Article

Sustainable rural livelihood-based approach on the impacts of climate change on small-scale fish farmers of Noakhali, Bangladesh

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Abstract: Climate change is a very common phenomenon which may affect rural livelihoods. A sustainable rural livelihoods approach was taken for this study to observe household incomes and any impact of climate to the livelihoods. It was found that there was negative correlation (Pearson value -0.449) to the income of males and females in 2014. Assumption of impact of climate change on income was not statistically significant in male farmers while it was statistically significant (Pearson value 0.332) in the year 2013 for female respondents. This current study suggests diversification in income generating activities and introduction of fair trade for betterment of the fishers.

Keywords: sustainable rural livelihood; fishers; climate change

1. Introduction

Noakhali is a coastal district of Bangladesh in which lot of people are dependent on fisheries sector. Aquaculture and capture fisheries practices have significantly increased in the recent years. DoF-DANIDA played a very important role in doing so as it is well known that fish is one of the main sources of protein for the poor (Jia et al., 2001). Bangladesh is a highly populated country the population of which has an increasing trend. Regular production costs and benefits from aquaculture ponds were found to be satisfactory in a study, the results of which were confirmed by another study (Hasan and Bhowmik, 2016).

A rural livelihood is sustainable when it can cope with stresses and shocks and also can adapt to vulnerabilities to lead life sustainably (Hoon et al., 1997). DFID’s sustainable livelihood framework is to reflect holistically about the susceptibility features poor might be unprotected to, the assets and resources that care them prosper and live, and the plans and institutions (Government and non-government organizations). The framework exhibits how sustainable livelihoods are achieved through access to a diverse livelihood resources that are collective in the hunt of livelihood strategies. Diverse resources are essential to obtain positive livelihood outcomes. This current study has considered livelihood assets of very poor 50 male and 50 female fishers and their yearly incomes from fisheries resources in the changing climate of Noakhali.

2. Materials and Methods

Widespread field visits, meetings and personal communications were done to study the ruling categories of fish farming in Noakhali. People who had worked for NGOs and Government informed about the aquaculture practices in the different levels and the poor households. Key informants also gave information about the susceptibilities, adaptation and livelihoods of fish farmers. Familiar meetings were set with the informants. Focus Group Discussions (FGDs) with the poor farmers were arranged to have better ideas of the vulnerability context and their resilience to those vulnerabilities. Questionnaire was used during the interviews (Hasan and
3. Results and Discussion

Year-wise data of income from 50 male farmers and 50 female farmers were collected for the period of 2010-2015 to have a little idea if there is any effect of the changing climate of these years incomes of the farmers (Table 1). It was found that yearly incomes were decreasing for both males and females who were involved somehow with fish farming. It was found that in some years, female incomes had been positively and negatively affected by male incomes (Table 2 a-f). There was negative correlation (Pearson value -0.449) in the income of these selected poor male and female farmers in 2014 where the correlation was significant at the level of 0.01.

**Table 1. Male and female respondents’ income during 2010 to 2015 (males at left) in Taka.**

| Year | Male Income | Female Income |
|------|-------------|---------------|
| 2010 | 24000       |               |
| 2011 | 23500       |               |
| 2012 | 23800       |               |
| 2013 | 20000       | 19000         |
| 2014 | 15000       | 15000         |
| 2015 | 18000       | 18000         |
| 2010 | 17000       | 12000         |
| 2011 | 12000       | 10000         |
| 2012 | 12000       | 6000          |

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Bhowmik, 2016) and data were finalized about the yearly profits from fisheries for the rural livelihoods. SPSS software was used for statistical analysis.
Table 2a. Relationship of yearly incomes of males and females in 2010 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | 0.162  |
| Significance (2-tailed) | 0.261  |

Table 2b. Relationship of yearly incomes of males and females in 2011 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | 0.257  |
| Significance (2-tailed) | 0.072  |

Table 2c. Relationship of yearly incomes of males and females in 2012 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | -0.055 |
| Significance (2-tailed) | 0.706  |

Table 2d. Relationship of yearly incomes of males and females in 2013 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | -0.104 |
| Significance (2-tailed) | 0.472  |

Table 2e. Relationship of yearly incomes of males and females in 2014 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | -0.449 |
| Significance (2-tailed) | 0.001  |

Table 2f. Relationship of yearly incomes of males and females in 2015 (N=50).

|       | Female |
|-------|--------|
| Male  |        |
| Pearson Correlation | -0.198 |
| Significance (2-tailed) | 0.168  |
Figure 1. Scatter plots showing the linearity level of male and female incomes from 2010 to 2015.

Figure 1 shows that male and female incomes in scatter-dot plots during the period of 2010 to 2015. In most of the years their income did not show linearity.

The vulnerabilities regarding the incomes of poor farmers are listed in Table 3.
Table 3. List of vulnerabilities faced by the poor fish farmers.

| Serial no. | Shocks, trends and seasonality pattern (Vulnerabilities)                      |
|------------|--------------------------------------------------------------------------------|
| 1.         | Increased storms and storm surges                                             |
| 2.         | Stagnant water bodies                                                         |
| 3.         | Salinity intrusion                                                            |
| 4.         | Diseases                                                                      |
| 5.         | Introduction of new dengue fever                                               |
| 6.         | Increased amount of rain in the rainy season                                  |
| 7.         | Marketing problem due to lot of intermediaries                                |
| 8.         | Lack of fare trade                                                            |

Table 4. Correlations between the impact of climate change and male income.

| Impact of climate change | Male 2010 | Male 2011 | Male 2012 | Male 2013 | Male 2014 | Male 2015 |
|-------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Pearson Correlation     | 0.125     | 0.021     | 0.102     | 0.188     | 0.230     | -0.101    |
| Significance (2-tailed) | 0.386     | 0.883     | 0.479     | 0.191     | 0.108     | 0.484     |

Table 5. Correlations between the impact of climate change and female income.

| Impact of climate change | Female 2010 | Female 2011 | Female 2012 | Female 2013 | Female 2014 | Female 2015 |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Pearson Correlation     | -0.031      | 0.003       | -0.114      | 0.332       | 0.260       | -0.181      |
| Significance (2-tailed) | 0.831       | 0.984       | 0.431       | 0.018       | 0.069       | 0.209       |

Male and female respondents (Yes=1, No=0), mentioned that there was increased vulnerability for changing climate which have affected their incomes. A correlation test has been mentioned in Table 4 where it was found that there was no statistical significance showing the impact of climate change on their income. But in case of
female farmers, there was statistical significance at the level of 0.05 which mentions that there was impact of changing climate on their income in 2013 (Table 5).

DANIDA with Department of Fisheries had been playing a very important role in the development of aquaculture and fisheries in the district of Noakhali through Regional Fisheries and Livestock Development Component project which ended in 2012 (Ahmed and De Wilde, 2011). From the income data of the poor farmers, it was found that there was a decreasing trend in income after 2012. Personal communications (Giasuddin, 2015) also mentioned the fact that many fish farms which were being provided technology closed farming of some species after the international organization left. A list has been provided in this study mentioning the vulnerabilities of fish farmers. Authors think lack of fare trade is the most important vulnerability than the climate change that impact on fishers income. Vietnam coffee farmers have opportunity to fare trade which means that they can get higher price for their product. Establishment of fare trade in this area for fish is very important so that the farmers can get the price if they could sell their products directly in towns or could export. Minimizing the intermediaries are very important.

Table 6. Usual costs and revenues from aquaculture in the area.

| Cost and revenue USD/ha/year | Community ponds | Paddy lands |
|-----------------------------|-----------------|-------------|
| Total Costs (TC)            | 704.96          | 369.60      |
| Total return (TR)           | 1610.29         | 732.38      |
| Net revenue                 | 905.33          | 362.78      |
| Benefit-cost ratio          | 2.28            | 1.98        |

Source: Hasan and Bhowmik (2016)

Table 6 has been retrieved from Hasan and Bhowmik (2016) which mentions the usual production costs and revenues from different types of farming system mostly available in Noakhali. Diversification has been suggested for increasing incomes of the fishers (Hasan et al., 2014) that can bring more money when agricultural practices are included with fish farming practices. The poor farmers who have a pond can produce vegetables and fruits besides their ponds or start cattle farming. Proper natural resource management plan can be introduced to help the poor farmers. Bangladesh partially as a result of noteworthy benefactor support, implemented stocking and culture-based practices of fisheries as national strategies to support a fast-rising population (Valvo and Thompson, 2007). The Department of Fisheries, Government of Bangladesh has been in charge for managing the quick development of fish farming in Bangladesh with a perception on giving attention to poverty (Ahmed and De Wilde, 2011). Shocks, trends and vulnerabilities found in this study was similar to the previous studies held in this area that affect the livelihood assets. However, Government of Bangladesh along with International Organizations had provided technical support to help in ‘transforming structures and processes to the development of farmers livelihood’ which has been a part of the DFID’s Sustainable Rural Livelihood (DFID, 1999).

4. Conclusions

The climate change vulnerabilities might affect the fish farmers. Government of Bangladesh has taken climate change strategy plans which should help the farmers (MoEF, 2008). Additional technology provided through the fisheries extension activities along with supporting in developing alternative income generating activities may help the farmers to be more resilient to climate change.

Conflict of interest

None to declare.

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