



Coastal livelihood vulnerability improvement of rural farmers to climate change in Bagerhat district of Bangladesh

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Article History

Received: 04 October 2017

Accepted: 09 November 2017

Published: January-March 2018

Citation

Borhan Uddin, Irteja Hasan, Golam Rabbani Akanda, Sanaul Haque, Shafiqul Islam. Coastal livelihood vulnerability improvement of rural farmers to climate change in Bagerhat district of Bangladesh. *Climate Change*, 2018, 4(13), 29-41

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General Note



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ABSTRACT

The study aimed at determining livelihood improvement of the farmers due to embankment establishment at Bagerhat Sadar Upzila of Bagerhat district and the relationships of 10 selected characteristics of them to their extent of livelihood improvement were also explored. Data were collected from a sample of 112 farmers rather than the population. The overall extent of livelihood improvement score of the farmers ranged from 76 to 148 with a mean of 120.22 and standard deviation of 13.61. Results showed that, majority (53.57 percent) had medium livelihood improvement while 36.61 percent of them had high improvement and only 9.82 had low improvement. The findings implied that most of the farmers (90 percent) had medium to high livelihood improvement regarding various capitals due to the favorable condition generated by the establishment of embankment. However, vast majority of the farmers (54.46 percent) had high improvement regarding financial capital aspects of livelihood improvement followed by social capital (46.43 percent). Out of ten selected characteristics of the farmers only six characteristics were significant. These were education, training experience, farm size, communication exposure, fatalism, and agricultural knowledge. Among these education, training experience, farm size, communication exposure and agricultural knowledge had positive relationship and only fatalism had negative relationship with their extent of livelihood improvement.

Keywords: Agriculture, Livelihood, Climate Change, Embankment, Bangladesh

1. INTRODUCTION

Bangladesh is one of the utmost disaster-affected countries in the world (Majumder, 2017). Disasters is considered as one of the most serious threats to the world with its potential deleterious impact on human, material, economic, or environmental losses and sometimes huge impacts (e.g. SIDR) exceed the ability cope using its own resources (Hasan et al., 2017). The coastal zone in southern Bangladesh adjoining the Bay of Bengal is characterized by a delicately balanced natural morphology of an evolving flat Delta subject to very high tides and frequent cyclones coming in from the Bay of Bengal encountering very large sediment inflows from upstream (Mandal, 2017). The strength of the tides and the flatness of the delta causes the tides to influence river processes a long way upstream in the southern estuaries. This entire area is called the coastal zone. The coastal zone, in its natural state, used to be subject to inundation by high tides, salinity intrusion, cyclonic storms and associated tidal surges etc (Rahman, 2017; Muhammad Rezaul Rakib and Md. Nurul Islam, 2017). The Government decided to construct polders surrounded by embankments along the entire coastal belt to protect the people and agriculture of the coastal zone and crops from tidal inundation and saline water intrusion and release a large extent of land for permanent agriculture which will develop their sustainable livelihood (Carney, B, 1998; Edris Alam, 2017; Frederick Bloetscher et al. 2016).

The term sustainable livelihood first came in 1991, when Robert Chambers and Gordon Conway introduced sustainable livelihood as a concept of knowing people's poverty from their inner strengths (Chambers & Conway, 1991). The patterns of livelihoods might vary from place to place, from rural to urban area, from remote to core. There are five important forms of livelihood assets that determine the foundation of livelihoods. These are Natural capital, Social-Political capital, Human capital, Physical capital and financial capital (USD, 2003). The previous study found that livelihood improvement of the farmers was high due to different development interventions (Mandal, 2011). Majority (70 percent) belong to deterioration in their livelihood status while 22.50 percent of them mentioned highly deterioration and 3.75 percent farmers mentioned no change in their livelihood status whereas none of the farmers mentioned highly improvement in their life due to climate change (Hossain, 2013). There was a significant positive relationship between age of the beneficiaries of seed production program of Proshika and their living status in terms of annual income, food consumption, housing condition, household assets, drinking water source and medicate facilities in their technological intervention (Islam, 2003). It was also observed that study that age had no significant relationship with their livelihood in the coastal region in Bangladesh (Mortuza, 2004; Kabir, 2003). Another study found that there was no relationship between education of the beneficiaries of PDBF and their living condition. A study on impact of micro credit in the poverty alleviation of BRAC women beneficiaries in a selected area of Dinajpur district found a significant positive relationship between family size of the beneficiaries of BRAC and their annual income and food consumption (Ali, 2005). The training experiences of the rural woman had no significant relationship with their improvement of socio economic status (Saifuddin, 2004). The training exposure of the CLP beneficiaries had significant positive relationship with their participation in the income generation activities (Islam, 2007). So the previous study proved that livelihood development intervention has a great role to benefit the farmers though it may be positive or negative significance (Jhahan, 2017). The main focus of the study was to find out the extent of improvement of

livelihood status of the farmers due to embankment establishment in Sadar Upazila of Bagerhat District in Bangladesh. The specific objectives of the study were as follows:

- To determine the extent of improvement of livelihood status of the farmers due to embankment establishment in the study area
- To determine and describe some selected characteristics of the farmers.
- To determine relationship between the extent of improvement of livelihood status of the farmers and their selected characteristics.

2. METHODOLOGY

This study employed both quantitative and qualitative research approaches in order to get a comprehensive view of the complex issues of improvement in livelihood improvement of the farmers in response to embankment establishment. Qualitative methods such as focus group discussions and key informant interviews were used to cross check the data given by the respondents and to have a clear view about the livelihood improvement of the farmers due to embankment establishment. The quantitative survey approach was used for determining the extent of improvement of livelihood improvement of the farmers due to embankment establishment. Thus, a mix method research design was applied to determine the extent of improvement of livelihood improvement of the farmers after embankment establishment in the study area. There are 29 and 16 villages under Bemorta and Dema unions respectively. Out of these 45 villages of these two unions, 5 villages from Bemorta and 2 villages from Dema, i.e. 7 villages were selected through simple random sampling technique (Table 1).

Table 1 Distribution of the population and sample farmers

Upazila	Union	Village	Population	Sample	Reserve
Bagerhat sadar	Bemorta	Chogram	136	14	1
		Vodrapara	135	14	1
		Boitpur	201	20	2
		Kolabaria	234	23	3
		Bergojalia	110	11	1
	Dema	Orjunbahar	182	18	2
		Dema	122	12	1
Total			1120	112	11

3. RESULTS AND DISCUSSION

3.1. Extent of Livelihood improvement of the Farmers Due to embankment establishment

The primary focus of the study was to determine extent of improvement of livelihood status of the farmers due to embankment establishment. This was the dependent variable and measured with five assets of livelihoods, namely natural, human, social, physical and economic capital. Twenty five (36) aspects were selected to measure the extent of improvement of livelihood status due to embankment establishment (Table 4.4). The findings were interpreted in the following subsections.

3.2. Livelihood improvement regarding human capital

The possible range of livelihood improvement score of the farmers regarding human capital could vary from 8 to 20 while the observed range was 8 to 18 with an average and standard deviation of 13.77 and 1.64 respectively. On the basis of human capital scores (Table 2) the farmers, they were grouped into three categories as "Low improvement" (8-11), "Medium improvement" (12-15), and "high improvement" (16-18).

Table 2 Distribution of the Farmers according to their Human Capital

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low improvement	6	5.35	13.77	1.64
Medium improvement	96	85.21		
Highly improvement	10	8.93		

Total

112

100.0

Findings showed that vast majority of the farmers (85.21 percent) had medium improvement compared to 5.35 percent low and 8.93 percent high improvement regarding human capital aspects of livelihood improvement. Human capitals are the main capital of the rural farmers. Rural people possess energy so that they can employ their energy in development work and energy uptake increases the human capital and others activities to improve their present status. It might be due to that embankment was establishment six years ago, so improvements like human capital which need time to improve yet not achieve satisfactory level.

3.3. Livelihood improvement regarding natural capital

The possible range of livelihood improvement score of the farmers regarding natural capital could vary from 7 to 35 while the observed range was 13 to 32 with an average and standard deviation of 25.37 and 3.02 respectively. On the basis of natural capital scores (Table 3) of the farmers, they were grouped into three categories as "Low improvement" (13-20), "Medium improvement" (21-27), and "high improvement" (28-32).

Table 3 Distribution of the Farmers according to their natural Capital

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low improvement	7	6.25	25.37	3.02
Medium improvement	90	80.36		
Highly improvement	15	13.39		
Total	112	100.0		

Findings showed that vast majority of the farmers (80.36 percent) had medium improvement compared to 6.25 percent low and 13.39 percent high improvement regarding natural capital aspects of livelihood improvement. Among the different capitals, natural capital mostly prone to improvement regarding livelihood because rural livelihood mostly dependent on the natural resources and if natural condition is favored the natural resources which are sources of income, livelihoods of the rural poor people are also improved.

3.4. Livelihood improvement regarding physical capital

The possible range of livelihood improvement score of the farmers regarding physical capital could vary from 7 to 35 while the observed range was 14 to 33 with an average and standard deviation of 24.83 and 3.37 respectively. On the basis of physical capital scores (Table 4) of the farmers, they were grouped into three categories as "Low improvement" (14-21), "Medium improvement" (22-27), and "high improvement" (28-33).

Table 4 Distribution of the Farmers according to their Physical Capital

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low Status	14	12.5	24.83	3.37
Medium Status	87	77.68		
Highly Status	11	9.82		
Total	112	100.0		

Findings showed that vast majority of the farmers (77.68 percent) had medium improvement compared to 12.5 percent low and 9.82 percent high improvement regarding physical capital aspects of livelihood improvement. It might be for the establishment of a infrastructure which enhanced different physical facilities are created for the farmers to bring the improvement in their livelihood.

3.5. Livelihood improvement regarding social capital

The possible range of livelihood status score of the farmers regarding social capital could vary from 8 to 40 while the observed range was 14 to 34 with an average and standard deviation of 28.75 and 4.23 respectively. On the basis of physical capital scores

(Table 5) of the farmers, they were grouped into three categories as “Low improvement” (14-21), “Medium improvement” (22-28), and “high improvement” (29-34).

Table 5 Distribution of the Farmers according to their Social Capital

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low Status	11	09.82	27.50	3.71
Medium Status	49	43.75		
Highly Status	52	46.43		
Total	112	100.0		

Findings showed that vast majority of the farmers (46.43 percent) had high improvement followed by to 43.75 percent medium and 09.82 percent low improvement regarding social capital aspects of livelihood improvement. It might be for the infrastructural development mobility, group formation and organizational activities of the farmers were facilitated to make a desirable improvement in their livelihood. Social capitals are the assets of the farmers so that they can share and can protect the natural problems jointly.

3.6. Livelihood improvement regarding financial capital

The possible range of livelihood status score of the farmers regarding financial capital could vary from 8 to 40 while the observed range was 15 to 36 with an average and standard deviation of 28.75 and 4.23 respectively. On the basis of financial capital scores (Table 6) of the farmers, they were grouped into three categories as “Low improvement” (15-22), “Medium improvement” (23-29), and “high improvement” (30-36).

Table 6 Distribution of the Farmers according to their Financial Capital

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low Status	13	11.61	28.75	4.23
Medium Status	38	33.92		
Highly Status	61	54.46		
Total	112	100.0		

Findings showed that vast majority of the farmers (54.46 percent) had high improvement followed by to 33.92 percent medium and 11.61 percent low improvement regarding financial capital aspects of livelihood improvement.

3.7. Overall livelihood improvement of the farmers

The observed score of livelihood improvement of the farmers ranged from 76 to 148. While the possible range was 34 to 170 (Table 4.16). The mean score of livelihood improvement was 120.22 with a standard deviation of 13.61. Based on the observed scores (Table 7) of livelihood improvement of the farmers, they were classified into three categories namely, low improvement (76-100), “medium improvement” (101-124) and “high improvement” (125-148).

Table 7 Distribution of the Farmers according to their Livelihood Improvement

Categories	Farmers		Mean	Standard Deviation
	Number	Percent		
Low improvement	11	9.82	120.22	13.61
Medium improvement	60	53.57		
High improvement	41	36.61		
Total	112	100.0		

Findings showed that, majority (53.57 percent) had medium livelihood improvement while 36.61 percent of them had high improvement and only 9.82 had low improvement. The findings implied that most of the farmers (90 percent) had medium to high livelihood improvement regarding various capitals due to the favorable condition generated by the establishment of embankment. The overall improvement in their livelihood indicates that farmers are the mostly enthusiastic to overcome hazards and they were able to cope up the situation favored. The rural livelihood mainly depends on the nature and when these natural resources are destroyed by the natural calamities then the total livelihood status becomes deteriorated in the village. The people in the study area were farmers and some were fish farmers who were dependent on their lands and ponds (gher) but due to embankment establishment these resources were protected by the embankment. By this reason their livelihood was improved. However, the farmers also took some measures to protect their lives and livelihoods.

3.8. Relationship between selected characteristics and livelihood improvement of the farmers

Livelihood improvement of the farmers studied in the study. The relationship of 10 selected characteristics of the farmers to their livelihood improvement in the selected area. In order to know the relationship of the selected 10 characteristics (independent variables) of the farmers to livelihood improvement (dependent variable), correlation analysis was done between the variables. The results of correlation analysis are shown in Table 8.

Table 8 Relationship between selected characteristics of the farmers and their livelihood improvement

Dependent Variable	Independent Variable	Correlation Co-efficient(r Value)
Livelihood Improvement	Age	-.067 ^{NS}
	Education	.419 ^{**}
	Family Size	-.015 ^{NS}
	Training Experience	.368 ^{**}
	Farm Size	.206 [*]
	Annual Income	.157 ^{NS}
	Communication Exposure	.303 ^{**}
	Organizational Participation	.180 ^{NS}
	Fatalism	.288 ^{**}
	Agricultural Knowledge	.266 ^{**}

NS =Not Significant *Significant 0.05 Level **Significant 0.01 Level

Out of 10 independent variables, the correlation coefficients of 6 variables were significant. These were education, training experience, farm size, communication exposure, fatalism, and agricultural knowledge. The coefficient of correlation indicates the linear relationship between the two variables.

3.8.1. Age and livelihood improvement

The relationship between age of the farmers and their livelihood improvement was determined by testing the following null hypothesis.

"There is no relationship between age of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concerned variables was found to be " r " = -.067 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- The computed value of " r " (r = -.067) was found to be smaller than the tabulated value (r = .182) with 110 degrees of freedom at 0.05 level of probability.
- The null hypothesis could not be rejected.
- The relationship between the concern variables was not significant and negative trend.

On the basis of the above findings the researcher concluded that age of the farmers had no significant relationship with their livelihood improvement. This meant that age of the farmers was not an important factor in livelihood improvement due to embankment establishment.

3.8.2. Education and livelihood improvement

The relationship between education of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between education of the farmers and their livelihood improvement due to embankment establishment".

The calculated value of the co-efficient of correlation between the concerned variables was found to be " r " = .419 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- The computed value of " r " ($r = .419$) was found to be greater than the tabulated value ($r = .232$) with 110 degrees of freedom at .01 level of probability.
- The null hypothesis could be rejected.
- The relationship between the concern variables was significant and positive.

On the basis of the above findings the researcher concluded that education of the farmers had significant relationship with their livelihood improvement due to embankment establishment. This meant that education of the farmers was an important factor in livelihood improvement due to embankment establishment. The more the education, the more was the livelihood improvement.

3.8.3. Family size and livelihood improvement

The relationship between Family size of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between Family size of the farmers and their livelihood improvement due to embankment establishment".

The calculated value of the co-efficient of correlation between the concerned variables was found to be " r " = -.015 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- The computed value of " r " ($r = -.015$) was found to be smaller than the tabulated value ($r = .232$) with 110 degrees of freedom at .05 level of probability.
- The null hypothesis could not be rejected.
- The relationship between the concern variables was not significant and negative.

On the basis of the above findings the researcher concluded that Family size of the farmers had no significant relationship with their livelihood improvement due to embankment establishment. This meant that Family size of the farmers was not an important factor in livelihood improvement due to embankment establishment.

3.8.4. Training experience and livelihood improvement

The relationship between training experience of the farmers and their livelihood improvement due to embankment determined by testing the following null hypothesis.

"There is no relationship between training experience of the farmers and their livelihood improvement due to embankment establishment".

The calculated value of the co-efficient of correlation between the concern variables was found to be " r " = .368 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- a. Computed value of "r" ($r = .368$) was found to be greater than the tabulated value ($r = .258$) with 110 degrees of freedom at .01 level of probability.
- b. The null hypothesis could be rejected.
- c. The relationship between the concern variables was significant and positive.

Based on the above findings the researcher concluded that training experience of the farmers had significant relationship with their livelihood improvement due to embankment establishment. This indicated that training experience of the farmers was an important factor for their livelihood improvement due to embankment establishment. The more the training experience, the more was the livelihood improvement.

3.8.5. Farm size and livelihood improvement

The relationship between Farm size of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between Farm size of the farmers and their livelihood improvement due to embankment establishment".

The calculated value of the co-efficient of correlation between the concern variables was found to be " $r = .206$ " as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- a. Computed value of "r" ($r = .206$) was found to be greater than the tabulated value ($r = .182$) with 110 degrees of freedom at .05 level of probability.
- b. The null hypothesis could be rejected.
- c. The relationship between the concern variables was significant and positive.

Based on the above findings the researcher concluded that Farm size of the farmers had significant relationship with their livelihood improvement due to embankment establishment. This indicated that Farm size of the farmers was an important factor for their livelihood improvement due to embankment establishment. The more the Farm size, the more was the livelihood improvement.

3.8.6. Annual Income and livelihood improvement

The relationship between Annual Income of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between annual Income of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concerned variables was found to be " $r = .175$ " as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- a. The computed value of "r" ($r = .175$) was found to be smaller than the tabulated value ($r = .182$) with 110 degrees of freedom at 0.05 level of probability.
- b. The null hypothesis could not be rejected.
- c. The relationship between the concern variables was not significant and negative.

On the basis of the above findings the researcher concluded that Annual Income of the farmers had no significant relationship with their livelihood improvement. This meant that Annual Income of the farmers was not an important factor in livelihood improvement due to embankment establishment.

3.8.7. Communication exposure and livelihood improvement

The relationship between communication exposure of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between communication exposure of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concern variables was found to be " r " = .303 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- Computed value of " r " (r = .303) was found to be larger than the tabulated value (r = .232) with 110 degrees of freedom at .01 level of probability.
- The null hypothesis could be rejected.
- The relationship between the concern variables was significant showing positive trend.

Based on the above findings the researcher concluded that communication exposure of the farmers had positively significant relationship with their livelihood improvement due to embankment establishment. This indicated that farmers having higher communication exposure had higher level of their livelihood improvement due to embankment establishment.

3.8.8. Organizational Participation and livelihood improvement

The relationship between Organizational Participation of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between organizational Participation of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concerned variables was found to be " r " = .180 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- The computed value of " r " (r = .180) was found to be smaller than the tabulated value (r = .232) with 110 degrees of freedom at .05 level of probability.
- The null hypothesis could not be rejected.
- The relationship between the concern variables was not significant and positive.

On the basis of the above findings the researcher concluded that Organizational Participation of the farmers had no significant relationship with their livelihood improvement due to embankment establishment. This meant that Organizational Participation of the farmers was not an important factor in livelihood improvement due to embankment establishment.

3.8.9. Fatalism and livelihood improvement

The relationship between Fatalism of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between Fatalism of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concern variables was found to be " r " = -.288 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- Computed value of " r " (r = -.288) was found to be greater than the tabulated value (r = .258) with 110 degrees of freedom at .01 level of probability.
- The null hypothesis could be rejected.
- The relationship between the concern variables was significant and negative.

Based on the above findings the researcher concluded that Fatalism of the farmers had significant relationship with their livelihood improvement due to embankment establishment. This indicated that Fatalism of the farmers was an important factor for their livelihood improvement due to embankment establishment. The more the Fatalism, the more was the livelihood improvement.

3.8.10. Agricultural knowledge and livelihood improvement

The relationship between Agricultural knowledge of the farmers and their livelihood improvement due to embankment establishment was determined by testing the following null hypothesis.

"There is no relationship between Agricultural knowledge of the farmers and their livelihood improvement due to embankment establishment"

The calculated value of the co-efficient of correlation between the concern variables was found to be " r " = .266 as shown in the Table 8. The following observations were made regarding the relationship between the two variables under consideration.

- Computed value of " r " (r = .266) was found to be larger than the tabulated value (r = .232) with 110 degrees of freedom at .01 level of probability.
- The null hypothesis could be rejected.
- The relationship between the concern variables was significant showing positive trend.

Based on the above findings the researcher concluded that Agricultural knowledge of the farmers had positively significant relationship with their livelihood improvement due to embankment establishment. This indicated that farmers having higher Agricultural knowledge had higher level of their livelihood improvement due to embankment establishment.

4. DISCUSSION

Livelihood improvement regarding human capital score of the farmers regarding human capital could vary from 8 to 20 while the observed range was 8 to 18 with an average and standard deviation of 13.77 and 1.64 respectively. Findings showed that vast majority of the farmers (85.21 percent) had medium improvement compared to 5.35 percent low and 8.93 percent high improvement regarding human capital aspects of livelihood improvement.

Livelihood improvement regarding natural capital improvement score of the farmers regarding natural capital could vary from 7 to 35 while the observed range was 13 to 32 with an average and standard deviation of 25.37 and 3.02 respectively. Findings showed that vast majority of the farmers (80.36 percent) had medium improvement compared to 6.25 percent low and 13.39 percent high improvement regarding natural capital aspects of livelihood improvement.

Livelihood improvement regarding physical capital improvement score of the farmers regarding physical capital could vary from 7 to 35 while the observed range was 14 to 33 with an average and standard deviation of 24.83 and 3.37 respectively. Findings showed that vast majority of the farmers (77.68 percent) had medium improvement compared to 12.5 percent low and 9.82 percent high improvement regarding physical capital aspects of livelihood improvement.

Livelihood change status regarding social capital improvement score of the farmers regarding social capital could vary from 8 to 40 while the observed range was 14 to 34 with an average and standard deviation of 28.75 and 4.23 respectively. Findings showed that vast majority of the farmers (46.43 percent) had high improvement followed by 43.75 percent medium and 9.82 percent low improvement regarding social capital aspects of livelihood improvement.

Livelihood improvement regarding financial capital improvement score of the farmers regarding financial capital could vary from 8 to 40 while the observed range was 15 to 36 with an average and standard deviation of 28.75 and 4.23 respectively. Findings showed that vast majority of the farmers (54.46 percent) had high improvement followed by 33.92 percent medium and 11.61 percent low improvement regarding financial capital aspects of livelihood improvement.

Overall livelihood improvement of the farmers

The observed score of livelihood improvement of the farmers ranged from 76 to 148 percent while the possible range was 34 to 170. The mean score of livelihood improvement was 120.22 with a standard deviation of 13.61. Findings showed that, majority (53.57 percent) had medium livelihood improvement while 36.61 percent of them had high improvement and only 9.82 had low improvement.

Relationship between selected characteristics and livelihood improvement of the farmers

The relationship of 10 selected characteristics of the farmers to their livelihood improvement in the selected area. In order to know the relationship of the selected 10 characteristics (independent variables) of the farmers to livelihood improvement (dependent variable), correlation analysis was done between the variables. The results of correlation analysis are shown in Table 4.3.

Out of 10 independent variables, the correlation coefficients of 6 variables were significant. These were education, training experience, farm size, communication exposure, fatalism, and agricultural knowledge. The coefficient of correlation indicates the linear relationship between the two variables.

5. CONCLUSION

The study showed that 70 percent of the farmers medium to high livelihood improvement regarding various capitals which is very positive issues for the farmers in their life; the farmers are enthusiastic to the embankment establishment and improve their capital. Thus, it can be concluded that planned infrastructural intervention like embankment establishment brings positive effects in their livelihood. The extents of improvement of livelihood regarding five capitals were different. Nevertheless, the highest portion of the farmers had high improvement in financial capital followed by social capital and on the other hand highest proportion of the farmers achieved medium improvement in physical and natural capital. Therefore, it can be concluded that embankment establishment mostly improves the farmers' financial and social capitals.

The study revealed that level of education of the farmers had highly positive and significant relationship with their extent of improvement of livelihoods due to embankment. Majority (90.7 percent) of the respondents had education with varying extent. Education brings a positive change in the behavior of human life and enhances the ability of individuals to pursue some activities that leads a desirable goal. Thus, it may be concluded that having higher education for farmers is an important factor for bringing improvement in their livelihood. Correlation test showed that training experience positive and significant relationship with their extent of livelihoods improvement. Majority (62 percent) had training experience with varying duration. It may be seen that this characteristic of the farmers have good link with the farmer's livelihood improvement. Thus, it can be concluded that training experience of the farmers may be considered while any planned program regarding livelihood improvement is taken up for the development of the livelihood status in the locality.

5. RECOMMENDATIONS

Recommendations for policy implications

- The recommendations for the study were formulated on the basis of the major findings, conclusions and expert views of the key informants. In order to improve the livelihood of the farmers, a number of measures need to be taken both by major intervening agencies, such as governmental organizations (GOs), non-governmental organizations (NGOs) and the community-based organizations (CBOs). Some of the strategic actions are mentioned below:
- Majority of the farmers improved their livelihood status after embankment establishment. So this will help the farmers for analyzing the situation and applying the knowledge for creating the new things and improved technologies to uplift their livelihood status. So, concerned authority should supervise that no adverse situation occur from embankment. They should maintain repairing the embankment structure time to time. The various GOs and NGOs should be involved in the conduction of various livelihood improvement program.
- It is seen that among the capitals, financial capitals of the farmers mostly were improved. So financial resources and opportunities should be conserved in order to utilize in the future generation. The newer financial resources and opportunities should be commenced by GOs and NGOs initiatives in this locality like establishment of agro-processing and small cottage industries should be established by the concerned authorities. As a result, farmers can earn more money, enlarge farm size and ultimately, bringing the positive change in their livelihood improvement.
- As education acted as an important factor for improving livelihood status of the farmers, it is, therefore, recommended that proper steps should be taken to increase the level of literacy of the farmers. Educated farmers might have opportunity for making working opportunity, decision making for proper utilization of natural resources and others resources for improving their livelihood status.
- As training experience, communication exposure, agricultural knowledge acted as an important factor for improving livelihood status of the farmers, it is, therefore, recommended that proper steps should be taken to increase the opportunity in the locality so that farmers can get more training experience, communication exposure and increase agricultural knowledge which ultimately improve livelihood through improving human capital. Farmers faced a lots of problem in their farming and daily life due to adverse climatic conditions. In order to reduce problems faced by the farmers in farming practices, the GOs and development agencies should motivate farming communities to adopt long-term climatic hazards mitigating measures like adoption of saline tolerant varieties, crop diversification, integrated farming, agro forestry, home gardening and improvement of soil management practices.

Recommendations for further studies

There is huge opportunity to pursue further research related to change of livelihood status of the farmers in the study area. Some of them are listed below.

- Further research can be undertaken to study specific farmers groups, such as landless farmers or young farmers so as to get a clear understanding of extent of the livelihood improvement.
- The current research has pointed out 34 important factors affecting the extent livelihood improvement of the farmers. However, other important factors like could be incorporated while conducting research in future.
- An attempt to conduct few case studies with regard to get in-depth information about the livelihood status and probable consequences of the livelihood improvement of the farmers due to embankment establish can be considered in future research.

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