

Gorakhpur Environmental Action Group (GEAG) is a voluntary organization working in the field of environment and sustainable development since 1975. Ever since its inception, GEAG has been actively engaged in implementing several development projects addressing livelihood issues of small and marginal farmers, particularly women, based on ecological principles and gender sensitive participatory approach. Besides, GEAG has accomplished several appraisals, studies, researches at the micro & macro levels as well as successfully conducted a number of capacity building programmes for various stakeholders including women farmers, civil societies groups and government officials etc.

Today, GEAG has established its identity in North India as a leading resource institution on Sustainable Agriculture, Participatory approaches, methodologies and Gender. Acknowledging its achievement, efforts and expertise, United Nation's Economic and Social Council (ECOSOC) accorded GEAG special consultative status in the year 2000. GEAG has also been recognized recently as North India hub for Intersard, South Asia-a network to facilitate information sharing on issues of concern.

Gorakhpur Municipal Corporation was established on 1982 under the act of Uttar Pradesh Government i.e, Municipal Corporation Act of 1959. The corporation is committed to provide basic services to its people and initiated several programme to make the city resilient from climatic aberration. It has given full support from the beginning of the Asian Cities Climate Change Resilience Network (ACCCRN) process and actively participated in the micro planning project.

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Developing Climate Resilient Ward Plan

A Guideline



[illegible]

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LIST OF ABBREVIATION

ACCCRN	Asian Cities Climate Change Resilience Network
CAA	Constitutional Amendment Act
CSO	Civil Society Organization
DAD	Depth- Area- Duration
GCMs	General Circulation Models
GDA	Gorakhpur Development Authority
GEAG	Gorakhpur Environmental Action Group
GIS	Geographical Information System
GMC	Gorakhpur Municipal Corporation
GPS	Global Positioning System
HHs	Households
ISSET	Institute for Social and Environmental Transition
LEISA	Low External Input sustainable Agriculture
MC	Municipal Corporation
CRWP	Climate Resilient Ward Plan
NGO	Non Government Organization
NH	National Highways
PLA	Participatory Learning and Actions
PWD	Public Welfare Department
SLDs	Shared learning Dialogues
SMS	Short message services
SWM	Solid Waste Management
ULB	Urban Local Bodies

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दिनांक 30.9.2014

प्राक्कथन

गोरखपुर परिक्षेत्र बाढ़ एवं जल जमाव से प्रभावित रहा है और महानगर इससे अछूता नहीं है। वर्षा के समय महानगर में जल जमाव की समस्या गंभीर हो जाती है। जल निकासी हेतु सुदृढ़ इन्फ्रास्ट्रक्चर की कमी, अतिक्रमण आदि ऐसी समस्याएं हैं जिसके कारण महानगरवासियों को समस्याएं झेलनी होती हैं।

ऐसे में जलवायु परिवर्तन व वर्षा के क्रम में बदलाव के कारण समस्याओं का बढ़ना स्वाभाविक है और इससे निपटने की तैयारी करना आवश्यक होगा।

संविधान के 74वें संशोधन की मंशा के अनुरूप मुहल्ले व वार्ड स्तर पर विकास व नियोजन को मजबूत किये जाने की आवश्यकता है जिसमें नागरिकों का योगदान व उनकी भूमिका महत्वपूर्ण है।

गोरखपुर नगर-निगम व गोरखपुर एनवायरन्मेन्टल एक्शन ग्रुप ने महानगर की जलवायु परिवर्तन से निपटने की एक रणनीति तैयार की थी। इसी क्रम में महेवा वार्ड के नियोजन हेतु एक मॉडल के रूप में विकसित करने का प्रयास किया गया है जिससे राज्य, राष्ट्रीय व अंतर्राष्ट्रीय स्तर पर सीख मिल सके और इस प्रकार की सामुदायिक योजनाओं को विकसित करने हेतु प्रयास किये जा सकेंगे।



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Message

Developmental planning with respect to climate induced risks has become indispensable. During last few decades, the city of Gorakhpur has been confronting with various hydro-meteorological disasters of like flood, heat waves, storms, etc.

In response to the above concern, Gorakhpur Environmental Action Group (GEAG) has done commendable job in assessing the climate-related vulnerabilities of people at a micro level and this has been done with the involvement of community through a bottom-up approach.

This document on “**Developing Climate Resilient Ward Plan: A Guideline**” demonstrates ways to incorporate the concern of urban vulnerability to climate change in decentralized planning. The whole process of micro planning and implementation was done under the project “**Urban community based micro resilience model of ward exposed to climate and hydro meteorological risks**” supported by The Rockefeller Foundation, USA to build resilience of various system and diverse agents to climate variability manifested in the form of recurrent floods and water logging.

We hope that this document will encourage the city managers, professionals, researchers, policy planners, and NGOs in implementing and integrating the process of micro planning in the overall development planning processes.



R.K. Tyagi
Municipal Commissioner
(Gorakhpur Municipal Corporation, Gorakhpur)

Executive Summary

The concept of building climate-resilience from micro- to macro- level is increasingly gaining currency as disaster risk reduction has progressively moved away from a 'predict and prevent' paradigm in the evolving context of rapidly transforming complex urban systems and increasing frequency and magnitude of disasters due to climate change. Similar context is evident in Mahewa ward too of Gorakhpur city in eastern Uttar Pradesh.

The Mahewa ward micro resilience planning demonstrates ways to incorporate concerns of urban vulnerabilities to climate change in decentralised planning. The whole process of micro planning and implementation in the ward aimed at building resilience of various urban systems and diverse agents (including ward level functionaries and local community) to climate variability manifested in form of recurrent flooding and waterlogging.

We believe this guideline will be useful to urban local bodies, local government agencies and departments, civil society organisations and donors to: understand the key elements and nuances in the process of building micro resilience focusing on involvement of neighbourhood (*mohalla*) and ward level community in planning, implementation, and monitoring; build capacity of ward members and municipal officials; and, mainstream decentralized micro urban resilience planning in their programmes.

Resilience is achieved within a system (economic, political, infrastructure, ecological, social and

institutional) that includes multiple activities, interactions and relationships. The intervention at Mahewa, led by GEAG (in collaboration with ISET and ARUP) for building micro resilience ward plan is perhaps the first project of its kind where urban climate change resilience has been planned, implemented and monitored through a bottom-up approach by local communities. Our point of focus within complex systems are communities, who are able to act within their sphere of influence, in the centre of the process. In this process GEAG has evolved certain principles that are as under :

- People participation is key to formulate realistic and effective resilience plan;
- The micro resilience ward plan should be based on practical experiences gained through piloting;
- Facilitator or a champion is must to lead the process of building the micro resilience ward plan; and,
- Formulating micro resilience ward plan is a dynamic process, not an episodic process.

In micro ward level resilience building process we envision a series of five important steps: creating baseline on current vulnerabilities and impacts of climate change; understanding urbanization scenario; assessing implications of climate change on current climate thresholds augmented by hazard mapping; identification, design and implementation of resilience building interventions; and, monitoring and learning.

Sound qualitative and quantitative base line information about the current risks, exposure and

capacity of existing system, agents and institution is essential to formulate the strategy. Mahewa ward, one of the 70 wards of Gorakhpur is located in the south west of the Gorakhpur city. Unfortunately, the capacity of natural, social, institutional and infrastructure system of the ward is too inadequate even to provide basic services leading to severe decline of quality of life of residents. In the vulnerability assessment community perceptions on level and effectiveness of conventional development, major climate risks and their root causes were diagnosed through a participatory process. Subsequently, the ward was divided into different clusters and a series of consultations with community and leaders at neighborhood cluster level, and relevant government departments were conducted to develop the vision of future development of the area by 2030s. At core, the results show an intensification and expansion of the habitation in future. Following this, climate downscaled projections were analysed to assess how the frequencies of current climate thresholds identified by community as historical signature events, would change. It was found that the

frequency of current set of thresholds would increase by 10-20 percent. Simultaneously, hazard mapping using participatory GIS technique could be conducted to show variations of depths and durations of waterlogging spatially.

Drawing on the above, resilience building interventions were identified, designed and piloted in six thematic areas in the ward: water and sanitation, community health, drainage, agriculture, building (house, community toilet and school), and livelihood improvement for women.

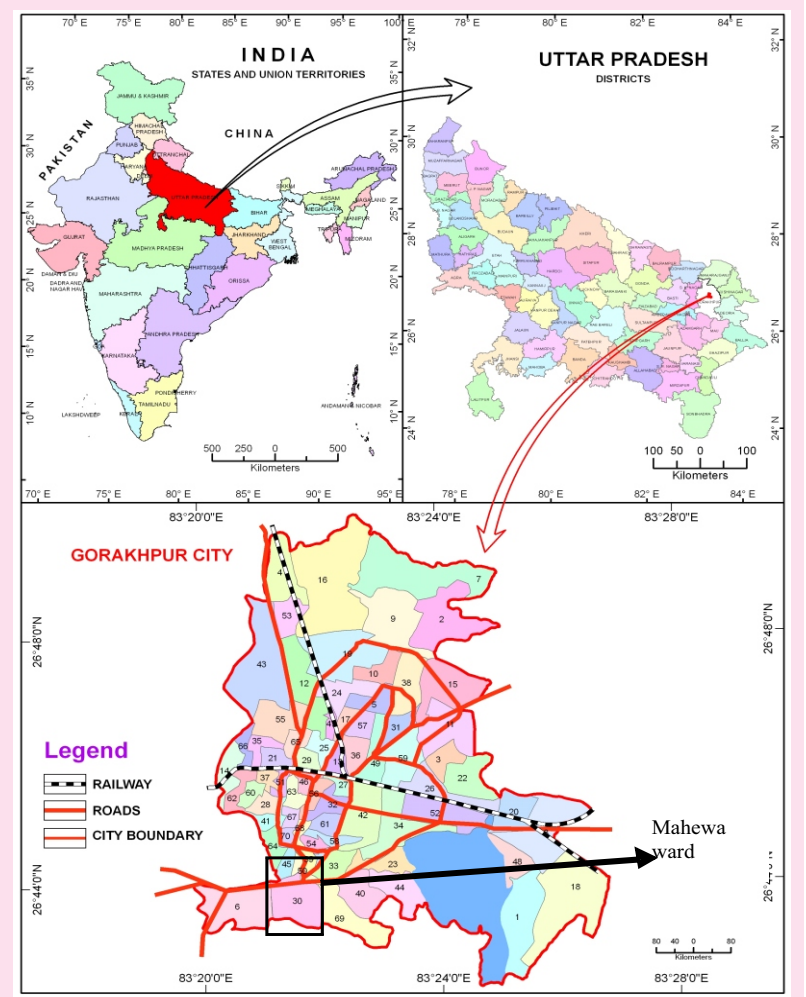
Micro ward resilience planning process needs to be dynamic to enable feedback-revision-implementation cycle. This is specifically important to align to evolving nature of climate projections and rapidly changing complex interactions between exposure, urban physical systems, institutions and change agents. Hence a set of indicators on system, agent and institution, based on the climate resilience framework, were evolved to monitor progress of resilience building at periodic intervals.

Goal and Objectives of Climate Resilient Ward Plan

This guideline document on micro ward resilience planning provides insights of the collaborating team led by GEAG with ISET and SEEDS from implementing the “Mahewa Ward Project”¹ in Gorakhpur as part of the ACCCRN programme. While many programmes or projects on city or ward level have been implemented in various sectors, this initiative is pioneering in the way that it addresses the triad of challenges of climate change concerns, rapid urbanization and poverty as prevalent in Mahewa ward in Gorakhpur city (Fig 1).

Micro ward resilience planning can be an effective instrument to catalyse climate resilient urban development and it is an opportune time given that: the 74th Constitutional Amendment emphasizes decentralized planning in urban areas; and, that more than 80 percent of urban India will be built in next 20 years. This guideline describes various tools, methods and approaches that we have used and feel are necessary for developing a micro ward resilience plan.

Figure 1 | Location Map of Study Area



¹ <http://www.hamaragorakhpur.com/content/urbanclimate.aspx>

Utility of Guideline on Climate Resilient Ward Plan

The 74th Constitutional Amendment Act² provides the needed space for decentralized planning in the context of urban development. However, the implementation of act is at the discretion of state governments to amend and apply taking into account local context. Strikingly, there are capacity gaps in urban department at the state level to take up the needed planning. The scenario is further grim at further lower levels such as at the Urban Local Bodies (ULB) levels.. Resultantly, there are not many examples of effective decentralized planning especially at the ULB levels that are especially developed using participatory bottom-up approach. Towards this, the micro level ward resilience planning in Mahewa provides several take aways for the ULBs, government, urban planners, social scientists, donors and civil society organizations in terms of process of community involvement, government interface, sectoral planning, resource identification and execution of sector plans. A unique feature of Mahewa ward micro resilience plan is that it demonstrates ways to incorporate concerns of urban vulnerability to climate change in decentralised planning. Entire process of micro planning and execution in Mahewa ward was meant to build resilience of various urban systems and diverse agents (including ward level functionaries and local community) to climate variability manifested in form of recurrent flooding and erlogging.

As stated above, this document on micro level ward resilience planning can provide resources to key stakeholders in diverse ways:

Utility for Urban Local Bodies

Municipal bodies in India have been given legal status through 74th CAA (Constitutional Amendment Act) to work as apex body for local development planning and execution, revenue collection and management of services and facilities. But unfortunately in many states these powers have not been delegated to municipal bodies fully as yet. Ideally decentralised developmental plans need to be developed in a participatory manner using bottom-up approach and Mahewa experience demonstrates the same. This guidance document will help urban local bodies to understand the process of community involvement in planning and implementation right from the mohalla³ and ward level. In addition, planning from the perspective of climate vulnerability would completely be a new learning for urban local bodies.

For example, understanding the way to assess increased frequencies of historical precipitation extreme thresholds by combining local wisdom of community and other experts with climate downscaling and analysis. It is noteworthy here this

Urban local bodies could use for

- ◆ Capacity building of ward members and municipal officials;
- ◆ Adoption of processes to mobilize community and awareness generation;
- ◆ Ensure participation of most vulnerable community; and,
- ◆ Mainstreaming of climate change component in its developmental planning.

guideline document does not deal with core infrastructural engineering designs. Rather it focuses on softer aspects of capacities and institutions of various actors including communities in responding to urban climate resilience as part of climate-smart development. We believe this guideline document would be useful to key institutions working on urban development and resilience issues.

Utility for Government Agencies and Departments

Despite the provision of 74th CAA, governments in various states are yet to delegate power to municipal bodies. This document aims to catalyse this process. It can be used as a guideline for ward level micro planning by urban local bodies. Government can use this in several ways:

- ◆ Developing a broad based guideline for climate sensitive ward level micro planning;
- ◆ Identifying steps of community involvement at every stage of planning and implementation;
- ◆ Forming and strengthening Ward level and Mohalla level committees; and,
- ◆ Incorporating climate change concerns and associated vulnerabilities at every level.

Utility for Civil Society Organizations (CSOs)

Urban resilience is gaining currency in global and national debates. Servicing this need, CSOs have started providing renewed attention to cities and

climate change. Many organizations are proactively working on this issue. This document can be utilized for :

- ◆ Promoting a structured approach to community mobilization and involvement;
- ◆ Capacity building of community workers and professionals;
- ◆ Developing new concepts and activities around building resilience;
- ◆ Mainstreaming climate change agenda in organizational and programmatic mandate; and,
- ◆ Advocacy for strengthening decentralization urban planning process.

Utility for Donor Agencies

The Mahewa experiment is perhaps the most pioneering experience on promoting decentralized urban resilience, at the scale of ward. It emphasizes the need to involve people for understanding their perceptions of risks and, ensure the effective and judicious use of resources and information in resilience planning. Donor agencies could find this document useful for :

- ◆ Training and other capacity building programs to build the capacity of project partners and key professionals;
- ◆ Re-shaping new programmes;
- ◆ Mainstreaming and promoting climate resilient planning in its urban projects; and,
- ◆ Initiating research projects to strengthen and catalyse urban micro resilience planning.

Utility for Community Workers

Community level workers are core drivers of the community level processes towards community mobilisation. We hope this document could be effectively used by translating it into a handbook or manual in local languages for such grassroots level practitioners.

2 The 74th Constitutional Amendment Act (CAA) enacted in 1992 was one such initiative, which gave constitutional recognition to the urban local bodies along with the constitutional rights to exist
3 Mohalla is the term generally used for sub division or neighbourhood.

Principles of Developing Climate Resilient Ward Plan

As emphasized, the pilot intervention led by GEAG (in collaboration with ISET and ARUP) for building micro resilience ward plan is perhaps the first project of its kind where urban climate change resilience has been planned, implemented and monitored through a bottom-up approach by local communities. The intervention brought together communities, municipal authorities, elected representatives and civil society groups. During the course of the intervention, GEAG has evolved certain guiding principles that could be useful in building similar micro resilience plans elsewhere. These principles are solely based on the experiences generated during the intervention and can be adapted suiting the local contexts.

People's Participation

People's participation is the key to formulating a realistic an effective micro resilience ward plan

One of the key principles for developing a micro resilience ward plan is that it should follow a bottom-up approach with people's participation being its core value. Urban climate change resilience planning is closely linked to urban development processes. Top-down planning processes without the participation of residents inadequately capture the local situation and capacity development needed at the city level. Hence, a bottom-up resilience planning approach should be adopted which ensures participation of people in the decision making processes, their contribution in the activities and hence their ownership in the long run.

Experiential Learning

The micro resilience ward plan should be based on practical experiences

Experiential learning is a process where knowledge is co-created through developing and promoting a shared vision and learning approach. The micro resilience ward plan should be developed on the basis of experiential learning generated through the implementation of pilot activities. This will help in getting a more realistic plan for implementation.

Entry Point Activities

Entry point activities are must for gaining confidence of urban communities

Entry point activities are crucial in terms of building micro resilience plan in an urban setting. These activities should be carefully chosen and implemented to build effective rapport with the community as well as achieve quick success by solving some of the key problems related to climate change impacts.

Implementation of 74th Constitutional Amendment

The 74th Constitutional Amendment calls for decentralized planning which should be taken into account for building an effective micro resilience ward plan

The 74th CAA provides for the devolution of planning funds, functions and functionaries (including the technical expertise of various departments) to municipal corporations. The development of micro resilience ward plan and governance in urban areas can be decentralized through a bottom-up approach as outlined in this Amendment. This can be achieved by promoting community institutions, ward-level micro planning and implementation of activities that especially considers the priorities of local marginalized and poor communities, with community-led monitoring of the process. Such a community-led process, which is based on people's priorities, needs, knowledge and capacities, will empower people to plan for and adapt to the impacts of climate change.

Facilitator

Facilitator or a champion is must to lead the process of building the micro resilience ward plan

Micro resilience plan development is an iterative and intensive process, more so in the urban setting where it can be more challenging. It is important to have a core facilitator like an NGO who can lead the whole process and play the role of a facilitator among the different stakeholders involved in the process.

Engagement of Government Departments

Working with the government departments helps in building their ownership of the processes and taking the initiatives forward for scaling up

For any micro resilience plan to be successful, it is imperative to have the engagement of government officials, decision makers and other stakeholders in the process right from the beginning. This will not only add credibility to the plan but will also help in further implementation and scaling up with the support of the government.

Dynamic Process

Formulating micro resilience ward plan is a dynamic process, not an episodic process

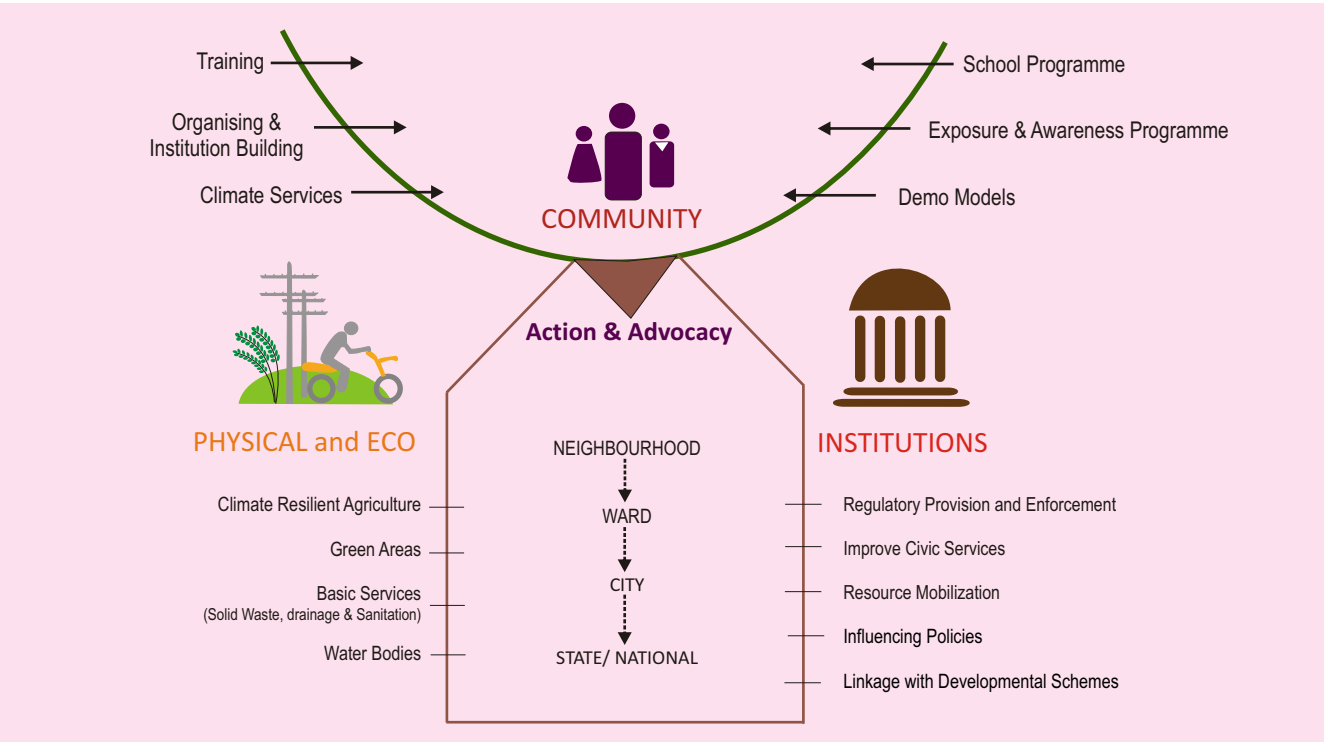
Resilience building is not a one-time process; rather it is a continuous process. Therefore, micro planning should be dynamic in nature that should be reviewed periodically and necessary amendments should be done based on the experiential learning. This is specifically important due to uncertainty in climate projections and the evolving nature of understanding of climate science and complex interactions between exposure, urban physical systems, institutions and change agents (please see details of resilience planning in section 5).

Steps and Process for Developing Climate Resilient Ward Plan : Mahewa Case

This section details out the core processes, approach, tools and methodologies that were used in developing the micro resilience ward plan (fig 2). Due to learning-by-doing nature of the experiment, the project team could not implement the steps in appropriate sequence though based on the overall project learning we propose a discreet sequence that we think would be necessary to develop a micro ward resilience plan. Although the proposed

sequence is important it can be modified appropriately considering the level of knowledge of actors on: local level climate projections and exposure; climate change vulnerability issues; and nature and extent of resilience building interventions. For example, the step of hazard mapping and threshold analysis can be skipped where there is fair understanding of exposure and changes in frequencies of critical historical exposure levels due

Figure 2 | Method and Approaches used for developing the MRWP



Source: GEAG

to climate change. We provide a detail account of processes here for the reader to pick the relevant ones as per the need of context in particular ward/ city.

Creating baseline on current vulnerability and impact of climate change

- ♦ The overall objective of the baseline survey was to assess the need, preference and priorities of the targeted communities of the project area. The specific objectives of the baseline study were:
- ♦ To establish a sound quantitative and qualitative baseline information on climate impacts and risks of community living in the ward;
- ♦ To assess the existing demographic, economic, health, sanitation, and livelihood status of the communities for preparing a guide map of resilience building interventions through micro planning; and,

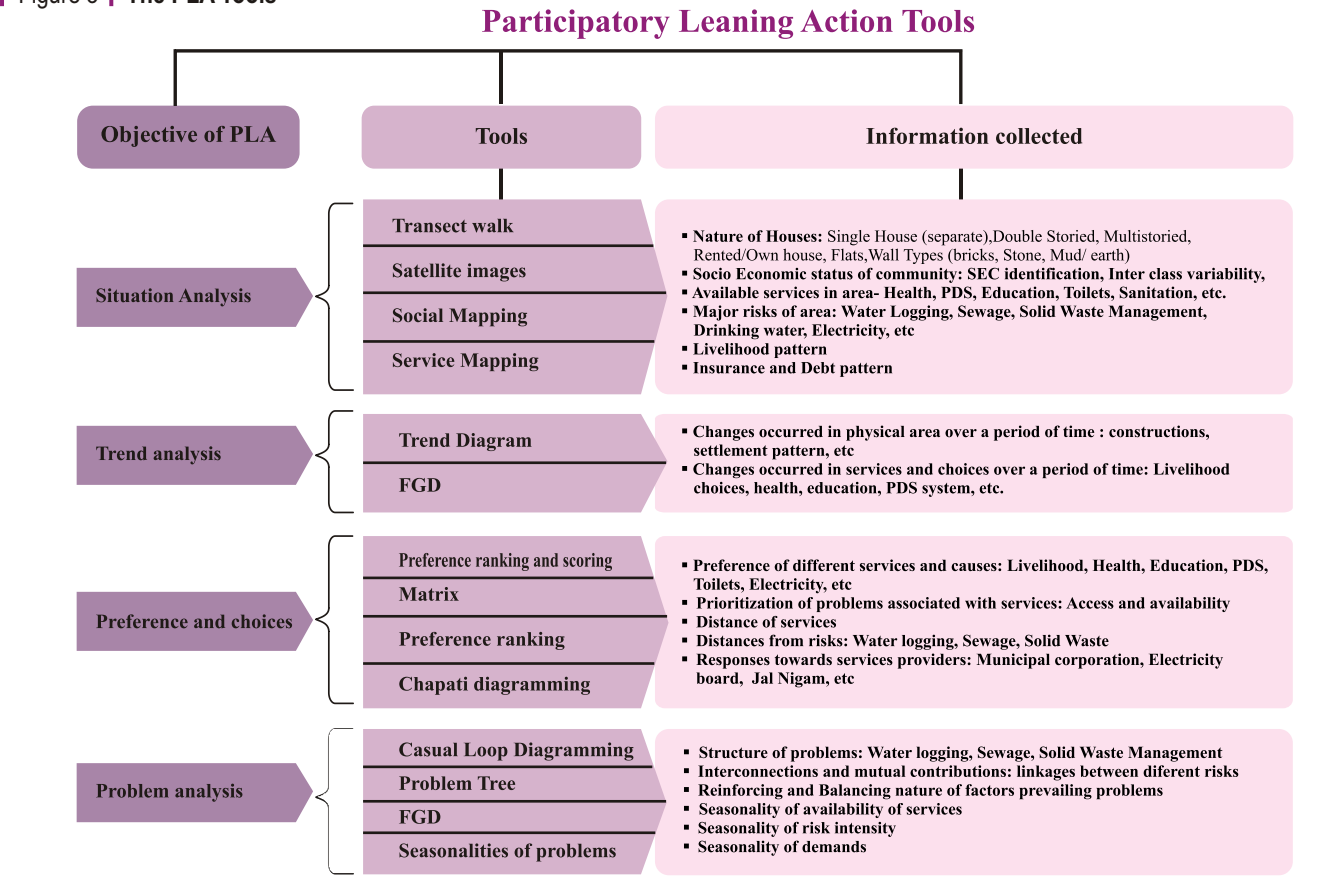
- ♦ To understand and assess the perceived needs and options of communities to resilience building through bottom-up approach.

Methodology of baseline survey

The baseline survey used both the quantitative and qualitative methods for data collection. While the quantitative data was collected through questionnaires the qualitative data was collected by community consultations (specifically, Participatory Learning and Action--PLA method) (fig 3).

The PLAs, in addition, were used to validate the quantitative data. In essence, the two methods complemented each other. It is worth mentioning here that the quantitative HH survey also aided developing initial rapport with the communities that in turn helped in collecting the needed data through PLAs.

Figure 3 | The PLA Tools



Source : Wajih et al., 2009

At the outset whole ward was divided into six *mohallas* (neighborhood) (Fig 4). Almost 90% of the total census HHs in the project area were covered in this survey. The idea was to collect data on nature and extent of current climate vulnerability and risks (for details please see Annexure 1). Specific focus was given to collecting such data disaggregated by gender, class and occupation. Overall, six community (PLAs) consultations by *mohallas* were conducted. Interestingly, we had encouraging level of participation and responses of community due to the basic ground work for rapport done during HH level quantitative data collection.

In summary, the following sets of activities were undertaken for baseline survey :

- ◆ The **questionnaire was developed** for the data collection. During the questionnaire development, need based approach was taken into consideration;
- ◆ The **field investigators were oriented** to the questionnaire and each questions deliberated and discussed in detail with them All the possible responses on each question were discussed in the group and the queries were sorted;
- ◆ **Field testing** of the questionnaire was carried in the area by the field investigators. The testing was

Figure 4 | Neighbourhood wise divisions of Mahewa Ward



aimed at identifying the possible modifications required based on the feedback received from the field.

- ◆ The questionnaire was redesigned accordingly;
- ◆ The questionnaires were administered for the HHs sampled through preliminary rapid assessment;
- ◆ **Community consultations (PLAs)** were conducted in the proposed area with two objectives: to validate the quantitative data; and, to collect qualitative data on aspects on which quantification was not possible, such as related to softer attributes of behavior and institutions In total, the PLAs were conducted in six pockets/ *mohallas*;
- ◆ **Data entry and analysis** based on identified indicators;
- ◆ **Baseline report documentation⁴** and,
- ◆ **Sharing** of the results of analysis and the output of the survey.

Understanding urbanization and assessing implication of climate change

The major climate risks including their root causes in Mahewa ward are :

Waterlogging

Unplanned development, poor infrastructure, localised underground sewerage, lack of solid waste management have contributed significantly to waterlogging problems in the ward. The citywide vulnerability assessment, conducted earlier, showed 18 percent of the city, especially the southern, western and central areas, face acute waterlogging that even the baseline survey in Mahewa ward corroborates (Wajih et al 2010). In Mahewa, water stagnates for more than three to four months at a stretch, deteriorating health conditions and increasing health hazards of the residents.

Sewerage and sanitation

Mahewa is poorly connected with a sewerage network. Open drains have become practically dysfunctional due to clogging by silt and garbage due to lack of maintenance. Some parts of Mahewa do not have drains at all.

Solid waste

Another important risk in the Mahewa ward was the poor management of solid waste, especially plastic. The municipality has no effective solid waste management plan. Collection of garbage from streets and homes was not regular. Due to lack of formal dumping sites, the entire solid waste generated was disposed either along the roads or used as land-filling material for low lying areas. Large scale use of plastics is a major cause of water stagnation in the ward. Aggravating it further, prolonged waterlogging together with poor solid waste management has caused an increase in the incidence of vector borne diseases as well as contamination of ground water. Malaria and dysentery have historically been major problems. The recent years have seen an acute rise in diarrhea, hepatitis and fluorosis.

The geo-hydrological study conducted by GEAG, conducted earlier, reports 31 low lying wards in the city that are highly prone to water logging during rainy season (Verma, 2009). Mahewa ward falls on the city's one of the major drainage lines where the low lying land is reclaimed by private developers, thus clogging the natural drainage system of the city.

Accessibility to municipal services in the ward is limited and existing infrastructure is of very inadequate. In addition, due to growing encroachments, natural water bodies within the ward are in severe threat causing problems of drainage and water quality. Being an peripheral area of the city, internal morphology and composition of communities in the ward are altering rapidly. As such there is limited social cohesiveness and a general apathy to city level governance issues.

In spite of a direct exposure to potential floods from the Rapti river basin (1998, 2001, 2007-10 floods) local planning processes have not sought to mitigate potential impacts.

All these climate analyses, geo-hydrological studies and baseline survey, at core conclude that severe water logging problems is primarily because of dysfunctional drainage system in the Mahewa ward. And, the problem is going to exacerbate due to climate change. A ward resilience micro plan project will hence; accentuate system management for delivering essential function under climate stressed condition.

The data and information collected through survey backed by community consultations were classified and categorized under the following heads:

- ◆ Demographic characteristics
- ◆ Social status
- ◆ Economic status
- ◆ Assets
- ◆ Livelihood
- ◆ Access to and quality of Services
- ◆ Hazards
- ◆ Prioritization of problems
- ◆ People view of development
- ◆ Future intervention and their prioritization

The detailed findings of the survey are presented in the baseline report²

Assessing critical thresholds of key climate parameters

The critical threshold is the magnitude or intensity that must be exceeded for a certain reaction, phenomenon, result or condition to occur or be manifested. The particular amount of precipitation that causes specific magnitude of waterlogging in a particular region/ area that has devastating impact, is referred to as threshold of precipitation of that area. The assessment of threshold of precipitation and its future projection is essential for the assessment of future scenario of flooding/ water logging which is prerequisite for proposing the climate resilient plan of an area.

Waterlogging and flooding is one of the major reasons of land degradation, loss of human life, and assets. The waterlogging may be the result of both natural such as relief, slope and its gradient, sudden heavy downpour and manmade factors like construction of developmental structure without proper consideration of drainage which obstructs the natural drains. In urban area the incidents of water logging happen to be when surplus rain/ storm water or used water (sewer and drains) stagnate and cannot drain out properly due to poor and unscientific drainage system. The present trend of Climate change implies severe exacerbation in flooding and waterlogging in the coming years in most of the urban centres of Asia. Hence amount and duration of precipitation should be estimated to

4 For further information concerning the base line report of Mahewa, see the link www.geagindia.org/PDF/final-base-line-survey.pdf

project the magnitude of future waterlogging on the basis of the threshold of rainfall for water logging. For this purpose the historical data of precipitation and past scenario of waterlogging should be analyzed to establish the relationship between amount and duration of rainfall and, depth and duration of waterlogging.

The historic data of precipitation may be available from the meteorological sources but the past information regarding the depth, duration and area of water logging might not be available for which the community consultations is the only mean to get the information. This participatory technique of data collection on precipitation and its impact in form of waterlogging can be used to acquire the quantitative data regarding the magnitude of waterlogging as a result of particular amount of rainfall. The different methodology for getting public opinion such as participatory learning action (PLA) and shared learning dialogue (SLD) may be used to measure the impact of participation on waterlogging which are widely being used by NGO and governmental agencies.

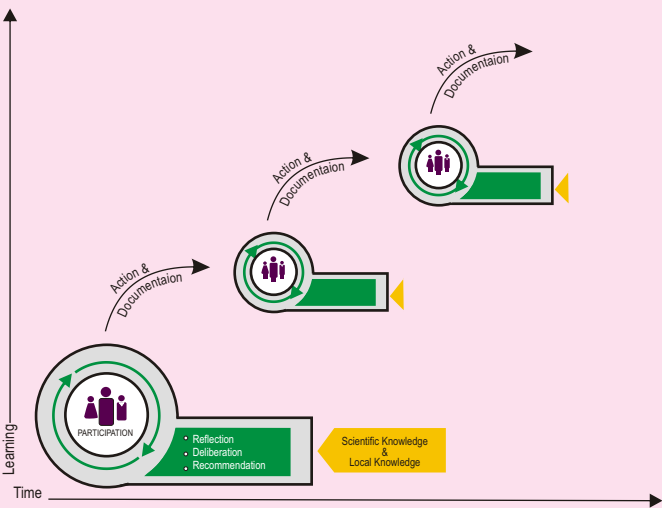
The participatory tool of data collection can be most effective tools to assess the impact of particular amount and duration of the waterlogging through which the future scenario of water logging as the result of present trend of climate change can be estimated which shall be an important component for formulating a climate resilient future plan of an area.

The whole area should be divided into different part on the basis of their physio-cultural attributes and community should be consulted in each micro region to analyse the past scenario of water logging in relation to rainfall. The amount and duration of rainfall be authenticated with the secondary data available from different sources. The data collected through process could be used for projection of future rainfall and its impact in form of waterlogging. The future expected scenario of infrastructural development should also be considered for final assessment of changes in frequencies of exceedence of thresholds of waterlogging in the area.

Figure 5 | Components of Shared Learning Dialogue

Box 1 : Shared Learning Dialogues (SLDs)

Shared Learning Dialogues (SLDs) were a central component in the research approach (Fig 5).Different techniques of shared learning bring together knowledge from different disciplines with that held by individuals and organizations in communities, the government, and other sectors. Shared learning involves structured one-to-one and small group interactions that elicit insights from participants and build their understanding of the views of others and their implications. Many of the techniques are similar to those used in participatory research, but they stand out for their ability to build new knowledge and common understanding. Shared learning processes move research away from outsider-driven, top-down, extractive information gathering toward participatory, bottom-up, and inclusive knowledge generation.



Source : ISET International, 2014

Box 2 : Assessing precipitation threshold in Mahewa

The SLDs were organized on different dates and communities were consulted for past rainfall and waterlogging incidents. Though the historic rainfall data for city is available but due to lack of such data at local level, recall method was used. The ever highest flood level of 1998 and heavy down pour of 17th September of 2009 (126 mm) in Gorakhpur has been kept in mind as an incidence of worst conditions of waterlogging and rainfall. In respect to these incidents community recalled the incidences of extreme rainfall and consequent extent and duration of waterlogging. The information thus obtained was consolidated and presented in following form. Mostly community information was qualitative which then was transformed into quantitative terms by looking into historical rainfall data.

Process of clustering the neighborhoods of Mahewa ward (Gorakhpur) for SLD

The SLD was conducted in the month of December, 2012. The entire Mahewa ward was divided into four parts, on the basis of their location, physical attributes like relief, slope, gradient and drainage, location of the bund, raised roads, nature of risk and socio- economic conditions of resident of the area. This division helped conducting SLD in a meaningful way that considered as much as possible homogeneity on hydrological and socio-economic parameters.

The whole ward was divided into four following parts for community consultation :

- ♦ **East Transport Nagar and New Mahewa Colony cluster-** It is north east part of the Mahewa where middle and high income groups are residing. It has higher altitude and a major drains have been constructed which are able to drain out most of the of water (domestic and storm). Therefore, it is free from the risk of waterlogging. But south part (New Mahewa colony) has been developed in low lying area still suffers the problem of water logging in monsoon period.
- ♦ **Bada and chota Mahewa cluster-** This cluster includes two neighborhoods Bada and Chota Mahewa- of south eastern part of Mahewa. This whole area is low lying. In this area, there were many natural water bodies which were buffer zones for accumulation of storm water but now most of them have been filled up for permanent construction. This part is highly venerable and water risk prone. One regulator/pump station has been established to pump the water in other side of embankment but gentle slope, least gradient, choked drains with silt and garbage, could not allow the water to reach to the pump station. Most of the inhabitants of this area are poor and belongs to backward castes and scheduled castes
- ♦ **Galan, West Transport nagar and North Chakara cluster-** The North western part of Mahewa ward was included in this cluster. It is a saucer shaped area whose central part has less elevation than periphery. Thus it is highly waterlogged. Its major part is under commercial use with transport establishment and shops which use to submerge

specially ground floor into water during rainy season causing heavy loss of material of shops and stores. Two regulator/ pump stations have been established to drain out water to other side of bund. But some time they prove to be inadequate measure to drain out the rain water.

- ♦ **South Chakara-** It is undeveloped flat flood plain with least slope along river Rapti. It is covered with Guava orchard. There is severe lack of roads, drains, electricity and other infrastructure. Due to absence of drainage system and domestic and storm water is drained in the open space of the nearby area. Owing proximity to river Rohini, it is worse affected by flood each and every year.

These physical and cultural features of each cluster affect the water logging condition, depth and period of inundation.

SLD Data Verification

The past climate data especially extreme rainfall dates/ weeks corroborated with the actual observed available data of the city available in government records. And, these were used as threshold extremes in historical past. The qualitative observations through community consultations as regard level and spread of waterlogging was fine tuned and quantified. For this, a GPS survey was conducted in the ward to collect the information of depth and duration of water inundation at different points of the ward as community has indicated the height of waterlogging. A fresh data base was prepared. Finally a hazard map was drawn on the basis of spatial and non spatial information. After developing the various layers of different themes (water inundation, settlement, land use, road and topography). A final map was developed after over lapping the all layer maps for indicating the vulnerability of the ward. Latter, the final map was reviewed by community and other key persons.

Analysis and results

The SLD data thus collected was analysed by ISET. In addition, ISET used its earlier studies for Gorakhpur on future Depth-Area-Duration (DAD) curves from downscaled climate projections for Gorakhpur. From the analysis of historic past data regarding the rainfall, it is deduced that there is high uncertainty in future rainfall. It has been projected that precipitation might *decrease* in the winter season and *increase* in the monsoon season. It is also anticipated that the intensity and frequency characteristics of rainfall events for Gorakhpur are likely to change with a potential increase in precipitation intensity. It is also obvious from the data collected from community consultation that specific magnitudes of rainfall over one, two, and three days (individually and cumulative) caused critical water logging/ flooding problems. For example, 100 mm rainfall cumulative over three days caused severe water logging problems in Maheva ward. Considering results of six GCMs for Gorakhpur, it is projected that Climate change will likely increase the intensity of similar rainfall events by 10-20 percent in the future which will create more water logging incidents (see Sarah Stapleton, 2013” for more details). Though embankments along river Rapti do protect some communities of east Mahewa from initial flooding, but it will trap the rains and can lead to waterlogging lasting 2-3 months in the ward.

Hazard mapping

With increasing knowledge about the scientific tools, various methodologies have been developed and used to assess various dimensions of vulnerabilities and risks induced by climate change. But in most of the cases, little emphasis has been given on the integration of scientific tools like Geographical Information Systems, Global Positioning Systems and local knowledge in preparing for disasters.

In recent decades, the urban environment in most of the low and middle-income countries has undergone rapid change. This includes rapid growth in area with little expansion in infrastructure and services. Consequently, floods, disease epidemics and rising incidence of water and vector-borne diseases are reported (IPCC, 2012). These problems are further exacerbated by unplanned development, lack of inter-departmental coordination and little scope for

people's involvement in developmental planning process and decision-making (see for instance Douglas et al., 2008; Ramachandraiah, 2011). The lack of government capacity and resources and the lack of reliable scientific data mean that the role of local communities in disaster preparedness has become more crucial. The recent devastations by floods in Asian countries (Indonesia, Malaysia, Thailand and India) have raised serious questions to policymakers and planners in regard to the extent to which development plans are meeting local needs including addressing disaster risks.

Thus, it led to the recognition that active participation of local people in decision-making (bottom-up approach) and use of GPS and GIS to develop hazard maps can be an effective and interactive tool to assess local vulnerabilities. It can be useful not only in mitigation aspects but also in planning all stages of hazard management including preparedness,



response and recovery, while actively involving the local community in decision-making processes (Tran et al., 2009).

In Gorakhpur, the method of participatory GIS has been used to comprehend the physical climate risks and social vulnerability through interactive hazard mapping developed through community participation and scientific tools (Singh 2014). The assessment of physical and social vulnerabilities requires comprehensive ground level dataset. In most of the cities of low- and middle- income countries the lack of ground level data is the common bottleneck or challenge to the planners and the policy makers to develop long-term vision for the city development. For Hazard mapping following core points are essential:

- ◆ The involvement of community for physical and social vulnerability mapping exercises is essential for collecting qualitative and quantitative information to assess the community's needs and intricacies of rooted problems.
- ◆ Orientation of the community on the concept of climate change and articulation of their problems with the climate change impact are also very important to get reliable qualitative and quantitative information from the field. In Gorakhpur people are not much acquainted to the concept of climate change and its adverse impacts in a scientific way, but they have good information and experience about the local risks and their causes. During vulnerability assessment initially about 300 local residents were oriented and information about the depth and duration of water logging, causes of water logging/ flood, losses of assets due to flood were collected.
- ◆ Involvement of local facilitators in vulnerability assessment also plays catalytic role in rapport building among the community. In Gorakhpur intervention, the survey team under the leadership of local facilitator met with local residents and conducted a settlement and landuse survey to delineate the boundary of the ward. During the entire survey period, the facilitator and team members explained to the community the objectives of the survey, the

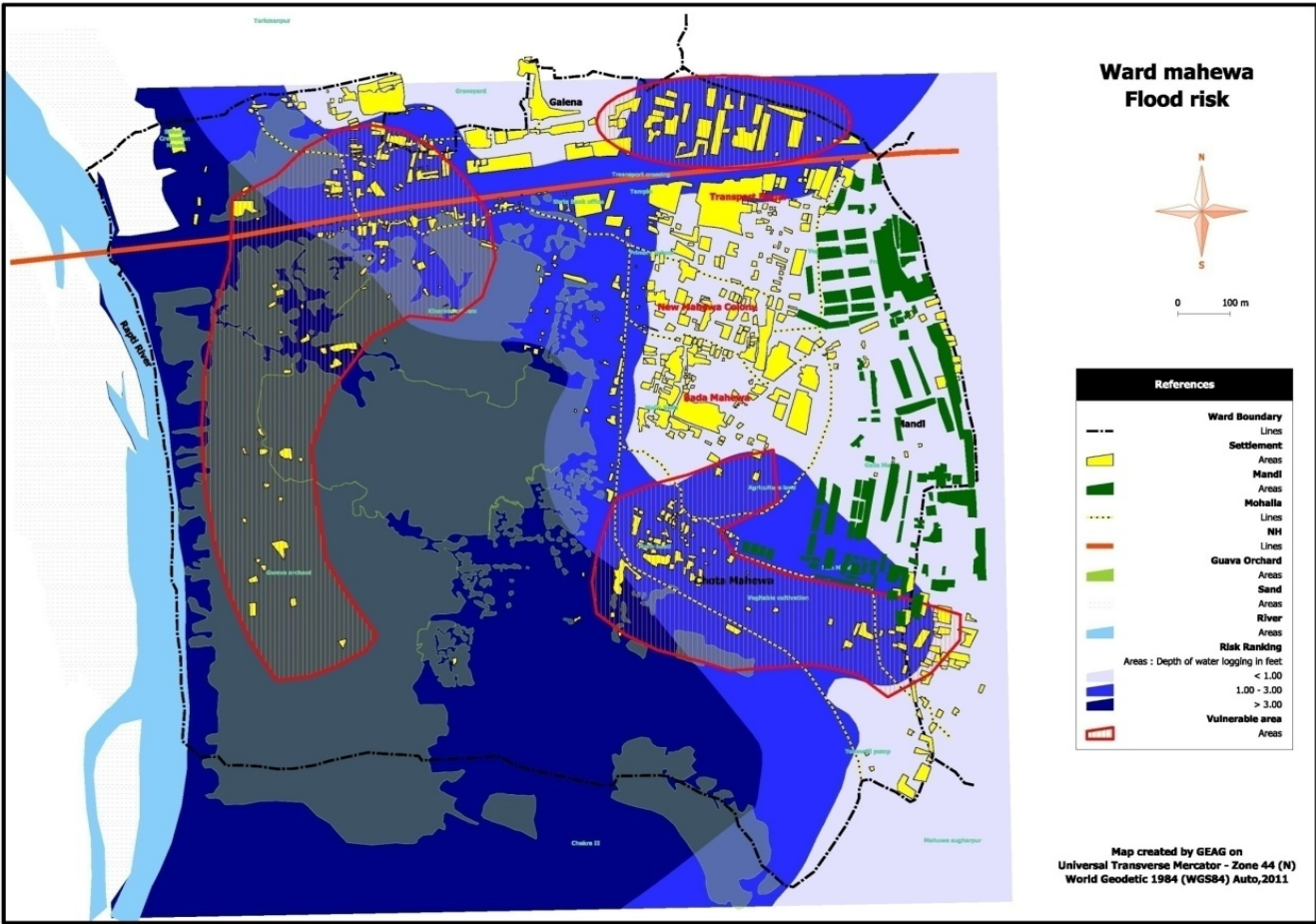
information they required, the rationality of the maps and how the information would eventually look like on the map.

- ◆ In the hazard mapping process, the use of attractive tools like Google images, GPS, toposheets play very important role in attracting the people in the mapping process. In Gorakhpur intervention, Google satellite image was the centre of attraction to the local people. They were very keen to see or identify their residences and after familiarization with the image they were responding to the situation of their neighbourhood very explicitly.
- ◆ In order to carry out a flood hazard assessment, comprehensive flood events, rainfall and damage data are required. But in low and middle income countries, such data are poorly maintained. To address this bottleneck, the identification of historic hazard events with recall method seems very effective. In the present study, due to dearth of historic flood records and rainfall data at micro level memory recall of past floods and waterlogging incidences of the community was taken into account. The city of Gorakhpur had experienced flood disaster in 1998 and a heavy downpour of 126 mm in 24 hours on 17th September 2009. These two incidences left a deep imprint in the memories of Gorakhpur's citizens and were the highest ever recorded flood/ waterlogging events in the Mahewa ward and the entire city. Resultantly these two events were considered and people have recalled the magnitude and level of exposure about these events (see earlier section on “critical thresholds”).

After preparing the ground for the survey, comprehensive waypoints through GPS and attribute information about the waypoints like depth and duration of water inundation and absolute height at that point, number of households in the locality, socio economic classes in the locality, reasons of flooding/ water logging and nature of losses are taken.

Next to the data collection is the analysis process. In this process attributed data collected from the field is tabulated in computer. This process brings data into the electronic environment and is eventually linked

Figure 6 | Flood Risk of Mahewa ward



with waypoints and hence, a comprehensive database for hazard and vulnerability assessment, is created.

Finally, the spatial and non-spatial data are placed in GIS platform and different thematic maps and hazard map (water inundation, settlement, land use, road and topography) are developed. Later on these thematic maps are shared with community and feedbacks are recorded and incorporated into the final hazard map. The result of such mapping exercise for Gorakhpur including the Mahewa ward is presented as map in Fig 6.

Future Development Scenario of Mahewa Ward

As evident, Mahewa is one of most backward ward of Gorakhpur City. It has physical, social, economic, political and institutional vulnerabilities. The western part of the ward along river Rapti, is flood prone while eastern part is low lying and inflicted

with water logging. Approximate one-third of the land is water logged by either floods from rivers or rainwater, and a majority of the population belongs to the low/medium income group. About 16% of population is living without the mere amenities in the slums. Accessibility to municipal services in the ward is limited and existing infrastructure is of very poor quality. Newly developed area transport Nagar and New Mahewa Colony are dominated by middle income group people while lower income group people are confined in the older parts of the ward. There are two slum clusters i.e Chota Mahewa and Bada Mehewa, as recognized by municipal corporation.

The climate change impact manifested through waterlogging has a devastating effect on the lives, livelihoods as well as it has negative and adverse affect on health, mobility, sanitation, clean drinking water and on employment of the people in the ward. Hence high income group HH stay away from

settling in the ward. But in some part of Chakra which is close to Transport Nagar is developing very fast though any permanent construction is prohibited due to flood plain. But people are very hopeful on rapid and large scale development in near future. A community consultation was organized to get an understanding of local people for future physical, social and economic development of ward.

Community consultations: A series of consultations with community and leaders at neighborhood level were conducted to develop vision of future development of Mahewa ward for 2030. The consultations facilitated a qualitative understanding of various aspects of development. The community consultations were conducted in all six mohallas. Followings provides snapshot of vision of Mahewa ward in 2030:

Vision for future Physical structural development in the ward

1. An embankment will come up along river Rapti starting from south of NH28 in Chakra to Kathaur and onward. The rationale for such infra-structural development included:
 - ☐ To protect the Malauli embankment which became old and could be damaged during the frequent floods of river Rapti.
 - ☐ To allow Chakra I, II, Kathaur and other areas adjacent to river for development and to accommodate the growing population of the city.
 - ☐ To mitigate the flood losses.
2. Between the new probable embankment and old embankment a fast pace of development shall take place like better basic amenities, new residential colonies, Private high-quality schools, private hospitals/ nursing homes, some public health service providers.
3. In Chhota Mahewa from the house of Beni Madhav to the embankment, existing road will be widened and the drains will be constructed to make direct approach to Mandi to embankment.
4. The transport Nagar will be transferred in GIDA and a new market will replace the present transport Nagar in which big Market, shops,

Malls and a bus station shall come up in future.

5. Near Overhead tank in TP Nagar a new Market centre for small shop keepers with small shops "Apana Bazar" is proposed to develop by Municipal corporation but land is under dispute. Hence it is still not materialized.

6. Near Mandi (wholesale market) a new whole sale market will be developed by Mandi Samitee who want to purchase the land from Municipal Corporation but this land is also under dispute between MCG and a private land holder.

7. A big Ceremonial hall / community will come up in east Transport Nagar by a private land holder which will provide some other services except marriage and other ritual services like meeting, conference, lodging facility, shopping and exhibitions.

8. A shopping complex or a big mall will be developed on the open land of Municipal Corporation (MC) which is at present being used as a workshop for repair of the vehicles of MC

9. The open land near graveyard of Galan will be used for development of Market centre for vendors who are selling fish, vegetables, and guava on nearby embankment and NH.

10. South Chakara will be developed as a residential colony with all infrastructure and amenities but due to improper drainage like in other part of Mahewa it will also suffer from the problem of water logging during rainy season.

11. After construction of embankment, Chakra area shall be free from flood and water logging. Hence the cost of land of this area might soar due to proximity to NH.

12. The open area shall be filled by population through the process of infilling in open/ agricultural spaces. Hence the area shall be dense populated

13. All the guava orchard will vanish along with other open spaces of the ward which will create the ecological imbalance in the area. Hence the land under the agriculture and horticulture practices will be converted into residential / commercial and other uses.

- 14. Most of landholders will sell out their land and will start some other profession or will be engaged in other occupations other than agriculture, horticulture and animal husbandry. In place of original landholders the whole area will be covered by migrants from outside of city or other part of city.
- 15. The illegal production of country liquor will minimize because the number of makers and the open spaces for performing the production activities both will reduce but this practice will get momentum in outskirts/ peri-urban areas which will create a problem for this area.
- 16. The social evils like theft, drinking, snatching will reduce.
- 17. Some of the family will lose all their assets/ livelihoods and migrate out in search of employment in other part of city/ country.

Vision of Future Economic Development Scenario

- 1. The economic condition of people of area will improve.
- 2. Mall/ big shops will come it existence in TP Nagar and adjacent areas
- 3. Employment opportunity will increase in nearby commercial areas.
- 4. Land of the area shall be sold out by old owner and new migrants will purchase and settle after construction of houses.
- 5. Land owner will construct the house for rent which will provide more benefit.
- 6. Tenant ship will intensify in area.

Vision for Future Political Development Scenario

- 1. The number of Local leaders, middlemen will increase.
- 2. There shall be sufficient scope for Land brokers/ negotiator / Stock brokers/ agents will increase in future.
- 3. The empowerment of women will be perceptible. Mayor of the city or MP of the constituency may be from the area.

Vision for Future Social development Scenario

- 1. Social evil of making country liquor will peter out because unavailability of open, abandoned and isolated areas.
- 2. Illiteracy will reduce drastically because literate migrants shall inhabit the area.
- 3. Schools, hospital, nursing homes, restaurants and some other means of entertainment will rise.
- 4. The gender disparities emerged on the education status of the area is pertinent enough, will minimise.
- 5. A large number of female population in Chota Mahewa, Chakra I and Bada Mahewa are engaged in liquor making and marketing. Besides it, the movement of large numbers of transporters and truckers in the Transport Nagar has also generated illegal activities drug peddling and prostitution activities, which will reduce drastically.
- 6. The quality of residences will improve. Most of thatched and kuchcha houses will be replaced by good pukka houses.

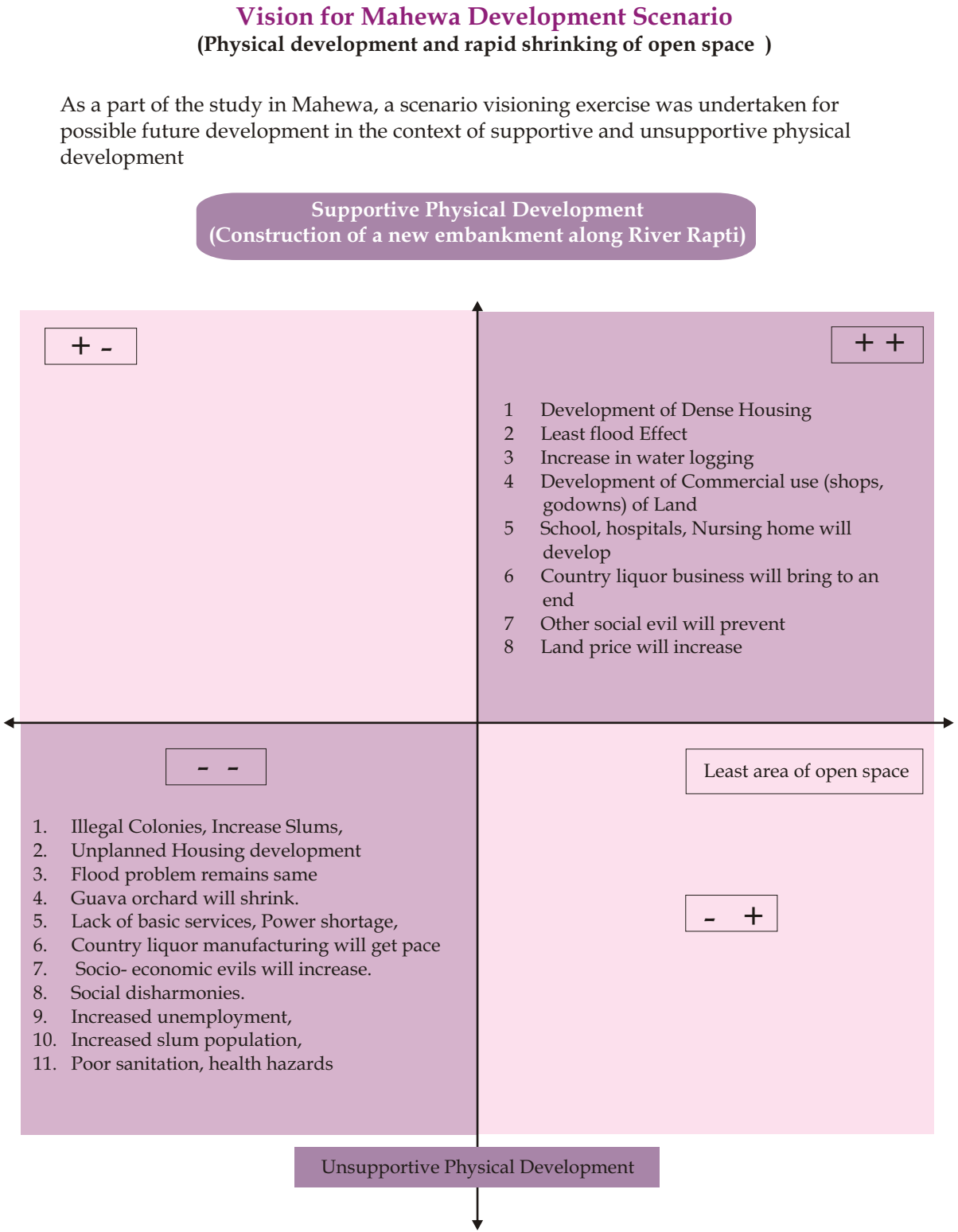
The vision especially on physical development was corroborated with government records and discussed by different government departments responsible for these activities of development. The views obtained through consultations with Mayor, Municipal Commissioner, Elected Corporators of Ward, Chief Engineer of MC, PWD and Jal Nigam and Secretary of GDA were integrated in developing the vision of Mahewa ward.

Visioning scenario in the contexts of supportive and unsupportive Physical Development conditions

Likewise another consultation with community and leaders was conducted to know the vision of ward if there is a supportive physical development especially construction of a new embankment along river Rapti in south of NH28 and another component i.e. effective management of open space as flood/ waterlogging buffers (fig 7).

It is apparent from result of consultations that the area will leapfrog development on all aspects but the process of development need to be monitored by GDA and GMC. Otherwise the haphazard growth may rampart various unpredictable, impenetrable and unsolvable problems.

Figure 7 | Vision for Mahewa Development Scenario



Building Resilience of Ward

The baseline survey, hazard mapping, climate threshold analysis, and visioning scenario of Mahewa ward combined, indicate that there would be increase in nature and extent of waterlogging. This is based on the fact that Mahewa would witness increased density of settlement (as evident from “future development scenario” section) and increased frequencies of historical precipitation extremes (as described in the climate threshold section). We present below core vulnerabilities and potential resilience building interventions for Mahewa ward:

- ◆ The six main issues or themes that were being impacted by climate change and needed urgent attention to build resilience were: water & sanitation, community health, climate resilient agriculture, decentralised drainage system, risk resilient building (primary school, house, and community toilet), and livelihood improvement specifically for women of slums;
- ◆ There was a need to mobilise community and unite them on these common interests;
- ◆ Construction of flood and waterlogging resilient architectural designed low cost housing in water logged area;
- ◆ Introduction of climate resilient agriculture planning, techniques (time and space management, multitier cropping, crop cycle management, adoption of water resistant crops, practicing integrated farming, waste recycling and training of farmers) for water logging affected farm areas using climate information;
- ◆ Plan for decentralized drainage system for storm water management;

- ◆ Design of low cost raised community toilet and establish link with banks for the household interested in construction of such toilets;
- ◆ Decentralized solid waste management at neighbourhood level with the support of community;
- ◆ Awareness on current quality of drinking water and safe drinking water standards, method of purification, sanitation and disease reduction at household level;
- ◆ Liaison with Municipal Corporation to enhance connectivity of municipal water supply though local demand;
- ◆ Need for monitoring drinking water quality through potable kits. Also raising of platforms for India Mark-II handpumps to allow access to safe drinking water at times of flood/waterlogging;
- ◆ Ward level committee, as per 74th Constitutional Amendments Act to be constituted having representation from other institutions and active individuals of the ward. This ward level committee would act as decision making institution at ward level;
- ◆ Common interest group committees on water & sanitation, community health, climate resilient agriculture, decentralised drainage system, risk resilient building (primary school, house, and community toilet), and livelihood improvement specifically for women of slums, to be constituted to monitor the situation of the services.

Community institutions to build resilience in Mahewa

The Vulnerability Assessment of the city and the City Resilience Strategy strongly advocated for a bottom-up approach to planning and service delivery. Top-down planning processes without citizens' participation largely ignore the local situation and the capacities available/needed at the city level. On the other hand, experiences have shown that people's participation has often remained central to the development processes. To develop climate resilient society too, it was envisaged that a community led process based on people's priorities, needs, knowledge and capacities will empower people to plan for and cope with the impacts of climate change in a much better way. Secondly, ward level micro planning by community institutions and implementation of activities prioritized by local communities ensures the sustainability of resilience building processes through empowerment of people.

In the Mahewa ward, the baseline survey inferred that collaborative actions at the local level were required to address the multiple challenges that the ward was facing and accordingly build resilience. Community institutions were formed at three levels at the neighborhood level, thematic level and at the ward level (fig 8). These institutions were formed with the agreement and participation of the community with GEAG playing the role of a facilitator. People who were active, had local influence, were articulate and had the interest in working for improving the condition of Mahewa ward were included in these committees. Membership was often voluntary where people came forward and depending upon their subject of interest (e.g. drainage management, solid waste management, etc.).

Neighborhood committee

Mahewa ward has six neighborhoods (locally called *mohallas*) as demarcated by the Gorakhpur Municipal Corporation. Open meetings were held with the community members and a committee of 10-12 members was formed in each of these neighborhoods. Since the committee members are the local community members, they also function as catalysts for mobilising other community members, sensitising them on the issues and bringing about

awareness on the problems and how it can be dealt with. Community consultations and baseline survey had identified six issues that were contributing to the vulnerability of Mahewa. In order to be effective, the neighbourhood committee comprising of 12 members distributed these six areas/sectors amongst them (two members responsible for each sector) and became responsible for their work around these issues. The distribution of issues was done in consultation with all the committee members and the members chose issues based on their interest and expertise.

Thematic committee

While there were two-member team in each neighbourhood committee working on a specific issue, it was important to collate the issues and problems of all the six neighbourhoods of Mahewa ward. Hence, two members from each of six neighbourhood committees were brought together and six thematic committees were constituted (comprising 12 members- two from each ward) on the following themes:

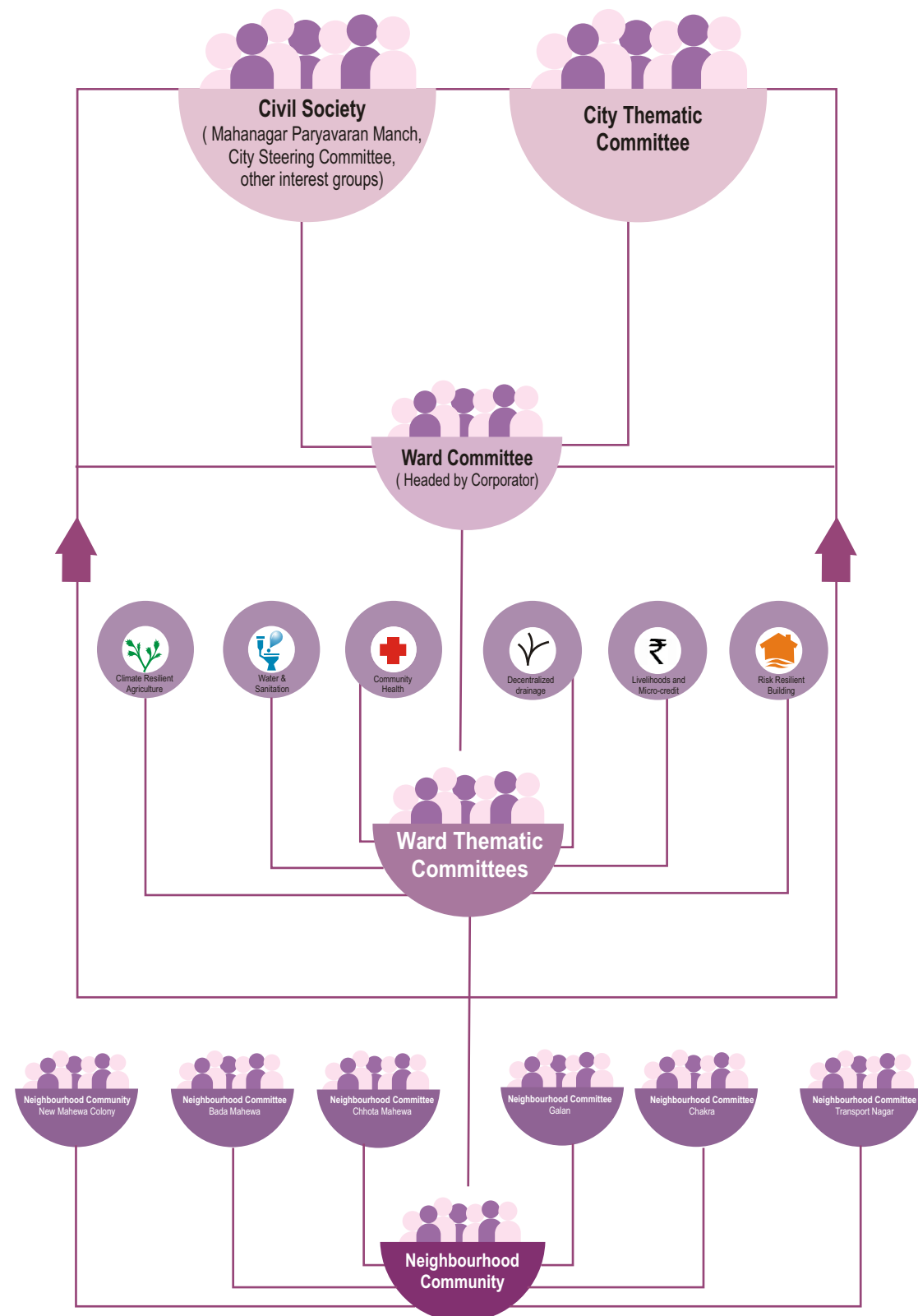
- ◆ Water and sanitation
- ◆ Community health
- ◆ Climate resilient agriculture
- ◆ Decentralised drainage system
- ◆ Livelihood opportunities, esp. slum women
- ◆ Risk resilient building

Members of the thematic committees come together on a monthly basis to discuss the problems of the whole ward collectively on their respective thematic areas. The thematic level committees have framed rules and regulations in consultation with the community members for effective functioning. For example, the water and sanitation thematic committee has fixed an amount of Rs.10/- to be paid by the community members as a fee for door-to-door collection of solid waste.

Ward committee

This is the third level committee in the institutional structure at Mahewa comprising two members from each of thematic committees. The ward level committee is headed by the Ward Corporator and serves as link between the households in the ward and city level institutions/departments. The members of this committee meet once in a month. The main function of the ward level committee is to implement the plans and actions decided by the

Figure 8 | Hierarchy of community and thematic institutions in Mahewa



thematic level committees. Based on the problems and needs, plans for generating resources are made by the ward committee. Regular monitoring is another important task of the ward committee to ensure that the actions are being implemented in a proper manner. The ward committee shares the updates on the progress of the work with the thematic committees on a regular basis (Mani,N and Wajih, S, 2013).

Resilience building interventions by Sectors/ Themes

Decentralized Drainage System for Storm Water Management

In order to reduce water logging problem in the Mahewa ward, a survey was conducted along with the members of the drainage thematic committee to identify specific locations afflicted by water logging. Five sites in the ward were selected in conjunction with the local people where retrofitting of existing drains would be undertaken. The drainage thematic committee organised several consultations with the local residents of Mahewa and motivated them for active participation. The people contributed in form

of cash, kind (material) or labour for construction/ repair of the drains at selected points. Thus with support from community, 751 metres long drainage was retrofitted.

Vulnerability

- ♦ Lack of proper storm water drainage system in the ward
- ♦ No maintenance of drains that existed
- ♦ Absence of solid waste management added to the issue
- ♦ Waste water from households adding to the problem

This activity has had a major impact on the residents of Mahewa. The entire area that used to get water logged for months together annually was free from water logging even during heavy rains (517 mm) in September 2012. About 4000 persons have benefitted directly or indirectly by this activity. After serious advocacy by the people from the ward, the Municipal Corporation also constructed the roads and drains in other parts of the ward.



Water and Sanitation

In order to deal with the water and sanitation problems in the ward which was very much felt by the residents as well, a thematic committee on this issue was constituted as mentioned earlier. The water and sanitation committee had intense consultations with the households and it was found that the three areas of access to clean drinking water, effective solid waste management and access to toilets to stop open defecation were of major concern that directly or indirectly impact the water and sanitation situation in the ward. Hence the committee planned for the following interventions:

Solid Waste Management (SWM) : Households in the ward, even though suffering from the adverse impacts mis-management of solid waste, especially during the rainy season, were reluctant to take initiatives to overcome this problem. This needed intense awareness programmes on importance of clean drinking water, sanitation and solid waste management in the ward to change the mindset and attitudes of people. The water and sanitation committee members undertook this task with support from the GEAG team. Awareness campaigns included inter-alia distribution pamphlets and posters, small group meetings and discussions, street plays and wall paintings.

Vulnerability

- ◆ Limited number of households having access to piped water supply
- ◆ Widespread use of shallow handpumps
- ◆ Households unaware of water quality issues
- ◆ Lack of individual and community toilets - unhygienic practice of open defecationes
- ◆ No door-to-door collection of solid waste households dumping watse on streets or open plots
- ◆ People's attitude on keeping the ward clean (belief that only Municipal Corporation is responsible)
- ◆ Erratic and increased rainfall in lesser number of days will lead also add to the above problems. mosquitoes, flies

Post to the awareness campaigns, the committee started the intervention for an effective solid waste management programme in the ward with support from GEAG. A solid waste management committee was formed comprising 12 members. For solid waste collection, two workers have been appointed for door-to-door collection of the solid waste in the morning. They separate the biodegradable waste from total collected waste for composting. The non-



degradable waste is given to rag pickers for recycling and other waste is disposed off at safe place. The committee in consultation with the community members has fixed a fee of Rs.10/- that every household pays on a monthly basis.

The community members also provided their land free-of-cost for establishing the solid waste management units where three units were established. Area specific technology was developed and adopted for the solid waste management. In Mahewa, drums are being used to convert the biodegradable waste in compost. The drum technology was adopted as it could be shifted from one place to another in case the area got waterlogged. The collected and segregated biodegradable kitchen waste is kept in a porous bag after mixing a bio-culture in it and finally the bags are put in drums. After 24 hours the liquid starts to come out from the hole made in lower side of drum and is collected in the containers to be used as liquid manure. After 14 days of last kept bag in drum the total waste is converted to a compost form that is used as manure after drying.

The solid waste thematic committee looks after this complete process such as the appointment of workers, monitoring of waste collection, separation and processing of composting as well as monitor the regular sweeping of roads and cleaning of drainage by municipal corporation persons. The committee also organizes regular awareness campaigns for sanitation, prohibition of plastic use, generation of resources and fund for the sustainability of SWM. The initiative has improved the sanitation in the ward and most of the drains are now free of garbage. Local farmers are using the liquid and solid manures prepared through solid waste management and they have given very positive response on its quality and effectiveness. It has raised the yield capacity of the soil and also act as bio-pesticide to protect from insects and pests.



Drinking water quality surveillance and awareness

During community consultations, it was learnt that they suffered from water borne diseases especially during monsoon season and this was linked to the quality of drinking water, which the people in this ward were not aware of. In order to make people aware of the poor quality of drinking water in their ward, a water testing laboratory was established by GEAG in the Mahewa liaison centre. Water samples from various sources like shallow & deep bore hand pumps, piped water and bore well were collected from different parts of the ward and their physical and chemical attributes were tested during pre and post monsoon season in the laboratory. The results from these tests were shared with the households in community meetings.

During these meetings, the thematic committee along with GEAG team also suggested adoption of various measures for ensuring safe drinking water. Consequently, more than 300 households adopted preventive measures like filter/RO system in their homes. During later interactions with the households, it was reported that access to safe drinking water has resulted in reduced incidences of water borne diseases like diarrhea, vomiting, fever, etc. Here too, the thematic committee members

undertake regular awareness campaigns, especially during the monsoon season to educate people to access safe water.

In addition to the above, the committee members along with people from the ward have managed to compel the water works (JalKal) department of Gorakhpur Municipal Corporation to enhance access of safe drinking water facility in the Mahewa ward. As a result, the concerned department extended 667 meters of water supply pipeline in the unserved area of the ward and 35 households were motivated to have new connections with valid registration. The community members also identified five deep bore hand pumps that needed to be raised so as to have access to clean drinking water even during monsoon. Currently, approximately 900 households who used to suffer because of water problems have access to clean and safe drinking water because of this initiative. This has also shown clear impacts on the health of the community people, especially children.

Community Health

The Community Health Committee was constituted to work on the health related issues in the ward. Initially, regular awareness campaigns on general hygiene like washing hands, etc. were undertaken through wall paintings and group meetings. Prevention from many communicable and water/vector borne diseases through immunization have also been undertaken in the ward. Trained doctors from the city were invited to community meetings to inform people on the causes and preventive measures of water and vector borne diseases. Door to door information campaigns were also conducted to reach the children, pregnant and lactating women for routine vaccinations. About 210 women and adolescent girls were trained on aspects

Vulnerability

- ◆ Poor sanitation, unmanaged solid waste dumped in low lying areas
- ◆ Low awareness on health and hygiene
- ◆ Open defecation
- ◆ Low lying ward- >stagnated water - > breeding of mosquitoes, flies
- ◆ Use of contaminated underground water for drinking

of proper health & hygiene who in turn are disseminating the messages in the entire community. A Clean Water Campaign was organized in the ward where several activities were undertaken for raising awareness of people on the importance clean drinking water and safe sanitation. Chlorine tablets were distributed to people for cleaning their water and they were also informed about the importance of boiling/ filtering the water before consumption. Due to increased awareness levels, about 337 households have also constructed individual latrines in their homes.

As a result of these and other activities as part of improving the water and sanitation and drainage conditions in the ward, there have been no incidents of malaria, cholera, jaundice, dengue, Japanese Encephalitis, etc. in the recent years after the project interventions.

Climate Resilient Agriculture

Agriculture is the major source of livelihood in Gorakhpur district. The land-use pattern in peri-urban areas of Gorakhpur city as identified in the Gorakhpur Master Plan 2021 consists of about 54% agricultural land. A majority of the farmers in these areas are small and marginal farmers. Even within the municipal boundary of Gorakhpur city, about 4.5% of the area is either open land or is under agriculture. The people engaged in urban agriculture are also categorized as small or marginal. This is the group of farmers that is hit severely by a multitude of problems discussed below which makes them socially and economically vulnerable.

Interventions towards Climate Resilient Agriculture

Climate resilient agriculture, based on the principles of integration of livestock-household-agriculture is being promoted which enhances the diversity-complexity and recycling processes in the farming systems. Use of low cost external inputs, appropriate crop varieties, space and time management, seed banking, land shaping and portable nursery systems are some of the practices being promoted among these small and marginal farmers. One such ward (Mahewa) where urban agriculture is practiced, on the western periphery of Gorakpur, was taken up as a pilot under the ACCCRN project where several climate resilient agricultural practices were demonstrated.

Integrated and diversified farming systems

The integration and diversification of farming systems have helped the farmers in achieving robustness which makes it flood resilient because the chances of losses are minimized. Increasing diversity in agriculture means increasing the number of elements performing one function. Beyond the crops, the number of sub-systems in the farm like pond for aquaculture, orchards/kitchen garden, livestock, poultry etc. have also added to the diversity of farm system. Complexity is also ensured as each of these elements performs multiple functions. Recycling processes adopted by the farmers among various farm sub systems fulfils several needs of the farm and hence reduces the need for external inputs.

Time and space management

Altering the timings of cropping cycle through pre-ponement, or postponement of crops was a successful strategy adopted by the farmers. Sowing varieties which can sustain water inundation was also helpful in saving the crops from flood effects. The traditional crop varieties of the area and other water resistant varieties developed by various research institutions were identified through participatory exercises and adopted by the farmers. Multi-tier cropping was another effective practice



adopted by the farmers. The layers of crops were able to deal with various water levels during flooding in this area.

Loft Farming

In waterlogged areas, loft farming is an innovative way of doing farming. Farmers fill old tyres or sacks with soil and manure and seeds of climber vegetable crops. Lofts or stilts are made using wooden sticks on which the climber crops are supported for growing. The produce is saved from getting spoilt in the waterlogged fields.

Raised low tunnel poly-house

Raising crop nurseries during summers for transplanting in winters used to be extremely difficult due to extensive waterlogging. Farmers



were trained to prepare and use raised-bed poly-house for nursery development. Depending upon the inundation height, seed beds are prepared above this height. A sloping drain all around the nursery is made so that the rain water drains out easily and does not enter the seed-beds. This raised seed-bed is covered by low height tunnel poly-house supported with bamboo sticks to protect from excess rainfall. Vegetable seeds of tomato, cauliflower, brinjal, chilly, etc. are prepared in these seed-beds and are ready for early transplantation by the end of monsoon.

Climber farming

Vegetable farmers, in the area grow creeper vegetables like sponge gourd, bottle gourd, etc. but due to excess water and humidity in the soil, these crops do not survive. Farmers have adopted an innovative practice of growing dhaincha (Sesbania aculeata) for green manure that is also used as a support for the creeper vegetables.



Farming in thermocol boxes and jute bags

In waterlogged fields, farmers are using thermocol boxes and jute bags to raise climber crops such as bottle gourd, ridge gourd, etc. Soil and manure is filled in the boxes or bags and the vegetable seeds are sown in it. The climbers are supported through wooden sticks for growing.

Flood resilient crop varieties

Flood resilient crop varieties have been promoted among farmers. Swarna Sub-1 variety of paddy and PV-7 variety of lady's finger have shown successful results. These crop varieties grow even in flood and waterlogged situations.

Climate information advisory

Weather stations have been installed and mobile SMS-based climate information advisories are set up which provides weather information to the farmers in advance. Information on temperature, rainfall, wind and humidity are sent to farmers through SMS which acts like early warning systems and helps the famers in scheduling their irrigation, harvesting or other farming activities.

Promoting Low External Input Sustainable Agriculture (LEISA)

The adoption of LEISA practices such as preparation of organic manure and pesticides locally has significantly reduced the use of high-cost external inputs like chemical pesticides and fertilizers, thereby increasing the net gain to small and marginal farming communities.

Risk resilient building

The intervention in risk resilient building was to demonstrate through an example, the concepts of a

Vulnerability

- ◆ Acute annual waterlogging renders school, community toilets, houses, etc. vulnerable
- ◆ The schools and community toilets become inaccessible during water-logging periods sometimes extending to 3 months
- ◆ Increasing construction costs leads to people opting for risk prone and/or sub-standard houses that do not have provisions for natural air or light to enter/circulate in the house

climate resilient building. One low cost and risk resilient house was constructed for a poor family who did not have a house but owned a small piece of land in the ward. This process has generated a lot of awareness amongst people of the ward. It is envisaged that the low-cost risk resilient house will:

- ◆ **Reduce impacts of climate and other disasters by encouraging practices of disaster resilient technologies :** It was found that the people and even the masons lacked knowledge of climate resilient construction methods and practices. As part of this project, local masons were trained on easy techniques and construction practices that will ensure adaptation/replication of safe housing for urban poor.
- ◆ **Ensure financial benefits by the use of low-cost construction techniques:** Low cost demonstration house constructed with rat-trap bond, arched doorway, frame-less windows, etc. reduces the cost of construction considerably as compared to conventional techniques.
- ◆ **Improve living conditions by minimize climatic impacts:** Techniques like rat-trap bond for wall construction provides people with comfort living in extreme weather reducing their dependence on other energy sources. This also reduces the cost of wall by 26% that allows savings on material, simultaneously minimizing the environmental impact. The house also has enough ventilation by way of windows and openings for air-flow and natural light.
- ◆ **Benefit the society/community as a whole by toilet facilities:** Many of the low-income households construct houses sans toilet as that is

Vulnerability

- ◆ Low income households
- ◆ Low awareness and capacity for income generation opportunities for women.

an additional cost. This leads to unhygienic living conditions and open defecation. The demonstration house was built with attached toilet and bathroom ensuring better health and hygiene for the family.

Livelihood for women

A majority of the people in Mahewa belongs to poor and low-income group households with hardly any income opportunities more so for women. Hence, to improve the income of a household by augmenting it through women's income, work on this theme was

initiated. The thematic committee, along with GEAG conducted a training need assessment workshop with women from two slum clusters (Bada mahewa and chota mahewa). Based on their skills and interest, 40 households are now linked with semi public micro-finance institutions for their entrepreneurship. Some women have shown interest in animal husbandry such as goat rearing and piggery. They have been linked with Gorakhpur Grameen Bank, which is in the process of sanctioning loans to them for this purpose. Adolescent girls who were interested and willing to learn sewing and stitching have been admitted in a charity school providing free training. An orientation meeting was organized where the Managers of Grameen Banks shared about the schemes and the procedures for availing financial support from the respective banks. As an outcome of this meeting, common interest groups have been formed to take the financial support from the bank.



Monitoring Ward Level Resilience Building

Need for Monitoring

Monitoring is important management tools for tracking the progress of ongoing intervention performance which might be a project such as the Maheva Ward Level Resilience Planning project. It usually encompasses tracking inputs, outputs and some of the outcomes, through record-keeping, regular reporting and surveillance systems as well as observation and survey studies. Process of monitoring fosters the programs, activities and intervention to be more effective, efficient, and yield focused results for the implementer and the communities too. It also helps organizations to track the achievements by regularly collecting information to assist timely decision making, ensure accountability, and provide the basis for learning. Monitoring is integral part of resilience building process given the emerging nature of climate science projections and rapid urban development, planned and unplanned.

Indicator

Indicator may be a qualitative or quantitative factor, indices or variables, the information of which are to be collected to know the baseline condition at the time of project implementation and assess trend of its progress during the implementation. The indicator should be focused, clear and specific. The change measured by the indicator should represent progress that the programme aims to make. It should be measurable at certain time intervals and relevant and appropriate in terms of goals and activities.

Indicators of Climate Adaptation and Resilience

Several different kinds of indicators have been developed to address different issues related to climate adaptation /resilience. The differences between them provide insights into key issues of indicator development, including their scope, content, purpose and processes. A further problem is that neither adaptation nor resilience can be measured directly. They are the result of complex systemic changes. The systems that are changing cannot be accurately represented in a few simple measures. So indicators are always proxies. They may measure observable change in specific parameters, but they are representations of more complex processes. There are no simple or common indicators that can be applied consistently across all sectors and locations. The indicators need to be relevant to local users, and the methods for collecting, interpreting and sharing them need to be simple enough.

Developing Indicators of urban climate resilience

ISET was involved in the different stages of this indicator development process, from conceptual development and guidance to local indicator definition and data collection. The focus of this effort was on the active engagement of city level partners of ACCCRN (our Mahewa ward experiment being part of the programme) in leading for indicator development. In most cases, the cities already faced climate hazards that could be expected to worsen

with an increase in the frequency and intensity of extreme events. They had undertaken a formal vulnerability assessment to determine areas of high vulnerability, and a resilience strategy to identify priorities for local action to build resilience. Normally, the logic of indicator development is that indicators can only be defined once goals and objectives (targets) are clearly specified. When communities do not have a clear goal or target for the value of different measurable parameters, but can easily reach consensus on a preferred direction of change, indicators provide a baseline for assessing qualitative and quantitative improvement.

To simplify the process and guide local partners of ACCCRN in the development of indicators, ISET worked with IISD to develop a “guidance tool” in the form of a spreadsheet providing direction for indicator development. ISET also developed a scoring tool a separate spreadsheet that would help users to convert indicator data to normative scores and then summarize these in a visual dashboard display. Because the indicators need to be integrated into city level resilience planning and intervention efforts over the long term, it is important that they be developed by local people and stakeholders. This was not only more likely to result in identification of meaningful indicators for the local context, but also greater understanding and commitment to their application. ISET suggested that the cities develop the sets of indicators for all top priority issues, as revealed in vulnerability assessments. The idea was that indicators would provide a baseline picture about the vulnerability that could be used to characterize resilience at the local level and could be tracked relatively simply by local authorities to monitor changes over time.

The selected indicators should be simple, specific, measurable, observable, verifiable, actionable, relevant to resilience characteristics, and dynamic (change over relatively short time periods) and in limited numbers. They could be quantitative or qualitative. They are to be relevant to local decision-making. They were to rely primarily on available data, in order to avoid high data collection costs and assure that they could be sustainable.

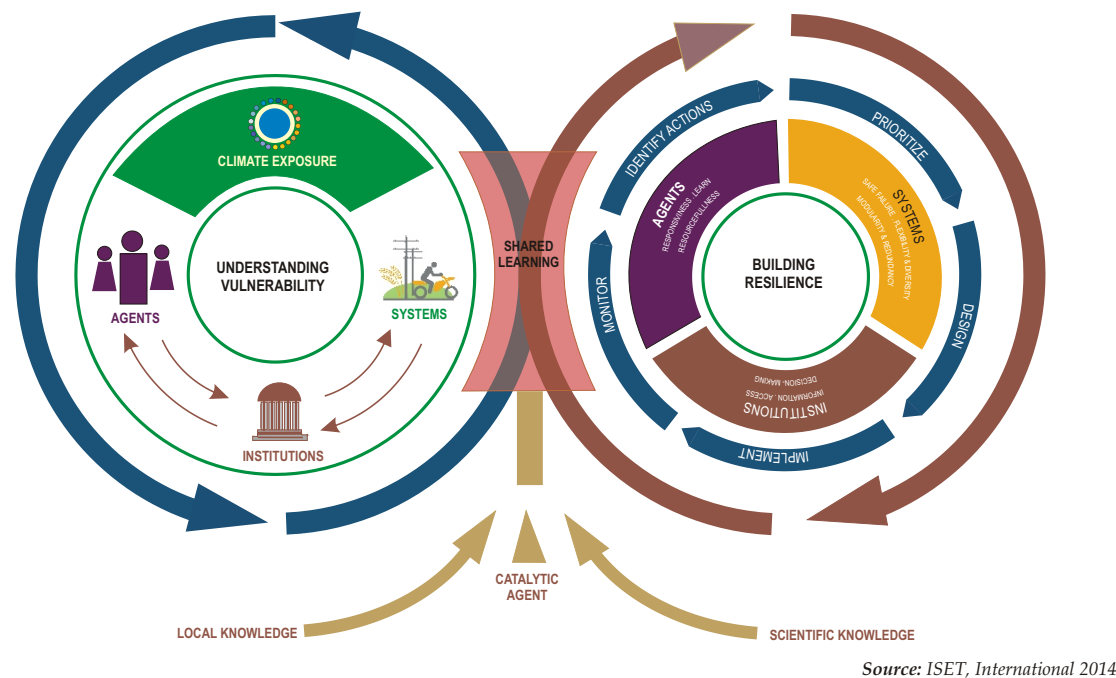
Indicator Development : Case of Gorakhpur Intervention

In Gorakhpur, indicator development was a process for the establishment of a community level resilience planning process of Mahewa wardwhere the micro resilience planning process is being promoted. In Gorakhpur, the teams started with community issues, and followed the interests of the community leadership to define indicators. One of the main objectives of the Gorakhpur resilience strategy was to raise the profile of drainage and poor public services in this poor backward ward, and to use the community's initiative to demonstrate to local government that modest improvements could achieve substantial results. To that end, this ward-level resilience project in Gorakhpur worked closely with community leadership adopting bottom-up approach to improve local drainage, water supply, solid waste collection, public health awareness, livelihood enhancement of vulnerable group of women, introduction of a climate resilient composting and community agriculture program and construction of climate resilient residential house.

ISET assisted to develop indicators within climate resilient framework³ (for details see Tyler and Moench 2013) for all six vulnerable themes chosen in Gorakhpur (Fig 9). In total a set of 46 indicators across all the six pertinent sectors were developed (see Annexure 2) which were shared with ISET, local team and community in a workshop organized at Gorakhpur . A list of 34 indicators and sub indicators was prepared and finalized after incorporating the all inputs suggested by the participants of workshop, and availability of data (See Annexure 3) . In Gorakhpur, the essentially data at the (Mahewa) ward level were not available. Some data were available at a city-wide level, but it was fragmentary and could not be disaggregated to the ward level. Hence some of the indicators were dropped out due to unavailability of data on secondary or primary level. Most of the data were collected through community surveys or from workshops with community leaders, because local government data proved either unavailable or unreliable. During

3 The Climate Resilience Framework has been developed by ISET International with other partners based on the experience of the Asian Cities Climate Change Resilience Network (ACCCRN) programme in 10 cities across 4 countries in South Asia and South-East Asia. For more details, visit www.i-s-e-t.org

Figure 9 | Climate Resilience Framework



collection of primary data it was felt that some other data were available which were very relevant for project monitoring. Hence they were also included in the list of indicators and number of indicators became 1(See Annexure 4). Therefore, for this purpose all the data had been collected as part of the resilience interventions that were planned and implemented (see section on Building Resilience Interventions).

As mentioned earlier, baseline data was collected through a comprehensive survey of 1000 HH of ward and a report was compiled in February-March, 2011 (see section Baseline Survey). On basis of that data a baseline inventory as value of each indicator was prepared which showed the status of situation at the beginning of intervention. Thus, Mahewa team was able to identify and collect baseline data on indicators within their planned timeframe. Again the community survey was conducted in December 2012 and January 2013, followed by the next round in June 2013 and December 2013. The data for the same resilience indicators were brought together in the same excel sheet for analysis and monitoring of development purpose. Finally the changes and the achievements were assessed at a time interval. (See Annexure 4).

Box 3 : Monitoring and Assessment Result A case of Gorakhpur

In Gorakhpur the resilience indicators were measured for impact monitoring over 24 months, immediately before and after the ward level resilience building interventions (as mentioned in detail earlier). Most of the indicators were designed to measure the impacts of these activities. The Annexure 4 demonstrates the community's success in improving solid waste management and drain maintenance, which have helped to reduce flooding and water logging problems. It is also notable that the community has become more politically active in attracting the attention of local government to these issues and demonstrating its successes. As a result of this work, some of these indicators are now being collected by local government in other wards of the city.

The indicators were effective in demonstrating to local government the benefits of small-scale infrastructure investments. For example, community construction of 750 meters of drains, using community-generated funds and voluntary labour, prompted the local government to add its own drainage and approach road improvements downstream to further enhance the ward's drainage and transportation. The measure of flood impacts demonstrated a major decline in inundation in the ward from 20 days in 2010 to just a few hours in 2013. The demonstrable success of the interventions in Mahewa ward has prompted interest from the city government in collecting similar data in other parts of the city, and it has built the capacity and interest of community leaders and local researchers in identifying and applying relevant indicators to measure the delivery of key public services.

Recommendations

Planning and implementation of building ward level micro resilience initiative provided great experience to the implementing team, community groups, city managers and other important stakeholders in Gorakhpur. While the process provided new ways to visualize development planning, it advocated for mainstreaming of climate resilience as new ways of living with natural disasters. We present below some key recommendations from our own learning from implementation of this project.

- ♦ **Open spaces:** Provisioning of open spaces and its strict implementation is extremely necessary for promoting climate resilient land use planning and implementation.
- ♦ **Role of Municipal Corporation:** Land use planning, service provisioning and maintenance should be transferred to Municipal Corporation. It will bring synergy between planning and maintenance functions of city.
- ♦ **Decentralised planning:** Ward committees function as catalyst for enhancing efficiency of systems and service delivery. Planning and maintenance of services and systems therefore should be decentralized and more representative.
- ♦ **Basic needs services:** Basic development needs e.g. safe drinking water, sanitation, drain and solid wastes need preferential treatment and budget allocations
- ♦ **Climate Change monitoring cell:** City should constitute climate change monitoring cell by involving multi-stakeholders to review resilience of existing/futuristic projects. Current practice of addressing climate impact vulnerabilities through disaster risk management cells are mostly response oriented.
- ♦ **Participatory hazard mapping:** The participatory hazard mapping and risk analysis can be helpful in determining threshold value of risk and damage, and have great scope for replication. Hence, it is a valuable tool that should be used.
- ♦ **Synergy between local knowledge and modern technologies:** The integration of local community knowledge with modern technologies are not only effective in collecting data and information on risks but also helps to understand the intricacies of flood related problems at the local level and enhance the capacity of community to tackle with risks.
- ♦ **Climate thresholds:** Climate thresholds as an approach is not only helpful in assessing the level of current and future exposure levels to climate risks but also aids planning interventions in the wake of uncertainty in climate change.
- ♦ **Dynamic process:** Building micro-resilience plan is an ongoing and dynamic process which requires iterations during the course as experiences

generate. Therefore, it is imperative to revisit the plan on a periodic basis and make changes wherever necessary.

- ♦ **Varying priorities:** Variations of priorities across socio-economic classes related to basic infrastructure and services differ greatly, and this should be kept in mind when carrying out micro resilience planning initiatives.
- ♦ **Community ownership:** The planning and management of services and infrastructure is the sole responsibility of the municipal corporation and its related departments, as service providers. Local community members, especially the poor and marginalised, have no say in planning, setting priorities or decision making, and so neither services nor management are community owned. Therefore, community owned systems and processes are very important for improving the services and ensuring long term sustainability of the initiatives.

- ♦ **Scientific and future planning:** Resources for urban development are often allocated based on historic data that, depending on its availability, may be inadequate. The Mahewa interventions showed that for proper decentralised micro resilience planning there is a need to combine future population and socio-economic projections with climate projections, as demonstrated in this guideline. Although this is resource intensive, in the long term it proves to be cost effective.
- ♦ **Capacity building:** The capacity building of staff engaged in planning and providing services is also important, so that they are able to deliver services efficiently and meet the emerging challenges of climate change, increasing disaster impacts and rapid urbanisation. Regular orientation, exposure and training would be helpful in this regard.

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Annexure : 1

Household Schedule for Baseline Survey

Background Information			
City		Date	
Name of the Settlement		Ward No.	
Investigator		Respondent	
Nearest reference			
Ref. No.		GPS Point	

Instructions

- ◆ Write all units wherever necessary (e.g. liters/day, Rs/month) as told by the respondent
- ◆ Do not insist on getting answers on sensitive questions (e.g. income details), but ask and if you get, write down. Expenditure information is less sensitive and try to get good figures
- ◆ You can sequence the questions differently, but ensure all information is filled before closing the interview. Some information can be gathered just by observation like floor no., no. of stories, electricity connection, etc. DO NOT ASK SUCH QUESTIONS.
- ◆ If the respondent is uninterested to give answers, it is better to close the interview and try another household respondent.
- ◆ Some information can be better gathered from women, if possible, try to include both male and female members during interview.

1. Household Basic Details

Type of Ration Card : White/ Red/ Yellow

Name of head of the Household and Relationship with Head	Gender (M/F)	Age (Yrs)	Education	Present Occupation (Just put a √ Mark)				
				Toddler (0-3 yrs)	Studying	Household Activity	Working	Temporarily working
Head of the household								
Respondent **								

Working Members in the Household	Primary Occupation (Name of Occupation)	Secondary Occupation (Name of Occupation)	Total working days in an Year	Distance from the work place A : 1-5 km, B : 6-10 km C : 11-15km, D : >15 km	Annual Income

2. House Details

a. House type ☐ Informal houses ☐ Single ☐ Row ☐ Flat ☐ Bungalow
If Flat, then floor number _____
Number of stories of House _____ Number of Rooms _____

b. Ownership ☐ Rented ☐ Owned
Building Materials (record by observation)
Roof Types : ☐ RCC/ RBC ☐ CGI/ACC/ Tin ☐ Stone ☐ Biomass/Thatch
 ☐ Tarpaulin/Plastic Sheet ☐ Tiles (MPT/Country Tiles)
 ☐ Others (Specify) _____
Wall Type : ☐ Bricks ☐ Stone Blocks ☐ Mud/Earth
 ☐ CGI/ACC ☐ Tarpaulin/Plastic Sheet ☐ Others (Specify) _____

c. Dimensions
Floor Area _____ (Specify sq.m./sq.ft.)
Plot Area _____ (Specify sq.m./sq.ft.)

3. Resource Status : Water Supply

Source	Normal Months					Scarcity Months (April- June/Aug)				
	Use Put a √ Mark	Price/ Unit (Range)	Quality*	Responsibility#	Distance from source (Mention the Unit)	Use Put a √ Mark	Price Unit Range	Quality*	Reliability*	Distance from source (Mention the Unit)
Municipal Individual										
Municipal Shared (Sd. Post)										
Personal Boring										
India Mark II										
Hand Pump										
Other Sources (Specify)										Normal
										Scarcity

Note : 1. *Quality-Clean-C, Hard-H, Turbid-T, Polluted/Contaminated-P
 2. # Reliability- (Score 1-5, where 1 is worst)

1. Ownership or arrangements if any (by source) :

☐ Municipal Corporation

☐ Private Ownership

☐ Owned by neighbor

☐ Water Contractors

☐ No Ownership

☐ Illegal Connection

☐ From Factory

☐ Shared/Community

☐ Others

2. Any changes observed during the last five years in the status of water supply

Reduced Water Supply

☐ Reduction in the supply duration

Degradation of Water Quality

☐ Water scarcity period (months) has increased

Cost of Water has increased

☐ Unpredictable timing of water supply

Incidence of water borne diseases increased

3. What are the perceived reasons for such a change *(highlight perceived reasons if any)*

☐ Reduced Water Supply

☐ Degradation of Water Quality

☐ Cost of Water has increased

☐ Incidence of water borne diseases increased

☐ Reduction in the supply duration

☐ Water scarcity period (months) has increased

☐ Unpredictable timing of water supply

4. Water purification measures undertaken

☐ Aqua Guard

☐ RO Purification

☐ Use of Alum (Fitkari)

☐ Water Filter

☐ Boiling

☐ Other (Use of bubble top)

4. What is the total water collected/used by the household in a single day or over a period of week? _____ ltr.

5. In house arrangement for water storage

Do you store water in your household?

☐ Yes

☐ No

If yes, then mention the water storage details in the household

Arrangement type	Nos.	Capacity/Volume (Specify/Units)	Shared (Yes/ No)	When Installed? (Which Year)
Over Head Water Tank				
Drums/Big Containers/dols				
Small Vessels				
Others (Specify)				

6. Resource Status- Electricity

a. Is there access to electricity?

☐ Yes

☐ No

b. If yes, then

☐ Direct Connection

☐ Indirect Connection

☐ Others

c. Do you pay for it?

☐ Yes

☐ No

d. If yes, the how much (Cost/per month)? Mention_____

e. Rate the quality (Voltage/fluctuation) of Electricity supply to your household on a scale of 1- 5 *(1- Lowest 5 - Highest)* :

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

f. Rate the reliability (No unscheduled cuts) of Electricity supply to your household on a scale of 1- 5 *(1- Lowest 5 - Highest)* :

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

Lighting devices used in house

Type of device	Number	Wattage	Duration of use
Type of device			
Bulbs			
Tubelights			
CFLs			

7. Sewerage Sanitation Connection Details

A. Sanitation details :

a. What is the sanitation facility available?

☐ Individual toilet (septic tank)

☐ Individual toilet (Sewerage connection)

☐ Shard toilet

☐ Community toilet

Open defecation

b. In case of community toilet who takes care of the operation and maintenance?

☐ Municipal corporation

☐ Private Contractors

☐ Community

c. In case the community toilet is used what are the user charges paid?

☐ Re 1/use

☐ Rs. 2/use

☐ Card System (Payment per month)

☐ Amount

d. In case the community toilet is used what are the issues?

☐ Improperly maintained

☐ Choked

☐ Women's safety

☐ No water

☐ Not cleaned regularly

☐ Others

e. What is the arrangement for the disposal of the sewerage?

☐ Sewerage connection

☐ Released in open drain/nala

☐ Septic tank

☐ None

☐ Others (Specify)

f. What happens to the toilet arrangement during flooding/water logging season?

☐ Overflow

☐ Not able to access the toilet

☐ Not clean

☐ Use other means/options

☐ No change/still in use

g. In case the sewerage system exists in the settlement, who manages them?

☐ Municipal Coorporaton

☐ Private contractor

☐ Self

☐ None

☐ Others (Specify)

h. Do you pay anything for this arrangement?

If yes, how much_____

i. Is there any problem with the arrangement? If yes, specify_____

J. What happens to the sewerage system during heavy rains/floods?

☐ Works properly

☐ Drain is choked temporally

☐ Water logging continues for a longer period of time

☐ Others

B. Drainage details (grey water)

a. What is the arrangement for the grey water/waste water disposal?

☐ Pucca drain/nala

☐ Open drain/nala

☐ Released in the open

☐ None

☐ Others (Specify)

b. Who manages them?

☐ Municipal corporation

☐ Private Contractors

☐ Self

☐ None

☐ Others (Specify)

c. Do you pay anything for this arrangement?

If yes, how much_____

d. Is there any problem with the arrangement? If yes, specify_____

e. What happens to the drainage system during heavy rains/floods?

☐ Overflows to the road/compound

☐ Water gets in to the household

☐ Water does not recede fro some time

☐ No change

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8. Solid waste management- Handling details

a. Where do you dispose off your household waste?

☐ House to house collection

☐ Dump on street/ outside

☐ Dumping in waste bin

☐ In the river/nallah

☐ Burn

☐ Others (Specify)

b. If there is house collection or proper management of the solid waste, mention the agency responsible?

☐ Municipal corporation

☐ Private Contractors

☐ Others (mention)

c. What kind of expense do you incur for solid waste disposal?

☐ No Expenses

☐ Rs._____ Per month

d. What happens to the solid waste disposal in case of floods/water logging?_____

e. Are there any special issues related to the soild waste disposal?_____

9. Exposure to Floods/ Water-logging/ risks

Occurrence (Mention Year)	Hazard Source	Distance from Hazard Source	Intensity (Mas. depth inside the house and surrounding areas	Duration (days)	Damages/ Costs	Loss of incomes, period

a. What is the source of alternate livelihood during such a situation?

☐ None

☐ Others (Mention)_____

b. What is the support system that you resort to in such a situation? _____

c. Has the community as a whole decided about handling such a situation?_____

d. What kind of support system do you think is most important for handling such a situation?_____

e. What are the preparatory measures to be taken in case such problem arises?_____

f. What are the measures that need to be taken after the problem phase is over?_____

Household Level Coping Measures to Floods/ Waterlogging Scarcity				
Measures	Yes/No	Additional Costs	Does the arrangement help or not?	Remarks
Raised plinth				
New first floor				
Attic Storage				
Raised Shelves				
Attic Storage				
Raised Shelves				
If Yes, Where do they relocate to : For how many days :				
Water Tank				
Drums/ Others				
Water sharing				
Others, if any				
Any other (specify)				
Government help if any		If yes, give details		
NGO help if any		If yes, give details		

10. Health Risk for the Household

Disease	Seasons	Epidemics (If Yes, mention Year)	Persons affected (in numbers)	Specific age group affected (if yes mention the age of the HH Members)	Annual Income

Emergency and Relief during water logging/ floods

a. What sort of benefits/ support you got?

☐ Flood

☐ Drinking water support

☐ None

☐ Emergency Shelter

☐ Medicine

☐ Others (Specify)

☐ Clothing

☐ Insurance/ Financial

b. Who all give you support?

☐ Municipal corporation

☐ NGO/ CBOs

☐ Others (Specify)

☐ Community support

☐ Missionary/Charity

☐ Local help groups

☐ None

(If there is any particular name of the organisation then mention the same)

- c. Rate the quality of support on a scale of 1 to 5 (1 lowest, 5 highst)
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- d. Highlight inadequacies/ difficulties
- ☐ No support at all
- ☐ Help came too late
- ☐ No medical support
- ☐ Few HHs got the benefits
- ☐ Support was not coordinated
- ☐ Support stopped after initial help
- ☐ Others (specify)

11. Family expenditure details

Family Expenditure Details (Mention either in months/years depending upon the budget heads)		
Item	Expenses Rs./ month	Annual Rs/ year
Food		
Cooking Fuel (L.P.G./Kerosene/Fuel Wood)		
Rent, House maintenance		
House tax, if any		
Entertainment/ habits		
Transportation (Public Transport, say Train/ Bus/Taxi/Auto etc)		
Personal Vehicle (Fuel expenses)		
Services- Communication		
Services- Electricity		
Service- Solid Waste		
Services- Water		
Health		
Education		
Travel (Leisure/pilgrimage)		
Insurance premium (Health/Home/Vehicle etc)		
Remittances (MO etc)		
Others (Specify)		
Total all the items to per year		

Note : Some of the expenditures will be on monthly basis, while others will be on annual basis. Try to fill them accordingly.

12. Debt/ Insurance savings

Debt/ Insurance/Savings (Family Count)				
Debt				
Type of Loans	Source (can include Money lender, bank, SHG, from relatives, Mortgage etc.)	Amount (approx) arrangement help or not?	Return time frame	Remarks
House loan				
Vehicle loan				
Business related loan				
Educational loan				
Others (Specify)				

Insurance					
Type of Insurance Policy (Health/Disability/Life/Home Property/Others)	Source	Coverage	Premium (approx)	Did you receive the claim (Yes/No)	Remarks
Do you save regularly?					
Are Floods/ Water scarcity affecting your financial planning? If Yes, give details :					

12. Asset Ownership

Asset Ownership				
Vehicle Description	Type and Nos.	Age	Km run/ month	Impact of floods or any other disaster
Bicycle				
Motor bike				
Car				
Motorized Vehicle for commercial use				
Non Motorized commercial				

- Do you have any of these assets as ownership?
- ☐ Shop
- ☐ Local business enterprise like flour mill etc
- ☐ Others (mention)
- ☐ None

If yes, then how does it get affected during floods/rainy season?_____

14. Appliance usage

Appliance Type					
Description	Numbers	When purchased	Usage/day (Number of hrs)		Remarks (also include impacts due to floods)
			Normal	Summer	
Household Appliances					
Fan/Cooler					
Fridge					
Television					
Cooling/Heating appliances					
Land-line phone					
Cell phone					
Washing Machine					
LPG Cylinder and Cooking stove					

Appliance Type					
Description	Numbers	When purchased	Usage/day (Number of hrs)		Remarks (also include impacts due to floods)
			Normal	Summer	
Water pumping and treatment appliances					
Pump					
Filter (specify)					
Others (if any, specify)					
Appliances in addition to the above					
For commercial purpose (specify if any)					

What is the normal unit consumption of electricity/ month in normal circumstances?_____

What is the normal unit consumption of electricity/ month in summer circumstances?_____

15. Community Linkages

- a. What are the community groups in your settlement?

☐ SHG☐ Festival groups/ committee☐ Professional groups

☐ Affinity groups☐ Yuva Mandals☐ Political affiliations

☐ RWA☐ Others(mention)

b. Are you the member of any community group?

c. If yes, then mention the name of the institution?

d. If yes, then since how long?

- e. Who are the members from your household? Mention relationship along with the community linkages :
1. _____

2. _____

3. _____

What is the role assigned for the members?

1. _____

2. _____

3. _____

What are the benefits/ support that you get from such linkages?

1. _____

2. _____

3. _____

16. Investigator Observations

- a. Water (including quality/scarcity)
- b. Sewage/drainage
- c. Solid waste disposal
- d. Floods/ water logging
- e. Disaster risk reduction
- f. Electricity
- g. Surroundings
- h. Reliability of information
- i. Any other

Annexure : 2

Initial Indicators Across all the Six Pertinent Sectors

Services	Main Indicators	Sub Indicators
Water supply	Zone wise demand/ supply ration of water supply	No. of NHs of water supply No. of water connection Norm of per capita water supply Actual amount of water supply
	Extent of Non revenue water	Total water produce Total water supply
	Coverage of water supply connection	No. of HHs in NHs Total No. of HHs with direct water supply connection
	Cost recevery in water supply services	Total operating expenses Total annual operating revenue
	Redressal of customer compalints	Total complain received Total complain readdressed
	Budget on water supply	Budget allotted for maintenance Percentage of expenditure in incurred on maintenance
Sewerage and drainage	Coverage of sewerage network	Total length of underground sewerage Are there any sewerage zone in the NH? No. of HHs having direct connection
	Storm water drainage network	Total length of road network Total length of PST drain
	Incidence of water logging/ flooding	No. of water logging points marked No. of days of flooding/ water logging
	Percentage redressal of customer complaints/ efficiency of redressal of customer complaints	Total number of sewerage related complaints received per month Total No. of complaints reddressed per month
	Efficiency in collection of sewerage charges	Current revenue collection in a year Total operating revenue billed during the year
	Total revenue received from sewerage charges (SLB)	Total annual operating expenses Total annual operating revenue
Health	Health related	No. of public/ private health care centres in the ward No. of physicians in ward No. of ICDS centres available in the ward No. of health camps organized No. of persons reached out through health camps Percentage of HHs adopted vaccination
Housing	Housing related	Percentage of built up area in the flood prone area No. of HHs who relocate voluntarily away from hazzardous areas No. of HHs in flood/water logging having safe plinth
Sanitation and solid waste	Sanitation and solid waste	No. of HHs covered with SWM services HHs level coverage os SWM services Percentage of redressal of customer complaints per month Percentage of expenditure incurred on SWM services Budget allocated under solid waste management services
Climate Resilient Agriculture	Conservation of open spaces	No. of farm models developed
	Adaptive agriculture in water logged condition	No. farmers linked with CRA Percentage of net income increased of Farmers Number of farmers adopted loft farming techniques No. of crops in the one year

Annexure : 3

Final Indicators with communities inputs

Services	Main Indicators	Sub Indicators
Water	Access to pipe line water	No. of HHs access to pipe line water supply No. of HHs in flood/water logging having safe plinth
	Source of safe drinking water	Number of Mark 2 handpumps raised No. of HHs access to raised India Mark Hand pump Frequency of quality monitoring of drinking water No. of HHs approached for drinking water testing No. of HH having more than one sources of safe drinking water
Sanitation	Defecation	No. of women access to community toilet No. of HHs adopted low cost toilet design
	Solid waste management	No. of HHs assess to solid waste collection through door to door collection activity
Drainage	Water logging	No. of storm water magntment scheme exists in the ward No. of days of water logging No. of water logging spots
	Condition of drainage	No. of HHs access to raised India mark hand pump No. of drains choked in the ward Frequency of drain cleaning
Health	Hygiene	No. of HH access of health services and schemes (smart card) No. of people participate in health awareness workshops No. of meetings of health surveillance groups with service providers Percentage of HH aware of hygiene and sanitation practices
	Health services	No. of HH visiting health check post No. of HH accessing govt. scheme like ICDS Cases of water and vector borne diseases No. of referral services through health check post
CRA	Conservation of open spaces	No. of farm models developed No. of farmers linked with CRA Net increased in income of farmers
	Adaptive agriculture in water logged condition	Number of farmers adopted loft farming techniques No. of crops in the one year
Climate Resilient Housing	Housing	No. of HHs who relocate voluntarily away from hazzardous areas No. of HHs in flood/ water logging having safe plinth
Economic and social empower-ment of poorest and most marginal group women	Empowerment of women	No. of HHs having access to banks No. of HHs linked with IGA Linkage of sectoral departments

Annexure : 4

Monitoring of Changes in Indicators

ACCCRN Mehewa Project							
S.No.	Key Issues	Indicators	Baseline status				% of achievements during March 2011 to December 2013
			Mar '11	Dec '12	June '13	Dec '13	
1	WATSAN	Duration of water supply service available	9	12	15	15	66.7
2		No. of HH having more than one sources of safe drinking water	397	856	1077	1101	177.32
3		Frequency of quality monitoring of drinking water	1	2	3	3	200
4		No. of HHs access to pipe line water supply	331	712	882	1021	208.45
5		No of women access to community toilet	1435	1772	1845	1967	37.1
6		No. of HHs adopted low cost toilet design	0	12	12	12	Infinite
7		No. of HHs access to raised India mark hand pump	0	125	135	153	Infinite
8		No. of HHs assess to solid waste collection through door to door collection activity	0	953	960	960	Infinite
9		No. of HHs approached for drinking water logging	0	50	250	360	Infinite
10		Number of Mark 2 handpumps raised	0	5	5	5	Infinite
11	Drainage system for storm water management	Community monitoring group active for the conservation of water bodies	0	1	1	1	Infinite
12		No. of drains choked in the ward	15	8	28	33	120
13		Frequency of drain cleaning	after 10-15 day	1	2-3 days	2-3	60-80
14		Self managed community surveillance group	0	6	2	3	Infinite
15		Number of water logging spots	5	0	7	7	
16		Feasibility study shared at city and state level	0		0	0	Infinite
17		Is there any storm mangt-scheme exists in the ward	02 pumps	2	2 pumps	2	0
18		No. of days of water logging	30 to 60		2 to 3	2-3	60-80

ACCCRN Mehewa Project							
S.No.	Key Issues	Indicators	Baseline status				% of achievements during March 2011 to December 2013
			Mar '11	Dec '12	June '13	Dec '13	
19	Health	No. of HH access of health services and schemes (smart card)	0	10	30	35	Infinite
20		% of HH aware of hygiene and sanitation practices	211	670	733	895	310
21		No. of HH visiting health check post	325	777	1010	1026	215-7
22		No. of HH accessing govt. scheme like ICDS	260	450	465	548	110.8
23		Cases of water and vector borne diseases	1936	2185	2310	2513	29.8
24		No. of people participate in health awareness workshops	0	89	224	344	Infinite
25		No. of meetings of health surveillance groups with services providers	0	4	4	10	Infinite
26		No. referral services through health check post	0	32	64	73	Infinite
27	CRA	No. of farm models developed	0	10	20	20	Infinite
28		No. of farmers linked with CRA	10	15	55	57	470
29		Net increased in income of farmers	6000	6600	7260	8500	41.7
30		Number of farmers adopted loft farming techniques	0	12	17	27	Infinite
31		No. of crops in the one year	2	1	8	8	300
32		No. of farmers linked with climate information	0	10	40	50	Infinite
33	CRA	No. of farm models developed	0	10	20	20	Infinite
34		No. of farmers linked with CRA	10	15	55	57	470
35		Net increased in income of farmers	6000	6600	7260	8500	41.7
36		Number of farmers adopted loft farming techniques	0	12	17	27	Infinite
37		No. of crops in the one year	2	1	8	8	300
38		No. of farmers linked with climate information	0	10	40	50	Infinite

ACCCRN Mehewa Project							
S.No.	Key Issues	Indicators	Baseline status				% of achievements during March 2011 to December 2013
			Mar '11	Dec '12	June '13	Dec '13	
39	Risk Resilience	No. of HH approached to CC resilient house design	0	0	1	1	Infinite
40		No. of children access to education facility during stress situation system	35	45	85	85	142.9
41	Economic and social empowerment of poorest and most marginal group	No. of HHs having access to bank	0	0	55	70	Infinite
42		No. of HHs linked with IGA	0	0	100	118	Infinite
43		Linkage of sectoral deparments	1	3	5	6	100
44	Advocacy at city level, knowledge linkage, sharing of experiences	No. of steering committee meeting	0	7	8	10	Infinite
45		No. of citizen in pressure groups	50	130	130	165	230
46		No. of meetings of city thematic group	0	5	5	5	Infinite
47		Media Engagement	0	0	0	2	Infinite
48		No. of visits of elected representatives, govt. officials, citizen groups	0	4	16	18	Infinite
49		No. of fact sheets	0	6	11	12	Infinite
50	State Level workshop	Attendance at the meetings	0	0.6	80	80	Infinite
51		Project fact sheets shared in media	0	3	4	4	Infinite
52	Project findings collaboratively published with ISET in journal	Project findings published	0	2	3	3	0
53	Handbook on Micro-Level planning	Hand book developed and published	0	0	1	2	Infinite
53	Water level strategic planning and institution building	Number of training and orientation carried out	0	3	7	9	Infinite
		Number of community volunteers mobilized	0	18	18	18	Infinite
		Number of participants in PRA activities	0	6	6	6	Infinite
		Number of community members express willingness to form local groups	0	80	80	92	Infinite