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Local Climate Change Governance and Making Climate Resilient Town: The Role of Local Authorities

Mushfique Ahmed[1], Mohammad Mizanur Rahman[2*]

[1]Town Planner at Local Government Division, Office of the Narsingdi Municipality, Narsingdi, Bangladesh.

[2]Assistant Professor, Department of Urban and Regional Planning, Jahangirnagar University, Savar, Dhaka, Bangladesh.

[*]Corresponding Author

E-mail Id:-*mizanurp@gmail.com*

ABSTRACT

Local institutions are increasingly challenged to respond to make resilient town under climate. Effective local adaptation requires local institutions that is able to adapt to the uncertainties associated with climate change. For the role of local authorities (Municipality) to make climate resilient town here at first the conceptual framework was developed and the research design was conducted. In the data collection level the data were collected through two ways and these are primary data collection and secondary data source. The selection process of stakeholders was on the basis of their potentiality to develop climate resilience actions at the community, city and policy level, supporting capacity that is essential to implement resilience actions at community and city. As per their valuable opinions five fragile urban systems are identified those are impacted and in risks of climate change. These show how resilience to disasters is being conceived and addressed by local governments. The local government as a key actor execute the functions at different scales and tools and different approaches to governing climate action in cities were found. We also found different criteria based adaptation measures as like as the tree plantation in the first ranked adaptation measures and construction and repair of embankment as the second ranked adaptation measures and so on. Ten challenges were identified and among them lack of funding for implementation (86% perception) and lack of institutional coordination (80% perception) were major challenges for planning and implementation of climate resilient town.

Keywords:-*Climate change, local governance, resilient town, adaptation measures*

INTRODUCTION

Bangladesh is one of the most densely populated nations on Earth [18]. The country's population in 2018 stands at about 16.16 million [28].Bangladesh is one of the most vulnerable countries to climate change in the world [25]. Among the Asian countries the vulnerability ranking is second [11] and seventh for extreme weather condition [20]. In the last 30 years, Bangladesh faced nearly 200 big disasters [25] caused by climate change. Bangladesh stands third among countries most hit by natural disasters [20] and these disasters are climate change related including drought, extreme temperature, variations in rainfall, floods, cyclone and storm surge, and salinity intrusion [25, 21]. Climate change driven threats are greater in Bangladesh [21] and in last thirty years by 200 climate change related disasters, the damaging cost is calculated approximately $16 billion [25]. It is very important to analyze the climate impacted local governance systems for proper resource allocation, infrastructural design and providing other civic services. A holistic, multi-sectoral approach is necessary to make a city resilient to the impacts of climate change. The people

who have better access to adequate food, clean water, healthcare and education will inevitably be better prepared to deal with stress including that arising from climate change [12].

In 2010, the Making Cities Resilient: "My city is getting ready!" Campaign was launched "to support sustainable urban development by promoting resilience activities and increasing local level understandings of risk" [26]. The Campaign was guided by three central themes: to Know More, Invest Wiser, and Build Safer. For making cities resilient autonomous adaptation is not sufficient to address the impact of climate change. Collective adaptation measure affects the individual decisions and resilience to climate change by sharing risk [6, 4] and incorporates information for long-term disaster management focusing on both scientific and indigenous knowledge [27]. The capabilities of municipal government is the critical issues in shaping the capacity for local climate change policy and action [5]. These capabilities are defined by central or regional governments and are substitute to local governance. Local governments have limited powers and responsibilities with respect to climate change adaptation measures [15, 17, 23, 24]. The role of national government, and of relations between local and national government, in shaping urban climate governance is critical [24].

In this research, it is tried to identify the climate change impacts on town development and initiatives taken by the local authority. For this, it is carried out an identification of governance issues and its adaptation, possible measures to reduce vulnerabilities and finally marked as resilience interventions. A north-western town which is lying on the Jamuna River of Bangladesh, Sirajganj Town area is selected for conducting this research. This Town is considered as the most disaster prone area for river flood and bank erosion. Already the city has been posing to a serious threat to bio-diversity and health that relates to water and solid waste.

METHODOLOGY

After preparing the required data list and data source, the sample was selected through simple random sampling to get the accurate data, which most represent the present actual scenario. In this study household was selected as sampling unit. We have used purposive sampling method to identify samples. In this research, 100 samples were selected.

In this study, Primary data was collected through in-depth interviews, focus group discussions, Shared Learning Dialogue (SLD) and interviews and content analysis of available survey and census reports to get quantitative information. Semi-structured questionnaire for in-depth interviews have used for primary data collection.

The sample size for questionnaire survey was calculated based on Yamane's formula [29].
Total population in the study area is 1,58,913 and number of household is 35,556 [3] from where 100 samples were selected. Sample size was selected through the following process:
Total population = 1,58,913
Number of household = 35,556
Yamane (1967) provides a simplified formula to calculate sample sizes:

$$n = \frac{N}{1 + Ne^2}$$

where,
n= sample size
N= Total number of households =35,556, Precision (e) = 10%, Confidence Level= 95 %, Proportion of Variability, P= 0.5
So, n= 35556/ $\{1+35556\ (0.1)^2\}$
= 99.71
= 100 (approximately)

LITERATURE REVIEW

The Role of Local/Urban Governance: Promoting Town Resilience

The multiplicity of climate change means that the most suitable adaptation responses will often be multi-level responses [2]. High density, housing pattern and urban expansion on particularly risky sites making cities in developing countries are at particular risk from climate hazards [16, 9]. So adaptation is mainly made up of individual choices at the local level, collective action at the community and municipal level is the most appropriate response for adaptation in an urban context [13]. But many municipal governments do not have adequate provisions in order to deal with increased climate hazards such as flood management [1]. So for making resilient town the role of local governance is very important to meet up all the climatic issues from the local level to make it resilient.

Empowered Local Governance: Political and Fiscal

The planning and management functions in cities are more effective when local government is recognized as a legitimate partner in the governance structure of a country, and when financial powers to raise revenues and responsibilities to deliver services are commensurate with urban growth and expansion [19].

Satterthwaite (2008) draws attention to the problem of a lack of municipal finance for providing basic infrastructures and the consequent implications for adaptation of climate resilient. This lack of service provision, he goes on to argue, reflects "local governments lacking the resources to meet their responsibilities – and often with very limited capacities to invest (as almost all local revenues go to recurrent expenditures or debt repayment). These inadequacies often reflect local governments that are unrepresentative, unaccountable and anti-poor – as they regard the population living in informal settlements and working within the informal economy as 'the problem." [22].

Urban Governance and Enabling Frameworks, Conditions

Enabling conditions and frameworks to support urban adaptation are grounded in institutional structures, values and local competence, interest, awareness, and analytical capacity.

Preconditions for sound adaptation decision making relate to principles of good urban government (what government does) and governance (how they work with other institutions and actors including the private sector and civil society) [7, 8]. To make the successful adaptation measures, there needs to be broad and sustained engagement of local stakeholders including local governments, communities, civil society and other businesses and here local authorities should need to adopt a collaborative approach to make it success [10].

Description of the Study Area

Sirajganj district is under Rajshahi division and also gate way of north Bengal of Bangladesh. Sirajganj town is situated on the bank of river Jamuna and some portion of town was already eroded by this river. Most of the year, flood water comes into Sirajganj town and the people are affected by flood water. The barrage of Sirajganj town was a little bit threatened in the year 2009, 2010, 2011 & 2013. Majority people are poor and extreme poor due to river erosion and they are migrating in town area.

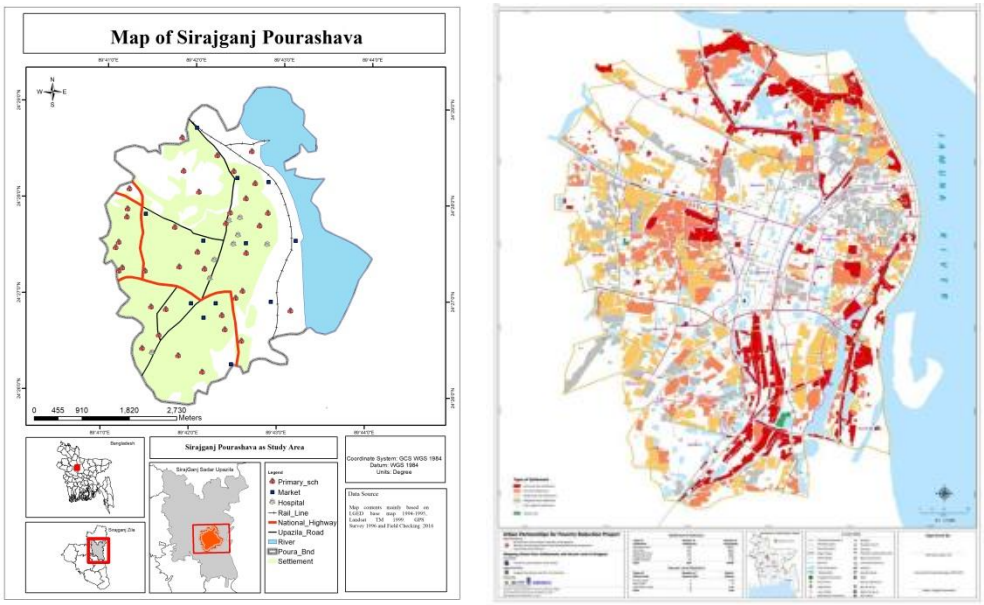

Fig.1:-*Map of Sirajganj Pourashava*

Climatic Changes in the Study Area

Sirajganj is considered as the most disaster prone area for river flood and bank erosion. Floods are the main natural hazards in the city and occur due to excessive precipitation during the monsoon. The flooding situation is aggravated by the excessive siltation of the Jamuna River whose depth has considerably reduced, caused due to the opening of Jamuna Bridge. The city, regularly subject to floods, witnessed one of the biggest floods in 2007. Discussions in the city reflected an increasing intensity in the floods since 1981. In fact in 2007, the city was flooded twice and the city was submerged under 7 feet of water. However, floods also cause serious damage to crops, property, fisheries and livestock and other resources In 2010, the flood level exceeded that of 1988 in Sirajganj. Recently in 2016, heavy rainfall and the onrush of water caused floods, marooning more than 100,000 people and submerging 500 villages in the district.

RESULT AND DISCUSSION

People of the Sirajganj Town are fighting against climate change years after years. A large area of this district is inundated due to Jamuna River. Many people and families are affected and have gone through untold miseries (field survey, 2019). The impact by loss of climate change is evident in many ways such as material loss, economic loss and social loss. In this study an attempt was made to find out the status of livelihood assets and sensitivity, exposure and adaptive capacity of people in the study area for the climate change.

Existing Physical and Institutional Adaptation Measures are practicing to Reduce Climate Change Impacts

Average Index, $A_i = \sum_{i=1}^{n} \frac{WiFi}{n}$

Where,

A_i = Index value (For a selected criteria)

F_i = Frequency of respondents giving the rating from1 to 5

W_i = Weight of the rating

N = Total number of respondents (100)

Table 1:-*Effectiveness for potential mitigation*

Effectiveness for potential Mitigation	Frequency (Number of Respondent)										
	Construction of Disaster Shelter	Construction and repair of embankment	Putting C.C block to protect embankment	Plantation trees	Providing housing structure	Free Tubewell and sanitary latrine	Free distribution of water purification tablet	Free livestock distribution	Assistance in agricultural sector	Rain water harvesting	Skill training on handicraft
Strongly disagree(1)	0	0	2	0	0	1	4	0	1	3	5
Disagree(2)	3	2	6	3	1	3	7	3	1	7	2
Neutral (3)	10	12	9	21	18	5	5	15	6	19	8
Agree(4)	28	39	52	44	65	53	37	38	68	41	37
Strongly agree(5)	59	47	31	32	16	38	47	44	24	30	48
Average Index, A_i	4.43	4.31	4.04	4.05	3.96	4.24	4.16	4.23	4.13	3.88	4.21

Source: Field Survey, 2019

In this method, index value of Feasibility/ Implement ability, Environmental friendliness, Equity, Economic viability, local people participation, cultural acceptability and multi-purposefulness have been calculated and finally ranking wise adaptation measures has been showed in Table 2.

Table 2:-*Ranking table of Adaptation Measures*

Adaptation measures										
	Effectiveness for potential mitigation	Feasibility/ Implement ability	Environmental friendliness	Equity	Economic viability	Local people Participation	Cultural acceptability	Synergies /Multi-purposefulness	Total	Rank
Construction of Disaster Shelter	4.43	4.18	4.07	3.22	3.46	3.05	2.54	4.52	3.68	7th
Construction and repair of embankment	4.31	4.13	3.44	3.97	2.68	4.19	4.15	4.69	3.94	2nd
Putting C.C block to protect embankment	4.04	3.70	3.37	4.10	2.94	3.80	3.83	4.03	3.72	6th

Plantation trees	4.05	4.13	4.57	4.21	4.41	4.51	4.43	4.48	4.34	1st
Providing housing structure	3.96	3.92	3.93	2.72	3.15	2.55	3.82	2.77	3.35	11th
Free Tubewell and sanitary latrine	4.24	4.26	4.51	2.23	2.88	2.73	3.72	3.33	3.48	10th
Free distribution of water purification tablet	4.16	4.15	4.86	3.79	4.22	2.44	4.23	3.04	3.86	4th
Free livestock distribution	4.23	4.28	4.32	3.34	3.62	2.26	4.04	2.96	3.63	9th
Assistance in agricultural sector	4.13	4.28	4.46	3.47	3.43	3.36	4.55	3.35	3.87	3rd
Rain water harvesting	3.88	3.54	4.18	4.14	3.88	3.86	3.86	2.92	3.78	5th
Skill training on handicraft	4.21	4.51	3.98	3.35	3.40	3.51	3.43	2.91	3.66	8th

Source: Field survey, 2019

Evaluation of Adaptive Measures

Many adaptation measures are in practice in the study areas to combat adverse impacts of climate change induced disasters like cyclone. The measures discussed above often are not equally responsive to the climate change impact. During household survey, people have been asked to give a value against each adaptation measures according to their effectiveness for potential mitigation, feasibility/implement ability, environmental friendliness, equity, economic viability, local people participation, cultural acceptability and multipurpose fullness. They all gave scores to adaptation measures in the study area. Such scoring gives an idea about each adaptation measures and also helps to ranking them. The people's perceptions about each adaptation measures are calculated By the Likert Scale there are five categories and each category have different scores. The following Table 3 shows the scores and respective category.

Table 3:*-Categories of selected criteria and score*

Category	Very Low	Low	Neutral	High	Very High
Score	1	2	3	4	5

Source: Prepared by Authors, 2019

The scale is for the evaluation of adaptation measures to reduce climate change impacts (Table 3). '1' score indicates very low and the score '5' indicates very high. Formation of shelter belt with mangrove forest is highly responsive without any considerable side effect and holds the number one position of adaptation measures. Construction and repair of embankment is also effective but comparatively lower than creation of mangrove forest along the embankment.

Table 4:-*Criteria Based Evaluation of Adaptation Measures*

Adaptation measures	Effectiveness for potential mitigation	Feasibility/ Implement ability	Environmental friendliness	Equity	Economic viability	Local people Participation	Cultural acceptability	Synergies /Multi-purposefulness	Total	Rank
Construction of Disaster Shelter	H	H	H	N	N	N	L	H	3.68	7th
Construction and repair of embankment	H	H	N	N	L	H	H	H	3.94	2nd
Putting C.C block to protect embankment	H	N	N	H	L	N	N	H	3.72	6th
Plantation trees	H	H	H	H	H	H	H	H	4.34	1st
Providing housing structure	N	N	N	L	N	L	N	L	3.35	11th
Free Tubewell and sanitary latrine	H	H	H	L	L	L	N	N	3.48	10th
Free distribution of water purification tablet	H	H	H	N	H	L	H	N	3.86	4th
Free livestock distribution	H	H	H	N	N	L	H	L	3.63	9th
Assistance in agricultural sector	H	H	H	N	N	N	H	N	3.87	3rd
Rain water harvesting	N	N	H	H	N	N	N	L	3.78	5th
Skill training on handicraft	H	H	N	N	N	N	N	L	3.66	8th

1= Very Low (VL); 2=Low (L); 3= Neutral (N); 4= High (H); 5= Very High (VH)
Source: Field survey, 2019

Climate Change is Happening and Affects Cities in Multiple Ways

Climate change has direct impacts on cities, such as health problems due to heat, or flooding damage to buildings and infrastructure. Many knock-on impacts affect other areas, sectors and people inside and outside the city. Higher temperatures increase the spread of certain infectious diseases into new regions. High temperatures can also put infrastructure at risk. Deformed roads and railways can hamper the movement of goods and commuters. Heavy rainfall can cause floods on beside rivers and from urban drainage.

The impacts of climate change may be significant. These include increased intensity of heat waves, with direct effects on human health particularly in cities, where an urban heat island effect compounds rising mean and extreme temperatures driven by climate change; increases in intense rainfall events, which increase the risk of inland flooding; retreat of mountain glaciers, with impacts on water availability and quality in urban regions; and an increased risk of drought and water shortage in already dry regions [14].

The Roles of Local Government on Climate- Resilient Sustainable Development

Climate change, like poverty and gender concerns, is a cross cutting issue not limited to one sector. Local plans and actions must therefore take into consideration a range of additional climate related concerns across the development spectrum. For example:

- Climate change adaptation and mitigation will involve retrofitting existing structures to better handle climate risks such as flooding, constructing new infrastructure such as flood protection walls or replacing current infrastructure with new climate proof designs. This requires great technical capacity at the local level.
- Climate change risks will also have to be addressed through improved land use planning and zoning that avoids developments on high risk areas (such as low-lying, flood prone, areas or steep slopes). Examples of other actions include strengthening building codes in urban areas to make infrastructure disaster/climate proof and energy efficient.
- There is a need to continue to strengthen their capacities in disaster risk management by putting in place risk management plans including early warning, evacuation protocols and emergency stocks as a priority.
- Health services will have to prepare for climate-induced health risks such as vector-borne diseases, extreme weather events that cause injuries, deaths, water contamination and increased pressure on health systems from diarrheal diseases, disruption to service delivery etc. Droughts and heavy rainfall can reduce crop yield and exacerbate malnutrition.

Urban planning in climate change, flood control, water supply, local parks/green-spaces sanitary waste etc. are implemented by Municipality as a role player as a local government body. In the study are Sirajganj some projects are implemented for the climate change adaptation. Some of these climate change projects in Sirajganj Municipality are the Asia Cities Climate Change Resilience Network (ACCCRN) Implemented by ICLEI; Adaptation to Climate Change into the National and Local Development Planning (ACCNLDP) Project; Resilience and Inclusive Urban Development Program (GIZ) and Urban Development Program (BRAC).

Approaches to Governing Climate Action in Cities are described in Table 5.

Table 5:-*Climate change and multilevel governance (key actors, functions and tools at different scales of action)*

	City/Local Governance	National	International
Government functions and roles	Local governance authority as like as Municipality implement microclimatic decisions through land use planning, decisions on local infrastructure (*e.g.* local roads, urban planning and zoning, flood control, water supply, local parks/reserves/green-spaces sanitary waste) Develop locally adapted policies and measures *e.g.* City Resilience Strategy, PPP and local public procurement policies regional and local decision making Examples: The Asia Cities Climate Change Resilience Network (ACCCRN) Implemented by ICLEI; Adaptation to Climate Change into the National and Local Development Planning (ACCNLDP) Project; Resilience and Inclusive Urban Development Program (GIZ) and Urban Development Program (BRAC).	National climate policy framework-near and long-term targets-strategic orientation for policy National laws, policies & standards in key climate-related sectors (*e.g.* energy, air pollution, water etc. related policy, Act and Rules). Infrastructure funding and authorization for construction (*e.g.* national roads, sitting power or transmission facilities) Monitor performance of climate policies related to local governments with tools and support to make good decisions.	Timeframe setting and priorities for cooperative action to guide national action. Monitor and peer- appropriate, compliance assessment for sharing of experience between nations.

Key Institutions or Actors	Public: Municipality, Upazila and Union Parishad Private sector: local Stakeholders and organizations	National Governmental, Semi-autonomous public-private Institutions e.g. ICCCAD, MoE, MoDM	International organizations and Institutions e.g. Greenpeace. WRI, red Cross
Tools for Decision Making	Urban planning and infrastructure decisions, Urban vulnerability mapping or risk assessment (*e.g.* flood risk and key Infrastructure)	Funding for research, Climate modelling – national research (*e.g.* ICCCAD, MoE) Project funding structures to support urban scale action	Funding for International research, collaboration and science-policy networks (*e.g.* IPCC, UNFCC)

Source: SLD, 2018

Table 6:-*Approaches to Governing Climate Action in Cities*

Approach	Policies & Mechanisms	Advantages & Limitations
Authorized Local Organization	Management of city government and facilities	Considerable assets lie under direct control of city government and improvement of it.
Public provision	Climate friendly infrastructure systems and approaches to service provision	Potential for significant reductions in emissions and vulnerabilities. But cities may lack responsibilities over key services, may not be willing to assume the financial risk, or lack sufficient capital.
Public-private provision	Development of climate friendly infrastructure systems and approaches to service provision, with private sector engagement	Private sector involvement may improve provision of certain services by contributing knowledge, financial resources or other inputs.
Regulations & incentives	Land use and building regulation; financial instruments such as taxes and subsidies; planning incentives for certified green buildings (e.g., greater permitted floor area ratio)	Promising approach to influence private investment. But some measures may be politically difficult to implement, are hard to apply retroactively, and are challenging to enforce where capacities are limited.

Source: SLD and Developed by Authors, 2019

Institutionalizing the Urban Governance of Climate Change Adaptation

Institutional Structures

The responses discussed following points to a mainstreaming of adaptation planning within local government structures. To understand these dynamics in more detail, respondents were asked to describe the agency principally responsible for climate change planning (covering both adaptation and mitigation), and then to rank the engagement of various other municipal agencies with the issue of climate change. According to respondent about 57% beliefs that there should be adapted a plan on climate change and 61% agree with that the city as a whole should be included in specific long range plans.

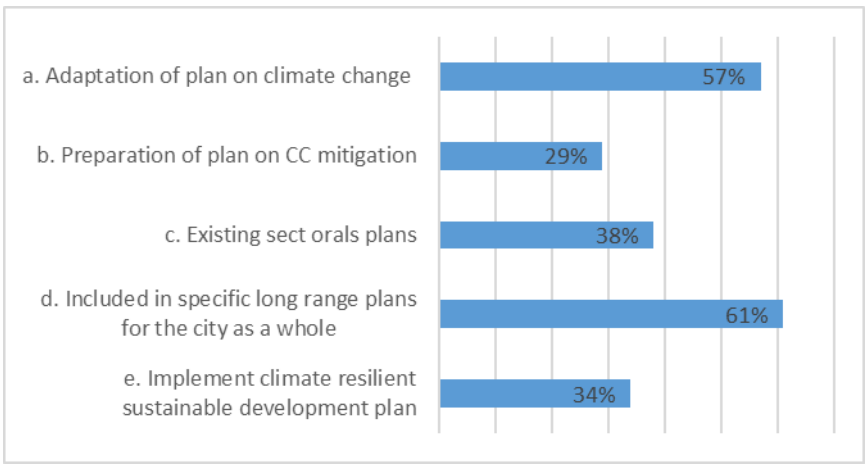

Fig.2:-*Integration of adaptation planning within local government plans*

Internal Support for Climate Change Policies and Programs

The level of internal support for climate change related work can have an important impact on efforts to design and implement adaptation policies and programs. Respondents were asked to rate support for climate change action from elected officials, employees and management within their local government structures. In most effective measures the respondent point out creating informal channels within local government agencies (67%) and in effective category the point out facilitating collaborative internal dialogues within local government and it is 48%. The most effective, effective and less effective measures are described in Figure 2.

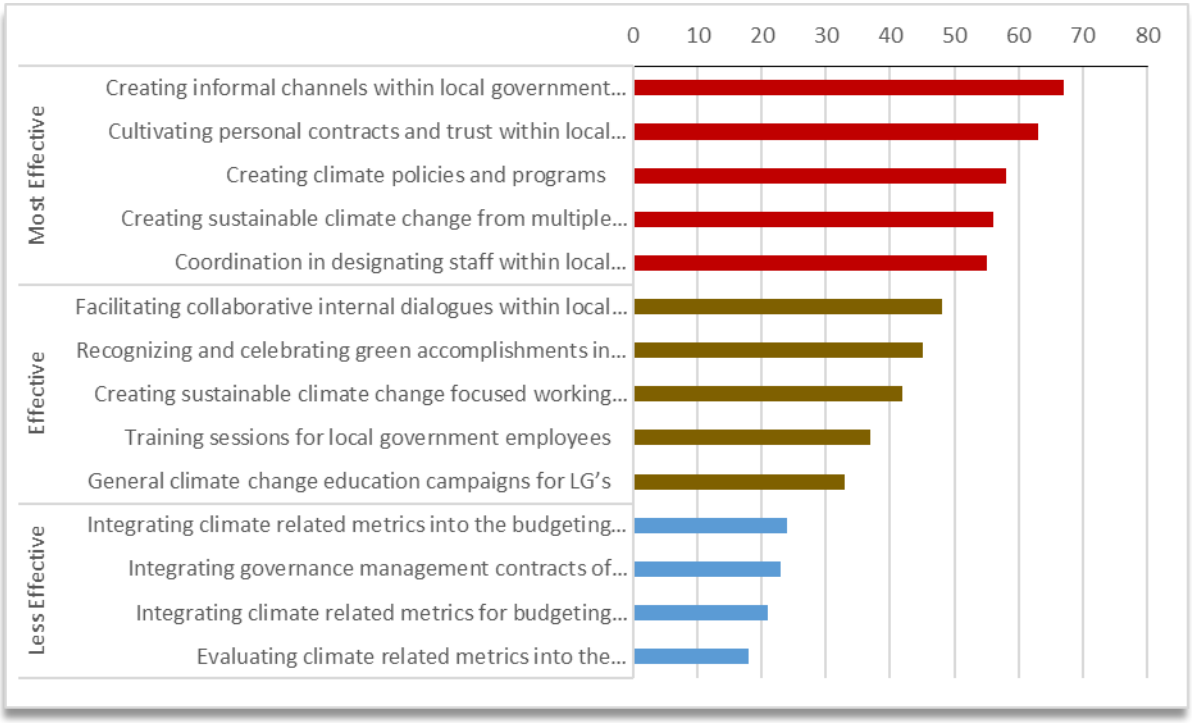

Fig.3:-*Tactics for encouraging engagement with climate change within local governments*

Barriers to Action

A variety of different challenges can affect a local government's ability to design and implement adaptation and mitigation strategies. Respondents were asked to rate the importance challenges in four key areas: Resource related challenges, Institutional challenges, Leadership challenges, and challenges related to information and awareness.

From the study area, five challenges were identified as important challenges a lack of funding for implementation (86%); lack of institutional coordination (80%); political focus on short-term goals (73%); inadequate infrastructure budgeting for CC (67%) and competing priorities (61%).

Outside of the top five, several other challenges linked to institutionalization, mainstreaming, and governance were also identified by a significant number of respondents. These include: a lack of funding to hire sufficient staff (59%); Lack of staff (57%), lack of understanding of LG responses (55%), lack of awareness among staff (53%) and difficulties in mainstreaming CC existing departmental functions (51%).

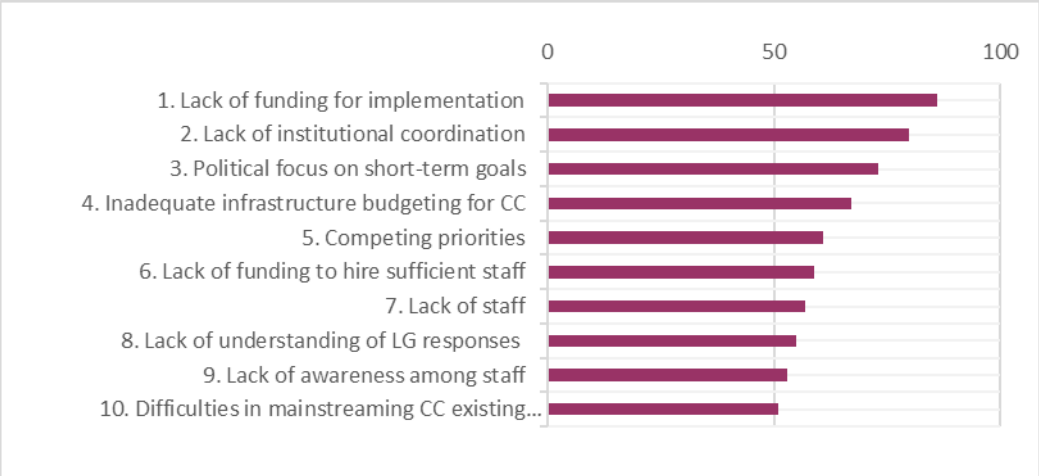

Fig.4:-*Top 10 challenges to climate change planning & implementation*

CONCLUSION

The local governance authority trying to make city resilient by locally adapted policies and measures associated by climate change but local people need basis measures not provided identified for different barriers of action. Resources unevenly distributed as they are, decline and grow thinner and the traditional practices of adjusting to the floods and erosion become increasingly difficult. Local climate change in terms of flood and erosion in the study area cause not only physical hardship but also irreparable loss in economic terms. They, therefore, become perpetually dependent on the local governance*;* this dependence proves to be an inescapable poverty trap. The people live with dreams and hope that a day will come when the local government will come forward and their dreams for a better life would be fulfilled. But so far, everything turns to be pious wishes. It is required to build the resilience in cities to tackle and cope with the increasing climate change shocks through improved knowledge sharing, capacity building, and building expertise.

Sirajganj Municipality itself is rated low on adaptive capacity in all the systems in terms of their capacity, access to resources necessary for response (manpower, technology, funds) and access to information necessary to develop effective plans and actions. The Municipality is trying to make resilient town and that will be scope and what level it is achievable.

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