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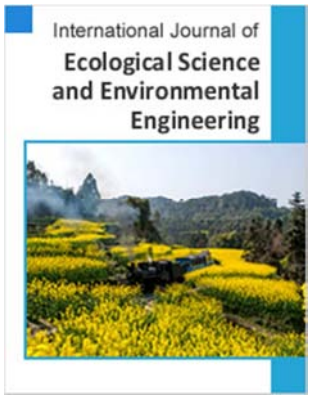

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Assessment of Community Capacities against Cyclone Hazard to Ensure Resilience in South Central Coastal Belt of Bangladesh

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Abstract
The study was conducted in Chawra Union under Barguna district which is one of the lower administrative units of low lying deltaic coastal region of Bangladesh. The study area is subject to seven types of natural disasters that are occurring more frequently in greater intensities along with prominent human activities. The study mainly concentrates on assessing disaster risk through prioritizing the major natural hazards, assessing vulnerabilities and capacities in the study area. The interaction between the hazard, Physical, Environmental, Social and economic vulnerability is discussed and combined in an equation for risk calculation. The study also demonstrates factors that are considered the empowerment of communities' capacity against cyclone in aspects of socio-economic conditions among the coastal communities. Both primary and secondary information was incorporated in the study. Primary information was collected through Household Survey, Focus Group Discussion, Key Informants Interview and necessary secondary information were collected from internet sources. The study revealed that shocking cyclone, underhanded river erosion, excessive rainfall, severe thunderstorm etc. are the major natural hazards in the locality and the risk of thunderstorm (0.758) got most priority comparing to others existing risk in the Chawra Union. Though the cyclones hazard and vulnerability is the highest but due to its strong capacity it got less priority comparing to thunderstorm. The study is found that communities are capacitated in terms of Physical (.750), Social (.704), Economic (.681), Human (.647) and Environmental (.701) capacity against cyclone and their total effectiveness to capacity (.70) is closely to medium level. Such information is vital to develop optimal intervention measures that will build resilience and reduce vulnerability in the study area.

1. Introduction

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 [2], [4], [8], [9], [13], [17], [21]. Bangladesh is one of the utmost disaster-affected countries in the world [22]. Although Bangladesh has a disaster management system, it does not empower communities to manage risks in aspects of capacity building. The coastal areas of Bangladesh are disaster prone due to its geographical location. The coastal region of Chawra Union under Barguna district of Bangladesh is situated within a hazard-prone region and exposed to a variety of natural disasters such as floods, cyclones, salinity intrusion, thunderstorm, hailstorm etc. Geographical location, rapid population growth, uncontrolled development and unmanaged expansion of infrastructure are the most common factors that result in more people being vulnerable to natural hazards than ever before [16].

Disaster Risk Assessment is an important tools to identify the dominated risk that harm the coastal communities' in the Chawra Union. Computation of disaster risks differ between communities and experts. The Coastal people who are involved in disaster risk assessment must have a clear understanding of the cross-cutting combination of vulnerability and hazards [23]. The study mainly concentrates on identifying some noticeable hazards in the study area that were selected on the basis of their frequency and severity. Understanding of the elements of risk is a prerequisite for the correct assessment of disaster risks. Hazard potential, Vulnerability and capacity factors were first resulting on the basis of communities and expert opinions. A combination of these factors was then used to create an integrated total risk assessment for different climatic shocks that addresses the social, economic, physical and environmental vulnerability in the study area. The study is also exploring capacities (e.g. physical, economic, Human, Environmental etc.) against Cyclone that were adopted by the local communities in the Chawra Union of Barguna District in Bangladesh.

2. Materials and Methods

In the study area, sixty households were selected for conducting the research. The study only focused on sixty households that were purposively selected for directing the research. The selected respondents' households were not representative of a larger sample, but they were cases which demonstrated different contexts. Individuals in a total of sixty households were preferred who had suffered from damage of disasters and develop their socio-economic conditions in aspects of resiliency. Moreover, different extreme poor household's compositions such as female headed, male headed, and female managed, larger family and religious minorities were also kept in mind when selecting the sample. Ten focus group discussions were organized for conducting the research. These groups were also comprised of men and women. This method was very effective to authenticate the opinion of communities and key informants personnel. It also provided useful information in a short period of time for understanding the real conditions of local communities in the study area. The research also conducted key informants interview such as four Key Informants Interviews among the local representatives and School teachers and seven Key Informants Interview among NGO Officers. In order to get socio-demographic information of selected households, baseline surveys have been used for shepherding the research. Similarly during qualitative field work, the study also collected detailed information on their socio-demographic status after different disasters. This information helped to compare change over time.

For supporting the first objectives, disaster risk assessment equation (H×V/C) was used. It incorporates three important issues such as hazard vulnerability and capacity value in the study area and finally risk is calculated for specific hazards in the study area. The different indicators are evaluated, weighted and integrated into the risk assessment equation. Moreover, to support second objective, the research have been identified five types of capacities (Physical, social, economic, environmental and social) to cope with cyclone and ranked them based on their effectiveness. And the total effectiveness of five types of capacities were incorporated to identify the conditions of community capacity in aspects of resilience.

3. Results and Discussions

3.1. Disaster Risk Assessment

3.1.1. Communities Hazard Assessment

The study area is facing tremendous rate of natural hazards. Because of the limitations on data availability, only seven hazard types have been selected for investigating the research. These seven major hazards (Such as cyclone, floods, excessive rainfall, thunderstorm etc.) are undoubtedly very important for study area and they all threaten local communities. Each type of hazard has its own explicit appearances with respect to intensity and frequency. That's why it is impossible to come up with a single classification for all hazard types. Each hazard type was therefore initially calculated on the basis of the combined frequency and intensity for each hazard. Some types of hazard are more significant (in terms of frequency and intensity) than others and different weights have therefore been assigned accordingly. The hazard priority index is based on expert and community opinions and has been adopted in this study to assign weights for each type of hazard (Table 1). For identifying most vulnerable hazard, overall hazards were classified them into five categories. 1 represents the most pressing hazard, 0 indicates hazard was identified but not constituting a community disaster. For the determination of

these priorities, only Sixty (60) respondents including experts were selected for conducting the research. This selection was in purposive survey basis form the total population in the study area. When the respondents were asked about priority wise hazards, top priority was given to Cyclone (0.733) because of its frequency and intensity. However, the last priority was Salinity Intrusion (0.370).

Table 1. *Communities Hazard Index in the Study Area.*

	Hazard Priority							
Hazards	**No (0)**	**1st (1)**	**2nd (0.75)**	**3rd (0.50)**	**4th (0.25)**	**Total Frequency**	**Priority index**	**Ranking**
Excessive rainfall	5	5	25	15	10	60	0.562	II
River erosion	7	10	15	16	12	60	0.537	III
Cyclone	0	26	15	8	11	60	0.733	I
Hailstorm	6	9	10	14	21	60	0.479	V
Flood	6	7	9	12	19	60	0.408	VI
Salinity intrusion	16	7	7	10	20	60	0.370	VII
Thunderstorm	11	4	24	13	8	60	0.508	IV

Note: (Priority index is calculated for each facility by multiplying each priority with its relative weight given in the parenthesis and dividing by summation of the frequency)

3.1.2. Communities Vulnerability Assessment

A high population density is increasing the vulnerability of the study area and the situation can be worsened by a combination of limited access to different capacities that is urgent required for the communities. In order to assess vulnerability, Physical, Social, Economic and Environmental Vulnerability consideration were selected for conducting this research. The existing natural shocks that impact on vulnerable coastal communities were considered to calculate the value (Table 2) of vulnerability for specific hazards in the study area. For the determination of assessing the value of specific hazard vulnerabilities, only Sixty (60) respondents including experts were selected for guiding the research. When the respondents were asked about vulnerabilities of hazards, top priority was given to Cyclone (0.795). Cyclones clearly indicate greater vulnerabilities than other natural hazards. As they living near the Pyra River, regularly they suffered greater losses due to destructive Cyclone. They have virtually no existing systems that can be said they are protected from cyclone or others natural disasters. Scale is 0-1 with 0 indicating no loss and 1 indicating high vulnerabilities. However, in the Table 2, it is indicate that the last priority to vulnerabilities was Thunderstorm (0.566).

Table 2. *Communities Vulnerability Index in the Study Area.*

Hazards	**Vulnerability Priority**					**Total Frequency**	**Vulnerability index**	**Ranking**
	No loss	**Physical**	**Economic**	**Social**	**Environmental**			
	0	**1st (1)**	**2nd (0.75)**	**3rd (0.50)**	**4th (0.25)**			
Excessive rainfall	3	15	27	10	5	60	0.691	II
River erosion	3	12	20	16	9	60	0.620	III
Cyclone	0	28	20	7	5	60	0.795	I
Hailstorm	6	14	17	16	7	60	0.608	V
Flood	4	14	20	10	12	60	0.616	IV
Salinity intrusion	7	10	24	11	8	60	0.591	VI
Thunderstorm	10	17	16	7	6	60	0.566	VII

3.1.3. Communities Capacity Assessment

Adaptation strategies to cope with different disasters in developing countries is vital and has been highlighted by them as having a high or urgent priority. Although insecurity remains about the extent of disaster impacts, the study area has some necessary information and knowledge available on strategies and plans to implement adaptation activities now [18]. Overall eight major actions (Figure 1) were identified as selected communities to cope up from the natural shocks or hazards in the study area: Changing crop varieties (50 percent), water harvesting system (36 percent); raising height of platform (75 percent); mutual support system (70 percent). Other adaptation measures such as migration (30 percent) wait for relief (46 percent), alternatives livelihoods (40 percent) were practiced by the grassroots local people of the study area.

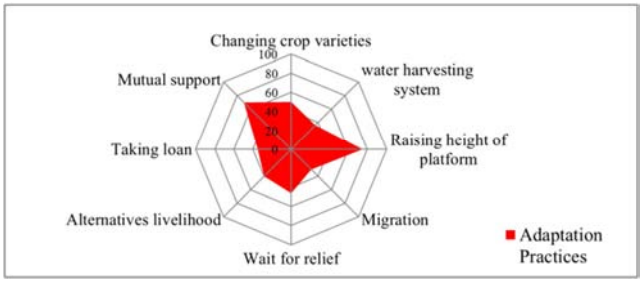

Figure 1. *Overall Adaptation practices in the study area.*

In Chawra Union under Amtali Upazilla not only governments but also NGO's and private organization who are providing support to victim communities to cope with different disasters. They are supporting in health and sanitation sectors, infrastructures, livelihood support,

awareness raising activities, income generating activities which are helping the affected communities in aspects of reducing vulnerability. In addition to community-led actions, different kinds of trainings can draw upon to advance local resilience priorities in Chawra Union. Selected respondents discussed that they have come mostly support from NGOs (51 percent), followed by local government (45 percent). NGO and local government support (Figure 2) is better associated with community priorities than support provided by other actors. The most common form of support that comes from external support is livelihood support. Majority of NGO's or other actors try to secure the community livelihoods in order to reduce poverty. And if the communities can reduce poverty, capacity will be habitually value-added in their life.

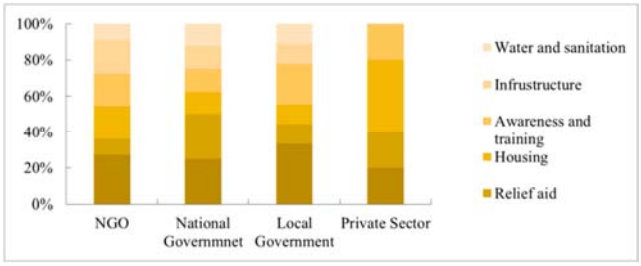

Figure 2. *Status of External support.*

3.1.4. Communities Capacity Assessment

Coping mechanisms for cyclone refers to the strategy applied by individuals, families, communities, institutions, firms and societies or governments to cope with the deleterious effects of a Cyclone. Coping strategies differ among the local communities that depending in most cases on what is available in the environment, the market and survival options [3], [6], [20], [7]. Communities' capacity is considered as an essential first step for resilience building. The studies examined the existing capacities against different natural disasters that were practiced by the individuals or communities. In the Chawra Union, the research have found some capacities that were acquired by the rural communities to cope up with different natural climatic shocks. Communities has raised some capacities that were categorized into four such as physical, economic, social and environmental capacity. For assessing communities' capacity, four indicators (Physical, Social, Economic and Environmental Capacity) were considered. In the four indicators they were divided into different sub variables for assessing the communities' capacity in the study area. When the respondents were asked about communities capacities based on four indicators, top priority was given to cyclone capacity (0.75). The coastal communities in the study area are capacitated in terms of increasing resiliency. Cyclones clearly indicate greater capacity comparing to other natural hazards. Because of its frequency and intensities, the study found that communities were developed additional capacities against cyclone in the study area. Experiencing the past extreme events, they are also developed in different sectors such as infrastructure, technology, health, livelihood, culture, skills etc. However, it is indicates that the less priority to community capacity was Thunderstorm (0.379). Every year a distinctive number of people were died due to thunderstorm. There is no formal or informal capacity for reducing the risk of thunderstorm. Majority of people mentioned that they did not take any preventive measures when any thunderstorm occurred. Again there is no specific rules and policies for coping with thunderstorm. Hailstorm (0.537) is another disasters that affected the communities most and its coping capacity of communities is so much lower. Due to hailstorm, agricultural crops and biodiversity are affected and coastal communities of the study area could not able to take any measures to cope with hailstorm As a result, the communities The priority response for different capacities for each hazards are shown in Table 3.

Table 3. *Communities Capacity Index in the Study Area.*

Category	Capacity Priority					Total Frequency	Priority index	Ranking
	No	Social	Economic	Physical	Environmental			
	0	1st (1)	2nd (0.75)	3rd (0.50)	4th (0.25)			
Excessive Rainfall	6	19	17	9	9	60	0.641	II
River Erosion	9	17	15	7	12	60	0.579	III
Cyclone	0	30	20	7	3	60	0.820	I
Hailstorm	9	14	11	14	12	60	0.537	VI
Flood	10	15	13	9	13	60	0.541	IV
Salinity Intrusion	7	13	11	10	19	60	0.516	V
Thunderstorm	11	9	9	7	14	60	0.379	VII

3.2. Communities Disaster Risk Assessment

Chawra Union is one of the first line victims of upcoming threats of different kinds of natural climatic shocks due to its geographical location. An integrated formula of Disaster Risk assessment was used by for identifying the most precious disaster in the study area. To calculate the risk in Chawra Union, the research is used the Basic Formula for Disaster Risk Assessment [1]

$$R = \frac{H \times V}{C}$$

Where,
R= Risk
H= Hazards
V= Vulnerability
C= Capacity

Figure 3. *Risk Assessment Equation.*

From the Table 4, it is indicate that the risk of Thunderstorm is the highest value (0.758) in the study area. And the second highest value of risk is Cyclone because of

its capacity is strong comparing to thunderstorm. Though the cyclone's hazard (0.733) and vulnerability (0.795) value were the highest but due to the communities existing Social, Environmental, Economic and Physical Capacities, the communities' risk of Cyclone is lower than thunderstorm. It is also marked that community capacity is low and gaps are significant to cope with different disasters. There is no existing effective emergency management (mitigation, preparedness or response) system that would save them from natural climatic shocks.

Table 4. *Communities Risks Index in the Study Area.*

Hazards	Values of Hazard (H)	Values of Vulnerability (V)	Values of Capacity (C)	Values of Risk R= (H*V)/C	Ranking
Excessive rainfall	0.562	0.691	0.641	0.608	III
River erosion	0.537	0.620	0.579	0.575	IV
Thunderstorm	0.508	0.566	0.379	0.758	I
Hailstorm	0.479	0.608	0.537	0.537	V
Flood	0.408	0.616	0.541	0.464	VI
Salinity intrusion	0.370	0.591	0.516	0.431	VII
Cyclone	0.733	0.795	0.820	0.710	II

As there is no existing strong framework for coping with thunderstorm, that's why its risk remaining the highest and affected the coastal vulnerable communities in the study area. It is found that majority of disaster risk reduction activities are not community based and has limited connection due to its separation from the community. It is marked that if the community have strong capacity to cope up from the natural disasters, their risk of disasters would be minimal.

4. Communities Capacity against Cyclone

4.1. Physical Capacity

4.1.1. Raised Homestead Platform

Before the destructive cyclone SIDR, the height of the platforms was lower than water levels. Majority of selected respondents mentioned that less height of platforms was as one of the major factors for loss of life, cattle and assets during the cyclones. Only those few families who had high enough platforms, they had saved their assets and cattle before moving to safe places. After the SIDR, the coastal communities have raised their homestead platforms to cope up from cyclones in the study area. There are still a number of poor families who have been unable to raise their platform but they are very much concerned about the raising homestead platform. Majority (80 Percent) of selected respondent's highlighted that two-layer homestead platform is more effective to protect their assets from the force of the Cyclonic water. The base of platform is a mixture of mud, dust of wood, dust of rice skin, cow dung, which is protecting it from the pressure of rising water level. In the meantime majority of respondents told that it is helping them to resist cyclonic winds.

4.1.2. Reinforcement of Homestead Structure

During focus group discussions with coastal communities in the study area, it was found that the typical homestead construction did not consist of any deep rooted pillars at the base of the house before the Cyclone SIDR. The lack of deep-rooted pillars was the main reason to damage or destruction of houses that could easily wash away the platforms of coastal communities. At present, the study recognized as well structured and traditional houses with deep-rooted pillars, and/or tied with rope to highly resistant trees. Seventy Percent respondents mentioned that deep-rooted pillars are protected against salinity.

4.1.3. Raised Platform for Preservation of Livestock Food

Livestock is a vital asset for the people in this study area especially for the ultra-poor. Livestock faced a serious risk in time of disaster. They did not pay any distinct attention before the cyclone SIDR. Most of the livestock in the study area has been enormously affected by tidal surges and cyclones water. After realizing this issue, sixty percent (60) respondents build a raised platform near their households for the protection of livestock.

Raised platforms for preserving the livestock food are also widely used in the study area. In the time of disaster cattle's are faced a serious food scarcity. Because majority of selected respondents were poor and they did not manage their food. Recently, some families have introduced the practice of raised platform for livestock food in this area and this practice is reduced the food scarcity of livestock.

4.1.4. Raising Pond Bank

People raise their pond bank by digging the soil from the inside and they use a group of working labor, spade, and bamboo and basket. The selected respondents (40 Percent) are planting trees to maintain banks stability. This measure is very effective against tidal surges and saline intrusion as it works as a barrier for water which can enter before and after disaster. It contributes to strengthening community cohesion. Raised pond bank also helps to reduce the migration of fishes to others during cyclone.

4.1.5. Construction of Bamboo Bridges on the Canals

About 60 percent respondents mentioned that they built local bridge using their own resource. The villagers used local resources such as necessary wood, bamboo, rope, iron screw and crowbar. The length of the bridge ranges vary from 20 ft. to 40 ft. It is cost effective and need not help to external

supports. This process increases the communities' interrelation. During the emergency situation, it link up to one village to other villages. After the disaster event, when communications are disrupted and relief is essential for the community, it works as a good communication sources for distributing emergency relief.

4.1.6. Road Repair

The extreme poor people are involved with different Government NGO's projects. These projects are involving with repairing road using local communities' efforts so that they can recover their economic constraints. Twenty five Percent of selected respondents are engaging with Employment scheme named "Cash for work" and they repaired the road. Sometimes when any destructive disasters hit the study area, they repair their road in own effort.

4.1.7. Raising Platform for Land Cultivation

Raising platform for land cultivation is a common practice for the local people in the study area. They raised their cultivable land platform to protect standing crops from water. Mainly they suffer from uncertain storm water inundation and that's why they didn't get enough time to harvest them or to protect crops from water. And in this case they raised their platform for land cultivation and these measures protect the standing crops from water and ultimately reduce crop damage which would harm their expectant production. Depending on water height, they are digging a canal surrounded the raised area and using the water for irrigation that is reducing their irrigation cost. As these activities are conducted using of local labour and that's why poor people can easily manage these practice.

4.1.8. Overall Effectiveness of Physical Capacities

Cyclone is one of the most common phenomenon hazards in the study area. As the study area is situated nearby the Pyra River, cyclone and storm surges water easily affected them more. After occurring cyclones (SIDR) they increase their physical capacities in their own or external supports from different organisations or governments. The Table 5 indicates the effectives of physical capacities and it is found that their overall Physical capacities against cyclone value is 0.750 which is medium effectiveness (≤0.75) considering the maximum value (1.00). Maximum respondents are aware about the importance of physical capacities, but due to their economic conditions, they cannot use these practice all time. If their economic capacity can be increased more, they can increase their physical capacities. In the Table 5, 0 indicating no effectiveness and 1 indicating high effectiveness of physical capacities.

Table 5. *Effectiveness Index of Physical Capacities against Cyclone.*

Physical Capacities	Effectiveness of Physical Capacity					
	No (0)	High (1)	Medium (0.75)	Low (0.50)	Total Frequency	Effectiveness index
Raised homestead platform	0	27	25	8	60	0.829
Reinforcement of homestead structure	0	26	17	17	60	0.787
Raised platform for preservation of livestock food	4	23	20	13	60	0.741
Raising pond bank	0	26	17	17	60	0.787
Construction of bamboo bridges on the canals	0	30	15	8	60	0.783
Raising platform for land cultivation	13	30	10	7	60	0.683
Availability of Drinking Water Sources	7	20	17	16	60	0.679
Road Repair	13	30	10	7	60	0.683
Resist flood water	0	30	15	8	60	0.783
			Total effectiveness value			**0.750**

4.2. Social Capacity

4.2.1. Affiliation with Different Institutions

Community Based Organization (CBO) is working for community capacity and increase awareness building activities involve all sections of the community in working together towards the long-term well-being of the community. About forty five percent sample respondents in the study area mentioned that they are member of various organizations (e.g. BRAC, OXFAM GB, ASA, Grameen Bank, Shushilan, NSS, Uddipan etc.) and Samities which are capacitated of communities with special focus on reducing poverty. Selected respondents remarked as CBO helps to empower the community and make them change agent of local development who would then take the lead of community risk reduction and adaptation works, mobilize and involve whole community in the advancement of their own development. The communities who are involved with different organizations, they play an important role in the decision making process. To involve with CBO's the respondents develop risk reduction plan as process of emerging as collective forces in the journey of improving livelihoods.

4.2.2. Educational Empowerment

Lack of education is considered one of the curses and barriers for development of community. Because of ignorance and inability to read and write, many impoverished people are subject to fraud, cheating and hardship as well. It is found that total number of school going students is increasing in last five years. Most of the household's (80 Percent) economic status was lower and their children's were involved with economic activities without completing the primary education. During focus group discussion, they mentioned that the rate of SSC and HSC completing students are increasing due to the improvement of financial conditions.

4.2.3. Improved Health Status

About 20 Percent respondents mentioned that they have started disaster friendly WASH techniques which are improving their access to basic sanitation, safe water and hygiene and to strengthen their resilience to prepare and respond to the risks associated with disasters. In the study area, it is found that communities are included in decision making processes and all WASH technologies are gender equitable, easily accessible to women, people living with disabilities, adolescents, children and the elderly. Some WASH program enables coastal people to achieve safe and sustainable water, sanitation and hygiene. It provides nonstop support to communities, inspires demand for sanitation and behavior change and trains hand wash method to change rural life. The communities in the study area are able to upgrade their economic conditions because it reduces the treatment cost of selected communities and they are able to cope at any disastrous situation. Getting counselling from different organizations, lactating mothers and pregnant women, adolescent and mothers are more aware about nutrition's components. The duration of exclusive breast-feeding rate are increasing (79 percent) in among the selected respondents and knowledge, attitudes, beliefs towards exclusive breastfeeding are changing.

4.2.4. Early Warning Information

The coastal communities in the study area were received cyclone warning from a wider range of primary sources than before. It was found that early warning information were received mostly from CPP (25 percent) Television (20 percent) and Radio (20 percent). Both them play a significant role to disseminate early warning among the communities. In general, radio broadcasting and word-of-mouth from neighbors or relatives is a most common sources for getting early warning information. The figure 4 shows the primary sources of early Warning in the Chawra Union.

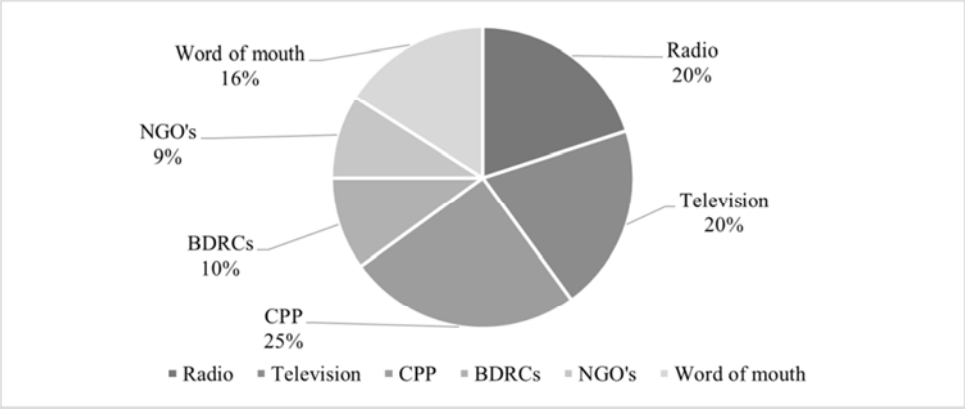

Figure 4. *Primary Sources of Early Warning.*

Moreover, respondents with radio or television hear to cyclone forecasting and they understand the cyclone warning fully. Some respondents understand the cyclone warning issues partially but they willingly go to the cyclone shelter during emergency period. Besides 60 percent respondents heard news of cyclone formation, but they became more curious to know about the further development of the cyclone that's why they were affected more. At present this situation is changing and people are willing going to cyclone shelter at any emergency situation.

4.2.5. Conduct Participatory Capacity & Vulnerability Assessment (PCVA)

Entire communities of the study area can shut down by a disaster. This includes local businesses, people's livelihood, buildings and other resources etc. It's noticeable that each of these communities create an in depth emergency plan for the continuity to cope with the impact of disasters. PCVA is a popular Community Risk Assessment (CRA) tools in the discourse of disaster management. This practice is also widely exercised by selected respondents for measuring their vulnerability and potential capacity in terms of ongoing climate shocks. Forty Percent respondents mentioned that they prepare Hazard calendar and analyzing Hazards to reduce risk through this tool. This also helps the communities to identify crisis time risk, vulnerability & their capacity to adapt with the newly emerged situation. It also helped to develop risk reduction plans which are shared with local Govt. representatives. This plan is locally known as 'Risk Reduction Action Plan (RRAP)'. Responders discuss about this plan in the monthly meeting and take necessary preparation for reduction risk. Such discussion in the monthly meeting helped to develop self-confidence of the coastal belt communities to face any crisis situations. Deliberate efforts were also made in PCVA to ensure participants of key stakeholders such as disaster affected vulnerable extreme poor men and women, UP chairman & members, local social leaders and person with disabilities.

4.2.6. Increasing Voluntary Savings among CBO

The coastal communities of the study area are vulnerable in terms of their livelihood. However, their livelihoods were not fully secured as they often faced various family and climate related shocks. It is noticeable that about 50 percent are involving with voluntary savings and such savings practice has brought manifolds positive impact in the way of lives of poor people. Selected responders took loan from the

saving and invested them in various businesses like tea stall, grocery shop, fishing etc. activities. It is changing their livelihood after taking loan and it also played a significance role in the empowerment of women.

4.2.7. Contingency Planning Update

The selected respondents (75 percent) mentioned that they plan their own for future activity. They are involving with local organizations and they discuss about their risk of disaster in order to find out the solution. Community people have identified various problems related to daily life they face and upon analyses of these problem, annual plan is developed. The communities of the study area developed their Annual Development Plan (ADP) with the cooperation of different private and Government activities. Communities annual plan consist of a range of activities like embankment repair, plinth raising, homestead raising, link road repair, pond re excavation, slow itch gate maintain, tree plantation, ensure drinking water, reduce salinity and income generating activities. Communities in the study area also developed an implementation strategy for achieving the annual target. Therefore community members also review the plan and measure the extent to which the plan is implemented for betterment of their area. If there is any major uncertainty of their target, then they take important decision for corrective measures.

4.2.8. Overall Effectiveness of Social Capacities

Various aspects of social capacity is essential for building resilient community in the study area. Social capacity enhances the mutual relations, interactions and networks, trust among the vulnerable communities in the study area. It is noticeable that a significant number of people are involving CBO's and they are benefitting from that organization. Educational empowerment also increased under social capacities. Communities are involving the participatory capacity and vulnerability assessment and they are also involved in updating their contingency plan. It will help them to cope with different natural climatic shocks. The Table 6 indicates the effectives of social capacities and it is found that their overall effectiveness of social capacities against cyclone value is 0.704 which is close to the medium effectiveness (≤0.75) considering the maximum value (1.00). It is found that the maximum effectiveness under social capacity is affiliation with different organization. The selected respondents mentioned that through the involvement with CBO's they can easily practice any social capacity otherwise it is considered so much tough for them. 0 indicating no effectiveness and 1 indicating high effectiveness of physical capacities.

Table 6. *Effectiveness Index of Social Capacities against Cyclone.*

Social Capacities	Effectiveness of Social Capacity					
	No (0)	High (1)	Medium (0.75)	Low (0.50)	Total Frequency	Effectiveness index
Affiliation with Different Institutions	0	27	25	8	60	0.829
Educational Empowerment	0	26	17	17	60	0.787
Improved Health Status	0	21	11	28	60	0.720
Access to Information	9	17	15	19	60	0.629
Conduct Participatory Capacity & Vulnerability Assessment	9	19	19	13	60	0.662
Increasing voluntary savings among CBO	7	17	7	29	60	0.612
Contingency Planning Update	9	23	19	9	60	0.695
				Total Effectiveness Value		**0.704**

4.3. Economic Capacity

4.3.1. Adopted Alternative Livelihoods

Disasters have affected the livelihood of the study area including damages in crop cultivation, fisheries, poultry, vegetables garden, livestock etc. It has also created a state of unemployment among the people of the study area communities. During the Cyclone SIDR, they lost their assets and livelihoods. Therefore, affected communities could realize the significance of alternative livelihoods. Majority of respondents mentioned that they received different IGA related trainings and they started on-farm activities, such as profitable livestock (cow, goat, sheep) rearing, poultry (duck, hen, pigeon) rearing, homestead gardening, garlic and watermelon cultivation, early maturing rice cultivation, nursery establishment and fruit sapling plantation etc. A number of off- farm activities, such as bamboo product-making (handicraft), mat making, blanket making, curd production and seed preservation, were also conducted by the coastal affected communities in the study area. It is found that sixty five percent of sample respondents were graduated from their extreme poor condition and enabling to fulfill basic needs of their families through the involvement with diversifying or alternative livelihoods. Diversified livelihoods are assisting selected households to insulate themselves from environmental and economic shocks, trends and seasonality-in effect to be less vulnerable.

4.3.2. Status of Food Security

Before the Cyclone SIDR, majority of selected respondents (80 Percent) lived through the poverty line and they were not able to manage their daily food. They always remained scarce of food round the year. After the SIDR they adopted different kinds of IGA activities and adopt the alternative livelihoods. They also got support from different NGO's and Government projects and reduced their poverty. As a result it is found that, about 69 percent people have changed their previous conditions and they secured three times foods per day. The Figure 5 shows the status of food security.

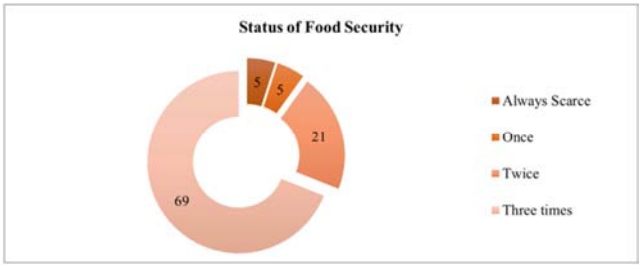

Figure 5. *Status of Food Security.*

4.3.3. Women Entrepreneurship

Rural women's economic and social development is necessary for overall economic progress of society and nation. Women entrepreneurs were faced great difficulties in accessing credit. This is partially due to a lack of confidence, as well as a gender bias towards women. Fortunately, different organizations and government's program works completely dedicated to women after the destructive cyclone SIDR and they facilitate access to assets for starting a new business. At present, more than 30 percent of extreme poor women consider themselves equally capable as their male members and rural women are now increasingly run their own business. It is indicates that entrepreneurship leads to self-fulfillment and makes women aware about their status, existence, right and their position is in the society.

4.3.4. Grain Bank Initiated

Grain bank is a new concept in the field of development which is practiced by the extreme poor people for ensuring their food security round the year. About 10 Percent respondents were started the weekly grain collection to ensure the food security during the crisis period or meet up the emergency food need. Therefore, communities are not familiarized this practice widely in the study area. This initiative contributed to reduce suffering of coastal communities during the emergency conditions. Moreover, it gave them self-confident to face any types of family shocks. Such household level saving is also helpful to face the challenges of any major natural shocks.

4.3.5. Community Opened Bank Account

After the destructive Cyclone SIDR, selected respondents realized the significance of savings and thirty percent (30 percent) respondents opened their Bank account in the different commercial Bank named Janata, Agrani, Krishi, Grammen Bank etc. Before opening the bank accounts, the respondents considered themselves as valueless person and they always need depended to others. During discussion period with the selected respondents, they discussed it is increasing their social status and also dignity in the society. They are more confident to face any adverse effects from natural climatic shocks.

4.3.6. Benefiting from Government Safety Net Programme

Ten sample respondents told that they are receiving support from SSNP. Selected respondents mentioned that they are more benefitted than before and they are on the way to reduce their poverty. The extreme poor people got support from Union Parishad such as VGD, VGF, Cash for Work etc. under the SSNP. Such support is playing important role to improve their economic condition of the coastal communities from the miserable poverty line. The social safety net programs meet their minimum basic requirements which added a new value to life and it also adequately protect against natural disasters and other external shocks. The Figure 5 shows the conditions of receiving social safety net program among the rural communities in Chawra Union

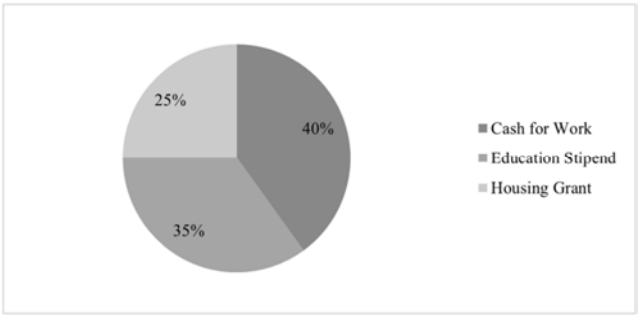

Figure 6. *Status of social safety net Programme.*

4.3.7. Increasing more Links with Local Market

About Eighty Percent households mentioned that they didn't get proper price of their assets due to lack of market linkage and appropriate management of these IGA. Different actors were remained active in the market that why they could not get the sufficient benefits. Because of this, rural respondents in the study area indicate that they could not improve their living standards is that they face serious difficulties in accessing local markets. During discussion period, it is found that 60 Percent respondents are fully aware of different factors like market demand and growth potential after involving with different market linkage trainings. After the involvement with local market, they are able to get proper price of their assets that enabling them to increase their incomes and enhancing their food security. To increase linkage with local market, it significantly impact on low-income groups and more successful poverty reduction.

4.3.8. Seasonal Migration Reduced

It is found that the poor people living in the study area were used to face seasonal unemployment almost on a regular basis during a specific time of the year. Therefore, seasonal migration was a regular phenomenon in the study area. While asked about the status of migration pattern, it was found that huge amount of people were migrated to others (Dhaka, Khulna, Chittagong etc.). But at present, the rate of migration is decreased due to their economic empowerment. It is apparent that people know this seasonal problem earlier and they take the initiative to reorganize their resources and activities according to their capacity to develop alternative strategies that help to their supplement incomes. Seventy five percent respondents' people are not migrated to others and some people are migrated to others due to uncertainty to economic conditions (Figure 7)

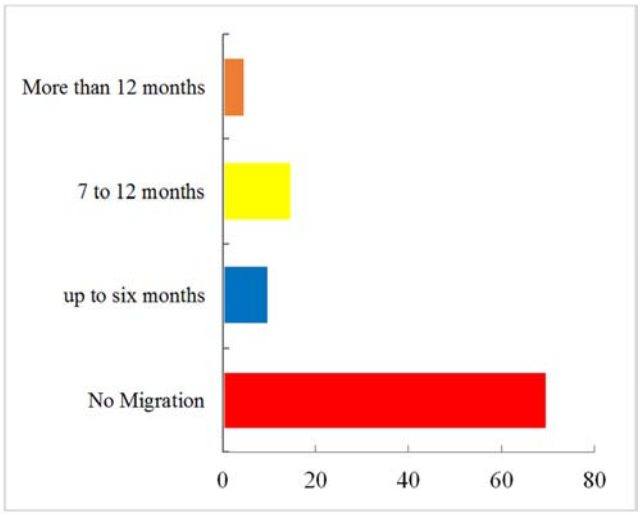

Figure 7. *Status of Migration Pattern.*

4.3.9. Overall Effectiveness Economic Capacities

Economic capacity is closely linked to well-being of the society also individuals and families. It is noticed that if the communities can increase their socio-economic conditions, they can easily handle any disastrous situations. After the cyclone SIDR, the communities are involved with different income generating activities and educed their poverty. It also noticeable that women's involvements in IGA's is increasing. Seasonal migration also reduced and communities are benefitting more than before under social safety net programme. Again some respondents opened their Bank Account that will help them to reduce disasters impact in future. The Table 7 indicates the effectives of economic capacities and it is found that their overall effectiveness of economic capacities against cyclone value is 0.681 which is close to the medium effectiveness (≤0.75) considering the maximum effectiveness value (1.00). 0 indicating no effectiveness and 1 indicating high effectiveness of physical capacities.

Table 7. *Effectiveness Index of Economic Capacities against Cyclone.*

Economic Capacities	Effectiveness of Economic Capacity					
	No (0)	High (1)	Medium (0.75)	Low (0.50)	Total Frequency	Effectiveness index
Adopted Alternative livelihoods	0	27	25	8	60	0.829
Food Security	0	26	17	17	60	0.787
Women entrepreneurship	9	11	25	15	60	0.620
Grain bank initiated	9	7	14	30	60	0.541
Community opened bank account	5	14	17	24	60	0.645
Benefiting from government safety net programme	0	30	15	8	60	0.783
Increasing more links with local market	7	17	24	12	60	0.683
Seasonal Migration Reduce	9	8	17	26	60	0.562
			Total effectiveness value			**0.681**

4.4. Human Capacity

4.4.1. Management of Cyclone Shelters

Most of the respondents did not know the management of cyclone shelters and they also mentioned that they also did not know cyclone shelter was made for betterment of the communities during emergency period. As a result they feel hesitated to go to cyclone shelter when any climatic shocks hit them. After the destructive SIDR, they are involved with different Climate Change and DRR related training and they are fully aware about the management of Cyclone shelters. Coastal communities in the study area can properly utilised gumboots, raincoats and torches and other utensils during emergency period. They have a strong committee to manage the cyclone shelters. The management committee are assessing the conditions of cyclones on a regular basis and highlighted the urgent requirements for cyclone shelters. It was also evidenced that government and other agencies are fully concerned for ensuring the facilities of cyclone shelters.

4.4.2. Received Gender and Women Leadership Trainings

Both men and women are concerned about the issues of gender and women leadership. They are participated in various trainings that help them to prevent gender related discriminations in the family and the society at large. They explore the reasons of gender related discrimination and the way to reduce it. From the training, men are able to learn how to respect the women in their work in family and society. Message also throws in the training that joint efforts and mutual understanding can bring peace to the society and it can ultimately reduce gender related violence.

4.4.3. Skill Development Trainings Based on Livelihood

About sixty percent respondents received training on livestock, poultry, small trade, agriculture and small scale production etc. During the interviewing period, it is found that majority of sample respondents know how to manage their IGA and how to nurse livestock related IGA like Goat, Cow, Duck and chicken. This training optimizes opportunity of extreme poor people to build rapport and accessing services available at local level. Skills development based on livelihoods is improving rural productivity, employability and income-earning opportunities, enhancing food security and promoting environmentally sustainable rural development and livelihoods. Despite rural women's major

role in agriculture and other rural activities, higher barriers in proper trainings limited their participation in more productive and remunerative work, perform managerial and leadership roles and participate fully in the development of their communities. With the involvement of different CBO's and getting trainings targeted respondents dismantle these barriers and add a new value of their life.

4.4.4. Increasing Women's Confidence

Surprisingly female headed families were also dominated by male. Although dominated by male but degree of power were little higher than that of male headed families and each and every decision making issues. In the study area, women did not feel encouraged to work in open fields side by side with men. They were afraid to move alone outside of their village. They were not confident in talking to men who are not closely related their family members. In FGD selected respondents have informed that women's are involving in income generating activities outside the home and reduced their household vulnerability. Therefore, at present, they easily move to outside (43 Percent) of their village and they are fully confident in talking to men (61 percent) who are not members of their family. The status of women confidence level is shown in Figure 8.

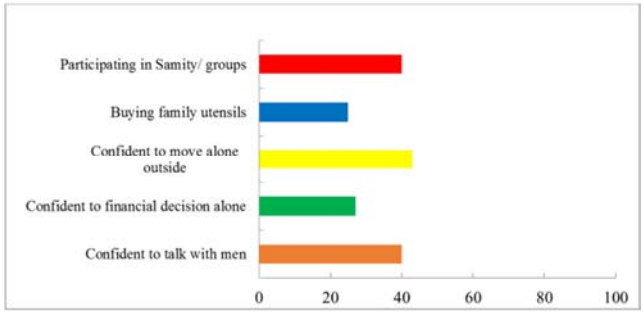

Figure 8. *Status of women confidence.*

4.4.5. Increasing Awareness on Climate Change and DRR Management

More than 80 percent of sample respondents discussed about the specific roles and responsibilities of household during the natural disaster. They discussed that awareness raising trainings helps them to develop community's confidence to handle or face disaster. They are well aware about DRR management and climate change issues including health and hygiene promotional and structural works like hand washing, use of latrine, installation of tube well, introduces safe drinking water sources etc. during the disaster period. If the study area frequently hit by cyclone and tidal surge, they strongly believe that knowledge on DRR and Climate change will help them to develop their capacity as well as communities capacities that substantially reduced community's vulnerability related to disaster.

4.4.6. Leadership Skill

Facing for all types of threats and hazards in the coastal region of Bangladesh, it is to be needed good leadership skill and experienced emergency management personnel. In the focus group discussion the selected respondents discussed about leadership quality and it is found that 54 percent people develop their leadership skill to engage with different DRR activities. Communities are actively engaged with monthly meeting, meeting resolution, accounts and other documentations with different CBO's. They are more aware about roles and responsibilities of a person related to his or her position in the society. Communities are also introduced about CBO constitution, committee reformation process, annual development plan, how to review plan and how to build up linkage with different stakeholders and it is increased their leadership skill that is helping them in any crisis or emergency period. They have certain skills and abilities in order to manage catastrophes based on the environmental conditions. The selected respondents mentioned that they have received different kinds of trainings which increases their leadership quality and thirty percent also told that they did not get any trainings based on leadership.

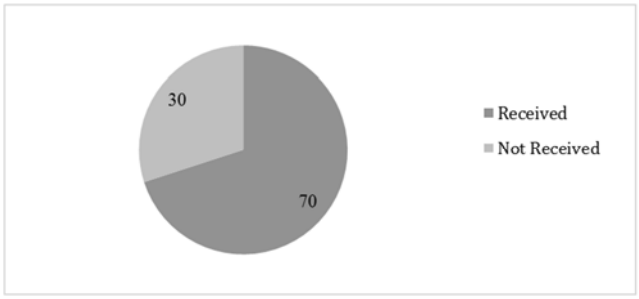

Figure 9. *Status of Leadership trainings.*

4.4.7. Overall Effectiveness Human Capacity

A variety of skill based trainings were received the communities that is increasing their human capacity in aspects of achieving resiliency. Human capacity improves the leadership skill that is helping in emergency situation. Selected respondents are involving with management of cyclone shelters. They are also got trainings on gender and women leadership trainings that is increased their leadership skill. Leadership skill is helping the communities to cope with any emergency situation or family disturbance. Again different organizations and governments are working with empower the women's and it is found that significant number of women's are willing to work outside and their confidence level is increasing. At present they are fully aware on the issues of disaster risk reduction and climate change and take actions in proper time to cope with natural climatic shocks. It is increased their capacity in aspects of resiliency. The Table 8 indicates the effectives of economic capacities and it is found that their overall effectiveness of economic capacities against cyclone value is 0.647 which is adjacent to the medium effectiveness (≤0.75) considering the maximum effectiveness value (1.00). Human capacity helps the selected respondents to face any disastrous situation. In the table, 0 indicating no effectiveness and 1 indicating high effectiveness of physical capacities.

Table 8. *Effectiveness Index of Human Capacities against Cyclone.*

Human Capacities	Effectiveness of Human Capacity					
	No (0)	High (1)	Medium (0.75)	Low (0.50)	Total Frequency	Effectiveness index
Management of cyclone shelters	13	9	11	27	60	0.512
Received Gender and Women Leadership trainings	17	11	12	20	60	0.50
Skill Development trainings based on livelihood	0	27	25	8	60	0.829
Increasing Women's confidence	9	21	15	15	60	0.662
Increasing awareness on CC and DRR management	0	26	17	17	60	0.787
Leadership Skill	13	15	19	13	60	0.595
			Total effectiveness value			**0.647**

4.5. Environmental Capacity

4.5.1. Trees around Houses

During cyclones, it is majority of people (80 Percent) recognized that people were died because of the trees around the houses were not sufficient and the wind speed that easily stricken the study area. As a result, they started the tree plantation around the houses that will prevent the cyclonic water to hit directly during tidal surge. They are planting cyclone resilient trees such as date's tree, palmyra tree, loha tree, coconut tree around their houses. Explore local tree varieties which can provide both economic returns and protection from disaster—and are readily useable as housing material after a disaster. Some respondents stated that coconut trees around the houses helps them with drinkable water during water crisis after cyclones. The trees also protects the soil from soil erosion and land slip around their houses. It will not only help to maintain ecological balance but also will help them financially in future.

4.5.2. Rain Water Harvesting

The study area suffers not only in cyclonic/storm surges water but also high salinity in surface and ground water. As, the average rainfall in the coastal area is increasing than before, so the selected respondents (45 Percent) people started rain water harvesting system in their own households. Catching and storing rain water is a common practice in the study area. The selected respondents mentioned that they store the rain water in Bucket or jar and it help them in dry season. The rain water is economically not only environmentally but also socially viable and it also reduce surface and ground water extraction.

4.5.3. Soil Conservation

Temporary or permanent land degradation was reduced productive capacity of land. Majority of respondents knows that if agricultural land lost their efficiency, crop production could be hampered their socio-economic conditions. As a result to increase the fertility of land, they were taken some measures which is ultimately identified as the significance in environmental capacity.

4.5.4. Mulching

About 35 percent respondents mentioned that they are practiced mulching and it is consists of waste materials, half decomposed, compost, straw, sun grass, leaves etc. It can be made using local resources and it increases the rate of germination of seedlings. Mulching helps in soil in soil conservation of soil moisture which reduces the irrigation requirements. It preserves the temperature of the soil. As it conserves the soil moisture, it reduces the groundwater pressure.

4.5.5. Compost Use

About 40 percent respondents stated that they are using compost in their field to increase soil fertility. Compost are mainly consists by decomposing farm and cattle wastes, weeds, straw, water hyacinth, agro wastage etc. in presence of micro-organisms. The main advantages of this practice used by the local communities due to its low production cost. Besides, compost fertilizers added a new dimension through improving the soil texture and structure. It is deceased the use of chemical fertilizers.

4.5.6. Green Manures

Green manures are prepared by decomposing green crops at young stage within soil through ploughing it. Sesbania or Dhaincha, Cowpea, Sunhemp, Kalai, Crotalaria are mixed with the soil before flowering and starts decomposed. The respondents mentioned that green manure is that it is used in the same place where it grown. Green manure influences soil fertility and supplies sufficient amount of organic matter in the soil. It increases the nitrogen content of soil.

4.5.7. Adopting Crop-Rotation

Communities in the study area understood that the land should not be kept in fallow and it is increased land degradation. Getting trainings and supports from different organizations, different crops are cultivated in rotation in the same piece of land. The reason found that if particular crop is cultivated on the same land repeatedly, pest attack will be remained higher. Cultivating different crops in rotation, it is reduced insects and pest attacks in the study area that is reducing the use of chemical fertilizers.

4.5.8. Light Trap

By setting light trap insects can be attracted towards light and can be killed. At night a pan having water mixed with kerosene or pesticide should be kept in the field. If a hurricane is kept hung on that pan many insects will be attracted towards the light of that hurricane. By this the insects will fall in the pan having kerosene or pesticide and then die. Adult stem borer, ear cutting cater pillar green plant hopper and rice bugs. Can be controlled by setting light trap.

4.5.9. Overall Effectiveness of Environmental Capacity

Realizing the significance of disaster risk reduction activities, communities start taking measures necessary changes of protecting environment. It also facilitates sustainable management of land, water etc. that improving environmental capacities. The table 9 indicate that overall effectiveness of environmental capacity. It is found that their overall effectiveness of economic capacities against cyclone value is 0.647 which is adjacent to the medium effectiveness (≤0.75) considering the maximum effectiveness value (1.00). 0 indicating no effectiveness and 1 indicating high effectiveness of physical capacities.

Table 9. *Effectiveness Index of Environmental Capacity.*

Environmental Capacities	Effectiveness of Environmental Capacity					
	No (0)	High (1)	Medium (0.75)	Low (0.50)	Total Frequency	Effectiveness index
Trees Around Houses	3	25	17	15	60	0.754
Rain Water Harvesting	4	19	27	10	60	0.737
Soil Conservation	7	14	14	25	60	0.616
			Total effectiveness value			**0.702**

4.6. Overall Communities Capacity against Cyclone

The communities' in the study have empowered in aspects of capacity building though they faced some problems to increase resiliency. Their capacity was so far weak before the cyclone (SIDR, Mohasen) and as a result when any disaster hit in the community, they easily broken. But at present capacity is not so bad and their overall effectiveness against different capacity is 0.70 which is closely to the medium level of effectiveness. Five indicators (Physical, economic, social, environmental and human capacity) were sum up for calculating overall capacities against cyclone. Maximum effectiveness value is 1 and lower effectiveness value is 0. Though cyclone SIDR and Mohasen affected the study area, they were able to bounce back their safer condition. At present their capacity is medium level and they are on the ways towards resiliency.

Table 10. *Overall Communities Capacity against Cyclone.*

Capacities	Effectiveness Value	Ranking
Physical Capacity	0.750	I
Economic Capacity	0.681	IV
Social Capacity	0.704	II
Human Capacity	0.647	V
Environmental Capacity	0.702	III
Overall capacities	**0.70**	

5. Conclusion and Recommendation

From the above discussion it is revealed that the resultant total risk assessment allows determination of hazard potential, its vulnerability, or to both, and enables the simple disaster risk rankings for Chawra Union under Barguna District. The priority ranking method adopted for determining the appropriate weightings for total hazard, vulnerability, capacity and risk assessments are based on mainly common understanding of the local people and expert opinion also taken for authenticity. The study shows that cyclones hazards vulnerability score is highest but due to its strong capacity, cyclone's risk is less than thunderstorm. There is minimal existing capacity for coping with thunderstorm. As a result thunderstorm affected more every year in the study area. Thunderstorm and cyclone and excessive rainfall are three biggest natural hazards with high damage potential in Chawra Union. Flood, hailstorm and river erosion are also prevalent in the area. The common understanding can provide an essential foundation for policy makers and local authorities to (a) select what is an acceptable level of risk, (b) define what level of protection needs to be put in the study area and (c) adopt which is the best mitigation measures that can be applied. From all the aspects of vulnerability, i.e. social, physical, human, economic and environmental, this village is highly risk to the different disasters. However, since the decade old livelihood pattern of the local community relies on the coastal ecosystem, the people in this study area do not want to move elsewhere. Instead, they are eager to adopt the mitigating measures and cope with disasters themselves. The study found that because of frequency and intensities of cyclone, a majority number of sample respondents were also found to be more successful shock absorbers" through adaptive strategies during cyclone. The communities are engaged in diversified income generating activities and increased the investment and generated additional employment opportunities. It was also found that livelihood diversification, proper nutritional support minimizes disaster risks and helped extreme poor households to overcome vulnerabilities. Data also revealed that most of the links with government safety nets (e.g. the cash for work scheme, children's education stipend and relief) have been increased. The government should emphasize more on networking with NGOs on DRR and even consider encouraging NGOs to form a DRR forum in coastal belt of Bangladesh for effective disaster risk management and should more concentration on increasing resiliency among the coastal communities of Chawra Union. The main recommendation for the study area found that-

- Utilize the disaster risk assessment as a basis for the development of disaster risk reduction plans and policy
- The government should implement some measures so that the coastal people can aware the issues on thunderstorm.
- Should be focused on recognized vulnerabilities and coping capacity for disaster risk reduction, instead of climate change
- Identify the difference in vulnerability to disasters between different groups

- The government should make women forum and the women forum can be enabled to influence village decision-making.
- For undertaking the future project implementation, should conduct more research for risk analysis to disaster-proof the communities
- Document the highly successful stories that is added a value of extreme poor communities and the relevant external stakeholders can learn as a good practice from that document
- Encourage and empower communities to play a more significant role in the post-disaster relief and recovery phase.
- Emphasize more on networking with other NGOs on DRR and even consider encouraging NGOs to form a DRR forum in coastal belt of Bangladesh for effective disaster risk management.
- To enhance the sustainability of CBO's, legal registration must be increased for getting benefit from CBO. Other activities can be done such as linking the committees to different NGOs working in or interested in working in these areas;
- Undertake more support with cyclone resilient houses that are vulnerable to cyclone.
- More Cyclone equipment can be provided to every cyclone shelter for combatting with cyclone
- Explore local tree varieties which can provide both economic support and protection from disaster and are readily useable as housing material.
- The government should focus more on networking with other NGOs to have them provide services which they cannot.
- Focus more on undertaking advocacy with Union Parishad for enhancing the linkages with local communities.
- Steps have been taken to encourage women to become involved in income generating activities which can improve their status and independence and provide greater security for their families. Besides their traditional roles in animal rearing and other agricultural activities, training in an alternative skills should be increase

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