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Community action planning in East Delhi: a participatory approach to build urban disaster resilience

Sunil Prashar · Rajib Shaw · Yukiko Takeuchi

Abstract The paper addresses disaster risk of an urban community in a mega city, which experiences high risk to natural hazards. The Community Action Planning (CAP) tool is used in this case. It has been developed from five resilience dimensions (physical, social, economic, institutional, and natural), 25 parameters and 75 actions. A detailed CAP structured questionnaire survey was conducted with 89 Residential and Welfare Associations (RWAs) in East Delhi, India situated in three types of settlements: planned Delhi Development Authority (DDA) housing and societies, colonies, and urban villages. The result identifies and prioritizes 32 actions as important for all three settlements. The result shows both consistent and inconsistent responses from RWAs. To give some examples, parameter S3 is "tasks to reduce number of people suffer from water borne diseases after a disaster". In response to this parameter, approximately 80% of total respondents prioritized action (A1), "promoting people to take preventive measures after a disaster". It shows consistent response from all three settlements. However, parameter S5 is "tasks to improve the awareness and knowledge about threat and impact of disasters". Approximately 40% of total respondents prioritized A1, "organizing training program for awareness and knowledge building". This action was prioritized in planned DDA housing and societies (56%) as well as in colonies (52%). However, none of the respondents from urban villages prioritized this action. These responses show inconsistency in response to specific action. In addition, the study shows the potential impact of CAP process for other communities in cities that are experiencing disaster risks and impact of climate change.

Keywords Community action planning · Delhi (India) · Disaster risk reduction · Participatory approach · Resilience · Urban community

S. Prashar (✉) · R. Shaw · Y. Takeuchi
Graduate School of Global Environmental Studies, Kyoto University, Yoshida Honmachi, Sakyo-Ku, Kyoto 6068501, Japan
e-mail: sunilparashar111@gmail.com

R. Shaw
e-mail: shaw@global.mbox.media.kyoto-u.ac.jp

Y. Takeuchi
e-mail: y.takeuchi@fw7.ecs.kyoto-u.ac.jp

1 Introduction

Climate change and its impact worldwide can no longer be ignored. Severe events are happening and likely to take place in the future. These events come in the form of increased number and intensity of extreme climatic events such as avalanches, landslides, extreme temperature, floods, heavy rain storms and cyclones. From 1950 to 2005, research indicates an upward trend in the number of large disasters arising from natural events (Satterthwaite et al. 2007; Hoeppe and Gurenko 2007). In addition, economic and insurance losses have also increased due to weather-related events. Most of the damage recorded in urban areas results from intensity and severity of climatic events and non-climatic stressors. The non-climatic stressors include slum population living on risky sites, inadequate infrastructure and services and poor built construction (Satterthwaite et al. 2007; Hoeppe and Gurenko 2007).

A strong linkage exists between urban growth and climate change (Lankao 2008). Urban areas are considered the key sources of greenhouse gas (GHG) and play an important part as drivers of global warming. Urban manufacturing and commerce, vehicles and population congestion are the major emitters of GHG in any urban area (Lankao 2008). Consequently, many cities have already exceeded their annual average per-capita of carbon dioxide (CO_2) emission (Dodman 2008; Lankao 2008). Now these cities are facing the likely possibility of extreme weather phenomena. Example include: an increase in heavy precipitation events over most areas; an increase in intense cyclone activities; warmer and more frequent hot days and nights over most land areas, an increase in warmer spells/heat waves as well as areas affected by drought, and ultimately an increase in the extreme sea level (IPCC 2007a; Lankao 2008). Several cities have already experience the disruption of their settlements, commerce, transport and societies (IPCC 2007a; Lankao 2008). Therefore, urban areas are vulnerable to climatic change and must better prepare for its impact.

Beyond risk and vulnerability from climate change, urban areas also have adaptive capacity to deal with the impacts of climate change. Intergovernmental Panel on Climate Change (IPCC) clearly defines adaptive capacity as the "potential, capability, or ability of a system to adapt to climate change stimuli or their effects or impacts. It also influences the vulnerability of communities and regions to climate change effects and hazards" (IPCC 2001). Many urban centers have successfully implemented their own coping strategies to deal with climatic phenomenon. Adaptation has become a salient feature in many locations including coastal cities (Amsterdam, the Netherlands), cities in arid areas (Tucson, USA, Mexico City, Mexico), and cities that are located around a lake system (Mexico City) (Lankao 2008). Successful responses of cities to climate change depend on the willingness and capacity to adapt. The level of adaptive capacity can also be assessed through specific and generic indicators. Specific indicators include: institutions, knowledge, and technology, whereas generic indicators are: education, income, and health (IPCC 2007a; Yohe and Tol 2002; Downing 2003; Brooks et al. 2005; Tol and Yohe 2007).

Several adaptation studies emphasize the role of government in the adaptation process. The government plays a crucial role in fostering urban adaptation (Adger et al. 2007). However, the adaptation process is mainly successful in cities where local governments first have the knowledge and then grow the capacity to take actions (Satterthwaite 2011). It is essential that national governments provide legislation, funding, and support to local government for dealing with disaster risks produced by climate change (Satterthwaite 2011). Several examples from Latin America countries show how disaster risk reduction is prioritized in their new legislation or through amendments to old legislation to enhance the cities' capacity (Satterthwaite 2011). In Colombia, a national law for disaster risk reduction has been passed along with the establishment of a National System for Prevention and Response to Disasters (Satterthwaite 2011).

The challenges are enormous in middle and low income countries. The city government often lacks the capacity to act (Lankao 2008). Moreover, Agrawala and van Aalst (2005) pointed out some additional challenges of adaptation with governments including "relevance of climate information for development-related decisions; uncertainty of climate information; compartmentalization with governments; segmentation and other barriers within development - cooperation agencies; and trade - offs between climate and development agencies" (IPCC 2007a; Agrawala and van Aalst 2005). In addition, city governments have limited capacity to act and national and international agencies give less importance to adaptation. Ronju Ahammad writing about constraints of pro-poor climate change adaptation in Chittagong city, Bangladesh clearly pointed out the lack of financial strength of city government and the support from national government (Ahammad 2011; Satterthwaite 2011). Furthermore, the paper notes that the city government's role with regards to climate change adaptation is not clearly defined. The Bangladesh national climate change adaptation policy does not consider urban adaptation in its planning and nor does the policy strengthen the city government in order to reduce the risk of low income group due to climate change (Ahammad 2011; Satterthwaite 2011). In addition, climate change has not been well integrated into the broader framework of sustainable housing and urban development of most developing countries (Satterthwaite 2011). Consequently, vulnerability in urban areas, especially of low and middle income countries is increasing. The most vulnerable are the urban poor, who often lack capacity to avoid the direct and indirect impacts of climate change. They mainly live in high risk areas such as flood plains, unstable slopes, over river basins, and other riskier sites (Lankao 2008; Hardoy et al. 2004). Moreover, they are least able to cope with loss of livelihoods and the resulting loss of income. Climate hazards often cause illness, injury and premature death among the urban poor.

The literature in adaptation has recognized the role of community in adaptation to climate change. When extreme natural disasters occur, communities at local level experience the greatest impact in terms of loss of lives and livelihood (Satterthwaite 2011). It is at the community or local level that disaster risk can be avoided before disaster occurs. Community action can help local governments to initiate and implement disaster risk reduction activities (Satterthwaite 2011). Communities can help local government by providing detailed, locally rooted information especially of informal settlements. This information helps in mapping risks and vulnerabilities of urban communities. For example, risk mapping was the central element of disaster risk reduction in Santo Domingo, Dominican Republic; Georgetown, Guyana; Port-au-Prince and Cap Haitien, Haiti (Satterthwaite 2011; Pelling 2011). This initiative brought core groups to engage with citizens. Similarly, low-income communities' initiatives in Mombasa and Estelí utilized participatory methods to define their vulnerability, priorities, therein identifying asset adaptation for building long-term resilience (Satterthwaite 2011).

This paper addresses disaster risk of urban area through development of community prioritized actions for disaster risk reduction. The actions prioritized by community can also be integrated into a community led adaptation process for reducing the impact of climate change. The main objective of the paper is to develop information (i.e. community prioritized actions) necessary for building disaster resilience. Further, this necessary information can help the local government in identifying community priorities within the development context.

The paper first describes climate change in Delhi and the back-ground and disaster profile of East Delhi. The CAP approach is then explained. The next section describes the methodology and data collection undertaken. The results and discussion that describe community prioritized actions for disaster risk reduction follow. Finally, the implication of CAP process on the other cities that are experiencing disaster risks and impact of climate change is presented.

2 Climate change in Delhi

Delhi also called National Capital Territory (NCT) of Delhi occupies an area of 1,483 sq. km. The total population as per the 2011 census is over 16 million. It comprises of nine revenue districts – Central Delhi, North Delhi, South Delhi, East Delhi, North East Delhi, South West Delhi, New Delhi, North West Delhi, and West Delhi (Parvin et al. 2011). Moreover, Delhi has a unique and complex structure of governance due to existence and functioning of two governments - Union Government and Government of NCT of Delhi (Government of India 2009). It is ranked the 10th largest among world's most populated cities (Government of National Capital Territory of Delhi 2006). The city has experienced very fast population growth in 1991–2001 and by 2015, the population is expected to reach 22 million. Ninety three percent of the population is urbanized. The population density as per 2011 census is 1,124 persons per sq. km. (Census of India 2011). The city is the largest metropolis in India in terms of area and second largest by population.

The climatic condition of Delhi is semi-arid. The hottest months are May-June when the maximum temperature is around 48°Celsius (Rahman et al. 2011). December and early January are the coldest month when temperature goes below 4°Celsius. The maximum rainfall is 296 mm, which takes place during the month of July and August (Rahman et al. 2011).

Mehrotra et al. (2009) conducted a study in order to create a framework on city climate risk for Delhi. The study revealed that extreme minimum and maximum temperature events are increasing (Mehrotra et al. 2009). In 2006, Delhi recorded lowest temperature since 1935 (Mehrotra et al. 2009). Similarly, in June 2007, in Delhi the maximum temperature recorded was 44°Celsius. Table 1 shows some of climate change projection for Delhi. Extreme precipitation was recorded in July 1994, July 1995, and June 2003. On several occasions, extreme precipitation brought inland flooding in the city.

Similarly, a study on climate change risks and adaptation in Indian mega cities by (Panda 2011) demonstrate the climate change risks of Delhi and associated climate vulnerability. It shows how the predicted climate change as mentioned in Table 1 would lead to rising intense rainfall, heat waves, cold waves, increased droughts, and water scarcity. The same study by (Panda 2011) shows the main indicators of climate change vulnerability of Delhi. To understand the current and projected effects of climate change on Delhi and how they can exacerbate disaster risks, it is essential to understand the climate vulnerability of Delhi. Climate vulnerability is a "function of the character, magnitude, and rate of climate variation

Table 1 Climate change projection for Delhi

HAZARD	Temperature observed trend and projections for 2050s	Precipitation observed trend and projections for 2050s	Sea level rise observed trend and projections for 2050s	Extreme events
Delhi	Slight warming since 1900; 2006 0.2°C, lowest temp since 1935; 2007 44.9°C, highest recorded temp; 1.5°C to 2.5°C projected warming	14 millimeters per decade increase since 1900 with large variability; projected change in precipitation uncertain: −15% to +35%	Non–coastal city; experiences local flooding during monsoons	Extreme precipitation July 1994, July 1995, June 2003; extreme temperature May 1978, April 1988, May 1996; faces inland flooding due to intense precipitation during monsoons

Source: Mehrotra et al. 2009

to which a system is exposed, its sensitivity, and adaptive capacity" (IPCC 2007b). In terms of exposure, the city is facing changes in climate itself as shown in Table 1.

In addition, there are other non-climatic stressors that are also likely to be affected by climate change. The IPCC 2007 Working Group II report clearly noted that climate change can amplify the risks that cities faces from non-climatic stresses (IPCC 2007c). The non-climatic stressors, especially in Delhi are: slum populations living in the risk prone areas, poor infrastructure and services, inadequate housing, poor air and water quality and inadequate solid waste disposal (Rahman et al. 2011; Mehrotra et al. 2009). The water demand for drinking, domestic use, irrigation and industrial purpose is 866 Million Gallon per Day (MGD) (Central Ground Water Board 2006). In contrast, the supply is 630 MGD, which is obtained from both surface and ground water after conventional treatment. It is expected that the water requirement will reach to 1,072 MGD by 2011 and 1,389 MGD by 2021 (Central Ground Water Board 2006). It shows an ever increasing drinking water shortage in the city. Geographically, Delhi is a dry land ecosystem, that means low, unpredictable, and erratic rainfall are expected to occur in future (Panda 2011). The existing condition will be further aggravated when climate change induced variability in rainfall further effects the shortage of drinking water in the summer. Another big challenge for the city is its dense population living in a very sensitive ecosystem. Delhi has experienced rapid population increases in the past decades (1901 to 2011). In 1901, around 47.34% of Delhi's population was living in rural areas, which has decreased to 6.99% in 2001 (Rahman et al. 2011). It is expected that the population will reach 20 million by 2020 (Panda 2011). In Delhi, the increase in population results in a concurrent increase in those, living below national poverty line. Currently, in Delhi, around 1.15 million people are living below the poverty line (Panda 2011). Most of them live in slums with inadequate access to basic amenities and poor sanitary living conditions. Scientists predict that climate change will further increase their risk because they lack the resources to adapt and live in high risk areas. For example, Yamuna Action Plan highlights the vulnerability of population especially slums who are living near the low-lying area of Yamuna (Mehrotra et al. 2009). Approximately 3 million people in Delhi live along the Yamuna River, which is prone to flooding during the monsoon. More than 600,000 of the total dwellings are classified as slums (Mehrotra et al. 2009). Another non climatic stress in Delhi is the physical urban environment. The physical environment is already at risk due to hap-hazard expansion (Rahman et al. 2011). Climate change will further accelerate this risk in the future. Increased physical urban migration and settlement has led to the decrease in agriculture areas; cutting of trees for development has impacted on carbon sinks. For example, in 1950–51, the net agriculture area of the city was 97,067 ha, later reduced to 25,000 ha in 2005–06, out of the total 148,300 ha (Rahman et al. 2011).

3 Background of East Delhi

3.1 Socio-economic profile

East Delhi is one of the nine districts of Delhi that came into existence in January 1997 when Delhi was divided into nine revenue districts as shown in the Fig. 1 (DDMA 2005; Rahman et al. 2011). The district is spread over an area of 64 square kilometers, which forms 4.3% of the total area of Delhi (Rahman et al. 2011). Physically, it is located on the eastern side of river Yamuna and surrounded by Ghaziabad and Noida district of Uttar Pradesh (Rahman et al. 2011). The district is situated in the Yamuna Plains, a very fertile land now transformed
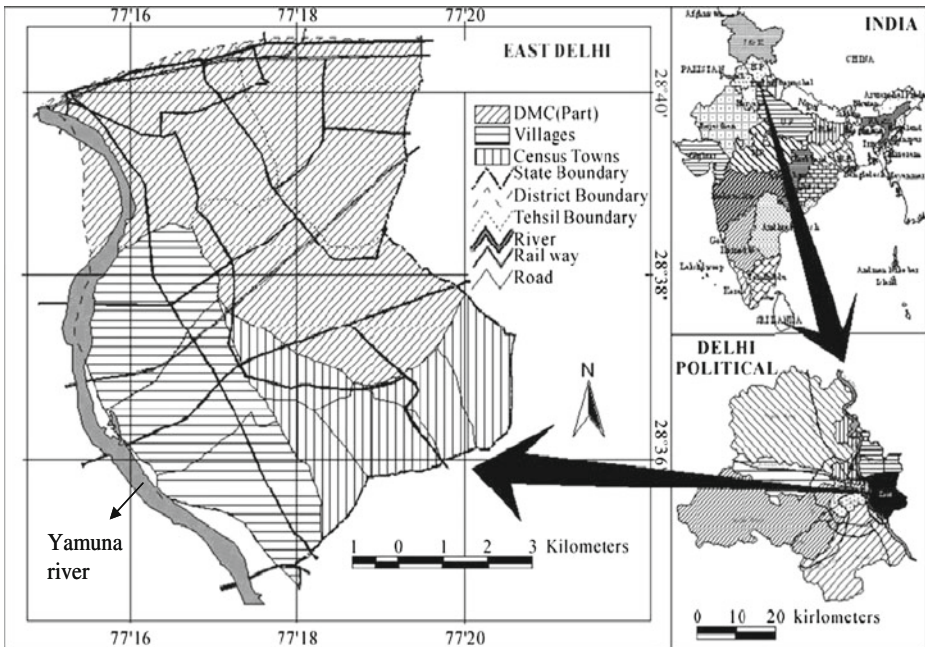
Fig. 1 The study location and administrative boundaries of East Delhi (from Rahman et al.)

into a built up area. Moreover, East Delhi has experienced rapid urban population growth in the recent past. As per 2011 population census, the population density of east Delhi is 26,683 persons per sq. km. With 98.75% urban population, it ranked third after central Delhi and New Delhi in population density (Rahman et al. 2011). The following section briefly describes three different kinds of settlements in East Delhi and by linked disaster risks.

3.1.1 Planned DDA housing and society

This kind of settlements is mainly developed in the form of bungalows and apartments. Settlements are well constructed as per the Delhi master plan, which was first developed by the DDA for the period 1961–81. Unlike the colonies and the urban village, the planned housing areas are well developed with all kind of services and infrastructure such as shopping complex, gardens, and open spaces. In addition, societies are also registered under "Delhi Co-operative Society Act 2003" (Delhi State Co-operative Union 2007). Under this act, they are categorized under "Group Housing/ Housing Coop. Society" classification (Delhi State Co-operative Union 2007). Thus, they are well structured and run by an appointed committee. The committee usually deals with all kinds of issues that are within the interest of the society. However, some major issues are still critical, need specific responses to air, water, and noise pollution; loss of green space; water scarcity; and local flooding.

3.1.2 Colony

Several types of Colonies exist in East Delhi. Most of them are – unauthorized colonies, resettlement colonies, regularized and unauthorized colonies (Singh 2009). In 2006, over 5

million people were living in colonies constituting more than 30% of total population of Delhi (Singh 2009). The key characteristics of unauthorized colonies include lack of proper access to basic amenities such as electricity, water, solid-waste disposal and waste water outlets. Most of them are multi-storey buildings that are illegally raised without abiding to building laws. These settlements, built close to the riverbed or close to industrial units, are at a higher risk due to their locations and exposure to natural hazards.

3.1.3 Urban village

"Urban Villages are 'traditional rural settlements which have been changed and merged with urban areas' or villages which have been incorporated over time into the urban limits of the present city of Delhi" (Department of Urban Development 2006). Around 165 urban villages exist in Delhi, housing approximately 1.05 million people (Singh 2009). These settlements are very old, bearing cultural, educational, and economic elements which form the spirit of past life. Unfortunately, current unplanned development has brought change in their traditional rural status. The villages have become densely populated due to mixed land-use practice. Their land-use includes residential, commercial, and industrial. The infrastructure services fails to serve the need of people living in urban villages. The major issues are similar to those of the colonies, needing serious attention from the government. The issues are – old and weak housing structure, unemployment, pressure on infrastructure facilities, lack of proper collection and management of solid waste, no sewerage connection etc. In addition, urban villages are also at higher risks to natural hazards. Local flooding occurs during the monsoon when most of the low-lying areas of villages become inundated.

3.2 Disaster risks

The district is vulnerable to natural and man-made disasters. In the recent past, Delhi has been affected by earthquakes, fires, and floods (DDMA 2005). Floods usually occur during the monsoon, when river Yamuna rises above the danger level. In the recent instances, the floods occurred in 1967, 1971, 1975, 1976, 1978, 1988, 1995, 1998, 2008, and 2010 (DDMA 2005). The most severe flooding occurred in 1978 when 130 villages and 25 urban colonies were submerged (DDMA 2005). The North East, East, and North West regions were the most severely affected parts of Delhi (DDMA 2005). Recent floods in September 2010 effected over a thousand people in terms of loss of livelihoods, housing, and infrastructure services (Times of India, 10 Sept, 2010, p4). In the aftermath of this flood, a multi-storey building collapsed in East Delhi and 60 people were reported killed while 70 people were injured (BBC News, 16 Nov, 2010). There are many new infrastructures that have been constructed in the Yamuna river bed such as metro depot, sport stadium, residential complexes, and dumping sites which obstruct the original flow of the river (YJA 2007). The city is prone to severe flooding when the water level of Yamuna River crosses the danger mark level during the monsoon. Consequently, settlements located near the Yamuna bed are relentlessly affected by floods. Climate change will further intensify the flood situation due to increase in the projected precipitation as shown in Table 1. The situation in the low lying areas will worsen if necessary actions are not taken. Several slum settlements and colonies settlements are either close to Yamuna River or situated on the low-lying areas. Thus, climate change impact will intensify the disaster risk of Delhi including East Delhi by intensifying the risk of non-climatic stressor discussed in section 2.

A recent study on climate and disaster resilience of Delhi by Parvin et al. (2011) represents a similar environment. This study addresses the disaster risk of Delhi through a resilience approach called the Climate Disaster Resilience Index (CDRI), which is developed from five resilience dimensions: physical, social, economic, institutional, and natural (Joerin and Shaw 2011; Parvin et al. 2011). The resilience of each dimension mentioned above is measured on a scale that varies from 1 to 5, where (1 = poor, 2 = Bad, 3 = Moderate, 4 = good, and 5 = best) (Joerin and Shaw 2011; Fig. 2). The study is unique because it was done in all nine districts of Delhi and shows the strength, weakness, opportunities, and threats of each district (Parvin et al. 2011). The result shows that East Delhi is the least resilient district (Parvin et al. 2011) with physical and social dimensions which are the main factors responsible for its low resilience score. In the physical dimension, the condition of sanitation and solid-waste disposal is poor. Moreover, the district is very poor in terms of land use planning and water in terms of accessibility and availability. Under the natural dimension, the district is poor in terms of severity of climate related hazards, ecosystem services, and land use in natural terms (Parvin et al. 2011). The land use pattern shows that the district is densely populated. Thus, there is a clear need to address the disaster risk of East Delhi to climate related disasters. Moreover, five earthquakes of 5.5 to 6.7 magnitude on the Richter scale have occurred since 1720 (DDMA 2005). There are probabilities of occurrence of high magnitude earthquake in the near future. The following section briefly discusses the CAP approach.

4 CAP

"CAP is a participatory approach that aims at community development through problem solving" (Prashar et al. 2011; Hamdi and Goethert 1997). The key essence of CAP is the development of community led action plans. It mainly targets risk reduction by focusing on specific themes including physical improvement, strengthening of community structures, and identification of community led environmental improvement initiatives (Bhatt et al. 1999). The concept of action planning derives from traditional urban planning, which was orthodox and less proficient at delivering its benefit on the ground (Hamdi and Goethert 1997). Consequently, very little benefit of urban planning was reaching the poor. Thus, by involving the local community, urban planning can be further improved.
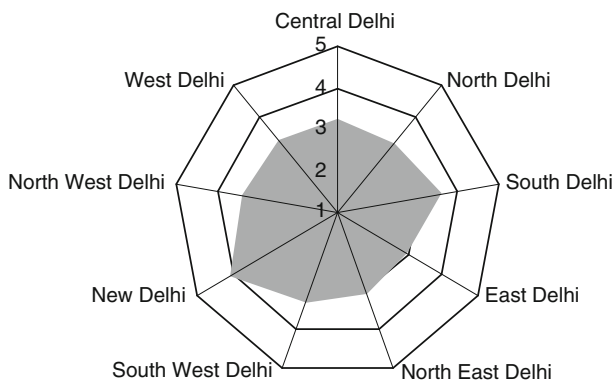

Fig. 2 Spider map showing resilience level of nine districts of Delhi. It shows resilience level on a scale of 1 to 5 (1 = poor & 5 = best). It is showing East Delhi is least resilience due its low resilience score (less than 3) among all nine districts (Parvin et al. 2011)

With an increase in urban density, environmental risks in urban areas are increasing correspondingly. For example, communities living on environmentally unstable areas, steep slopes, and other riskier sites are increasingly becoming vulnerable to flooding, fire, landslides, climate and other hazards. Rapid urbanization is increasing the risk in urban areas. Planners need to address these risks in urban planning. In spite of having close links, the urban planning model considers risk management as a separate discipline. However, urban planning can effectively address urban risks by adopting practical and community led risk mitigation measures. Hence, community vulnerability can be significantly reduced. The CAP approach tries to overcome this limitation by integrating risk reduction through community participation.

The CAP process can be classified into three stages: problem and opportunity identification; prioritizing solutions and implementing and monitoring actions. The process of action planning consists of various stages and is more organic (Fernandez et al. 2011). Thus, the stages overlap as the action plan progresses with revised objectives and community priorities. The stakeholders involved in CAP include community, government authorities, Non-Government Organizations (NGOs) and other civil society organizations. Community can be defined as "a group of people that are directly linked to each other through a common identity, activity or interest" (Jones and Rahman 2007).

4.1 Problem and opportunity identification

The first stage of CAP is problem and opportunity identification. The literature on CAP describes several tools and methods for this stage. For example, there are various Participatory Rural Appraisal (PRA) methods that can be used including community mapping, time-line development, problem mapping, and development of problem matrix (Bhatt et al. 1999). Apart from this, Hamdi and Goethert 1997 also describe several other tools and methods that can be used for problem and opportunity identification: direct observation, semi-structured interviews, resource survey, diagramming, mapping and modeling, games role play, and group work intermixing. These tools help the community in identifying the problems and solutions through their local knowledge. Thus, local knowledge is the key aspect of this stage. To develop community actions for this study, literature on past community development activities was reviewed (Government of National Capital Territory of Delhi 2010). Several brochures and pamphlets describing RWAs (i.e. Neighborhood community) and their actions in community development were examined. In addition, PRA exercises, direct observation, and resource surveys were also undertaken to identify problems and potential opportunities with the local people of East Delhi. Finally, consultation with key personnel from the District Disaster Management Authority of East Delhi and local NGOs for the development of community actions occurred.

4.2 Prioritizing solutions

The second stage of CAP is based on a needs/benefits analysis which involves creating strategies to deal with the problems and trade-offs. Typically, a selection of solutions or options that can be handled by the community itself or with the support of intermediary organizations emerges. The outputs are in the form of community prioritized actions that are mainly community based and seek to reduce disaster risk. There are various tools and methods that can be used such as questionnaire survey, brain storming, diagramming, time lines, daily routines, seasonal calendars etc. These methods are adapted to the setting and environment. This paper focuses principally on this stage. The output from this stage is community prioritized actions, necessary, viable, and capable of being implemented by the community in the near future with some support from intermediary organizations.

4.3 Implementing and monitoring actions

The third stage of CAP is implementation and monitoring. This stage mainly deals with how prioritized actions can be implemented or what kind of platform is required to implement prioritized actions. For example, project teams are formed and a plan of action is developed, where timetables or timelines, costs, commitments, and responsibility are discussed. Monitoring of implemented actions is essential for measuring the output from community action plans. Monitoring also helps the project manager to evaluate the impact of their work at two levels. Firstly, did the program successfully achieve targeted objectives at local level? Secondly, what kinds of impact will this program likely have at the city level? The indicators developed for monitoring during this stage will be both qualitative and quantitative. Beaudox et al. (1992) describe several monitoring indicators for projects monitoring: technical indicators, economic indicators, operating or organizational indicators, social indicators, and environmental indicators. The environmental indicator will describe the impact of intervention on the environment by measuring the impact of improved sanitation on the health, and ecology of neighborhoods (Prashar et al. 2011; Hamdi and Goethert 1997). Monitoring and learning from CAP can also be useful in modifying and improving the strategic plans at city level (Hamdi and Goethert 1997). The objective is to channel lessons learned from the local level to the city level. Through CAP, community can also lobby city authorities for strategic city level change (Hamdi and Goethert 1997). Thus, it can be further useful in influencing policy and ensure community or local level participation in the governance of the cities.

5 Study methodology and data collection

The research was carried out in East Delhi at the community level with a specific focus on RWAs. RWAs are neighborhood associations which have as their main objective to work for the welfare of their residents or people through engaging in public services such as electricity, water, road maintenance, street lighting, solid waste management and parking. These associations are non-profit bodies that are listed under the Society Registration Act, 1860 (Chakrabarti 2007; Government of National Capital Territory of Delhi 2008). They are also recognized as neighborhood management committees, where the residents have to pay some regular payment for security issues, maintenance of common resources such as parks, drainage, roads, street lights, scavenging, water and electricity supplies, banking, post office, bus services facilities, community hall, milk booth, health center, rationing shop, mini-super market, and shopping facilities (Chakrabarti 2007; Government of National Capital Territory of Delhi 2008). Moreover, they are also responsible "to help and assist poor and needy residents and their families during emergencies such as flood, war, earthquake and rains" (Government of National Capital Territory of Delhi 2008).

Eighty nine RWAs's were interviewed as shown in the Table 2. They fall under three residential categories: planned DDA housing and societies, colonies, and urban villages as described in section 3.1.1; 3.1.2; and 3.1.3. In Delhi, as per the housing data of 2000, the percentage of population living in the planned housing and societies accounts for 23.7%, the colonies around 30.7% (include unauthorized colonies, regularized colonies, and resettlement colonies), and the urban village is 6.4% (Mehta 2009; Planning Department 2001). The target communities were selected according to the risk they face due to natural hazards, their legal status and existence. For example, RWAs have existed in Delhi since 1980s and are actively engaged with Delhi Government through Bhagidhari (partnership) programs (Chakrabarti 2007). The programs aim to bring people to participation in governance through join

Table 2 Sample size and distribution

Types of settlements	Total RWAs	Sample collected
Planned DDA housing and societies	107	37
Colonies	85	46
Urban villages	11	6
Total	203	89

ownership between citizen and government. Moreover, they are listed under the District Disaster Management Plan for training and awareness activities as they frequently get affected during floods, earthquakes, and water scarcity (DDMA 2005).

The aim of the CAP questionnaire survey is to identify community prioritized actions for disaster risk reduction. The study is based on this assumption that community leaders are very capable of identifying and prioritizing community actions. Prioritizing actions are mainly based on community's willingness to take further action in the near future. The CAP tool is utilized for the survey. This tool is developed from five resilience based dimensions: physical, social, economic, institutional, and natural of CDRI study (Joerin and Shaw 2011). Each dimension has some specific parameters and each parameter in turn has three actions (Table 3). For example, physical dimension has four parameters: P1) Task for reducing interruption in electricity, P2) Task for reducing interruption in water, P3) Task to improve the collection of solid waste, and P4) Task to improve treatment of solid waste before dumping. In addition, three actions for parameter P1 are: A1) Promoting use of generator/inverter/emergency light, A2) Promoting use of low energy/eco-friendly appliances, and A3) Registering complaints with Delhi Electricity Board (DEB). In addition to three actions, each parameter also carries additional choice A4 for respondent's own action. The A4 choice is not a compulsory option for the respondent. Therefore, all in all, the questionnaire has five dimensions, twenty five parameters, and seventy five actions (without A4) as shown in Table 3. Moreover, during the survey, the respondents were requested to assign rank order to these actions in order to reflect the need and priorities of their own community. In the survey questionnaire, they were requested to rank order these actions on a 1 to 3 scale (1 = most important, 2 = important, and 3 = least important). If the respondent chose to provide additional action A4 for any parameter, then respondent also needed to rank all four actions based upon his/her priority. The respondents were also instructed not to duplicate the ranking when prioritizing the actions. The limitation of this study is the knowledge level of the community leaders about community needs and priorities. Not all leaders are very aware about their community. This knowledge depends upon many factors such as interaction with the community members, involvement in the local problems and educational level.

Using the data collected from questionnaire survey, the results were analyzed. To identify the specific priorities and needs, the analysis is carried out separately for all three settlements. The results are further analyzed in the form of bar charts shown in Fig. 3. The next section discusses the results.

6 Results and discussion

6.1 Planned Delhi Development Authority (DDA) housing and societies

In planned housing, RWAs prioritized 25 actions as the most important out of total prioritized actions as shown in (Fig. 3a). Most of the actions prioritized are community-based and can be

Table 3 Framework of Community Action Planning (CAP) questionnaire

Resilience dimensions	Parameters	Community Prioritized Actions
Physical	P1. Task for reducing the interruption in electricity	A1. Promoting use of generator/ inverter/ emergency light etc.
		A2. Promoting use of low energy/eco-friendly appliances
		A3. Registering complaint with Delhi Electricity Board
	P2. Tasks for reducing the interruption in Water	A1. Promoting use of back up like tube wells, hand pumps, purchasing water
		A2. Promoting to reduce water consumption
		A3. Registering complaint with Delhi *Jal* Board (water leakage, theft etc.)
	P3. Tasks to improve the Collection of solid waste	A1. Promoting to incorporate 3R (Reduce, Reuse, and Recycle)
		A2. Promoting community collective actions for waste collection
		A3. Promoting creation and maintenance of waste collection point
	P4. Tasks to improve treatment of solid waste before dumping	A1. Promoting practices of waste segregation at household level
		A2. Promoting "Say no to plastic bags"
		A3. To appoint outsider for waste segregation
Social	S1. Tasks to reduce number of people suffer from waterborne diseases every year	A1. Promoting community awareness on water borne diseases
		A2. Community drills
		A3. Promoting community to monitor sanitation condition
	S2. Tasks to reduce number of people suffer from vector borne diseases every year	A1. Promoting community awareness on vector borne diseases
		A2. Community drills
		A3. Promoting community to monitor sanitation condition
	S3. Tasks to reduce number of people suffer from water borne diseases after a disaster	A1. Promoting people to take preventive measures after disasters
		A2. To provide people with safe drinking water
		A3. Monitoring by community groups
	S4. Tasks to improve literacy rate	A1. Promoting "Each one teach one"
		A2. To organize literacy campaign
		A3. Promoting informal education within the community
	S5. Task to improve the awareness and knowledge about the threat and impact of disaster	A1. Organizing training program for awareness and knowledge building
		A2. Collaborating with external stakeholders (Delhi Disaster Management Authority, NGOs etc.)
		A3. Motivating people to participate in the awareness building program
	S6. Task to improve people's	A1. Creating awareness and interest for people's participation

Table 3 (continued)

Resilience dimensions	Parameters	Community Prioritized Actions
	participation in community activities	A2. Forming different groups (Women, Youth groups, Environment groups etc.)
		A3. Providing incentives and awards for best participation
	S7. Task to improve the acceptance level of community leader	A1. Promoting democratic election
		A2. Promoting transparency
		A3. Promoting monitoring
Resilience dimensions	Parameters	Community Prioritized Actions
Social	S8. Tasks to improve consensus building within the community	A1. Having regular interaction within the community
		A2. Promoting common goal or interest in the community
		A3. Participating in the decision making process
	S9. Tasks to improve community participation in the district decision making process	A1. Promoting people to build consensus
		A2. Joint ownerships
		A3. Protests and vigilance
	S10. Task to improve the inter-linkage between different ethnic groups	A1. Promoting people to participate in all festivals
		A2. Promoting people to get on well together in their local area
		A3. Promoting people to participate in community activities
	S11. Tasks to improve the preparedness of households for disasters in terms of logistics, materials, and management	A1. Promoting people to participate in disaster education program at local level
		A2. Promoting people to develop disaster management plan
		A3. Community drills
	S12. Task for providing shelter and support for affected people after disaster	A1. Promoting people to create community evacuation or relief center
		A2. Collaboration with disaster management authority for support
		A3. Community drills
	S13. Task to improve participation of people in relief work after disasters	A1. Promoting people to participate voluntarily
		A2. Promoting people to form relief group in case of disasters
		A3. Community drills
Economic	E1. Task to reduce the unemployment among the youth	A1. Providing skills and training program to youth
		A2. Community them self-posting jobs for employment opportunities
		A3. Youth Cooperative
	E2. Task to increase women employment	A1. Training to women
		A2. Micro Credit
		A3. Women them self-posting jobs for employment opportunities

Table 3 (continued)

Resilience dimensions	Parameters	Community Prioritized Actions
	E3. Task to reduce child labor	A1. Encouraging parents to send their children to school
		A2. Enhancing community awareness
		A3. Child homes
Institutional	I1. Tasks to improve community participation in development plans	A1. Participating in need assessment
		A2. Participating in decision making
		A3. Participating in implementation and evaluation
Natural	N1. Task to improve the quality of urban biodiversity	A1. Promoting people to create wildlife gardens
		A2. Promoting people to use gardens in wildlife friendly ways
		A3. Partnership schemes with external stakeholders like Ministry of Environment and Forests, NGOs etc.)
	N2. Tasks to improve Urban air quality	A1. Promoting people to get their vehicles pollution check done regularly
		A2. Sensitizing people about implication of bursting crackers during certain festivals
		A3. Partnership schemes with external stakeholders like Ministry of Environment and Forests, NGOs etc.)
	N3. Task to improve water quality in rivers	A1. Participating in the clean-up activities
		A2. Monitoring sanitation condition at household level
		A3. Partnership schemes with external stakeholders like Ministry of Environment and Forests, NGOs etc.)
	N4. Task to improve loss of urban green space	A1. Planting trees
		A2. Involving in park services
		A3. Partnership schemes with external stakeholders like Ministry of Environment and Forests, NGOs etc.).

implemented by the community. The prioritized actions are significant not only because they address disaster risks but also because they provide local solutions to major issues that are discussed in 3.1.1 section such as pollution – air, water, and noise; loss of green space, and the impact of natural hazards. For example, N1 is the task to improve the quality of urban biodiversity (Fig. 3a). The result shows that 62.16% of respondents chose as their first priority A3, which is "to engage in a partnership schemes with external stakeholders like Ministry of Environment and Forests (MoEF), Non-Government Organizations (NGOs), etc." (Fig. 3a), whereas 29.72% chose as their first priority A2, "promoting people to use gardens in wildlife friendly ways", and only 8.1% opted for A1, "promoting people to create wildlife garden" as their first priority (Fig. 3a). There was no additional choice A4 provided by the respondent. Similarly, N4 is task to improve loss of urban green space (Fig. 3a). The result shows that 56.75% of respondents chose as their first priority A1, "planting trees", whereas 35.13% chose as their first priority A2, "involving in park services" and only 8.1% opted for A3, "partnership schemes with external stakeholders like MoEF, NGOs" as their first priority (Fig. 3a). None of the respondents provided an additional choice in A4. To reduce disaster risks, respondents prioritized three actions. For example, S11 is tasks to improve the preparedness of households for disasters in terms of logistics, materials and management (Fig. 3a). The result shows that 64.86% respondents chose as their first priority A2, "promoting people to develop disaster
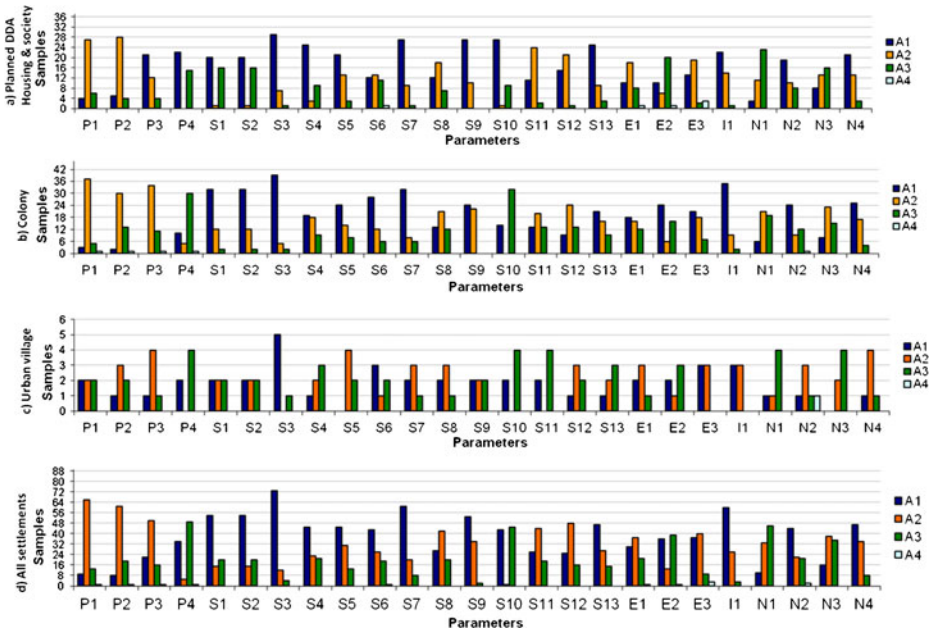
Fig. 3 Community prioritized actions in East Delhi

management plan", whereas 29.72% preferred as their first priority A1, "promoting people to participate in disaster education program at local level" and only 5.4% opted for A3, "community drills" as their first priority (Fig. 3a). Thus, the results show the chosen and prioritized solutions necessary to address the key issues of planned housing and society. The key solutions are local actions based on the local knowledge of the community. Moreover, these actions can also effectively improve the quality of city programs on environment improvement. For example, "Delhi Urban Environment and Infrastructure Improvement Project by MoEF and Government of NCT of Delhi aims at environment and infrastructure improvement of Delhi (Planning Department 2001). Incorporating prioritized actions in this program would bring greater participation of community and an increased role for RWAs in city environment improvement initiative.

6.2 Colonies

In the colonies, RWAs prioritized 25 actions as most important for disaster risk reduction as shown in (Fig. 3b). Most of prioritized actions are similar to those of DDA planned housing and societies. These actions are significant in addressing the key issue such as collection of solid waste, risk of natural hazards, accessibility to basic amenities and poor environmental conditions. P3, the task to improve the collection of solid waste (Fig. 3b) proved most important. The result shows that 73.91% percent of the respondents chose as their first priority A2, "promoting community collective actions for waste collection", whereas 23.91% chose as their first priority A3, "promoting creation and maintenance of waste collection point" and only 2.17% prioritized the additional choice A4, which is "door to door collection of solid waste" (Fig. 3b). Similarly, S5 is tasks to improve the awareness and knowledge about the threat and impact of disaster (Fig. 3b). The result shows that 52.17% of the respondents chose as their first priority A1, "organizing training program for awareness

and knowledge building", whereas 30.43% chose as their first priority A2, "collaborating with external stakeholders (Delhi Disaster Management Authority (DDMA), NGOs, etc.)" and only 17.39% opted for A3, "motivating people to participate in the awareness building program" as their first priority (Fig. 3b). In addition, action, such as A2, "collaborating with external stakeholders (DDMA, NGOs etc.)" could provide opportunity to local community in sharing their local risks with concerned authority at district level. Moreover, it will help district authorities in understanding the local risks. Further, through awareness building programs, the community can well prepare in advance to assess and resolve local risks. As in planned housing and society, the prioritized actions show local solutions to key issues of the colonies. These actions can further be utilized by the city government for improving the quality of their programs which benefit local community. For example, DDMA can utilize prioritized actions as key information in the development of the district disaster management plan for East Delhi. Furthermore, it can assist the district manager in identifying the local solutions for improved preparedness against disasters.

6.3 Urban villages

The survey was done in 6 out of a total sample of 11 urban villages. The actions prioritized by RWAs are not very similar to DDA planned housing and societies, and colonies. For example, in several parameters such as P1, S1, S2, and S9 all three actions are equally prioritized as shown in (Fig. 3c). The prioritized actions deal with critical issues as discussed in the section 3.1.3. For example, P1 is the task of reducing the interruption in electricity (Fig. 3c). The result shows that 33.33% of the respondents chose as their first priority A2, "promoting use of low energy/eco-friendly appliances", whereas 33.33% opted for A1, "promoting use of generator/inverter/emergency lights" as their first priority, and the rest 33.33% prioritized A3, "registering complaints with DEB" (Fig. 3c). Similarly, S5 is tasks to improve the awareness and knowledge about the threat and impact of disasters (Fig. 3c). The result shows that 66.66% of the respondents chose as their first priority A2, "collaborating with external stakeholders (DDMA, NGOs)", whereas 33.33% opted for A3, "motivating people to participate in the awareness building program" as their first priority. Action such as A3 can also help in the disaster preparedness of the most vulnerable groups such as young children, disabled, and senior individuals. The awareness building program will guide these groups in taking informed actions before, during, and after disasters. The RWAs also prioritized action for coping with the problem of unemployment. For example, E1 is task to reduce the unemployment among the youth (Fig. 3c). The result shows that 50% the respondents chose as their first priority A2, "community themselves posting jobs for employment opportunities", whereas 33.33% opted for A1, "providing skills and training program to youth" as their first priority and remaining 16.66% chose as their first priority A3, "to promote youth corporative" (Fig. 3c). The prioritized actions are very useful in providing key information in building the Government of NCT of Delhi strategy for the development/redevelopment of urban villages in Delhi. For example, the expert committee on urban villages recommended several measures for the development of urban villages that include "building up proper urban infrastructure for better health & hygiene; promotion of trade and commerce for creation of job opportunities and economic prosperity; providing modern, decent living accommodation to all the present residents of villages and for natural increase in the future (Shrivastav 2009). The incorporation of these prioritized actions will improve the implementation of measures recommended by expert committee through improved community participation, shared needs and solutions, and greater ownership by community.

6.4 Actions prioritized in all settlements

In all three settlements, RWAs prioritized 32 actions as most important for disaster risk reductions as shown in (Fig. 3d). These actions address the urgent issues in all three settlements. The overall analysis of the three settlements shows some limited consistency of focus. For example, S3 is tasks to reduce number of people suffering from water borne diseases after a disaster (Fig. 3d). The overall result shows that 82% of the respondents chose as first priority A1, which is "promoting people to take preventive measures after disasters" (Fig. 3d). This response is also consistent in all three settlements. For example, in the planned housing and society, 78% respondents prioritized A1 (Fig. 3a), in colony 85% prioritized A1 (Fig. 3b) and in urban village 83.33% prioritized A1 (Fig. 3c). Similarly, S5 is task to improve the awareness and knowledge about threat and impact of disasters (Fig. 3d). The overall result shows around 50.56% of the respondents chose as first priority A1, which is "organizing training program for awareness and knowledge building" (Fig. 3d). Moreover, in planned housing and society 57% of respondents prioritized A1 (Fig. 3a) and around 52.17% of respondents prioritized A1 in colony (Fig. 3b), whereas in urban village, A1 is not prioritized by any respondent (Fig. 3c). Indifferent communities perceive different priorities in rank ordering potential actions.

The prioritized actions are not only beneficial to the targeted community but also useful for District Development Committee, Government of NCT of Delhi. The committee works for the development of residential areas by providing funding support to the community development projects. Projects submitted to this committee can be evaluated based on community prioritized actions. This will help in meeting the needs and priorities when the project is implemented. Successful implementation would bring improved community accesses to basic services; increased preparedness and planning for disasters; better job trainings, literacy, and career development opportunities to youth and women and increased citizen participation in recreational, social, and cultural activities. Similarly, the study results can also be employed by other stakeholders such as NGOs, Community Based Organizations, Disaster Management Authority, among others, who work to create better community by increasing the capacity of the neighborhood and recognize and respond to the changing community needs.

6.5 Implications of CAP process to other cities

The experience of conducting CAP in Delhi provides valuable knowledge to extend the same process to other cities also experiencing disaster risks and impacts of climate change. In the current study area, RWAs can be considered as the entry point for CAP. This entry point provides access to the communities and addresses their core issues. In Indonesia, community groups such as women welfare associations, youth unions, and faith based organizations could be an entry point as they largely exist at the grass roots level and deal with several issues including risks from natural disasters (Mulyasari and Shaw 2011). Women in Indonesia are considered more vulnerable to disasters than men (Tanesia 2007), as exemplified by the Aceh earthquake and the resulting tsunami of 2004. The female death rate was 30 to 40% higher than that of male. They were affected more due to low income capacity, lower literacy than men, more susceptible to illness, and slow in saving their own life due to religious factors (Tanesia 2007). Thus, women welfare associations could be one of the important entry points for CAP to address their vulnerability to natural disasters.

The CAP process derives its strength from local knowledge of the community as well as from other stakeholders. Information that comprises local knowledge is passed orally and seldom formally documented (Hatfield 2006). The present study enables local knowledge to

be included into local priorities and actions in an urban mega-city context. This information is also very useful to city managers for carrying out hazards and risk analysis of a local area. In addition, it allows planners to survey on need and opportunities for mitigation (Twigg 2007). Often, when this information is unavailable, the city officials find it difficult to assess the risk and opportunities of the targeted community. A study of World Bank on building resilience for the urban poor in Dar es Salaam, Jakarta, Mexico City and Sao Paulo shows that the city managers in Jakarta and Mexico City were unable to carryout effective risk assessment due to the lack of awareness of demand and priorities of urban poor (World Bank 2011). City officials in these cities could employ CAP tools such as direct observation, semi-structured interviews, problem and resources mapping, and group work combining to understand the local knowledge and utilize the same in the assessment process. Further, it will help them in building strong networks with local community.

There are the challenges when the CAP process is implemented in a community in an urban area. Typically, people who live in an urban area are different in terms of their jobs, education back ground, family status, religion, caste, and economic status. These conditions create different needs and priorities for the individual and the related family. Thus, in the CAP process, actions priorities established by the community leader do not always reflect the true perception of the individual and family within the community. This is an important challenge. Further research must be completed on how the perception of the community can be improved in the CAP process so that it can reflect the priorities of majority of residents.

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