Chapter 22
Do Community-Based Institutions Spur Climate Adaptation in Urban Informal Settlements in India?

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Key Messages

- Empirical evidence in this paper for women led CBOs to lead the way in increasing awareness about climate change and spurring climate adaptation action in the informal settlements in developing countries.
- While CBOs by definition are inclusive institutions, yet they may need to be more sensitive towards participation of marginalized in the slum setting.
- CBOs may have the potential to be the bridges between slum dwellers and local governments to access development and adaptation benefits.

22.1 Introduction

Half of the world's urban population resides in Asia (UN-Habitat, 2015; United Nations Human Settlements Programme, 2011) and Asian cities are among the densest and most populous cities in the world. The resource strapped city governments in most Asian cities face an overwhelming challenge of creating the necessary

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infrastructure for the ever-expanding areas and are typically not able to keep up with the demand. This has resulted in one in seven people living in poor quality and congested habitats with limited or no access to necessary infrastructure and services and lack of legal land tenure (Mitlin & Satterthwaite, 2013; Satterthwaite, 2007; United Nations Human Settlements Programme, 2011). In India, every sixth urban Indian resides in slums (MoHUPA, 2013). Many informal settlements are located in geographically disadvantaged, high-risk areas, more prone to climate-related hazards (like floods or landslides). In addition, informal settlements are resource scare, often in dilapidated conditions and do not have essential infrastructure that can withstand climate shocks, making them more vulnerable to climate risk. Adaptation to climate risk is an important strategy for reducing impacts of climate hazards, which requires development of capacity to adapt.

National plans and strategies for reducing vulnerability to climate risk, typically in the form of planned adaptations to climate change, are often formulated and designed with no involvement of the urban residents—many of whom live in informal settlements (Satterthwaite, 2007). Additionally, the people living in informal settlements often lack capacities to implement adaptation options. It is hypothesized that if the slum residents are provided with a supporting system to act, including access to knowledge, they may develop learning capacities which may lead to enhancement of capacities to achieve desired outcomes. All these point to the need for appropriate institutions to facilitate the learning process and hence the process of enhancement of adaptive capacity of slums.

The residents of slums are socially marginalized from access to critical services or resources, and this is closely linked to the institutional exclusion in urban areas. Informal settlement residents usually have difficulties engaging with local governments (Mitlin & Satterthwaite, 2013). In India, despite the implementation of the 74th amendment act, which pertains to the urban governance and the role of citizens in collective decision-making, the voice of urban citizens has been scarcely included (De & Nag, 2016). A community-based organization at the level of a slum can help to voice the concerns enabling behaviour of collective action and collective decision-making strengthening capacity to adapt.

One of the difficulties that community-based adaptation faces in cities is that much of the population lives in informal settlements on land that is occupied without formal authorization. Local governments may refuse to provide risk-reducing infrastructure because of this apparent ‘illegality’ (Satterthwaite, 2007). The interaction of community-based organizations with the formal government institutions would help strengthen bottom-up decision -making and collaboration between the governmental service providers and slum residents.

The objective of the study is to understand whether community-based organizations (CBOs) like women’s community action groups enhance the ability of people living in urban informal settlements to take action to reduce vulnerability to climate risk. This has some similarities with the type of intervention attempted in Bangladesh as documented by Rakib et al. (2021, Chap. 24 of this volume). We draw from the

'Women-led Resilience Building of Urban Poor in South Asia' project which was developed by Mahila Housing SEWA Trust (MHT) and its partners as a part of the Global Resilience Partnership (GRP) challenge (MHT, 2018). The research question that we raise is: Are CBOs effective in (a) raising *awareness* of climate change and adaptation options, and (b) help slum households to reduce climate impacts due to heat stress, flooding and vector-borne diseases? Another objective of this paper is to assess some preliminary evidence on their ability to engage meaningfully with local government.

22.2 Mahila Housing Trust (MHT) and the Global Resilience Project

The 'Women led Resilience Building of Urban Poor in South Asia' project aimed to build the resilience capacities of twenty five thousand low-income families living in slums/informal settlements in seven cities of South Asia, to take the lead in action against four climate risks. These four climate stressors are (a) heat waves; (b) flooding and inundation; (c) water scarcity; and (d) increased climate change-related incidence of water- and vector-borne diseases (MHT, 2018).

The project worked to create an integrated model wherein women take a lead through collective action and technology incubation, to devise locally relevant pro-poor and gender-sensitive climate resilient solutions and promote a culture of sustainable development and resilience among the urban poor in South Asia (MHT, 2018). To achieve this required, among other things, the formation of Community Action Groups (CAG) where women were trained on different aspects of climate change and urban governance.

22.3 Methods

22.3.1 Framework for the Study

There are three main elements in the framework for this study—one is the vulnerability of the system to external climate stimuli such as temperature and rainfall, two is the adaptive capacity of the system and the third is the adaptations made or actions taken by community members or households to address the climate risk (see Fig. 22.1).

This chapter uses the notion of 'vulnerable situation' conceptualized by Füssel (2005), where 'vulnerability' can only be used meaningfully with reference to a particular vulnerable situation (i.e. assessment context). Four fundamental dimensions describe the vulnerable situation—(i) the system (or region and/or population group and/or sector, e.g. slum communities in this study), (ii) the hazards (or threats

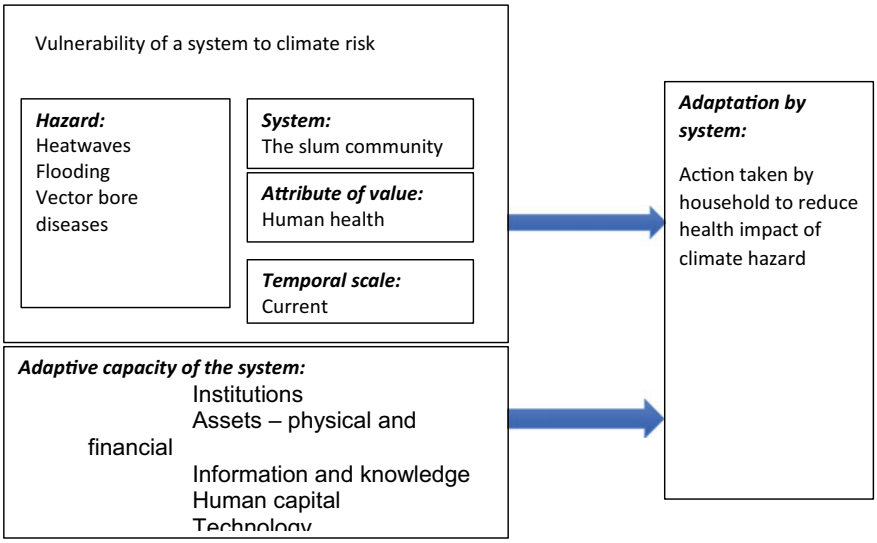


Fig. 22.1 Framework for the study

or stressors) considered (e.g. heatwaves, flooding and vector-borne diseases such as malaria and dengue), (iii) the consequences (or effects or valued attributes or variables of concern, e.g. impact on health and economic activity) and (iv) a temporal reference (e.g. current time period instead of future time period in this study).

Adaptive capacity of a system is defined as the ability of the system or its units to perceive the risk (need for change in behaviour), formulate a response (in terms of required change in characteristics or behaviour) and then implement the response (i.e. bring about a change in the characteristics or behaviour) with the view to reducing climate risk Patwardhan et al. (2003). The adaptive capacity inherent in a system is determined by (Brooks & Adger, 2005)—the resources available for adaptation such as natural resources, financial capital, human capital, knowledge of risk, appropriate social institutions for managing risks and appropriate technology, and, by the ability and willingness of those who need to adapt to deploy these resources effectively.

Adaptation involves an alteration in something (the system of interest, activity, sector, community or region) in response to something (the climate-related stress or stimulus) (Smith et al. 2001). The forms that adaptation takes can be classified in many ways. One way of classifying adaptation options can be based on Morgan's (1981) suggested four conceptual approaches to reducing technology-induced risk through modifying the effects and the exposure. They are:

- The natural and human environment can be modified—for example by raising plinth level to avoid flooding of house.
- The exposure processes can be modified or avoided—for example bed nets and netting screens on windows and doors can be installed to avoid mosquito bites.

Table 22.1 Four cities included in this paper

City	State	Climate	Population (lakhs)	Slum population (%)
Ahmedabad	Gujarat	Hot semi-arid	55.7	4.49
Bhopal	Madhya Pradesh	Humid subtropical	17.9	26.68
Jaipur	Rajasthan	Hot semi-arid	30.4	10.62
Ranchi	Jharkhand	Humid subtropical	10.7	20.8

Source Compiled from Census of India (2011)

- The effects processes can be modified or avoided—for example taking oral rehydrating salts (ORS) in case of dehydration in heat waves, taking medicines for malaria and dengue if affected by it.
- The effects, once they occur, can be mitigated or compensated for—for example compensation given by local governments for loss of property during extreme climate events.

22.3.2 Study Area

The study was conducted in four cities in India—Ahmedabad, Bhopal, Jaipur and Ranchi. In Ahmedabad, some slums already had well-established networks of women leaders in both the informal settlements and citywide, emerging out of MHT's long history of intervention. In the three other cities, MHT was in the process of establishing networks of women leaders at both the informal settlement and city levels, emergent out of MHT's shorter history of working in these cities. Table 22.1 presents a brief description of the four cities included in this paper. They represent different geographic destinations in India with varied climatic conditions. Each of them is the capital city of their respective states. The highest slum population is present in Bhopal followed by Ranchi, Jaipur and Ahmedabad.

22.3.3 Intervention

MHT made many interventions to achieve the objectives of its project on resilience building. However, the most pertinent one for this paper is the creation of Community Action Groups (CAGs). A total of 100 slums was selected by MHT for intervention based on a dearth of basic amenities within the slums and to provide diversity in the level of pre-existing social capital. This was verified based on a slum profile developed interactively with slum residents, focused on level of individual water supply connections, sanitation, housing pattern and existence of a Community Action Group (CAG). In the treatment slums, the project formed a CAG at slum levels by training, on an average, 10–12 women and youth leaders in each slum to act as

local community advocates and climate specialists on climate risk, surveillance and vulnerability assessment, collective response action and technical solutions (MHT, 2018). In the established and emergent cities, MHT worked with CAGs to form Vikasinis (city-level women led federation of CAGs) which would represent the voice of people in their slum communities in discussion with local government and technical groups (MHT, 2018).

22.3.4 Sampling

Selection of Treatment and Control Slums

Out of 100 slums selected for intervention by MHT, 20 project intervention (treatment) slums in Ahmedabad and 15 treatment slums in the other 3 cities (5 in each) were selected randomly. Since Ahmedabad contained both established and emergent slums, the sample in Ahmedabad was stratified based on the existence or not of a Community Action Group (CAG) in the slum prior to the project. Equal number of slums with existing CAGs and ones lacking a CAG were selected randomly. The other three cities only contained emergent slums because MHT has begun working in these cities only recently and no intervention slum contained an existing CAG. Control slums were selected based on their similarity to treatment slums. Slums were matched one to one on the basis of proximity, infrastructure status and governance and vulnerability to climate risks. Data used to match control slums to treatment slums was verified through slum profiles developed with the participation of local residents (MHT, 2017).

Selection of Households

In all the treatment slums, 10 households with CAG members were surveyed mainly based on the data supplied by the MHT programme staff. 15 non-CAG households were surveyed in the treatment slums. In the case of control slums, geo-spatial coordinates within the boundaries of the slum were randomly generated to select the respondents. A list of 15 households was surveyed based on their availability and acceptance to participate in the survey during the first home visit. In all households, only adult women respondents were interviewed. Table 22.2 presents the sampling plan for the study (MHT, 2017).

22.3.5 Data Collection

Data was collected through survey using a structured questionnaire (details available in MHT, 2017). The baseline survey was conducted from June to December 2016 with a sample of 1241 households and the endline survey was conducted from October to December 2017.We included 852 observations in our sample for the purpose of

Table 22.2 Sampling plan for the study

City	Slum type	Treatment slums				Control slums	
		No. of slums	No. of CAG household per slum	No. of non-CAG household per slum	Total no. of households	No. of slums	No. of households
Ahmedabad	Established	10	10	15	250	10	150
	Emergent	10	10	15	250		
Jaipur	Emergent	5	10	15	125	5	75
Bhopal	Emergent	5	10	15	125	5	75
Ranchi	Emergent	5	10	15	127	5	75
					875		375

Source MHT (2017)

this paper. The reason for attrition of about 30% of households in the endline survey was mainly related to relocation of the family in another slum or city or because the women head of the household declined to participate in the survey, or because the same household or same respondent could not be located.

22.3.6 Description of Sample

Table 22.3 presents a brief description of key aspects of the sample in this study. The mean age of the sample is 40 years. The sample consists of 29% control, 38% non-CAG households and 33% of CAG households. Almost 31% of the respondents cannot read and write. 50% of the respondents' income is below INR 10,000 per month. About 52% of the sample lives in pucca houses and 20% in kutcha houses.

22.3.7 Techniques for Data Analysis

The present study allows us to use the difference-in-difference (DID) method to evaluate the outcomes of the interventions. DID is used to estimate the treatment effects by comparing the pre- and post-treatment differences in both groups: treatment and control. The difference-in-difference equation is as follows:

$$Y_i = \beta_0 + \beta_1 \text{Treatment} * \text{Year} + \beta_2 \text{Treatment} + \beta_3 \text{Year} + \beta_4 \text{Covariates} + \varepsilon \tag{22.1}$$

Here, Y_i is an outcome of interest; and 'Treatment' refers to whether the respondent is part of the control group or treatment group. Year is an indicator of endline year. Treatment * Year is an interaction of these treatment and year variables and

Table 22.3 Description of the sample

	Responses	Total	Control	Non-CAG	CAG	Control & Non-CAG	Control & CAG	Non-CAG & CAG
		(n = 852)	(n = 248)	(n = 323)	(n = 281)	p-value	p-value	p-value
City	Ahmedabad	56%	46%	60%	60%	0.005***	0.001***	1
	Bhopal	20%	28%	17%	17%	0.001***	0.002***	1
	Jaipur	12%	9%	13%	12%	0.25	0.37	0.92
	Ranchi	13%	17%	10%	11%	0.88	0.05	0.85
Slum type based on MHT operations established or emergent	Established	56%	46%	60%	60%	0.000***	0.001***	1
	Emergent	44%	54%	40%	40%	0.001***	0.001***	1
Literacy	Can't read and write	31%	35%	39%	18%	0.4	0.000***	0.000***
	Can read or write	69%	65%	61%	82%	0.4	0.000***	0.000***
Income (in INR)	Below 10 k	50%	50%	44%	56%	0.15	0.21	0.0034***
	Between 10 to 20 k	33%	29%	40%	29%	0.01	0.95	0.0069***
	Above 20 k	17%	20%	16%	15%	0.3	0.14	0.7
House type	Kutcha	20%	27%	21%	11%	0.08	0.000***	0.002***
	Semi-Pucca	29%	30%	26%	30%	0.31	1	0.29
	Pucca	52%	42%	53%	58%	0.012	0.000***	0.23
Age (in years)	Mean age	40	41	39	38	0.05**	0.003***	0.2324

Source Based on primary survey
** significant at alpha = 0.05, * significant at alpha = 0.1

ε is the stochastic error term. The coefficient of the interaction term (Treatment * Year) is the DID estimator used to assess the impact of the interventions in the slums. Covariates are the control variables. This design allows us to account for observable and time-invariant unobservable factors and thus attribute changes in outcomes to the Community Action Group intervention of the Mahila Housing Trust under the Global Resilience Project. Since the dependent variables are binary in nature (as shown in Sect. 22.4.1), we use linear probability regression for the data analysis in the DID framework.

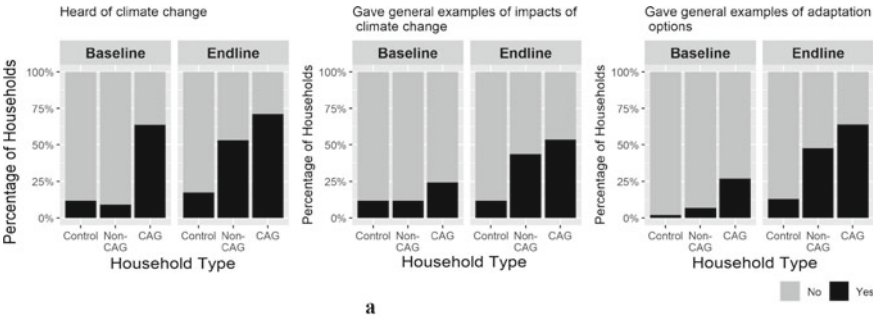
22.4 Data Analysis and Results

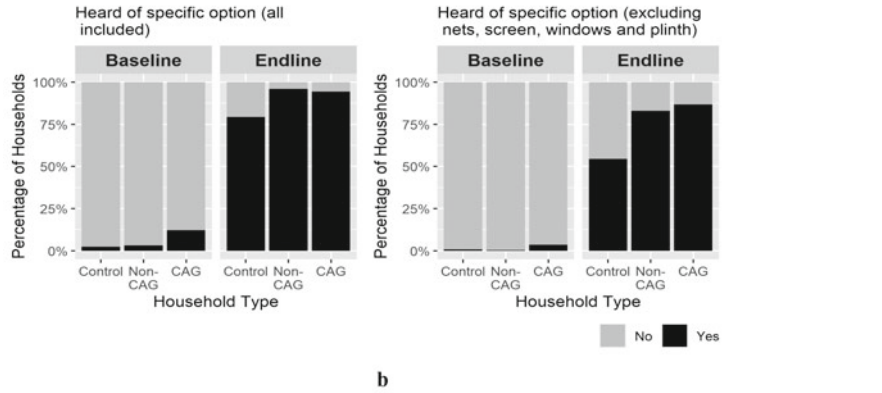
22.4.1 Main Variables of Interest in the Study

***Treatment* (*main independent variable*)**: The treatment variable had three levels, i.e. control group, non-CAG group and CAG group. Control slums had no CAG programme. Within the treatment slum a respondent household could either be a member of Community Action Group (labelled as 'CAG') or not be a member of CAG (labelled as 'non-CAG').

***Slum household's awareness of climate change* (*dependent variables*)**: Three binary (yes/no) indicators were considered for assessing awareness of respondents about climate change. The first indicator was whether the respondent had *heard of climate change or not*. The second indicator on respondents' *awareness of climate change impacts* was captured through an open-ended question which was converted to a binary form based on assessment of qualitative responses. From among the respondents who gave responses different from 'don't know', majority of the respondents said that heat stress was increasing, followed by increase in disease incidence, flooding, pollution and water stress. The third indicator on the respondents' *general awareness of options to reduce impact of climate change* was captured through another open-ended question. The responses were coded 'yes' if the respondent mentioned a reasonable option to reduce the impacts of climate change, and 'no' if the respondent said, don't know or the response was not very coherent. The most common responses were afforestation or tree plantation, followed by. 'over-population must be controlled', 'vehicle use must be reduced', avoid the use of air conditioning, etc. Figure 22.2a presents the distribution of responses for awareness of climate change across control, non-CAG and CAG groups.

***Action on climate change by slum households* (*dependent variables*)**: Two indicators were considered for assessing the action of slum households in terms of adopting specific options to reduce climate risk. The first was whether the respondent had *heard of specific options to reduce climate risks* faced by them in the context of their slums. As part of MHT's intervention, the Community Action Groups attempted to build capacity building of agents through communication exercises and workshops on the understanding of climate change, participatory vulnerability assessment and an exposure to set of risk reducing or adaptation options for reducing climate risks faced by the community. The sample of respondents was asked, whether they had heard of certain options to reduce the heat stress in summers due to higher temperatures, reduce the mosquito menace and reduce impact of flooding. The response options consisted of 'heard' of the option, 'not heard' of the option and 'invested' in the option. For some of the options, the question was asked only in the endline year, as these were technologies which had not been introduced through the intervention in the baseline year. Figures S1 and S2 (in supplementary material) present the array of such risk reducing or adaptation options in terms of the proportion of





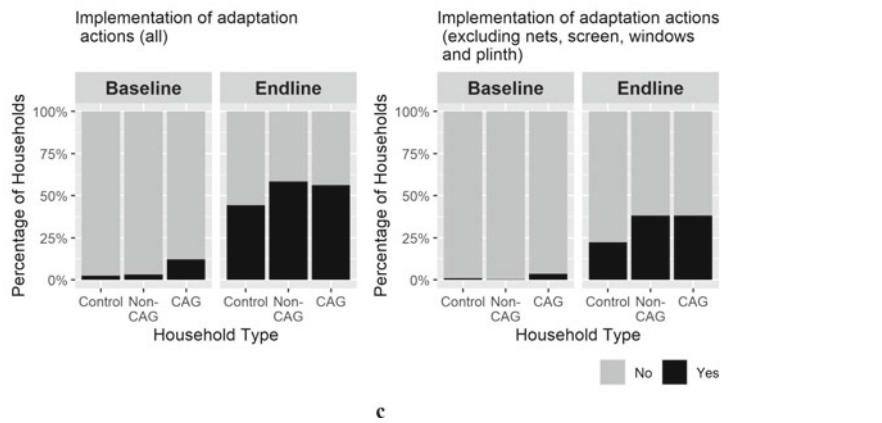


Fig. 22.2 **a** Slum household's awareness of climate change. **b** Slum household's awareness about specific adaptation options to reduce climate risk in their slums. **c** Slum household's implementation of specific adaptation options to reduce climate risk in their slums

respondents who had chosen, 'heard' and 'not heard' (invested option was converted into 'heard' category for this piece of analysis) responses across control, Non-CAG and CAG households. The second indicator was the *implementation of adaptation option*(*s*) by slum households which was captured by looking at the actual options in which people invested their money in baseline and endline years. The endline year had more number of options in which households invested as the Community Action Groups had sensitized their members to additional options available to reduce risk (see Fig. 22.2c).

Control variables: The awareness of climate change and actual implementation of adaptation option will depend on the vulnerable situation of households in slums and adaptive capacity of households in slums as shown in the conceptual framework for the study (Fig. 22.1). The attribute of value, i.e. human health issues due to heat stress and vector-borne disease and economic effect of flooding in terms of loss of property, loss of work and loss of schooldays for child, is included in the equation as independent variable. The greater the loss in these dimensions, the greater the expectation of a household being aware of climate risk and investing in adaptation options.

Three indicators for adaptive capacity are included here. One is related to the institutions at the local level, i.e. whether a respondent is a member of a CAG or not which is also the treatment and the main independent variable in the study. The second is the income of the households which is expected to affect the ability of the slum household to implement a particular adaptation option and is also a proxy indicator of many other dimensions of adaptive capacity related to wealth. The third indicator is literacy, with the expectation that greater the literacy, the greater the awareness of climate change and agency to implement adaptation options. Also, Table 22.3 shows that the control groups and treatment groups are unbalanced with respect to these variables. Hence, including these in the regression equation as controls is reasonable.

Another covariate included in the regression equation is whether the slum belongs to cities where MHT has established operations and is experienced in implementation of community action groups for resilience building in slums (like Ahmedabad) and cities where their operations are new and emergent (like Bhopal, Jaipur and Ranchi) to account for city fixed effects.

22.4.2 Effect of Community Action Groups on Awareness Climate Change and Implementation of Adaptation Options

For each outcome (dependent variable), Fig. 22.3 displays (i) the DID estimate and (ii) robust clustered standard errors of the DID estimate. The complete results of DID regression with all its covariates are available in the supplementary material as Table S2.

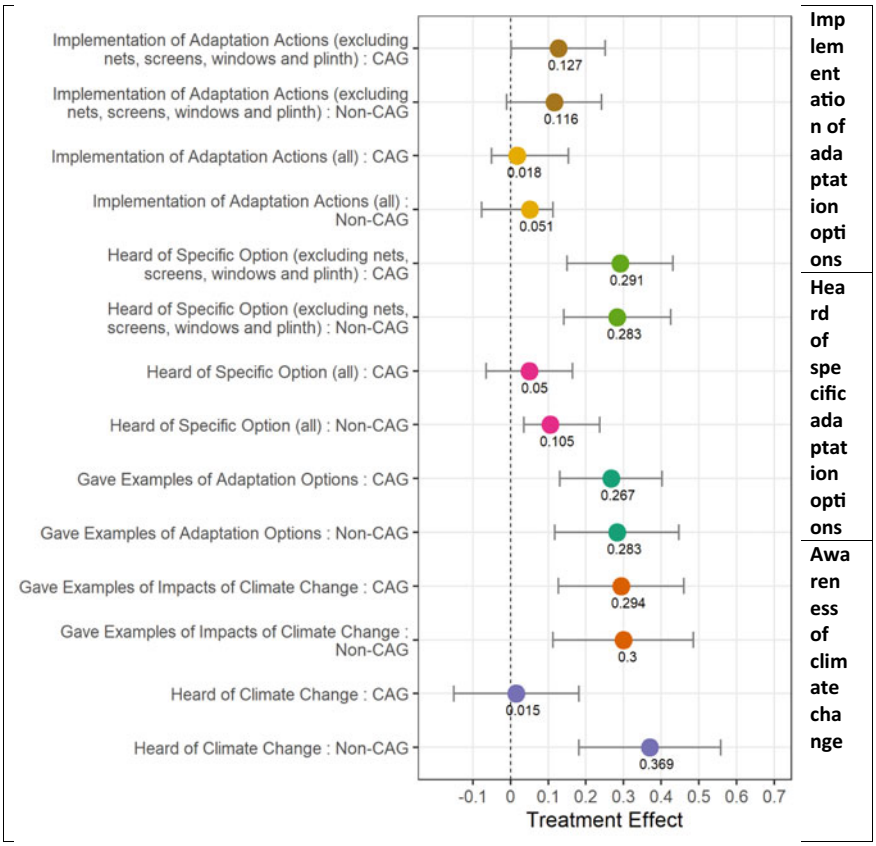


Fig. 22.3 Impact of Intervention on household awareness of climate change and implementation of adaptation actions to climate change

The DID estimates suggest that membership of Community Action Groups had a significant effect on two out of three indicators of awareness of climate change. The effect of treatment was not significant for whether the respondent had heard of climate change in the CAG group. This is because as Fig. 22.2a shows that awareness of climate change was already high among the CAG members in the intervention slums in the baseline year (probably, because MHT already had a presence in the established city (Ahmedabad) slums even before the intervention). The MHT's intervention and facilitation in these slums had included discussions on climate change even previous to the start of the Global Resilience Project. This is validated by some qualitative comments of respondents in the baseline year, when they were asked, 'Where have you heard or learned about climate change?' Majority of the respondents said that they learnt about climate change from MHT meetings. The interesting result is that even among respondents who are not members of CAG, but part of treatment slums, there is a significantly higher awareness of climate change. There seem to be spillover effects

of knowledge from CAG to non-CAGs in the same treatment slum communities whereas control groups are in slum different communities with no treatment at all.

The DID estimates for awareness about specific adaptation options and implementation of adaptation actions are not significant if we include all thirteen specific adaptation options in the dependent variable. This seems counterintuitive as Figs. S1 and S2 (in supplementary material) show that for many adaptation options there seems to be a significant difference between awareness of specific adaptation options in baseline period and endline period. Delving deeper into the data, we found that the number of respondents who had adopted 'mosquito nets' and 'mosquito screens', and implemented more 'windows for ventilation' were quite large in the endline year and across not just non-CAG and CAG groups but also control group (see Tables S3 and S4 in supplementary material). The relatively large number in control group for the above three options was masking the effect of intervention on awareness and implementation of other specific adaptation options. Also, the option of construction of plinth for reducing flood risk is greater among CAG households in baseline year compared to intervention year (see Table S3 in supplementary material). Hence, we excluded the mosquito nets and screens and more windows for ventilation and construction of plinth in computing the dependent variables—'awareness of specific adaptation options' and 'implementation of specific adaptation options'.

After this, we found the effect of the intervention to be significant not only for CAG group but also for the non-CAG group, again implying positive spillover or externalities of the intervention in the treatment slums. Moreover, the effect on non-CAG group seems to be bigger in case of some dependent variables as the change in non-CAG group from baseline to endline year is a bigger change compared to the change in CAG group from baseline to endline years (the bar plots show, in many instances, in the baseline situation, the non-CAG is at a much lower level than CAG). A probable cause of more people in the control group becoming more aware of and implementing these three specific options could be the sensitization during baseline year through the questionnaire interview. Since these are commonly understood options and relatively easy to implement, we see a greater awareness and implementation of these across all three groups, irrespective of the treatment.

Though the effectiveness of CAGs to enhance the awareness of climate change, and implementation of adaptation options by slum households to reduce climate impacts and risks is established by the empirical evidence in this paper, however, the efficacy of CAGs to do the above is not perfect as is discussed in the next section.

22.4.3 Impact of Heterogeneities Within Treatment Group on the Effect of Treatment

From Fig. 22.2a and Figs. S1 and S2 (in supplementary material), it is evident that in none of the plots of climate change awareness and awareness of specific adaptation options, the proportion of CAG members who are aware of climate change or of the

adaptation options is greater than 75%. This means, that at least 25% of members of CAG have either not heard of climate change and specific adaptation options or could not recall it when asked about it. There could be many reasons for this—one, that not all members necessarily attend all CAG meetings and its training programmes. The members who miss the meeting and/or training programmes naturally have lost the opportunity to learn about these issues. A second reason could be that some of the members may not comprehend fully the notions of climate change and different types of adaptation options due to lack of capacities such as education and income.

Hence, for the sample of CAG respondents only ($n = 281$), Table 22.4 presents an OLS regression with dependent variable being the number of specific adaptation options that a household had 'heard' of. The independent variables are three socio-economic indicators of capacity, i.e. being above or below BPL, literacy and house type. Literacy is positively correlated with whether a person heard of or had not heard of adaptation options to reduce heat stress and vector-borne diseases. Hence, lack of education could be a barrier in comprehending and understanding fully the various adaptation options. Similarly, people living in kuccha houses are less likely to have heard of adaptation options.

The implication of this result is that even though CAGs by definition seem to be inclusive and participatory, but even at such a decentralized level, heterogeneities in demographic and socio-economic conditions of members may mean exclusion of certain members from full and complete participation.

Table 22.4 Determinants of a CAG group respondent having 'heard' of a specific adaptation option

	Independent variables	Heard about climate actions
BPL Base: Yes	No	2.080** (0.424)
House type (Base: Kuccha house)	*Semi-pucca*	3.939*** (0.633)
	Pucca	1.9763** (0.567)
Literacy Base: can't read and write	Can read and/or write	1.197* (0.554)
Constant		2.261*** (0.651)
Observations: 281 $R^2 = 0.231$, Adjusted $R^2 = 0.219$ Residual std. error (df = 276) 3.349, F statistic (df = 4; 276) 20.685***		

Source Based on data collected
*** significant at alpha = 0.01, ** significant at alpha = 0.05, * significant at alpha = 0.1

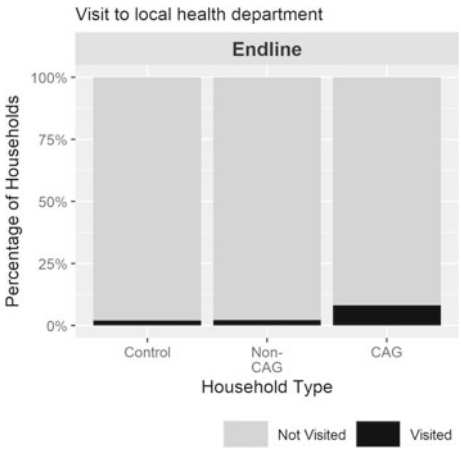


Fig. 22.4 Visit to local health department by respondents across control, non-CAG and CAG groups

22.4.4 Community Action Group Membership and Engagement with Local Government

One of the objectives of the CAGs facilitated by MHT is to improve the ability of the women to collectively to engage with local governments in co-creating and implementing solutions to the problems that slum dwellers face. The qualitative interviews with CAG members do point to this. However, the quantitative data, which has been the focus of analysis in this paper, did not include many variables which could tap into this dimension (ability to engage with local governments) of capacity enhancement of slum households and communities. We could find only one variable in the data set that reflected this dimension—which was whether the respondent household had approached the health department to address the mosquito problem in the endline survey (see Fig. 22.4 for results).

We find that a very small proportion of respondents answered in the affirmative to this question across all the respondent categories, i.e. CAG, Non-CAG and control group. However, the odds of CAG respondents approaching the health department to address the mosquito problem was at least four times the odds of a control group respondent doing so (see Table S5 in supplementary material).

22.5 Observations and Conclusions

This paper provides empirical evidence on the effectiveness of CAGs to enhance the awareness of climate change, awareness about specific adaptation options to reduce climate impacts and to facilitate the implementation of adaptation options by slum households. We expected the household members of community action group to lead in taking climate actions because of access to information about adaptation options

and various training activities conducted by the CAGs. This did hold true as we found that the household members of CAG were more likely to take climate actions than the control group, particularly in case of those options which are less commonly known such as green roofing and airlite ventilation. We even saw spillover effects to non-CAG household who also took significantly higher climate action compared to control groups.

This study further contributes to the literature on the role of institutions, particularly decentralized and participatory institutions in enhancing adaptive capacity and response actions of slum households and communities to climate change. While CBOs cannot build the trunk infrastructure (elevated roads, water, sewer and drainage mains) that all city areas and zones need, they can help install and make smaller connections and/or pipes that feed into the trunk infrastructure, thereby improving the inclusion of slum households in the use of trunk infrastructure. Example of this was seen in this study when the community together elevated an inner street connecting to the main road, so that flooding could be reduced.

We also found evidence that CBOs like the CAGs in this study can be effective in improving the capacity of slum households to engage meaningfully with city-level authorities in climate risk reduction options for their communities. This resonates with other studies like Adger et al (2003) who find that actions based on collective action can benefit and can be more effective in strengthening the voice of the people living in slums ultimately enhancing their adaptive capacity. This also adds to the literature from the global South as reviewed by Shammin and et al. (2021, Chap. 3 of this volume).

However, the efficacy of CAGs to enhance the awareness of climate change and adaptation options to reduce climate impacts and risks are not perfect as the results in Sect. 22.4.3 illustrate. The implication of this finding for functioning of CAGs is to introspect on how to increase members' participation in CAG meetings and trainings and how to make participation of members more inclusive. The role of training has been highlighted in the literature as noted in the systematic review done by Bahinipati and Patnaik (2021, Chap. 4 of this volume). Community-based models need to have higher social capital and will require collective action and continuous social learning where the vulnerable population come together for a common cause (Adger et al., 2003).

One lacuna is, that adaptive capacity building and resilience building is a sustained, long-term process, and assessments like the one made by MHT and Global Resilience Projects are one-time snapshots. Moreover, after an intervention has been made by a CBO, e.g. training related to climate change and options to address climate risk, it takes a while for the effect of these interventions to convert into desirable outcomes. Data from one year immediately after the intervention may not always capture the extent of change in capacities that has been brought about. It could be that with sustained effort, these capacities would strengthen or they could deteriorate over a period of time after the initial enthusiasm, if mechanisms to sustain the capacity building are not built into the institution.

Continuous engagement of the communities is a mounting challenge in the whole process. It should also be noted that very less empirical studies exist in measuring the

resilience of the slum communities through a participatory approach. More studies in future would help to illuminate insights in improving the framework. More research is also needed into what are the variations in institutional forms of CBOs and what institutional features make some CBOs more successful than others in achieving their objectives.

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