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Training Module

Flood Disaster Risk Management: Gorakhpur Case Study

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Training Module

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Message

Dr Dieter Mutz
Director
Indo-German Environment Partnership (IGEP) Programme
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New Delhi, February 2013

Since 2010, GIZ has been collaborating with the National Institute of Disaster Management for implementing the "Environmental Knowledge and Disaster Risk Management" (ekDRM) project, aimed at strengthening capacity building initiatives in knowledge management and risk reduction for disasters caused by natural hazards, such as floods, cyclones, drought, or manmade disasters caused by industry. The design and development of training tools, such as an internet based training and knowledge management system, blended learning training methodology and the development of training materials are important activities under this project.

It gives me great pleasure to introduce this case study highlighting the Gorakhpur Flood Scenario, mitigation strategies, approaches and lessons learned. This case study module will significantly support trainers as well as trainees to get familiar with real life examples on how the problems are addressed and the pathways for solutions, and last but not least, in to develop knowledge and skill in the area of flood preparedness and risk reduction .

I congratulate the academic team from GEAG and NIDM for producing an excellent work in the form of this case study module. I take this opportunity to express appreciation of the commitment of NIDM and ifanos Germany and India for extending their willing support and cooperation to this effort. I wish that such modules are used extensively by stakeholders across the country as well as in other countries in the region.

Foreword

Dr. Satendra, IFS,
Executive Director,
NIDM
New Delhi, February 2013

Knowledge of environmental systems and processes are key factors in the management of disasters, particularly the hydro-meteorological ones. Climate-change is the challenge of modern times known to aggravate natural hazards like floods, drought, cyclone, landslides and forest fires, and it also intensifies people's vulnerability by affecting their resources and capacities.

Environmental conditions including climatic and topographic factors also determine the dispersion, transport and thereby, the fate of chemical incidences. NIDM and GIZ Germany, under the aegis of Indo-German Environment Partnership (IGEP) Programme with Indian Ministry of Environment and Forests, implemented a joint project entitled “Environmental Knowledge for Disaster Risk Management (ekDRM)” with the National Institute of Disaster Management, wherein development of case studies and training modules are among the key activities.

Floods are the most frequent type of disaster worldwide. It can strike anywhere and anytime. Although floods can be predicted, they often cause massive damage and destruction of property as most urban communities are located near water sources such as coasts and rivers. Flood has always been a recurrent phenomenon in India. According to the HPC Report of Government of India, around 75% of the total rainfall is concentrated over 4 months of monsoon (June – September) and, as a result almost all the rivers carry heavy discharge during these four months. Around 12% of the country's land area is prone to floods which means around 40 million hectares are prone to flood and annually on an average 8 million is affected by floods. However, this doesn't include the area under urban flooding and even many incidental areas of flash floods.

Study and management of flood risk and disaster is a multidimensional affair that calls for interdisciplinary expertise. Case studies offer value addition to training packages and their deliveries by presenting example and simulation so that trainees are exposed to a real life situation. Gorakhpur in Eastern Uttar Pradesh is a recurrent flood prone area and its flood management strategies have been documented as a Case study under this training module. Efforts of the authors are praiseworthy, as they meticulously brought in the contexts in a very systematic way to help the cause of flood disaster management in general and related training and research on flood disaster management in particular. I am sure the module shall be useful for the readers and trainees, and would welcome any suggestions to improve its future editions.

Contents

1 Introduction

1.1 About the module

The aim of the module is to give an overview of flood risk management in the context of Gorakhpur where annually floods play havoc. This module is designed and developed in the form of a case study to help users to understand the problem of floods, its different perspectives, impacts on livelihood, risk adaptation methods, community based and community led measures. The case study cites some examples from the work done by the Gorakhpur Environmental Action Group (GEAG) in the field of flood management in Gorakhpur district. This case study module supplements the core training module of NIDM on flood disaster management and does not substitute it.

A case study is an effective training and research methodology through which in-depth analysis of an individual, event or place is done, which in turn gives a clear understanding of the concepts and perspectives related to an issue or area to be studied. "Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame — an object — within which the study is conducted and which the case illuminates and explicates" (Thomas, 2011).

Through this example we shall be able to comprehend and have a good understanding about floods, their impacts, and the management perspectives and solutions for adapting to floods. Special focus has been given on interventions of Gorakhpur Environmental Action Group (GEAG) in flood disaster risk reduction which has helped the local communities in assessing the ground realities and building resilience to floods in future.

Salient features of this module:

- Comprehensive study of Gorakhpur floods
- Field based data analysis and interpretation
- Localised adaptations and solutions relevant to native communities
- Good understanding of concepts and themes related to floods
- Indian example for fighting flood menace

1.2 Structure of the module

This module is divided into five learning units

Learning Unit A: Understanding floods and its impact

Learning Unit B: Towards disaster risk reduction planning

Learning Unit C: Adaptive agricultural practices

Learning Unit D: Community level disaster risk reduction interventions

Learning Unit E: Cost benefit analysis for DRR measures

2

LU-A: Understanding Flood and its Impacts

Objectives

After going through the module, the readers shall be able to:

- Understand the flood hazards in historical context and trends in Gorakhpur region
- Describe the geo-climatic and socio-economic profile of the study area
- Understand impacts of floods on food, health, water systems and livelihood and on the gender dimensions of flood impacts
- Describe tools for assessing vulnerability in different forms – material, institutional, attitudinal taking the Rohini-basin as an example.

Floods

According to MSN Encarta (2006), a flood is an overflow of water that submerges land. The European Union (EU) Floods Directive (2007) defines a flood as a covering by water of land not normally covered by water. In the sense of "flowing water", the Glossary of Meteorology (2000) says the word may also be applied to the inflow of the tide. Flooding may result from the volume of water within a body of water such as a river or lake, which overflows or breaks levees, with the result that some of the water escapes its usual boundaries.

India is highly vulnerable to floods and out of the total geographical area of 329 m.ha, more than 40 mha is flood prone. Floods are recurrent phenomenon, which cause huge loss of lives and damage to livelihood systems, property, infrastructure and public utilities. It is a cause of concern that flood related damages are showing an increasing trend. The average annual flood damage during the last 10 years

(1996-2005) was Rs. 4745 crore, as compared to Rs. 1805 crore, the corresponding average for the last 53 years. This can be attributed to many reasons including rapid increase in population and urbanisation coupled with growing developmental and economic activities in the flood plains and global warming (NDMA, 2008).

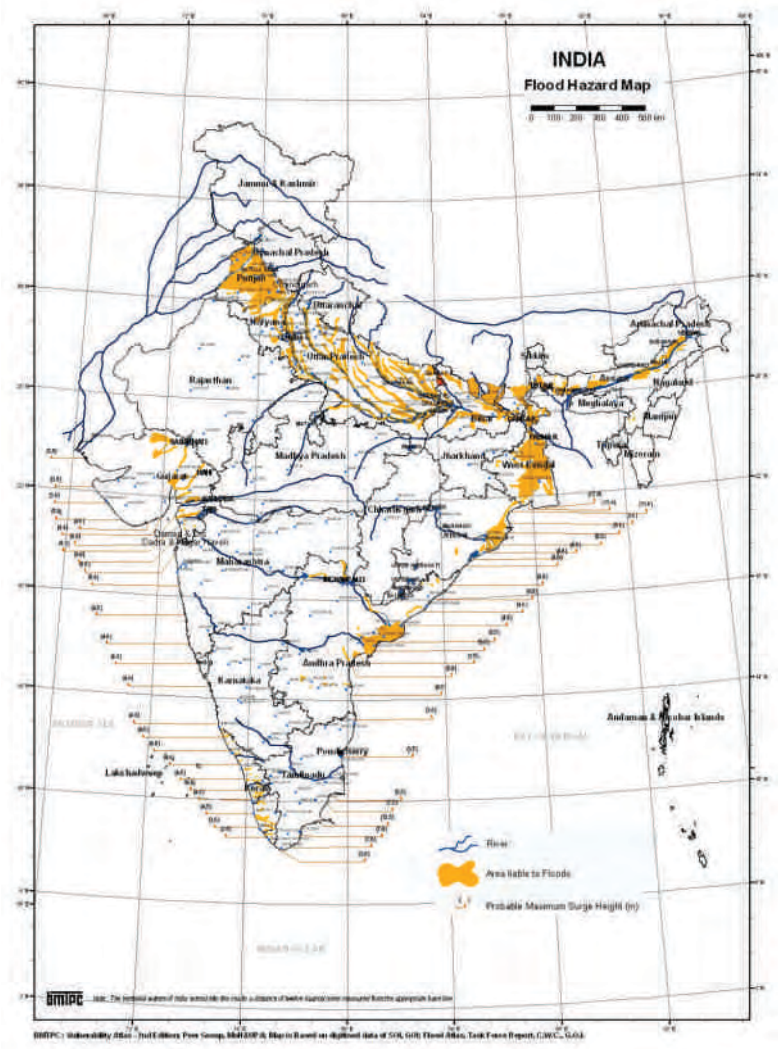


Figure 2.1: Flood zone map of India

(Source: Vulnerability atlas of India, BMTPC)

2.1 Demographic and agro-geo-climatic settings: Trans-Saryu region (Eastern Uttar Pradesh)

River basin approach

Uttar Pradesh (UP) is home to 190 million people living in high density areas - 800 (population density) persons per sq km (Census 2011). The population is spread over 70 districts, with 300 tehsils and 813 blocks across 4 geographic regions - Western, Eastern, Central and Bundelkhand. It is the third poorest state in India with a per capita annual income of US$200. Some 80 percent of the people in UP live in rural areas; and 66 percent depend on agriculture for their livelihood. Agriculture accounted for 38 percent of the gross state domestic product (GSDP) in 2001-02. Six percent of the population is involved in household industries and 28 percent in other services.

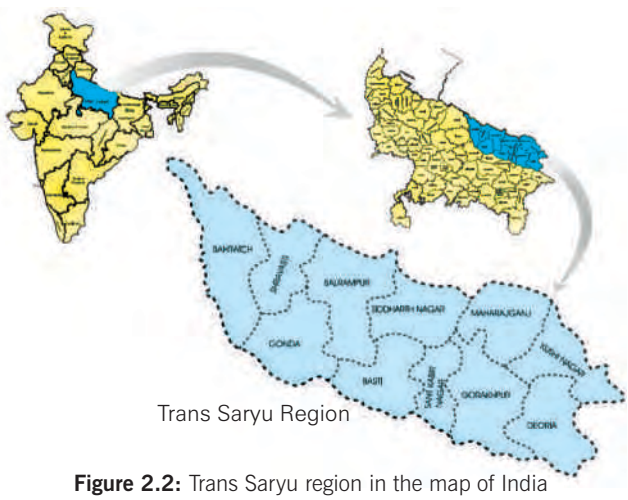


Figure 2.2: Trans Saryu region in the map of India

The Trans Saryu region is located in the foothills of Nepal Himalayas, to the north of the Ghaghra/Saryu River and the middle of Ganga River. The region comprises 11 districts of Eastern Uttar Pradesh. The land fertility and availability of ground water is good due to alluvial soil and the location of the area in the Terai region. However, the area is chronically flood prone and the very nature of flooding is changing due to climatic conditions, with a greater intensity of flash floods. The embankments along the various rivers, unable to withstand the heavy flooding, often break, washing away croplands and mud homes. There has been change in flooding patterns also. The floods are frequently flash and accidental, smaller rivers are also causing larger damages, water retention (and hence water logging) periods are increasing, etc. The damages to crops are also on an increasing trend. Cropping patterns are changing and pulses (once a major crop in the area and a major source of protein) are not grown due to longer water logging periods. The water logged situation disrupts the whole crop cycle and production even in Rabi season is severely affected. Many people become victims of water borne diseases like diarrhoea, cholera, dengue and Japanese encephalitis, as the flood waters stagnate and the natural lines of drainage are disrupted due to construction of embankments, roads and other encroachments. The present case study is largely based

on experiences from the areas falling within Gorakhpur, Deoria, Maharajganj and Sant Kabir Nagar districts, in the basins of River Rapti and Rohini. Depending on the gradient which averages 20 cm/km, the region is divided into three distinct parts known as the *Tarai, the Khadarand the Bangar.*

The Rohini and Rapti Rivers are part of the Ganga Basin. Starting in Nepal, the river Rohini flows approximately north to south with a catchment area in India of about 872 km^2. The Rohini ends at its confluence with the Rapti River near Gorakhpur City. The basin location and its features are shown in Figure 2.3.

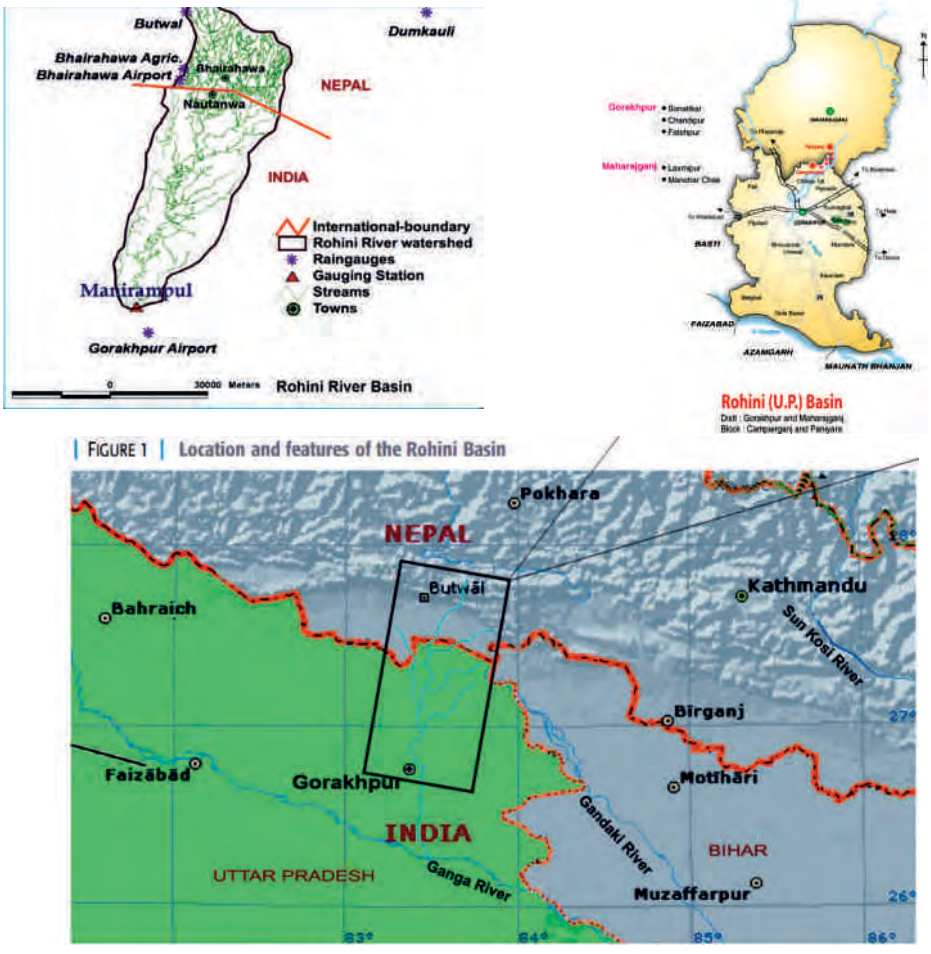


FIGURE 1 | Location and features of the Rohini Basin

Figure 2.3: District boundary of Gorakhpur City
(Source: Kull et al.2008, Working paper 4,From Risk to Resilience)

Agro-ecological setting

India, Rohini Basin covers elevations from 107m in the northeast to 76m above sea level in the southeast, resulting in a gentle slope from north to south. With a very small slope, even the smallest disruption in the natural flow of water can cause large-scale and long-term flooding.

The Rohini and Piyas Rivers traverse the case study area and merge in the middle of the basin. Many other hill streams and drainage channels join the Rohini River, which itself is a tributary of the Rapti River. These rivers and streams swell with water and debris during the monsoon, and with poorly formed banks, are prone to overflowing and erosion. This leads to frequent changes in the course of the rivers, more often in the northern reaches of the basin.

A large number of permanent water bodies (*charans*) cover the area; these developed over time due to changing river courses and abandoned meanders blocked by silt. The basin also contains a vast expanse of temporary swamps and local water bodies (*jheels*), which vary from broad sheets of water during the rains to shallow marshes or even arable land during the dry season. Historically, these water bodies played an important role in flood management and provided livelihoods to a large population. In the last two decades, however, the water bodies have been heavily encroached upon.

The climate of the area is monsoon dominated. The temperature ranges between 5°C to 46°C and the average rainfall is approximately 1200-1400 mm/annum, over 80% of which falls during the monsoon months of June through September. July and August are the wettest months, receiving about 60% of the monsoon season rainfall.

Numerous rivers and drainage channels transport soil and silt from the hills of Nepal. This soil plays a vital role in crop production. The low-lying lands usually have clayey soil well suited for rice paddy, while the higher lands have loam or a clay and sand mixture well suited for wheat, pulses and oilseeds. About 80% of the area is under cultivation. There are two main crop seasons: *kharif* (monsoon) and *rabi* (winter), with a third during the summer (*zaid*) in places where suitable irrigation exists. The main crops of the region are paddy in *kharif*, wheat in *rabi* and vegetables and maize in *zaid*. About 50-60 years ago, the copping pattern was quite different. Paddy was the main crop, particularly in areas having older alluvium (clayey) soil, with only a few minor rabi crops like pulses and oilseeds. *Madua, kerav, kodo, chana, jau, savan* (millet and legume crops) and a little bit of wheat, sugarcane and *bajra* (pearl millet) were also grown. With increasing irrigation through canals and private tube wells, wheat became more popular than minor crops. Many of the *kharif* crops like *madua* and *kodo* (millets), which had been either grown separately or inter-cropped with paddy have almost disappeared.

The growing popularity of 'green revolution' methods, while relatively recent in the region compared to other parts of India, has substantially changed agricultural patterns. High yield variety (HYV) seeds have replaced indigenous varieties and the use of chemical fertilizers has increased, along with groundwater irrigation. While agricultural productivity in the region has increased, it still remains low by national or state averages, primarily due to small land holdings, lack of irrigation and an absence of extension services. Lack of infrastructure for food storage and processing, communication, and electricity further limits the agricultural income. There is potential for families to strengthen incomes through agricultural diversification, off-farm and non-farm employment opportunities. However, these opportunities are limited to date, and there are only some small industries in the region, primarily agriculture based, such as rice and flour mills.

Socio-economic profile

High population densities—of over 1000 persons per km^2 in some areas put many people at risk in these flood affected areas (see Table2.1 below). This is significantly higher than the national average of 250 persons per km^2 in rural areas. Increasing population density is placing additional pressures on already stressed environmental and economic resources in the region. Human development indicators in the two districts in the Rohini Basin are much lower than both national and state averages (Uttar Pradesh itself is lower than most of India). In Maharajganj and Gorakhpur, official figures report 30.8% and 28.2% of the population live below the poverty line (BPL), as compared to 25.5% for Uttar Pradesh and 21.8% for India (Singh, 2007). The incidence of poverty is even higher in scheduled caste (SC) and scheduled tribe (ST) households, with over 40% scheduled caste households under BPL in 2007 (Singh, 2007). While less than 5% of the surveyed households were scheduled tribe, they were extremely poor with limited land or other assets, have low levels of literacy, and generally remain socially disempowered. Primary sources of income are farming (65%), agricultural labour (14%), non-farmwages (14%), service (2%), business (4%) and animal husbandry (1%). While 60% of the population derives household income from local opportunities, 22% migrate to compensate for lost household income. In a significant number of cases (30%) distress migration occurs due to livelihood and productive asset losses.

Table 2.1: Population density in the study area

Area	Density 1991	Density 2001	Density 2011
Uttar Pradesh State	548	689	828
Gorakhpur District	923	1,140	1,336
Maharajganj District	568	734	

Source: Based on the 2011 National Census (Office of Registrar, 2011)

It is generally accepted that a strong correlation exists between educational attainment and poverty. In India, poverty levels are almost four times higher among illiterates as compared to those with higher education (Office of Registrar, 2001). Literacy rates in the study area are low, particularly among women, as illustrated in Table 2.2.

Table 2.2: Literacy rate at state, district and survey scales

Data Scale	Literacy		
	Total	Male	Female
Uttar Pradesh	57.4%	70.2%	43.0%
Gorakhpur	61.0%	76.7%	44.5%
Maharajganj	47.7%	65.4%	28.6%
Survey All	56.0%	n/a	n/a
Survey BPL	48.7%	n/a	n/a

Source: Office of Registrar, 2001 and Survey 2008

A typical household in the rural Rohini Basin consists of 6 to 7 people (average of 6.2 with standard deviation of 2.0), and earns an average annual income of USD 712. Annual household income ranges from USD 90 to USD 15,300, though most household incomes are at the lower end of this range. In rural areas, poverty is strongly associated with land ownership, which is the main productive asset. On average, households own less than a third of a hectare of land (see Table 2.3).

Table 2.3: Household income, land owned, debt and savings (from survey)

Sample	Average annual Household Income	Land owned (in ha)	Total Outstanding loan(s)	Savings
ALL	$712	0.32	$76	$29
BPL	$550	0.22	$51	$24

Source : Survey 2008

Savings are generally very small for all classes. Most of the household income is used for consumption, especially food. Only a fraction is saved, or used for other purchases, as shown in Table 2.4.

Table 2.4: Consumption and savings in percent of annual income

Sample	Consumption Food	Consumption Medical	Consumption Other	Savings	Remainder
ALL	63%	5%	18%	4%	10%
BPL	67%	6%	16%	4%	7%

2.2 Flood hazards: History, trends and impacts

Like all of eastern India, the Rohini and Rapti Basins are prone to floods during the four monsoon months. About one third of Rohin's catchment lies in the Nepal Tarai where cloudbursts cause intense rainfall events. There is always some annual flooding, with major floods having occurred in 1954, 1961, 1974 and 1993. In the last 10 years the intensity and frequency of floods appear to have increased and three major floods have occurred within a decade: 1998, 2001 and 2007. In the upper part of the basin, *piyas*, or small hill streams and drainage channels, are prone to erosion and sudden course changes. In the lower part, the very low gradient causes the Rohini to meander sluggishly through the plains.

Since the 1970s, embankments (currently totalling over 113 km in length) and some spurs have been constructed for flood control. However, these embankments have been frequently breached, causing more damage than if they had not been built. The structures fail primarily because they are not maintained properly, or in some cases their hydraulic designs are exceeded. Embankments have also caused the river bed to rise, decreasing the river's carrying capacity and increasing chances of flooding. Water logging occurs because of drainage congestion caused mainly by embankments and other linear developments (roads, railways, canals, urbanization, etc.). In certain areas, including Maharajganj, the water logged area increased by 65-95% during 1971 to 1991. In many cases waterways developed across road and railway embankments, drain water away insufficiently. Excessive rainfall can cause overflowing of low and poorly formed riverbanks, and drainage congestion is a serious problem. Siphons are either closed during high floods or do not function due to silting and clogging. The flood hazard is pronounced where drainage channels merge into the Rohini, especially lower in the basin above the confluence of the Rohini and Rapti Rivers. The overall nature of flooding therefore has changed; inundation depths have become higher and more unpredictable (embankment failures), with constant water logging in certain areas. While earlier floods were considered to have done more good than harm, they now cause immense damage to life and property, and have become an obstacle to development in the region.

The region has been affected by floods from ancient times and, in fact, the floods have played a major role in formation of the area. People have been living with the floods and they have adapted according to the situation. The problems have significantly increased due to land pressures, locally inappropriate developmental practices and policies and the change in climatic conditions. The history and trends of floods have been traced with the help of secondary information and recollection of the communities living in the area.

Flood frequency and ethno-history of flooding

Rohini and Rapti: The water levels in various rivers are gauged at identified points by government department and danger levels have been marked on the basis of flooding magnitude. Such gauges help in issuing alarms and warnings and reporting to relevant points at the state and national level. However, for any community centred disaster risk reduction initiative it is important that inundation, water levels and its impacts are observed at the affected village level. Efforts are made to trace the ethno history of floods in various villages, in a river basin, where DRR initiatives have been undertaken by GEAG. Such a record of flooding along the Rohini in UP is outlined in the Table 2.5. It documents the varied nature of flood events and their social impacts. Major flood events occurred in 1904, each year from 1952 to 1957, 1962, 1968, 1970, 1971, 1974, 1980, 1981, 1998, 2000 and 2001. The flood of 2001 was followed by a drought in 2002. Attempts were made to control flooding along the Rohini and Rapti rivers by constructing embankments, a process which began in 1952 and continued intermittently until 1985. It is impossible to provide details on the impacts of flooding in all case study villages, but the case of Gaighat village illustrates the situation well.

Gaighat is situated on the bank of the Rapti River between the Rapti and the Bathuanala River. It has been affected by flooding and land cutting for as long as the villagers can remember. In most years, flooding has occurred for a brief period and hasn't had a major impact on life. During the period from 1952 to 1957, however, parts of the village were cut down by the shifting course of the Rapti and villagers were forced to settle elsewhere or to build new houses in agricultural fields. This history repeated itself between 1960 and 1980, when the shifting course of the river destroyed more land and houses. As a result, approximately half of the villagers have migrated to safe places. The remaining villagers have moved their dwellings into agricultural fields. As a result of the regular disruption and shifting, Gaighat has been sub-divided into three smaller villages-Gaighat, Rampur and Sonbha Ehtemali.

In the late 1980s an embankment was constructed to check the problem of flooding and much of Gaighat was indeed protected from annual floods to some extent. Many houses, however, were located beyond the embankment and most of these collapsed one after another as the river encroached upon them. In 1998 the

embankment breached and the village experienced the worst flood in its history. The initial breach occurred in the adjacent village of Malpurwa and after that dozens of more breaches occurred. The resultant flash flood destroyed many structures and the water also remained in the area for a long period afterwards. There was dangerous flooding again in 2001, 2007 and 2009 but not on the scale of 1998. The history of Gaighat is typical of the history of many villages between the Rapti and Rohini.

The gradual movement of the river often affects those located on the banks of large rivers. They are also flooded on an annual or, in any case, frequent basis. Except during extreme years most of these floods are manageable. When embankments are constructed the situation changes: regular flooding is reduced for villages inside the embankments but the impact of large floods is increased by embankment breaches.

Table 2.5: Ethno-history of floods in Rohini Basin

Chandipur	**Flood events:** 1962, 1972, 1984, 1991, 1998, 2001 and 2002
1962 flood	Flooding caused by heavy rainfall led to loss of property and lives. Villagers took shelter in neighbouring Mahuwari forest and Aligarh village three kilometres away.
Sonateekar	**Flood events:** 1962, 1971, 1980-81, 1986, 1998 and 2001
1962 flood	Flood affected agricultural fields and houses. Sonateeker, Baggha, eastern Gulahriya and Rehar were inundated.
1981 flood	A junior engineer fell in the floodwater. Villagers saved him. Later he lodged an FIR against them. Many villagers were arrested. The matter was settled through compromise, but the villagers see this as the main reason for the neglect of their village by officials.
Fattepur	**Flood events:** 1962, 1964, 1976-78, 1984, 1998, 2000 and 2001
1984 flood	Embankments breached at more than a dozen places and the entire village was inundated. Villagers took shelter in Mahuari forest for about three months. Government did not provide support.
Singhorwa	**Flood events:** 1957, 1962, 1974 and 1998
1962 flood	Floods in the Rapti River marooned the entire village. Crops and houses were ruined and livestock were swept away. According to villagers, the government has raised height of the village in the past but the village is still affected.

Chittahri	**Flood events:** 1904,1952,1962-63,1964,1974,1980,1990,1998,1999,2000 and 2001
1990 flood	The village was inundated. The river flowed through the village and it vanished. Collector of the area suggested that the villagers migrate to some safer place and leave this flood-prone area. No relief was distributed.
Ranapar	**Flood events:** 1957, 1998
1957 flood	Village height was raised under a government scheme.
1998 flood	Embankment damaged near Tighara. Vishunpura, Silhat, Dieva and Ranapar villages were also affected. Sand casting occurred in some fields to a depth of 10 feet. Around 225 animals were swept away. Five elderly persons died due to the lack of food and treatment. Due to lack of timber dead bodies could not be cremated and were thrown in floodwater.
2002	Drought
Gaighat	**Flood events:** 1952-57,1960-80,1985,1997 and 2001
1952-57 flood	The river eroded the village and the inhabitants resettled on adjacent land.
1960	Bank cutting destroyed much of the village
1980	Bank cutting destroyed much of the village
1998	• The flood of 1998 was the most damaging in last 100 years. Many kachha houses and huts were destroyed and some pakka houses developed cracks. Agricultural fields were totally destroyed. Luckily, no human lives were lost. People took shelter in Mahuwari forest. The flood affected all villages. • This flood was a nightmare for people of Fattepur. Due to the heavy downpour, water levels entered houses. People stayed at shelters for about three months. Many houses, huts and agriculture fields were destroyed. Government distributed relief of Rs. 1000/- per household along with some food, and kerosene.
Sonbah Mustakil	**Flood events:** 1950,1962,1962-74,1980-82, 1998 and 2001
2001 flood	Flood destroyed embankment at Shital Majha. As a result, water entered in the village and destroyed everything. The flood drained by breaching the embankment on the south side of the village. Kachha houses and huts were destroyed completely. Stored grain, fodder and fuel rotted. Water logging lasted for around a month.

Kodri	**Flood events**:1965-70, 1983, 1985, 1998, 2001 and 2002
2001 flood	An embankment breached near the village of Hosh. Water remained for about 40-60 days.
All villages were flooded in 1998	

The information and data which helped GEAG in developing its understanding related to floods and its nature in the area are as follows:

Information needed for instructors to guide field practitioners:

- *Historical flood levels or discharge (secondary, local knowledge)*
- *Floodmaps (historical/floodzones) (secondary)*
- *Drainage maps (contour maps with drainage channels) (secondary, local knowledge)*
- *Basemap (villages, riverbasin, block, tehsil, district, state etc) (secondary)*
- *Census (secondary)*
- *Hazard Mapping and inundation levels (secondary and local knowledge)*

Impacts of flooding

The impact of the floods is not only during the floods but it extends to post flooding period and in fact, during the whole year. The impacts are not only in form of losses and damages of life and property but they affect the very basis of livelihoods and make communities vulnerable to a vicious cycle of losses, lack of capacity and poverty. The impacts of floods are also not uniform and it varies according to socio-economic classes, gender, age etc. Hence, DRR planning and reduction of vulnerabilities requires disaggregated information.

The impacts of floods in the Trans Saryu region are devastating. Recurring flooding has destroyed the livelihoods of many poor and vulnerable communities. Health and sanitation suffer, educational institutions are forced to close and employment opportunities dry up. Transportation is rendered difficult and local populations face major problems accessing markets and key services. In some cases, where bank cutting or sand casting occurs, the land is destroyed and owners lose their main productive asset. As a result, those who are able migrate to other areas. The impacts of flooding on women are particularly severe. These aspects are discussed in detail below.

Livelihood system

In most of the case study villages, vulnerable communities usually reside in *kachha* houses made of mud and other locally available materials. These are regularly destroyed by floods (Table 2.6). Each time a house is destroyed other critical assets such as stored food and household goods are lost as well. Losses are great because people have no place to move their things to, even when materials are portable and the flood arrives gradually. Saving bulky materials such as food and fodder is particularly problematic for the poor. Many of the wealthy are, however, able to move their goods onto the roof of their *pakka* brick and cement houses.

When the poor lose everything to floods, they are forced to take loans to meet their consumption needs. Since local moneylenders charge interest rates as high as 120% per annum and daily wages are the main source of income for the poor, they never accumulate the money they need to build a *pakka* house of cement and bricks. As a result, each time floods occur they lose their assets again. Furthermore, if they are dependent on earning a daily wage they often cannot devote enough time to growing crops on the land they own. Thus, they end up depending on the market to meet even their basic food needs. Since food is expensive, food insecurity is high. Despite their clear impacts, not all aspects of flood are negative. In some places, there are examples that flooding helped cultivation of banana, increased soil fertility and helped fisheries.

Table 2.6: Housing condition in case study areas

Types of house	Bagmati	Rohini	Total
Thatched (mud and thatch)	872 (78.7)	374 (37.3)	1,246 (51.1)
Kachha (mud or unbaked brick and sloping tile roof)	114 (10.3)	163 (16.3)	277 (13.1)
Pakka (cement and brick)	122 (11.0)	465 (46.4)	587 (27.8)
Ownership			
Male	808 (91.6)	334 (93.6)	1,142 (92.2)
Female	24 (2.7)	9 (2.5)	33 (2.7)
Joint	50 (5.7)	14 (3.9)	64 (5.2)

*Figures in parentheses represent percentage
(Source : Table 37, Moench & Dixit, 2004)

The level of vulnerability is clearly indicated by the nature of houses in the villages surveyed. Despite the wide variety of house types, only 28% are solidly built *pakka* houses. Men own virtually all houses in these basins. House ownership by women is limited because they have no decision-making authority regarding the selling and buying of property.

The impact of the floods creates a vicious cycle of poverty and livelihoods. The following causal diagram (Figure 2.4), constructed on the basis of participatory appraisals in few villages of Rapti-Rohini basin explains that floods impact various facts of poor life and the overall cumulative effect traps the poor communities in poverty cycle. This information also explains that the problems of floods cannot be solved merely by controlling floods or limiting the interventions to immediate relief. The causes of the problem and inter-linkages indicate that a multi-faceted approach is needed in addressing the problems of floods and the livelihoods of the flood affected areas.

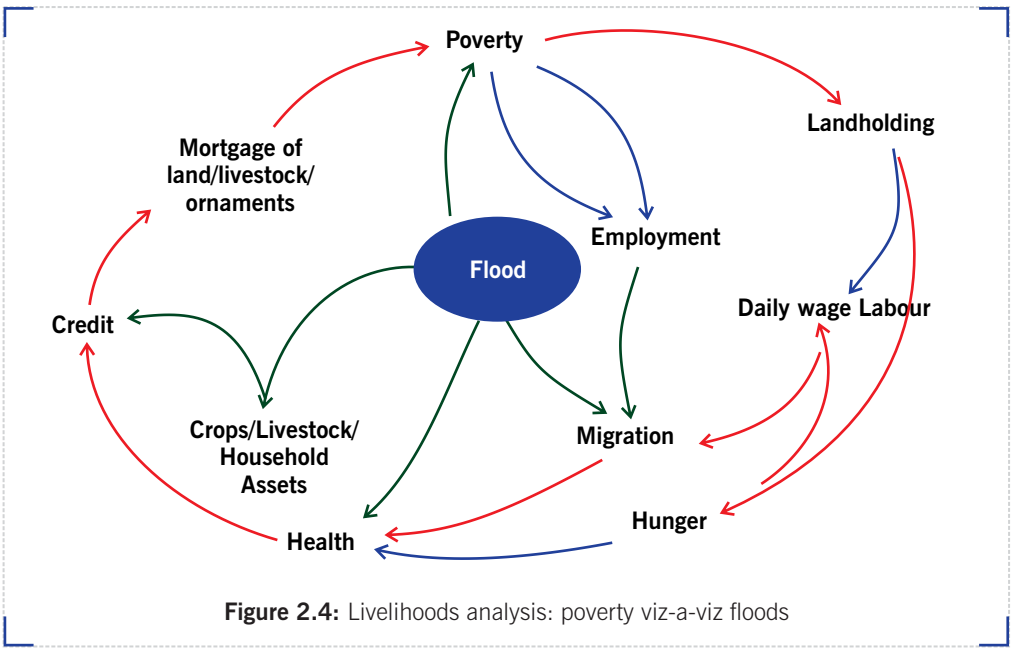


Figure 2.4: Livelihoods analysis: poverty viz-a-viz floods

Information needed for instructors to guide field practitioners:

- *Occupational patterns*
- *Livelihood assets (land,livestock, jobs,skillsetc)*
- *Coping mechanism during and after floods*
- *Housing status (storage facilities, coping strategies)*
- *Major crops*
- *Availability of markets*
- *Mobility of men and women in accessing livelihood opportunities*

Health and sanitation

Poor health is a major problem in all flood-affected study sites. Water-borne diseases such as cholera, typhoid, dysentery and other gastrointestinal disorders are common, particularly during floods. Water related diseases such as malaria and Japanese encephalitis are also common as are some non-water related illnesses. Anaemia and malnutrition are frequent particularly among women and children. The presence of many disease vectors is compounded by the lack of an effective health care system. Due to the poverty and backwardness of the region, well trained doctors are rare and government health services are unavailable or, because of their high cost, private services are inaccessible in most areas. People depend on local knowledge or poorly trained 'health workers' to meet their medical needs.

Local populations attribute many of their health-related problems to the recurrence of floods. Flooding exacerbates poverty and renders local populations unable to attract the types of resources needed for regional development to occur. Social infrastructure such as a health care system has had no chance to develop.

Information needed for instructors to guide field practitioners:

- *Major health related problems during after floods (seasonality of problems)*
- *Number and percentage of households affected*
- *Impact on health (recurrent expenditure, improved hygiene)*
- *Psycho-social impact*
- *Health care availability (govt, private, local)*

Drinking water

The poor health system is compounded by the lack of clean drinking water, a major point of concern in all the villages surveyed. This concern is heightened during floods. The situation in the Rohini is illustrated below in Table 2.7. The GEAG survey of nine villages indicated that a total of 78 public India Mark-II hand pumps (hand pumps with deep boring-more than 120 ft- for availability of water from second strata of ground water table) serve about 15% to 20% of the population. A further 40%, most of who are well off, have installed private pumps drilled to the depth of 30 to 50 feet. The remaining population obtains water from surface sources. Even where they have access to wells, the quality of the water in most is poor and many have dried

up and are no longer functional. As a result, during floods women must spend a substantial amount of time collecting water. Furthermore, in Gorakhpur, even at 100 feet depth groundwater is of poor quality. Many of the poor are forced to drink floodwater. The level of drinking water vulnerability is clearly indicated in the detailed village survey results summarised in Table 2.7 (Moench and Dixit, 2004).

Table 2.7: Sources of drinking water in Rohini Basin

Village	India Mark II	Private	Remarks
Chandipur	9	More than 60% families have private hand pumps, which are generally drilled to a depth of about 40-60 feet	The available water is of poor quality and not at all drinkable. In short, the quantity and not the quality of water is an issue for them.
Sonateekar	6	45 (bore 36' to 50')	1 well (dry). Two or three families jointly use one hand pump. After the flood they got bleaching powder from Block for cleaning water.
Fattehpur	2	45 (30-50 feet)	Even in normal days private hand pump's water gets pale in colour and this changes after few hours. They did not get bleaching powder during or after flood period from the government officials
Singhorwa	17	215 (40-60 feet)	17 hand pumps were provided to the villages with a population of over 2,500.
Chitahari	13	90	During flood, most of the hand pumps were sunk in flood water. People bring water by boat from the open (not inundated) hand pumps.

Village	India Mark II	Private	Remarks
Ranapar	4 (more than 110 ft)	60	During flood, hand pumps not flooded are used for taking water.
Ghaighat	12 (100 ft)	28 (30-40 feet deep)	The quality of private small hand pumps is good.
SonbahMustakil	12	42 (40-50 feet deep)	Cost of 6 hand pumps were shared by individual persons. Except this individual families have also installed pumps. Quality of water is poor.
Kodari		72	Drinking water from hand pumps is polluted. Water is pale and smells bad, Water does not taste good. Only one India Mark-II hand pump does not sink during flood. It is the only source of drinking water during flood.

Source: Table 38, Moench and Dixit, 2004

Information needed for instructors to be told for field practitioners:

- *Drinking water sources and its spread on village map*
- *Quantity of drinking water needs (per capita, per day)*
- *Seasonality of drinking water sources*
- *Quality of water for its potability, sources wise*
- *Who collects water in the family and time consumed everyday*
- *Availability of drinking water during floods*
- *Awareness of community on need of quality water and disinfection methods (especially during floods), health problems due to drinking of unsafe water*

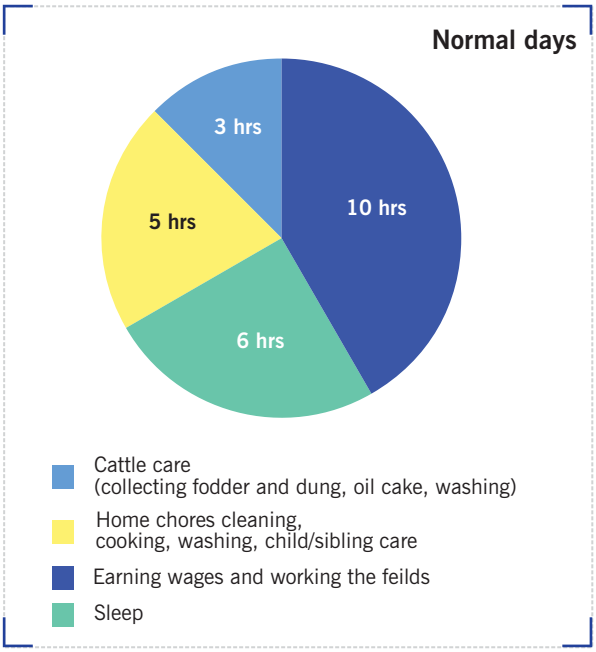
Impacts on women

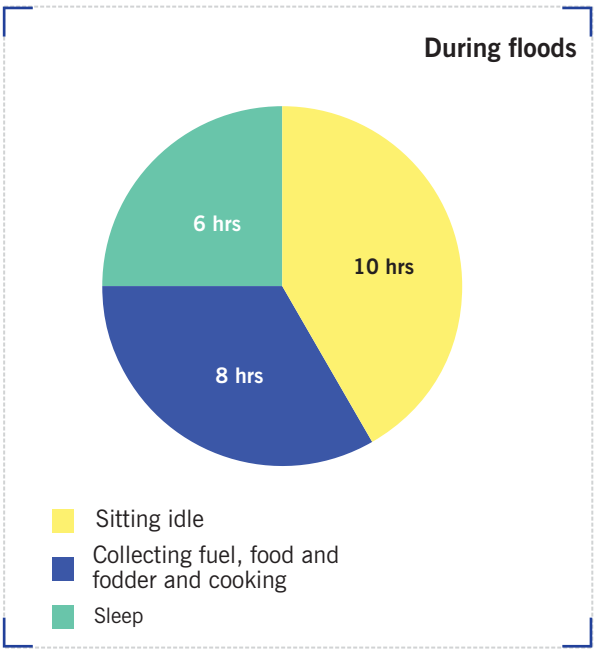
As noted above, flooding has led to a high level of male out-migration and left women with much of the responsibility for dealing with floods. Since exploring the impacts of floods on women provides direct impact on basic survival needs. In a society traditionally influenced by feudal structures based on caste, women in the villages around Gorakhpur and Bihar, for example, have restricted access to food. Specific ways in which floods disproportionally affect women are discussed in detail below:

Responsibilities vis-à-vis workload

Women have the dual responsibility of managing a household (cooking, washing, cleaning, child rearing, etc.) and working outside the home (working in the field or working for a wage). Figure 2.5 shows the variation in workloads for women before, during and following flood events. From the data, it is evident that women's workload is higher during and after disasters than during normal periods. The workload analysis brings up certain salient points:

- During floods, it appears that the workload of women is low, but in reality the trauma and psychological pressure of living in a temporary shelter (on the roadside or on embankments), without adequate food or protection makes their life miserable. Caring for and feeding children and cattle is an enormous responsibility. With inundated homes and fields, obtaining dry fuel becomes a major problem and cooking is very time consuming.





- Finding and collecting fodder also becomes very difficult and the responsibility rests with the women as the men go to nearby towns to look for work. Everyone's health suffers.

- During disaster situations, the productive role of women outside the home is totally disrupted as they are neither able to work in their fields nor have the time to work as wage labourers. They therefore neither have access to nor control over wages.

- During emergency and disaster situations, and during the periods following them, household chores and activities increase dramatically – house repairs, cleaning, drying and fixing belongings, collecting fuel wood and fodder, etc. Regular household activities must also continue.

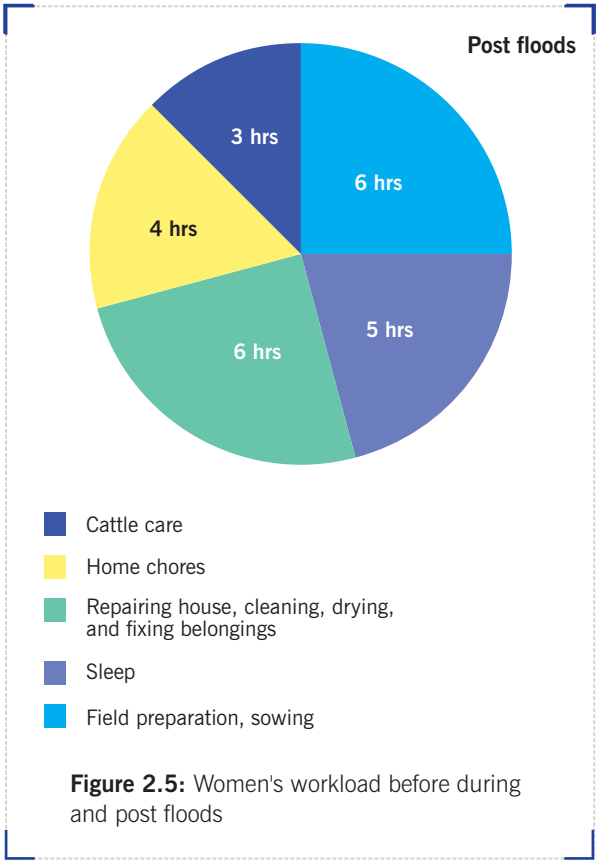


Figure 2.5: Women's workload before during and post floods

(Source: Moench& Dixit, 2004, Adaptive Capacity and Livelihood Resilience)

- Post-disaster periods are the most difficult for women, with reclaiming fields for planting added to repair and maintenance activities as well as regular household chores. In such situations, they have no option but to sacrifice their sleep and time to rest.

Access and control

Women's access to and control over resources, responsibilities and services are important to consider when planning their participation in disaster mitigation and development. Table 2.8 (Moench and Dixit, 2004) presents the access to and control over such resources for both men and women during normal and disaster times:

Table 2.8: Gender differentials in access and control over resources

Resource	Normal time		Flood time	
	Access	Control	Access	Control
Food	F	F	F, M	M
Fodder	F	F	F	F, M
Fuel	F	F	F	M
Cattle rearing	F	F	F, M	M
Home Care	F	F	F	F, M
Wages	F, M	F, M	M	M
Health services	F, M	M	M	M
Market	F, M	M	M	M
F= Female; M= Male				

Source: Table 40, Moench and Dixit, 2004

By analysing the situation, it becomes clear that, during times of disaster:

- Women lose control over those resources which normally are in their responsibility/domain: food, fodder, fuel and cattle rearing.
- The productive roles of both men and women are adversely affected. Women, however, completely lose opportunities to earn wages, largely due to their limited mobility and stereotyped roles. Women lose access to basic services such as health care and access to markets because of their lack of mobility and the unavailability of produces.
- In post-disaster recovery phases, households headed by women suffer the most. Having no control over productive assets such as land, which is never in their name, women face difficulties in obtaining loans. The recurring nature of floods in the region, with the consequent loss of assets, coupled with the total dependency on primary production activities for their livelihoods, out-migration of men is increasing. Women have no option but to manage their household in a situation where they have no control over productive assets.

Many common problems associated with flooding have a particular impact on women. The collapse of a house, for example, damages commodities and property, which are generally under women's control. Thus recovery from a collapsed house creates increased pressure on women. Defecation and the lack of private

places is one of the biggest problems for women and creates a situation where women sometimes have to wait for long periods before being able to relieve themselves. Self-imposed starvation to avoid having to defecate is a common occurrence in flood affected areas. Personal hygiene becomes an acute problem, with genital problems increasing many-fold during floods. Skin diseases, respiratory problems and gastro-intestinal disorders are major problems. Obtaining water that is safe to drink becomes a big problem and women have to manage with dirty, unhygienic water for their families. They are obliged to use flood water for cooking.

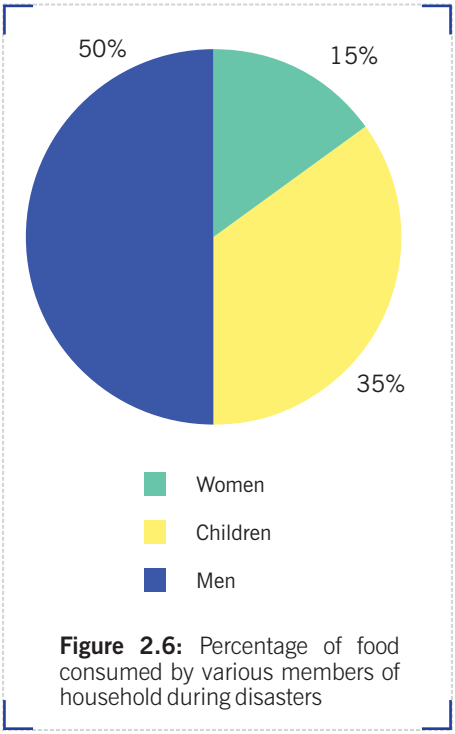


Figure 2.6: Percentage of food consumed by various members of household during disasters

Families who have their own land grow produce for sale and home consumption. Producing vegetables and fodder for sale and home use is generally in the woman's domain, and when crops are destroyed in floods, the women are deprived of direct access to these food sources and the earnings from crop sales. Women also work as agricultural labourers in the fields of others, and as these get inundated, this wage earning possibility is taken away from them. The situation leaves women without any direct access to and control over income and key food sources. As women's earnings are generally spent on their own and their children's needs, such as food, toiletries, hygiene products and clothing, they and their children's are adversely affected by the loss of such income. The change in food consumption that results is shown in Figure 2.6 (Source: Moench & Dixit, 2004).

Health issues

Women eat very little even during normal times, approximately 1,000 calories a day, after the men and children have had their fill. This becomes acute during times of flood when there is very little food available, and women's daily caloric intake can go down to as little as 300 calories a day. In general, women get 15% of the available food, while the men of the family consume 50% and the children 35% as shown in Figure 2.6 (Source: Moench & Dixit, 2004).

In addition to the health impacts associated with food, other health problems are a major concern. Quacks and faith healers play a significant role in the community health care system, and in an area where babies delivered in institutions are still less than 20%, traditional birth attendants play a vital role. When serious diseases or health problems strike, however, allopathic doctors are consulted at Primary Health Centres or private practitioners in towns and cities. In general, women are more easily able to consult local healers and traditional birth attendants and men are responsible for accessing the services of Primary Health Centres or private doctors if needed. Women in this region suffer from various health problems even during normal times. They are more vulnerable to diseases and sickness due to their poor nutrition and consequently weaker bodies. During times of disaster, their problems become more severe. The major health problems, in order of importance, suffered by women during the flood and post-flood periods are shown in Table 2.9.

Table 2.9: Health problems suffered by women during and after disaster

During	After
Skin diseases	Cough, cold
Flu, cold, cough	Fever, malaria
Fever, malaria	Diarrhea/intestinal problems
Body aches	Reproductive tract infections
Respiratory problems	Skin diseases
Stomach disorders	
Diarrhoea	
Reproductive tract infection	

(Source: Moench & Dixit, 2004)

Overall, diminishing resources and limited options during and after a disaster affect the women more than the men. It is clear that although the impacts of disasters affect everyone in general, the extent of suffering varies according to gender, and that women are the worse off.

Prioritising problems

It is common, when attempting to identify the problems faced by a community, that the men only be consulted, and hence that solutions be male biased. This is true during times of disaster as well, and thus the

problems, priorities and needs of women are neglected. As a result, it is necessary to involve women in disaster planning and development and to ensure an effective communication and information system to help them address their situation, needs and priorities. During focused group discussions with women, problems related to floods, both during and after the disaster, that directly affect them were identified and can be prioritised as follows:

First: Loss of commodities and property due to collapsed homes, lack of sanitary facilities, lack of food

Second: Evacuation, lack of fuel

Third: Lack of drinking water, health and disease concerns (both for humans and cattle) shelter

Information needed for instructors to guide field practitioners:

- *Number of men, women, children and aged persons in the village/area*
- *Roles and responsibilities of men and women in various productive and reproductive activities*
- *Changes of roles and responsibilities according to disaster phases (pre, during and post flood)*
- *Direct Income of men and women during normal, flood and post floods period*
- *Gender disaggregated access and control over resources and decision making; changes during eco-stressed situations*
- *Formal ownership of property and resources (land, house, bank account etc) by women*
- *Mobility mapping- men and women during normal and floods situations*
- *Food consumption (male, female, children) during various months (seasonality)*
- *Access to basic needs like drinking water, toilets, health services etc during normal and flood situations*
- *Problem prioritization: Men and women during normal and flood and post flood situations*
- *Health ailments during normal, floods and post floods period (men and women)*

Lack of access to services and transport

The above detailed discussion of the gender dimensions of flood impacts in the survey villages, in addition to outlining many of the root causes of vulnerability, also indicates the close link between overall levels of development and flood impacts. Villagers surveyed in our study regularly raised issues related to lack of access to formal credit facilities, the absence of functioning institutions (banks, government departments, and schools), the lack of all weather roads and communications systems and, during flood periods, the lack of access to markets.

All these aspects increase the impact of flooding and the difficulty of recovering from flood events. Most villages do have access to communication systems (radios and TVs are relatively common) but there is little information available relating to flood prospects that relates directly to their areas. The situation with regard to credit and institutions outlined in Tables 2.10 and 2.11 for the Rohini case study site illustrates the situation well.

Table 2.10: Saving and credit in Rohini Basin

Village	Savings and Credit
Chandipur	Nearest banks are at Compierganj (10 km) and Pipiganj (15 km). The Post Office in Bhanwrabari is also used for savings. People mostly rely on Tharia Baba,' a moneylender at Azamgarh District for loans. He charges exorbitant interest (120%) per annum. Every month, his men come to the village for providing loans and collecting interest. Villagers also take money from the rich men (Mahajan, Sahukaretc) of the village or from their relatives.
Sonateekar	Post Office is situated in another village Sarar at five kilometres. The villagers use banks in Campierganj and Pipiganj. These banks are Gorakhpur regional bank, Union bank of India and State bank of India. Most take loans from local mahajan or sahukar at interest rates of 40% per annum.
Fattehpur	Post Office is situated in Bhawrabari (three kilometres) and banks in Campierganj {10 km) and Pipeeganj (12 km). They usually take credit from the Tharia baba' at the rate of Rs 120/- interest per annum.
Singhorwa	Villagers borrow money from the rich men of the same village or the nearby villages for a variety of needs including festivals, marriages, medical emergencies, etc. They pay interest rates of five per cent per hundred rupees per month. They also borrow from the shops.

Village	Savings and Credit
Chitahari	Generally they use the bank of Bhari and Kauri Ram. They also borrow from Sahukar and the rich people of the village at the interest rate of 60% per annum. Generally they repay interest every month.
Ranapar	People take credit from the rich persons of the same village at interest rates of 24 to 60% per annum. This facility is always available. They also borrow money from their relatives but without interest. After flood people mortgage ornaments. Agricultural land does not remain as an asset. Due to sand-casting it loses its value.
Ghaighat	Sahukar and rich persons of the village provide loans at an interest rate of 10% per month or 120% per annum. During floods, the rich also accept ornaments as mortgage. The poor borrow seeds and food grains from shopkeepers.
SonbahMustakil	The nearest bank is in Madanpur. Very few people have an account in the bank. They use the post office for saving and credit. For loans they usually go to sahukar or the rich man of village of Madanpur. They get credit at the interest rate of 60% per annum. Sometime they get loan without any interest. People mentioned mortgaging their ornaments or selling their cattle during floods. General merchant shopkeepers also provide grain or other material on credit. Villagers return the money when they earn wages.
Kodari	Two banks of Pidra Ghat (three kilometres) and Rudrapur (1/2 km) are used by the villagers for saving and credit. They have to give 10% commission to the officers for taking loan or credit on farmer credit card. The Post Office is in Badha Village (1km). It is also used for saving and credit. Local Sahukar and Mahajans of Pachlarideeh also provide credit or debt at an interest rate of 60% per annum.

Table 2.11: Government and Non-Government Organizations in Rohini and Rapti

Village	Government and NGOs
Chitahari	Panchayat Bhawan located in the village is used for meetings of governmental officials and other block level functionaries. Sometimes people also get involved in these meetings.
Sonateekar	There is one women's self help group. They use this to deposit fixed amounts and take internal or external loans for marriage, festivals, and to meet agricultural needs. No other organisation exists.
Fattehpur	Not a single government or non- government organisation works here. Villagers are ignorant about the schemes of Government and other support.

Village	Government and NGOs
Singhorwa	No Institutions
Chitahari	No Institutions
Ranapar	There is one women's Self Help Group (SHG) formed by Swarna Jayati Swarozgar Yojna. The main purpose is saving and credit for general consumption. Jan Kalyan Sansthan an NGO is working in Ranapar. After the flood this organisation worked on land levelling, removing RANA (straw) and also initiated growing sugarcane on the sand laden area. Four bore wells were also drilled.
Ghaighat	There are two self help groups (SHGs) operating in the village for savings and credit. People use these taking for consumption loans. The groups are not any income generating activity and are not recognised in the village.
SonbahMustkil	There are two self-help groups in the village. The male SHG is linked with a local bank while the female SHG is no1. Female SHG collects money and uses this to provide loans to members. Neither SHG is involved in other activities.
Kodari	8-10 farmers are members of a cooperative society located in Pachlari Deeh. They take fertilizers and seeds from that society. It has not worked for at least 6 months (2003 march). They now depend on retail shops of Pachlari Deeh and Rudrapur. There are three self-help groups of women. They do not work in community level preparedness or in any income generating work.

Information needed for instructors to guide field practitioners:

- Mapping of service providers (especially on services like agricultural inputs, credits, health facilities, compensation, shelter, programmes/schemes helpful in post flood recovery, communication etc.).
- Effectiveness of services.
- Availability and effectiveness of existing institutions providing services.
- Households having communication facilities (radio,TV, phone etc.).

2.3 Vulnerability analysis

It is known that the vulnerability is caused mainly by the exposure of the hazard and the socio-economic conditions of the affected community. It is important that the vulnerability of the area and the most vulnerable groups are understood before starting the DRR interventions. The limitation of resources also demands that the most vulnerable communities are addressed on a priority basis. In virtually all situations, different groups face different levels of risk in relation to specific hazards.

A tangible example is the tendency of poor populations to cluster in high-risk areas such as urban and rural flood plains. As a result, they have a far higher level of vulnerability to flooding than groups living in less hazard prone areas. Interventions to mitigate flooding can be designed that meet the needs of such groups. However, in many cases interventions that might "benefit" the larger society as a whole actually increase the risk some groups face. The fact that interventions often have differential effects or may not reach specific groups is common across most hazards and contexts. In many situations the factor scausing vulnerability are not as direct or immediately evident as in the flooding example given above. Instead, vulnerability may be related to culturally based gender differences (women can be more vulnerable to floods due to cultural inhibitions on swimming or clothing styles), differential access to basic services (you cannot call for help as effectively if you do not own a phone), and a host of other factors. As a result, clear understanding of patterns of vulnerability is essential to identifying effective risk reduction strategies.

This understanding needs to move beyond the immediately evident exposure to specific hazards and address deeper systemic factors that shape risk for different groups. Furthermore, we believe it is important for approaches to vulnerability analysis to be based on common metrics -indices, maps and disaggregated data -in order to provide an effective basis for planning and decision-making. At present most approaches to vulnerability analysis are narrative based. Because of this they are difficult to map in ways that illustrate the concentration or diffusion of vulnerable groups. They are also difficult to aggregate and disaggregate in ways that assist in identifying common factors contributing to vulnerability across large areas or multiple groups.

The concept of vulnerability has been one of the most insightful and influential additions to hazards and climate change research during the last three decades. Although vulnerability is a contested term, partly because of different epistemological roots which are beyond this summary, we define vulnerability as a "set of conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impact of hazards," (the Hyogo Framework, 2005-2015, adopted by the UN at the World Conference on Disasters in 2005).

While vulnerability analyses from varying intellectual and theoretical perspectives have enriched the conceptual and analytical understanding of the patterns of damage from environmental extremes, their contribution to the policy realm has been peripheral at best.

The Vulnerability and Capacity Index (VCI), as evolved by a coordinated study, including GEAG, identifies eleven most critical drivers of vulnerability and its converse, capacities, from the universe of drivers of social vulnerability identified in the literature.

The index is not comprehensive, but rather indicative. Because it is concerned with persistent conditions that drive vulnerability, the index does not measure them relative to any thresholds of damage from specific hazards as some other vulnerability indices. The overall weight distribution of vulnerability drivers between the three categories of material, institutional and attitudinal vulnerabilities is 35, 50 and 15%,respectively. Table 2.12 outlines the VCI used for households in rural areas. The scoring of categories would be different for urban areas and for assessments at the community level.

For details on scoring and more information on rationale for the different indicators as well as examples of its use in different contexts, rural/urban and at the house holdor community level in each context, one can refer to Risk to Resilience Working Paper No. 2 (http://www.i-s-e-t.org/images/pdfs/WP%202_highres.pdf). Brief introduction of various parameters in this index are being provided in following heads and the data requirements are being furnished in the table.

Material vulnerabilities

A diverse livelihood strategy, rather than the quantum of income, is one of the key elements of resilience against environmental hazards (Moench and Dixit, 2004). Therefore, the diversity and stability of livelihoods is listed as a key component contributing to capacity and its converse to vulnerability in this case.

Formal education, as a driver of vulnerability is considered, as this may be a factor for gaining access to livelihood opportunities and facilities both in rural and urban areas, although the degree of importance may differ.

Liquidity of assets can be important in terms of helping recovery. For example, maintenance and selling of farm animals to recover from flood damage is often an important component of recovery. It may also include sale of valuable items, e.g., jewellery, scooters, land etc. However, sale of these assets in some cases can seriously undermine the resource picture and mobility of the household.

Exposure to specific hazards is a component of material vulnerability, but only a component and not the whole picture. Attention has to be on the social in addition to the physical component as well.

Institutional vulnerability

Social networks and social capital have been deemed to be important contributors to building resilience and helping recovery from hazards particularly since they can be conduits for information, preparedness, relief and recovery.

Extra-local kinship ties, although important, are difficult to assess in terms of their quality. However, there is also evidence that sometimes, extra-local family members are either unable or unwilling to extend significant help to disaster victims, possibly because of their own precarious livelihood situations, and can at times become a burden in terms of social obligations rather than an asset.

The proportion of dependents in the household is similarly considered to be an institutional vulnerability because the effects of it are institutionally mediated. Having a large family by itself is not a bad thing, because of the extra labour that comes with large families in rural settings. But dependents, particularly young children and the elderly, in the absence of social systems for taking care of them, can be a drain on family resources.

The infrastructural measures are similarly listed as institutional vulnerability, because they are a function of the quality of governance in a society. Warning systems are a special case where just the existence of a warning system is not sufficient, but rather its credibility and awareness is just as important.

The last category of belonging to an ethnic minority and/or a lower caste can be an important factor in determining vulnerability. Similarly, for ethnic or religious minorities, sometimes specialized networks can facilitate access to resources for relief and recovery in addition to employment and education opportunities.

Attitudinal vulnerability

Among the attitudinal vulnerabilities, *sense of empowerment* is considered to be the key category. Proximity to local and regional power structures in addition to a personal sense of efficacy—all self perceived—is evidence of a sense of empowerment in the face of adversity. Proximity to power structures can be very effective in terms of channelling relief and recovery in the aftermath of disasters and even gaining access to government services in addition to critical productive resources which otherwise may not be possible for disadvantaged poor, minority or low caste groups. Furthermore, people's knowledge about and attitude towards potential hazards can also be critical in determining behaviour and vulnerability to hazards.

Data to compile the VCI can be drawn either from primary sources (e.g. household surveys or focus group discussions for the community level VCI), or from secondary data sources (existing surveys). All data collection tools that were developed and used in the process were simple enough for community researchers to adopt; the idea being that they could repeat this exercise six months or one year down the line to look at the impact of the various adaptations or DRR interventions. Before undertaking data collection, there must be thorough discussion of the scoring technique amongst field team members. Scoring should be done by at least two field researchers, particularly for some of the more difficult calibrations on livelihoods, assets and exposure.

Table 2.12: A Composite vulnerabilities and capacities index for the household level in rural areas (RHH-VCI)

S. No.	Types of vulnerable and indicators	Vulnerability	Capacity
	Material vulnerability	**35**	
1	***Income source:*** If 100 per cent dependent on a local level productive asset, e.g. fishing, land, shop, tec. • Lower vulnerability score by 1 for every 10 per cent of non- local income reported • Subtract 2 if the income source is stable and insensitive to local hazard. • Add 2 to the score if the income source is unstable, e.g. day labour	10/12	
2	***Educational attainment:*** If no member of the household is literate • Lower vulnerability score by 1 for every 5 years of schooling of the most educated male member of the household • Lower the score by 2 for every female member's 5 year schooling	5	
3	***Assets:*** If none of the assets are immediately fungible, e.g. farm implements, household items • Lower the score by 1 for every Rs. 20,000 of fungible assets, e.g. tractor, animals saving, jewellery (to be calibrated empirically)	8	

S. No.	Types of vulnerable and indicators	Vulnerability	Capacity
	Material vulnerability	**35**	
4	***Exposure:*** Distance from the source of prime hazard, e.g. river, coastline, landslide zone. If within the equivalent of 10-yr flood plain. • Lower the score by 1 for the equivalent of every 10-yr flood plain residence and or assets. • Lower the score by 1 for every piece of evidence of hazard proofing, e.g. building of a house on higher plinth for floods, light construction, low cost construction which could be rebuilt with local resources.	10	
	Institutional vulnerability	**50**	
5	***Social network:*** Membership of ethnic, caste, professional or religious organization or grouping. If none, then • Lower vulnerability score by 2 for every instance of past assistance by a group/ organization in adversity. • Lower multiple times if multiple organizations. • Lower score by proportion of respondents reporting the organization to be efficacious.	10	
6	***Extra local kinship ties:*** If no extra-local kinship or other ties which could be source of shelter and assistance during adversity • Lower the score by 2 for every immediate family member living extra-locally • Lower the score by 1 for every non-immediate family member living outside	5	
7	***Infrastructure:*** Lack of an all-weather road If seasonal road then Lack of clean drinking water Lack of robust telecommunications (mobile coverage) Lack of local medical facility	4 2 2 4 4	-4 -2 -2 -2 -4 -4

S. No.	Types of vulnerable and indicators	Vulnerability	Capacity
	Material vulnerability	**35**	
8	***Proportion of dependents in a household:*** If the proportion is greater than 50 per cent • Lower the number by 1 for every additional earning member If a single parent headed household	5 or 10	
9	***Warning systems:*** Lack of a warning system Warning system exist out people are not aware of it or don't trust it	4 or 4	-4 or -4
10	***Membership of disadvantaged lower caste, religious or ethnic minority***	5	
	Attitudinal vulnerability	**15**	
11	***Sense of empowerment*** Self declared community leadership or Proximity to community leadership Proximity to regional leadership structure or Access to national leadership structure Lack of access to community or regional leadership Lack of knowledge about potential hazards (lower score by 1 for every type of hazard and its intensity accurately listed by respondents)	10 5	-10 or -10 -15 or -15
Total possible vulnerability score		**100**	

Who is vulnerable: the case of Rohini Basin

Socio-economic vulnerability

Due to flooding and poor drainage, large expanses of land in the Rohini Basin remain water logged and fallow for long periods, sometimes permanently. Breaches in embankments occur regularly, causing immense and often irreversible damage to agricultural land and property, resulting in lost livelihoods for those dependent on the farming sector.

Over the past 10 years, 45% of households have had at least one death in the family due to floods, and in 65% of these households, victims were an earning member. While a significant percentage (24%) of casualties was caused by drowning, flood related deaths are caused also by other factors such as snakebites, malaria, diarrhoea and viral infection.

The type of housing structure not only determines the extent a house is damaged during floods, but also affects the risk faced by assets inside the house. According to the survey, 55% of houses in the Rohini are pukka (brick), which, of the common local building types, offers the greatest resilience to floods; 16% are semi-pukka and 29% *kuchha* (mud). During the 1998 flood, 43% of surveyed houses were devastated, while the 2007 flood destroyed 21% of houses. Housing thus provides limited protection during floods, with only 16% of people taking shelter on their own or a neighbour's roof.

Most of the population does not have access to potable water, exacerbating their vulnerability to waterborne and gastro-intestinal diseases especially during floods. A majority of households (71%) fetch drinking water from open dug wells, which are not well maintained. Many of the un-lined *kuchha* wells cave in due to excess moisture. Privately owned hand pumps provide poor water quality, especially during and after floods, because of their shallow nature and tendency to become submerged. Government hand pumps generally deliver potable water during non-flood periods but they are rare.

Private sanitation facilities are limited with only 17% of households owning a toilet, and very few people use them due to cultural/religious habits. Furthermore, none of these toilets are built on elevated land or with higher plinth levels, rendering them in-operable during floods. Poor sanitation leads to an increase in cholera and gastrointestinal diseases, exacerbated during floods. Water logging leads to increases in vector borne diseases such as malaria affecting both humans and livestock.

Floods cause enormous hardships to all people, but especially to women, children and the aged. Women suffer from reproductive health problems arising from flood conditions. Their workloads are increased and they are challenged to meet basic needs of their families, such as obtaining water or food. Additionally, situations for women's personal hygiene and sanitation are compromised during flood situations.

Financial vulnerability

The average financial losses of surveyed households due to the floods of 1998 and 2007 are shown in Table 2.13 (Moench & Dixit, 2007). Comparing total household losses with average income reveals that income loss due to floods are most dramatic for people below the poverty line, but also significantly high for all households. Recurring droughts (among other economic shocks) also cause significant financial losses, and the impacts of the 2004 drought are included in Figure 2.7 (Working Paper 5: Risk to Resilience, 2008) for comparison to those of the 1998 and 2007 floods.

Table 2.13: Household average financial losses in USD due to floods in1998 and 2007

	1998 Flood	2007 Flood
Crop Losses	101	76
Total Wage Losses	39	37
Additional Expenditures[5]	13	15
House Damages	160	22
Asset Damages	96	11
Total	410	161

The percentage of household losses compared to average annual income were significantly less in the 2007 flood than in that of 1998. Households may have increased their resilience with improved housing (pukka construction), better access to early warning systems through communication technologies, and improved transport infrastructure enabling residents to move assets to safety. Financial means to cope with floods are limited for the average household in the Rohini Basin. The initial and obvious source of disaster risk financing during and after an event is a household's own assets and income. However, only 15% of the lowest wealth classes and 50% of the highest classes report income sufficient to cope with flood impacts. Livelihood

diversification is generally believed to be an effective risk reduction strategy and in the Rohini Basin, 38% of households changed employment after floods. There are, however, only limited diversification opportunities in this predominantly agricultural region. Currently, only non-farm wage labour and service industries provide more income than agriculture, 10% and 83% more than farming one's own land, respectively. Agricultural wage labour (37%), business (sales kiosks, 75%), animal husbandry (33%), artisanal crafts (33%) and other income sources (25%) provide farless income than farming. As a result, most households (80%) earn their living through farming-related livelihoods, at risk to floods.

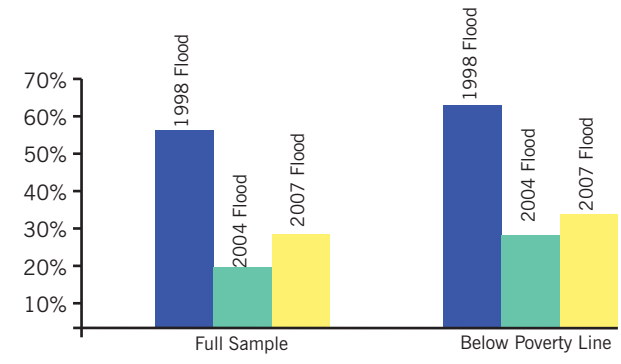


Figure 2.7: Recent flood and drought household losses as compared to average annual income

Relief, primarily governmental and not dependable, is often perceived as the primary source of disaster risk financing for poor and/or marginalized communities. Despite this, in the RohiniBasin, only 29% of households received relief after floods, and 19%receiving compensation payments after droughts. In both cases, payments were made long after the event (on average 1 month for flood relief, and 4 months for drought).

As household savings are insufficient to cope with disasters, the primary sources of funding during and after floods are local money lenders (who charge extremely high rates of interest) followed by other community members and family (Figure 2.8). Repayment of these debts adds significantly to households' financial burdens during disasters, with only 6% reporting that loan providers show some flexibility in repayments during droughts.

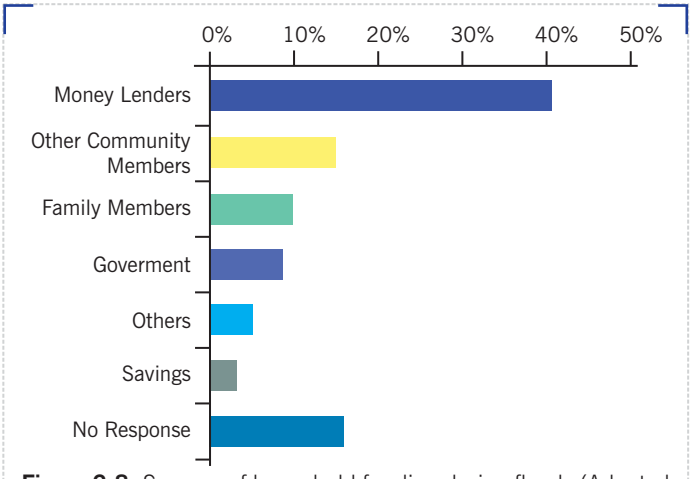


Figure 2.8: Sources of household funding during floods (Adopted from figure 3, Catalyzing climate and disaster resilience, Risk to resilience team, 2009)

Spatial vulnerability

Villages located close to the Rohini River or the embankments are vulnerable to

erosion, sand deposition, river flooding and water logging. Thirteen villages are trapped between the river and the embankment, suffering increased flooding and sand deposition. It is generally the poor and low caste whose land and homes are situated in low-lying areas close to the rivers, especially in flood prone areas. People in these villages tend to shift their houses onto the embankments during floods, living in temporary shelters that sometimes become permanent housing. These villages lack the most basic infrastructure, such as roads, and due to water logging and/or regular deep flooding, most of their lands have become unfit for cultivation.

There are 48 villages located within one kilometre behind the embankments. Here, large tracts of land remain water logged due to flow and drainage obstructions caused by embankments. The embankments block water from local rainfall from flowing in to the river. In addition, water seeps through the embankments, inundating or causing water logging in adjacent land. *Kharif* paddy is either partially or fully destroyed and even *Rabi* wheat cannot be sown or suffers from lower productivity. Incidence of vector borne diseases has also increased in these villages. An additional 75 villages, 1–3 km from the embankments also suffer in years of high floods, especially when embankments breach in the vicinity or inundation is caused by water backing up from blocked drains. Siphons are frequently either closed during high floods or have become useless due to silting and clogging. Therefore about 136 out of 837 villages in the basin are directly affected by flooding, which is often exacerbated by the embankments. Another 267 villages lie within two kilometres of the river, mostly in the upper reaches of the basin. Here numerous hill streams and drainage channels cause much flooding and sand deposition, and the villages are unprotected by embankments or other structures.

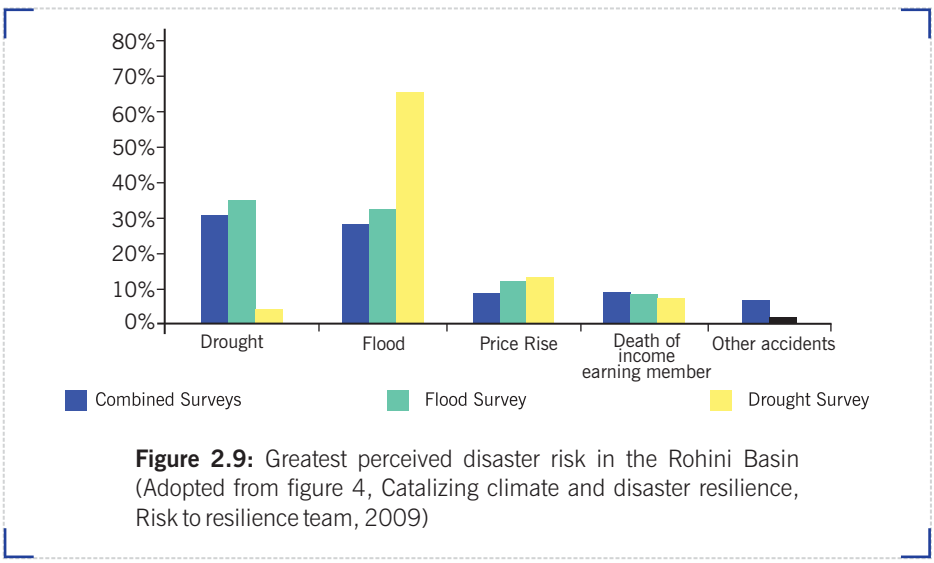


Figure 2.9: Greatest perceived disaster risk in the Rohini Basin (Adopted from figure 4, Catalizing climate and disaster resilience, Risk to resilience team, 2009)

Summary

Eighty per cent of survey respondents consider flood impacts on their families to be high. The greatest natural disaster risks in the Rohini Basin are perceived as flood and drought; however, the importance of commodity price shocks should not be ignored (Figure 2.9). The high dependence of the population on agriculture and the sensitivity of this livelihood to external factors are clear, as is currently being experienced with global price rise impacts in India.

The entire population in the Rohini Basin is vulnerable to floods, with certain location sand villages at higher risk than others. As this is one of the poorest areas in India with approximately 50% of the population below the poverty line, the population does not have the financial means to cope with floods, and barely any resources to spend on livelihood investments, much less flood risk reduction. Centralized flood risk reduction approaches have led to a strong dependency on the government for disaster management. Over 90% of those surveyed feel that the government should have primary responsibility and is the most trusted entity for preventing and responding to hazards.

Vulnerable groups: the gender context

Poverty levels in Eastern U.P. are higher than in other parts of the state and agricultural growth has been characterized by green revolution inputs which has affected soil sustain ability and agricultural productivity as well as increased social inequity. Floods and water logging are annual as well as perennial problems, while mechanization has caused considerable labour displacements. This in turn, has led to high male out-migration to distant urban areas, putting an additional burden on women to manage land in the absence of any recognition of their roles and limited control, let alone access, over to productive resources.

Not only are women denied land rights, there are marked gender differentials in agricultural wages, in the gender division of labour and in the valuation of women's work. In addition, the low status of women, particularly dalits, tribals and Muslims, is indicated by the sex ratio (881 women for 1000 men according to 1991 census) and gender discrimination in terms of access to education, health and nutrition, marriage practices (high dowry and limited control over one's body (Moench & Dixit, 2000). Cultural norms also limit women's mobility and decision making roles.

The cultural and social environment of the area has denied the weaker sections the access to development and services. Illiteracy, poor health, access to information and other such factors have played significant role in marginalizing these communities and making them vulnerable. Dalits and women have been the worst

sufferers and the disaster situation enhances their vulnerability and livelihood related risks. Loss of property and crops, non-availability of food during and after disasters, problems in access to health, education and other basic services etc. further deteriorate the situation of affected people in an area which is already poverty stricken. This vicious cycle goes on and on and the disasters like flood only accelerate the process. Floods have played a major role in poverty of the area and vulnerability of marginalized communities.

Women, as the co-worker in earning livelihoods, with their male counterparts and as managers of their households have a dual responsibility and hence the workload. The effect of floods in this way directly and more strongly affects the women of marginalized communities. Disaster like floods on one hand further enhances the vulnerability of women and at the same time also affects their participation in development and well being. The situation and problems of women, in the context of flood specific disasters, are being discussed in following paragraphs.

It is important that quantitative and qualitative data and information is collected, on the gender aspects, for any intervention related to disaster risk reduction in flood prone areas. Such information helps in prioritizing intervention areas and evolving mechanisms to address women- one of the most vulnerable group of the community.

Conscious attention has been paid to women groups and their problems and priorities have been addressed in the intervention areas. The information needed in this regard and the methods used for collecting such information are being furnished in Table 2.14.

Table 2.14: Relevant issues in vulnerability – types of information needed and their sources

Issue	Information	Method of collection
Status of women	Demographic data, male: female ration, women headed households	Census data, village records, social maps
Productive, reproductive roles as affected by floods	Roles and responsibilities work loads	Listing of responsibilities in the groups of men and women; Division of labour and activities during 24 hours cycle- before, during, after floods

Issue	Information	Method of collection
Access and control affected by floods	Assets, resources and livelihood issues and access and control of men and women during normal and flood affected timings Access to government schemes helping in coping with floods	FGD with men and women groups: Listing of household assets and resources and issues where decision making is needed: Access and control of men and women during normal and flood affected periods Listing of relevant govt programmes and FGDs with men and women groups
Priority problems	Problems and priorities of problems during and after floods	Problem listing and prioritization, matrix ranking, FGDs
Health	Health problems and facilities	FGDs with women groups

Assessing vulnerability

While working on adaptation and livelihood resilience in Rapti-Rohini basins, as a part of South Asia collaborative research-cum-pilots programme in coordination of ISET, it was identified that patterns of vulnerability, the nature of ecosystems and status of communication were the three main parameters broadly capture the context of vulnerability.

The vulnerability assessment consisted of following processes:

- Mapping exposure to climate hazards: the physical and ecological mapping of different risks and potential hazards
- Understanding system vulnerability: the extent to which a given system will be affected by those risks and potential hazards, as determined by differential vulnerabilities, physical and social spaces and structures
- Assessing adaptive capacity: the ability to reorganize and minimize loss at different levels and measured by system resilience and the perceptions and motivations of actors

Participatory methodologies (PRA/PLA) were quite helpful in vulnerability assessments. The participatory tools used for various variables and parameters are being summarized in following Table 2.15 (Moench & Dixit, 2004):

Table 2.15: Vulnerability assessment, variables and tools

Parameters	Variables	Tools used
Vulnerability	Livelihood analysis: Existing livelihood options (local and non local), household occupations (primary and secondary)	Social map
	Uninformed migration: Trends and patters of migration, individual household migration, preferred destination of migration	Seasonality, social map
	Food insecurity: Food deficient months, season wise food habits	Seasonality, focussed group discussion
	Hazard and vulnerable groups: Major hazards, affected areas and households, vulnerable groups	Hazard map
	Services and opportunities: Major services and their status, levels of access and satisfaction	Service and opportunity maps
	Physical infrastructure: Types of infrastructure and status, including agricultural inputs, transport, electricity, hospitals etc	Site visit, FGD
	Social capital and belief system: Existing community based organizations and their focuses, social norms and traditions, local perception of hazards	FGDs and interviews

Parameters	Variables	Tools used
Communication	Existing means of communication and their trends Information needs Existing information on available weather forecasts, flood warning and level of inter-departmental coordination in disseminating such information	Social maps, trend analysis
Ecosystems	Existing ecosystems Changing patterns of availability and use of natural resources Impacts of floods and livelihood practices on ecosystems	Resource map, FGDs, transect walk

Source: Adopted from table 4.1, Adaptation and Livelihood Resilience, Dixit, 2004.

Addressing vulnerability

The vulnerability attributes identified on the basis of situation analysis and cause analysis, in various villages of Trans-Saryuregion, were as follows:

- Susceptibility to physical damage
  - Mud houses
  - Inundation of cultivated land
- Lack of safe drinking water, especially during floods
- Lack of access to sanitation facilities, especially during floods
- Lack of irrigation facilities after floods
- Low income, landless groups
- Lack of access to information and early warnings

Such attributes are helpful in identifying the most vulnerable groups/population and the causes of risks and vulnerabilities which are needed to be addressed on a priority basis.

The risks have potential for increasing vulnerability. The actions for addressing the vulnerabilities can be classified into two broad groups:

(i) The interventions directly addressing risks, for example for the agriculture based marginal farmers it is helpful if non-farm activities are integrated. Such diversification helps in situations of crop losses due to floods.

(ii) The interventions addressing underlying systems for risk reduction, for example the general diversification within economic and livelihood systems help the agriculture based small farmers.

Information needed for instructors to guide field practitioners:

After going through the unit the readers are required to answer the following questions:

1. Is your area affected by floods? Describe a recent flood incident in your vicinity and elaborate on the impacts caused?
2. What are the institutional mechanisms at your district/city/state level to face the impediments of flood occurrences?
3. Assess the vulnerability index of your region or near your place and find out any gendered approach for relief in times of post-disasters?
4. Can you suggest some ways of reducing the vulnerability of your area to any ofthe disasters, if possible floods?

3

LU-B: Towards Flood DRR Planning

After acquiring knowledge about the hazard and vulnerability of Gorakhpur, in learning unit B the readers shall be introduced to disaster risk reduction planning in context of floods in Gorakhpur region.

In this unit, learners will be able to understand:

- The convergence of community and government interventions.
- Tools and methods to perform hazard, social vulnerability and resource mapping at village level involving communities.
- How to make a social chart based on vulnerability data for a particular flood affected region.
- How can one plan for an impending disaster by charting out different resources which shall be required during disaster.
- What are coping mechanisms opted by the community in the flood prone villages.

3.1 Convergence: Community and government interventions

It is well known fact that communities are the first responders in the disaster events. It has been observed during various floods in Trans-Saryu region that communities have to face the brunt of floods and it is them who manage the impacts of floods with their own resources and abilities. The government interventions are secondary and quite small compared to the efforts of communities. However, in the last decade Government has taken various actions and initiatives for strengthening the institutional and programmatic support

to disaster management. It is necessary, however, that the DRR interventions of the communities and the government is in synchrony and are planned in the context of local ecology and geo-physical situations and are designed to address the priorities of vulnerable communities. The inter-complementarity of efforts can enhance the impacts of the initiatives in a big way and the invested resources and efforts will be more meaningful and sustainable.

Gorakhpur Environmental Action Group has worked for facilitating the convergence of efforts made by various stakeholders in addressing flood related problems. It was also necessary that the efforts of various stakeholders are understood in the local context and needed advocacy is undertaken through pilots and dialogues.

The flood preparedness, response and recovery-rehabilitation cycle covers the whole year, with the major time period division as follows:

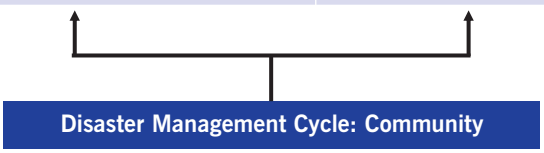
Preparedness	:	Before March and intensive during March-May
Response	:	June-July to September
Recovery	:	October-December and beyond

For the local communities, the activities for preparing to face the flooding starts during March-April onwards when the community make efforts for identifying and locating safe places in case of required evacuation and storage of flood, fodder and fuel. This is also the time when people make arrangements to protect the houses in case of inundation. Repair of mud walls and roof tops, raising the adjacent areas near habitation etc are the usual practices in this regard. The community also repairs the nearby embankments to protect it from the eventuality of flood and such repairing efforts and protecting it from breaches are generally on a voluntary basis. Communities prepare and make arrangements for light (kerosene oil lamps) and polythene sheets. During the floods, whole village unites in saving life and property of people and evacuations to safer places along with their cattle. It is a normal practice that pregnant women are sent to their parents or relatives. After the floods, communities make efforts in procuring information about the relief packages and relevant schemes and compensations. However, availing compensations (such compensations are provided generally for collapse of houses) is a tedious work and the actual availability is only towards the end of November/December or even later. In the recovery period of post disaster, organizing credits for agricultural inputs, house repair etc. is also a problem.

Proper and timely information to communities, related to various activities of disaster management, are required to be ensured. The time of such information and related activities, if matches with the activities cycle of community, becomes highly useful. A plan of such information, according to management cycle is being provided in the Table 3.1 below. As this cycle cannot be standardized, the information cycle may also vary for different areas/districts.

Table 3.1: Information cycle indicating time period, activity and required information.

Time/Period	Activities	Required information
Oct – Nov	• Arranging credits • Repair of houses • Arranging agriculture inputs	• Depots/ stores for agriculture inputs, varieties etc • Availability/ methods for availing credits • Employment opportunities/ schemes
Sept- Oct	• Compensation/ recovery information • Medicines • Repair of houses	• Reporting points for damages • Compensation schemes/ methods of accessing it, points for receiving it
Aug – Sept	• Shifting to safer places • Care of vulnerable individuals • Staying at embankments	• Water situation/forecasts • Care points: Health, snake bites etc. • Food availability
July – Aug	• Monitoring/ protecting embankments • Boats, polythene etc	• Forecast/ warning and health • Nearest flood and health post and available services • Availability of boats • Availability of polythene/ tarpaulin during emergency • Reporting point for breaches/ cuts of embankments
June – July	• Arranging petromax/ lantern • Repair of drainage channels	• Availability of kerosene oil during flood • Nearest PDS depot for food grains/essential commodities
April – June	• Identification of places for temporary shelters • Storage of food grains • Raising plinth of houses • Vaccination of livestock • Repair of embankments	• Places of temporary shelters • Vaccination requirements (cattle and people) availability • Do's and don'ts in emergency



The reliability of information, however, is crucial. Availability of services, personnel etc as informed to community will have to be ensured. All care will have to be taken in this regard as the accessibility and communication during floods is extremely difficult and any misinformation in such difficulties only enhances frustration of affected communities.

For example, availability of compensation for collapsed houses during October-November when people are busy in repairing/ re-construction will be helpful. Similarly, availability of credits and agricultural inputs, in required quantities, will have to be ensured during October-November. Such timely assistance will ensure its effectiveness and usefulness.

3.2 Community led village flood risk management plans

Village level Disaster Risk Reduction micro-plans have been helpful only if these have been developed by the community and the needs and priorities of the communities, especially the most vulnerable groups, are adequately addressed in such planning. The information required for such plans are both secondary and primary. PRA tools have been quite helpful in developing such plans. The methods and required information in developing such village DRR plans are being explained below:

Social mapping of the village

The social mapping being the first participatory exercise, care should be taken to develop an atmosphere where community can come forward and actively engage in providing necessary inputs.

Generally people do not feel confident in drawing a map and they suggest that teacher, Patwari or educated men will be the best person to draw the map. What we can do is we draw an outline on the ground or chart paper (with the help of a stick/stone or ink marker) showing the place (school, temple or any place) where everybody is sitting. The adjacent place is also drawn and gradually pen or stick is given to community members who draw adjacent lanes, houses etc. Many people start taking

The social map usually gives following information:

- *How the village is inhabited*
- *Lanes, roads, embankments (mud, brick)*
- *Houses (mud, brick, huts)*
- *Drinking water sources*
- *Electric connection*
- *Community places (temple, health post, school, Public Distribution System (PDS), shops, Panchayat building)*
- *Caste/religion wise inhabitation/ settlement pattern*

interest and they guide the person drawing the map. The map is corrected repeatedly. People start feeling confident and develop the map of whole village. Local materials like seeds, leaves, pebbles, twigs etc may be used to mark various things. If the map is drawn on ground, it can be copied on a chart paper. Community can be asked to draw roads and embankments, as well.

Inferences:

- Population: Men, women, children
- Caste structures, number of houses and locations
- Kucha/ Pucca houses
- Occupational patters
- Linkage with services/markets
- Common places (school, community building, Panchayat building etc).
- Cattle
- Other livelihood patterns
- Links of village with roads, markets, bank etc.

Figure 3.1: Village Razapur social map

Venn diagrams:

(Availability and accessibility to services)

Cut small circular cards and ask community about the most effective services/ institutions/ resources for managing floods. This is shown by larger circles. The other services and institutions are asked and according to their effectiveness they are given size of card. One card showing village is kept in the center and community is asked to place other cards near or far from the village card according to their physical distances.

The reasons for effectiveness and ineffectiveness of services/resources/institutions should be discussed.

The diagram may provide following information:

- *Presence and effectiveness of various departments, institutions and services.*
- *Influential persons*
- *Decision making system in village*

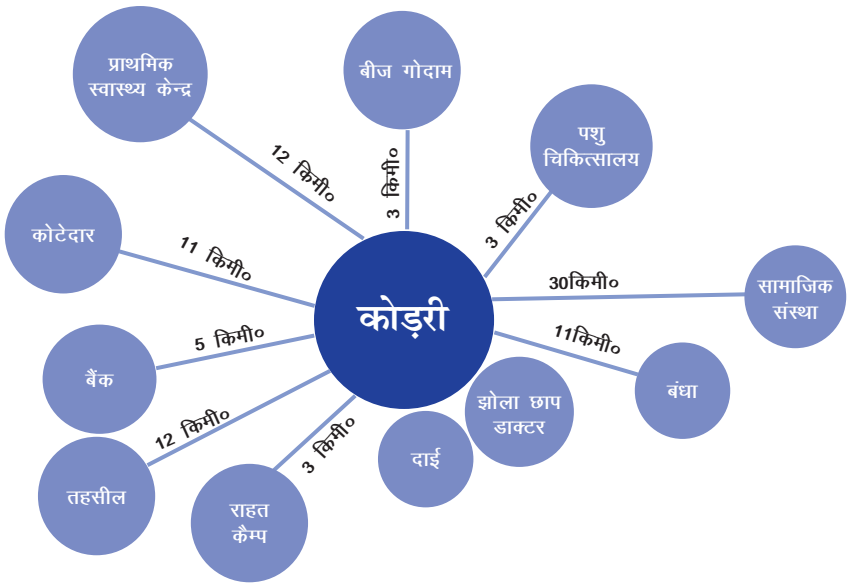


Figure 3.2: Venn diagram for accessibility to services

Inferences:

- Available services (health, education, agricultural inputs, PDS, bank, Veterinary etc) and linked institutions (PHC, Tehsil, Lekhpal, Block etc.) during normal, disaster and post disaster time periods.
- Resources related to disasters (embankments, boats, shelter homes, floods posts etc).
- Relative effectiveness and usability of the services/institutions.

Basic services mapping

(to be mounted on social map)

Ask the community members to show the basic services and their locations on the social map. Different colors may be used to show different services. Following is a suggestive list:

Figure 3.3: Village Kodri basic services map

- *Households having electric connection*
- *Households having TV/radio sets*
- *Community and private hand pumps*
- *Houses having boats and vehicles*

Inferences:

- Households having electrical connection
- Households having TV/radio sets
- Community and private hand pumps
- Households owning boats and vehicles

The services and opportunities can also be seen in terms of the availability of various services and the level of satisfaction for each service, as perceived by the communities (especially poor and marginalized groups, including women of the village)

The following tables explain the sector wise (relevant for the area) services and the satisfaction levels expressed by the communities of specific villages. The examples of education and health sectors are being mentioned as follows:

Table 3.2: Services and opportunities

Education

Village	Aganwadi		Primary		Jr. High / High school		Inter college		Degree college	
	D	S	D	S	D	S	D	S	D	S
Rohini										
Sonateekar	1.0	0.0	1.0	4.0	4.0	5.0	6.0	5.0	18.0	3.0
Chandipur	0.0	2.0	0.0	2.0	2.0	1.0	5.0	7.0	16.0	4.0
Fattehpur	0.5	0.0	0.5	0.0	2.5	2.0	6.0	8.0	17.0	2.0
Lakshmipur	2.0	2.0	0.0	7.0	0.0	5.0	7.0	9.0	19.0	7.0
Manoharchak	0.5	9.0	0.5	4.0	1.5	5.0	6.0	8.0	17.0	7.0

Village	Aganwadi		Primary		Jr. High / High school		Inter college		Degree college	
	D	S	D	S	D	S	D	S	D	S
Bagmati										
Gharari	0.0	4.0	1.0	3.0	5.0	7.0	11.0	8.0	20.0	8.0
Akraha	1.0	1.0	0.0	4.0	3.0	7.0	15.0	7.0	25.0	8.0
Nayatola	-	-	0.0	4.0	4.0	8.0	15.0	8.0	25.0	8.0
DusadhTola	1.0	2.0	0.5	3.0	3.0	8.0	15.0	7.0	25.0	10.0

Where S: Satisfaction level (on 10 point scale) D: Distance from village (in km)

Table 3.3: Services and opportunities

Health

Village ROHINI BASIN	Private Doctors at Village level		Primary Health Centre		Community Health Centre		District Hospital		Primary Nursing Home		Medical College	
		D	S	D	S	D	S	D	S	D	S	D
Sonateekar	3	0	-	-	7	18	2	37	5	37	4	37
Chandipur	6	0	3	6	8	15	4	50	6	10	4	50
Fattehpur	8	3	3	5	8	11	4	38	6	13	-	-
Lakshmipur	5	2	4	10	5	15	5	42	8	20	4	56
Manoharchak	5	1	1	10	5	16	6	43	9	55	2	55
Gharari	4	0	2	5	4	20	8	13	9	20		
Akraha	4	0	5	3	3	25	8	20	8	25		
Nayatola	2	0	3	3	4	25	8	15	6	25		
DusadhTola	2	0	4	3	5	25	8	8	8	25		

Where S: Satisfaction level (on 10 point scale) D: Distance from village (in km)

Flood mapping

Here an activity is described which can be done with community people on the issue of disaster preparedness and planning after analyzing their village surroundings/geographical topography.

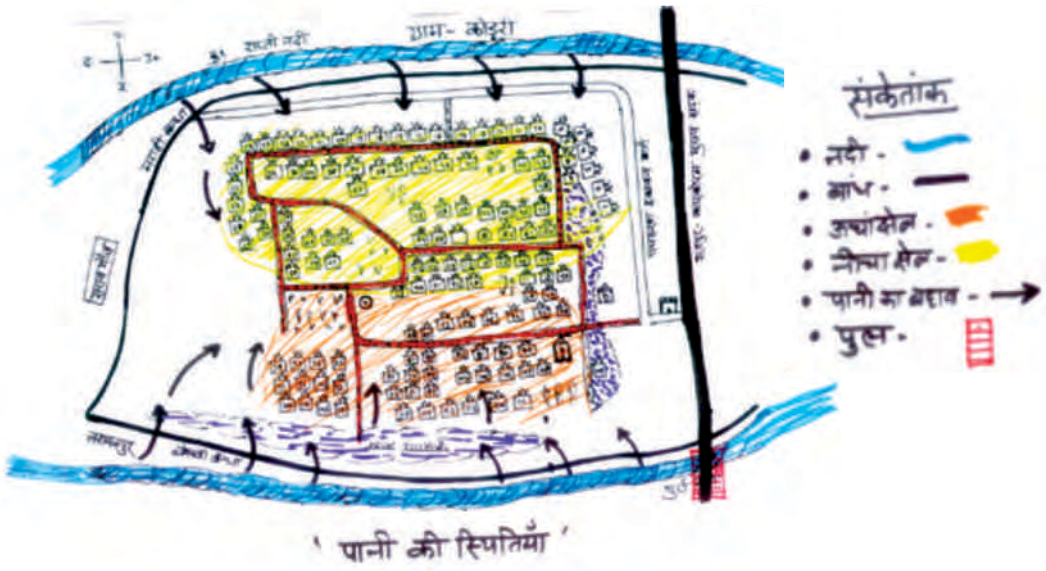


Figure 3.4: Flood mapping

Paste the A-4 size social map in the centre of a chart paper. Ask the community to draw major roads, embankments, rivers, streams in the vicinity of village which influence the flooding of village, in some way or the other. Let the community explain and mark with arrows how and why water enters in the village. What are blocks in the vicinity which cause water logging, duration of water logging. Ask the community about their `Alarm Criteria' (what level/ reach/ direction of water indicates warnings).

Ask the community to draw contour line for the water level (submergence of village) for the highest, medium and lowest floods, on a recall basis during major flood events. The three contour lines, as above may be drawn with different colors. This will help in identifying the areas of village submerged/saved during extreme and moderate floods.

This exercise is conducted with 3-4 elderly men and women. They are asked to remember and tell the most devastating disasters in the village. They may not remember exact dates and year of the events. This may be related with other events like 'when the first electric connection was given to village', 'when Gandhi ji came to our village', 'when plague affected the village' etc.

The magnitude of disaster, reasons etc may also be discussed and documented. For example:

1958	Construction of embankment
1962	Most disastrous flood
1972	Devastating flood
1998	Huge loss of human life due to flash flood
2001	Breach of nearby embankment

Inferences

- Major floods and disasters in the village and the respective years.
- Trends in occurrence of disaster and its effects.
- Reasons for escalating effects if any.

Accessibility map

A route map shows the accessibility of escape routes during flood when the village is partially/completely marooned. The route should guide links with major roads as well as movement within the village. The road and water routes will be helpful in evacuation/relief operations as well as help in accessibility to markets, flood posts, emergency health services etc.

Social Map is drawn at the center of a chart paper. Then ask the community to draw major roads, embankments, rivers and streams in the vicinity of village. Next ask the community to draw the road and water routes used during floods. They may be asked to emphasize on the routes which can be used by ordinary boats and heavy boats (Steamers etc.).

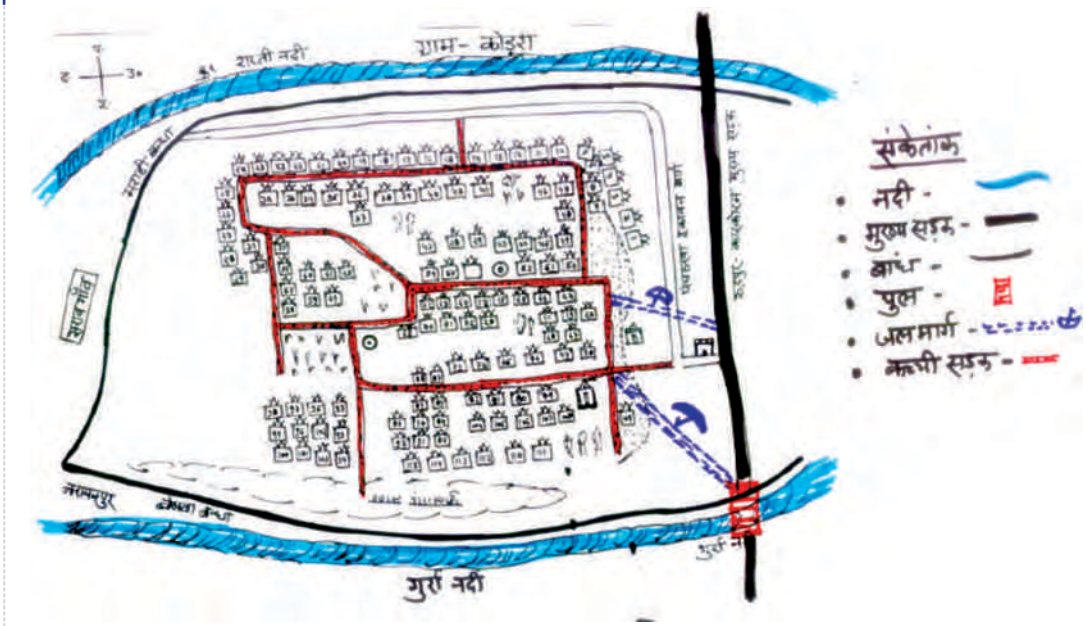


Figure 3.5: Accessibility map

Problem prioritization

The purpose of the exercise to know the problems faced by affected communities in different phase of disaster cycle viz. pre, during and post disaster periods.

This is a group exercise through which it becomes clear that what are the main problems faced by the group and which ones affect maximum number of people.

First the community group identifies various problems which affect the people due to flood/disaster. These problems are written on cards (one problem- one card). Each problem is comparatively discussed and provided a score (out of maximum 10). In this way 10 is the biggest problem and 1 is the least problem. Each problem gets a number according to its priority.

The reasons for such prioritization should be discussed.

The problem prioritization should be done separately for pre, during and post disaster (flood) periods.

Toilet for women	* * * * *(10) * * * * *
Non availability of food	* * * *(8) * * * *
Fuel problems	* * * *(7) * * *
Non availability of boats	* * *(5) * *
Non availability of drinking water	* * *(5) * *

Inferences:

- The problems and its priorities.
- Variation in problems during different periods viz. pre, during and post disaster.
- Actions taken by communities at local level to address these problems.
- Possibilities of external linkages to address the prioritized problem.

Coping mechanisms

(Tool: Focus Group Discussion)

Inferences:

How the people cope with the disasters:

- Evacuation mechanisms
- Temporary shelters and means of food, fodder, fuel
- Communication systems
- Health and sanitation aspects

- Care of vulnerable groups (disabled, old persons, children, pregnant women)
- Drainage system of village
- Drinking water system of the village
- Households having electric connection and wiring routes
- Sources of Information and mechanisms of communication
- Toilet arrangements during flood/normal times
- Available boats, vehicles etc and its ownership

Knowledge check

- Draw a social map of a village and locate essential amenities for flood management.
- List out agencies who can reach out during flood disaster.
- Make a vulnerability map of your own region-city/village or district with focus on flood.
- Highlight various parameters which need to be taken into account before chalking out a village disaster risk reduction plan.

4

LU-C: Adaptive Agriculture

As climate change becomes omnipresent and a widely accepted phenomenon, everyone is getting a glimpse of it in small portions in their respective lives. In this unit the focus shifts to other ways of coping with disaster risks keeping issues related to climate change in the backdrop. In this context, the readers shall be exposed to the agricultural methods which are adopted by villagers to avert the impacts of disasters like floods.

The unit is aimed at providing updated information about various techniques used by farmers of Trans Saryu River Basin for warding off the wrath of floods in their area. After going through the unit readers will be able to:

- Know how climate change is impacting agricultural cycles and food security
- Understand various techniques which are used by farmers facing the similar climatic conditions for agriculture produce
- Know about the methods in detail and their success and limitations.

The hills in Himalayas and Terai in the foothills are vulnerable due to frequent floods. Climate change effects like large amounts of rainfall in fewer days, dry spells during monsoon, higher temperatures during winter etc., are increasing the vulnerabilities of people solely depending on agriculture. Historically, food insecurity has resulted from a combination of factors, including, inter alia, changing demographics, poor agriculture infrastructure, wide spread poverty and the incidences of frequent floods. One sign of this vulnerability is seasonal food shortage at the household level. This vulnerability in food security in this region can be categorized as:

- Food deficient periods due to prevalent cropping cycles
- Nutritional deficiencies: Health problems due to specific nutrient deficiency
- Food problems due to eco-stressed situations (floods, water logging, dry spells)

There seems to be need of looking at food security beyond (limited) production frames and addressing the socio-economic and technological hurdles towards the accessibility and availability of food to vulnerable groups, especially in eco stressed situations. There are strong research needs in evolving community managed and local resource based viable agricultural models which can provide adequate sustained food security.

Gorakhpur Environmental Action Group (GEAG) has been working in the region for improving the livelihoods of small-marginal-landless and women farmers for more than 20 years. The approaches adopted in such interventions have been low external input, sustainable and flood resilient agriculture, food security and rights of small-marginal, women farmers. Robustness of farming system helps small farmers in dealing with bridging the food gap periods. In the process, communities need to use the skills of the organization and its institutions in removing hunger periods through adaptive and resilient agriculture systems and in the process establish methodologies for larger sharing and scaling.

Figure 4.1: showing flood devastation affecting families with children (http://www.agritech.tnau.ac.in)

The major strategies, as evolved during various studies of GEAG, helping small farmers to cope with floods (and especially in response to changing climatic conditions) are:

- Intensification: Intensification of crops and agriculture related activities
- Diversification: The flood affected areas are richly bio diverse. With this diversification people can adapt in the stressed situations. The identified areas were Mixed farming, integration of Animal Husbandry, Fodder and fuel production etc

- Value Addition in products: Value addition enhances the use and price of the products. Opportunities like value addition in paddy, milk products, vegetables etc have ample scope in this regard
- Use of indigenous technical knowledge: The traditional knowledge is quite rich in the area particularly in the sectors like treatment of sick cattle, seed preservation, grain storage, house construction etc
- Collective marketing: Market is emerging as an important factor in people's livelihood accretion and resilience

The activities of resilient agriculture comprises of:

- Farm level interventions
- Ecosystem level (Farm-landscape- river basin)
- Information and extension system
- Marketing systems

Various activities and needed information related to these activities may be summarized in following categories:

4.1 Assessment of food security situations

The food (quantity and quality) availability to the communities in the flood affected areas during various parts of the year is important. However, it has been realized that the food availability is low and better in different periods.

Figure 4.2: Food security dilemma (http://www.beforeitnews.com)

Through surveys, the seasonality assessment was done for the following information:

- Food availability (at least two meals per day). The households who can have two meals per day for less than 15 days in a month were classified as food insufficient periods (shown as black dots in the diagram below

- Livelihood activities: What are the activities done by the community to ensure two meals per day? There are months when poor community has to make distressed migration
- Food habits: The variety of foods consumed during the different months of the year. It varies with the agriculture cropping pattern in the region

It is also realized that the three aspects are closely linked and this determines the work load, need of male migration, involvement of child labour (in difficult period), health ailments etc. The information on the seasonality can be overlapped with other such information as per the local needs. The information is collected through the community consultation and for this purpose; the months are divided in the way community understands. Later, for the analysis and documentation this may be converted into conventional calendar months.

The disaggregated information on food consumption has been already explained under sections on vulnerability and gender.

Table 4.1: Seasonal diagram indicating the food availability, habit, livelihood and food gap of village Chandipur, Rohini Basin

SEASONAL DIAGRAM

(Village: Chandipur, Rohini basin)

MONTH / VARIABLES	APR चैत्र	MAY वैशाख	JUN ज्येष्ठ	JUL आषाढ़	AUG सावन	SEP भादो	OCT क्वार	NOV कार्तिक	DEC अगहन	JAN पौष	FEB माघ	MAR फाल्गुन
FOOD AVAILABILITY	30/30	30/30	30/30	20/30	15/30	5/30	30/30	25/30	20/30	15/30	10/30	5/30
LIVELIHOOD	15 days daily wage labour in villages/ local cities	25 days daily wage labour in village	15 days daily wage labour in village	25 days wage labour in vill.paddy field	20 days wage labour in village	10 days wage labour in village	25 days labour in village paddy field	4 days labour in village		Migration		
FOOD HABIT	Bread seasonal veg.	Pulses, Bread vegetable	Pulses, Bread vegetable	Pulses, Bread vegetable	Salt Bread vegetable	Bread Salt Fasting	Rice Pulses (If not flood)	Rice Vegetable Pulses	Rice Vege-table	Rice Salt Oil	Bhuja Fry Potato Sugar beet	Bhuja Fry Potato Sugar beet

● Food gap month

4.2 Intensification and diversification

The majority of small farmers in the area have, fortunately, not fully converted to mechanized, chemical intensive and package driven agriculture. The small farms are still bio- intensive and GEAG- in the last 15 years has facilitated farmers to evolve low external input agriculture which is less cost intensive and largely relies on local resources and ecological principles. Farmer's rich local knowledge has been very helpful in such system oriented agriculture.

The main strategies followed in the process of developing such farms systems are:

- ***Increasing diversity:***

The number of elements performing one function enhances the diversity in farm system. For example, if the function of fodder is performed by agricultural residues, fallen leaves and pruned branches of the trees on farm boundary, cattle residues and other such farm sources will be better than relying on single option like cow dung. Similarly, the number of crop varieties, number of crops grown simultaneously, number of crops grown during the year in the farm, number of crops replaced over years etc. are other mechanisms of enhancing the diversity of farm. Beyond the crops, the number of sub-systems in the farm also enhances its diversity. For example, presence of pond for aquaculture, orchards/ kitchen garden, honey bee, livestock, poultry and other such aspects increases the diversity of farm system.

- ***Increasing complexity:***

The number of functions performed by a single farm element increases the complexity of farm system. For example, if the livestock of the farm system is utilized for using its dung for compost, milk, ploughing etc. it increases the complexity of farm element that is livestock. Similarly, the trees can be used for wood, fuel, shadow, multiple cropping and other such functions; it increases the utility of the element.

- ***Recycling:***

Recycling amongst various farm sub systems fulfils various needs of the farm and hence reduces the need of inputs from outside the farm gate. The more are the recycle flows better is the health of farm and this reduces the input costs of the farm without having any negative effect on outputs. The example of such recycling in one farm is shown in following diagram.

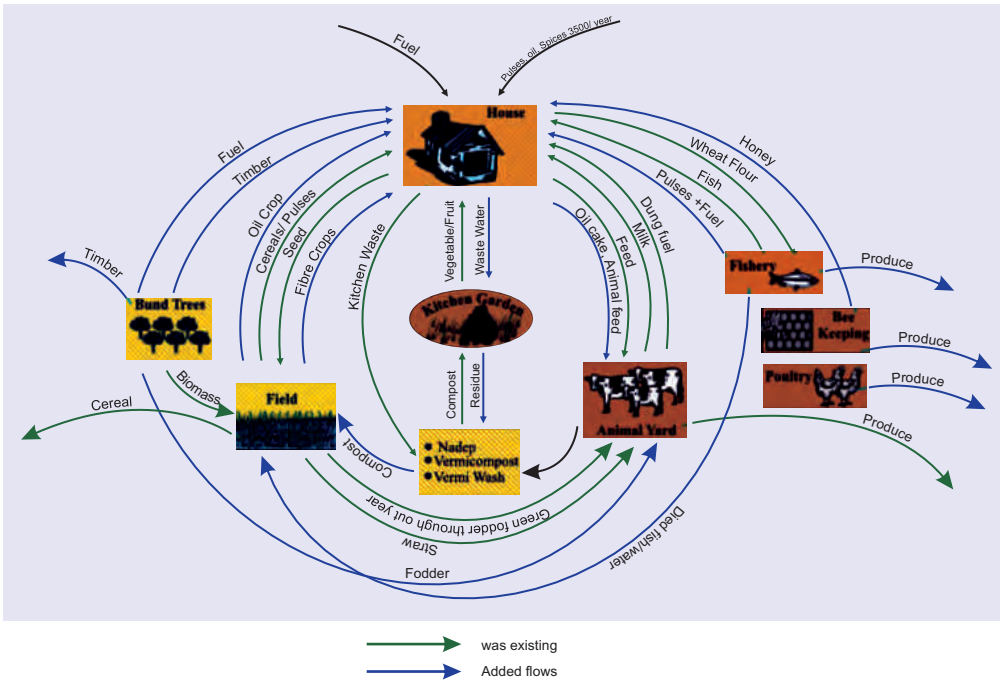


Figure 4.3: Integration of farm sub-system

A resilient system can function and achieve results through multiple paths or nodes when one fails, when performance is critical. In contrast, a "single best solution," is not resilient because if this single option fails, the system collapses. Back-up systems, or decentralized nodes for service delivery in a linked network, are preferable.

The integration and diversification of farm system helps in robustness of the farm system and experiences have shown that the robustness of farms make it more flood resilient because the chances of losses are minimized and recovery is faster.

Information needed for the study

The information and data needed for developing such resilient farms may be, for example:

- *Cropping cycle in the area*
- *Soil type and physical-chemical analysis*
- *Irrigation facilities, ground water table*
- *Possibilities of integration of farm elements considering social and ethical norms and local geo-ecology*
- *Availability of natural resources*
- *Farmers local knowledge*
- *Available flood resilient crop varieties (local and from outside)*
- *Farm vulnerability for water inundation*
- *Water logging in the farm system, duration*
- *Relevant govt programmes and schemes (including credits)*
- *Insurance provisions*

4.3 Time and space management

GEAG and small farmers of the area have worked together to develop the resilient farm models and crop management through alteration in cropping cycle and spatial adjustments have provided effective strategies in this regard.

Brief accounts of such strategies are being explained below.

(a) Time management through alteration in cropping cycle

The manipulation in the timings of cropping cycle through pre-ponement, or postponement of crops was a successful strategy adopted by the farmers. Sowing the varieties which can sustain water inundation was also helpful in saving the crops from flood effects. This strategy was particularly helpful in a climate change situation where the rainfall (and hence flood patterns) are un-predictable (early or late). The crops adopted in this regard and the timings of various crop combinations may be shown in Figure 4.5.

Figure 4.4: Resilient farming practices.
(http://www.travel-expert.in)

June - August	August - October	December - June
Preparedness/ Preventive	**Living with Floods**	**Recovery Rehabilitative**
Preponing crops	**With standing crops**	**Postponing crops**
Paddy (turanta, satha, N-97, radh-4, Bangalia-10) maize, watermelon, lady finger, pointed gourd	Paddy (sengar, jal lahri, jalhar+15 deep rooted) guava, arjun, bamboo, cane trapa, lotus	Paddy (boro, chainiya, etc.) barseem, mustard, coriander, auricle pea

Figure 4.5: Crops adopted for climate change and their timings for sowing

Appropriate crops and crop varieties were identified with the help of local farmers and they were followed during two consecutive years. The traditional varieties in the area and other developed varieties by various research institutions were identified in participatory exercises and adopted by the farmers. The strategy was quite helpful particularly in the floods of 2008 and 2009 where farmers reported very small losses in spite of the seriousness of 2008 floods.

(b) Space management

Multi tier cropping is very effective in low land where water logging is the major problem. In flood prone areas where farmers grow vegetables, the entire crop gets washed away in the situation of floods and the sowing of new crops is also hindered due to water stagnation in the fields. In such situations, experimentation of multi-layered cropping has proven to be quite effective.

The layers of crops are able to deal with various water levels in case of flooding in the area. One example of such spatial combination of crops in the area is being provided in following Table 4.2:

Table 4.2: Seasonal and spatial combinations of crops under multilayered

	Kharif (June-Sept)	Rabi (Oct- Mar)	Jayed (Mar-May)
Upper layer (on machan)	Nenua, bitter gourd, satputia, bottle gourd, pumpkin, cucumber, kunduru,	Bottle gourd, bitter gourd, sem, nenua	Cucumber, bitter gourd, kundru
Standing crops (on the bunds)	Arhar, brinjal, chilli, spinach	Soya, brinjal, chillis	Ocra, (lady finger), maize, brinjal
Ground layer	Groundnut, elephant leg, spinach, kulthi, urad, turmeric	Garlic, onion, Palak, raddish, carrot, methi, spinach, tomato, coriander	Onion, spinach, tomato, coriander

It will be worth mentioning here that the whole annual crop cycle is planned for which appropriate varieties are identified. The crops cannot be considered in isolation – as a practice. The choice of the adopted crops also varies according to family size, available resources and priorities of farmers.

In this method two or three cropping is practiced with the highest crops being at a height of 5-6 ft. The higher crops get saved even if lower crops are fully or partially damaged due to flood and water logging.

Early variety of paddy (NDR 97)

As the districts of Gorakhpur and Maharajgunj are affected by both flood and drought every year, farmers can grow only one crop during the rabi season. Because cultivating kharif (autumn harvest) rice takes at least 135 to 150 days, and is cultivated in mid-June and harvested in October, when floods arrive in early September, as they usually do, the crop is washed away of damaged. And when the monsoon is late or irregular, the rice doesn't get water in crucial periods and productivity is low. To tackle these problems, we searched for a variety of rice that grows quickly and needs little water.

NDR-97, a variety developed at Narendra Dev Agriculture University, takes only 90 to 100 days to grow, so it can be harvested before the onset of flooding. It can be planted a little earlier than other kharif crops, in mid-May, because it can withstand the heat of summer, and is harvested in mid-August, just before most floods occur. One problem which remains, though, is that flooding can come as early July, as it did in 2002 in which case even NDR-97 would be damaged. Because the climate is growing increasingly erratic, it is best to adopt planned agriculture which can respond to variable climate characters.

Information needed to study the issue

- *Soil type*
- *Traditional crops able to sustain water inundation*
- *Water resilient crop varieties developed by research stations*
- *Water resilient varieties of fruit and other trees*
- *Plant (crops, medicinal plants, vegetables etc.) varieties appropriate for local conditions having various heights (herbs, shrubs, trees)*
- *Plant varieties which have potential to sustain alteration of timings*
- *Short duration crop varieties*

4.4 Ecosystem level interventions

The agriculture based livelihoods of the majority of small farming population has been traditionally linked to local ecology and natural resources. Although, the green revolution practices have promoted monocultures and intensive input driven agriculture techniques but the resource poor small farmers are still linked to local ecology and practice bio-intensive agriculture. Such small farms are dependent on neighbourhood landscapes and natural systems like forests, water bodies, common and fodder land etc. and cannot be managed in isolation or in controlled situations within farm boundaries. The isolated farm operations tend to enhance the inputs costs many fold. Further, these farms are open and exposed to neighbourhood ecosystems and influenced by events like floods and water logging. Hence, the agriculture based livelihoods cannot be resilient unless an ecosystem approach is adopted for coping with the current and future risks of floods.

The link of farm and neighborhood ecosystems is not limited at the micro level. This micro-macro linkage, inter dependence and inter-influencing of systems continues to higher levels like:

- Farm ecosystem - village/landscape
- Village - cluster of villages
- Villages - river basins / watersheds
- Rural - peri urban-urban systems
- River basin - agro ecological zones

Example: Farm landscape/neighbourhood linkage

The low slope gradient in the region makes it prone to water logging. The lack of adequate drainage provisions in the developmental activities, during last decades, and the intensive rain fall patterns have enhanced water logging. It is resulting in extended water logging periods and hence the land unfit even for winter (rabi) crop which provides recovery opportunities to the farmers after the losses of monsoon floods. The decreasing open natural land spaces and water bodies, due to increasing land pressures, is further decreasing the water holding capacities of the area. It is important that the natural ecosystems in form of land spaces, water bodies, forests etc are conserved to increase the water holding capacities of the area and helping in the drainage of water. At the same time developmental schemes are needed to have adequate drainage provisions for swift drainage of water. The schemes like MNREGA can be effectively used for construction of drainage channels which helps in draining out the water and making the lands available for winter crops. Such field interventions adopted in Rapti-Rohini Basins have demonstrated that the ecosystems management can significantly help the farmers to develop flood related risk resilience

Figure 4.6: Ecosystem approach in rural systems - Linkage of farms and the landscape; the drainage channels constructed by local community in one of the operational village

Case Study

In adopted village, the community members took the initiative at the village level-in consultation with village panchayat-and constructed drains so that the stagnated water flows out and the field is available for the timely sowing of next crops, helping farmers to compensate the losses of floods. In the village Manoharchak and Laxmipur there was around 500 acres of agriculture land where water logging was acute. The old water passage was choked due to deposited silt. 170 villagers contributed their labour and constructed a channel of 400 meters to connect the water logged area with the nearby water stream. As a result 500 acres of land were made useful for cultivation of crops in post flood period.

Information needed for the study

- Identifying the agricultural land in the village affected by water logging
- Duration of water logging in such areas (social/resource maps)
- Water bodies (ponds, puddles, streams etc), forests, open spaces in the nearby areas (social/resource maps)
- Provisions/schemes with *Panchayat*/local bodies for investments in drainage improvement
- Collective will of the villagers for labour contribution

4.5 Flood sensitive extension system

It is important that the farmers get the information of such adaptive agriculture and also the space for more of such innovations. At the same time it is important that the inputs (seeds of appropriate varieties, compost, pesticides etc.) are also made available to farmers. The linkage of relevant government schemes and departments has been also helpful in this regard.

In developing appropriate extension systems, using locally available knowledge has been seriously considered. In fact, for all extension measures a synergy of traditional knowledge and technical and scientific know how has been vital. This can be shown as follows:

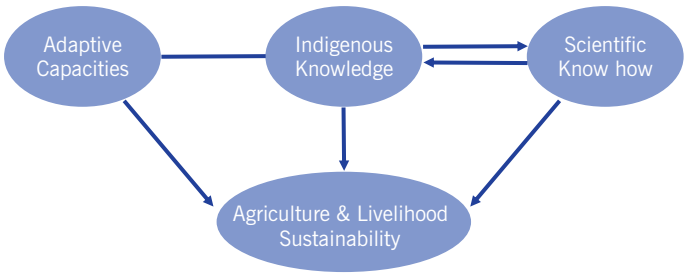


Figure 4.7: Adaptation, agricultural sustainability and indigenous knowledge

This also ensures the sustainability of extension efforts as it also considers local knowledge and local resources.

The community level institutions and processes involved in this regard in various villages where GEAG is operational are as follows:

Farmer field schools (FFS): for sharing experiences amongst farmers, learning new knowledge, information-communication platform, problem solving operative at village level, organizing field days at farm models etc

Agro-service centres (ASC): for storing and availability of flood resilient seeds, inputs like compost, bio-pesticides, raising collective nurseries for flood resilient plants (crops, vegetables, fruit trees etc)

Master trainers: Farmers trained on flood resilient farming and able help the fellow farmers with relevant techniques, knowledge and solution of problems

Self help groups/community collectives: For dissemination of information, organizing community for collective actions, linkage with credit providing institutions and markets etc. are been practiced.

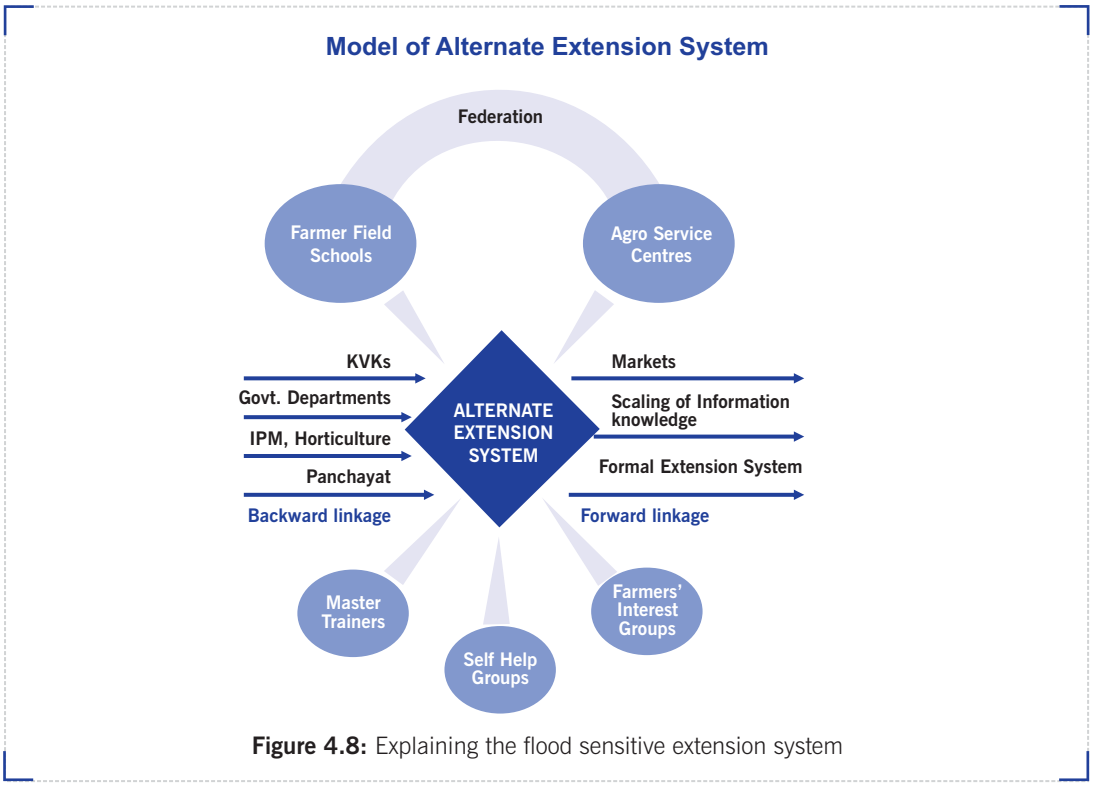


Figure 4.8: Explaining the flood sensitive extension system

Seed production: To increase yields, seeds must be of good quality. In flood-affected regions, small and marginal farmers struggle with this problem as floods often destroy their own stores, and the seeds the government provides are often of low quality. They can buy good quality seeds in the market, but these are expensive. If seeds could produce and store locally, they would increase their self-reliance. With this aim in mind, GEAG trained 32 farmers. Eleven out of 32 farmers, 11 of whom are linked with a local organisation that purchases seeds directly from these farmers and gives them a better price than that they would get on the open market.

Vegetable cultivation: A mixture of clayey and sandy soils, such as found along riverbanks, is best for cultivating vegetables. Farmers with such land can cultivate vegetables to earn their livelihood. Vegetable cultivation is a year-round occupation which takes little time and has a nearby market accessible for minimal transportation costs.

Nursery-raised seedlings: In flood-prone areas, the non monsoon period brings irregular rainfall and heat damages many seedlings cultivated in the field. To increase survival rates, which are currently very low, seedlings can be raised in homestead by using whatever plastics bags, cups or pots are available. The technique also works in cold conditions. Farmers were taught how to make holes in the bottoms of the containers and use an appropriate amount of compost serve and other techniques at regular.

Needed information to study the issue

- *Problems of farmers due to floods and priorities (problem prioritization)*
- *Available solutions at village/area level through farmers experimentations*
- *Research and extension institutions in the vicinity (ATMA, Krishi Vigyan Kendras, University and other research stations etc)*
- *Local knowledge and farm practices adopted successfully for coping with floods*
- *Innovative farmers having conducted on farm experimentation towards solving problems*
- *Model farms having developed water resilience and the techniques adopted*
- *Govt schemes able to help farmers in solving flood related problems*
- *Water resilient plant varieties and availability of seeds/saplings*
- *Farmers willing to lead as master trainers, develop flood resilient models*

Knowledge check

- Explain the terms- intensification and diversification in context of farming practices.
- Mention the essence of time and space management for agriculture productivity.
- Describe ecosystem level interventions for resilient agriculture based livelihoods with examples.
- Explain briefly the flood sensitive extension system.

5

LU-D: Community Level DRR Interventions

In learning unit D readers shall be introduced to community level interventions which are effective for disaster risk reduction in case of floods. The role of NGOs is also highlighted extensively as they are the change bringing agents at grassroots level.

This part specifically covers the pilot programmes undertaken by GEAG under the South Asian level collaborative programme, coordinated by ISET with the support of IDRC. The criteria for identifying the pilot interventions are also being provided here. Although, the programme was focussed on Climate Change Adaptation but the example provided here covers experiences exclusively from the flood affected areas, where GEAG has worked.

The approach to identify pilots for intervention was anchored in the conceptual framework that underpinned the role of basic systems such as water, food, energy, transport and communication as well as ecological and financial. The basic premise here was to increase the resilience.

The pilots were of two categories:

1) Risk and adaptation specific interventions and

2) Underlying systems for Risk Reduction and Adaptation. The matrix of pilot activities, in general, is as follows:

Table 5.1: Matrix of pilot activities

Livelihood and economic diversificaiton	Ecosystem	Oraganisation	Education and skill development	Financial and risk spreading	Communication for adaptation (Climate specific)	Adapted Infrastructure
Risk and Adaptation-Specific Interventions						
Creating livelihood opportunities outside affected areas	Forest as buffers	Formation of DRR and rescue committee	Training about food relief	Insurance	Flood warning system	Shelter during floods
Non-farm livelihoods	Pollution control measures	Establishment of DRR and relief organisations	Targeted strengthening of construction to increase resilience to floods	Catastrophe bonds	Strengthenin Communication towers	Wetlands conservation
Underlying Systems For Risk Reduction and Adaptation						
Increasing ability to access global and regional labour and other markets	Developing productive inland fishery and farming systems	Increasing the number and diversity of civil society organisations-the right to organise	Skills such as global languages, that enable populations to access global labour and other markets	Strengthen banking system and improve access to it	Cell phones and other personal communication devices	Improving transport systems
General diversification within economic and livelihood systems	Controlling pollution to enable long-term productivity of ecosystems as they change	Incubating new forms of business organisations that can utilise and manage local resoures	Region-specific skill training (tourism, etc.)	Productive investment of remittance flows	Increasing access to and freedom of the media	Changing approaches to infrastructure design (houses, roads,bridges etc.) to account for uncertainty

This will be clearer if one goes through specific pilot activities taken-up in various villages of Gorakhpur. This is being compiled in Table 5.2.

Table 5.2: Specific pilot activities taken-up in various villages of Gorakhpur

Description of village	**Lakshmipur** Population-1765 (M-726, F-679, C- 360),agricultural land-125 ha, irrigated-95 ha, non-irrigated-95 ha, non-irrigated-30 ha, total HH-199, 80% small farmers	**Sonatikar** Population-525 (M-242, F-198, C-85), agricultural land-78 ha, irrigated-68 ha, non-irrigated-O ha, Total HH-100	**Manoharchak** Population-467 (M-198, F-86, C-83), agricultural land -45 ha, irrigated-29 ha, non-irrigated-16 ha, Total HH-104
Adaptation-specific interventions			
Diversification/Ecosystem			Early maturing and water-tolerant crops, fodder conservation
Disaster risk reduction	Provision of irrigation pumps, maintenance and disinfection of hand pumps, laying of drainage pipes on both sides of embankments and roads dependent upon local support of local people	Provision of community tube wells, maintenance of hand pumps	Provision of community tube wells, maintenance of hand pumps, training in hygiene practices, construction and raising of toilets making and raising,
Organisation and incubation	Establishment of self-managing institutions, including farmers and self-help groups and a village health committee and of village resource centres	Establishment of self-managing institutions, including framers and self-help groups and of village resource centres	Establishment of self-managing institutions, including framers and self-help groups and a village health committee, and of village resource centres
Skill development	Awareness programmes and trainings in intensive farming, the design and construction of portable raised toilets, and personal hygiene	Awareness programme on disaster mitigation and trainings in intensive farming, vegetable production, seed production, water-tolerant crops, composting, and personal hygiene	Awareness programme on disaster mitigation, trainings, exposure visits
Financial initiatives and risk spreading	Income-generating activities such as mushroom production, goat rearing, fishery, poultry rearing and candle-making.	Income generating activities such as mushroom production, goat and poultry rearing, fishery, and candle-making	Income-generating activities, such as mushroom production, kitchen gardening, goat and poultry rearing, fishery, and candle-making

Communication	Village-level information center, early warning system, communication centers, community FM radio, mobile phones	Village-level information centre, early warning system, communication centres, community FM radio, mobile phones	Village-level information centre at village level, developing an early warning system with mobile phones and community FM radio but will depend upon external stakeholder's support
Support For underlying systems			
Education	Training in seed production, farmers credit cards, crop insurance, ensuring availability of IEC materials, exposure visits	Training in seed production, both vermi-and ensuring availability of IEC materials, exposure visits, farmers credit cards, and crop insurance	Training on framers credit cards (KCC), crop insurance, ensuring availability of IEC materials through resource centre, visits.
Transport	Boats, bamboo bridge	Boats, bamboo bridge	Boats, bamboo bridge
Financial mechanisms	Linking banks with the self-help groups and savings and credit organisations	Linking banks with the self-help groups and inter-loaning	Linking banks with the self-help groups and inter-loaning
Organisation	Community irrigation management, setting up systems for community contribution to repair water pumps	Community irrigation management	Community irrigation management, labour contribution by people to drain excess water
Livelihood	Off-season vegetable and mushroom farming, seed production, kitchen gardening.	Off-season vegetable and mushroom farming, seed production, kitchen gardening and vermi-composting	Vegetable and mushroom production, kitchen gardening nursery raising vermi-composting, goat rearing, fishery, incense-making, and candle-making

5.1 Examples of community initiatives

Raised road with public participation: One major issue is restricted mobility. In many villages flooding submerges roads. To counter this problem in Manoharchak, where the main Chak Road is submerged for long periods, the disaster management group meeting decided to elevate it to improve mobility. About 462 worked together to raise the road four feet using soil that flooding had deposited. GEAG encouraged their work by providing participants with food grains.

Raised hand pumps and water chlorination: Accessing safe drinking water was a primary concern during floods because all the existing sources were submerged and the chance of contamination was high. To counter the problem, villagers raised six India Mark II hand pumps four feet each and constructed concrete platforms around them. Women have particularly benefited as they no longer have to travel kilometres in search of clean water. Village level community group (Disaster Management Group) DMG sent four people from each village to attend a training programme on water and sanitation organised by the Air Force. These groups shared their knowledge with other villagers.

Rehabilitation of Link Bridge: During the flood of 2002, both approaches to a bridge that connects Bagailari Satguru village with Harizan Tola was damaged hampering mobility. In just five days, using their own resources the local disaster management group (DMG) repaired damage. They cleaned pipes and used earth from the barren land close to the bridge and filled the breached sections and established mobility.

Relief support during floods: During a flash flood on 30 July, 2007 the Domra Jardi embankment between Ranipur and Aurahiya was damaged and within five or six hours 25 to 30 villages had been submerged and around 25,000 people affected. The DMG assisted the *panchayat* in evacuating people to safer place by making boats available and ensured that government relief packages were properly distributed to the affected. Its effort was successful because the community is more aware and more willing to support the local government in fulfilling its responsibilities.

Grain bank: Though villagers do have several traditional ways of preserving food for months of food stress, they were looking for additional ideas. The women members of the DMG were inspired by an exposure visit to see grain banks, and raised structures of earth or other locally available materials with the capacity to store at least 200 kg of grain, to build their own in Manoharchak. Every member committed to donating a fixed quantity of grain to the bank after the rabi and kharif seasons.

1. Information and warning system

Eastern U.P. has one of the lowest literacy rates in the country. According to 2001 census percentage of literate people in the three districts is as follows:

Table 5.3: Literacy in Gorakhpur, % division

District	Male	Female
Gorakhpur	60.6	24.4
Deoria	55.3	27.8
Maharajganj	46.6	10.2

However, these figures are still on a higher side and the literacy percentage in rural areas is very low. However the situation has improved as per the census of the year 2011. Average literacy rate of Gorakhpur as per 2011 census is 73.25 as compared to 58.49 in 2001. If gender segregated data is considered, male and female literacy were 84.38 and 61.54 respectively. These are encouraging figures.

The prevailing modes of information in the area are as follows:

- *Newspapers, magazines, etc.*
- *Wall writings, poster, handbills etc*
- *Folk media (nautanki, plays, songs, music etc)*
- *Radio and television, other audio-visual methods*
- *Direct communication (public meetings, inter-personal, trainings group meetings etc).*

The readership of newspapers and magazines and other linguistic modes is limited because of very low literacy rates. Further, the literacy being still lower in women, the information to women by such modes is very limited. Methods like wall writings, posters and handbills (without designs and visuals) also have limited scope in such situations.

The number of television and radio in the area is also low. TV has limited potential considering large number of villages without electric connections and a very irregular power supply in the villages having electric connectivity. Radio listening is a popular method and it is observed that about 10 percent of rural household have Radio sets. Group listening of radio is quite common.

The most effective mode of information and communication is through folk media and personal-direct communication. According to a study in the area more than 80 percent information is communicated through such methods. It will be worth to mention that Gorakhpur has All India Radio station and the Doordarshan center. There is one private FM radio which has limited access and generally caters the urban population of Gorakhpur city.

These situations will have to be considered while planning any information system for the area.

In the situation explained earlier, it is clear that reaching the information to ultimate users/ effected people is not easy. It is proposed, on the basic of successful experiences of a number of agencies, that the village level institutions like community based organization, self help groups, farmers groups etc. besides the *Panchayati* Raj set-up will be helpful in receiving the information from various sources and communicating this to communities. The village institutions, as organized structures, are in a better position to receive the information and hence adequately and effective pass it on to larger communities. The information and feedback from the community may be largely communicated to Government institutions/departments working at various levels, NGOs and other agencies- directly, and through the village level institutions.

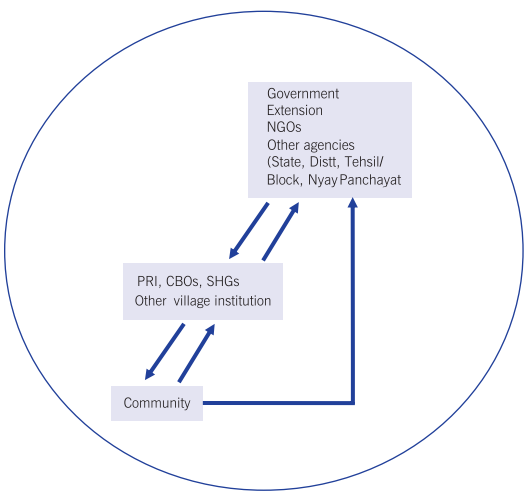


Figure 5.1: Relations between community and different agencies for information and feedback

Experiences of recent floods and the response measures suggest that effective and efficient flow of information has been very useful in mitigation of effects and dealing with emergency situations. The problems, as experienced by involved functionaries/ agencies, have been that there is no organized and pre-planned system in place for efficient flow of information.

From the communities' perspectives, it is proposed that relevant and accurate information should be with the communities. The relevant information, modified and updated regularly, should be placed with the community/village. The Village Disaster Management Group and *Panchayat* Committees can be oriented for maintaining such information and sharing it with the whole village, especially women.

Following is a suggestive list of information to be maintained in each village:

- Places to go in case of evacuation: temporary shelters
- Nearest Barh Chowki and the assistance available at Chowki
- In case of emergency, availability locations for:
  - *Boats*
  - *Food*
  - *Fuel (kerosene oil)*
  - *Polythene*
- Agency/official to be contacted for getting information about forecasts/trends and its location.
- Where to go/ report in case of:
  - *Minor accidents*
  - *Snake bites*
  - *Natal care*
  - *Vaccination (human, cattle)*
- Do's and don'ts related to emergency.
- Name of official to be contacted, in emergencies, at block and tehsil levels.

(*It will be important to ensure the actual availability of services as per the above information*).

A regular flow of information from and to village is important towards effective disaster management. The two way information flow and important areas of information is being presented as follows:

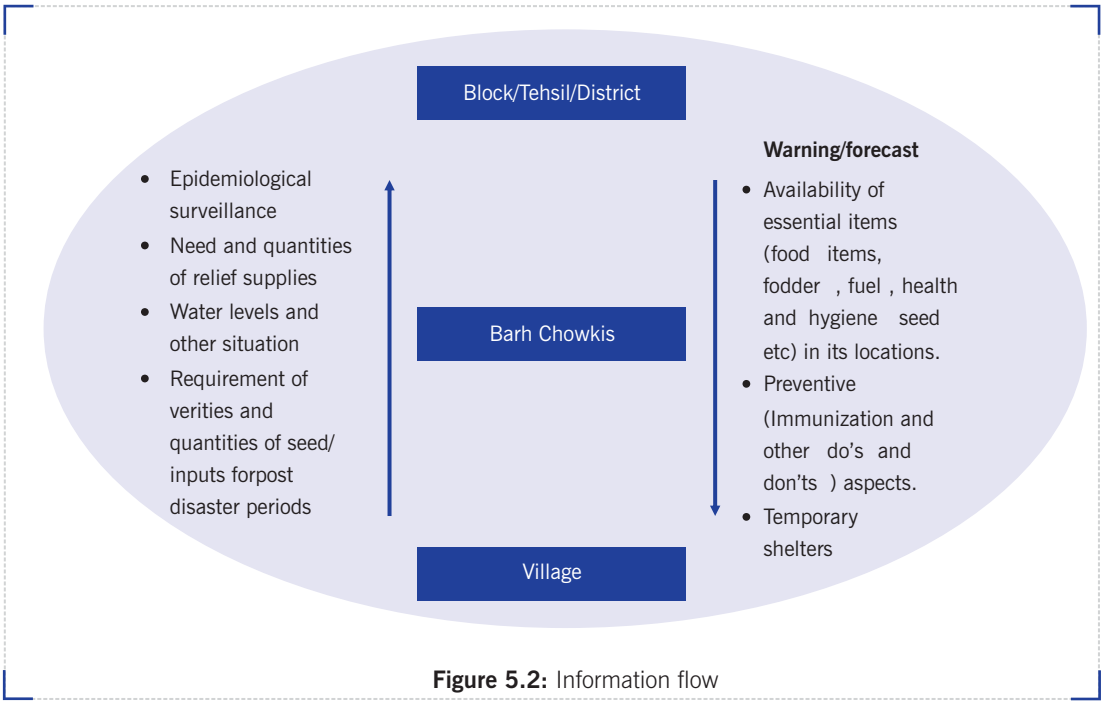


Figure 5.2: Information flow

2. Weather advisory

On the above understanding, GEAG and the local communities evolved a mechanism on linkage with ND University of Agriculture (approx 13 kms away from the villages). In this mechanism, the University issues weekly advisories on the weather and recommended actions for the crop management. The advisory is faxed to GEAG on the agreed mechanism. The advisories are packaged at GEAG in small text messages and sent to the village institutions and the lead community members like coordinator of farmer field schools, agro service centres, master trainers, members of Disaster Management Group etc in form of SMS. The advisories are quite helpful to the farmers.

3. Public address system

After the flood in 2007, village information centres were established in all four villages of GEAGs intervention areas. A member of the village disaster management group was selected as the anchor person and given the

responsibility to regularly dialogue with the community and with the GEAG, as well as to update information, maintain regular communication with other disaster management members. A Public Announcement System (PAS) with microphone and amplifier has been provided to each centre so that during emergencies message can be broadcast to the entire village in a short span of time. In addition, these centres, as well as other community places, display a list of radio programmes related to weather, disaster, and agriculture supplied by All India Radio. More villagers are listening to these programmes.

The centres also collect and provide information regarding government relief programmes and any locally relevant developmental schemes at scheduled meetings run by the anchor person. The GEAG facilitates the process and helps the anchorperson procure block- and district-level. For their part, the other members of the disaster mitigation group collect information about river water levels at different points from the local office of the Irrigation Department and give it to anchor person. When no information is forthcoming, as is often the case, they measure the depth on their own, using long bamboo poles. The anchor of Manoharchak, said, "We not only collect and disseminate information but also help people to broadcast village-level issues through organising public hearings.

4. Self managing community institutions

Developing institutional mechanism for specific adaptation interventions can be one of the most effective ways of implementing a plan and achieving the expected outcome. Unless people have the capacity and are given the space to make decisions and to act, it will be difficult to achieve expected outcomes.

As a key strategy GEAG has worked with community level institutions. Such community institutions are generally of two categories:

1. Formal institutions: Covered by legal provisions like *Panchayat*, cane societies, cooperative societies etc

2. Informal institutions: Developed by communities as per the needs and these have defined operative principles

While in DRR interventions, GEAG has largely relied on the informal mechanisms where poor communities have effective controls, it has been tried at the same time that the linkages and coordination with formal institutions are maintained.

Such self managing Institutions also take up advocacy for the benefits of poor communities and their rights of livelihoods.

While in livelihood programmes GEAG has facilitated development of community institutions which can take up agriculture based livelihoods. The community institutions have been helpful in ensuring community ownership of the interventions and mobilization of resources. Such institutions are:

Self Help Groups (SHG): represented by homogenous groups, have the bank linkages and also perform the function of saving-credits. They maintain proper documents and accounts

Farmer Field Schools: Farmer led and owned institutions for sharing information and innovations, linkages with resource organizations and problem solving

Agro Service Centres: Procuring, Storing and selling agricultural inputs like seeds, bio fertilizers, bio pesticides etc, needed for flood resilient farming system

Master Trainers: Subject specific skilled trainers from amongst the farmers

Farmer Unions: taken up the issues related to the needs and priorities of small farmers in the situations of floods, at the village, district and state levels and such advocacy efforts have been joined by other actors engaged in related advocacy.

Village Federation: The village level apex institutions in form of village resource centres are evolved from various community institutions working in the village for the purposes of governance of adaptive activities, linkage with relevant schemes, programmes and actors and resource mobilization

In the DRR interventions local institutions play a major role in designing and implementing DRR plans. In GEAGs operational areas community-based organisation with the following features played a vital role:

- Vulnerable households participate.
- Specific rules and regulations guide people in performing certain assigned tasks.
- A self-initiated decision-making process enhances people's confidence about being able to act.
- Sanctions help people to work together in a transparent and equitable fashion.
- Feedback and corrective mechanisms enable people to share learning and redesign and/or reorganise activities if required.

The institutional structure followed in the DRR intervention areas can be presented as shown in the following diagram. The roles of respective institutions and the linkages with other institutions have been also mentioned in the diagram.

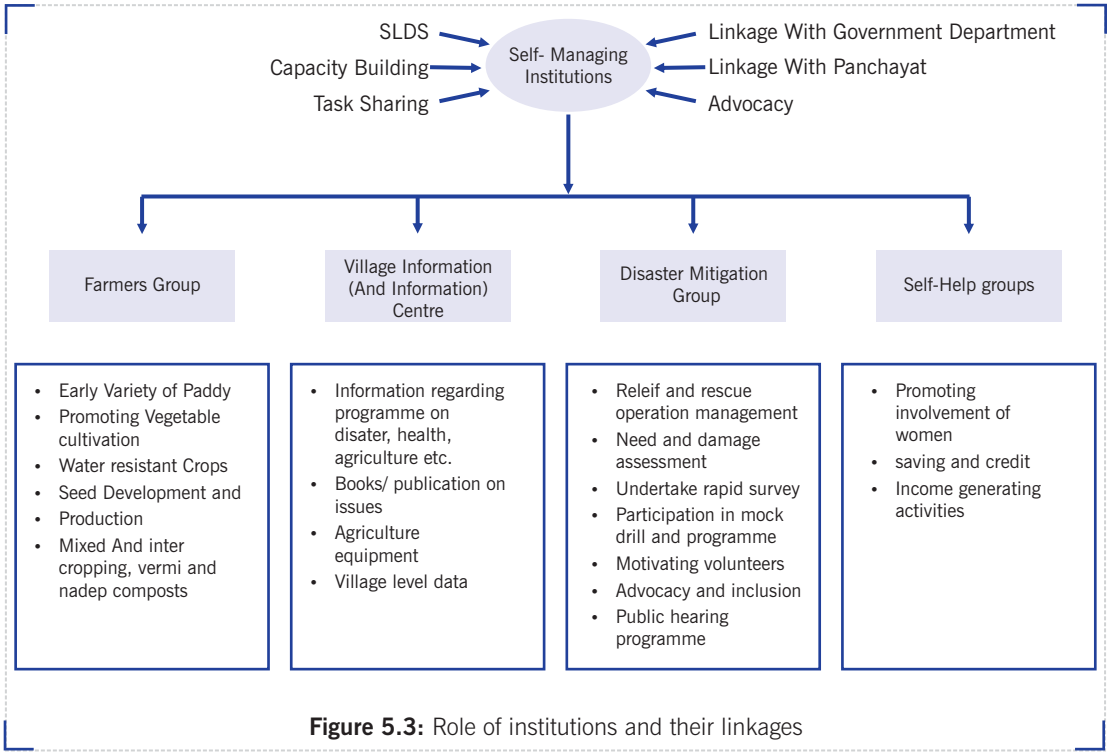


Figure 5.3: Role of institutions and their linkages

Source: Wajih (2009)

Knowledge check

- List the various community based initiatives which help them to cope with disasters like floods (in this case).
- What are the different parameters to be looked into for planning community based interventions?
- Describe the role of Self managing community institutions.

6

LU-E Cost Benefit Analysis for DRR Measures

In this unit readers will get to know the economic angles of studying the flood disaster events. Whenever the social perspectives gives qualitative output to a study the economics bring out the quantitative aspects and thus help in better assessing the situation in any case study. After going through this unit the readers will be able to:

- Understand the concept of cost-benefit analysis.
- Know the data requirements for carrying out Cost Benefit Analysis
- Assess the development plans which are taken up for disaster reduction.

6.1 Introduction

Cost-Benefit Analysis is a established mechanism to evaluate the developmental interventions. Cost-benefit analysis is a useful support tool for decision-making, but it does not capture distributional (who benefits?) and non-monetizable aspects of disaster risk reduction well. It should, thus, not be used alone, but rather concurrently with more vulnerability and stakeholder-driven processes.

Detailed evaluation of the costs and benefits of alternative strategies for flood risk management along the Rohini Basin in Eastern Uttar Pradesh, India, highlight substantial differences in economic returns. The flood risk reduction strategies were evaluated through both quantitative and qualitative frameworks, the focus of this report being the quantitative cost-benefit analysis.

The primary flood management strategy that has been implemented by national and state government actors in the Rohini Basin has focused on flood control through structural

measures, in specific the construction of embankments and spurs. Although the major focus on structural measures for flood control started in the 1950s, most of these have been constructed since the 1970s. Detailed analysis undertaken demonstrates that this investment cannot be concluded to have been economically beneficial.

The traditional highly centralized and hierarchical (in terms of decision-making and implementation processes) strategy to control rivers through embankments was analyzed for its past as well as projected future economic performance. A contrasting decentralized and more egalitarian ("people-centred") strategy, implemented at different levels, was also designed and analyzed for projected future economic performance. Interventions in this strategy at the household, community and wider societal level that were evaluated included.

At the individual level:

- Raising of house plinths,
- Raising of fodder storage units, and
- A water and sanitation package (rainwater harvesting, raising existing private handpumps and toilets).

At the community level:

- An early warning system,
- Raising community hand pumps and toilets,
- Building of village flood shelters,
- Establishing community grain banks,
- Establishing community seed banks,
- Local maintenance of key drainage bottlenecks,
- Development of self help groups, and
- Purchasing of community boats.

At the societal level:

- Promotion of flood adapted agriculture, and
- Strengthening of the overall healthcare system.

6.2 Data issues

An overview of data required for analyzing the multiple factors that contribute to hazard exposure, vulnerability and the effectiveness of risk reduction strategies was developed to guide data acquisition and analysis. Data were collected from secondary sources (government agencies, non-governmental organizations, etc.) and through a detailed survey of a sample of households in the basin. Confidence in data collected through the survey is higher than in data gathered from secondary sources, particularly for hydro-meteorological data. Focusing on evaluating flood risk reduction strategies, survey villages were selected within zones at varying distances from the river and existing embankments. This involved identifying six zones, including one actually between the river and the embankments. One village from each of these six zones was selected in the upper, middle and lower reaches of the basin.

Altogether, 18 villages were selected, with 10% of households in each village surveyed, resulting in a total of 208 households surveyed. Households were selected to capture diversity across landholding size, wealth, caste, women-headed households and engagement in different risk reduction activities. Drawn-up through extensive consultation with field teams during a pre-survey visit and testing, the survey questionnaire was designed to collect specific disaster-related loss, coping, exposure, vulnerability, preference and cost/benefit data.

Despite this intensive data acquisition effort, data availability and quality remained key issues in determining not only the specific analysis structure, but also the robustness of the results. The table below summarizes the key data elements required for a probabilistic cost-benefit analysis and issues that arose specifically in the Rohini Basin.

Table 6.1: Data requirements and issues for the Rohini Basin flood risk analysis

Key Data Required	Issues
Post flood losses	Secondary data incomplete, survey data likely not representative of full basin. Only two events available
Maps of flooded areas	Some satelite photos, available, insufficient resolution for analysis
Basin topograpy	Topographical maps of insufficient and mismatched resolution. Only one cross section available for entirer ever

Key Data Required	Issues
Hydrometeorologic time series	Rainfall data wan available only for the Nepali side of the Rohini basin, but its validity was unknown. Significant gaps exist in the streamflow data of the Rohin river and the record in short both raifall and stream flow datasets had to be corrected and estimates used to fill significant gaps.
Embankment details including past performance	Failure data limited, Specific maintenance information not available
Demographic information	Recent census at village level but projected future trends only available at state level.
Ongoing flood risk reduction activities (explicit and /or autonomous)	Very limited information, some trends on autunomous risk reduction could be inferred from surveys (primary housing dynamics)
Climate change projections	Down scaling of regional climate model result and transformation into changes in flood regime highly uncertain

6.3 Inferences

While cost-benefit analysis of classical engineering solutions like embankments is considerably easier than for more community/household-based approaches, the results appear to be less robust. People-centred resilience-based flood risk reduction approaches tend to provide benefits that occur every year, regardless of if a flood occurs or not. As costs are also primarily annual (as opposed toone-time initial), it is safe to say that if annually benefits are greater than costs, than the project is "worth it." This holds true also for embankments, but such threshold-driven benefits are probabilistic (they may or may not be realized in any given year), while resilience-based approaches tend to yield at least some benefits every year. Resilience-based approaches therefore reduce some of the cost-benefit uncertainty, or at least the dependence of the strategy's performance on known risk, because they do not depend on certain events happening to be beneficial. This further manifests itself also in light of projected climate change: the people-centred approach continues to perform well even though flood risk increases, while embankments clearly lose efficiency with increased flood risk. Estimating the costs and benefits of the embankment strategy proved more straightforward than the people-centred strategy. Embankments are engineering constructions with specific dimensions and thus costs, as well as threshold-driven designs that make it relatively easy to estimate benefits. These are, however, challenged by

the primary assumptions that embankments will always be perfectly maintained and subsequently perform as planned and that all flood losses including those involving financial flows and regional supplies are reduced proportionally to the reduced area of flooding. People- centred benefits are more difficult to assess. Assumptions must be made on intervention impacts at the household level, also varying by flood intensity. Further, the combining of benefits of multiple interventions, while performed linearly in this study, is in reality likely not a simple sum of benefits. As different interventions provide benefits, behaviours and risk choices may change, leading to dynamic starting points for other benefits. Non-flood related benefits, while clearly of importance to people-centred strategies, may also be difficult to quantify. In theory, the resource management of a people-centred strategy, defined by relatively high annual costs, should be left to the served communities and include self-propagating resource mobilization (return on investments). It also, however, begs the question of securing guaranteed long-term outside support as opposed to one-off "donations."

Knowledge check

- What is the importance of doing cost benefit analysis in a disaster event?
- What are the various data and information required for doing a cost benefit analysis and how its absence can impact the analysis?
- Highlight the result of CBA analysis in the Rohini basin. What are the lessons learned from the example?
- Highlight the challenges faced while doing cost- benefit analysis.

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About the Gorakhpur Environmental Action Group (GEAG)

Gorakhpur Environmental Action Group is a voluntary organisation that undertakes development initiatives to impact positively the lives of the poor, deprived and marginalized through a people-centred approach focusing on their participation, awareness and empowerment for sustainable development. In 1975 a motivated group of students, researchers and faculty of the Ecology lab of the Botany department of Uttar Pradesh's Gorakhpur University, influenced by the Chipko Movement at home and the Stockholm Conference of 1972 formed the Gorakhpur Environmental Action Group (GEAG) to preserve the local environment and conserve natural resources. In 1983 the informal organization was registered as a non-profit organization under the Society's Registration Act, 1960. Since then GEAG has emerged as a well established implementing, resource, consultative and support organization in northern India on low external input sustainable agriculture (LEISA), sustainable livelihood models, and adaptation to climate change, gender equity and rights of small and marginal farmers across the state. Today GEAG implements several development programmes based on sound ecological principles and gender sensitive participatory approaches to address the livelihood issues of the marginalised and vulnerable: small and marginal farmers, women farmers and the landless. It is closely associated with more than 200 partner organizations working at the district, national and international levels. Its publications have influenced the attitudes and practices not only of many NGOs and CSOs, but also of the government.

About NIDM

National Centre for Disaster Management (NCDM) set up under the Department of Agriculture and Cooperation, Ministry of Agriculture in March 1995. NCDM has been upgraded into full-fledged National Institute of Disaster Management in October 2003. Under the Disaster Management Act, 2005, the Institute has been entrusted with the nodal national responsibility for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.

NIDM is steadily marching forward to fulfil its mission to make a disaster resilient India by developing and promoting a culture of prevention and preparedness at all levels. Both as a national Centre and then as the national Institute, NIDM has performed a crucial role in bringing disaster risk reduction to the forefront of the national agenda. It is our belief that disaster risk reduction is possible only through promotion of a "Culture of Prevention" involving all stakeholders.

We work through strategic partnerships with various ministries and departments of the central, state and local governments, academic, research and technical organizations in India and abroad and other bi-lateral and multi-lateral international agencies.

About GIZ

The services delivered by the Deutsche Gesellschaftfür Internationale Zusammenarbeit (GIZ) GmbH draw on a wealth of regional and technical expertise and tried and tested management know-how. As a federal enterprise, we support the German Government in achieving its objectives in the field of international cooperation for sustainable development. We are also engaged in international education work around the globe. GIZ currently operates in more than 130 countries worldwide.

GIZ in India

Germany has been cooperating with India by providing expertise through GIZ for more than 50 years. To address India's priority of sustainable and inclusive growth, GIZ's joint efforts with the partners in India currently focus on the following areas:

- Energy - Renewable Energy and Energy Efficiency
- Sustainable Urban and Industrial Development
- Natural Resource Management
- Private Sector Development
- Social Protection
- Financial Systems Development
- HIV/AIDS – Blood Safety

About the Indo-German Environment Partnership (IGEP) Programme

IGEP builds on the experience of the predecessor Advisory Services in Environment Management (ASEM) programme but at the same time strengthens its thematic profile in the urban and industrial sector, up-scales successful pilots and supports the environmental reform agenda and priority needs of India.

The overall objective of IGEP is that the decision makers at national, state and local level use innovative solutions for the improvement of urban and industrial environmental management and for the development of an environment and climate policy that targets inclusive economic growth de-coupled from resource consumption.

For information visit http://www.igep.in or write at contact@igep.in

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Sreeja S. Nair is Assistant Professor at National Institute of Disaster Management since 2007. She is a disaster management professional having more than 12 years of experience in the field. Her areas of research, documentation and training activities at NIDM include geoinformatics applications in disaster management, environmental law, disaster data and information management, ecosystem approach to disaster risk reduction and chemical disaster management. Ms. Nair published 10 papers in national and international journals, authored 3 training modules and edited 2 books and 2 proceeding volumes. She is the coordinator of Indo German Cooperation on Environmental Knowledge for Disaster Risk Management and co-principal investigator of ICSSR research project on drought vulnerability and mitigation analysis. She is also involved as a technical expert in the GIZ-European Union pilot project on integrating climate-change adaptation with disaster management planning process coastal Andhra & Tamil Nadu.

Ms. Sunanda Dey, Research Scholar, Dept. of Anthropology, Delhi University has completed her M Phil. in the area of disaster and development. The main focus of her research was on indigenous disaster risk reduction measures in context of floods in Mishing community of Majuli Island, Assam. A graduate in environmental science from Delhi University, she has a diploma in disaster management from IGNOU. Ms. Dey has been associated with eKDRM as a Project Associate since May 2011. She has participated in various training programmes related to disaster management and presented papers at national and international conferences. Her research interests are disaster risk reduction, indigenous methods, disaster and development issues and hydro metrological disasters.

Case Study Contributor

Dr. Shiraz A. Wajih, Post Graduate in Botany, Ph.D. in Plant Ecology from Gorakhpur University in 1980. Working as President of Gorakhpur Environmental Action Group (GEAG, a resource agency of MoEF) and Associate Professor in MG Post Graduate College (Gorakhpur University), Gorakhpur. Contributed significantly on action research, planning and knowledge management for Flood and Drought mitigation, land-use aspects, community approach and indigenous knowledge for climate-change adaptation and disasters reduction. Have published more than 50 research papers and research reports on issues related to Ecological Agriculture, Natural Resource Management, Climate Change Adaptation and Resilience in rural and urban settings.

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Indo-German Environment Partnership, New Delhi (IGEP),
GIZ Germany
&
National Institute of Disaster Management (Govt. of India), New Delhi