Original Research Article

The impact of training;technology adoption and improvement of livelihood of trained livestock farmers in different zones of Bangladesh

ABSTRACT

The present study was conductedto examine the impact of training provided to livestock farmers facilitated bythe Bangladesh Livestock Research Institue (BLRI)for transferring technology, adoption, and its impact on the livelihoods of trained farmers from July 2020 to June 2021.A purposive sampling technique was used to select 80trainedlivestock farmers from Dhamrai, Jessore Sadar, and NaikhongchhariUpazilas of Dhaka, Jessore, and Bandarban districts respectively.Data waswere collected through a pre-tested questionnaire and analyzed descriptively.The majority of respondents were foundmale (66.25%) and the average age, year of schooling, and family members were 37.10±0.86, 9.05±0.24 years, and 5.10±0.19 respectively.Agriculture (72.50%) was the main occupation of livestock farmers.The average number of cattle and poultry was the highest in Dhamrai (5.83±0.20) and JessoreSadar(727.20±54.79) Upazilas respectively.The livestock farmers were found moderately adapted to scientific management and technologies. However, in most of the cases, there was a significant difference ($p<0.05$)found between knowledge and skill level.It was also observed that after training all parameters of livelihood assets were improved.The annual income increasedwaschanged from BDT 181937.50±19169.98to BDT 247637.50±20079.57. after training and the change was found statistically significant ($p<0.05$).Thus, the training was found

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to be moderately effectivein disseminatingto disseminate knowledge and skill in technology and management of livestockand improvingethe livelihoods of the livestock farmers.

Keywords: Training, Adoption, Knowledge, Skill, Livelihood assets, Annual Income

INTRODUCTION

Bangladesh is a South Asian developing country and its economy primarily depends on agriculture. The sectoral share of agriculture to total GDP at constant prices is 12.07% and the sectoral growth rate is 3.17% in the FY 2020-21 (BBS, 2021). However, within agriculture, the livestock sub sector is an essential component of the economy. The sectoral share of animal farming to total GDP at constant prices is 1.98% and the sectoral growth rate is 2.94% in the same FY(BBS, 2021). The production of animal proteins like milk, meat, and eggs increased to 119.85 lakh MT, 84.40 lakh MT and 2057.64 crores respectively. As a result, per capita availability of milk, meat and eggs increased to 193.38 ml/day, 136.18 gm/day, and 121.18 nos/year respectively in the FY 2020-21 (BER, 2021)against the demand of 250ml/day, 120 gm/day and 104 nos/year respectively. In Bangladesh, the The farm animals in Bangladesh mostly include cattle, buffalo, goat, and sheep whilst and the most important species under of poultry is chicken and duck. Most of the farm animals are still reared under the traditional production system except some commercial dairy and beef fattening farms that have developed recently. The development of the commercial poultry production system has been based on imported germplasm, feed, and medicines Hamid *et al. (*2017). Cattle is one of the most desired livestock species in the subsistence agriculture of Bangladesh. They provide almost all the

market milk (95%) in the country (DLS 2019). About 5.786 million MT of cow milk is produced annually Hamid *et al. (*2016). The country produces about 1.751 million MT of beef annually, the most popular type of meat. Presently, ~~Cattle~~Cattle and buffalo provide 65% of the total draught power of the country.~~at present~~. Landless and small farmers hold about 62.6% of the total large ruminants and are used as sources of income and nutrition, and considered as a resource for employment and poverty alleviation. Beef fattening, dairying, and heifer rearing are the production systems for the exploration of cattle germplasm in the country. About 68% of village families keep cattle traditionally. ~~A family o~~n ~~-~~According to Huque*et al.* (2004) on average,a family producesabout 8.3 liters of milk per ~~in a~~ week whilst ~~and~~ a cow produces an average of 0.8 litres per day.~~the average production of the cow was found as 0.8 liters per day Huque *et al. (*2004)~~. Goats are another species of livestock that plays ~~occupies~~ an important roleplace as an animal genetic resource in the agro-based economy of the country ~~having greater importance,~~ particularly~~,~~ in subsistence agricultural operations. In the case of chicken, one one hand,the last two decade has seen commercial chicken production developing at a faster rate than any other poultry species in the country''s last two decades. ~~developed at a faster rate than that of other poultry species.~~Whilst ~~O~~on the other hand, the production system of native chicken did not change very much as ~~. M~~most of the native chicken are~~is~~ still raised under a low input system and this has resulted in their productivity to remain~~remains~~ low.Therefore, in order to develop the livestock sector in Bangladesh, new strategies needs to be adopted~~Strategies are to be adopted for the development of the livestock sector in Bangladesh.Adoption~~ and dissemination of livestock technologies and training ~~technologyare~~areimportant tools for the development of this sector as alluded by~~and training is considered a strong tool~~Hossain *et al. (*2021).As pointed out by Sharma *et al.* (2017), trainings can expediate the ~~D~~development of the behavior ~~in the~~

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~~behavior~~ of farmers towards the adoption livestock technology and this will resultantly improve livestock rearing by them. ~~can occur as a result of training~~~~Sharma~~*~~et al.~~* ~~(2017).~~The participation of rural people in livestock farming activity plays an important role in the economic development of BangladeshHuque*et al. (*2017).Realizing the great contribution of the rural people in the production process of farm facilities, government planners, policymakers and administrators have been ~~are~~ trying to take necessary steps to include rural people in the livestock development process in recent years. ~~It is observed that s~~Smallholder farmers ~~s~~have the potential to ~~can~~ play an important role in livestock development if they get ~~and would get far~~ better opportunities to organize themselves as a functional group. ~~for livestock development.~~ In the production of livestock, both men and women integrate with the rearing and management.Despite the fact that ~~The~~ trainings and adoption of livestock technologies have the potential of improving the ~~improvement of~~ livelihoods and food security of moderate and hard-core poor households whilst at the same time ~~and the~~ empowerment ~~of~~ rural women ~~through training on the adoption of livestock technologies for~~ through sustainable income-generating activities there is limited studies done in this area~~need to be studied~~.Through the Bangladesh Livestock Research Institute (BLRI)farmers were trained~~has given farmers training~~ on different livestock technologies~~y~~ in different areas of Bangladesh through its revenue and development budget. Despite undertaking these trainings and availing financial resources to rural farmers~~But~~ there hasbeen limited ~~no~~ information about the impact of the training on-farm conditions used by fattening, dairy, and poultry farmers. Considering these facts,this~~e present~~ study ~~attemptedto~~ examines the impact of training on the adoption of technology and management practices along withthe impact on livelihoods improvement of trained livestock farmers in selected zones of Bangladesh~~.~~

Comment [M3]: By putting the word observing, you are already talking about results, whilst at the moment its still an introduction.

Comment [M4]: This is a very strong word, substituting it will be better.You can use extremely poor

METHODOLOGY

Selection of study areas and sample farmers

The selection of Farm/households was based on those who had been ~~were selected who are~~ trained in livestock technologiesand managementfrom Dhamrai, Jessore Sadar, and NaikhongchhariUpazilas of Dhaka, Jessore, and Bandarban districts respectively. Table 1 shows the locations, frequency, and percentage ratio of respondent farmers interviewed. These are the part of the areas where livestock farmers were trained on different livestock technologies and management.

Table 1: Location and distribution of respondents

Location	Frequency (N)	Percentage
Dhamrai, Dhaka	30	37.50 (%)
JessoreSadar, Jessore	30	37.50 (%)
Naikhongchhari, Bandarban	20	25.00 (%)
Total	80	100 (%)

Methods of data collection

The purposive sampling technique was used to select livestock farmers for interviews in each of the areas. A direct face-to-face on-farm individual interview approach using a standard pre-tested questionnaire was used to collect necessary data. A questionnaire was designed to measure the perceived level of knowledge and skill on a list of topics related to livestock production which topics followed a logical sequence of the production chain.A 4 points Likert scale was developed to measure the level of knowledge and skills that respondents perceived to possess about the topics in the questionnaire. The Likert scaleis a fixed choice response format to measure attitudes

Comment [M5]: The methodology needs to be revisited. The researcher did not highlight whether the study is a qualitative or quantitative or mixed methods. How was the selected zones identified was it purposivel or something else. Also was this a case study or not

Comment [M6]: What was the population for this study?

Here the simple random sampling method was the ideal sampling method

and opinions of respondents and also measure the competencies and what an individual believes, perceives, or feels about self, others, activities, institutions, or situations Gay *et al.(* 2009). For the present study a 4 points Likert scale was developed from score 1=least knowledge, 2= moderate knowledge, 3= much knowledge, andscore 4=highlyknowledged andscore 1= least skilled, 2= moderate skilled, 3= much skilled, andscore 4= highly skilled for measuring the level of knowledge and skill respectively. In the case of assessment of the level of need of training 3 points score from 1= do not need training, 2= would need training, and 3= strongly need training was used.

Analytical technique

The means and standard error were used to indicate the level of knowledge and skill respectively the livestock farmers indicated against the statement.

Equation 1:Formula for mean: $A = \frac{1}{n}\sum_{i=1}^{n} a_i$

A= arithmetic mean

n= number of values

a_i=data set values

Equation 2: Formula for standard error: $SE = \frac{\sigma}{\sqrt{n}}$

SE= Standard error of the sample

σ = Standard deviation of the sample

n= number of the sample

Therefore, the lower means indicate possession of lesser knowledge and skill, while the higher means indicate possession of higher knowledge and skill about the statement. A parametric test (z-test) was conducted to measure the significant difference between knowledge and practical

skill of trained livestock farmers at 5% level of significance.In the case of assessment of the level of need for training, the lower means indicate a lesser level of need for training, while the higher means indicate a higher need for training against the subject.To measure the improvement of livelihood status of livestock farmers before and after situation of getting training from BLRI was compared using five types of livelihood assets or capitals upon which livelihoods are built namely human assets, social assets, natural assets, physical assets, and financial assets(DFID, 2000). The livelihood outcome such as annual income along with expenditure and savingswas also measured and compared (paired sample t-tests) using the before and after approach.All the collected data were processed and analyzed with descriptive statistics, z-test,and paired sample t-tests were conducted using MS Exel and SPSS 20.0software.

RESULTS AND DISCUSSIONS

Demographic characteristics of livestock farmers

Table 2 shows the demographic characteristics of livestock farmers. From the respondents interviewed, (66.25%) were males and were alsowere the majority ~~The majority of respondents were male (66.25%)~~ as compared to female who constituted (33.75%). The average age of the livestock farmers was 37.10±0.86 yearswhich was almost similar to Hossain *et al.* (2021) who reported the average age of the respondent was 36.73. The average years of schooling was 9.05±0.24 years indicating that the livestock farmers were moderately educated. Akteruzzaman*et al.* (2008)reported that the average level of education of the respondent was 4.50 which was lower thanthe present finding because the education level of respondent farmers may have ~~be~~ improved.The level of education was found slightly higher in Jessore SadarUpazila of Jessore district. Agriculture was the main occupation and 72.50% of livestock farmers found agriculture as their main occupation. The average family member was 5.10±0.19 which was almost the same

asHossain *et al.* (2021) who found the average family size of the respondent was 4.77. The highest number of family membersper household was found in DhamraiUpazila (5.97±0.41) and the lowest was in Jessore SadarUpazila (4.57±0.14).

Table 2: Demographic characteristics of livestock farmers

Variables	Dhamrai	JessoreSadar	Naikhongchhari	Overall
Gender				
Male (%)	50 (15)	83.33 (25)	65 (13)	66.25 (53)
Female (%)	50 (15)	16.67 (5)	35 (7)	33.75 (27)
Age (Mean±SE)	39.40±1.49	35.37±1.29	36.40±1.64	37.10±0.86
Year of schooling (Mean±SE)	9.13±0.31	9.60±0.44	8.10±0.52	9.05±0.24
Main Occupation				
Agriculture (%)	100 (30)	26.66 (8)	100 (20)	72.50 (58)
Family member (Mean±SE)	5.97±0.41	4.57±0.14	4.60±0.24	5.10±0.19

(Number in the parenthesis indicates the respondent number)

Comment [M7]: The table should come at the top then followed by discussion of results. First sentence could read as follows;

Opening sentence can read as follows: The following table provideds the demographic data of the respondends.

Types of livestock reared by respondent farmers

Different types of livestock were reared by the respondent farmers presented in Table 3. The average number of cattle was the highest in DhamraiUpazila (5.83±0.20) followed by Naikhonchhari (2.45±0.62) and overall was 3.60±0.27. In the case of goats, the average number was the highest found in Naikhonchhari (2.90±1.05) and the overall value was 1.58±0.34. However, the average number of poultry was found 279.76±43.98 and the highest was in Jessore Sadar (727.20±54.79).

Table 3: Types of livestock reared by farmers

Types of livestock	Dhamrai	Jessore Sadar	Naikhongchhari	Overall
Cattle (Mean±SE)	5.83±0.20	2.13±0.23	2.45±0.62	3.60±0.27
Goat (Mean±SE)	0.77±0.38	1.53±0.43	2.90±1.05	1.58±0.34
Sheep (Mean±SE)	0.13±0.07	0.20±0.11	0.10±0.10	0.15±0.05
Poultry (Mean±SE)	11.33±1.64	727.20±54.79	11.25±2.98	279.76±43.98
Duck (Mean±SE)	0.50±0.5	0.50±0.29	1.90±0.88	1.02±0.38

Extent and rate of the adoption of different parameters of livestock technologies

Table 4 shows the knowledge and skill level of different parameters of livestock technologies adapted after the training. The higher points of knowledge and skill indicate a higher level of the adoption rate of livestock technologies among livestock farmers in the study areas. From the table, a comparatively higher knowledge level was found in the case of housing and shed management. However, the skill level was found slightly lower than the knowledge level indicating that farmers apply less in practice than they know about housing and shed management. The highest score was 2.45±0.08 found in the case of knowledge level about the type of housing and the lowest knowledge level was found in the case of fencing management (1.91±0.08). However, the skill level was the highest at 1.71±0.06 and the lowest was 1.42±0.05 in the case of the type of housing and fencing management respectively. Moreover, in the case of housing and shed management, the difference between knowledge level and skill level in the case of all parameters was found statistically significant ($P<0.05$).Hunda*l et al.* (2016)reported the awareness of farmers regarding housing management was improved. In the case of feeds and

Comment [M8]: Table should come at the top the discussion at the bottom to enable easy reference and reading

feeding management,the highest knowledge score was 2.00±0.06 and 2.00±0.09 found on the use of supplement and fodder processing techniques respectively and the lowest score was 1.66±0.06 on water supply and quality. Moreover, the highest level (1.56±0.05) of skill was found in the balance ration and the lowest was 1.30±0.06 forthe fodder cultivation technique. However, in this case,the skill level was also found slightly lower than the knowledge level indicating that farmers apply less in practice than they know and in the case of all parameters the difference between knowledge level and skill level was found statistically significant (P<0.05). Table 4 contains data on the perceived knowledge and skill levels of livestock farmers about breeding management. The highest knowledge score of 2.25±0.08 was found on natural breeding and artificial insemination and the lowest score was 1.76±0.07 on service per conception rate. Moreover, the highest skill score of 1.57±0.05 was found fornatural breeding and artificial insemination and the lowest was 1.47±0.07 for service per conception rate. Similarly, the skill level was found slightly lower than the knowledge level in the case of breeding management, and in the case of all parameters, the difference was statistically significant (P<0.05).In the case of health management practices, the highest knowledge score of 2.01±0.06 was found on deworming and the lowest score was 1.49±0.06 on parasite control. However, the highest skill score of 1.50±0.08 was found for deworming and the lowest score was 1.12±0.03 and 1.12±0.04 on symptom and primary treatment of disease respectively. From table 4 the difference between knowledge level and skill in the case of health management practices was much indicating the gap between high knowledge but less in practice.A previous study found that awareness level was higher about ~~heath~~ health management after training Hundal*et al.(*2016).

Comment [M9]: Each table must be discussed separately by first having it at the top

Table 4: Knowledge and skill level on different parameters of livestock technologies

Sl.	Technology	Parameters	Knowledge level	Skill level	Sig.

No.			(Mean±SE)	(Mean±SE)	
1	Housing/shed management	Type of housing	2.45±0.08	1.71±0.06	*
		Light and aeration	2.43±0.07	1.70±0.07	*
		Drainage	2.01±0.06	1.61±0.06	*
		Cleaning and hygiene	2.22±0.07	1.56±0.06	*
		Fencing management	1.91±0.08	1.42±0.05	*
2	Feeds/feeding management	Balance ration	1.90±0.08	1.56±0.05	*
		Feeding pattern and quantity of feed	1.96±0.06	1.35±0.06	*
		Use of supplement	2.00±0.06	1.45±0.06	*
		Fodder cultivation technique	1.85±0.06	1.30±0.06	*
		Fodder processing technique	2.00±0.09	1.52±0.05	*
		Water supply and quality	1.66±0.06	1.43±0.06	*
		Preparation of Silage and UMS	1.81±0.09	1.40±0.07	*
		Homemade and readymade feed	1.81±0.09	1.40±0.05	*
3	Breeding Management	Natural breeding and AI	2.25±0.08	1.60±0.05	*
		Breed identification	2.03±0.08	1.50±0.06	*
		Heat determination and time of insemination	2.12±0.08	1.57±0.05	*
		The idea of service per conception rate	1.76±0.07	1.47±0.07	*
		Management of pregnant animal	2.14±0.09	1.54±0.06	*
		Other reproductive traits	1.97±0.09	1.50±0.06	*
4	Health management	Neo-natal nourishment practice	2.00±0.07	1.29±0.06	*
		Deworming	2.01±0.06	1.50±0.08	*

		Vaccination	1.99±0.07	1.49±0.08	*
		Dipping	1.50±0.06	1.15±0.04	*
		Symptoms of disease	1.67±0.07	1.12±0.03	*
		Primary treatment	1.64±0.06	1.12±0.04	*
		Parasite control	1.49±0.06	1.14±0.04	*
		Treatment by an expert veterinarian	1.74±0.06	1.26±0.05	*
5	Record keeping and account management	Livestock Inventory	1.47±0.06	1.12±0.04	*
		Production record	1.35±0.06	1.01±0.01	*
		Income and expenditure record	1.33±0.05	1.02±0.02	*
		Profit/loss calculation	1.39±0.05	1.10±0.03	*
		Family and farm account combination	1.26±0.05	1.00±0.00	*
		Farm diary	1.31±0.05	1.01±0.01	*
		Sales record	1.26±0.05	1.00±0.00	*
		Net worth calculation	1.27±0.05	1.09±0.03	*
		Unnecessary and unplanned investment	1.27±0.05	1.00±0.00	*
6	Marketing management	Idea of marketing	1.35±0.06	1.01±0.01	*
		Idea of intermediaries	1.34±0.06	1.04±0.03	*
		Market selection, pricing,and selling time	1.32±0.05	1.04±0.03	*
		Market information and networking	1.01±0.01	1.00±0.00	NS
		Idea and calculation of marketing cost	1.04±0.02	1.00±0.00	*
7	Other	Preparation of Silage and UMS	1.61±0.08	1.28±0.07	*

	livestock technologies	Feed master app	1.16±0.05	1.30±0.05	*
		Breeding app	1.31±0.05	1.27±0.05	NS
		Fodder cultivation	1.51±0.07	1.26±0.05	*

(* Significant, NS-Non-significant at 5% level of significance)
(Score: Knowledge level: 1= Least Knowledge, 2= Moderate Knowledge, 3= Much Knowledge, 4=HighlyKnowledged)
(Score: Skill level: 1= Least Skill, 2= Moderate Skilled, 3= Much Skilled, 4=Highly Skilled)

Record keeping and account management are important for farm monitoring and evaluation of the performance and decisions making about the farm enterprises. Table 4 contains data on the perceived knowledge and skill levels of livestock farmers about farm records. From the ~~R~~respondents it was apparent that the farmers were less knowledgeable and lacked record keeing as well as account management skills.~~skilled in record keeping and account management found in the study areas.~~ Respondents indicated that they were not skilled in any of the farm records listed. The respondent farmers indicated that though they had some knowledge on why ~~may know~~why farm records are kept~~,~~ but they did not have the expertise to properly keep them.~~properly.~~ From the study, the highest knowledge score was found 1.47±0.06 on-farm inventory and the lowest was 1.26±0.05 on family and farm accounts combined and sales records. Also, the least skill score was found on family and farm accounts combined and sales records, and the score was 1.00±0.00.This was~~is~~ an indication of a serious problem in farm management because ~~if~~ farmers were not able to ~~cannot~~ keep proper records of their farms. The difference between knowledge and skill level, in this case,was also found statistically significant($p<0.05$). Significantly,~~However,~~results also indicates that livestock farmers were less knowledgeable and lacked skills in ~~in the case of~~ marketing management of their livestock. ~~livestock farmers were also found less knowledgeable and skilled.~~ The highest knowledge score was 1.35±0.06 and the lowest was 1.01±0.01 on the idea of marketing and market information

Comment [M10]: It would be easy to read if author (s) put sub headings since table 4 has many variableanalysed under variables.

and networking respectively. In the case of skill level, the highest score was 1.04±0.03 on the idea of intermediaries and market selection, pricing, and selling time, and the lowest was 1.00±0.00 on market information, networking, and calculation of marketing cost respectively. The least scores on the parameters of marketing management indicated that farmers were not aware and skilled in the marketing of their livestock and products.From the study, it was also observed that farmers have moderate knowledge of silage, Urea-Molasses-Staw (UMS) preparation, and fodder cultivation but the skill level was near to least level. It indicates that the farmers were lesser skilled in the use of these technologies. In the case of feed master application farmers were found lesser knowledgeable but higher-skilled and found statistically significant($p<0.05$).Ceballos *et al.*(2018)reported that the trained farmers have better knowledge and skill in on-farmmanagement practices.The provision of training facilities could make a positive impact on the farmers and make them better farm managersSharma *et al.*(2017). From the present study, it was found that the trained farmers moderately adopted livestock technologies after getting training, and more inclusive training and demonstration were needed for further expansion of the livestock technologies.

Perceived topics and level of interest of livestock farmers for assessing the training need

For the rapid dissemination of livestock technologies, integrated training and demonstration are very important factorsAkteruzzaman*et al.*(2008).Table 5 contains the topics that livestock farmers identified as the gap in knowledge and skill and showed interest and need to receive training on the topics further. It was observed that livestock farmers express their highest training interest score of 1.87±0.04 on record and account management followed by marketing management (1.56±0.06) and breeding management (1.46±0.07). The livestock farmers showed a higher level of interest in the topics in which they were less knowledgeable and have least

Comment [M11]: You first discuss the findings then write if they are in agreement with previous researches or not. This helps to contrast what is known and not known. As indicated table to be on top

Comment [M12]: Was observation part of data collection method, if not then a better term is needed

skillshave lesser knowledge and skill.The training content development process should take into account the training needs found of livestock farmers at the field levelAbdulkadir *et al.*(2021).

Comment [M13]: Is this citation agreeing with what came from respondents or its disagreeing. There is need to compare and contrast.Provide a discussion not just citation

Table 5: Perceived topics of interest in livestock training

Topics	Level of training need (Mean±SE)
Housing management	1.02±0.02
Feed/feeding management	1.30±0.06
Breeding management	1.46±0.07
Health management and treatment	1.25±0.05
Record and account management	1.87±0.04
Marketing management	1.56±0.06

(Score: Level of need:1=Do not need training on the subject area, 2= would need training on the subject area, 3= strongly need training on the subject area)

Improvement of livelihood of trained farmers

Table 6 shows the improvement of livelihood assets of trained farmers after training irrespective of the study areas. Thus the assessment of the impact of training is difficult immediately after training. The results showed It was observedthat after training all parameters of human assets were improvedas reported by most of the livestock farmers. From the respondents it emerged that The highest 91.25% of farmers reported that on among human assets, the condition of health and sanitation was improved along with the training facility. However, knowledge/efficiency was the lowest as it stood at was 53.75 %. in the case of knowledge/efficiency. The findings suggested that training wasis an important factor in increasing the human assets of the farmers. In the case of social assets, farmers reported that the 91.25% whichwas the highest 91.25% got involved in social groups or activities and their decision-making ability was improved.

Comment [M14]: As highlighted above on tables

Comment [M15]: The use of this word is misplaced either the results showed that after training etc

Conversly ~~and the lowest~~ 21.25% of farmers which was the lowest indicated ~~thought~~ that their social prestige was improved. On the other hand~~However~~, 43.75% of respondent farmers reported an improvement inwomen empowerment and this~~the~~ finding resonate well ~~agreed~~ with the result reported byJadav *et al.*(2014) when he stated that ……. Remarkable improvement occurred in the case of social assets among trained farmers.Table 6 also indicates that the highest 50.00% of farmers reported that their mortgage in cultivable land was increased and the lowest was in the case of access to open water sources (0.00%) followed by own cultivable land (15.00%). This means the farmers who were trained had ~~have training~~ the number of natural assets increased but at a lower ratio. However, among physical assets, the highest improvement occurred in the case of tubewell or pump and electric fan reported by 91.25% of the respondent farmers, and the lowest 37.50% have increased the freeze or computer. The findings suggested that training was~~is~~ an important factor also for increasing the physical assets of the farmers. ~~Moreover, the least amount of farmers reported that their financial assets increased after training.~~ In the case of financial assets, 52.50% of farmers reported that their liquid cash in hand increased remarkably. However, no one farmer has found whom the donation or aid increased and only 13.75% of farmers reported that their amount of cash in the bank increased. The increase in ~~Increasing~~ all kinds of livelihood assets of farmers, indicated that training exposure helped to improve their~~the~~ livelihood status and this is in agreement with argument postulated by ~~of the trained farmers which was agreed with the argument of~~Hossain *et al.* (2021) when they stated that….

Comment [M16]: The study was not being done to measure thoughts of respondents but what they actually responded to.

Comment [M17]: Put Jadav's finding here

Comment [M18]: Sentence needs to be revisited its not coming out clearly.

Comment [M19]: Indicate their argument

Table 6: Livelihood improvement of trained farmers

Comment [M20]: Table at the top discussion later

SL. No.	Assets	Parameters	Improved (%)

1	Human Assets	Health and sanitation	91.25 (73)
		Education	90.00 (72)
		Training facility	91.25 (73)
		Knowledge/efficiency	53.75 (43)
		Access to information	82.50 (66)
2	Social Assets	Involvement in social group/activities	91.25 (73)
		Political involvement	37.50 (30)
		Self-managerial capability	52.50 (42)
		Social prestige	21.25 (17)
		Decision-making ability	91.25 (73)
		Women empowerment	43.75 (35)
3	Natural Assets	Cultivable land (Own)	15.00 (12)
		Cultivable land (mortgage in)	50.00 (40)
		Pond area	37.50 (30)
		Open water access	0.00 (0)
4	Physical Assets	Housing	50.00 (40)
		Furniture	58.75 (47)
		Agricultural Equipments	48.75 (39)
		Bicycle/motor cycle or van	57.50 (46)
		Tube well/pump	91.25 (73)
		Electricity	53.75 (43)
		TV/radio/DVD	48.75 (39)
		Cable network	43.75 (35)

		Freeze/computer	37.50 (30)
		Electric fan	91.25 (73)
		Mobile phone	53.75 (43)
		Toilet facility	53.75 (43)
5	Financial Assets	Cash in hand	52.50 (42)
		Cash in bank	13.75 (11)
		Jewelry	0.01 (1)
		Donation/aid	0.00 (0)

(Number in the parenthesis indicates the respondent number)

Changes in annual income, expenditure, and savings of trained livestock farmers

Table 7 represents the changes in annual income, expenditure, and savings of trained livestock farmers~~. after getting training~~. The highest annual income before being trained by BLRI was ~~found~~ in DhamraiUpazila (BDT 320333.30±37242.55) and the lowest was in Jessore Sadar (BDT 79500.00±500.02) Upazilas and ~~overall~~ was BDT 181937.50±19169.98~~. before getting the training from BLRI~~. However, after being trained~~getting training~~ the annual income of all study areas improved and the highest improvement recorded was~~occurred~~ in DhamraiUpazila (BDT 76133.33±4287.12) followed by NaikhongchhariUpazila (BDT 66850.00±21374.64) and was found statistically significant ($p<0.05$). The overall change in annual income was BDT 65700.00±17309.35 and was also found statistically significant ($p<0.05$). A similar result was reported by Akteruzzaman*et al.*(2008)who reported that ~~the~~ farmers after being exposed to training ~~having training exposure~~ earned more money than before. Moreover, the overall annual expenditure ~~was~~ also increased (BDT 26175.00±2135.79) and found statistically significant ($p<0.05$). In NaikhongchhariUpazilaannual expenditure ~~was~~ also increased and found

Comment [M21]: As highlighted above

Comment [M22]: Overall to what?

statistically significant ($p<0.05$). Furthermore, the annual savings of all study areas was increased and overall improvement was (BDT 43232.88±17632.76) and in Dhamrai it was found statistically non-significant ($p<0.05$). The highest increase in annual savings was occurred in NaikhongchhariUpazila (BDT 51500.00±17612.87) and found statistically significant ($p<0.05$).

Table 7: Annual income, expenditure, and savings of trained livestock farmers

Particulars	Dhamrai	Jessore Sadar	Naikhongchhari	Overall
Annual income				
Before (BDT) (Mean±SE)	320333.30±37242.55	79500.00±500.02	128000.00±21027.55	181937.50±19169.98
After (BDT) (Mean±SE)	396466.70±32096.61	134000.00±2779.23	194850.00±37610.56	247637.50±20079.57
Change (BDT) (Mean±SE)	76133.33±4287.12	54500.00±2737.03	66850.00±21374.64	65700.00±17309.35
Significance	*	*	*	*
Annual expenditure				
Before (BDT) (Mean±SE)	71766.67±3874.97	73700.00±1835.25	47250.00±8625.81	66362.50±2924.81
After (BDT) (Mean±SE)	98133.33±6317.78	106900.00±5453.95	62600.00±12230.12	92537.50±4748.35
Change (BDT) (Mean±SE)	26366.67±3020.04	33200.00±3620.31	15350.00±3861.60	26175.00±2135.79
Significance	*	*	*	*

Annual savings				
Before (BDT) (Mean±SE)	248566.70±38360.59	5800.00±1831.02	80750.00±13195.27	126315.10±19405.76
After (BDT) (Mean±SE)	298333.30±30157.68	27100.00±2798.74	132250.00±25418.07	169547.90±18570.32
Change (BDT) (Mean±SE)	49766.67±43775.88	21300.00±1214.99	51500.00±17612.87	43232.88±17632.76
Significance	NS	*	*	*

(*Significant, NS-Non-significant at 5% level of significance)

CONCLUSIONS

The livestock farmers were moderately knowledgeable and skilled and the rate of adoption of livestock technology such as housing or shed management, feeds or feeding management, breeding management, and health management were moderately satisfactory for the beneficiaries~~, having training exposure~~. However, they were less knowledgeable and skilled in record keeping, account management, and marketing management which should be integrated into all livestock extension training programs. However, in most of the cases, skill level score was lower than knowledge level and found statistically significant ($p<0.05$). It was also noted~~observed~~ that after training all parameters of human assets ~~were~~ improved remarkably as reported by most of the livestock farmers. However, other livelihood assets such as social assets, natural assets, and physical assets moderately improved~~, as reported by the farmers~~. In the case of financial assets, cash in hand improved more than other parameters found in the study. Further~~However~~, after getting training the annual income of all study areas was improved and found statistically significant ($p<0.05$). Moreover, the annual average savings of all study

Comment [M23]: Sentence not making sense with these words

Comment [M24]: No need to repeat same words

areas was increased.The intervention of BLRI technology was found moderately effective in the improvement of knowledge and skill and adaption of technologies at the field level along with the improvement of livelihoods of the livestock farmers. A more integrated training approach followed by practical demonstration is~~may be~~ more helpful for the rapid dissemination of livestock technologies at the field level and it will~~may~~ be more effective in contributing to the extension of technologies and development of the livestock sector in Bangladesh.

Comment [M25]: The word may indicate hesitation and lack of courage to provide recommendation.

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