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STUDIES ON THE FARMER'S INNOVATIVE TECHNOLOGIES FOR LIVESTOCK PRODUCTION IN BANGLADESH

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ABSTRACT: *The present study was undertaken to investigate the innovative technologies used by farmers for livestock production in Bangladesh. A field survey was conducted on farmers' innovative techniques on livestock in the Sirajganj, Jashore, and Bandarban districts. For that survey, a total of 220 farmers who traditionally used innovative technologies in the study area were considered. The information was collected by using an interview schedule. Agriculture was the main occupation of the farmers in the study areas, namely Shahjadpur, Sirajganj (70%), Jashore Sadar (67%), and Naikhongchari, Bandarban (60%). In Jashore, Bandarban, and Sirajganj, the cattle possessions were 5.30±1.10, 3.20±0.97, and 11.96±2.11 no./family, respectively. In the case of small ruminants, the average numbers of goats were 11.20±3.11, 6.32±1.10, and 5.76±1.30, whereas for sheep were 3.84±0.68, 3.21±0.97, and 1.77±0.56 no./family in Jashore, Bandarban, and Sirajganj, respectively. According to the general information provided by the farmers, small-scale livestock production systems exist in the study area. The study tries to highlight the list of farmers's innovative technologies that were used for livestock production. Among the identified innovative technologies, it was found that 63.33%, 23.33%, 10%, and 3.34% were utilised by farmers in the districts of Jashore, Bandarban, Sirajganj & Bandarban, and Sirajganj & Jashore, respectively.*

KEYWORDS: Livestock, innovative technologies, medicinal herbs.

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INTRODUCTION

Livestock plays a significant role in sustainable development by supplying animal protein and creating enormous employment opportunities for unemployed individuals in Bangladesh (Uddin et al., 2020; Ronchi & Scipioni, 2016). The contribution of this sector to the national GDP is 1.85% and its growth rate is 3.23% (DLS, 2023). Furthermore, livestock farming helps to diversify income sources for rural households and improve food security in the country (Feyisa et al., 2023). In order to eliminate poverty and generate opportunities for income and employment in rural Bangladesh, enthusiastic farmers and various governmental and non-governmental organizations are implementing several livestock and poultry production initiatives in rural areas. Farmers and rural youth are engaged in dairy farming, poultry farming and beef fattening programs for economic and social upliftment (Hasan & Habib, 2023). Livestock production has recently increased using synthetic drugs, antibiotics, and growth promoters. Many veterinary antimicrobials (4,802 tons of active ingredients) are used to treat livestock in Bangladesh (EMA, 2020). As a result, the possibility of cross-resistance between human and animal pathogens occurs (Marshall & Levy, 2011; WHO, 2004). However, many countries have prohibited antibiotic growth promoters as feed additives because they can lead to cross-resistance to infections and leave residues in tissues (Sun et al., 2022).

Medicinal plants may be considered one of the most important alternatives to treat livestock. Plant-derived products have demonstrated their natural properties, lower toxicity, and absence of residues. They are considered excellent feed additives in animal nutrition, unlike synthetic antibiotics or inorganic compounds (Tsiplakou et al., 2021). The demand for organic livestock products is increasing as the sales of organic products continue to rise, with an actual global demand 170 times higher than ten years ago (Willer et al., 2013). Most farmers and enterprises apply indigenous techniques for feeding, breeding, care, management, and disease control of their livestock species. Applying such indigenous techniques in livestock production has been a long tradition in Bangladesh, and farmers have used these techniques from generation after generation. Farmers may have learned most of these indigenous techniques from their ancestors or developed them themselves. Most indigenous technologies are based on locally available medicinal herbs and tested by farmers for a long time. Indigenous plants play an essential role in livestock diets, particularly in the remote areas of Bangladesh. About 250,000 species of flowering plants have been designated as medicinal plants (Sharmin et al., 2020). According to Ghasi et al. (2000), Bangladesh possesses over 500 plant species considered medicinal plants due to their therapeutic attributes. Using indigenous herbs and plants, individually or in combination, as feed additives can enhance production performance and improve the quality of livestock products (Sarker et al., 2017).

The per capita income of Bangladeshi people is increasing, and at the same time, people have become more conscious about the quality and safety of food. Today, most people like indigenous or Deshi taste of food. Farmer's innovative technologies play a crucial role in indigenous communities' traditions and historical legacy. Moreover, they are essential for conserving genetic resources to ensure the sustainability of specific breeds or types (Naharki K. & Jaishi M., 2020). Considering all these points, indigenous technologies used by the local farmers decade after decade are organic in nature, and the potentialities of using such kinds of technologies are indescribable in terms of local availability throughout the year. Farmers are accused of using those technologies. It is a matter of regret that there is no information about how many such kinds of technologies exist; moreover, these technologies are not scientifically proven. Although the farmer's innovative livestock production techniques in Bangladesh may

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be impoverished to decline and even vanish over time, this innovative knowledge could be acquired and documented to address the multigenerational information gap and enhance the resilience of future livestock production. Therefore, the study investigated farmers' innovative livestock production and management systems in different locations of Bangladesh while assessing and screening the most suitable techniques for refinement and giving feedback to scientists for future research.

METHODOLOGY

Description of the Study Areas

The study was conducted in Sirajganj, Jashore, and Bandarban districts to find out the innovative techniques used by the farmers for livestock production during the year of July 2019 to June 2020. Sirajganj is a district in the North Bengal region of Bangladesh, located in the Rajshahi Division. The Sirajganj district is located at the longitude of 89.5700° E and latitude of 24.3141° N. The annual average temperature reaches a maximum of 34.6 °C and a minimum of 11.9 °C. The annual rainfall is 1,610 millimeters. The Sirajganj district is known for "bathan" or "milk pocket area." Jashore is a district in southwestern Bangladesh. The Jashore district is located at the longitude of 89.2182° E and latitude of 23.1634° N. The annual average temperature ranges from 15.4 to 34.6 °C (59.7 to 94.3 °F). The annual rainfall is 1,537 millimeters. The Jashore district is characterized by good potential livestock production. Bandarban is a district in South-eastern Bangladesh and a part of the Chittagong Division. The Bandarban district is located at the longitude of 92.3686° E and latitude of 21.8311° N. The annual average temperature ranges from 23.22 to 29.45 °C (73.8 to 85.01 °F). The annual rainfall is 1,686 millimeters. The Bandarban district is a hilly area with different natural topography and environment and a diversified livestock population.

Sampling Technique and Data Collection

A standard questionnaire was developed and pre-tested by interviewing some farmers. Subsequent corrections and refinement were made in the questionnaire based on the observations. A total of 220 farmers from Sirajganj, Jashore, and Bandarban who used their innovative techniques for livestock production were selected for this study. Data were collected through face-to-face interviews using an interview schedule, and a field survey method was followed to collect data. More attention was given to the general form of the interview schedule to ensure a logical and appropriate sequence of the questions in the questionnaire. Furthermore, special care was also taken in the wording of questions so that the farmers were not unfamiliar with the topic at any interviewing stage. Both open and closed questions were used in the questionnaire. The farmers' general information, occupations, livestock possessions, innovative technologies, and farmers' opinions were all included in the questionnaire. The data collection was performed in *Bengali.*

Data Management and Analysis

The field survey data were aggregated, synchronized, and then entered into computers using the MS Excel application (2016). Using an appropriate scoring technique, the qualitative data were converted into quantitative data. To analyze the data, a combination of descriptive

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statistics (means, percentages, standard deviations, etc.) and mathematical techniques was used to obtain meaningful results.

RESULTS AND DISCUSSIONS

General Information about Farmers

General information like education, family members, land availability, and occupations of farmers is shown in this section. Figure 1 represents the education level of farmers in percentages. Results indicate that the primary level literacy rate was higher in Naikhongchari and Bandarban (40%) compared to Shahjadpur, Sirajgonj (30%), and Jashore Sadar (20%). Whereas, secondary (SSC) and higher secondary (HSC) studies were higher in Jashore (50% and 20%) compared to Shahjadpur, Sirajganj, and Naikhongchari, Bandarban. However, the lowest literacy rate was found in graduates/masters in all study areas.

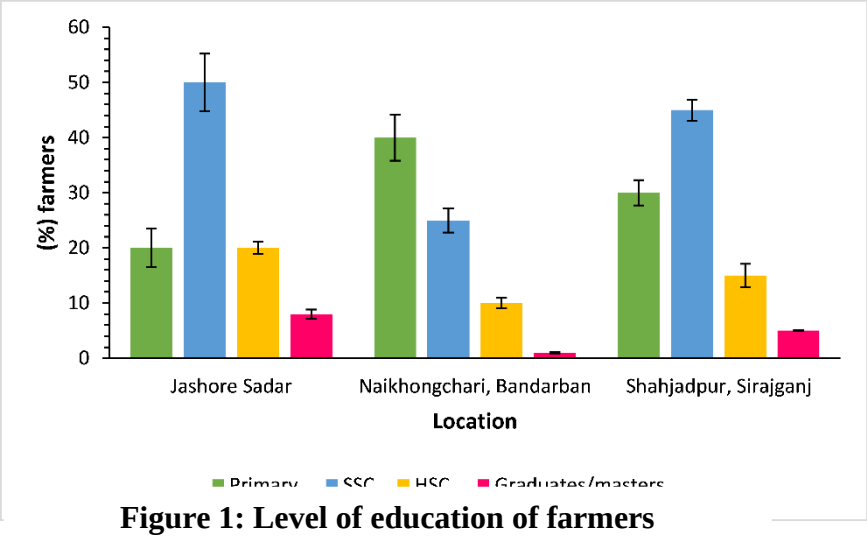

Figure 1: Level of education of farmers

The family members and land availability of farmers are presented in Table 1. The percentage of males <18 was higher in Shahjadpur, Sirajganj, followed by Jashore Sadar and Naikhongchari, Bandarban. The highest percentages of females <18 and males >18 was observed in Jashore Sadar compared to the other two locations. However, the highest percentage of females >18 was found in Naikhongchari, Bandarban.

Table 1: Family members and land availability of farmer

Parameters	**% Farmers**		
	Jashore Sadar	**Naikhongchari, Bandarban**	**Shahjadpur Sirajganj**
Family members (number/family):			
● Male <18	2.7±0.08	2.2±0.07	2.9±0.06
● Female <18	2.3±0.96	1.8±0.13	1.9±0.11

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● Male >18	3.5±0.1	2.6±0.1	2.9±0.1
● Female >18	2.50±0.11	2.81±0.32	2.43±0.15
Land availability (acre/family)			
● Housing area	0.58±0.11	1.38±0.12	1.04±0.12
● Cultivable land	3.30±0.41	2.23±0.32	3.80±0.51
● Uncultivable land	0.41±0.12	1.41±0.13	0.34±0.09
● Fodder land	0.26±0.12	0.10±0.08	0.72±0.09

Land availability and housing area were much higher in Naikhongchari, Bandarban, and Shahjadpur, Sirajganj than in Jashore. However, cultivable land and fodder land were more available in Shahjadpur, Sirajganj, and Jashore Sadar than in Naikhongchari, Bandarban.

Occupation of Farmers

Table 2 shows the occupations of farmers in Jashore Sadar, Naikhongchari, Bandarban, and Shahjadpur, Sirajganj. Agriculture was the main occupation of farmers in the study areas, and the highest percentage was found in Shahjadpur, Sirajganj (70%), followed by Jashore Sadar (67%) and Naikhongchari, Bandarban (60%). After agriculture, business was the second occupation in the survey area.

Table 2: Occupation of farmers

Occupation	**Percent (%)**		
	Jashore Sadar	**Naikhongchari, Bandarban**	**Shahjadpur, Sirajganj**
Agriculture	67±4.11	60±3.21	70±2.12
Business	23±3.23	30±2.54	20±3.23
Services	6±1.11	5±0.98	4±0.68
Others	4±0.78	5±0.67	6±0.87

Livestock Possessions of a Farm Family

Table 3 depicts the livestock possessions of farm families in Jashore Sadar, Naikhongchari, Bandarban, and Shahjadpur, Sirajganj. The possessions of cattle were 5.30±1.10, 3.20±0.97, and 11.96±2.11 no./family in Jashore, Bandarban, and Sirajganj, respectively. In the case of small ruminants, the average numbers of the goats were 11.20±3.11, 6.32±1.10 and 5.76±1.30 whereas for sheep were 3.84±0.68, 3.21±0.97 and 1.77±0.56 no./family in Jashore, Bandarban, and Sirajganj respectively. The current survey results indicate that the respondents were mainly small-scale farmers.

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Table 3: Livestock possessions of farm family (no./family)

Species	Percent (%)		
	Jashore Sadar	**Naikhongchari Bandarban**	**Shahjadpur, Sirajganj**
Cattle	5.30±1.10	3.20±0.97	11.96±2.11
Goat	11.20±3.11	6.32±1.10	5.76±1.30
Sheep	3.84±0.68	3.21±0.97	1.77±0.56

Innovative Technologies and Farmers' Opinion

About 46 indigenous innovative techniques have been identified, and farmers use these for feeding, breeding, care, management, and disease control of their livestock species. Among the identified innovative technologies, it was found that 63.33% were utilised by farmers in Jashore, while 23.33% were employed in Bandarban. Additionally, 10% were adopted in Sirajganj & Bandarban, and 3.34% in Sirajganj & Jashore districts. Table 4 shows the most common and economically important technologies.

Table 4: List of innovative technologies and farmer's opinion

Sl. no	Farmers Innovative Technology	How long use it? (Year)	Source of technology	Advantages of the technology	Location
1.	Use of Fenugreek (*Trigonella foenum-graecum*) to reduce abdominal fat and increase commercial layer egg production	4±0.21	Inherited from ancestors	Reduce abdominal fat and increase egg production	Jashore
2.	Use of Bael (*Aegle marmelos*) leaves to reduce libido and increase bull growth	6±0.33	Inherited from ancestors	Eliminate genetic bad habits and increase the growth rate	Jashore
3.	Feeding cooked Sabudana with salt for cattle/goat fattening	5±0.33	Own invention	The growth rate was doubled	Bandarban
4.	Use of boiled Spiny Amarnath *(Amaranthus spinosus*) and broken rice to increase cows' milk production	4±0.45	Inherited from ancestors	Increase milk production	Jashore
5.	Use of German creeper for increasing digestibility and deworming of cattle	5±0.25	Own invention	Increase production	Jashore

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Sl. no	Farmers Innovative Technology	How long use it? (Year)	Source of technology	Advantages of the technology	Location
6.	Use of Fig (*Ficus hispida*) and Gugo (*Entada phaseoloides*) fruits for the fast removal of cow placenta after parturition	5±0.18	Own invention	Rapid discharge of placenta	Jashore
7.	Use of Azolla to increase growth and milk production performance of cattle/goats	7±0.22	Inherited from ancestors	Increase growth and milk production	Jashore
8.	Feeding Chickpea (*Cicer arietinum* L.) with salt for cattle/goat fattening	4±0.43	Own invention	Increase growth rate	Bandarban
9.	Feeding bottle gourd for cattle/goat fattening.	7±0.26	Own invention	Increase growth rate	Bandarban
10.	Feeding brinjal for cattle/goat fattening	5±0.31	Inherited from ancestors	Increase growth rate	Bandarban
11.	Uses sugarcane leaves for rapid discharge of the placenta of cattle, goat, and sheep	5±0.19	Inherited from ancestors	Rapid discharge of placenta	Bandarban
12.	Use of Sweet potato (*Ipomoea batatas*) leaves for increasing the milk production of goat/sheep	8±0.91	Inherited from ancestors	Increase milk production	Jashore
13.	Feeding giant crape-myrtle (Jarul) extract for the treatment of diarrhea and bloat	4±0.16	Inherited from ancestors	Reduce medicinal cost	Bandarban
14.	Feeding pineapple leaves for deworming of cattle	5±0.32	Inherited from ancestors	Reduce medicinal cost	Bandarban
15.	Use of Papaya (*Carica papaya*) leaf extract to treat coccidiosis	4±0.25	Inherited from ancestors	Reduce medicinal cost	Jashore
16.	Use of Stone Chip (*Kalanchoe pinnata*) leaves extract and salt for the treatment of bloat of goat/cattle	8±0.31	Inherited from ancestors	Reduce medicinal cost	Jashore
17.	Use green Sapodilla (*Manilkara zapota*) fruit to remedy goat diarrhea	6±0.11	Inherited from ancestors	Reduce medicinal cost	Jashore

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Sl. no	Farmers Innovative Technology	How long use it? (Year)	Source of technology	Advantages of the technology	Location
18.	Use of Neem (*Azadirachta indica*) for deworming of cattle/goats	10±0.56	Inherited from ancestors	Reduce medicinal cost	Jashore
19.	Use of Basak (*Adhatoda vasica*) leaves for the treatment of cold cough of cattle/goats	6±0.31	Inherited from ancestors	Reduce medicinal cost	Jashore
20.	Use of Black Dhutras (*Datura mete*) fruits for the remedy of cattle/goat diarrhea	6±0.23	Inherited from ancestors	Reduce medicinal cost	Jashore
21.	Use of Turmeric powder and mustard oil for treatment of chickenpox	8±0.41	Inherited from ancestors	Reduce medicinal cost	Bandarban/Sirajganj
22.	Use of Vermi Shak for the remedy of allergy and deworming of cattle/goats	6±0.11	Inherited from ancestors	Reduce medicinal cost	Jashore
23.	Use of Goldilocks and Sara tree leaves for the treatment of cattle/goat diarrhea	5±0.32	Inherited from ancestors	Reduce medicinal cost	Jashore
24.	Use of mustard oil and salt solution to remedy eye stickiness in poultry	3±0.97	Own invention	Eliminate eye stickiness problems of poultry	Jashore
25.	Use of Tulsi (*Ocimum sanctum*) leaves and root extract for deworming of calf	4±0.99	Inherited from ancestors	Reduce medicinal cost	Jashore/ Sirajganj
26.	Use of Neem ((*Azadirachta indica*) and Nishinda (*Vitex negundo*) leaves for the remedy of fever and deworming of cattle/goats	6±0.57	Inherited from ancestors	Reduce medicinal cost	Jashore
27.	Use of young Guava leaves and salt for the remedy of acidity of cattle/goats	4±0.68	Inherited from ancestors	Reduce medicinal cost	Jashore
28.	Use of Ashwagandha (*Withania somnifera)* leaf extract in urinary incontinence of goat	6±0.96	Inherited from ancestors	Reduce medicinal cost	Jashore
29.	Uses Salt+Water+Turmeric powder to eliminate fowl pox	5±0.79	Inherited from ancestors	Reduce medicinal cost	Bandarban/ Sirajganj

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Sl. no	Farmers Innovative Technology	How long use it? (Year)	Source of technology	Advantages of the technology	Location
30.	Uses Honey+Turmeric powder for FMD treatment	50±0.33	Inherited from ancestors	Reduce medicinal cost	Bandarban/ Sirajganj

The survey study reveals that the farmer applies the innovative technologies for an average of 5.5 years with a range of 3–50 years for their livestock production. About 80% of sources of innovative technologies for livestock production were inherited from an ancestor of farmers, and the remaining 20% were the farmer's innovations. Among the most popular (30) innovative technologies for livestock production, 26.67% were related to increasing production (milk, meat, and egg), 60% were related to treatment, and the remaining 13.33% were related to solving other problems of livestock.

Fat accumulation in the belly region is a significant problem that reduces the reproductive performance of laying chickens (Xing et al., 2009). Farmers claim that feeding fenugreek to the commercial layer reduces abdominal fat and increases production in the present study. Many studies have shown that fenugreek can lower plasma triglycerides and bad cholesterol levels, making it beneficial for weight control due to its hypocholesterolemic and anti-obesity actions in humans (Visuvanathan et al., 2022). Farmers indicate that using Bael (*Aegle marmelos*) leaves reduces libido and increases bull growth. Agrawal et al. (2012) reported that Bael methanolic extract lowers reproductive organ weight and testosterone. Sperm examination demonstrated reduced density, motility, viability, and acrosomal integrity without affecting rats' libido or vital organ weight. Farmers use cooked Sabudana with salt in this study to fatten cattle/goats. Sabudana is an excellent food choice for promoting healthy weight gain in infants and young individuals. Sabudana is usually prepared from cassava. Kusmartono et al. (2022) concluded that including cassava peel silage up to 60% mixed with protein meals and urea and 20% maize stover increases LWG and profitability of the production system. According to farmers, boiled Spiny Amaranth (*Amaranthus spinosus*) and broken rice increase cow milk production. Using high-protein fermented amaranth feed increased milk production and also enhanced milk quality (Pavlenkova et al., 2020). In Jashore, farmers use Azolla to increase the growth and milk production performance of cattle/goats. Azolla contains 17–23%, and its higher digestibility increases milk production and feed conversion efficiency in cattle (Katole et al., 2017).

The feeding of Chickpeas (*Cicer arietinum L.*) with salt for cattle/goat fattening was claimed by farmers in Jashore. According to Bampidis and Christodoulou (2011), chickpeas can be utilized as a high-energy and protein-rich feed in animal diets, promoting the production of milk, meat, and eggs. Sweet potato (*Ipomoea batatas*) leaves for increasing the milk production of goats/sheep were also argued by the farmers in Jashore. Abonyi et al. (2012) examined the use of a diet containing 50% sweet potato leaves and 50% pelletized concentrate feed for optimum rabbit growth performance and subsequent reduction in the overall cost of rabbit production in the humid tropics. In the Bandarban region, farmers use pineapple leaves for the deworming of cattle, whereas in Jashore, Neem leaves are used for the same purpose. The pineapple, scientifically known as *Ananas comosus*, is a tropical plant extensively cultivated

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that has demonstrated anthelmintic properties (Hossain et al., 2015). Amin et al. (2009) found that Neem (*Azadirachta indica*), an evergreen plant native to India, contains medicinal compounds that have strong antiseptic, antiviral, antipyretic, anti-inflammatory, antiulcer, anti-fungal, and anthelmintic activities. To treat poultry coccidiosis, farmers use Papaya (*Carica papaya*) leaf extract in the study area of Jashore. The efficacy of the ethanolic leaf extract of *C. papaya* is comparable to that of traditional anti-coccidial medications, provided it is administered prior to reaching the threshold level of parasite infection (Nghonjuyi et al., 2015).

The use of green Sapodilla (*Manilkara zapota*) fruit to remedy goat diarrhea was also proven by Kusuma et al. (2020), who found that *Manilkara zapota (L.)* is extensively utilized in traditional medicine to address a range of conditions, including diarrhea, respiratory illnesses, piles, ulcers, and wound healing in human. Basak (*Adhatoda vasica*) leaves have a long history of effective treatment of asthma, chronic bronchitis, and other respiratory ailments in humans (Gangwar et al., 2014). As some farmers declared, Tulsi (*Ocimum sanctum*) leaves and root extract were used for calves' deworming. Tulshi (*Coleus amboinicus*) leaf, stem, and root alcohol extracts exhibit anthelmintic activity against the Indian earthworm *Pheritima Posthuma*, according to Taj et al. (2023). Verma et al. (2018) showed that turmeric is a natural antiseptic, disinfectant, analgesic, and is anti-inflammatory. Additionally, it was frequently employed to improve intestinal flora, aid digestion, and alleviate skin irritations.

CONCLUSION

The farmers' general information indicates that small-scale livestock production systems exist in the study area. The study highlights the list of farmers' innovative technologies used for livestock production. Among the identified innovative technologies, 63.33%, 23.33%, 10%, and 3.34% were utilized by the farmers in the districts of Jashore, Bandarban, Sirajganj & Bandarban, and Sirajganj & Jashore, respectively. Finally, this study provided some basic information and valuable insights regarding farmers' innovative livestock production technologies that could be utilized in future research.

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