Disaster Resilience of Slums in Delhi through Appropriate Risk Communication

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Several disasters occur in urban areas and affect millions of people through loss of lives, injuries, and affecting livelihood and infrastructure. The urban poor groups are the most affected by such disasters. In addition, their disaster risks are intensified due to their socio-economic condition as well as due to disadvantages associated with slums, such as poor quality of housing, overcrowding, inadequate access to safe water, improper sanitation, and other infrastructure. This paper addresses emerging climate-related hazard risks to urban poor groups in the slums of Delhi. It seeks to build disaster resilience of urban poor groups by integrating risk communication into the slum development program, *Sanjha Prayas* (Collective Action). *Sanjha Prayas* is a program of the Government of National Capital Territory of Delhi (GNCTD) and addresses the three core issues of water, electricity, and sanitation-solid waste disposal. The paper builds on the argument that *Sanjha Prayas* can provide an efficient platform to address climate related hazard risk of urban poor groups in Delhi.

Keywords: Risk communication, Disaster resilience, Urban poor, *Sanjha prayas*.

1. Introduction

Several disasters occur in urban areas, impacting people through loss of lives, injuries, and affecting livelihood and infrastructure. The risk in urban areas is building up due to rapid urbanization. For example, large scale disasters that occurred between June 1999 and March 2000 are due to convergence of urbanization and natural hazards.[10] In addition, the urban population of low and middle income countries is close to 2.5 billion and is growing at around 60 million a year rate. Moreover, there is a considerable proportion of this population that lives on the site at risk of disasters.[6]

The Emergency Database (EM-DAT) of the Center for Research on the Epidemiology of Disasters (CRED) has reported an increase in the number of climate related hazards and their impacts in Asia from 1991 to 2009. One of the major reasons of the higher impact of climate related hazards is their increasing

intensity and the impacts of which are largely concentrated in low-income households that face high levels of risk due to poor living conditions. These households are known as the "urban poor". The urban poor live in slums and are severely hit by a combination of factors such as exposure to hazards, lack of hazard removing infrastructure, low capacity to cope with impacts, and low legal protection.[6] In addition, their vulnerability is enhanced by such risks as dangerous location, lack of infrastructure, lack of disaster preparedness, and poor quality of houses. The dangerous locations include slums located on hills that are prone to landslides or on land prone to flooding. Slums located on the hills can be largely seen in Rio de Janeiro (Brazil), La Paz (Bolivia), Caracas (Venezuela) and in many other countries.

Slum is defined as "a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services".[20,42] These kinds of sites are affected heavily by disasters. In addition, when pre-disaster vulnerability interacts with climate related hazards, the risk is created in the form of direct impacts on health, living condition, and livelihood. Furthermore, social, economic, political, cultural and global forces also play important roles in affecting impacts during the hazard event.[24] For example, in the Mumbai flood of 2005, new residents (less than 20 years) and old residents (more than 20 years) living in slums were more at risk than medial residents (10–20 years) due to their social, economic and cultural characteristics. Further, the positive and negative aspects of slums certainly play important roles in influencing their risk to climate related hazards. Hence, there is a need to increase disaster resilience of urban poor groups. United Nations International Strategy for Disaster Reduction (UNISDR) defines resilience as "the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures".[35]

This paper seeks to enhance the disaster resilience of urban poor groups living in the slum areas of Delhi. In addition, it tries to integrate risk communication into the slum development program, *Sanjha Prayas* which means "Collective Actions".

The subsequent section of the paper introduces key characteristics of slums. It is followed by a discussion of Delhi slums and some emerging challenges. The next section focuses on the vulnerability of slums to climate related hazards. It is followed by a discussion on *Sanjha Prayas:* Delhi's slum development approach and scope of its further improvement. Finally, the last section discusses on the implication of integrating risk communication into *Sanjha Prayas* and how it is useful in building disaster resilience of urban poor groups in Delhi.

2. Key Characteristics of Slums

2.1. *Insecure residential status*

The urban poor groups often acquire land in the unused and undesirable areas of the city. These areas are often considered vulnerable to flooding, landslide and other natural hazards due to their demography. In addition, they have very limited rights to a safe environment. As an example, in 1984, the accidental release of methyl isocyanate from the pesticide factory in Bhopal, India killed around 20,000 slum residents.[3,46] Similarly, poor residents situated in flood prone areas were severely affected in the case of Hurricane Katrina in the United States because of the neglect of political institutions.[3,19,11]

2.2. *Substandard structure*

Many cities have building standards for residential housing. However, slum houses are often built with substandard materials such as earthen floors, mud, wattle walls or straw roofs. The structure is considered weaker as compared to a planned residential area where land-use regulation and building codes are strictly followed. Moreover, these structures often lack insulation and residents suffer from heat waves particularly elderly people, children, and people who are in delicate health condition.[17,34] As an example, around 10 percent of total deaths in the summer in Buenos Aires is correlated to heat strain.[17] Similarly, settlements are often built on unstable, low-lying lands without sewers and drainage systems which increase the risk of floods. In addition, most of the settlements have single-storey houses which get flooded during the monsoon season. In Buenos Aires, for instance, there are only a few houses that are built on stilts, particularly in La Boca-Barracas, Isla Maciel, Avellaneda (south of Buenos Aires), and Tigre (north of Buenos Aires).[17] The remaining houses are single-storied and resulted in flooding during heavy rains.[17]

2.3. *Overcrowding*

Overcrowding is associated with low living space per person, high number of single rooms units, high occupancy rate, and cohabitation of different families. UN-Habitat describes overcrowding as "lack of sufficient living area". Sufficient living area means, "a house has sufficient living area for household members if not more than three members share the same room".[44] In slums, around five or more people share a one-room unit used for common cooking, sleeping, and living purposes. As a result, residents often face health problems such as respiratory infections, meningitis, and asthma.[3,39,25] For example, children who live in the squatter settlements of Manila are nine times more likely to have tuberculosis (TB) than other children.[3,40]

2.4. *Inadequate access to safe water*

The lack of access to basic services such as safe water is one of the key characteristics of slums. As a result, the cases of morbidity and mortality are high worldwide.[3,48,47] Intake of poor contaminated water leads to life threatening infectious diseases such as cholera and hepatitis.[3,43] Moreover, the lack of access to water also reduces water utilization for cooking, bathing, and personal hygiene. Furthermore, it creates skin infections which can lead to acute glomerulonephritis.[3,18]

2.5. *Inadequate access to sanitation and basic services*

Lack of access to sanitation creates an unhygienic living environment which is often accompanied by an absence of basic services such as solid waste collection, electricity supply, paved roads and footpaths, street lighting, and rainwater drainage. For example, five million slum residents in Mumbai live without access to toilets leading to the contamination of the human environment. To illustrate the severity of the condition, say each person defecates half a kilogram per day, then 2.5 million kilograms of human waste will contaminate the living environment everyday.[3,38] Furthermore, this polluted environment leads to breading of mosquitoes and the spread of vector born diseases.

2.6. *Unhealthy living conditions and poor health services*

Slums display unhealthy living conditions such as open sewers, lack of pathways, uncontrolled dumping waste, and deplorable environment. As a result, they cause severe manifestation of infectious disease such as leptospirosis. In addition, slum dwellers also suffer from acute respiratory diseases such as viral infection, tuberculosis, skin disorders, and kidney and urinal infections.[26] Children and women often lack in nutritional status due to improper food intake and parasitic infections. Similarly, infant and child mortality rates are higher among urban poor. In addition, health services in slums are poorly organized and beyond the control of slum residents. It requires specialized training personnel and the delivery of health services demand infrastructure which involve provision of specialized information, physical examination, diagnostic services, hospitalization, medication, follow up care, prevention, and surveillance. Unfortunately, these services cannot be created by slum dwellers.[23] Generally, health services in slums are inconsistent and provided by private, public, charity-based NGO, and fee-for-service private clinics and pharmacies (usually run by unlicensed or poorly trained professionals or even non professionals). Further, this creates progression of diseases such as hypertension, diabetes and create the risk of drug- resistant infections such as multidrug-resistant TB.[3,15]

3. Delhi Slums and Emerging Challenges

The slum population of Delhi is 1.85 million, which is 18.7 percent of Delhi's urban population.[26] The Economic Survey of Delhi estimates that "around 50% of Delhi's population lives in slums and other poor habitations".[26] According to the National Family Health Survey (NFHS) 2005–2006, only 29 percent urban poor households have access to piped water supply at home which is lower than state average of 73.1 percent. Similarly, 65 percent of urban poor households use a sanitary facility for the disposal of excreta (flush/pit toilet) which is lower than the state average of 92.4 percent. People living in slum areas suffer more from infectious diseases. Similarly, the prevalence of infectious diseases is also higher in slum areas than the state average. For example, the prevalence of TB is 510 persons per 100,000 in slum areas, which is higher than the state average of 231. Moreover, households suffer from high mortality rate (child and infant), poor maternal health, poor family planning, and lack of nutrition among women and children.[26] Further, they often are trapped in the vicious circle of poverty particularly due to poor health and go through loss of income, burden of health cost, loss of labour, and low consumption expenditure (Fig. 1). For example, a study conducted with informal workers in South Delhi shows that low income manual workers spend more than 5 percent of their income on health expenditure which is higher than what typical households spend in developing countries which is between 2 to 5 percent of health care.[22] In addition, Nair describes that manual workers face a huge amount of wage loss due to illness.[22]

There are several reasons behind poor health condition in Delhi's slum. For example, lack of public health infrastructure, growing urban poverty, weak policy implementation, poor environment, and inadequate mapping and poor coverage of slums.[26] Sometimes, lack of knowledge and awareness about health programs, policies, and schemes among slum dwellers is another reason for their poor health condition. This is kind of situation is very common in many slums of Delhi that are more vulnerable and characterized with weak community networks and poor linkage with health service providers. Thus, the gap between health workers and
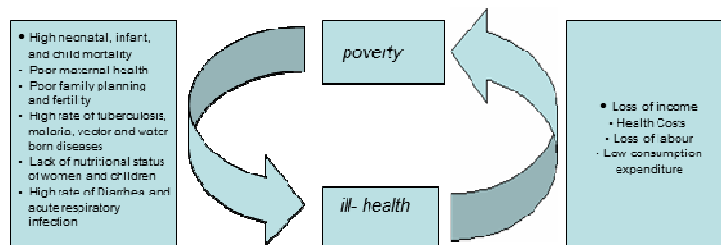

Figure 1   Vicious circle of poverty and ill-health in slums of Delhi.

dwellers further increases in the absence of proper communication. Sometimes, lack of communication also leads to disasters. As an example, in April 2010, around 1,250 hutments in Delhi were destroyed due to fire.[9] The fire accidents in the month of April killed 5 people and injured 50.[9] One of the main reasons found was the lack of communication facilities in slums to inform fire brigade about any incident on time.

The challenges shown in this section are also interlinked to disasters. For example, Dodman and Satterthwaite describe that urban poverty has direct link to the vulnerability to disasters.[7] Moreover, a study on flood risk management in central Viet Nam shows that flood has most significant impact on the human health.[32] The impact is very high on the communities that have limited access to the safe drinking water. In addition, the floodwater also increases the chance of infections that arise due to water and vector born pathogens. The next section presents vulnerability of urban poor groups to climate related hazard and shows their positive and negative aspects.

4. Vulnerability to Climate Related Hazards

This section presents the positive and negative aspects of slums' vulnerability to climate related hazards. Delhi is highly vulnerable to climate related hazards such as floods, droughts, and epidemic diseases. In the recent past, the city was affected by some of the major floods in the years 1924, 1947, 1976, 1977, 1978, 1988, and 1995.[5] Moreover, the city also received severe flooding in 2008, 2009 and 2010.[5,29] Floods in Delhi have mainly occurred when Yamuna River crossed its danger level due to heavy rainfall during monsoon. As a result, low lying areas along the Yamuna were severely affected. For example, in 2009, over hundreds of slum dwellers residing on the Yamuna bank were affected when their crops were washed away by flood (New Delhi, Sep 13 (ANI). Similarly, floods also cause severe damage to houses, infrastructure, and services. In 2008, around 148 trains were cancelled or diverted due to flood situation.[14] In addition, flood water also inundated agriculture fields of eastern bank, NOIDA link road, DND Flyways, Usmanpur village, among others.[12] The most affected people were urban poor. As an example, a multi-storey building in East Delhi collapsed on 15 November 2010, soon after two months of September 2010 flooding.[36] This building was illegally raised to five storeys and inundated under flood water for several days.[36] It suddenly collapsed due to its weak structure.[37] Around 70 people killed and over 65 were severely injured.[37] This building was located in the poor working class area and homes of several migrants from Bihar and West Bengal. As a result, urban poor groups were mostly killed and affected by after flood event.

Recently, a study was done on assessing the disaster resilience of Delhi. Conducted by Kyoto University, it addresses the disaster risk of the city through the Climate Disaster Resilience Index (CDRI) approach.[16] CDRI is developed
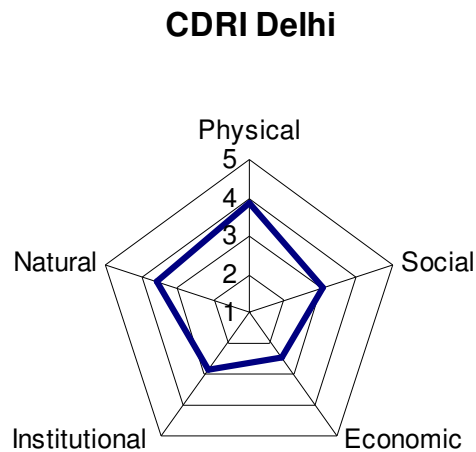
CDRI Delhi

Figure 2   Map showing the Climate Disaster Resilience Index (CDRI) of Delhi.

and based on five resilience dimensions: physical, social, economic, institutional, and natural. The result shows moderate resilience (i.e. 3.14, 1=bad, 2=poor, 3=moderate, 4=good, & 5=best).

The study revealed moderate to poor resilience particularly in social, economic, and intuitional dimensions where in some variables require more attention in the near future (Fig. 2). Some of these include (i) awareness or knowledge of population about the threat and impact of disasters, (ii) how often city authority organizes public awareness program, (iii) extent of participation of city population in community activity, (iv) acceptance level of community leader, and (v) ability of city communities to build consensus and shared interest.[16] It is often seen particularly in the city that the vulnerability of urban poor groups is overlooked in spite of having established institutions and disaster management plans. For instance, despite having the Delhi disaster management plan, the study shows the low awareness and knowledge of the population about threat and impact of disasters especially in the case of urban poor groups.

Disaster practitioners believe that not all urban poor groups are equally vulnerable. It is essential to understand that sometimes, social, political, and global forces play crucial roles in determining their vulnerability to natural hazards.[24] For example, the case of the Mumbai flood in 2005 shows the relationship between socio-economic characteristics of households in slums and impact on households' survival during, immediately after and long term recovery from flood. Certain characteristics such as religion, employment, region, gender, demographic composition of households, and language play important roles in determining their level of vulnerability. For example, in terms of shelter dependency, new residents (less than 10 years) and old residents (more than 20 years) were more vulnerable than medial residents (10–20 years).[24] New and old residents were mainly dependent

on randomly available places, whereas medial residents found refuge with social networks. Religion also played an important role during flood events in determining the vulnerability of Christian, Hindu, and Muslim families living in the slum areas. Christian families were supported by formal institutions, whereas Hindu and Muslim families were dependent on social connections and more vulnerable than Christian families, who had access to religious buildings.[24] Moreover, the home state origin, which is a socio-cultural factor, played a crucial role in determining the vulnerability. Households belonging to the Maharashtra state were less vulnerable than families belonging to other states as they lack resources and access to decision making.[24] Similarly, economic characteristics also came out as determining factor for household's vulnerability. In the recovery stage, skilled and permanent workers were capable of protecting formal means of shelter and safeguarding resources whereas unskilled workers were highly vulnerable than skilled workers, who receive financial assistance or easy loans from employers.[24] Because of this, they recover faster than unskilled labor. Thus, in spite of being poor and vulnerable, the example of the Mumbai flood in 2005 shows a new spirit in response and recovery efforts. In addition, it shows the resilience of urban poor groups through collective coping strategies.

5. *Sanjha Prayas*: Delhi's Slum Development Approach

5.1. *The approach*

Under the citizen-government partnership, *Sanjha Prayas* is a scheme launched to promote better participation of poor people in governance.[8] *Sanjha Prayas*, particularly focuses on slum development of three core areas: water, electricity, and sanitation-solid waste disposal. It was launched by the Delhi Government in 2007, particularly in slum areas with the help of different stakeholders/agencies such as local representatives from slums, *Bhagidhari* (partnership) Cell, Delhi *Jal* (water) Board (DJB), Bombay Suburban Electric Supply (BSES) Yamuna Power Ltd., Delhi Municipal Corporation (DMC), and Center for Urban and Regional Excellence (CURE) – NGO (Fig. 3).[8] The following section briefly discusses the role of key stakeholders and their functions.

5.2. *Key stakeholders and functions*

5.2.1. *Local representatives from slums*

Local representatives are elected by the local people. Their duty is to work for the welfare of the local community. As an example, women groups that exist in the slum areas work for the welfare of women. Through the *Sanjha Prayas* program, local representatives came forward and showed keen interest in partnership with the Delhi government for slum development. They played important role by
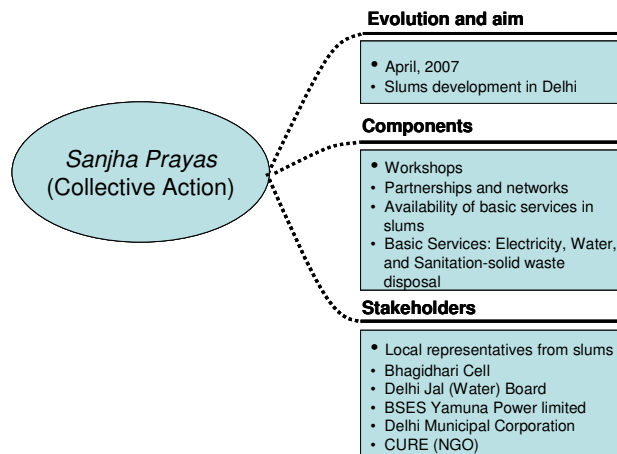
Figure 3   Sanjha Prayas (evolution, components, and stakeholders).

highlighting the key issues of slums to the Delhi government. In April 2007, a workshop was organized under *Sanjha Prayas* program by *Bhagidhari* Cell, where local representative brought three key issues: water, electricity, and community toilets.[8] The local representatives explained about water scarcity issues that arise due to the limited number of community taps, limited duration of water supply, and polluted water supplied through tankers. In addition, issues related to electricity such as low number of street lights, power interruption, unawareness of electricity meter reading, and high cost of electricity connection were raised. Moreover, issues related to public health such as low number of public toilets, maintenance of community toilets and internal drainage were prioritized. Finally, local representatives also played an important role in developing the action plans for slum development.

5.2.2. *Bhagidhari (partnership) cell*

Initially, *Sanjha Prayas* originated from the *Bhagidhari* (partnership) Cell located in the Chief Minister's office. "*Bhagidhari*", is "a citizen-partnership program in governance.[13]" It aims to bring change through "joint ownership" between citizens and Delhi government. Key officials from the *Bhagidhari* cell played important roles in organizing workshops for the *Sanjha Prayas* program. In addition, they also organize periodic meetings for discussion of critical issues of slum development. For example, in *Sanjha Prayas* workshop, as mentioned in section 5.2.1, the cell invited various stakeholders such as the Delhi Municipal Corporation (Slum Department), Delhi *Jal Board* (DJB), and BSES Yamuna Power Ltd, and local representatives of slums from the east and north-east districts of Delhi.

5.2.3. *Delhi jal (water) board*

Delhi *Jal* Board (DJB), constituted in 1998 through an act of Delhi Legislative Assembly, is responsible for the production and distribution of potable water supply in the city. The board is also associated with *Sanjha Prayas* program and provides services to improve water supply in slum areas. In the *Sanjha Prayas* workshop, as stated in section 5.2.1, the officials provided advice to the local representatives for improving the drinking water supply in slum areas. Some of their advices include i) to have committee at local level which looks after the maintenance of community water taps and ii) different ways to reduce wastage of drinking water. The officials also provided assurance to increase community water taps.

5.2.4. *BSES yamuna power ltd.*

Bombay Suburban Electric Supply (BSES) Yamuna is a private agency that distributes power to an area spread over 200 sq. km. covering central and east Delhi. The agency has 1.19 million customers and provides support to problems such as power interruption, illegal usage, and high consumption. Similar like Delhi Jal Board officials, the BSES officials, during *Sanjha Prayas* workshop, provided suggestions to local representatives for improving the poor condition of electricity in slum areas. Further, they recommended setting up a local level committee which will provide functions such as monitor misuse of electricity, maintain street lights, and promote ways to save electricity.

5.2.5. *Delhi municipal corporation*

The Delhi Municipal Corporation (DMC) is one of the largest municipal bodies in the world that provide civic services to 13.78 million people in the city. It provides civic services to various kinds of settlements including urban and rural villages, resettlement colonies, regularized unauthorized colonies, and slum squatters. Some of the civic services include construction, maintenance and cleansing of drains, public toilets; reclamation of unhealthy localities; registration of births and deaths; public vaccination and inoculation; construction, maintenance, alteration and improvements of public streets, bridges, culverts, causeways; and lighting, watering and cleansing of public streets and other public places. During *Sanjha Prayas* workshop, as stated in section 5.2.1, the DMC officials advised local representatives to form committees in slum areas for the repair and maintenance of public toilets. The corporation also provided equipment and manpower support to improve solid waste disposal and sanitation conditions in slums of east and north east Delhi.

5.2.6. *Centre for urban and regional excellence*

The Centre for Urban and Regional Excellence (CURE) is a non-government organization that specializes and works in the area of community mobilization, participatory planning assessment, pro-poor policy research and reform, community based information system, slum upgrading and physical infrastructure development, and capacity building. The organization empowers and works for the development of poor communities such as improved access to basic services and improved participatory governance. As an example, the organization is a consultant to the Delhi Government providing support to the *Sanjha Prayas* program. It engages through meetings and discussions with local people in slum areas frequently. In several instances, the organization helps local slum representatives in identifying and highlighting the key issues of slums such as drinking water, electricity, public toilets, and drainage improvement and maintenance.

6. Scope for Further Improvement

The *Sanjha Prayas* program provides a functional platform at the lower level to urban poor and aims to improve their life by enabling them to access better infrastructure services like sanitation, water, and electricity. Furthermore, this program has expanded its activities to improve education, livelihood opportunity and housing in slum areas. However, this program lacks in meeting the challenges discussed earlier in section 3 and 4 such as challenges related to human health, lack of communication facilities, and vulnerability of urban poor groups to climate related hazards. Moreover, their increasing vulnerability often contributes to a disaster in the form of loss of lives, injuries and damage to infrastructure. Thus, addressing their vulnerability to climate related hazards is essential for their well being. The following section briefly discusses about risk communication and how it can addresses the risk of urban poor groups to climate related hazards.

6.1. *Risk communication*

Many authors have traced the development of risk communication in different fields such as health, food safety, technology, and chemical risks. From the 1970s onwards, the literature in risk communication has grown due to popularity and modification of the concept. However, risk communication in the field of natural hazards is less developed. Social scientists from the field of natural hazards believe that it is vital before, during, and after a hazard event.[4,27,2] The following section discusses risk communication from a natural hazards perspective.

CapHaz-Net Consortium defines *Risk communication* as "both a one-way transfer of hazard and risk related information and their management, and as a two-way exchange of related information, knowledge, attitudes and/or values". Furthermore, "It is a preventive activity that prepares communicating actors for

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hazard events, that enables them to cope with hazard events and which helps to reduce adverse impacts on people and social system". Clearly, it distinguishes from disaster, crisis, and emergency communication that only focus on activities during and after hazard events.[4]

The inspiration for significant studies in the different areas of risk communication started with Shannon's traditional communication model.[30] The model states that there is an information source on one side that sends message through some channel to the receiver. Later, a long debate started on whether this communication should be one-way or allow a more interactive exchange of information. In 2005, there was emphasis on a "two-way communication and exchange of information, where all actors should engage with and learn from each other".[4,31] Moreover, the traditional communication model failed to bring desired changes in risk related attitude and behavior and is considered as one of the causes for increasing interest in the two-way communication.[4,1]

6.2. *Integrating risk communication in Sanjha Prayas*

Despite the growing debate on the one way or two way risk communication process, a few scientists also believe that risk communication is not just a two-way information sharing but a dynamic process that requires a forum or actions-oriented platform for its implementation. The *Sanjha Prayas* can be considered

Elements of risk communication		Existing in Sanjha prayas	Additional suggested
	Actors	Local representatives from slums, CURE (NGO), Bhagidhari Cell, Delhi Jal Board (DJB), BSES Yamuna power ltd., Delhi Municipal Corporation (DMC)	Delhi Disaster Management Authority (DDMA), Media, Schools, Local NGOs
	Purposes	Slum development through improving water, electricity, and sanitation - solid waste disposal	Raising awareness, encourage protective behavior, inform to build knowledge on hazards and risks, to promote acceptance of risks and management measures, how to behave during event, improve relationship
	Modes	Lectures, conversations, and story telling	District HFA Forum
	Tools	Workshops and meetings	Workshops and meetings
	Messages	How to deal with problems of power interruption, problems of water supply, and solid waste management in the locality	How to deal with the spreading of infectious diseases, disaster waste, contamination of water after floods, and impact of climate related hazards.

Figure 4   Existing and suggested elements of risk communication in Sanjha Prayas Program.

as dynamic and action oriented platform for risk communication. Moreover, the program incorporates key elements of risk communication. The key elements are: actors, purposes, modes, tools, and messages (Fig. 4). Further, Hoppner describes these elements, as the main pillars of any risk communication. The following section briefly describes key elements and suggests additional elements for integrating risk communication into *Sanjha Prayas* program.

6.2.1. *Actors*

Actors can be defined as individuals, groups and institutions that act as nodes in risk communication.[4] Further, the exchange of information can take place between actors in one or many directions. For integrating risk communication, the study suggests inclusion of actors such as Delhi Disaster Management Authority (DDMA), media, schools, and local NGOs (Fig. 4). In addition, Community Based Organizations (CBOs) such as *mahila mandal* (Women's Group), *mohalla samitis* (Neighborhood Committees), Self Help Groups (SHGs), can also be included as potential actor in risk communication. Moreover, actors' roles and their activities are very important in risk communication. For example, DDMA addresses disaster risk of Delhi through disaster management frame work, which is based on command, control, and coordination mechanism.[5] In 2010 Delhi Food, the authority played crucial role in all different phases of hazard cycle. The most affected were slum dwellers situated in the low lying areas of Tibetan Colony, Garhi Mandu, Usmanpur, and Yamuna Pushta.[33] The impact was recorded in the form of deaths, injuries and loss to livelihood and infrastructure, especially in the affected areas. DDMA along with concerned department provided continuous support to slum dwellers by issuing evacuation warning and carried out rescue and response operation in the affected areas. Later, the affected were rehabilitated in the temporary shelters. Moreover, the authority also intervened in relief phase by meeting the need of affected people by providing food, clothing, and first aid services. Thus, the example here shows the DDMA's role in reducing impact of flooding on the slum dwellers. Similarly, media can play a very important role as transmitters between sources or messenger (DDMA, *Bhagidhari* Cell, DJB, BSES Yamuna power ltd. DMC) and receivers or audiences (local representatives from slums, CURE, schools and other local NGOs). Schools can play important as an information center in risk communication. Many times, school organizes festivals and local people gather as an audience. Thus, sources or messengers can utilize the platform of schools in bringing information and knowledge to the dwellers.

6.2.2. *Purpose*

The purpose of risk communication is to develop the disaster resilience of urban poor groups in Delhi. As mentioned in the earlier section, resilience can be defined as capacity of a system or a community to (i) absorb the stress through resistance,

(ii) maintain or manage the certain functions and structures during disaster events, and (iii) recover or bounce back after an event.[21] Therefore, the study seeks to build capacity of urban poor through different kind of interventions, which are needed to be included such as raising awareness, encouraging protective behavior, inform to build knowledge on hazards and risks, to promote acceptance of risks and management measures, how to behave during an event, and improve relationship.[4] In addition, these purposes also develop the social capacity to deal with climate related hazards and are undertaken in the different phases of the hazard cycle: before event (prevention and preparation); during event (warning and response); and after event (recovery and reorganization).[4,41]

6.2.3. *Modes*

There are different kinds of modes used in risk communication. Some of them are verbal (e.g. lecture, story telling, conversation), while others are non verbal (e.g. gestures, body language, sign language, facial expression, graphics, movies).[4] Further, Hopnner describes that modes can also be distinguished as one-way communication and two-way communication. Indeed the choice of communication modes should also match or be guided by the purpose of risk communication.[4] In the present case, the purpose of risk communication is to build disaster resilience of urban poor groups. Therefore, the study suggests a platform of district Hyogo Framework for Action (HFA) forum. The HFA is an instrument that offers principles, priorities for action, and practical means for disaster risk reduction.[21] It aims to reduce disaster losses through building resilience of most vulnerable community.[21] In 2011, East Delhi District HFA Forum started to support most vulnerable groups affected by Yamuna flood in 2010, and emphasized on building their disaster resilience. On 1st March 2011, the first workshop of this forum was held at District Disaster Management Centre (DDMC), east Delhi.[28] The workshop brought together 35 participants representing disaster affected communities, Residential and Welfare Associations (RWAs), NGOs, DDMA, Kyoto University, and experts from research and training institutions.[28] During the workshop, local community including RWAs and affected communities from 2010 Delhi flood suggested to form training wing. Through this forum, the volunteers from local community will be trained and certified by DDMA. The trained volunteers would benefit in better preparedness for disasters – in terms of logistics, material, and management. Later, these volunteers can also sensitize and train their local people in slums areas and reduce the impact of disasters. This example shows that how HFA forum can create opportunity for local people to learn and prepare themselves for future disasters. It can further help in improving their disaster resilience.

6.2.4. *Tools*

Tools are considered as one of the important elements of risk communication. For effective risk communication, the tools should also match with communication

modes.[4] For example, a two way communication between individuals or small groups can be realized through meetings, focus group, and lectures.[4] For integrating risk communication, the study suggests use of workshops and meetings as shown in the Fig. 4. This would also mean that risk communication would utilize same platform of *Sanjha Prayas*, which has been instrumental in effectively communicating with the most vulnerable sections residing in slum areas. Therefore, by using the same platform, the risk communication can be implemented in most of the slum areas of Delhi.

6.2.5. *Messages*

The message development and its presentation are the most important components for making risk communication effective.[4] The style, content, language, and transparency of the message are the important factors in the process of message development.[4] For example, the content and style of a message has a striking effect on the audience response. In addition, the content of a message should also fit the need of the audience in risk situation.[4] As an example, Sorensen (2000) describes that public warning messages in the whole spectrum of natural hazards should include the nature, the location, the guidance, time, and sources of expected hazard events.[4] Similarly, there are different means of message presentation including – visualizations such as time lines, charts, labels, maps, and graphs.[4] Many authors have also agreed to the notion that visual means of presentation are much better than text.[4] In the case of Delhi slums, the study suggests creating of messages that address disaster risks of urban poor groups. For example, how to deal with spreading of infectious diseases, disaster waste, contamination of water after floods, and impact of climate related hazards (Fig. 4).

7. Conclusion – Way Forward

The paper explores several challenges and climate related hazard risks of urban poor groups in Delhi. The key characteristics of slums place urban poor groups at the greater risk. Moreover, their risks further get intensified due to their socio economic conditions as well as due to increase in the frequency, severity, and intensity of climate related hazards. In addition, when disaster strikes, the impact is largely concentrated on urban poor groups in the form of deaths, injuries, and damage to their infrastructure. Hence, the paper addresses climate related hazard risks of urban poor groups by taking the case of Delhi's slums. It further seeks to build disaster resilience through integrating risk communication into existing slum development program, *Sanjha Prayas*.

The paper is build on the notion that *Sanjha Prayas* can provide a efficient platform to address climate related hazard risks to urban poor groups in the slums of Delhi. The study unitizes this platform for integrating risk communication in

the form of actors, purposes, modes, tools, and messages. The following section discusses the implication of integrating risk communication to the slum areas of Delhi.

The messages, for example, are the most important component for making risk communication effective.[4] Moreover, the contents and style of message has a remarkable effect on audience response.[4] For instance, how to deal with the spreading of infectious diseases after flood would help urban poor in taking the preventive measures. In future, this would have a positive impact on the reduction of number of people affected from infectious diseases after flood. Similarly, the messages on how to deal with the impacts of climate related hazards would lead to increase in the capacity of urban poor groups in the form of better knowledge, interest to learn more, and motivation to act after disasters. This would also help urban poor to recover faster from the impact of disasters. Likewise, the messages on how to deal with disaster waste would lead to improved capacity of urban poor in the form of disaster waste assessment, planning, and management.[45] Moreover, the improved knowledge of urban poor groups would help them in effective communication and coordination with other key stakeholders, who are primarily responsible for disaster waste management. Indeed this would also help urban poor in quick recovery from the impact of disasters. Therefore, the messages can show the positive implication to the slum areas. Furthermore, they can also develop disaster resilience of urban poor through improved capacity to addresses climate related hazard risks.

Finally, integration of risk communication can also be useful for improving the resilience of CDRI study. For example, the social resilience of urban poor would increase through improved preparedness for disasters – including household preparedness in terms of logistics, materials, and management; support from NGOs, CBOs or religious organization after a disaster etc; increase in the extent of affected people evacuate voluntarily after disasters; and increase in slum participation in relief work after disasters.

Acknowledgements

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