospitals (5.7%), and owners himself/herself (4.6%). Most of the farmers (68.9%) did not provide painkillers.

Table 4.7 Overview of the castration of goats at farms (N=87)

Variables	Category	Frequency (%)
Castration performed by	Owner	4 (4.6)
	Family member	51 (58.6)
	Neighbor	7 (8)
	Quack/Pharmacy	20 (22.9)
	Veterinary hospital	5 (5.7)
Suture material used in castration	Silk	12 (13.7.4)
	Cotton	6 (6.8)
	No suture	69 (79.3)
Agent used in castration	Ash	9 (10.3)
	Ash and oil	3 (3.4)
	Soil (terracotta)	27 (31)
	Chloroxylenol	6 (6.9)
	Turmeric	3 (3.4)

	Povidone-iodine	6 (6.9)
	No agent use	33 (37.9)
Pain killer in Castration	Yes	27 (31.03)
	No	60 (68.9)

4.5. Goat behavior

The interaction of goat can be with another goat or with human. In terms of human-goat interaction, the relationship can be positive or negative. Table. 4.8. Shows that, goats were victims of malicious behavior by family, neighbors, and others in 3%, 8%, and 6% of farms, respectively.

Table. 4.8. Malicious behavior to goat from human (N=539)

Variables	Category	Frequency (%)
By family member	Yes	6 (3)
	No	194 (97)
By neighbor	Yes	16 (8)
	No	164 (82)
By other	Yes	12 (6)
	No	188 (94)

Table. 4.9. Shows that, social interaction with other goats was normal in 90.54% goats. Accepting the owner's approach was seen in 95.36% of goats and the observer's approach was accepted by 69.39% of goats.

Table. 4.9. Overview of goat interaction (N=539)

Variables	Category	Frequency (%)
Social interaction	Show	488 (90.54)
	Withdrawal	43(7.98)
	Aggressive	8 (1.48)
Accepting the owner's approach	Yes	514 (95.36)
	No	25 (4.64)
Observer's approach	Yes	374 (69.39)
	No	165(30.61)

4.6. Interrelationship among various factors of goat welfare with management:

Table. 4.10. Shows that frequently organized extension programs and farmers' visitation by extension agents improve farmers' knowledge and experience about goat farming which in turn increases productivity and enhanced the fast adoption of modern goat management practices. Farmers who got training on goat farming did vaccination and deworming more regularly to their goat compare to others.

Table 4.10. Relationship among training on goat farming and PPR vaccination and deworming (N=200)

Parameters	Training on farming			P-value
	Category	Yes	No	
PPR vaccine	Yes	108	11	0.00
	No	23	55	
Deworming	Yes	112	29	0.00
	No	37	19	

Table. 4.11. Shows that, pond water and rice gruel were responsible for loose feces of goats.

Table 4.11: Relationship among goat feces condition of goat with a drinking water source and rice gruel consumption (N =539)

Parameters	Feces condition			P-value
	Category	Normal	Loose	
	No drinking water	94	0	0.00
Water source	Pond	59	23	
	Tube well	353	10	
Rice gruel	Yes	274	24	0.038
	No	232	9	

Table. 4.12. Shows that, if the floor of the house was within 3 feet of the ground level, the respiratory problems would increase in goats.

Table. 4.12: Relationship between respiratory sound of goat with floor height (N=539)

Parameters		Respiratory sound		P-value
	Category	Normal	Grunting	
Floor height from soil	< 3 feet	136	33	0.029
	> 3 feet	366	4	

Table. 4.13. Shows that, hoof overgrowth was found to be higher in male goat compared to female goats.

Table. 4.13. Relationship between hoof overgrowth of goat with sex (N=539)

Parameters		Hoof overgrowth		p-value
	Category	Present	Absent	
Goat's sex	Male	33	94	0.001
	Female	55	357	

Table. 4.14. Shows that, ectoparasitic infestation in goats led to alopecia in goats and poor body condition score of goats.

Table. 4.14. Relationship among alopecia, body condition score of goats with ectoparasitic infestation in goat (N=539).

Parameters		Ectoparasite		P-value
	Category	Present	Absent	
Alopecia	Present	10	0	0.00
	Absent	513	16	
Body condition score	2	5	37	
	3	11	415	0.001
	4	0	71	

Table. 4.15. Shows that, male goat showed negative interaction with other goat, owners and an unknown person compared to female goat.

Table. 4.15. Sexual difference on the social interaction of goat (N=539)

Parameters		Goat's sex		P-value
	Category	Male	Female	
Social interaction	Positive	96	390	0.00
	Negative	31	22	
Interaction with owner	Positive	108	406	0.00
	Negative	19	6	
Interaction with an unknown	Positive	69	304	0.00
	Negative	58	108	

Table: 4.16 shows that comparison between Chattogram and Cox's Bazar district regarding farmers got training on goat rearing, PPR vaccination, Deworming, and Drinking water for goat. It showed that the farmers in Cox's Bazar district had more training and had better management system compared to Chattogram district.

Table 4.16. Managemental difference in goat farms on geographical distribution (N=200)

Parameters		District		P-value
	Category	Chattogram	Cox's Bazar	
Training on goat rearing	Yes	66	90	0.00
	No	34	10	
PPR vaccine	Done	43	76	0.00
	Not done	57	24	
Deworming	Performed	44	97	0.00
	Not performed	56	3	
Goat mortality (In last 12 months)	Present	49	18	0.00
	Absent	51	82	
Provide tube well water	Yes	58	80	0.00
	No	42	20	

Chapter V: Discussion

In this study, 200 semi intensive small-scale goat farms were visited and 539 no of goats' data were collected. The average number of goats per household was2.7. According to PKSF, (2014), the average number of goats per farm is four in Bangladesh. The male farmer was 13% and the female farmer was 87%. This is similar to Tudu et al., (2015), who stated that women members of farmers' family played a major role (89%) in the rearing of goats. However, the male members of the family were also involved (11%) in rearing of the animals. Mostly women and children took out of grazing in the morning and brought back in the afternoon. Therefore, woman empowerment is occurring through goat rearing. Farmer's age was below or equal to thirty 34%. The mean age was 35.5 years (Table 4.1). This age represents the active labor force or working population which means that a large percentage of goat farmers belong to the active working population and are still in their years of economic productivity. The educational qualification of the farmers was no institutional knowledge, below primary and above primary level were respectively 18%, 55%, and 17% of farmers. According to Rokonuzzaman et al., (2009) farmers' education level majority of 56% fell into primary categories while 31% and 12% fell into no institutional knowledge and secondary categories respectively. Table: 4.1. Shows that, 67% of farmers got goat-rearing training from NGOs and the department of livestock services. In Cox's Bazar, NGOs are trying to improve livelihood of the local community through goat rearing. Table: 4.16 shows that, comparatively farmers of Cox's Bazar got more goat farming training than farmers of Chattogram. In 2017, Forcibly Displaced Myanmar Nationals (FDMN) influx occur in Cox's Bazar. From then many NGOs were trying to increase income of host community through goat rearing. Thus, higher number of farmer got training on goat rearing in Cox's Bazar. Farmers of Cox's Bazar took preventive measure such vaccination and deworming than farmers of Chattogram. The purpose of the farming backup/income, hobby, and sunnah is respectively 49%, 45%, and 6%. Farmers were rearing goat mainly as secondary income but few of them rear goats for their religious mindset (Table 4.2). In hadith, goats are mentioned as (blessing) barakah. Approximately 65% of the households were connected with goat farming either as a primary or secondary occupation (Chowdhury et al., 2002).

Figure 4.1: shows farmers perceptions of goat rearing. Most of the farmers found agreed that goat farming was easy. Farmer's opinion was that goat demand was high. They

48

reared goats as insurance and strongly agreed on feed cost was high. Ali et al., (2011) and Hossain et al., (2006), found that high feed cost and shortage of animal feed were the greatest problems of the farmers for rearing cattle. Farmers said that they are neutral support from their neighbors and got huge support from their family members. Farmers agreed on goat farming is profitable.

Here study results are discussed under farm animal five freedoms:

1. Freedom from hunger and thirst:

Study data shows, most of the farmers rear goats in semi-intensive systems 90% others rear in intensive systems 10% (Table 4.1). Therefore, most of the goats had access to a variety of roughage. According to Islam et al., (2009), most of the farmers (80.5%) reared goats in the semi-intensive system but few farmers (7.3%) used a confinement system of rearing while 12.2% of farmers used free-range system. Tudu et al., (2015) observed that about 39.5% of small flock holders used to rear goats by tethering where facilities for grazing are limited. Huq and Mollah (1969), reported goats are generally reared as scavengers by the rural farmer in Bangladesh. Most of the farm's feeder was dirty where feeder-cleaning agent used water in most of the farms. Generally, farmers used to clean feeder prior to provide concentration feed. Goats are among the most efficient domestic animals in the use water just next to camel (Nandi et al., 2011). In this study data drinking water source pond 11%, tube well 69%, and did not provide additional drinking water in 20% of households (Table 4.3). This result is not similar to Hossain et al., (2006). Pond water as the source of drinking water for goats is found to be very common (59.13%) and in 23.23 % of cases farmers used water from well and 17.64% from tube well. In addition, Hossain et al., (2006) reported that sources of drinking water were (46.3%) tube well, (51.2%) pond and (2.4%) supply water. In table 4.11 shows that there is an association among water source, feeding rice gruel and loose feces of goat (p≤0.05). Table: 4.16 shows that, high percentage of farmers of Cox's Bazar provide tube well water to goat compare to Chattogram's farmers. Table:4.1 shows that, 20% of farmers do not provide water to their goats. Dehydration was found in 29.7% of goats. It may be due one fifth of farmers not provide drinking water to the goat on farms. Presence of prolong thirst is a violation of farm animal freedom.

Table: 4.3 shows that, most of the farmers provided solely wheat bran in 58% of farms, mixer concentrated feed in 25% of farms and 17% of farms did not provide any

concentration feed. Farmers mostly depended on local loose feed as concentrate. According to Choudhury et al., (2016) maximum farmers (82%) of central region supplied concentrate feed but 61% of farmers of southern region did not supply concentrate to their goats. Farmers provide natural grasses to their goats in traditional farming conditions. They did not cultivate fodder for their goat rearing. The goats used to collect their feeding requirements by grazing, tethering in fallow land on the roadside, and even on riverbanks where facilities for grazing are limited in the traditional farming system.

2. Freedom from discomfort

Most of the goat houses were built in the perch method (85%) and 15% of goat house's height ground level. Perch method was popular in study area. But Islam et al., (2018) stated in Sylhet, a smaller number of goats rearing farmers (15.33%) built this system in their goat shed and rest of the farmers (84.67%) did not. It resulted; ammonia formation occurred in goat's house, which leads to frequent respiratory disease occurrence in the farms. Moreover, due to the lack of proper house designing planning, they failed to maintain adequate ventilation to the shed, though it was very important for goat comfort. In table 4. 12. Shows that, the house height from the ground related to goat having the respiratory problem is significance (p≤0.05). In this type of house, goats were not exposed to manure as it collected under the bamboo/wooden slat floor. Most of the houses were prepared with bamboo and galvanized tin. Most of the farmers (90%) used to clean the floor weekly and clean the shed fortnightly. According to Islam MA et al., (2018), roughly 79 % of goat farmers in Sylhet used to clean their goat houses on a regular basis, whereas 21% clean them irregularly. 5% farmers provided separate space for dam and kid. Hoof overgrowth was present in 16.5% of goats. Hoof overgrowth found higher percentage in male goat compared to female goat (table: 4.13.). Most of the goat's (87.9%) hair coat was shiny. The good hair coat condition was suggestive of absence of external parasites. Regular cleaning of goat houses corroborates the fact that fecal soiling was not evident in majority of the goats. According to Berg et al., 2009, besides predictable factors such as parasites and skin infections, hair coat condition may reflect the presence of internal or systemic diseases

3. Freedom from pain, injury or disease

In the castration of goats (4.7), welfare was severely violated by farmers. During castration pain, detection in farm animals requires expertise and training, and such knowledge may not have been available to the respondents. Most of the farmers (68.9%) did not provide painkillers. Castration performed by family members without anesthesia and no painkiller was used after castration. Skin injuries on any part of the animal's body are indicators of the welfare status of the animal, particularly concerning its environment. Skin injury was found in very negligible percentage.

In this study goat's body condition score (BCS) two, three, and four respectively 7.79%, 78.8%, and 13.4%. Body condition score (BCS) was found to be a good indicator of goat welfare on commercial farms. Islam et al., (2008) reported that, goat generally infected with ectoparasites like the tick, mite, and endo-parasitic diseases. Study data shows (Table 4.5) that ectoparasite is present at 2.97% this result is significantly lower than Huq and Mollah (1969), they reported that the prevalence of lice on sheep and goats in Mymensingh and Dhaka was found at 36.20%. Table 4.14 shows that poor BCS and ectoparasitic infestation is significant ($p \leq 0.05$). Also, table 4.14 shows there is a relation between ectoparasitic infestation and alopecia ($p \leq 0.05$). Shaikat et al., (2013) reported that, goats of Chattogram were suffering from emaciation and unsatisfactory product performance due to malnutrition, diseases, and the un-consciousness of the farmer.

Table 4.5 shows that only 59.5% of the farmers vaccinated their goats against major diseases like PPR. 66.5% of farmers dewormed their goats. Hossain et al, (2006), reported that 80.50% goat farmers vaccinated and 97.60% farmers de-wormed their goats. The results of this study are lower to Begum et al., (2007) where they reported that 83.3% farmers used vaccination, 80% farmers practiced deworming and 45% farmers removed sick animals from healthy animals. Parasitism is one of the main causes limiting livestock productions in most of the tropical and sub-tropical countries of the world. Farmers who got training on goat rearing do regular deworming and vaccination ($p \leq 0.05$). This study finding revealed that farmers who did regular vaccination earned significantly significant ($p \leq 0.05$) higher than another experienced farmer (Table: 4.10) but deworming and farming experience related to higher income is insignificant ($p > 0.05$). Table 4.16 shows that vaccination and deworming rate in

Cox's Bazar was significantly higher (p≤0.05) than vaccination and deworming rate in Chattogram.

The health care and veterinary services are inadequate and considerable constraints for sustainable goat production in the country. Department for Livestock Services (DLS) is the main actor to provide health care services to the farmers through upazilla veterinary hospital. Diseased animals were mostly treated by quack 74.5% and pharmacists 17%, veterinary hospitals 15%, neighbors 6% themselves 4.5% (Table 4.5). Study data shows that goats died of PPR 20.8%, diarrhea 16.6% and respiratory problems 14.7%, acidosis 8.3%, sudden death 8.3%, castration complications 2.6%, dog bite 10.35%, other 10.35%. Kashem et al., (2011), reported similar observations. He stated that major causes of kid mortality are PPR (25.5%), pneumonia (21.15%), diarrhea (17.31%), and the invasion of predators (23.08%). Study shows that dog bite incident in goat is very common and mortality is considerable. Islam et al., (2016) reported that, the proportionate prevalence was found higher in goats (25.7%) irrespective of study placements. Hind leg (28-50%) and hindquarter (13-34%) of all species were found as the most vulnerable body part for dog bite. Table 4.16 show that goat mortality occurs Chattogram district's farm higher percentage than Cox's Bazar district's farm.

Udder abnormalities and mastitis were found in 8.24% of goat. Mastitis (clinical) was (0.56%) where most of the goat was more than two years. Amin et al., (2011) reported that the overall prevalence of clinical mastitis and subclinical mastitis were 4.54% and 37.19%, respectively. Predisposing factors such as poor management and hygiene, teat injuries and faulty milking machines are known to hasten the entry of infectious agents and the course of the disease (Majic et al., 1993). Feces condition was diarrheic in 1.86%, loose in 6.13%, and rest of normal. Drinking water source is responsible for diarrheic feces. Heat stress in goats were found in a very negligible percentage of goats and cold stress was found in 22.9% of goats. The survival rates of kids in this study are 87% and the kid mortality rate is 13% (Table 4.5). This data is lower than Chowdhury et al. (2002) who found that about 30% of kids' mortality were observed under semi-intensive conditions.

4. Freedom to express normal behavior

Behavior can be an indicator of good or poor welfare in any animal. Farm animal behavior research is relevant and necessary for animal production enterprises to be carried out effectively and economically Broom and Fraser, (2007). There is substantial evidence of a negative relationship between underlying fearfulness and productivity in farm animals. Because positive interaction can reduce the fear of humans, such practice may enhance the productivity of farm animals. Mostly male goats showed negative interaction compared to female goats (Table: 4.15). Negative interaction mainly occurred in case of unknown person. According to Waiblinger et al., (2003), farm animals prefer to keep a distance to unfamiliar persons. Overall goat's male to female ratio is 1:3 which is good for reproductive behavior. There was no weaning of goats. This probably enabled the kids to fully express their suckling behavior. This safeguards kids from nutritional, social, physical, and psychological stressors, which cause alterations in behavioral physiological responses as stated by Lynch et al., (2019).

5. Freedom from fear and distress

A good relationship between humans (e.g., farmers, owners) and farm animals is vital for the productivity and profitable. The quality of stockman ship contributes to both farm animal welfare and productivity. Goats have high cognitive and communicative abilities towards humans. Table 4.8 shows goats were victims of malicious behavior by family, neighbors, and others respectively 3%, 8%, and 6%. It happens mostly by neighbors whenever a goat enters agricultural land or neighbor premises. However, in this study fear of humans was not reported in majority of the goats probably implying farmers are not brutal to their goats and because healthier goats are calm (Muri et al., 2016). Table 4.15 shows buck shows significantly ($p \leq 0.05$) negative interaction with other goats, owner, and unknown person.

Chapter VI: Conclusion

Black Bengal Goat is a vital component of livestock in Bangladesh. It is possible to increase its productivity by ensuring animal welfare. In this study with 200 farms and 539 goat population, it was observed that mostly female member of the households takes care goat. Average number of goats per household is 2.7. From this study, it can be concluded that most of the farmers reared their goats in semi-intensive system. All the farmers provide night shelter to their goats. Perch method housing system is popular to the community. One fifth of farmers do not provide additional drinking water to goats. Neither sufficient grazing land, nor spare land is available for growing fodder. Main feed item of goats was green grass, tree leaves, kitchen wastes and roadside grass and as concentrated feed supply wheat bran to their goats. Different types of diseases infectious and non-infectious both are important hazards and problems in goat rearing of our country. PPR, pneumonia, diarrhea, and bloat are most common diseases in goat. However, most of goat farmers used vaccine against PPR and de-wormed their goats. Mastitis was found in very negligible percentage. The mortality of goat is associated with irregular vaccination and deworming along with improper husbandry practices. During castration animal welfare badly violated. Most of the farmers do not follow proper procedure. Farmers have no knowledge on pain management during castration. From the present study, it is suggested that extensive work is needed for deduction of adult mortality by appropriate management practices and preventive intervention.

Chapter VII: Recommendations

This thesis was aimed to assess the welfare of goats and gave an overview of welfare of goats at small-scale farms. In future, the researchers may take initiative to investigate more with a larger population size and may initiate intervention study to assess the welfare and behavior of goats, and human-goat interaction and conflict.

References

Acharya RM. 1988. Goat breeding and meat production. In Goat meat production in Asia: proceedings of a workshop held in Tando Jam, Pakistan.

Adu, I. F. 1980. Sheep farming in Nigeria. National Animal Production Research Institute Bulletin, 3: 19 – 46.

Akhter S, Husain SS, Chowdhury A, Munzur, MM and Dev GK. 2006. Estimation of variance components and prediction of breeding value for some economically important traits of Black Bengal goat. Bangladesh Journal of Animal Science 35: 20-26.

Alam MR. 2008. A review of the animal welfare situations in Bangladesh. Journal of Commonwealth Veterinary Association. 2: 21-23.

Ali MH, Bhuiyan MKJ and Alam MM. 2011. Retrospective epidemiologic study of diseases in ruminants in Khagrachari hill tract district of Bangladesh. Bangladesh Journal of Veterinary Medicine. 9 (2): 145-153.

Amin MA, Samad MA and Rahman AA. 2011. Bacterial pathogens and risk factors associated with mastitis in Black Bengal goats in Bangladesh. Bangladesh Journal of Veterinary Medicine. 9(2): 155-9.

Amin, M. R., Husain S.S. and Islam A. B. M. M. 2001. Reproductive peculiarities and litter weight in different genetic groups of Black Bengal does. Asian-Aust. J. Anim. Sci. 14(3): 297-301.

Anderson US, Maple TL and Bloomsmith MA. 2004. A close keeper non-human animal distance does not reduce undesirable behavior in contact yard goats and sheep. Journal Applied Animal Welfare Science. 7: 59–69.

Arey DS and Edwards SA 1998. Factors influencing aggression between sows after mixing and the consequences for welfare and production. Livestock Production Science. 56: 61–70.

Ayoade JA. 1999. Problems and prospect of small ruminant production in Benue State. Proceedings of the Animal Conference of Nigerian Society for Animal Production.

Balicka-Ramisz A. 1999. Studies on coccidiosis in goats in Poland. Veterinary Parasitology. 81(4): 347-349.

Balicka-Ramisz AK and Ramisz AZ. 1999. Benzimidazol resistance in nematode parasites in domesticated animals in north-west part Poland. Electronic Journal of Polish Agricultural Universities. Series Animal Husbandry. 2: 2.

Bartussek H. 1999. A review of the animal needs index (ANI) for the assessment of animals' well-being in the housing systems for Austrian proprietary products and legislation. Livestock Production Science. 61(2-3): 179-92.

Battini M, Barbieri S, Mattiello S, Stilwell G and Vieira A. 2014. Invited review: Animal-based indicators for on-farm welfare assessment for dairy goats. Journal of dairy science. 97(11): 6625-6648.

Battini M, Mattiello S, Stilwell G and Vieira A. 2015. AWIN Welfare assessment protocol for goats.

BBS. 2022. Bangladesh Bureau of statistics, Ministry of Planning, Government of the Peoples' Republic of Bangladesh.

Begum MAA, MM Hossain, M Khan, MM Rahman MM and Rahman SME. 2007. Cattle fattening practices of selected farmers in Panchagarh district. Bangladesh Journal of Animal Science. 36(1-2): 62-72.

Berg, W., Jolly, A., Rambeloarivony, H., Andrianome V and Rasamimanana, H. 2009. A scoring system for coat and tail condition in ringtailed lemurs, Lemur catta. American Journal of Primatology, 71(3): 183–190.

Berg, W., Jolly, A., Rambeloarivony, H., Andrianome, V. and Rasamimanana, H. 2009. A scoring system for coat and tail condition in ringtailed lemurs,

Bertenshaw C and Rowlinson P. 2009. Exploring Stock Managers' Perceptions of the Human-Animal Relationship on Dairy Farms and an Association with Milk Production. Anthrozoös. 22: 59–69.

Boivin X and Braastad BO. 1996. Effects of handling during temporary isolation after early weaning on goat kids' later response to humans. Applied Animal Behaviour Science. 48(1-2): 61-71.

Bouissou MF. 1980. Social relationships in domestic cattle under modern management techniques. Italian Journal of Zoology. 47(3-4): 343-53.

Broom DM and Fraser AF. 2007. Domestic animal behaviour and welfare. 4th ed. Wallingford (GB): CABI Publishing. pp.438

Choudhury MP, Khatun A, Hossain MS and Islam F. 2016. Feeding and breeding management system of goat at central and southern regions of Bangladesh. Asian Journal of Medical and Biological Research. 2(1): 9-12.

Choudhury MP, Sarker SC, Islam F, Ali A, Bhuiyan AK, Ibrahim MN and Okeyo AM. 2012. Morphometry and performance of Black Bengal goats at the rural community level in Bangladesh. Bangladesh Journal of Animal Science. 41(2): 83-89.

Chowdhury SA, Bhuiyan MS and Faruk S. 2002. Rearing Black Bengal goat under semi-intensive management. Physiological and reproductive performances. Asian-Australasian Journal of Animal Sciences. 15(4): 477-484.

Cimen M and Topcu H. 2013. Effect of body condition score on biochemical milk parameters having economic importance in dairy goat during the first month of postpartum period. International Journal of Agriculture and Biology. 15(2): 395-397.

Devendra C and Burns M. 1983. Goat Production in the Tropics (pp. 60) (Technical communication no. 19). Commonwealth Agricultural Bureaux. Farnham House, Farmham Royal Slough SL2 3BN, UK.

Devendra C. 1999. Goats: Challenges for increased productivity and improved livelihoods. Outlook on Agriculture. 28(4): 215-226.

Djebli I, Ameur AA and Gaouar SB. 2020. General characteristics of goat milk cheese (Feta) in the region of Tlemcen, Algeria. Genetics & Biodiversity Journal. 4(3): 60-73.

Einarsson S, Madej A and Tsuma V. 1996. The influence of stress on early pregnancy in the pig. Animal Reproduction Science. 42(1-4): 165-172.

EMA Committee for Medicinal Products for Veterinary Use (CVMP) and EFSA Panel on Biological Hazards (BIOHAZ), Murphy D, Ricci A, Auce Z, Beechinor JG, Bergendahl H, Breathnach R, Bureš J, Duarte Da Silva JP, Hederová J, Hekman P. EMA and EFSA. 2017. Joint Scientific Opinion on measures to reduce the need to use antimicrobial agents in animal husbandry in the European Union, and the resulting impacts on food safety (RONAFA). EFSA Journal. 15(1): 66.

Ershaduzzaman M, Rahman M, Roy BK and Chowdhury SA. 2007. Studies on the diseases and mortality pattern of goats under farm conditions and some factors affecting rates in Black Bengal kids. Bangladesh Journal of Veterinary Medicine. 5 (1 and 2): 71-76.

FAO. 2004. Food and Agriculture Organization of the United Nations Production Year Book, Rome, Italy, 58.

Faruque MO and Khandoker MA. 2007. Recent advances of goat genotyping in Bangladesh. Workshop on recent advances of livestock genotyping in Bangladesh. Genotyping of goats and buffaloes for breed and type determination. 10: 28–40.

FAWC (1993). Second Report on Priorities for Research and Development in Farm Animal Welfare. Farm Animal Welfare Council, DEFRA, London, UK

Haenlein G. F. W. 2004. Goat milk in human nutrition. Small Ruminant. Research. 51: 154-163.

Haque MN, Husain SS, Khandoker MA, Mia MM and Apu AS. 2013. Selection of Black Bengal buck based on some reproductive performance of their progeny at semi-intensive rearing system. Journal of Agricultural Science. 5(8): 142.

Hartung J. 1989. Practical aspects of aerosol sampling in animal houses. In: C.M. Wathes and R.M. Randall (eds.) Aerosol Sampling in Animal Houses. European Community Commission Publications, Luxembourg. pp 14-23.

Hasan MJ, Ahmed JU and Alam MM. 2014. Reproductive performances of Black Bengal goat under semi-intensive and extensive conditions at rural areas in Bangladesh. J Advance Veterinary Animal Research. 1(4): 196-200.

Hatziminaoglou Y and Boyazoglu J. 2004. The goat in ancient civilisations: from the Fertile Crescent to the Aegean Sea. Small Ruminant Research. 51(2): 123-9.

Hemsworth P.H., Coleman GJ, Barnett JL and Borg S. 2000. Relationships between human-animal interactions and productivity of commercial dairy cows. Journal of Animal Science. 78(11): 2821-2831.

Hemsworth P.H., Coleman, G.J., 1998. Human–Livestock Interactions: The Stockperson and the Productivity of Intensively Farmed Animals. CAB International, Wallingford, UK.

Hossain, M. M. 2006. Importance of indigenous tree pods/fruits in goat diets in Bangladesh: A training manual for extension workers and development organizers. DFID-LPP-BAU (Project no. ZC0305). P 1-36. Islam M. N. and A. Islam. 2014. Goat rearing management through improved methods (Module 2). In: Livestock and poultry development technology training module. BLRI. pp 42-53

Huq, M. M. and Mollah, M. A. 1969. A study of lice in sheep and goats of Dhaka and Mymensingh districts, Bangladesh Veterinary Journal. 6: 21-24.

Husain SS, Amin MR and Islam AB. 1998. Goat production and its breeding strategy in Bangladesh. In First National Workshop on Animal Breeding. Bangladesh Agricultural University, Mymensingh. pp. 17-36.

Husain SS, Horst P and Islam AB. 1996. Study on the growth performance of Black Bengal goats in different periods. Small Ruminant Research. pp. 165-171.

Husain SS. 1999. Sustainable genetic improvement of economic traits of Black Bengal goats through selective and cross breeding. Bangladesh Agricultural University Research Progress. pp. 72-80.

Husain, S.S. 1993. A study on the Productive Performance and Genetic Potential of Black Bengal Goats, Ph.D, Thesis, Bangladesh Agricultural University, Mymensingh. pp. 103-108.

Husain, S.S., Islam, A.B.M.M. & Horset, P. 1995. Effect of different factors on pre-weaning survivality of Black Bengal kids. Small Ruminant Research. 18: 1-5.

Hussain, S.S. 1999. Sustainable genetic improvement of economic trait of Black Bengal goats through selective and cross breeding. BAU Research Programme. 10: 72-80.

Islam KB and Taimur MJ. 2008. Helminthic and protozoan internal parasitic infections in free ranging small ruminants of Bangladesh. Slov Vet Res. 45(2): 67-72.

Islam KM, Hossain MI, Jalal S, Quader MN, Kumar S, Islam K, Shawn AI and Hoque A. 2016. Investigation into dog bite in cattle, goats and dog at selected veterinary hospitals in Bangladesh and India. Journal of Advanced Veterinary and Animal

Islam MA, Hossain MN, Chokraborti SS, Rahman S, Tasnim A and Al Zabir A. 2018. Socio-economic Profile of Goat Rearing Farmers and Their Management Practices in Sylhet, Bangladesh. Journal of Agriculture and Ecology Research International. 15(4): 1-10.

Islam MR, Amin MR, Kabir AK and Ahmed MU. 2009 Comparative study between semi-intensive and scavenging production system on the performances of Black Bengal goat. Journal of the Bangladesh Agricultural University. 7: 452-476.

Islam MR, Asaduzzaman MU, Begum J. 1992. Women's role in livestock raising in Bangladesh. Asian Livestock (FAO).

Islam MS, Khan MS, Kader HA, Begum MR and Asgar MA. 2012 Prevalence of PPR of goat and their response to antibiotic treatment at Mirzaganj Upazila of

Patuakhali Distrtict. Journal of Environmental Science and Natural Resources. 5(2): 181-214.

Jabbar MA and Green DA. 1982. The status and potential of livestock within the context of agricultural development policy in Bangladesh.

Jackson, K.M. and Hackett, D. 2007. A note: the effects of human handling on heart girth, behaviour and milk quality in dairy goats. Appl. Anim. Behav. Sci. 108: 332–336.

James-Rugu, N. N. and Iwuala, M. O. E. 2000. Ectoparasites of some domestic animals on the Jos Plateau, Nigeria. Science Forum, 5: 146 – 156.

James-Rugu, N. N. and Iwuala, M. O. E. 2000. Ectoparasites of some domestic animals on the Jos Plateau, Nigeria. Science Forum, 5: 146 – 156.

Kashem MA, Hossain MA, Ahmed SU and Halim MA. 2011. Prevalence of diseases, morbidity and mortality of Black Bengal Goats under different management systems in Bangladesh. University Journal of Zoology, Rajshahi University. 30: 01-04.

Livestock Economy at a glance. 2021-2022. Department of Livestock Services. Ministry of Fisheries and Livestock. Government of the Peoples' Republic of Bangladesh.

Lynch Y, Murray J, Moulam L, Meredith S, Goldbart J, Smith M, Batorowicz B, Randall N, Judge S. 2019. Decision-making in communication aid recommendations in the UK: cultural and contextual influencers. Augmentative and Alternative Communication. 35(3): 180-92.

Lyons DM, Price EO and Moberg GP. 1988. Individual differences in temperament of domestic dairy goats: constancy and change. Animal Behaviour. 36(5): 1323-1333.

Lyons DM. 1989. Individual differences in temperament of dairy goats and the inhibition of milk ejection. Applied Animal Behaviour Science. 22(3-4): 269-82.

Majic B, Jovanovic BV, Ljubic Z and Kukovics S. 1993. Typical problems encountered in Croatia in the operation of goats milking machines. Proceedings of the 5th Internacional symposium on machine milking of small ruminants. Budapest, Hungary. pp. 377-379.

Mason IL. 1951. A world dictionary of breeds types and varieties of livestock. A world dictionary of breeds types and varieties of livestock.

Mattiello S, Villa S and Cioccarelli G. 2008. Wellbeing in goat farms in the Valtellina valley. Notebook So. Zoo. Alp. 5: 179-188.

Mcinerney J.P. 2004. Animal welfare, economics and policy. London: DEFRA. pp. 52

Metz J and Wierenga H. 1997. Behavioural criteria for the design of housing systems for cattle. Cattle housing systems, lameness and behaviour. Martinus Nijhoff Publishers. pp. 112

Mia, M.M. (2011). Genetic evaluation of performance of Black Bengal goat. Ph.D Thesis, Department of Animal breeding and genetics, Bangladesh agricultural university, Mymensingh.

Morand-Fehr P and Lebbie SH. 2004 Proposals for improving the research efficiency in goats. Small Ruminant Research. 51(2):145-53.

Muri K, Stubsjøen SM and Valle PS. 2013. Development and testing of an on-farm welfare assessment protocol for dairy goats. Animal Welfare. 22: 385-400.

Nandi D, S Roy, S Bera, SS Kesh and AK Samanta, 2011. The rearing system of Black Bengal Goat and their farmers in West Bengal, India. Veterinary World, 4: 254-257.

Nari A and Hansen JW. 1999. Resistance of ecto-and endoparasites: current and future solutions. 67th General Session. International Committee, OIE, Paris.

National livestock development policy, 2007. Department of Livestock Services. Ministry of Fisheries and Livestock. Government of the Peoples' Republic of Bangladesh.

Neindre P, Boivin X and Boissy A. 1996. Handling of extensively kept animals. Applied Animal Behaviour Science. 49(1): 73-81.

Neindre P. 2017. Animal consciousness. European Food Safety Authority.

Newman SA, McEwan JC and Young MJ. 2009. A decade of sheep improvement limited (SIL). InProc. Assoc. Advancement of Animal Breed and Genetics. Vol. 18, pp. 624-627

Niyonzema, A. and H. H. Kiltz. 1986. Control of ticks and tick-borne diseases in Burundi. Australian Centre for International Agricultural Research Proceeding No. 17: 16-17.

Nooruddin M, Hoque MH, Barik MA and Islam SM. 1987. Prevalence of skin diseases in Black Bengal goats. Bangladesh Veterinarian. 4(1-2): 5-9.

Nsoso SJ, Mannathoko GG, Tadubana TT and Malela L. 2004. The effect of methods of castration on live weight, dressed percentage and linear body measurements of indigenous Tswana goats raised under semi-intensive management in Southeast Botswana. Livestock Research for Rural Development.16: 2.

Pattamarakha K, Tanapannarachwong J, Saithanoo S. 1997. The use of recommended goat husbandry practices by farmers in southern Thailand. Asian-Australasian Journal of Animal Sciences. 10(6): 587-92.

PKSF. 2014. Semi-intensive Black Bengal goat rearing: An innovation for poverty alleviation. Palli Karma-Sahayak Foundation.

Price EO. 1984. Behavioral aspects of animal domestication. The quarterly review of biology. 59(1): 1-32.

Rahman AU, Badshah SN, Khan J, Ayaz M. 2012 Goats Rearing Under Islamic Teachings and its Profitable Impact on Agricultural Economics. Asian Journal of Agriculture and Rural Development. 2: 235-237.

Rahman, M. H. and M. M. H. Mondal. 1985. Tick Fauna of Bangladesh. Journal of Parasitology, 9(2):145-49.

Rashid MA, Nooruddin M, Dey AS. 1994. Distribution of dermatomycosis in cattle, goat and their in-contact human. 11: 79-86

Rokonuzzaman M, Islam MS. 2009. Participation of rural women in goat rearing in a selected area of Bangladesh. Journal of the Bangladesh Agricultural University. 7(2): 361–366.

Rout PK, Joshi MB, Mandal A, Laloe D, Singh L, Thangaraj K. 2008. Microsatellite-based phylogeny of Indian domestic goats. BMC Genet. 9: 11.

Saadullah M and Hossain MM. 2000. Quantification of locally available feed resources and feeding systems of animals in different regions of Bangladesh. Project Report, Bangladesh Agricultural Council.

Samad, M. A. 2000. An overview of livestock research reports published during the twentinth century in Bangladesh. Bangladesh Veterinary Journal, 34: 53-149.

Sarker S, Islam MH. 2011. Prevalence and risk factor assessment of Peste des petits ruminants in goats in Rajshahi, Bangladesh. Vet World. 4(12): 546-549.

Sevi A, Casamassima D, Pulina G, Pazzona A. 2009. Factors of welfare reduction in dairy sheep and goats. Italian Journal of Animal Science. 8 (sup1): 81-101.

Shaikat AH, Hassan MM, Khan SA, Islam MN, Hoque MA, Bari MS and Hossain ME. 2013. Haemato-biochemical profiles of indigenous goats (*Capra hircus*) at Chittagong, Bangladesh. Veterinary World. 6(10): 789.

Sherman, D. M. 1987. Causes of kid morbidity and mortality. An overview. Proc. IV International Conference on Goats. Brazil. pp: 335-354.

Shivakumara C and Kiran S. 2019. Economics of sheep and goat rearing under extensive, semi-intensive and intensive methods of rearing. Economic Affairs. 64(3): 553-61.

Siegel PB. 1993. Behavior-genetic analyses and poultry husbandry. Poultry Science. 72(1): 1-6.

Son, Y.S. 1999. Production and uses of Korean native Black goat. Small Ruminant Research, 34: 303-308.

Tareque AM and Chowdhury SM. 2010. Agricultural Research Priority: Vision-2030 and beyond. Dhaka: Bangladesh Agricultural Research Council.

Thakur C, Shahi A, Singh R and Swamy M. 2018. Incidence and characterization of hoof affections in goats. Ruminent Science. 1: 319.

Thornton, P.K., R.L. Kruska, N. Henninger, P.M. Kristjanson, R.S. Reid, F. Atieno, A.N. Odero & T. Ndegwa (2002). Mapping Poverty and Livestock in the Developing World. Nairobi: International Livestock Research Institute.

Tudu NK, Goswami KK, Ghosh N. 2015. Black Bengal goat farming: an important component of integrated farming system. Journal of Crop and Weed. 11:80-85.

Vacca GM, Ben Ali OA, Carcangiu V, Pazzola M, Dettori ML. 2009. Genetic structure of the casein gene cluster in the Tunisian native goat breed. Small Ruminant Research. 87: 33-38.

Veissier I and Boissy A. 2007. Stress and welfare: Two complementary concepts that are intrinsically related to the animal's point of view. Physiology & Behavior. 92(3): 429-33.

Villaquiran M, Gipson TA, Merkel RC, Goetsch AL and Sahlu T. 2004. Body condition scores in goats. American Institute for Goat Research, Langston University. pp. 1-8

Waiblinger S, Menke C and Coleman G. 2002. The relationship between attitudes, personal characteristics and behaviour of stockpeople and subsequent behaviour and production of dairy cows. Applied Animal Behavior Science. 79(3): 195-219.

Waiblinger S, Menke C, Fölsch DW. 2003. Influences on the avoidance and approach behaviour of dairy cows towards humans on 35 farms. Applied Animal Behaviour Science. 84(1): 23-39.

Wall, R. and D. Shearer. 1997. Veterinary Entomology, 1st edition, Chapman and Hall. London, UK. P.265 and 290.

Webb EC, Casey NH, Simela L. 2005. Goat meat quality. Small ruminant research. 60 (1-2): 153-66.

Webster J. 2005. The assessment and implementation of animal welfare: Theory into practice. Revue Scientifique et Technique. Oie. 24: 723–734.

Zeder MA, Hesse B. 2000. The initial domestication of goats (*Capra hircus*) in the Zagros mountains 10,000 years ago. Science. 287(5461): 2254-2257.

Zulkifli I. 2013. Review of human-animal interactions and their impact on animal productivity and welfare. Journal of animal science and biotechnology. 4(1): 1-7.

Annex-1 Questionnaire

Area: **Start Time:**   **Total Time:**

A) **General Info:**
1. Name of the farmer:
2. Gender:
3. Age:
4. Educational Q:
5. Years of farming:
6. Any other species:
7. Other species taken care by:
8. Helping family member:

Member	Son	Daughter	Daughter-in law	Husband	Grand son	Grand Daughter	Other
Number							

9. Any training on farming:
10. Purpose of rearing goats:
11. Previous income from goat sale in last one year:
12. Number of goat: (In last 12 months)

Types	Goats			
	Current	**Died***	**Sold***	**Purchased ***
Adult male (> 1 year old)				
Adult castrated male (> 1 year old)				
Adult female (> 1 year old)				
Young (≤ 1 year old)				

13. **Reasons of mortality:**

Causes	Sudden death	Respiratory Problem	Diarrhea	Acidosis	Post labor stress	Complication in castration	Other
No							

Castration information:

   a. Castration performed by:
   b. Types of suture material used:
   c. Stitches performed: Y/N
   d. Pain medication: Y/N. If yes which drug……………
   e. Antibacterial product: Y/N. If yes which drug…………
   f. Fly repellant use: Y/N. If yes which drug…………….
   g. Complications in Castration:
   h. Treatments of those complications:
   i. Treatment performed by:
   j. Treatment prescribed by:

Health and Treatment:

   1. PPR Vaccination: Y/N
   2. Regular deworming: Y/N   Last deworming:
   3. In general diseases, from who do you take treatment support?
   4. Proper veterinary support is: Easily reachable/not found

B) Perception:

Traits	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Goat farming is easy					
Demand of goat is high					
Rearing goat as insurance					
Feed cost is high					
Huge support from the neighbor					
Huge Support from family member					
Goat farming is profitable					

Farm information:

  A) Housing style

    1. Roof made of:
    2. Roof height in the middle from floor:………..ft
    3. Wall made of:
    4. Wall height in the side:……………..ft
    5. Floor made of:
    6. Height from the soil: …………… feet
    7. Open space in the wall: ……… feet

8. Open space type: Net/bamboo
9. Ceiling: Present/absent
10. Ceiling made of:
11. Use of jute bag in the wall: Y/N
12. Use of Tarpaulin in the wall: Y/N
13. Temperature and Humidity inside the shed:………………&……………
14. Temperature and Humidity outside of the shed:……………&…………
15. Dedicated space for mother and new born: Y/N
16. Area of that space:………..*…………. Sq. ft.
17. Dedicated bedding material for the Dam and Newborn: Y/N
18. Material type:
19. Cleaning of that material performed: once in …….hour/…..day
20. Presence of spider web on the wall:
21. Presence of maggot in the floor:
22. Gap in the grated floor: …inch
23. Cleaning of the floor: once in a …hour/….day
24. Cleaning of the shed: once in a …hour/…day
25. Stocking density:

B) Feeds and Feeding:
1. Feeding space: Within shed/outside of shed
2. Feeder: Number-   Material-
3. Feeding space:………..feet (measuring the size of the feeder)
4. Queuing in feeding: Number of goats can eat together: Number-
5. Frequency of feeding: …….times/day
6. Cleaning of feeder: once in a…hour/…day
7. Cleaning agent:
8. **Condition of the feeder? Clean/dirty/very dirty**
9. Water source:
10. Drinker: Number: Material:
11. Drinking space:………..feet (measuring the size of the drinker)
12. Queuing in drinking: Number of goats can drink together: Number-
13. Frequency of drinking: …….times/day
14. Cleaning of drinker: once in a…hour/…day
15. Cleaning agent:
16. **Condition of the drinker? Clean/dirty/very dirty**
17. Concentrate source:
18. Ration of concentrate:

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   …………………………
19. Different rationing for the different age or sex group: Y/N
20. Feeding of kitchen waste: Y/N
21. Do you feed rice gruel? Y/N

22. Feeding of kid: Only dam/Extra milk supplied
23. Can dam feed milk to all the kids? Y/N
24. Do you allow the dam to give colostrum to the kids? Y/N
25. Can dam feed colostrum to all the kids? Y/N
26. From which age do you start tethering/grazing of the kid?.........
27. Vitamin/mineral supplement to the herd: Yes/No.

Grazing:
1. What type of grass-eating system? Cut and carry/Grazing/both
2. Time of grazing: Across the year/Seasons……….
3. Type of grazing: Tied/Free-roaming/both
4. Grazing in: Own space/community space
5. Time of cut and carry: Across the year/Seasons…
6. Types of grass in cut and carry: Roadside grass/cultivated grass
7. Roughage source in grazing:

C) HAR
1. Any previous malicious behavior by the family member: Y/N
2. If yes a small description:
3. Any previous malicious behavior by the neighbor: Y/N
4. If yes a small description:
5. Any previous malicious behavior by any other people: Y/N
6. If yes a small description:

D) Individual animal data:

Animal No	1	2	3	4	5
Age					
Breed					
Sex					
Social interaction Show=0, Withdrawal=1, Aggressive to other=2					
Accepting owner's approach Yes=0, No=1					
Accepting observer's approach Yes=0, No=1					
Castrated (Y/N)					
BCS (1-5)					
Hair coat (Matted= 2, Rough=1/Shiny=0)					
Eye (No abnormality= 0, moderate=1, severe=2)					

Dehydration (%) (4-5 s= 5%, 7s=7%, >7s=>10%)					
Nasal discharge (0= Absent, Clear=1, Yellow=2)					
Coughing intensity (0= absent, 1= sporadic, 2= mild, 4= continuous, 5= severe)					
Respiratory sound (Auscultation) Normal=0, Grunting=1					
Mucous membrane (Pink=0/slight pale=1/pale=2/cyanotic=3)					
Hoof overgrowth (present=1, absent=0)					
Hoofs (Limbs) affected (Number=1-4)					
Lameness (Number of limbs= 1-4)					
Lameness Normal=0 Slight to moderate irregular gait, slight arched ramp=1 Extremely irregular gait, not bearing weight on limbs, severe arched rump=2 Reluctant to stand/move=3					
Dag Score (0= No soiling, 1= very light soiling, 2= moderate on the breech area, 3= Excessive dag on the breech and the hind legs, 4= Sever/watery and spread up to hock)					
Presence of ecto-parasites (Yes=1/No=0)					
Type of ecto-parasites					
Alopecia (No=0, Presence of patch> 4 sq.cm=1)					
Number of patches					
Location					
Severity (Superficial/Healed=1, Skin and s/c layers broker, visible red tissue= 2, Deep enough to show muscle/bone/tendon=3)					
Udder abnormality (0-5) Male= NA, Normal udder= 0 One udder is 33% smaller than the other= 1 One udder is >33% smaller than the other=2					

Swelling of mammary tissue=3 Reddening, crusting or scabbing on 12.5% udder area=4 Severe skin lesion >12.5% of udder area= 5					
Mastitis (Absent=0, Present in one teat=1, Present in both=2, Gangrenous=3)					
Fibrosed udder (Absent=0, One udder=1, Both=2)					
Feces condition (Diarrheic/Normal/Loose)					
Injury in leg/neck [No=0, Healed (scar)=1, Skin and s/c tissues are seen=2, Deep (muscle/tendon/bone are seen)=3]					
Cause of the injury Unknown=0, Tethering=1, Malicious=2, Other=3					
Cold stress (Huddling/shivering) Yes=1, No=0					
Heat stress (panting) No=0, Yes=1					

Brief Biography

Dr. Shahid Newas Nisan passed the Secondary School Certificate Examination in 2011 from Bandarban Govt. High school and then Higher Secondary Certificate Examination in 2013 from Govt. Hazi Mohammad Mohsin College, Chattogram. He obtained his Doctor of Veterinary Medicine (DVM) Degree in 2019 from Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh. Now, he is a Candidate for the degree of MS in Physiology under the Department of Physiology, Biochemistry and Pharmacology, Faculty of Veterinary Medicine, CVASU. He has immense interest to work in welfare science.