ASSET BASED PROFILE APPROACH FOR UNDERSTANDING DIFFERENTIATED VULNERABILITY AND RESILIENCE OF COASTAL HOUSEHOLDS IN THE CONTEXT OF CLIMATE CHANGE

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ABSTRACT

There is growing recognition that people living in the coastal area are highly vulnerable to climate variability and change but they are also resilient as they already, consciously and/or unconsciously, adapting to climate change impacts, both in physical and behavioural terms. The level of vulnerability and resilience are differentiated in nature, depending on assets and capabilities of the households. Therefore, this research intends to identify differentiated nature of vulnerability and resilience of households in the context of climate change through using 'asset-based profile approach'. The mixed method research strategy was adopted in this research. Specific methods utilised for the data collection process included questionnaire surveys and 98 households are considered as the samples for this study. The significance of the results was in the differences of the vulnerability and resilience of the households into different asset profile which revealed a complex relationship within asset, vulnerability and resilience. This research also highlighted that the households with limited asset and high vulnerability could be highly resilient through adopting a significant number of adaptive strategies to deal with climatic hazards with also having the results in contrast where households rich in asset profile and with low vulnerability prove to be less resilient. Moreover, this research is an attempt to reveal the role of assets in understanding differentiated nature of vulnerability and resilience of coastal households in Bangladesh that would be helpful to develop an effective disaster risk reduction framework in the context of climate change.

Keywords: Climate change, index, asset profiles, vulnerability, and resilience.

Introduction

In the recent time a serious exploration is conducting by the scientific community to conceptualize the relationship between asset, vulnerability and resilience, particularly in the context of climate change. This research is framed to contribute this integrated thinking of asset, vulnerability and resilience that may provide a useful framework in the context of climate change. As policy planning, decision making and planning for adaptation gained currency among the governments, organizations and stakeholders, the framework integrates asset, vulnerability and resilience will be more powerful concept to guide it.

The asset based approach traces its beginnings to Amartya Sen`s vulnerability conceptualization, focusing on famine and food insecurity to explain vulnerability to famine due to production failure and shortage of food which leads to failure to entitlements and shortage of capabilities (Sen,1981). It does not explain differential vulnerability and resilience within some communities and between same communities facing the same crisis event. Most of the researchers on vulnerability has focused only the negative qualities and characteristics of vulnerability without considering the inherent resilience or capacities of an individuals or communities on which programs and resource can built to resist, recover and cope with climate change and extreme events (Joakim, 2008). Though a community is experiencing vulnerability it can have some resilience and capacity to adopt and transform. Usamah et al. (2014) stated that, settlement may have signs of vulnerability associated with poverty and exposure to hazards, but simultaneously they can have aspects contributing to their resilience such as social cohesion and social networks that can counterbalance the vulnerable condition.

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To understand differentiated nature of vulnerability and resilience of coastal population, it is essential to analyse asset, vulnerability and resilience nexus, though only a few researches have attempted to build an interrelationship between asset, vulnerability and resilience. Incorporating these three concepts into an integrated framework can advance research thinking, policy and practice in the context of climate change, particularly when the knowledge gained from asset and vulnerability research will integrated with the concept of resilience.

Study Area

Chila and Burirdanga Union of Mongla Upazila under Bagerhat District is selected as the study area in this research. These two union is located in between 22°20'55.687" and 22°34'33.198" north latitudes and in between 89°33'26.107" and 89°43'10.86" east longitudes. World largest mangrove forest is situated at the southern part of this union with having Poshur river in the west.

Methodology

Data Collection

Data were collected through questionnaire survey of 98 sampled households. The data were collected between August 01 and August 30, 2018. Stratified random sampling technique is adopted to conduct this research. At first, Mongla Upazila is divided into five zones based on the distance from the cost and a number of random grids is generated using ArcGIS 10.3 for Chila and Burirdanga union. Among all of the grids six grid is randomly selected for each of the union which also incorporated equal distribution of grids among the zones. At the end, number of samples was allocated based on the concentration of the households in each grid using google earth.

Analytical Framework

To establish the asset, vulnerability and resilience differential of the households the asset index, household vulnerability index and resilience index was calculated. The variables that are selected for the calculation of these indices are given in the Appendix.

Indexing Method: As each of the sub-components used is measured on a different scale, it is first normalized to make the sub-components comparable using the methodology developed for the calculation of the Human Development Index (UNDP,2007) to calculate the life expectancy index. Eq.1 is used for the normalization of the sub-components with positive functional relationship and Eq.2 is used for the normalization of the sub-components with negative functional relationship.

$$Index\ S_{B_x} = \frac{S_{B_x} - S_{min}}{S_{max} - S_{min}} \tag{1}$$

$$Index\ S_{B_x} = \frac{S_{max} - S_{B_x}}{S_{max} - S_{min}} \tag{2}$$

Here, *Index* S_{B_x} is the normalized index value of the sub-components for a household, S_{B_x} is the original value of the sub-components of a household, and S_{max} and S_{min} are the maximum and minimum values, respectively, for each sub-components determined using data among the households. After normalization, the sub-components are averaged using Eq. 3 to calculate the value of each major component. The same approach was used by Hahn et al (2008) for the calculation of livelihood vulnerability index.

$$M_{Bx} = \frac{\sum_{i=1}^{n} Index_{Bx^i}}{n} \tag{3}$$

M_{Bx} represents the value of one of the major components for a household, $Index_{Bx^i}$ *is* the subcomponents, indexed by *i*, that makes up each major component and n is the number of sub-components in each component. The household level asset index (AI), livelihood vulnerability index (LVI) and resilience index (RI) is calculated as the weighted average of the nine major components using Eq. 4

$$AI\ or\ LVI\ or\ RI = \frac{\sum_{i=1}^{7} W_{Mi} M_{Bx}}{\sum_{i=1}^{7} W_{Mi}} \tag{4}$$

Where, AI, LVI and RI are respectively the asset index, livelihood vulnerability index and resilience index for a household and W_{Mi} is the weightage of the major components.

Results and Discussion

The asset index (AI) is juxtaposed with livelihood vulnerability index (LVI) and resilience index (RI) here, so as to classify households with different asset profile in terms of these two indices. The results of the juxtaposition of the asset and vulnerability indices and asset and resilience indices computed for the purpose of this study, are shown graphically in Figure 01 and Figure 02 respectively.

It can be seen that the household's asset and vulnerability indices and asset and resilience indices represented by the blue markers respectively in Figure 01 and Figure 02, occupy the four quadrants of the diagram, with households registering varying asset profile, vulnerability and resilience group. The boundaries of the quadrants were set as the average score of each of the indices. At last, vulnerability and resilience differential in different asset profile is discussed following the preceding analysis Figure 03.

Juxtaposing Asset, Vulnerability and Resilience

The predictive power of the linear regression model juxtaposing asset and vulnerability shown in Figure 01 is significant $(R^2 = 0.40, p \leq 0.001)$ and it is statistically 40% successful while predicting the household's livelihood vulnerability in terms of their asset. The equation for the fitted line between the asset and vulnerability is *LVI= 0.747669-(0.742622*AI)* and a strong negative correlation with *Pearson Correlation Coefficient -.630* is also evident which elicit that with the increase in the asset of the households the vulnerability is reduced. Likewise, for asset and resilience juxtaposition, predictive power of the linear regression model shown in Figure 02 is significant $(R^2 = 0.35, p \leq 0.001)$ and it is statistically 35% successful while predicting the household's resilience in terms of their asset. The equation for the fitted line between the asset and resilience is *RI= 0.180516+(0.770513*AI)* and a strong positive correlation with *Pearson Correlation Coefficient .593* is also evident which elicit that with the increase in the asset of the households the resilience power also increases.

Though it is only one side of the coin, for more detail understanding of the asset, vulnerability and resilience differential, asset in terms of vulnerability index (LVI) and resilience index (RI) is juxtaposed. Four possible categories are identified for both the asset and vulnerability juxtaposition and asset and resilience juxtaposition into which households can be placed according to their asset, vulnerability and resilience characteristics. For asset and vulnerability juxtaposition four categories are identified which are respectively represented as households with high asset profile and high vulnerability, households with high asset profile and low vulnerability, households with low asset profile and high vulnerability and households with low asset profile and low vulnerability Figure 01.
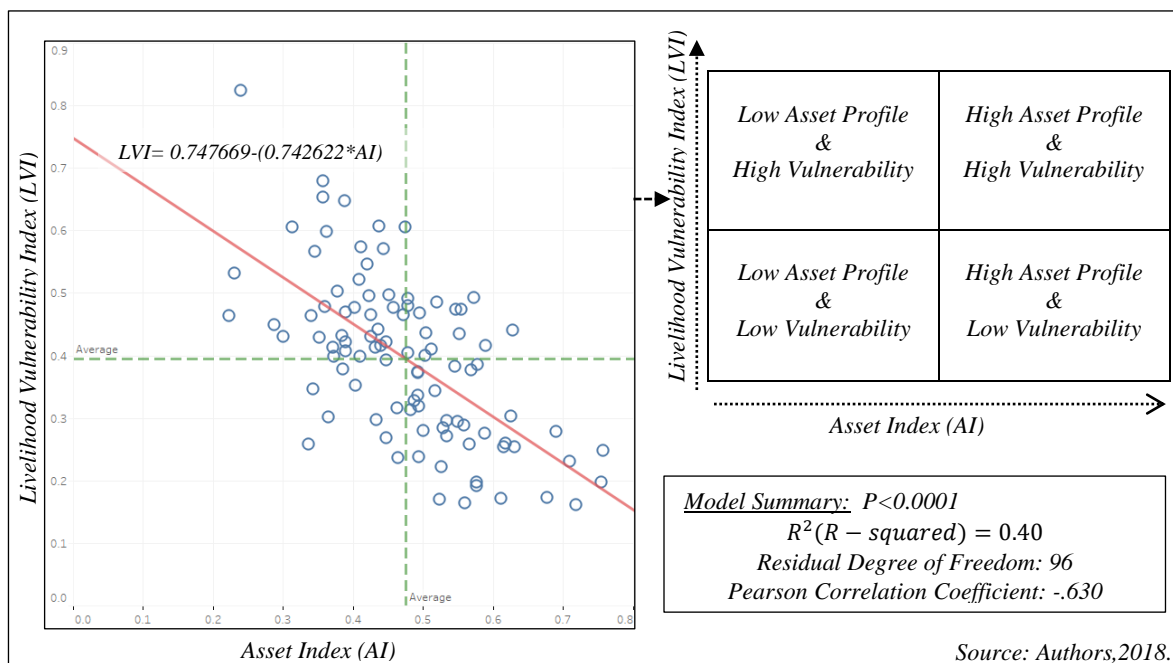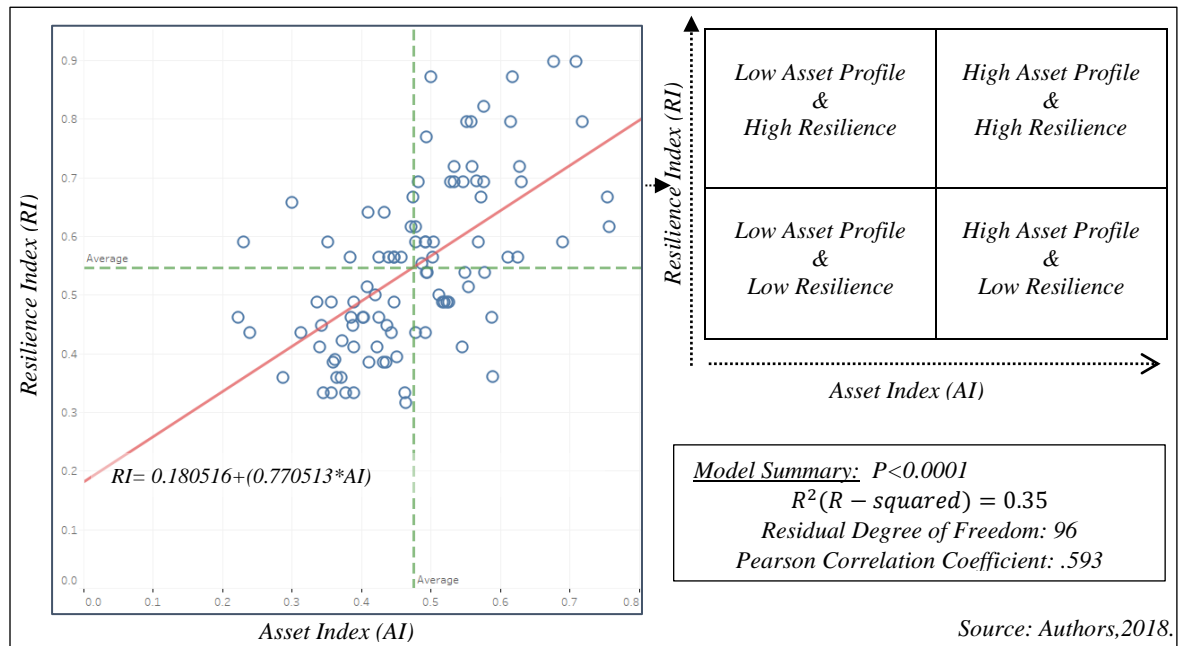

**Figure 01.** The asset and vulnerability indices, juxtaposed

Likewise, for asset and resilience juxtaposition four categories are identified which are respectively represented as households with high asset profile and high resilience, households with high asset profile and low resilience, households with low asset profile and high resilience and households with low asset profile and low resilience Figure 02.

Figure 02. The asset and resilience indices, juxtaposed

Vulnerability and Resilience Differential in Different Asset Profile

The preceding analysis revealed that a household with low asset profile can have low vulnerability and high resilience power whereas in some case households with high asset profile can be more vulnerable and less resilient in the context of climate change. It is different than the common scenario of asset, vulnerability and resilience relationship where the increase of the asset of the household's will always decrease vulnerability and increase resilience power. To categories households in terms of their asset, vulnerability and resilience differentials resilience index (RI) and livelihood vulnerability index (LVI) is overlapped with the asset profile and eight categories are identified which are illustrated in Figure 03.
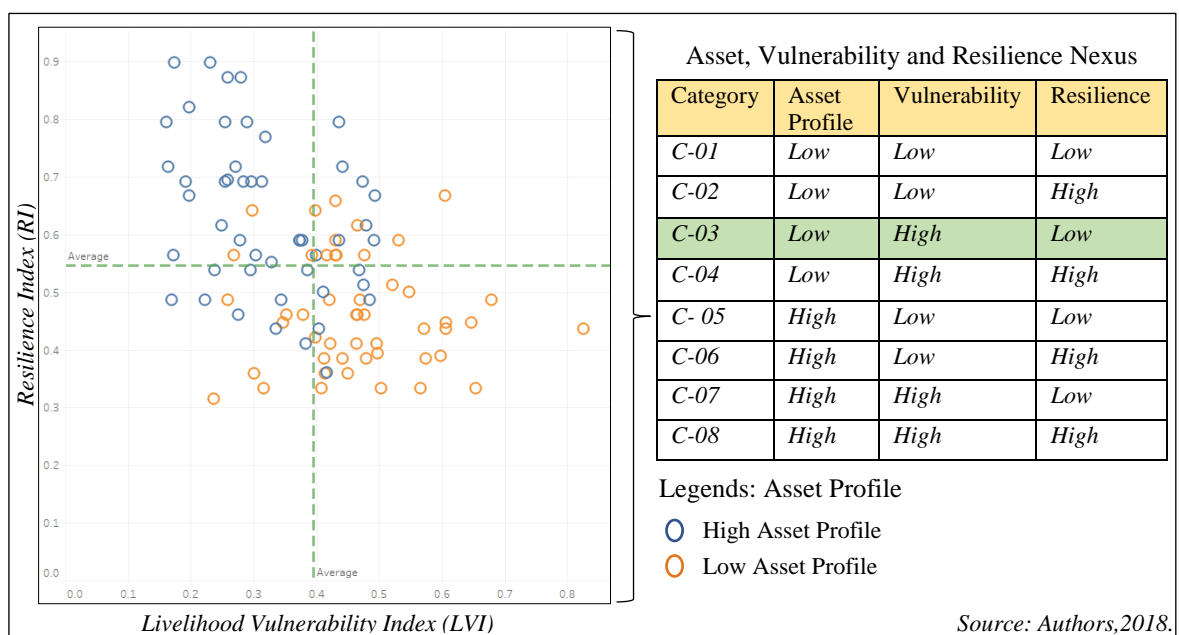
Figure 03. Vulnerability and resilience differential in different asset profile

So, in terms of asset, vulnerability and resilience differential a household can be categorized under any of these eight categories. In decision making consideration of asset, vulnerability and resilience is important for the selection of appropriate beneficiaries or participants such as, category three households need to give the highest priority in terms of any crisis event as their asset is low with having high level of vulnerability and low level of resilience.

Conclusion

Households with different asset profile experiencing similar exposure to a climatic extreme can have different level of vulnerability and resilience over time. Although they are faced with vulnerability relating to geographical location, tenure insecurity, social exclusion, inadequate infrastructure and political bias in resource distribution, they have perceived themselves resilient in terms of climatic variability and change due to having strong social cohesion, economical and physical adaptation practices, where physical, social, natural, financial and human capital plays differentiated role. The discrete view of asset, vulnerability and resilience can mislead planners and decision makers to manage crisis event. To achieve a deeper understanding of disaster risk reduction framework it is essential to focus on the nexus between asset, vulnerability and resilience that would help to assess hazards more holistically.

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Appendix

Indexing Type	Major Components and Sub-Components
Asset Index	***Human Capital:*** Skilled member, able bodied member, no. of earning member, vocational training, disaster management training, knowledge about modern farming techniques. ***Natural Capital:*** Acreage of Land ownership, access to open water fishing, access to khas land, access to firewood from forest. ***Financial Capital:*** Have cash savings, have savings in Bank/NGOs, amount of remittance, family members employed in formal sector. ***Social Capital:*** Having assistance from relatives/friends/ extended family members, having inherited property, having membership in the NGO`s microfinance project, having membership in locally organized committee or samiti, having contracts with local elites, number of social safety nets. ***Physical Capital:*** Having television or radio, types of housing, number of owned bicycles, hygienic sanitary latrine, access to cyclone shelter, having affordable means of transport, drinking water quality, adequate water supply, water reservoir ownership, access to electricity, having jewelry.
Livelihood Vulnerability Index	***Physical Vulnerability:*** Number of natural disasters during the last 10 years, average. months/days homesteads remained inundated due to cyclone or flooding, duration of stagnant water due to rain or flood, duration of waterlogging in the agriculture field, frequency of flash flood, average height of water during flood, average time to reach nearest health center, average time to reach nearest vehicle station, average cost of reaching health center, acreage of land ownership, average time to reach to the cyclone shelter, amount paid to buy water from private /NGOs developed water plant, chance of

	losing land due to river erosion, do not have access to rehabilitation aid after disaster, unavailability of vehicles to evacuate people and livestock, do not have access to food relief in disaster time, do not have access to early warning system, drinking water sources affected/damage during heavy rains, cyclone, storm surge and storms, households do not have vehicles to use for evacuation, condition of dwelling unit, unhygienic sanitation. ***Social vulnerability:*** Disconnected from extended family members/relatives/friends, excluded from the community, having seasonality effect on household's income and consumption, HH head/adult members engage in hazardous and risky activities, existence of women insecurity, child labor in the family, having disability/chronically illness in the family, access to social safety nets program, amount of remittance support, amount of loan. ***Political Vulnerability:*** HH heads and adult members have lack of mobility in community activities, tenure insecurity, political violence in the community, political bias in distributing safety nets, government development activities fail or have minimal effects on minimizing impacts of climate induced hazards, political influence in rehabilitation programs, corruption of political leaders in post hazard reconstruction programs, political bias in hazard time relief distribution
Resilience Index	***Housing:*** Making houses on raised plinths, elevated courtyard, tree plantation around the house, repair or rebuild house with hardy materials, climate proofing construction, change of housing location, special techniques for hazard mitigation, elevated latrines to avoid spread of diseases, cooking on elevated platforms. ***Livestock:*** Raised platforms used for cowsheds, poultry kept inside houses during hazard, move the animals to elevated platforms or land. ***Fish:*** Changes of fishing locations, build embankment to reduce risk of being flooded shrimp and open water aquatic resources, fishing ponds protected with nets and barriers. ***Agriculture and crops:*** Adopt crop varieties, adopt climate resilient crop types, changing irrigation techniques, use of canals for irrigation. ***Source of water:*** Renovation of ponds for freshwater and aquaculture, build rain water reservoir in the house/ community, involving with community-based water supply system, establish tube well in newly built house. ***Infrastructure:*** Regular maintenance of infrastructure of the village, canal rehabilitation through channelization, removal of obstacle in drainage system to reduce congestion, collective maintenance of common facilities such as school and mosque for emergency response, construction of robust infrastructure. ***Dykes:*** Raise elevation of the dykes, planting tree near the river bed, conservation of mangrove plantation. ***Social adaptation:*** Regular saving from family income, adoption of weather information products, attending capacity building training provided by GO/NGO, household making coalition with NGO`s/ Donor`s organizations, HH engaging in community-based organization, participating in social convention, having membership of the political party, maintaining networks with political elite.