Community Based Evaluation of the Costs and Benefits of Resilient Housing Options: Gorakhpur, India

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INTRODUCTION

Shelter is one of the basic human needs and also the most important factor influencing the exposure of people and their assets to disaster risks, especially in flood prone areas and more so in water-logged areas. Gorakhpur is one of the cities in eastern India where waterlogging has been a problem because of its layout, topography and a host of other factors—and this challenge is worsening by the year. The peri-urban areas adjoining the city, where the city is expanding rapidly, face flooding on an almost annual basis. Housing has been identified as one of the nine vulnerable sectors in the city (Wajih,et al, 2010). Hence, evaluation of housing designs and structures in terms of costs and benefits in relation to climate change impacts is relevant for management of current and future disaster risks and facilitating resilience building. In flood prone areas the cost-effectiveness of a resilient shelter design depends upon many factors, such as the frequency and magnitude of disasters, the extent to which communities are impacted, and the cost of interventions. Such factors can vary widely according to location and have differential impact on different socio-economic classes. Thus, it is important that the cost-effectiveness of actions should be evaluated in terms of regional, socio-economic and physiological conditions. Though cost-benefit analysis (CBA) has been carried out in many fields, very little information is available on the costs and benefits of shelter design improvements to reduce disaster losses in developing country conditions, particularly for vulnerable communities. Due to climate change, the occurrences and gravity of natural disasters and complex emergencies are increasing, thereby causing adverse impacts on shelter and human lives overall. Disasters destroy decades of human efforts and investments, thereby placing new demands on society for rehabilitation and reconstruction. Disasters affect both the rich and the

poor, but the impacts of disasters are suffered more by the poor as they struggle to recover from losses. When shelters are destroyed, people are displaced from their homes and eventually their livelihoods are also affected (Habitat for Humanity-India, 2013).

PURPOSE

This discussion paper is an attempt to understand perceptions about the resilient options adopted in flood-affected areas in peri-urban and rural parts of Gorakhpur. The study also paves direction for architects, policy makers and local administration to consider climate change in their developmental plans, disaster schemes and housing designs. This discussion piece also recommends that in flood prone areas the housing designs should be made in such a way that they respond to short and intermediate-term climate risks with the expectation that this will enhance resilience capacity. Thus, it is imperative to explore the community perceptions on options for alternative shelter designs that ensure cultural compatibility, as well as social acceptability, to reduce future risks. The research team carried out a series of community SLDs to identify and analyze community perceptions of the costs and benefits of various options that households have adopted to mitigate losses from flood and waterlogging. It may be noted that qualitative analysis and quantitative CBAs can show very different results for the same options, indicating that a community may assign greater value to non-monetary aspects (eg: aesthetics, status in the society, environment, etc.).

INTERVENTION AREA

Floods and waterlogging are a recurrent phenomenon in peri-urban and city areas of Gorakhpur and have continued to visit the area year after year with varying intensity. The rising population and accelerated rate of housing construction in the city, and its peri-urban areas, has a serious impact on flood and waterlogging problems and can cause deteriorating living conditions. During the last few decades the nature of flooding and waterlogging in the area has transformed due to changes in land use patterns and other anthropogenic activities. The changing climate has given new dimensions to the problem and further increased the risk of floods and related damages. Climate change is likely to increase Gorakhpur's extreme rainfall events. After 100mm of rain fall in 24 hours (a common rain event in Gorakhpur) flooding occurs in many low-lying areas of the city. Climate change will likely increase these types of events by 10%–20% (Opitz-Stapleton, 2013). This is certainly a serious concern for the people of Gorakhpur in terms of infrastructure development. These recurrent floods have increased housing costs and have affected the livelihoods of rural and peri-urban people. In response, people have created and adopted a number of new safety measures. In recent decades people of peri-urban areas have observed that though the severity of flooding has been reduced with the development of embankment construction, it has also enhanced the risks of waterlogging. During a shared learning dialogue (SLD)[1] community members responded that, due to poor drainage system, flood water remains in agricultural land and sometimes even around homes for more than 20-30 days during the monsoon period. This causes heavy losses in agriculture, shelter, indoor assets, and education and working days of poor and vulnerable people. Therefore, this study was carried out in peri-urban and rural areas of Gorakhpur. The entire Gorakhpur Development Authority (GDA) planned area was included in this study. For better reflection of housing investment in flood prone areas, a buffer zone of 5 km beyond the GDA boundary (GDA Master Plan 2021 boundary) was also included to better comprehend the dynamism of construction in peri-urban areas. These

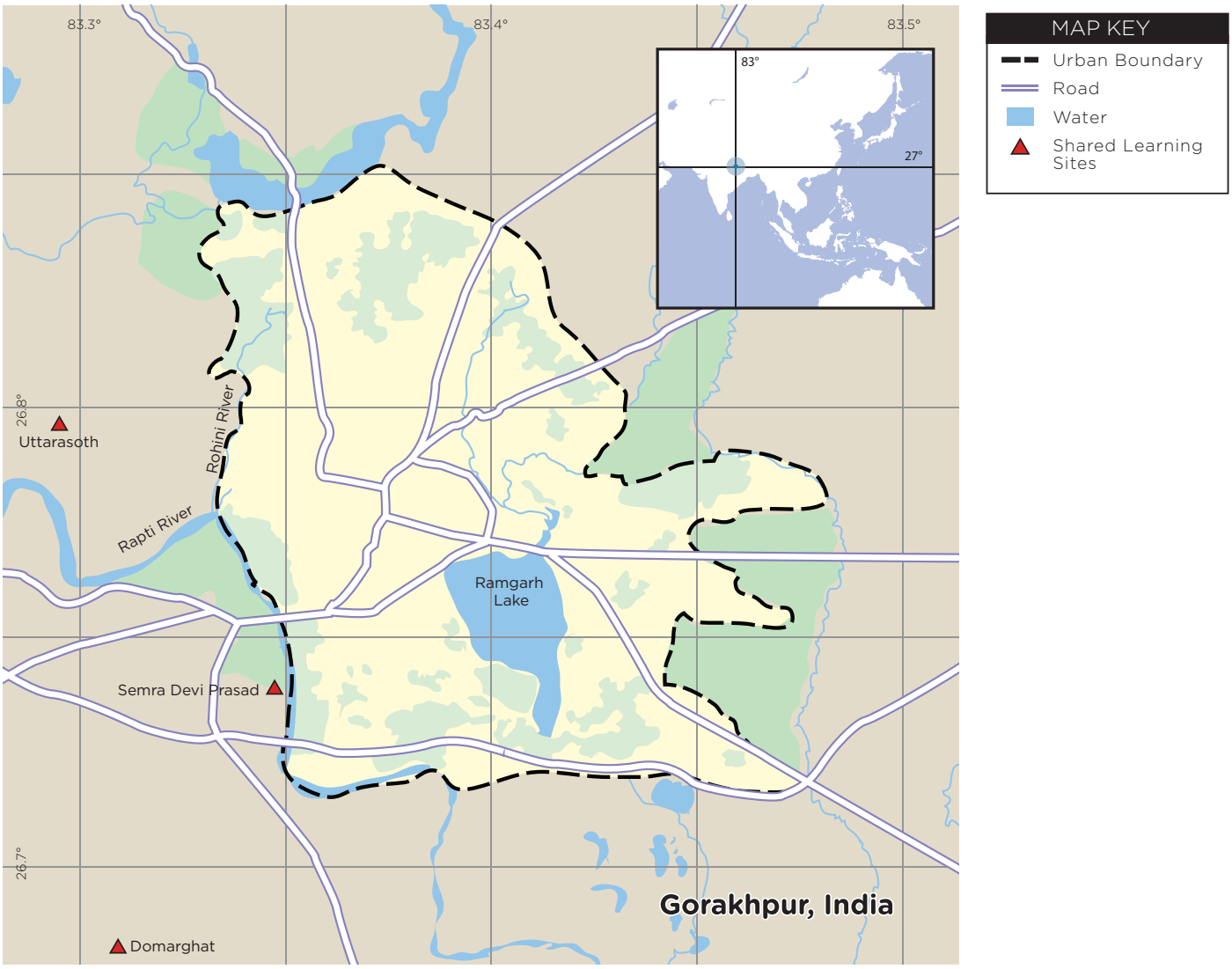
1 Shared Learning Dialogue (SLD): The shared learning dialogue process brings together different stakeholders and different types of knowledge both scientific and local. It is intended to generate discussion and innovation based on new understandings of climate change, risk and uncertainty. Shared learning dialogues are founded on principles of meaningful public participation – bringing together stakeholders with different interests and perspectives, different information, knowledge and power – in a public arena of debate on a level playing field (Reed, 2012).

zones are very dynamic in terms of land use change, population density, types of housing, and material use. Gorakhpur has a fairly flat topography with minimal rise and fall over the land, so even a small disruption in the natural flow of water can impact the flooding and water-logging regime in the area. The area had a large number of permanent water bodies, which were developed over time due to changing river course and abandoned channels. Historically, these water bodies played an important role in flood management and provided livelihood options to the population. In the last two decades, however, large-scale haphazard housing construction and lack of futuristic disaster planning, many of these water bodies have disappeared due to encroachments. Figure 1 below shows Gorakhpur city limits and the areas that were investigated for this study. The map also shows the location of villages where SLDs were undertaken.

METHODOLOGY AND DATA COLLECTION

The study encompasses a vast area, which made it difficult to select the villages which are most severely affected by flood and waterlogging. Human

FIGURE 1: CDKN INTERVENTION VILLAGES, GORAKHPUR*



*This map is used for illustrative purposes only.

beings have the capacity to learnt from the past; this transformation has been explicitly seen in peri-urban and rural areas of Gorakhpur. Most households have learned lessons from past flood events and have adopted specific features in their housing designs that enhance their ability to reduce damages due to floods and waterlogging. This study was based on primary data collection through several SLDs with the local community. However, before community consultation, an intensive desk assessment was carried out with team members to comprehend the situation of the study area. Strategies were formulated to collate the flood risks of the area through Google Earth satellite images and some secondary data available from Tehsil and the District Disaster Management Authority, Gorakhpur. The entire process of conducting a qualitative community based analysis of resilient options can be divided in two phases:

1. Vulnerability and flood risk assessment; and

2. Conducting SLDs with communities in the selected villages

VULNERABILITY AND FLOOD RISK ASSESSMENT

A vulnerability assessment was carried out in five villages (Uttrasoth, Domarghat, Semra Devi Prasad, Gayaghat, and Manjharia) selected on the basis of the following criterion:

- Location of village must be within 5 km from the 2021 boundary of the GDA as proposed in the Gorakhpur Master Plan 2021;
- Elevation of the village (calibrated from SRTM data);
- Proximity to Rapti river; and
- Proximity to an embankment.

The vulnerability assessment was carried out in these five villages and included SLDs with communities. All of the selected villages are affected by flood and waterlogging problems for two to three months during the monsoon period. Through these conversations, qualitative and quantitative household information was collected on a number of factors:

- socio-economic condition;
- housing structure;
- types of houses;
- depth of water inundation;
- duration of flooding;
- nature of damages;
- flood impacts by gender;
- impact of floods on health;
- housing cost; and
- adopted measures for coping with floods.

Investment in housing is mostly a matter of personal capacity, need and level of income. The level of vulnerability is clearly indicated by the types of housing in the surveyed villages. During the vulnerability assessment it was noted that, despite the rising price of housing materials, even poor people preferred pucca houses to reduce the future damages from flooding. The 1998 flood was a historic event in Gorakhpur, and acted as a paradigm shift in the nature of housing designs. After the 1998 flood the tendency to construct *Kutcha* houses declined drastically. Now *Kutcha* houses are rarely seen in peri-urban villages. During community consultations, detailed information was collected regarding the use of different housing materials. It was noticed that middle-income households had a long term vision regarding housing construction while the poor did not have such perceptions, mainly due to economic constraints. The poor build their houses according to their current economic capacity.

With this is mind, different income groups were consulted to ascertain the level of acceptance of mitigation measures and use of different material.

It is important to mention here that the 1998 flood depth also created a benchmark for raising the plinths of houses in the area. People have raised the plinths of their houses by about 2–7 feet from ground level, depending on location. Along with raised plinths, people have started using several other practices in housing construction to reduce flood and waterlogging damages. The mitigation measures identified at a household level (compiled from the discussions in these five villages) are given in the table below.

TABLE 1: FLOOD MITIGATION MEASURES IDENTIFIED BY HOUSEHOLD

Double roof	Almirah construction
RBC roof	Raised plinth with brick wall
RCC roof	Hook on roof
Raised plinth with mud	Pillar house (double storied)
Construction of staircase	Raised door
Concrete shelf	

Note: Most of these measures/construction options are shown by way of photographs.

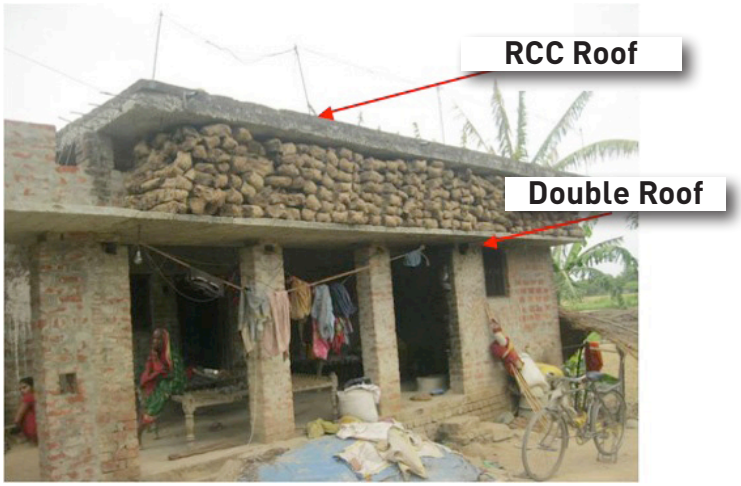
Data collected from shared learning dialogues in 2012

A short description of these measures (and the rationale for using them) is given below.

1. **Double roof:** This is a simple structure (much like a ledge or a loft) that is inside the house and runs along the walls of a room. It is used for storing grains and other items. In some houses, this ledge is also present on the outside walls and is used primarily for storing fodder and fuel (wood and dung-cakes).

2. **RCC roof:** This is a reinforced cement concrete roof and is generally chosen by households of higher income. This type of roof is very common in urban areas and is now being adopted by rural households as well. People felt that RCC roofing allowed them better protection against heavy rains as well as provided a place they could quickly go to with their belongings to safeguard from the floods if and when water entered their homes.

3. **RBC roof:** Reinforced brick concrete, or RBC roofing, is weaker than the RCC but much stronger than the usual tiled or sheet roof that is found in rural areas. RBC roofs are generally preferred by households who do not have enough capacity to build RCC roofs, but want a better house and one that also emulates urban homes.



4. **Raised plinth with mud:** After the 1998 flood, raising the plinth level of the house to at least the height of inundation became standard. A mud-fill is the cheapest way to raise the plinth to desired levels, and almost all poor households resort to this mud-fill technique.

5. **Raised plinth with brick wall:** For households from higher income groups, raising plinth using brick walls is the standard practice. The brick plinth is filled with debris or mud to give the house a stronger base.

6. **Pillar house:** This is another way to raise plinths and is most often practiced by households with high incomes. The pillars are reinforced with cement concrete and the space under the house is generally left open. In some cases residents enclose the plinth area with walls and use that space either for storage or even as a cattle shed.

7. **Construction of a staircase:** This was considered an important measure by the people having RCC or RBC roofs. Staircases to the roof are critical during the floods as they help residents to go to the roof and more importantly help them carry household items and grains, etc., to a safer place.

8. **Concrete shelf:** Construction of a concrete shelf is similar to having a double roof, except that it does not run along the whole wall. It is smaller in size and is used to store important household items high above the inundation level.

9. **Almirah construction:** This is the same as a concrete shelf but has doors to cover the shelf, allowing residents the possibility to lock goods inside.

10. **Hook on the roof:** Having a hook on the roof is considered important by the local people as they could easily hang perishable items (like sacks of grain) with this hook and save it from the flood water. Even the people without pucca roofs (RCC or RBC) have hooks on the wooden beams of their ceiling that support tiles or sheets for such purposes.

11. **Raised door:** This is an interesting coping mechanism adopted by low-income households who cannot raise the plinth to adequate levels or have old houses and cannot construct new ones. They construct a low height wall on the door of the house that opens to the outside. Because of this raised door, the flood water does not easily enter their house.

Shared Learning Dialogue in Domarghat, 2012
Photo: GEAG, 2012

CONDUCTING A COMMUNITY BASED EVALUATION

During the vulnerability assessment, it was noted that people in flood prone areas no longer panic about the flood. They have become good planners and are generally prepared for flood events. The information collected from the five villages was collated and analyzed to shortlist at least three villages where this exercise on qualitatively gathering community perceptions would be conducted. The three villages selected were Uttarasoth, Domarghat and Semra Devi Prasad (see Figure 1). These villages were selected based upon their proximity to the river and/or an embankment. The reason behind such selection was to understand the nature of housing designs and acceptability of various resilient options by various socio-economic classes in different geographical conditions. During the SLDs in these three villages, the people were again consulted regarding the measures adopted to reduce flood risks in their houses. As the adopted measures and types of materials used in the houses varied according to the economic status of the household, different socio-economic groups of people were consulted and housing construction costs were only used as proxies. The process of finding out community perceptions on costs and benefits of

different adopted measures through consultations was a long-drawn process, as explained below:

1. **Schedule community meetings and encourage community participation:** The village community was informed in advance regarding this community meeting and the date was fixed with their consultation. Upon reaching the village the first activity was to inform stakeholders about the whole process and the objective of the study.

2. **Identify various flood mitigation practices:** Next there were discussions about different construction practices undertaken by villagers to mitigate or minimize losses. All the options identified were written down in a tabular format on a large chart. For each construction option, participants discussed associated costs and benefits.

3. **Rank the costs and benefits of various construction options:** The next step was to note down all the options on different colour cards to facilitate the ranking process. Before initiating the ranking process, people were briefed on the method of ranking. Each adopted measure was written on a card and placed before participants. People were asked to rank the adopted measures as per cost incurred in construction. The same process was repeated again on the perceived benefits of these options.

In this cost-benefit analysis, we adopted a 'recall' or 'backward looking' approach to comprehend the changing design of housing vis-a-vis flood events. During the vulnerability assessment phase, it was found that, due to accumulated experience and knowledge, awareness about the impacts of floods in the region had enhanced significantly and it is reflected in local housing designs. The recurring

Community ranking of Resilient options adopted in shelter
Photo : GEAG, 2012

flooding and waterlogging in the region has reinforced households' adoption of different mitigation measures.

As seen in the table on the next page, the location of the village affects how the communities value different flood resilient measures for the house. For instance, raising plinth with brick wall was perceived as providing maximum benefits in Uttarasoth and Domarghat because both these villages have a very unique location and have suffered from 3–10 feet of severe flood and water inundation during the entire monsoon period. In the village of Semra Devi Prasad, the same measure was scored much lower because it is located almost entirely on the embankment, which is quite high from the Rapti river water bed. Also, it is interesting to note that the costlier options are not always viewed as providing the maximum benefits. For example, the cost of raised plinth with brick wall in two villages (Uttarasoth and Domarghat) was perceived as less

costly than the RCC roof while the perceived benefits that people derive from them was higher than that from the RCC roof. Also, the benefits from specific options like a double roof was accorded as providing greater benefits in Domarghat, as opposed to the same option in the other two villages. This is because of the large number of households in Domarghat engaged in dairy (thus using the double roof to store fodder). Overall, it is important to note that the cheaper options like raised door, concrete shelf, etc. are perceived to be providing larger benefits than their perceived (or near to actual) costs, as compared to the costlier options like RCC or RBC roofs.

TABLE 2: COMMUNITY BASED RANKING OF ADOPTED MITIGATION MEASURES IN DIFFERENT VILLAGES OF GORAKHPUR

RESILIENT OPTIONS	Uttrashoth		Semra Devi Prasad		Domarghat	
	Ranking (by cost)	Ranking (by benefit)	Ranking (by cost)	Ranking (by benefit)	Ranking (by cost)	Ranking (by benefit)
Almira construction	3	2	4	2	2	4
Raised plinth with mud	5	4	6	5	4	2
RCC roof	10	8	10	9	10	5
RBC roof	9	9	8	8	9	6
Pillar foundation double story house (pillar house)	11	10	11	11	11	8
Construction of staircase	6	7	5	6	6	5
Hook on roof	1	1	1	1	1	1
Raised door	2	3	2	4	3	3
Double roof	7	6	7	3	8	10
Raised plinth with brick wall	8	11	9	7	7	11
Concrete shelf	4	5	3	10	5	9

Source: Data Collected from SLDs, 2012

CONCLUSION

From this study a wide range of options already being adopted by people in flood prone areas of Gorakhpur have been identified for alternative shelter resilient options to mitigate the risks of floods and waterlogging in flood prone areas. Although investment in shelter is a matter of personal capacity, similar interventions are perceived to have different costs and benefits depending on the hazard zones. The purpose of this qualitative exercise was to ensure that the research team investigated those measures that communities adopt and that provide the most value to their households. The qualitative perception based analysis also supports the research in identifying costs and benefits that go beyond the traditional avoided losses approach.

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Disclaimer

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ANNEX 1: AVERAGE COST INCURRED IN DIFFERENT RESILIENT OPTION AND BENEFITS (AS NOTED DURING SLD's)

ADOPTED RESILIENCE MEASURES	AVERAGE COST INCURRED (INRS)	BENEFITS
Double roof	10,000	• Used to protect essential durable and non-durable goods during flood and non-flood period. Also used extensively during monsoon to protect goods from rain
RCC roof	56000	• It enhances the life of the house. It is stronger than a RBC roof. It also protects from dampness of walls. Recurring cost is low.
RBC roof	40000	• It is more cost-effective than a RCC, although not as strong.
Raised plinth with Mud	4000	• It is mostly used by the low income group as it costs less in comparison to a plinth raised on brick wall and concrete platform.
Raised plinth with brick wall	100000 to 120000	• It is the most prevalent measure in rural areas, and is a one-time investment. It provides protection to assets and life in heavy flood period. Recurring cost is low.
Construction of staircase	30000 to 35000	• It provides easy access to the roof.
Hook on roof	Rs 40/ hook	• It is the cheapest measure to protect goods in house. It provides protection to non-durable goods.
Almirah construction (shelving built into the wall)	3150	• It is used to store small items of house.
Double stored house (pillar house)	300000 to 400000	• It is prevalent in the high income group households. It is a long term protection measure. It prevents temporary displacement. It provides shelter to other vulnerable group in village.
Raised door	3000 to 5000	• It is cost-effective. It provides protection from flood water and damage of non-durable goods in the house.
Concrete shelf	3600	• It is cheaper than a double roof. It is acceptable in low and middle income group. It provides protection of necessary goods during flood period.

Source: Collected From Community Consultations/ SLDs, 2012 and 2013

ANNEX 2: MATERIALS USED AND COST INCURRED IN HOUSING CONSTRUCTION IN DIFFERENT SOCIO-ECONOMIC GROUPS

The table shows the cost of housing construction with consideration to different materials over different time periods for middle and lower-income groups. In urban centres, households with annual income of up to Rs 1 lakh are classified as Economically Weaker Section (EWS) and those with income between Rs 1 lakh and Rs 2 lakh or monthly earning of up to Rs 16,667 are classified as low income group (LIG). Raising plinth has emerged as an important phenomenon amongst households from all socio-economic groups in the villages. About 90% of households have raised the plinths of their dwellings. The table below also highlights the costs incurred in the raising of plinth through different methods.

	LOW-INCOME GROUP			MIDDLE-INCOME GROUP		LOW-INCOME GROUP	
MATERIAL USED	243 SQ. FT			1600 SQ. FT		875 SQ. FT	264 SQ. FT
	1970 (INR's)	2002 (INR's)	2012 (INR's)	2012 (INR's)	Plinth Hight 5ft (Cost in INR's)	Plinth raised by mud Height 5ft (Cost in INR's)	Plinth raised by concrete Height 5ft (Cost in INR's)
BRICK	0	20000	41600	144000	36000	25200	18000
IRON	0	7800	32200	101200	27600	9200	14400
CEMENT	0	8060	31500	173375	29200	9100	14400
LABOUR	1200	12000	25000	180000	36800	5000	11760
SOIL	0	0	15000	25000	25000	15000	0
STONE SMALL	0	0	30000	60000	10000	5200	14000
DOOR	1000	8000	8000	40000	0	0	0
HAND MADE TILE	150	0	0	0	0	0	0
WOOD	4590	0	0	0	0	0	0
SAND	0	2400	1800	21000	0	9200	3000
DOOR FRAME	0	4000	4000	18000	0	0	0
SHUTTERING	0	3000	4000	20000	0	0	0
MORANG RED	0	0	26000	52000	4500	3150	5000
MORANG WHITE	0	0	12000	0	0	0	0
GRILLE	0	0	0	25200	0	0	0
GRILLE FRAME	0	0	0	4830	0	0	0
TOTAL	**6940**	**65260**	**231100**	**864605**	**169100**	**81050**	**80560**

Source: Data collected from shared learning dialogues, 2012