

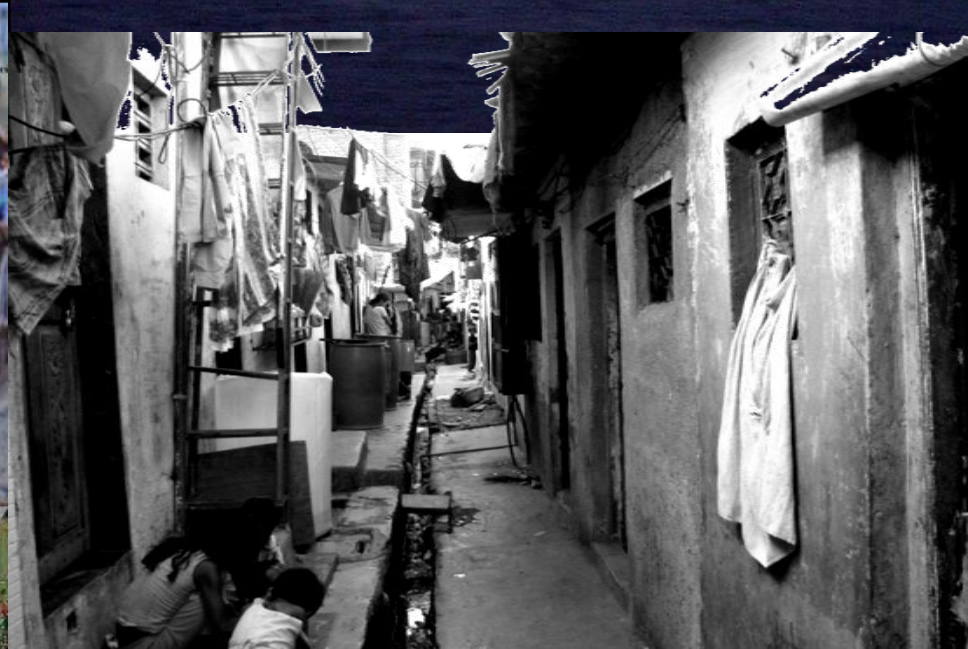
# IDENTIFYING VULNERABILITY PATTERN IN A FLOOD PRONE MICRO- HOTSPOT OF MUMBAI, INDIA

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Don't speak unless you could improve  
the silence

# GCOE Mumbai Project- Broad objectives of the phases

- Phase – 1 **Knowing the people and problem, and building trust.....** (Working time: 1.6 Years, specify the month/year)
- Phase – 2: **Working with the people and creating knowledge .....** (Working time: 2 Years)
- Phase 3: **Using innovative ideas and knowledge and implementation of IDRiM.,.....** (Working Time : 1.6 Years)

# Mumbai Flood: July 26, 2005

- Rainfall of 944 mm during the 24 hours.
- Over 60% of Mumbai was inundated to various degrees (FFC, 2006)



- 419 people were killed
- Another 216 people were killed due to water born disease
- The immediate impact was a total collapse of the transport and communication system
- Preliminary indications show that the floods caused a direct loss of about **Rs 450 crores** (Wikipedia)



# July 26, 2005



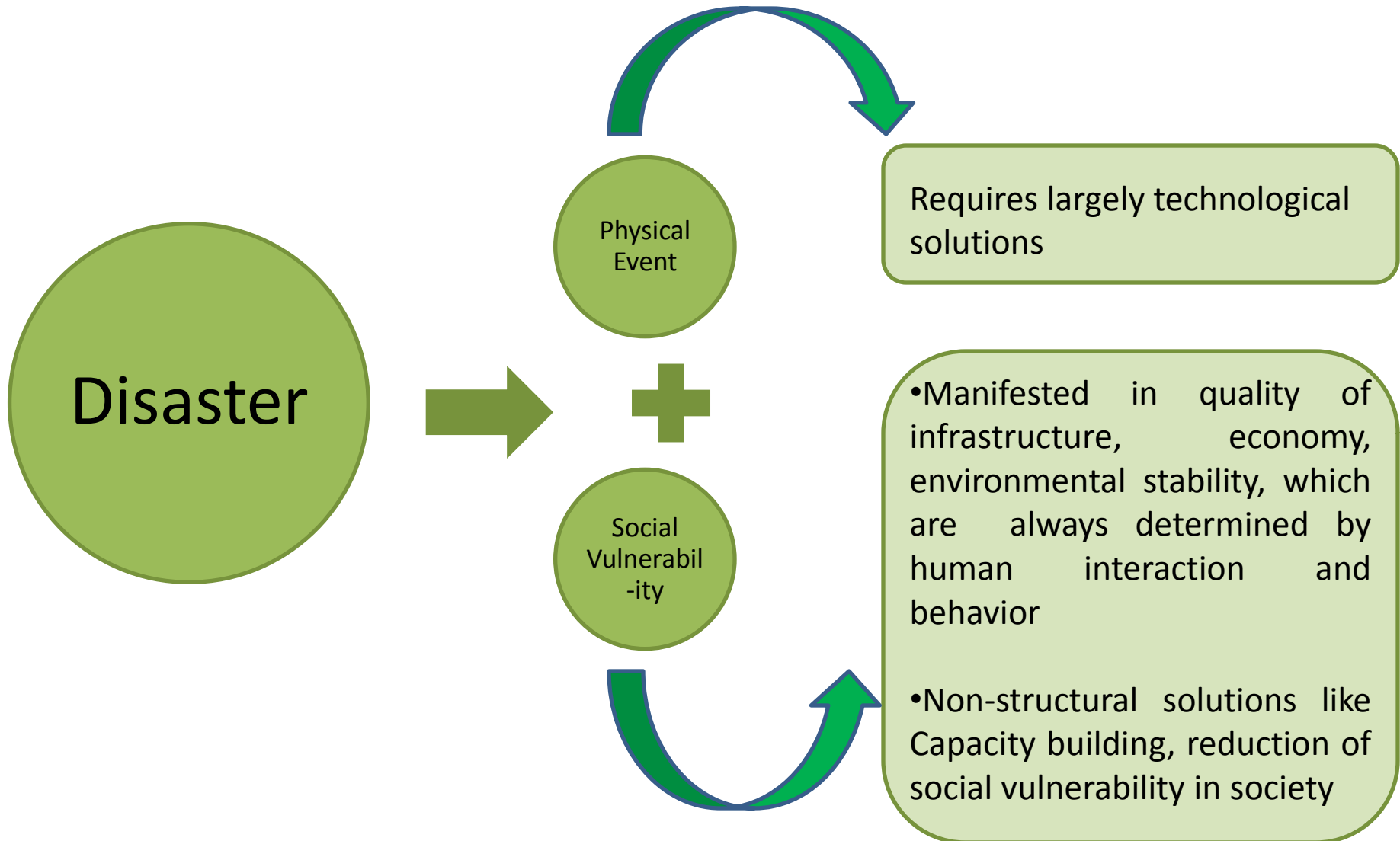
- In order to promote disaster resilience in a community, sensitive planning and initiatives are required
- focusing not only for the engineering based solutions which focus mostly on the structural measures,
- but also non-structural social engineering solutions which focus on capacity building and **reduction of social vulnerability of the community.**



# Significance of the Study

- Lack of empirical study
- Lack of available data
- Lack of initiative by the government / non-government to understand the level of prevailing vulnerability
- Focus on micro-hotspot will help sharpen and pinpoint the solutions in risk management that are feasible to implement

# *Vulnerability*



- O.D. Cardona

***Vulnerability*** is defined as an intrinsic predisposition to be affected by or to be susceptible to damage, that means vulnerability represents the system or the community's physical, economic, social or political susceptibility to damage as the result of a hazardous event of natural or anthropogenic origin.

# Factors for Measuring *Vulnerability Pattern*

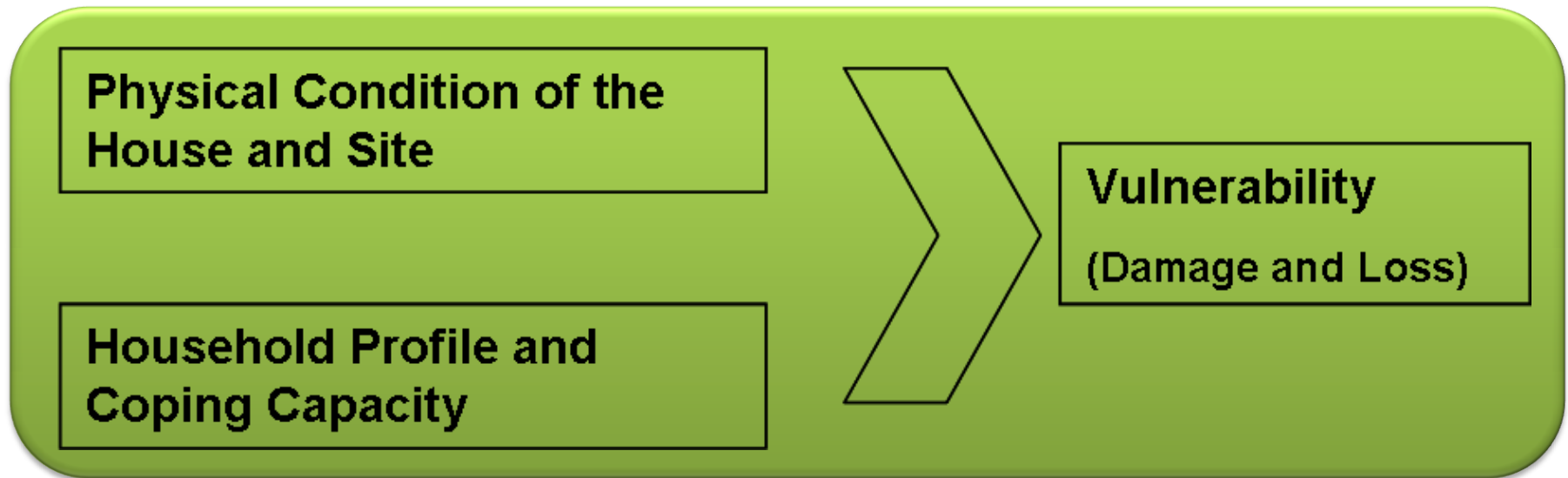


Figure: Conceptual framework of household vulnerability elements

# Methods

## Date Collection

- Face to face Interview
  - Field survey was conducted from February to March , 2010.
  - It took 14 days to cover the entire settlement for the present study area.



**Survey Population : 208 households**

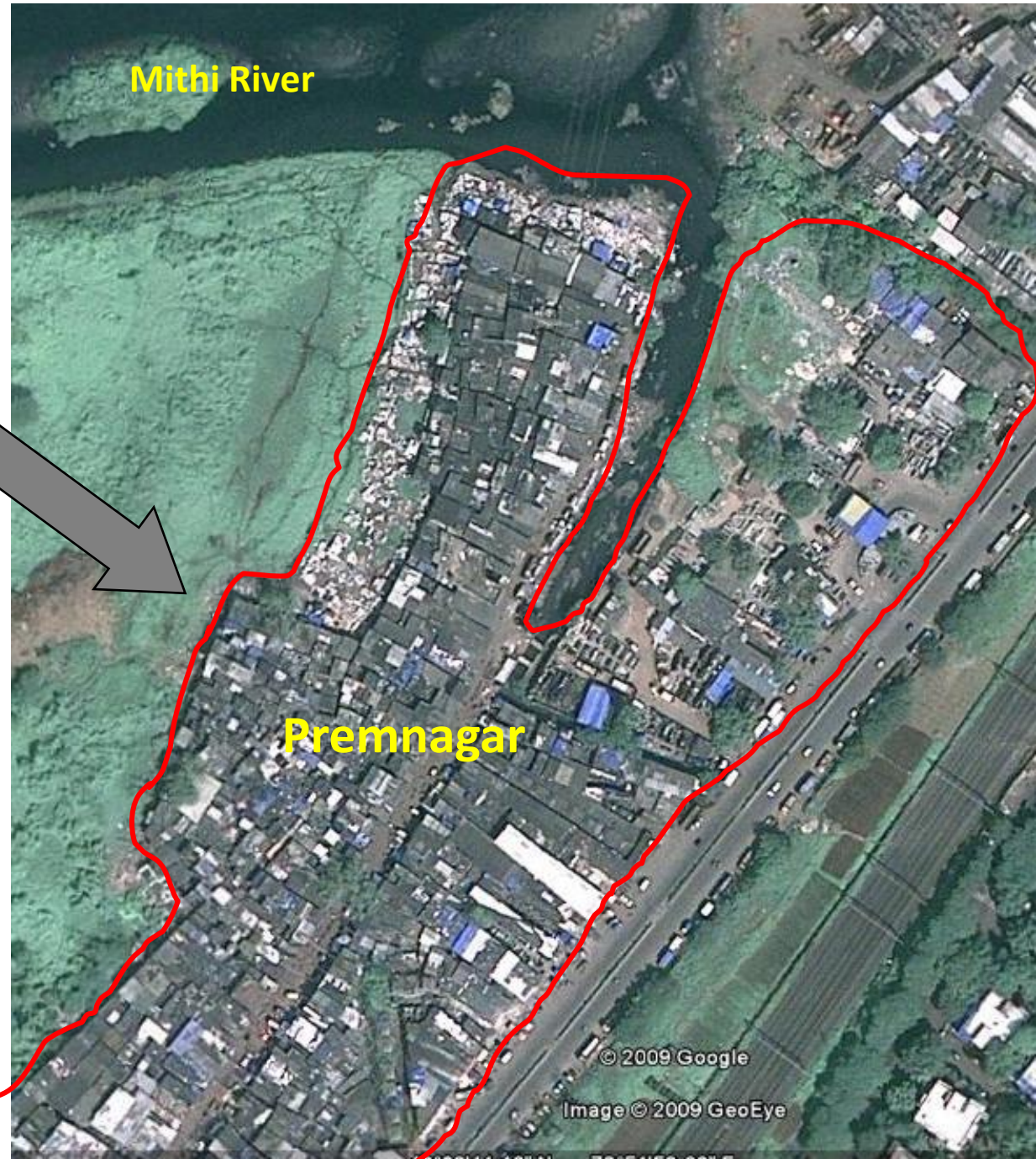
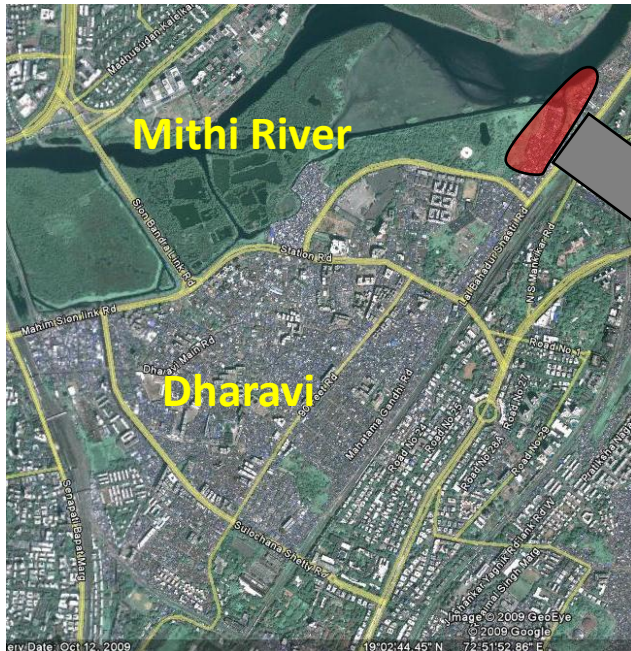


# Location of Dharavi



**Dharavi**

# Hot – Spot : Premnagar





# Case Study

## “Premnagar”- An overview



**Population :** 15000 (Approximate)

**Age of the settlement :** 30 - 35 Years approximately

### **Settlement Features :**

- Situated on the bank of Mithi river.
- It was earlier a marshy land abounded by mangrove forest.
- The settlement is situated 2 to 3 feet below from road level.
- Predominantly mixed landuse observed.
- One of the most severely affected settlements of 2005 Mumbai flood and prone to local flood every year.

# Profile of Premnagar Settlement

- **Religion:** Both Hindu and Muslim communities present



- **Mother Tongue:** Predominantly Hindi speaking

- **Migration Status:** Majority of people are immigrants from Uttar Pradesh, Bihar and economically weaker provinces.



- **Occupation:** people are mainly engaged in small scale factory, wage laborer, and various others unorganized sector of economy.



- **Height of building:** Both ground storey buildings and G+1 buildings present.

# Threats in Premnagar

- This low lying settlement is prone to flood
- In 2005 the magnitude of the flood was huge.
- Our survey found that in an average there was 5 to 6 feet water inside the house for 36 hours.
- The area is vulnerable to various kinds of environmental risks accelerated by
  - ✓ narrow lanes,
  - ✓ very poor ventilation,
  - ✓ inadequate infrastructure facility,
  - ✓ hazardous garbage and waste generated by recycling factories
- So far, apart from the routine maintenance of drainage system, no initiative has been taken by the local government or by any non governmental organization.





## Recycling factory, Near the outfall at Premnagar

The area is so dirty that it is quite difficult to stand there for a while. Recycling industry is one of the major source of income for the local people, however, causing lot of environmental pollution including river pollution, health problem etc



- A significant proportion of buildings are G+ 1 building. In some cases G+2 also are observed
- Though only ground level structure is allowed even after the authorization of the slum



- Interiors lanes are very narrow, hardly one people could move at a time.

- Basic Infrastructures like water supply, drainage system and sanitation facilities are insufficient.



## Water Level during 2005 Flood

- 6 to 8 feet inside the house
- 10 to 12 feet on road or surrounding areas

## Duration of Flood

- 18 to 24 hours inside the house
- 36 hours to 48 hours on road



# Results And Discussion

- ***“Two-step cluster analysis”*** is performed to categorize the households based on
  - **Household Profile**
  - **Physical Condition Of The Site And House**

## Indicators and variables of Household Profile

Indicator	Variable
<b>Socio-economic Characteristics</b>	Religion
	Mother Tongue
	Native Place ( The place from where the head of the household actually migrated)
	Period of Staying
	Education ( Education level of the head of the household)
	Income (Income of the head of the household )
<b>Housing Characteristics</b>	Housing Type  (Types of building materials )
	Building height
<b>Infrastructure</b>	Source of water supply
	Duration of receiving water
	Sanitation Facility

	<b>Household profile Score</b>			
	<i>Cluster – 1</i>		<i>Cluster – 2</i>	
<b>Religion</b>	Hindu	47.3 %	Hindu Muslim Illiterate	100 %
	Muslim	52.7 %		0 %
<b>Education</b>	Illiterate	18.9 %	Only Can read and write Up to Class 4 Up to Class 8 Up to Class 10 Up to Class 12	15.6 %
	Only Can read and write	13.5 %		18.8 %
	Up to Class 4	16.2 %		25.0 %
	Up to Class 8	25.7 %		15.6 %
	Up to Class 10	18.9 %		12.5 %
	Up to Class 12	4.1 %		6.25 %
	Graduation	2.7 %		6.25 %
<b>Monthly Income</b>	6067		3859	
<b>Household Size</b>	6.48		5.50	
<b>Period of Staying</b>	21		27	
<b>Building height</b>	Ground	40.5 %	Ground G+1 G+2	96.9 %
	G+1	39.2 %		0.0 %
	G+2	20.3 %		3.1 %
<b>Building Structure</b>	Pucca	81.1 %	Pucca Semi-pucca Kachcha	3.2 %
	Semi-pucca	17.6 %		90.6 %
	Kachcha	1.4 %		6.2 %

# Revealed Characteristics of Clusters

Household Characteristics	Cluster 1	Cluster 2
<b>Religion</b>	Hindus & Muslims uniformly distributed	Predominantly Hindus
<b>Education</b>	(not much variation with cluster 2)	(not much variation with cluster 1)
<b>Income</b>	More income	Less income
<b>Household Size</b>	Larger	Smaller
<b>Period of Stay</b>	newer to the place	older migrants

<b>Building Height</b>	Most of the higher storey structures concentrated here,	Predominantly ground storey buildings
<b>Building Structure</b>	Mostly pucca structures	Mostly semi-pucca structures

# Components **Not** Considered for Two Step Cluster Analysis of Household Profile

Components	Reason for not considering for cluster analysis
<i>Mother Tongue</i>	94 % people are Hindi-speaking; so not considered for cluster analysis
<i>Native Place</i>	93 % people are from U.P.; so not considered for cluster analysis
<i>Water Supply</i>	Source & quantity of water supply is same for an area ; so not considered
<i>Sanitation Facility</i>	Sanitation facilities are same for a particular area; so not considered

**Table: Components not considered for two step cluster analysis of household profile**

- ***Household characteristics*** - two types of clusters can be observed

## Cluster 1

- More Prosperous, Heterogeneous and Multi cultural = Prosperous



## Cluster 2

- Relatively weak and homogeneous = Puny



## Indicators and variables of “Physical Condition of The Site And House”

Indicator	Variable
Extent and magnitude of flood	Level of flood water inside the house (in feet)
	Duration of flood water inside the house
	Duration of flood water outside the housing or immediate surrounding areas

*Note : All the variables of Physical Condition Of The Site And House are self reported.*

# Description and Score of Cluster Distribution of Physical Conditions of the House and the Site

Indicator of Physical Conditions of the House and the Site	Score of Physical Conditions of the House and the Site		Description of Physical Conditions of the House and the Site	
	<i>Cluster : 1</i>	<i>Cluster : 2</i>	<i>Cluster : 1</i>	<i>Cluster : 2</i>
<b>Average Level of Flood Water</b>	7 feet	5 feet	<b>High</b>	<b>Low</b>
<b>Average Duration of flood (in hour) inside the house</b>	42 hours	22 hours	<b>Long period</b>	<b>Short period</b>
<b>Average Duration of flood water (in hours) outside the house</b>	49 hours	25 hours	<b>Long period</b>	<b>Short period</b>

**Table: Detailed description and score of Cluster distribution of Physical Conditions of the House and the Site**



# Results And Discussion

- Premnagar Community is divided into two clusters based on *physical condition of the site and house*

## Cluster 1

- More Flood Prone

## Cluster 2

- Less Flood Prone

- Thus, based on the two factors:
  - **Household Profile**
  - **Physical Condition Of The Site And House**
- There are 2 clusters / groups in Premnagar:

<b>Factors</b>	<b><i>Cluster 1</i></b>	<b><i>Cluster 2</i></b>
<b><i>Household Profile</i></b>	Economically And Culturally More Prosperous	Economically And Culturally Less Prosperous
<b><i>Physical Condition Of The Site And House</i></b>	More Flood Prone	Less Flood Prone

# Vulnerability Level / Pattern (Damage / Loss) ??

		<i>Household Profile</i>	
		Rich	Poor
<b>Condition of the site and the site</b>	High Flood Prone		
	Low Flood Prone		

# Vulnerability Level / Pattern (Damage / Loss) ??

		<i>Household Profile</i>	
		Rich	Poor
<b>Condition of the site and the site</b>	High Flood Prone	??	??
	Low Flood Prone	??	??

# Vulnerability Level

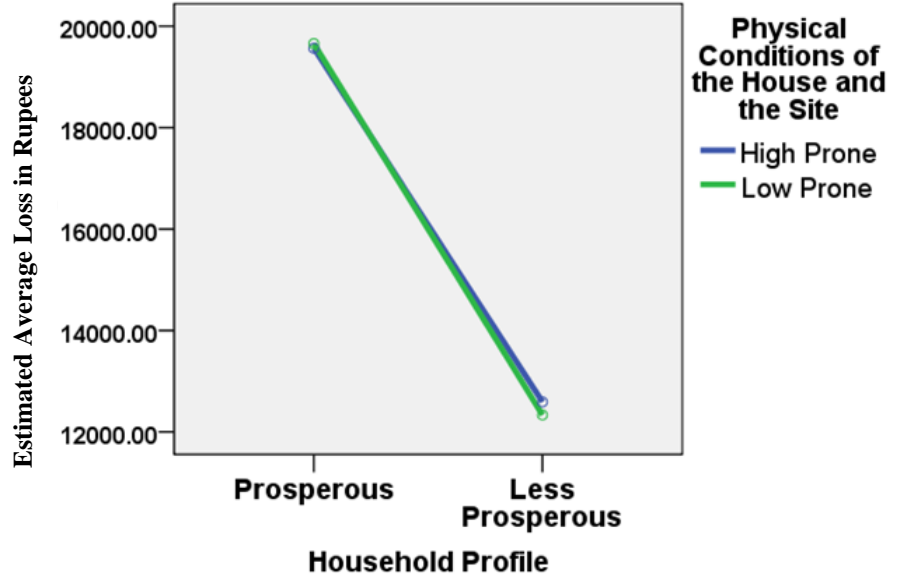
## Damage / Loss

- 1) Total Monetary Loss
- 2) Damage to Cloths
- 3) Damage to Food
- 4) Damage to Household durable assets
- 5) Damage to building materials

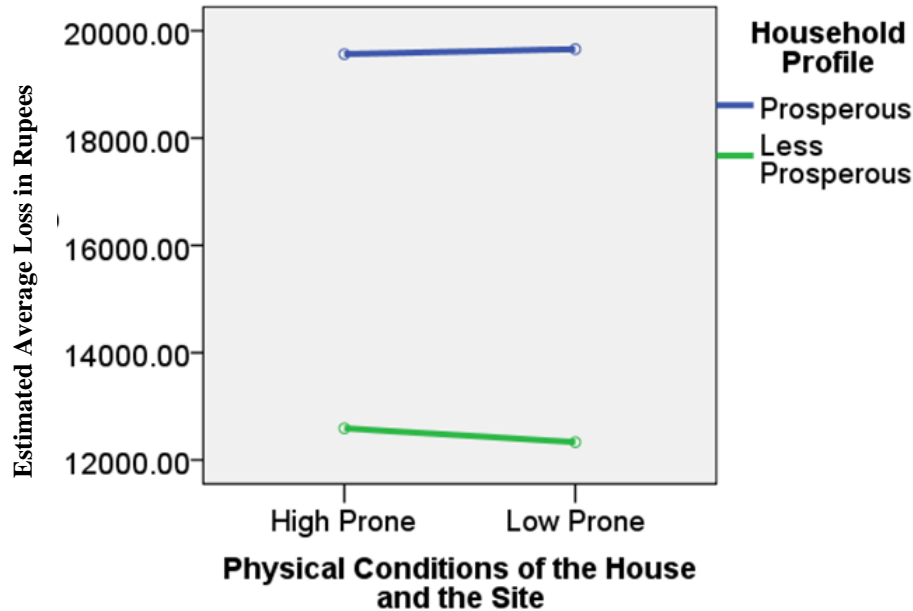
# Observed Vulnerability Pattern

- ***“Two way ANOVA”*** was performed to examine the vulnerability pattern of Premnagar, considering two factors:
  - **Household Profile**
  - **Physical Condition Of The Site And House**

**Figure: Estimated Marginal Means of Total Estimated Loss (Self Reported)**

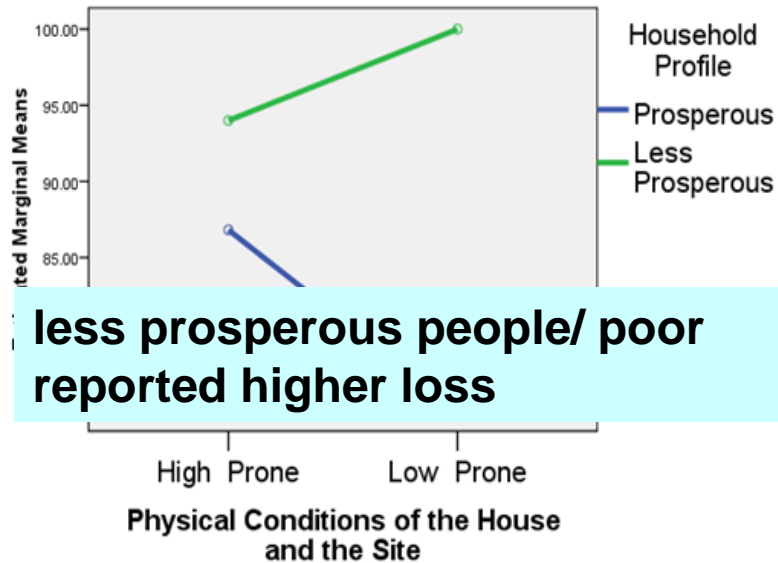


Damage of the prosperous people is much higher than the less prosperous people irrespective of physical conditions of the house and the site.



# Damage to Food

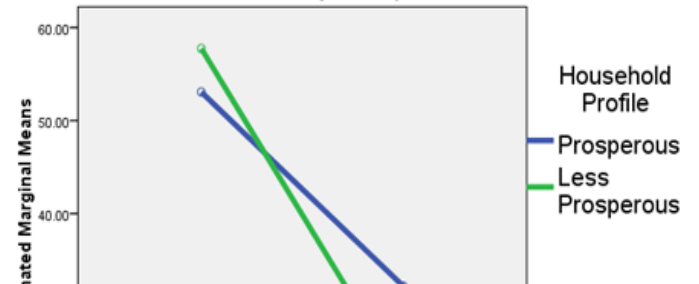
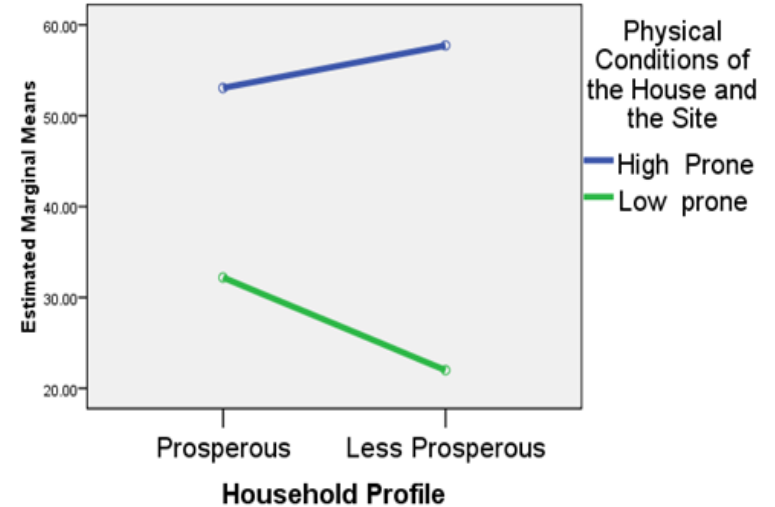
Estimated Marginal Means of Damage to Food Stored in House ( Self Reported)



**less prosperous people/ poor reported higher loss**

# Damage to Cloths

Estimated Marginal Means of Damage to Clothes ( Self Reported)

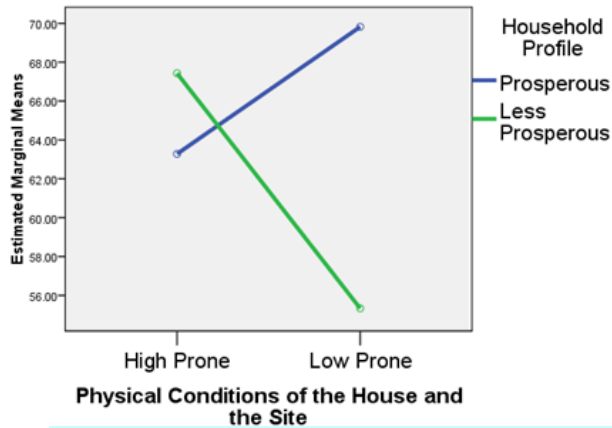
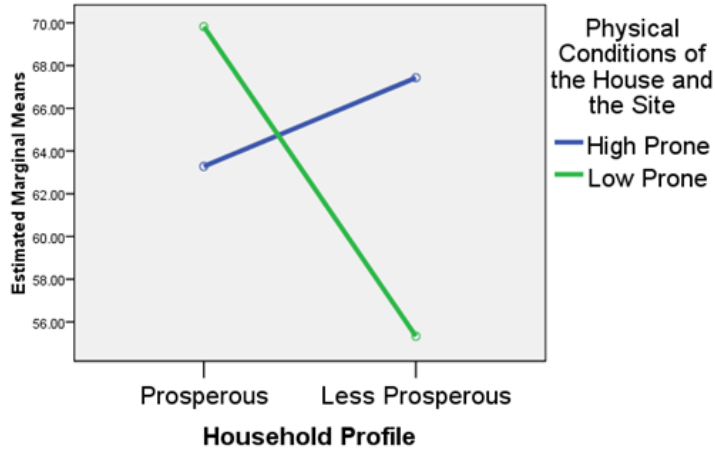


**Households who are high prone to flood is more vulnerable irrespective of their household profile background**



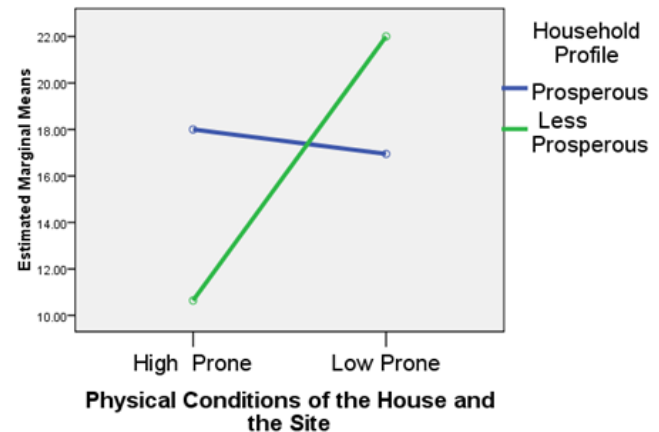
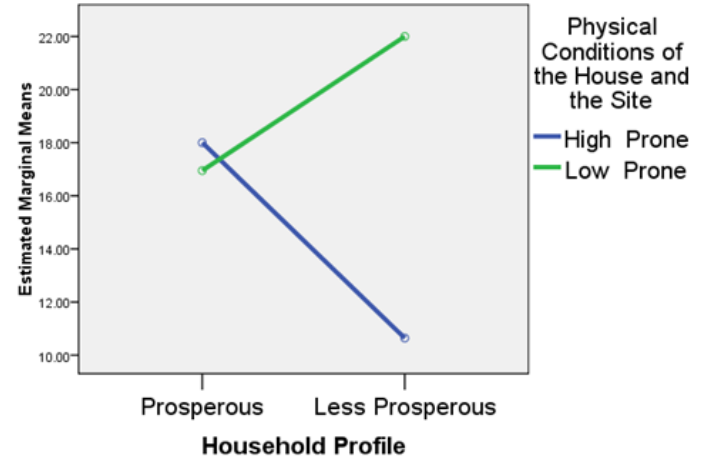
# Damage to Durable assets

Estimated Marginal Means of Damage to Household Durable Assets ( Self Reported)



# Damage to Building/House

Estimated Marginal Means of Damage to Building/House ( Self Reported)



**Both factors influence the vulnerability**

# Conclusions

- **Prosperous people have more money loss than poor irrespective of the level/exposure of flood**
- Poor People have more damage to food stored in house than prosperous group irrespective of their level of hazard.
- Household of high flood prone category reported more loss to clothes than low flood prone category irrespective of their household profile.

# Conclusions

- Combined impact of household profile and physical condition of the house and the site is observed in all kinds of damage, but no particular pattern of common impact on vulnerability has emerged.

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## Proposed Study

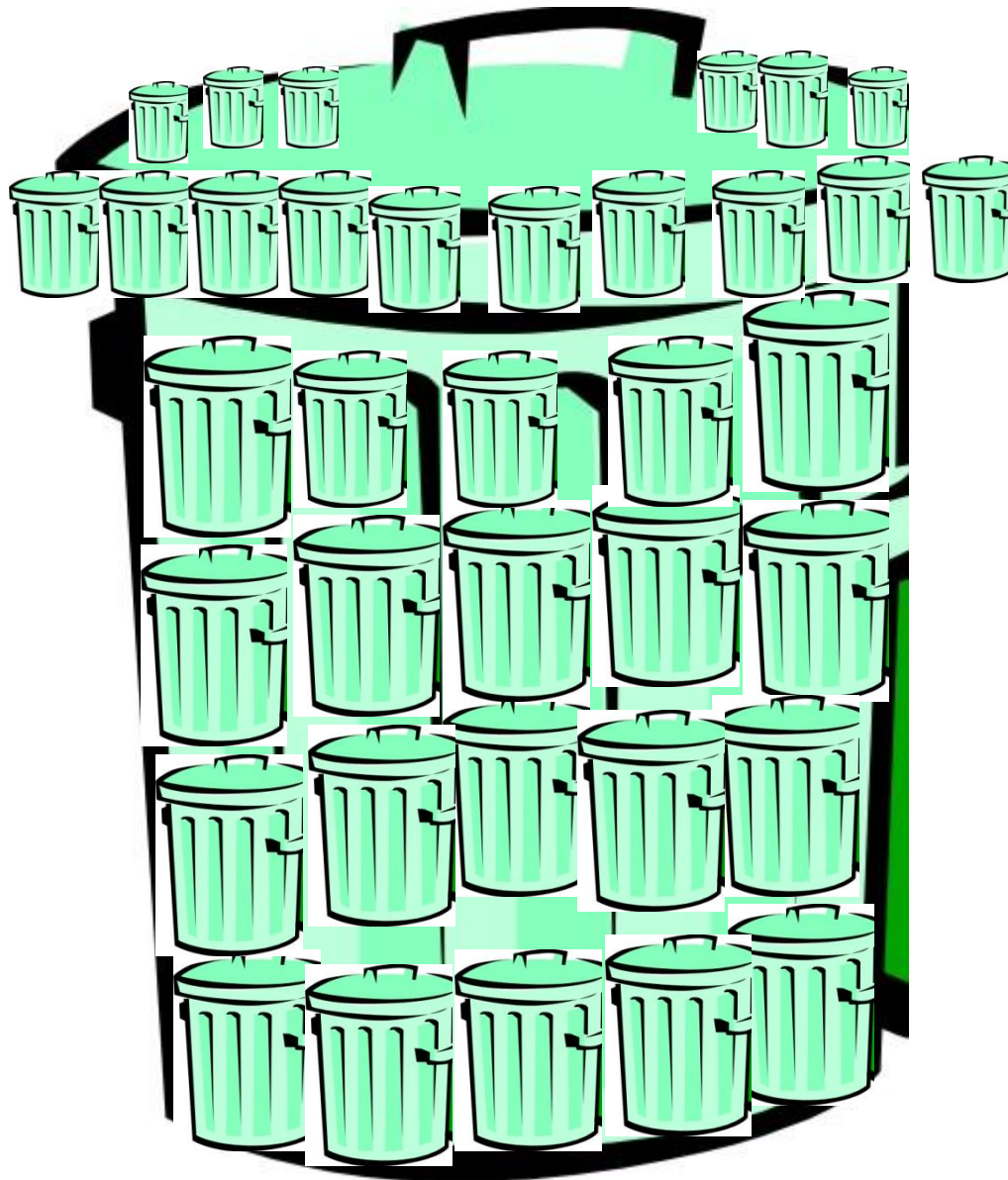
Measuring Self Efficacy and Collective Efficacy : Dynamics behind Coping Capacity Development Process in Flood Risks Reduction

- Adoption of preventive measures at household level and community level is instrumental for reducing flood damage and loss.
- The international commission of the Rhine (2002) estimates that long term precautionary adaptation by household at risks by flooding, such as installation of protective barriers can reduce monetary damage by as much as 80%

# Technology / Innovation







**Diffusion or adoption of new technology/knowledge is instrumental for  
Integrated Disaster Risks Management**

Advantages and disadvantages of the technology is unknown to the potential users

The idea in the new message contains **Uncertainty**



Its risky to make decision

➤ **Adaptation is critical to risk reduction and preparedness.**

## Risk communication

**Municipal Corporation of greater Mumbai (MCGM)**

- Evacuate during flood
- Manage solid waste
- Follow building bylaws
- Store food during emergency .
- Contingency/ survival kit
- Follow collective action plan

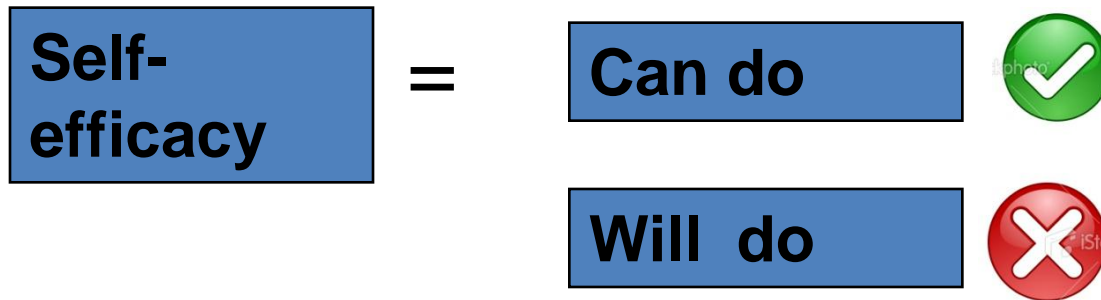
**Community (Eg. People of Dharavi )**

# Self efficacy

**Self Efficacy** : Perceived Self-efficacy is a judgment of capability to execute given types of performance. It is concerned with perceived capability.

*“Self Efficacy is the belief in one’s capabilities to organize and execute the sources of action required to manage prospective situation”*

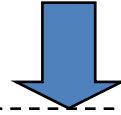
(Bandura, 1986)



*“Can”* is a judgment of capability

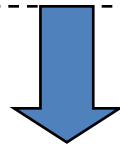
*“Will”* is a statement of intention

# Impact / Function of Self Efficacy on Coping Capacity of Individual / Group of Individuals



- Challenges and Goals are set by the Individual
- The course of action people choose to pursue
- People's commitment to fulfill their goals
- The amount of effort are put forth by the individual in given endeavor
- Level of perseverance in the face of obstacle
- Resiliency to adversity
- The quality of their emotional life and how much stress and depression they experience in coping with taxing demands

**Coping Capacity**



**Adaptive Behavior**

# Example...

*The Stronger the perceived self efficacy, the higher the goal challenges people set for themselves and firmer is their commitment to them. ( Bandura, 1991)*

*People who are plagued by self-doubts anticipate the futility of efforts to modify their life situation. They produce little change even in environments that provide many potential opportunities. But those who have firm belief in their efficacy, through ingenuity and perseverance, figure out ways of exercising some control, even in environments containing limited opportunities and many constraints ( Bandura, 1993)*

*When faced with obstacles and failures, people who harbor self-doubts about their capabilities slacken their efforts or give up quickly. Those who have strong belief in their capabilities exert greater effort when they fail to master the challenge. Strong perseverance usually pays off in performance accomplishment. ( Bandura, 1993)*

# High Self-Efficacy



# LOW Self-Efficacy





## High Self Efficacy



*“The problem is too easy to solve”*

## Low Self Efficacy



*“The problem is too difficult to solve”*

**Attitude Development by Self Efficacy of Individual**

There's one reason people fail to reach their goals - They never take the first steps!



It doesn't matter if it's a small step - just take it!



POSITIVE POOCH!



## ***Bandura ( 1977) –***

Behavior and behavioral change depend on both outcome expectations or response efficacy and personal efficacy expectation.

➤ **Outcome expectations ( Response efficacy)** consists of belief about whether a particular will lead to particular consequences .They are beliefs about consequences of an act

➤ **Self Efficacy** refers to person's expectations regarding his capability to realize a desired behavior. It does not reflect a person's skill , but rather one's judgment of what one can do whatever skills one possess.

# During the coping process, A Person Considers -

- 1) Which coping strategies are available
- 2) The likelihood that some strategy will result in the expected outcome



**Outcome  
Expectancy  
/ Response  
Efficacy**

- 3) Whether he can use the coping strategy effectively



**Self Efficacy**

## Previous studies shows – Individual or community have following adaptive behavior

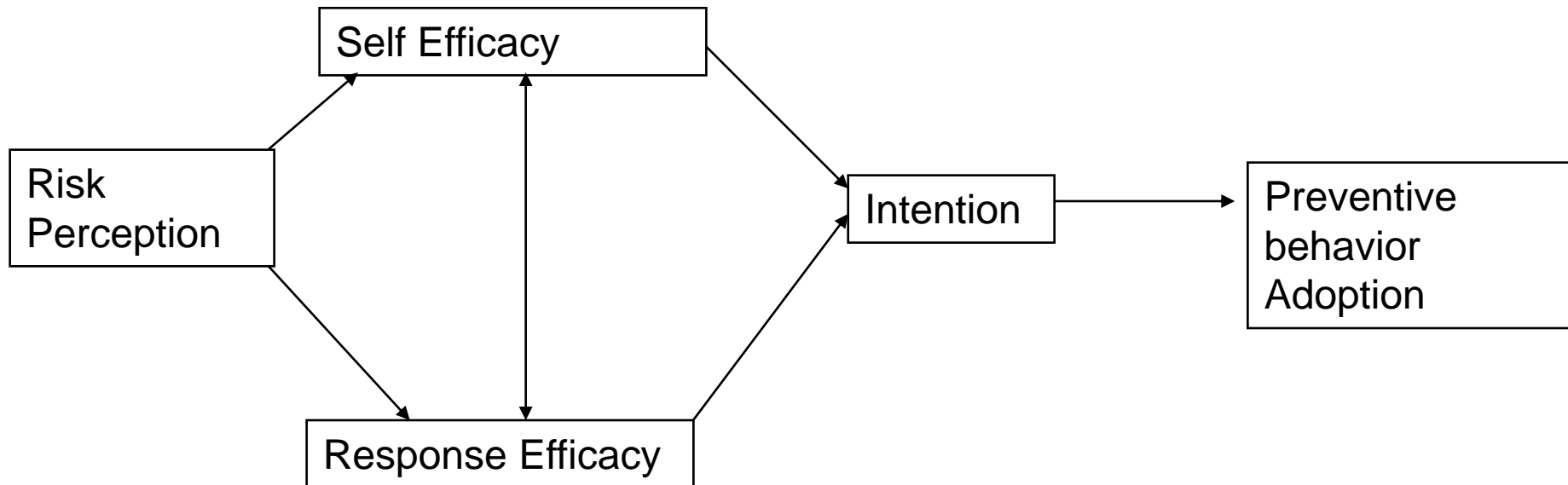
- 1) High response efficacy + Low self efficacy = Fatalist
- 2) High risk perception + low self efficacy = Fatalist
- 3) High Risk perception + high self efficacy = Higher Intention
- 4) High response efficacy + high self efficacy = Higher Intention

## Research Question – 1

How self-efficacy influence individual intention to adopt preventive measure or coping behavior?

# Objective – 1

To find out the role of self efficacy in the process of preventive measure adoption and to find out the relation between risk perception, response efficacy and self efficacy in the process of adaptive behavior?

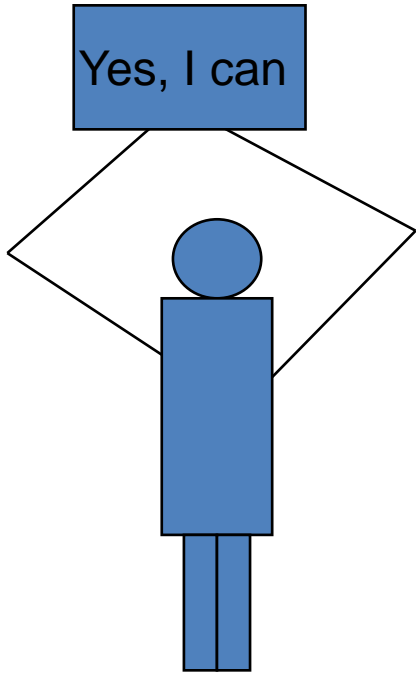


**Model to explain behavioral intention and the role or influence of Self – Efficacy**

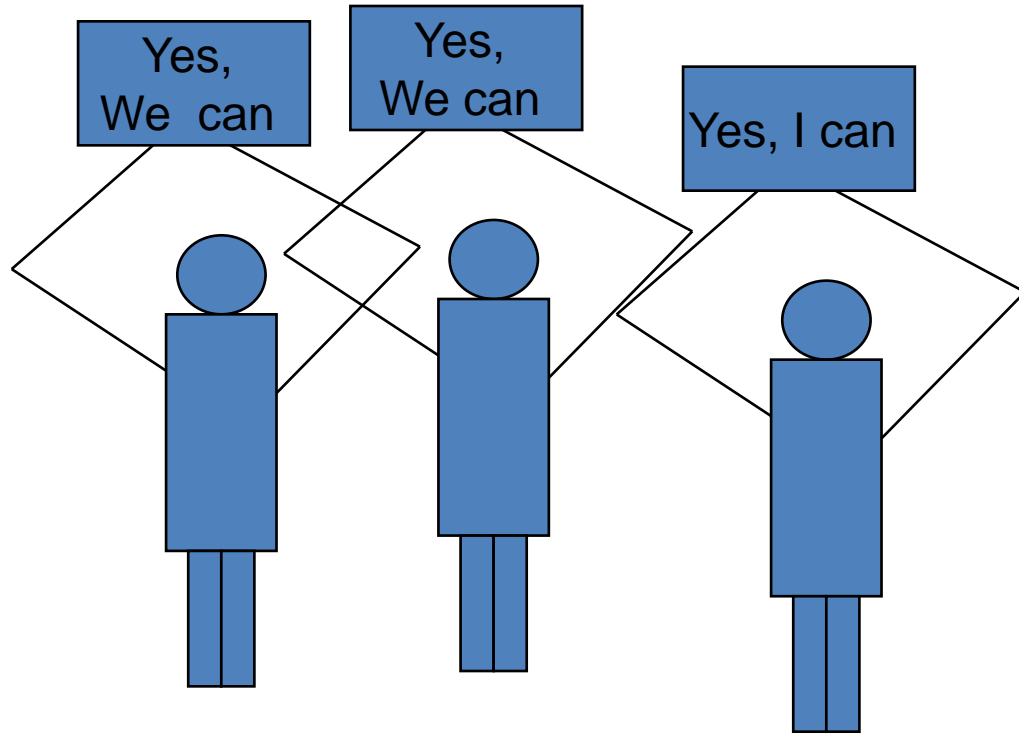
# Dimensions of Perceived Efficacy

( Self efficacy, Group Efficacy/ Collective Efficacy)

- People do not live their lives autonomously
- Many of the outcomes they seek are achievable only through interdependent efforts. Hence, they have to work together to secure what they can not accomplish on their own.
- People's Shared beliefs in their collective power to produce desired results is a key ingredients of collective agency
- A group's attainments are the product not only of shared knowledge and skills of the different members, but also of the interactive, coordinative and synergetic dynamics of their transactions. Therefore, perceived collective efficacy is not simply the sum of the efficacy beliefs of individual members, rather it is an emergent group level priority. A group operates through the behavior of its members.



**Self-Efficacy**



**Collective- Efficacy**

Perceived collective efficacy resides in the minds of members as beliefs in their group's capability

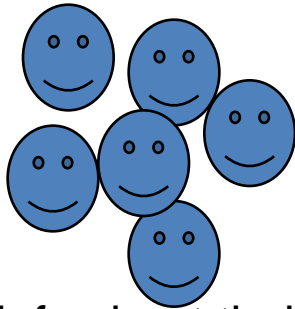


# Collective- Efficacy

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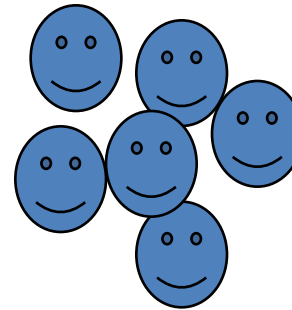
## Disaster risks Management/ Preparedness Context

### Group Efficacy



People beliefs about their collective power or capacity they can perform with the help of power or capacity of relatives, neighbors, religious and social organizations

### Institutional Efficacy



People Beliefs about their collective power or capacity can be achieved by the joint effort of local community and local government and non-governmental organizations

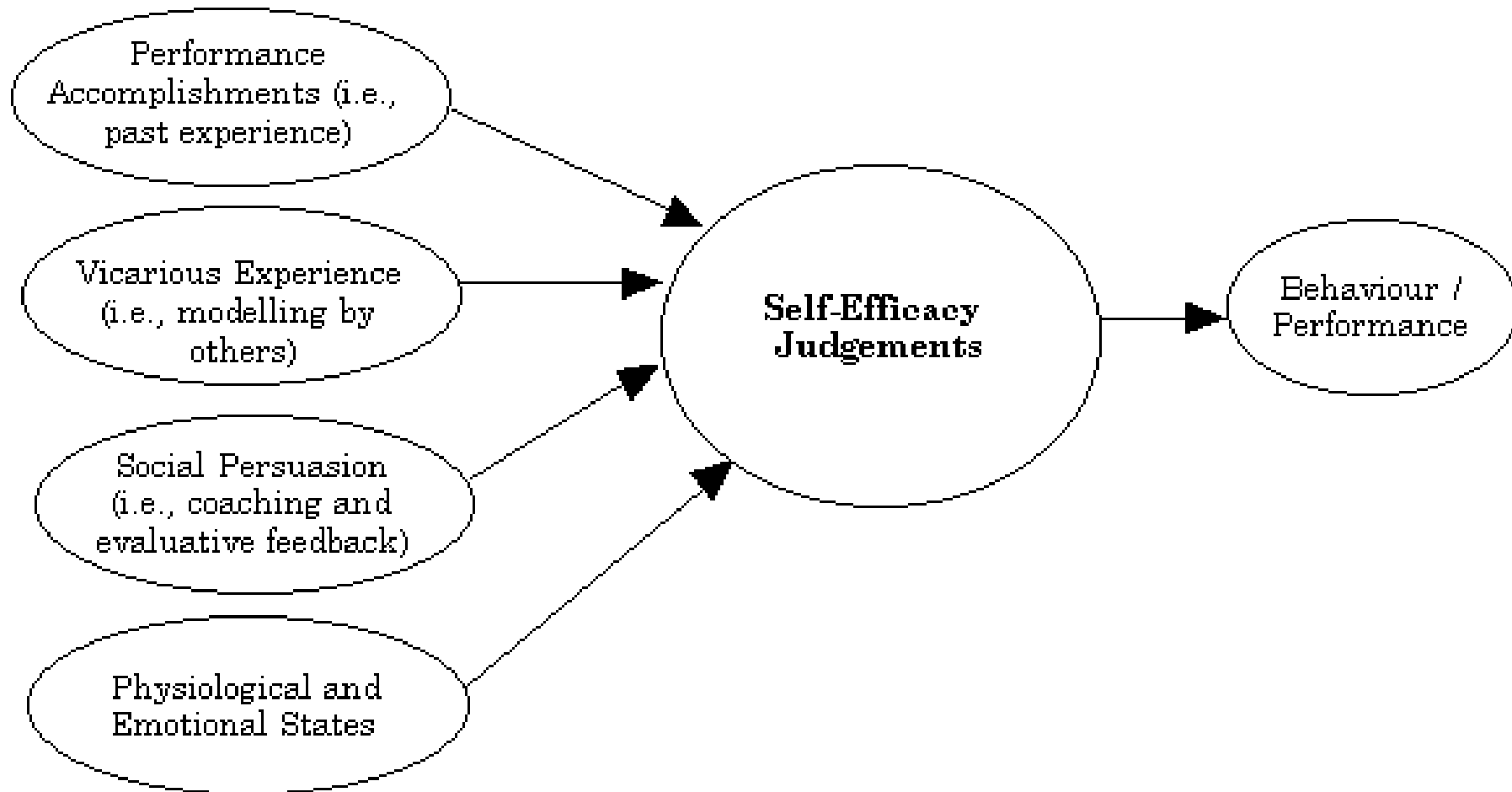
???

- What I can do alone to prevent flood risks ?
- What we all (neighbors, religious and political groups) can do to prevent flood risks?
- What we can do by the help of local Government to prevent flood risks?

# Objective – 2

- To find out the perceived self -efficacy and collective-efficacy of the community for flood risks reduction

# How do self-efficacy expectations develop?



Sources of Self-efficacy Information

# How do self-efficacy expectations develop?

- ❑ **Performance Accomplishment:** People learn through experience . Self-efficacy expectations increase through successive mastery of behavior while repeated failures lower them.
- ❑ **Vicarious Experience :** Other people serve as a frame of reference. Self Efficacy appraisal are specially sensitive to vicarious information if people have little prior experience with certain behaviors and if the criteria for evaluating performance diverse or vague.
- ❑ **Verbal persuasion :** is another means to insert or to increase efficacy expectations in individuals. People who are persuaded verbally are more likely to mobilize more effort than if they remain convinced of their incapability.
- ❑ **Physiological information** can influence self efficacy as well. If people have too much arousal, they are less inclined to expect success than if they have moderate levels of arousal. For example, having trembling hands during a driving test might cause a person to think that they are very nervous and unable to drive well.

# Objective – 3

- To find out the role of the sources in self efficacy and collective efficacy development of the community to cope with flood disaster risks.

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