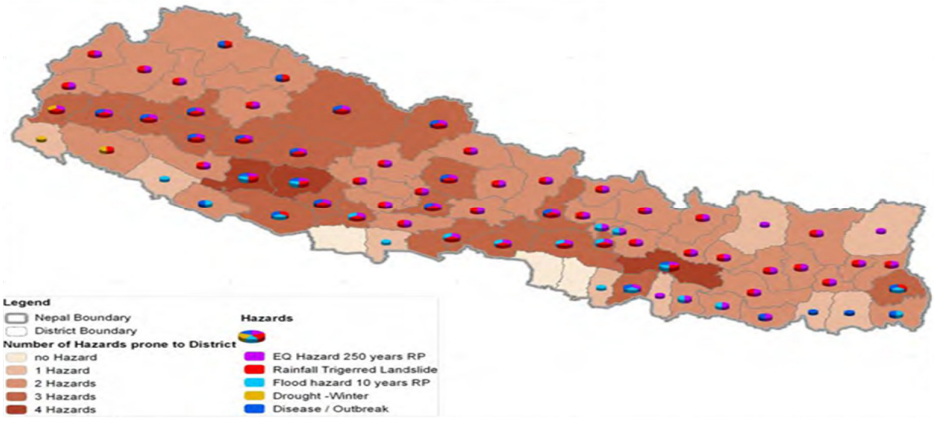
Final Report

# Market assessment for climate resilient low-cost housing in Nepal

**Prepared for**

International Finance Corporation





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# List of Abbreviations

| | |
|---|---|
| ADB | Asian Development Bank |
| BoK | Bank of Kathmandu |
| CB | Commercial bank |
| CCCI | Cities and climate change initiatives |
| CGI | Corrugated galvanized iron |
| CIF | Climate Investment Funds |
| CIUD | Centre for Integrated Urban Development |
| DB | Development Bank |
| DDC | District Development Committee |
| DFID | Department for International Development |
| DUDBC | Department of Urban Development and Building Construction |
| EMI | Equated monthly instalment |
| EPF | Employee Provident Fund |
| EU | European Union |
| FORWARD | Forum for Rural Women Ardency Development |
| GCN | Global Citizen Network |
| GDP | Gross domestic product |
| GLOF | Glacier lake outburst flood |
| HB | Himalayan Bank |
| HFHN | Habitat for Humanity Nepal |
| HURDEC | Human Resource Development Centre |
| IFC | International Finance Corporation |
| MFI | Micro finance institution |
| MoHA | Ministry of Home Affairs |
| MoUD | Ministry of Urban Development |
| NBC | National Building Code |
| NGO | Non-governmental organization |
| NHMEL | Nepal Housing and Merchant Finance Ltd |
| NIB | Nepal Investment Bank |
| NLHDA | National Land and Housing Developers Association |
| NLSS | National Living Standards Survey |
| NPR | Nepali Rupee |
| NRB | Nepal Rastra Bank |
| NRCS | Nepal Red Cross Society |
| PPCR | Pilot Program for Climate Resilience |
| PPP | Public private partnership |
| RCC | Reinforced cement concrete |
| RONAST | Royal Nepal Academy of Science and Technology |
| SB | Sidhartha Bank |
| SCAEF | Society of Consulting Architectural and Engineering Firms |
| SLTD | Shelter & Local Technology Development Centre |

| | |
|---|---|
| SME | Small and medium enterprise |
| SPCR | Strategic Program for Climate Resilience |
| TDF | Town Development Fund |
| TERI | The Energy and Resources Institute |
| UHIE | Urban heat island effect |
| UN | United Nations |
| VDC | Village Development Committee |

# Executive Summary

Nepal has extremely varied climate and diverse terrain. The tectonically active Himalayas make Nepal prone to frequent earthquakes. The country has been facing flood, landslide, earthquake, cloudburst, drought, Glacier Lake Outburst Flood (GLOF), avalanches and epidemics. Among 200 countries, Nepal ranks 4th in vulnerability to climate change (CIF, 2014). It is estimated that approximately 1% of country's Gross Domestic Product (GDP) is lost to natural disasters (CIF, 2014, Nepal SPCR).

Studies indicate that the loss due to landslides and related problems in the Himalayan region alone constitutes about 30% of the world's total landslide-related damage value (Li, 1990). In Nepal, in the monsoon period of 2007, 70 people were killed by landslides (NRCS, 2007). The dilapidated houses are at risk as thousands of people lose them to landslides, floods and other natural disasters each year (MOSTE, GoN, 2013). There are many cases of disasters in the form of landslides that isolated many communities as paths and roads are destroyed.

The objective of the study was to assess the market for climate resilient low cost housing in Nepal and explore appropriate technologies and financial models for private sector developers and financers to consider venturing into the market for low cost climate resilient housing for the target segment of population earning NPR 200000 to NPR 600000/annum (USD 2000 to 6000 per annum).

The National Population and Housing Census (2011) points out that the majority of houses are built with materials, such as mud bonded brick foundations, mud bonded brick walls, thatch /GI sheet for roof, and these do not withstand climate risks. The Shelter Policy of Nepal classifies only 10% of shelters in Nepal as good quality permanent structures. The deteriorating housing condition has been aggravated by the fact that Nepal has been going through political instability for a long time. Policies in the domain of housing are very limited. Allocation of government resources for housing has been in the range of 0.5-2.0% of the total budget. On the other hand, private sector –both financers and developers have not ventured into low cost climate resilient housing. The study thus explored the unexplored market to establish feasibility for making a business case for Climate resilient housing for the target income group. The enabling environment in terms of policies and other measures required to support the business models have been suggested.

To understand the housing needs and market potential, household survey comprising of the target segment was carried out. The survey was conducted in six identified districts that experience various climate risks, and represent different geographical zones and development regions of Nepal. These were: Banke, Dhankuta, Kaski, Kathmandu, Rupandehi and Sunsari. The total sample size was 500 households, distributed across the six districts in proportion to their share in the national total. The household survey helped in the understanding of demand for climate resilient homes.

To understand the barriers in implementation of climate resilient housing, about 35 stakeholder interviews were undertaken with Government organizations, financial institutions, developers, NGOs, donor bodies and insurance agencies.

The household survey revealed that more than 50% of surveyed households have experienced climate risks. Almost 90% of households confirmed that they wish to buy or build a house which can withstand climate risks. However, it is also important to note that Nepalese wish to own their house. Less than 10% of households' surveyed wish to live in a rented climate resilient home. There is also a huge opportunity for replacing older housing stock with climate resilient housing or upgrading them with climate resilient design features. The household survey undertaken in this study showed 30% of homes older than 15 years.

While the household survey data clearly reveals that there is paying capacity of less than NPR 5000/month (USD 50/month) especially by the income segment of NPR 200000/annum (USD 2000/annum), the stakeholder interviews brought out the challenges in the supply side. Lack of supporting government policies and priorities, financial mechanisms, capacities and enabling codes /standards/cost effective standardised technologies are the primary challenges that need to be addressed. To give an example, the Ministry of Urban Development, has delivered only 3000 homes for marginalised segment since 2009 while The National Shelter Policy 2012, aims at constructing 3,90,000 homes for poor and 16,10,000 homes for non-poor population within 10 years through private and public institutions.

Also, it is important to note the role of Non-Governmental Organizations in Nepal. They have been meeting the demand of housing for households that are affected during climate disasters. Habitat for Humanity Nepal for example has already built 48,000 low cost houses in Nepal and they have a target to build 1 Million such homes by 2020. These are however, for mostly those households which have an income less than USD 2000 per year. Lumanti majorly works in urban areas; in response to floods recently in Sunsari they raised 235 homes. Shelter And Low Cost Technology Development Centre has been developing pre cast construction members where they save 50% construction cost. The NGOs are currently working with mostly grants available from World Bank or multilateral funding. Thus, with available knowledge in the NGO sector, it is important that Government should involve NGOs as Technology partners in implementing low cost climate resilient homes in Nepal.

Analysis of the private sector driven housing shows that developer community in Nepal is currently building only for upper middle income segment, and they are building only in and around Kathmandu valley, barring few exceptions. The developer community is also aware that the upper middle income group housing market is saturated and that there are huge business opportunities for providing housing for lower middle income group. The main reason for developers not investing in low cost housing is high cost of land, high cost of capital; also infrastructure is not available in semi-urban and rural areas. If these are resolved through policy changes, it is possible that developers will start venturing into low cost climate resilient homes.

It is proposed in the study that the Climate Resilient Low Cost homes shall integrate building features which will provide resilience to the climate hazards, additionally these will be solar passive homes which will have the ability to naturally provide cooling/heating thus reducing dependence on electricity for example electric heaters in winters. It is also proposed that these homes will integrate energy efficient lighting for overall savings in electricity consumption and hence O & M cost. Use of local building material and alternate construction technologies such as Pre-Cast, shall make these homes low cost.

With the data collected in stakeholder interviews such as construction cost, cost of buying an affordable home, financial products available currently, TERI carried out an analysis to calculate the increment in initial construction cost by adding climate resilient features for various districts covered under the study. As an average 10% increase in initial cost is predicted.

This was followed by development of business models for climate resilient homes with the incremental cost. An important consideration was to make the business model feasible for both developers and financers to consider venturing into the market of climate resilient homes, while meeting the paying potential of target segment.

It was found out that by reducing the built up area to 350-400sq.ft and by use of alternate construction technologies and alternate materials for constructing climate resilient homes, the target segment will be able to repay the EMI for home loan from bank. The EMI repayment period through these models can be as low as 5 years in some cases, with Interest Rate as 10.5%. The Internal Rate of Return is more than 16% for home owners; it is thus profitable for both financial institutes as well as for home owners. The savings by home owners is achieved as the climate resilient homes are energy efficient, thus reducing the consumption of electricity and also these homes do not require repair/maintenance cost as oppose to conventional homes which are vulnerable to climate hazards. On carrying out Life Cycle Cost Analysis for 20 years, it was found out that the Savings is 3.5 – 4 times the initial investment in the energy efficient climate resilient low cost homes. Due to savings in electricity bills and maintenance cost since these homes are resilient to climate vulnerabilities, it is observed that the payback period is 6 to 7 years, within which the initial investment is recovered and after which there are only savings.

Since the business models are feasible, it is important to estimate the market for Climate Resilient Low Cost Housing. Based upon data from National Housing and Population Census, 2011, literature review and assumptions considered in the proposed business models, it is estimated that the potential for construction of low cost climate resilient homes in the next 10 years will be 0.7 Million homes. This will need a capital investment of USD 7.35 Billion and Financial Institutions would require USD 4.4 Billion to sanction funds for building 0.7 Million climate resilient low cost homes.

To implement climate resilient low cost housing, beside business models it is equally important to have in place right regulations and policies. In brief, the levers suggested under the study are:

1. Policies for Commercial Banks and Financial Institutions to lend for construction of low cost climate resilient homes.
2. Policies by Government to allocate land for low cost climate resilient housing.
3. Incorporation of climate resilient housing design parameters in National Building Code. The code should also include methodologies for alternate technologies to reduce the construction cost of climate resilient low cost housing.

# 1 Introduction

## 1.1 Climate hazards in Nepal

Nepal has an extremely varied climate, ranging from tropical to polar types, and a highly diverse terrain, ranging from high mountains to fertile plains. Summer temperatures in the Terai or plains can exceed 40ºC while freezing temperatures and snowfall are experienced in winter in the mountains.

Nepal is drained by a number of snow fed rivers as well as non-snow fed rivers that are prone to flooding during the monsoon season. Heavy monsoon rainfall also causes frequent landslides in the hilly region. Due to orographic (mountain) effects, central Nepal gets high mean annual rainfall as well as high extremes of daily rainfall (Dahal and Bhandary 2012). The tectonically active Himalayas make Nepal prone to frequent earthquakes – in particular, Kathmandu city is expected to face an earthquake every 75-80 years (NRCS 2007).

The country has been facing flood, landslide, earthquake, fire, hailstone, windstorm, thunderbolt, cloudburst, drought, glacier lake outburst flood (GLOF), avalanches and epidemics. The combination of these multiple hazard events poses a severe threat to human settlements and economic development. An estimated 1% of the country's Gross Domestic Product (GDP) is lost due to natural disasters (CIF 2014, Nepal SPCR).

Among 200 countries, Nepal ranks 4th in vulnerability to climate change (CIF 2014). Climate change is projected to increase heat stress and exacerbate the risks of extreme events. It's projected that mean annual temperature in Nepal will increase by 1.3 to 3.8°C by the 2060s, and 1.8 to 5.8°C by the 2090s (Mc Sweeney et al 2010). Temperature rise in the mountain zone will increase the threat of glacier melt and GLOFs. Glacial lakes in the Himalayas are vulnerable to sudden flooding due to warming. Of 3252 glaciers and 2323 glacial lakes in Nepal, 20 are identified as being very vulnerable to such flooding (MoHA 2009), posing a risk to downstream human settlements.

Summer monsoon could decrease or increase depending on the climate change scenario considered, but the contribution of heavy rainfall days is projected to increase, which could increase the risks of floods and landslides in the hills and plains. Winter precipitation is projected to decrease, which could adversely affect water availability (Mc Sweeney et al 2010, World Bank et al 2011, Mishra and Herath 2011).

## 1.2 Need for climate resilient housing in Nepal

Housing in Nepal is vulnerable to multiple climate hazards. Although Nepal's Constitution and its National Housing Policy (1986) recognize shelter as a basic need, national housing surveys reveal the lacunae in housing availability and conditions.

- The Shelter Policy of Nepal classifies only 10% of shelters in Nepal as good quality permanent structures. The National Population and Housing Census (2011) points out that the majority of houses are built with materials that cannot withstand climate risks (Table 1.1). Moreover, in rural areas, houses lack toilets, making these families vulnerable to the health risks exacerbated by climate change.

- An estimated 7-10% of the urban population (i.e. about 100,000 households) reside in slum or squatter settlements that are vulnerable to heat stress, extreme rainfall, flooding, or landslides (UN-HABITAT 2010). These slum households, however, earn less than USD 2000 per annum (UN 2014)[1], and consequently lack the ability to pay for climate resilient housing.
- In urban areas, 40% of families do not own their homes, but live in rented houses. These households will also form a percentage of market who would buy in future, new homes that would need to be climate resilient.

**Table 1.1: Housing status in Nepal (in % households)**

| **Ownership** | **Own** | **Rented** | **Institutional** | **Other** | |
|---|---|---|---|---|---|
| | 85.26 | 12.81 | 0.63 | 1.30 | |
| **Foundation type** | Mud-bonded bricks | Wooden pillar | Cement-bonded bricks | RCC pillars | Other |
| | 44.21 | 24.9 | 17.57 | 9.94 | 2.33 |
| **Outer wall type** | Mud-bonded bricks or stone | Bamboo wall | Wood / planks | Cement-bonded bricks or stone | |
| | 41.38 | 20.23 | 5.31 | 28.74 | |
| **Roof type** | Thatched/straw | Galvanized sheet | Tile/slate | RCC | |
| | 19.03 | 28.26 | 26.68 percent | 22.48 | |
| **Drinking water source** | Tap / piped water | Tube well / hand pump | Spout | Uncovered well | Covered well |
| | 47.78 | 35 | 5.74 | 4.71 | 2.45 |
| **Toilet access** | In house | | | | |
| | 61.83 | | | | |

Data source: National Population and Housing Census (2011)

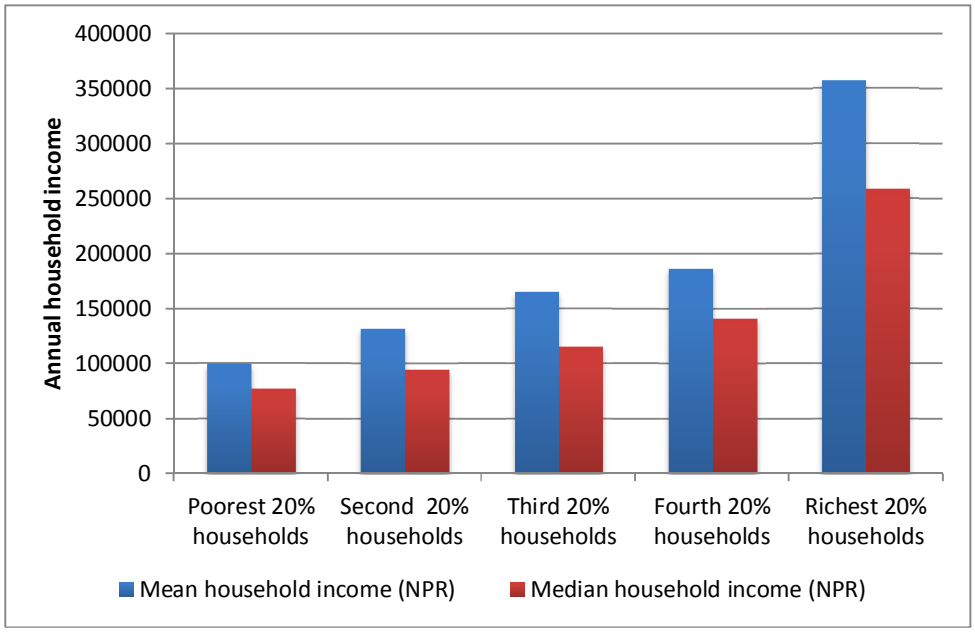
## 1.3 Recent trends in housing demand and supply in Nepal

The demand for housing is rapidly growing in Nepal. In the last decade, the number of households in Nepal increased by more than a million (Census 2011). This population is increasingly concentrated in cities and towns: Kathmandu district, for instance, has a population density of 4416 persons per square km (compared to only 153 persons per square km in rural areas), and its population increased by 61% in the last decade (compared to the national average of 14%). Nepal's other cities are also growing at rates of 4-5% per year (Census 2011).

A consequence of this urbanization is a rise in rental housing: from barely 2% in 1995, the fraction of households living in rented housing is now 13%, constituting a potential market of 694,701 households seeking to build or purchase homes (NLSS 2011, Census 2011). By conservative estimates 30,000 urban dwelling units need to be built annually during 2010-2020 (UN-HABITAT, 2010).This situation offers opportunities for promoting climate-resilient housing techniques, provided that finance is made available and awareness is created.

[1] http://un.org.np/oneun/undaf/slumThe average slum household in Kathmandu valley lives on less than half a dollar a day.

However, housing developers in Nepal have targeted the upper middle income and high-income market segments. Developer-made homes tend to cost NPR 5-6 million (about USD 50,000) for the middle-income group and more than NPR 10 million (about USD 100,000) for high-end residential units. In a country where the mean annual household income is estimated to be NPR 202,374 (about USD 2024), while the median annual household income is only NPR 127,281 (about USD 1273) (NLSS 2010/2011), such homes are unaffordable for the vast majority. From the income distribution in Figure 1.1 we can infer to the households in Nepal as per their earning per year, which is the target market segment for this study.




Data source: Nepal Living Standards Survey 2010/2011

**Figure 1.1: Income distribution of households in Nepal**

An important component of Nepalese households' ability to pay for climate resilient housing – and indeed, a significant driver of residential property developments in Nepal – is the inflow of remittances (Figure 2). As the world's top remittance receiving country[2], Nepal received 29% of its GDP or more than USD 5 billion in 2013 (WDI 2014). More than half the households receive remittances[3], and an average household receives 17% of its annual income or about NPR 80,000 (USD 800) as remittances (NLSS 2010/11).

In the last decade, the housing sector in Nepal experienced an upswing followed by a downturn. Fuelled by remittance inflows with few alternate investment opportunities, there was a speculative bubble in the housing market during 2003 to 2009 (Muzzini and Aparicio 2013). Land prices around Kathmandu doubled during this period – from NPR 822 (USD 8) per square foot to NPR 1500 (USD 15) per square foot (UN-HABITAT 2010). In 2008/09, government revenue from property transactions touched a high of NPR 6.3 billion, but subsequently, the Nepal Rastra Bank asked commercial banks to cap their lending to the real estate sector. A dip in remittances due to the global economic recession reduced house purchases and home prices declined after peaking in mid-2009. Revenue from property

[2]in 2013 as % of GDP (World Development Indicators)
[3]In contrast, less than a quarter of Nepalese households received remittances in 1995/96.

transactions fell to NPR 4 billion (USD 40000) in subsequent years, but recovered to NPR 7.8 billion in 2013-14[4].Figure 3 shows that while banks are interested in lending to small retail customers, they are hesitant to give large real estate loans[5].

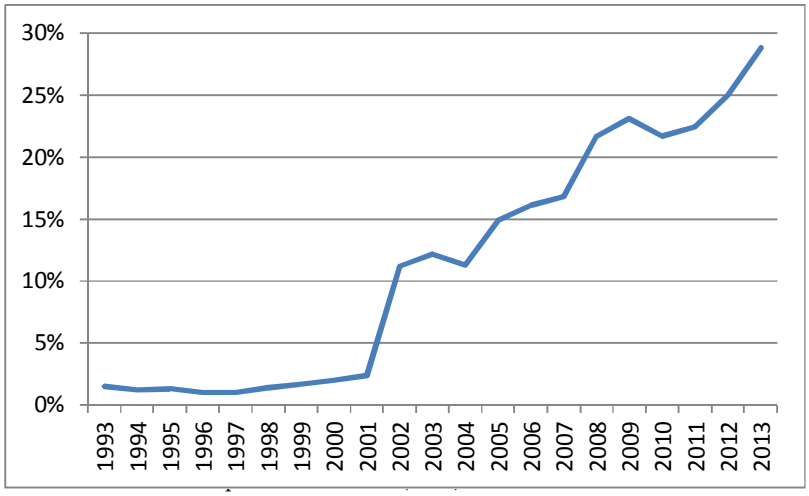
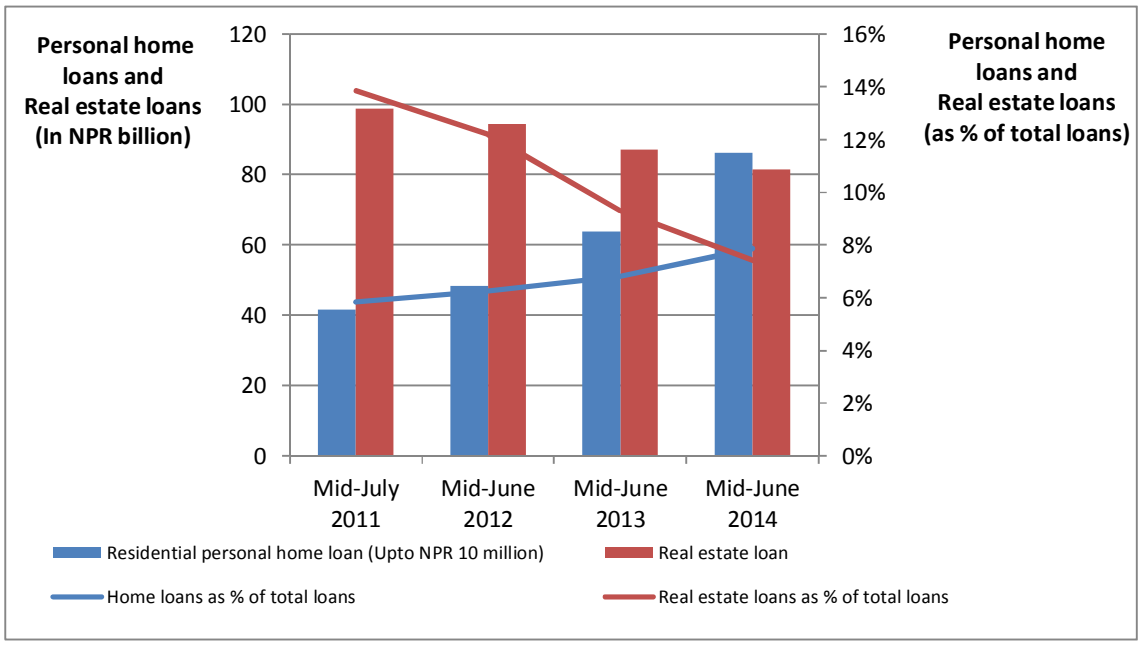



**Figure 1.2: Personal remittances received in Nepal (as % of GDP)**




Data source: Nepal Rastra Bank (Various years) Banking and financial statistics (monthly).

**Figure 1.3: Product wise credit of licensed banks and financial institutions (including commercial banks, development banks, finance companies and microcredits)**

Residential property developments so far have been concentrated in Kathmandu Valley and a few other cities. For instance Kathmandu alone contributes 35% of land revenue. However, the government's declaration of 70 new sub-municipalities reflects urban growth trends and

[4]Another factor could be that people are no longer deliberately underpricing property for registration.
[5]This is partly because they were required by the central bank to limit their exposure to real estate loans.

will encourage real estate developments in these towns also. These new houses should be made climate resilient.

Moreover, building affordable climate resilient housing also creates scope for employment generation. The real estate, renting, and business sector in Nepal creates 71000 jobs, while the construction sector creates 367,000 jobs (Nepal Labour Force Survey 2008). The two sectors together contributed 14% of the country's GDP in 2011/12.

## 1.4 Housing policy and institutional framework in Nepal

The Ministry of Physical Planning and Works is the main policymaking body for the housing sector in Nepal, with its Department of Urban Development and Building Construction (DUDBC) specifically charged with implementation of urban development programmes and standards. The National Shelter Policy 2012 is the overarching policy document that drives housing priorities in Nepal. It aims at constructing 3,90,000 houses for poor and 16,10,000 houses for non-poor within 10 years through private and public institutions. The DUDBC initiated the People Housing Program (JantaAwasYojana) in 2009 to provide safe housing to the rural poor, under which it aimed to build low cost modern housing targeting 3000 households. The National Building Code of Nepal has extensive provisions for design and construction of buildings to be resilient to earthquakes, but does not specify any measures for climate resilience. There is little cognizance of the need for climate resilient housing at the policy and institutional level and no formal demand estimation for climate resilient housing.

There are initiatives for climate resilient and low cost housing from many NGOs in Nepal, like Habitat for Humanity and Lumanti Support Group for Shelter. But such initiatives rely upon (national or international) public funding, and the role of the private sector remains marginal.

## 1.5 Housing finance in Nepal

Banking and financial institutions in Nepal are subject to the surveillance of the nation's central Bank- Nepal Rashtra Bank. As of mid-June 2014, 203 banks and financial institutions were licensed by the Nepal Rastra Bank (Nepal Rastra Bank Monthly Statistics, including:

- 30 commercial banks
- 85 development banks
- 53 finance companies
- 35 micro credit development banks

Housing finance in Nepal is provided by commercial banks, the Nepal Housing Development Finance Company, the Employee's Provident Fund, and cooperative societies. International funds in the form of grants or concessional loans are also available. International NGOs also provide indirect subsidies in the form of micro-loans for housing improvement (Global Housing Policy Indicators). Microfinance institutions do not usually provide housing loans but act as enablers.

Informal sources of funding dominate in rural areas, including traditional moneylenders (who may charge interest rates in the range of 36%), relatives and friends, while formal sources of housing finance have tended to focus on the urban market. The importance of the informal sector in housing finance has declined over the last 20 years: in 1991 an estimated 70% of housing finance came from the informal sector, while in 2010, this had fallen to 4% (UN-HABITAT 2010). At present, banks in Nepal provide housing finance at 9-12% interest per annum. The average home loan is for NPR 5 million (about USD 50,000) and the typical repayment period is 15 years.

However, there continues to be heavy reliance on personal savings, followed by various forms of debt, bank loans, and co-operative lending. This indicates low market penetration of housing loans due to such factors as limited access to housing finance facilities, high transaction costs, and lack of awareness. Low-income households, in particular, are underserved because of lack of collateral and a regular income stream. Remittances are an important but potentially volatile source of income for repaying home loans.

## 1.6 Housing insurance in Nepal

Insurance companies in Nepal come under the regulatory purview of the Bima Samiti. Nepal has 16 general insurers (of which 13 private, 2 foreign and 1 joint venture) and one composite insurer. Of 21 micro insurance schemes in Nepal, only one provides housing insurance (the Centre for Self-help Development has a Life and Housing Protection Scheme in Dang District since 1996).

Property insurance is a mandatory requirement for those seeking house building loans from financial institutions. The property is insured against fire, earthquakes, storm and landslide, and terrorism. The premium paid by individuals is usually only for the loan amount of such borrowings from financial institutions and not for the total value of the property. Thus it does not really protect home owners from losses due to climate hazards.

The demand for housing insurance is very low. The majority of the business is focussed on Kathmandu valley. As the household survey conducted in this study showed, only 45% household surveyed have insurance of any kind, and less than 1% has home insurance.

Housing insurance is currently not perceived as a profitable sector and not driven by any regulation. Hence insurance products for climate resilient housing or low cost housing are not available in the market. Given the frequent occurrence of climate hazards and earthquakes in Nepal, global reinsurers are hesitant to reinsure against climate change perils.

## 1.7 Information gaps with respect to climate resilient housing

There are major information gaps that lead to market failure with respect to climate resilient low cost housing.

- ***Consumers*** lack access to information about climate risks and climate resilient housing technologies, and have limited access to suitable housing finance products.

- ***Developers*** do not have detailed information about consumers' demand for such housing and their ability to pay. The conventional business model also dissuades them from adopting new technologies and catering to the target segment
- ***Financiers and insurers*** lack accurate data about risks (both external risks due to climate hazards and internal risks due to credit worthiness of consumers)
- ***Policymakers and regulators*** need to improve awareness about climate risks and climate resilient technologies, provide suitable financial/fiscal incentives (e.g. interest rates, tax exemptions), set appropriate building codes, and foster a culture of risk mitigation rather than reconstruction.

# 2 Household survey-based assessment of market for low-cost climate-resilient housing

A detailed quantitative household-level survey was conducted in six districts of Nepal to assess:

1. the need for climate resilient housing due to the exposure to climate risks
2. the ability to pay for such housing
3. the access of households to formal housing finance and insurance

The target population segment for this assessment was households with an annual income in the range of NPR 200,000 – 600,000 (i.e. approximately USD 2000 – 6000[6]).

The questionnaire is given in Annexure 1.

## 2.1 Survey locations and sampling

Six districts were selected to conduct the household survey in Nepal. The rationale for the selection of these districts was to include districts representing different development regions and different geographical zones of Nepal, which experience various climate hazards.

Nepal is divided into three main geographic zones: mountain, hill, and terai. The mountain zone (or parbat) begins at an altitude of more than 10,000 feet and mainly comprises sparsely populated areas that are used for seasonal pastures. In terms of natural disasters, the mountain zone represents less than 3% of total human casualties in Nepal during 1900-2005 (Aryal 2007[7]). Due to its low settlement density, the mountain zone was not considered as a priority region for the household survey for the present market study.

The hill region (or pahar) is located south of the mountain region and has an altitude ranging between 2,000 and 10,000 feet. This region covers 56% of the country's land mass and recorded the highest number of natural disaster events in Nepal during 1900-2005 (Aryal 2007). The hill region is prone to floods, flash floods, landslides, heavy rainfall, storms, landslides, and sinkholes.

The terai region is home to 55% of Nepal's population (Census 2001). Of the three geographical zones of Nepal, the terai region accounted for more than 80% of the total reported human casualties due to natural disasters during 1900-2005 (Aryal 2007). The terai region is prone to heat stress, floods, and heavy rainfall.

Due to their importance in terms of population, area, and proneness to climate hazards, the hill and terai zones were selected for the household survey.

[6]The exchange rate as on 25 July 2014 at www.xe.com has been used in this chapter, where 1 NPR is approximately 0.01 USD.
[7]Aryal K R. 2012. The history of disaster incidents and impacts in Nepal 1900-2005. International Journal of Disaster Risk Science 3(3): 147-154.

These hill and terai zones span across five development regions in Nepal: far west, mid west, west, central, and east. Districts in four of the five development regions were identified to capture varying levels of economic growth, urbanization, and market potential. The far west region, which comprises only nine districts, was not prioritized for the sample selection.

Another criterion applied at this stage of site selection was vulnerability to climate hazards. Many parts of Nepal have faced severe climate hazards in recent years, e.g. landslides in Dhankuta and floods in Sunsari, and there is an impending threat of earthquakes in Kathmandu.

Finally, six districts emerged as the sites for the household survey, which are depicted in Figure 2.1.


**Figure 2.1: Districts in Nepal where household survey was conducted**

Table 2.1 lists the number of households in the six districts selected for the household survey, and the number of municipalities and village development committees (VDCs) in these districts.

**Table 2.1: Selected districts and sample size for the household survey**

| District | Geographical zone | Development region | Key climate hazards[8] | Number of municipalities | Number of VDCs | Area (sq km) | Number of households (Census 2011) | Share of total number of households | Sample size (after data cleaning) |
|---|---|---|---|---|---|---|---|---|---|
| Kaski | Hill | West | Heavy rainfall, flood, landslide Sink hole | 2 | 44 | 2017 | 125,673 | 0.023 | 76 |
| Kathmandu | Hill | Central | Heat stress Earthquake | 2[9] | 57 | 395 | 252,292 | 0.047 | 165 |
| Dhankuta | Hill | East | Landslide | 1 | 37 | 891 | 37,637 | 0.007 | 20 |
| Banke | Terai | Mid-west | Flood Landslide Heat stress | 1 | 47 | 2337 | 94,773 | 0.017 | 46 |
| Rupandehi | Terai | West | Heat stress | 2 | 71 | 1360 | 163,916 | 0.030 | 104 |
| Sunsari | Terai | East | Flood Heat stress | 3 | 49 | 1257 | 162,407 | 0.030 | 84 |
| | | | | | | | | ***Total*** | ***495*** |

[8]Earthquakes were also included even though they are not a climate hazard because various parts of Nepal are prone to earthquakes and hence, housing that is designed to be climate resilient should also be earthquake proof.

[9]Kathmandu district has one municipality and one metropolitan city

**Box 1. Sampling approach for household survey in six districts**

The total target sample size for the household survey was 500 households, which was distributed across the six selected districts in proportion to the district's share in the national total number of households. The sampling strategy was designed so that both urban and rural households would be covered under the household survey.

Within the six identified districts, specific municipalities and VDCs were selected such that they represent the whole district in terms of geography as well as the probability of climatic risks. At least four VDCs were selected in each district – from the eastern, western, northern, and southern parts of the district. Data on areas affected by climate hazards was collected from the District Development Committees (DDCs), the Local Development Officer, the Nepal Red Cross Society, NGOs that worked in these districts in the aftermath of natural disasters, such as HURDEC Nepal and CARE Nepal, the microcredit organization FORWARD.

In each area, the first household was selected randomly and subsequently every tenth household was selected for the survey.

The households surveyed included people who own their houses and people who stay in rented accommodation. In Kathmandu, a few households living in resettlement housing and squatter settlements were also surveyed.

The actual number of households surveyed was 564, but after data cleaning and discarding households whose reported income did not fall within the target income range for this study, the final sample size was 495 households. Table 2.2 gives the distribution of the survey sample by income and location. Details are given in Annexures 2 and 3.

**Table 2.2 Distribution of survey sample by income and location**

| | **Households with annual income of NPR 200,000-400,000 (USD 2000-4000)** | **Households with annual income of NPR 400,000-600,000 (USD 4000-6000)** | ***Total*** |
|---|---|---|---|
| **Rural** | 84 | 75 | *159* |
| **Peri-urban** | 64 | 45 | *109* |
| **Urban** | 122 | 105 | *227* |
| ***Total*** | *270* | *225* | ***495*** |

## 2.2 Key characteristics of housing in Nepal

The household survey established the following key characteristics of housing in Nepal.

- Almost all houses in rural areas are individual dwellings but 38% of houses in urban and peri-urban areas are multi-storied apartments. Multi-storied apartments are concentrated in Kathmandu, with some in Banke and Kaski districts.
- 67% of houses (332 of 495 households surveyed) are owner occupied, while 29% (143 of 495 households surveyed) are renter occupied. Only 4 of the rented houses in the survey sample were located in rural areas.
- 15% of houses (73 of 495 households surveyed) had been built in the last five years, and 74% of these households (54 households) provided the cost of house

construction or purchase, including the cost of land (Figure 2.2). The average cost of an individual dwelling in rural areas, as reported by 32 households, is NPR 1548 per square foot[10] (i.e. approximately USD 15.5 per square foot), while that of an individual dwelling in urban areas, as reported by 12 households, is NPR 2010 per square foot (i.e. approximately USD 20 per square foot). The average cost of multi-storied apartments in Kathmandu suburbs, as reported by 3 households, is NPR 2841 per square foot (i.e. approximately USD 28.4 per square foot).

- The average household size is 5.9 persons in rural areas and 4.8 persons in urban areas surveyed. This corresponds to the average household size for the country, which is 5.0 for rural areas and 4.3 for urban areas (Census 2011). The average number of rooms per household is 4.6, the average house area is 605 square feet, and the average housing plot is 1625 square feet (NLSS 2011).

**The household survey indicated that while property development and rental housing is concentrated in Kathmandu, pockets of growth are emerging in other districts. There is a potential market of renter households in urban areas who may not own land but are looking to purchase their first homes.**

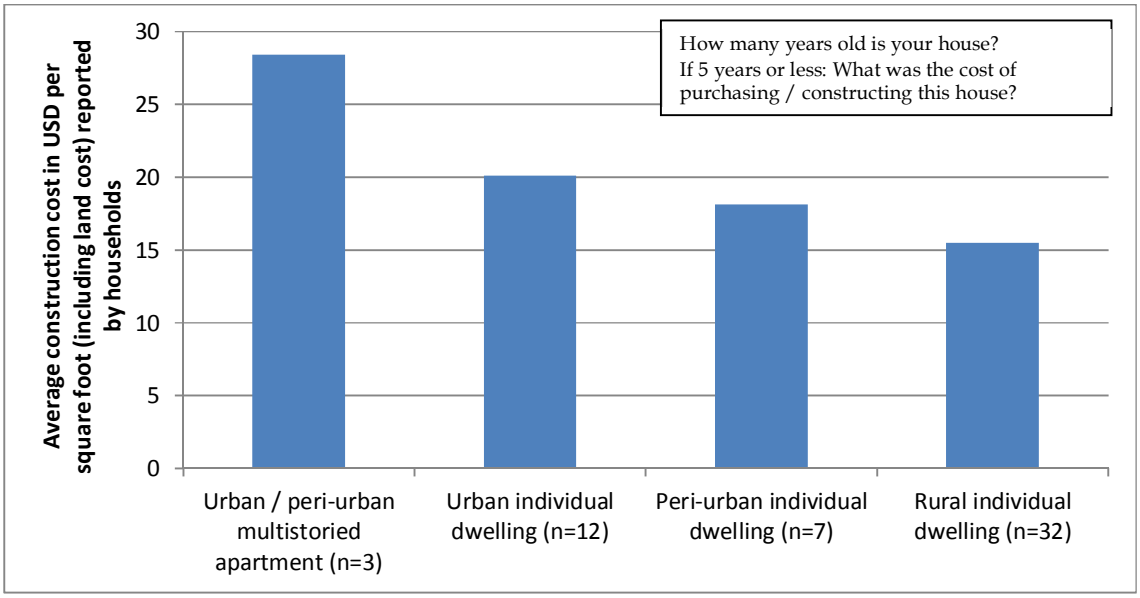



**Figure 2.2 Average construction costs reported by surveyed households (including land cost)**

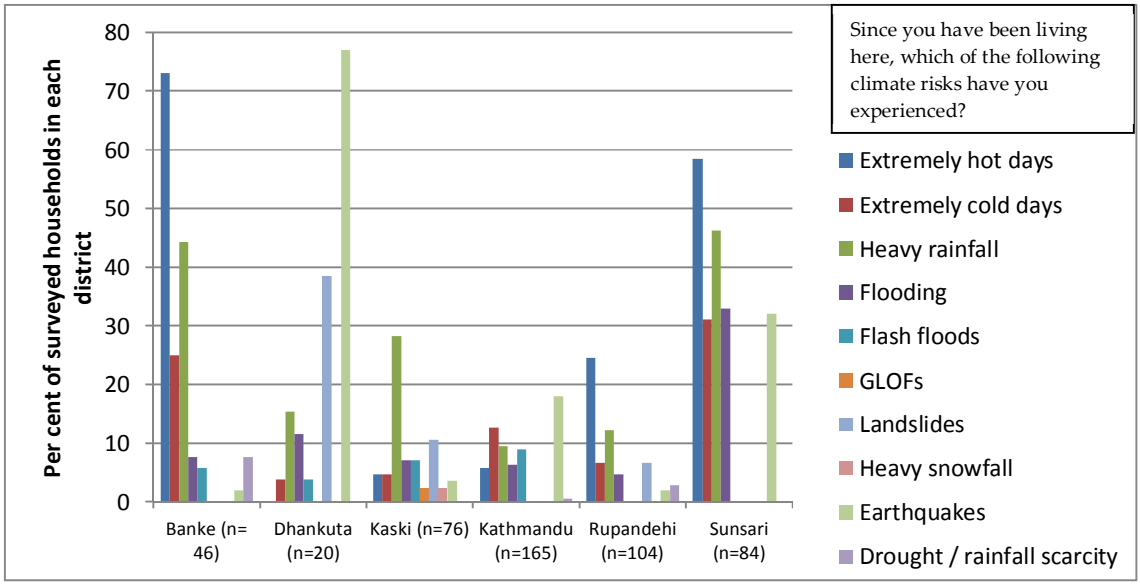
Source: Primary survey conducted in 2013 by HFHN and TERI
Note: Number in brackets on x-axis shows the number of households, who reported that their house is five years old or less, and who reported the construction cost.

[10]The per square foot costs have been calculated from the total construction costs reported by the surveyed households. There may be errors of recall and reporting even though care has been taken to include only those houses built in the last five years. For the purpose of further analysis and business model development, validated data on construction costs obtained through stakeholder interviews has been used.

## 2.3 Need for climate resilient housing in Nepal

**There is relatively high exposure to climate hazards in Banke, Dhankuta and Sunsari districts.** More than 50% of surveyed households in these districts reported that they have experienced climate risks (Figure 2.3).

- In Banke, the main climate hazards faced by households are extremely hot days and heavy rainfall.
- In Dhankuta, the main hazards are earthquakes and landslides.
- Households in Sunsari are prone to multiple climate and geological risks like extremely hot days, heavy rainfall, flooding, earthquakes, and extremely cold days.




Source: Primary survey conducted in 2013 by HFHN and TERI
Note: Number in brackets on x-axis is the number of households surveyed in each district.

**Figure 2.3 Percent of surveyed households reporting climate risks that they have experienced**

In five of the six surveyed districts, with the exception of Kathmandu, households reported that their house was uncomfortable to live in for 1.5 to 2.5 months of the year, including the

- rainy months of Shravan, Bhadau (mid-July to mid-September)
- summer months of Jesth and Asadh (mid-May to mid-July)
- winter months of Poush and Maagh (mid-December to mid-February)

**There is relatively low exposure to climate hazards in Kathmandu district**. 80% of the 165 households surveyed in Kathmandu said that their house was comfortable to live in round the year.

**Commonly used roofing material makes houses vulnerable to heat stress and heavy rainfall.** While most households in the target segment live in houses with strong foundations and outer walls, 32% of households use galvanized iron for their roofs (instead of concrete or cement) and are vulnerable to heavy rainfall and storms, as well as being exposed to heat stress.

**There is little use of insulation in walls or roof or false ceilings to protect against extreme cold in the hill districts.** Only in Kaski, 40% of the houses surveyed had insulation in the walls or roof.

**Climate hazards affect the house structure directly and human health indirectly.** 9% of surveyed households reported direct damage to the house structure (mainly walls and roof) due to climate hazards. The most common impacts experienced by households due to heavy rainfall and flooding are

1. stagnant water around the house (12% of households)
2. water-logging inside the house (10% of households)
3. roof leakage (9% of households)
4. wall seepage (7% of households)

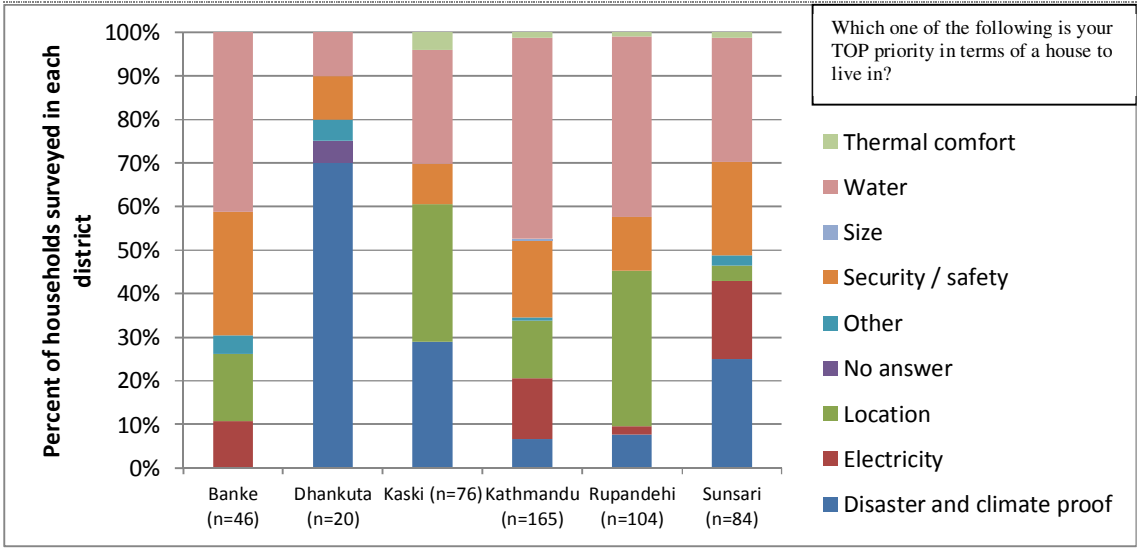
**Poor access to clean water and sanitation contributes to vulnerability to climate change by making households more susceptible to infectious water-borne diseases in the aftermath of heavy rainfall events or floods**.

- The survey revealed that only 45% (225 out of 495) of households surveyed have piped water supply within the house premises. The majority of households surveyed in rural areas of Kaski get piped water from the neighbourhood while the majority of rural areas of Banke, Rupandehi, and Sunsari depend on hand pumps for their water.
- Just as Kathmandu city is relatively well served by piped water supply, it is the only survey location that has good coverage of underground drains for the disposal of liquid waste from houses. All other survey locations rely mostly on open drains, which can overflow during flooding and heavy rainfall events and cause health problems.

## 2.4 Demand for climate resilient housing

**42% of all surveyed households were planning to buy or build a house. 88% of these households said that they would like to buy or build a house that can withstand climate risks.**

**Disaster and climate proof housing was the top housing priority – along with water – for rural households in Nepal.** Recent exposure to climate hazards influences households' housing priorities. Disaster and climate proof housing was in the top two housing priorities for households in Dhankuta, Kaski, and Sunsari districts, which have actually faced climate hazards in recent years (Figure 2.4). However, in Kathmandu district, disaster and climate proof housing was given very low priority by households, despite the vulnerability of Kathmandu valley to earthquakes (Uprety and Poudel 2012).



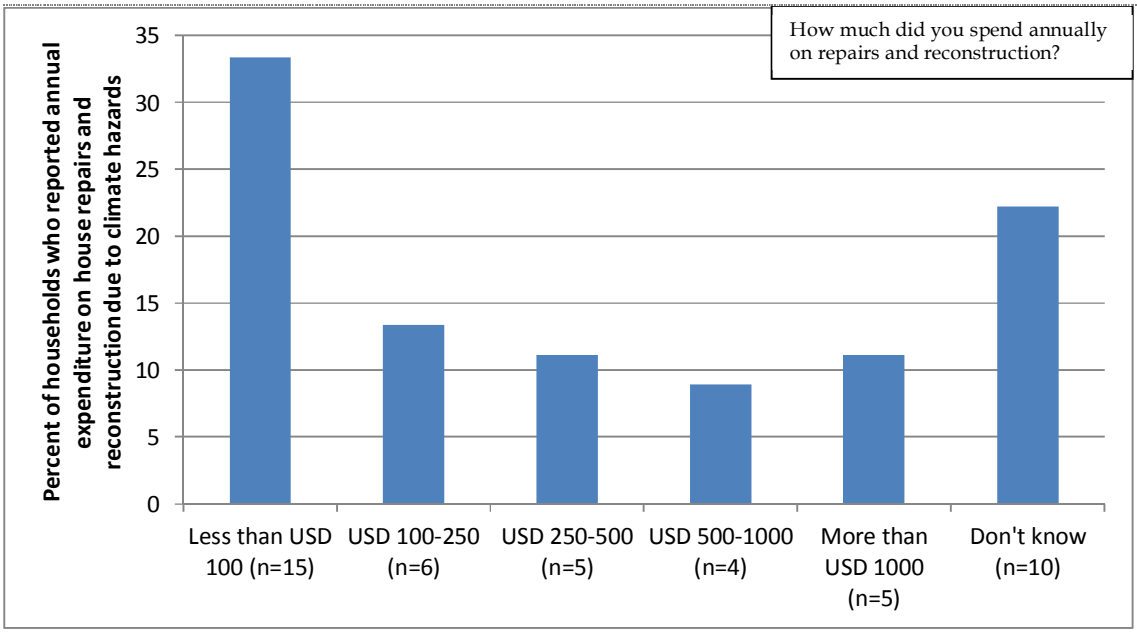

Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI
Note: Number in brackets on x-axis is the number of households surveyed in each district.

**Figure 2.4 Top housing priorities for surveyed households**

**There is an opportunity to replace older housing stock with climate resilient housing.** About 30% of houses surveyed are more than 15 years old and do not have the benefit of newer construction materials or design technologies that can enhance the climate resilience of a house. In the next ten years, their owners may consider retrofitting these houses or buying new ones. This can be seen as an opportunity to replace older housing stock with climate resilient housing or reinforcing it with climate resilient materials. Taking 30% of the 4.6 million households residing in their own homes (Census 2011), and then considering the number of households may fall in the target market segment of NPR 200,000-600,000 annual income, this offers a potential market opportunity of about 275,000 houses.

**Repeated expenditure on repair and reconstruction represents the value of climate resilient housing**

- There is wide variation in the annual expenditure on repairs and reconstruction (Figure 2.5).
- 15 households had to repair/reconstruct their house many times (including 6 in Kaski and 4 in Banke), while 18 households reported having repaired /reconstructed their house once.



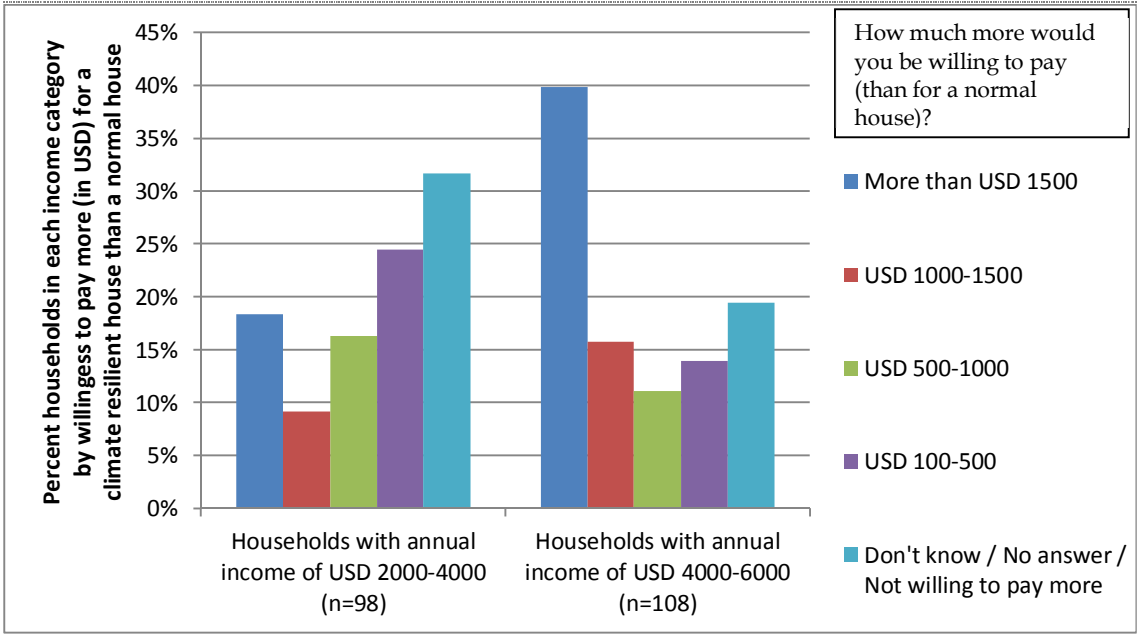

Source: Data reported by 45 households in primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI.
Note: Number in brackets on x-axis shows the number of households, who reported that their house was damaged due to climate hazards, and who reported how much they spend annually on repairs and reconstruction. 282 households who reported that they had faced climate hazards were asked whether their house had been damaged as a result, and 47 of them answered "yes". These households were asked "How much do you spend annually on repairs and reconstruction".

**Figure 2.5 Percent of households by annual expenditure on repairs and reconstruction**

### Willingness to pay

Of 206 households who reported that they were thinking of buying or building a house, 88% answered yes to the question "Would you like to buy / build a house that can withstand weather / climate risks". These 182 households were asked "How much more would you be willing to pay (than for a normal house)". Their willingness to pay is depicted in Figure 2.6[11]. It is significant to note that 40% of households earning USD 4000-6000 annually are willing to pay USD 1500 more for a climate resilient house compared to a normal house.

[11] Though the questionnaire was designed to explain the concept of climate resilient housing to the respondents, some households may not have fully understood the implications of such a decision and would not have adequate information about climate resilient housing materials and technologies. Hence the numbers on willingness to pay should be taken as indicative only.




Note: Number in brackets on x-axis shows the number of households in each income category who reported that they were thinking of buying / building a house. These households were asked "Would you pay more for such a house that can withstand climate risks? How much more would you be willing to pay (than for a normal house)?"
Source: Data reported by 206 households in primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

**Figure 2.6 Willingness to pay for climate resilient housing**

**Renter households have little demand for *rented* climate resilient housing.** 80% of renter households said that they were not interested in moving to a *rented* house with features that can withstand weather / climate risks. One reason for this low level of interest is that most renter households are concentrated in Kathmandu, where households reported relatively low exposure to climate hazards.

**High cost and low awareness are the major constraints to climate resilient housing**

The single most common constraint to buying or building a house that can withstand climate hazards was:

1. High cost

Other common reasons were:

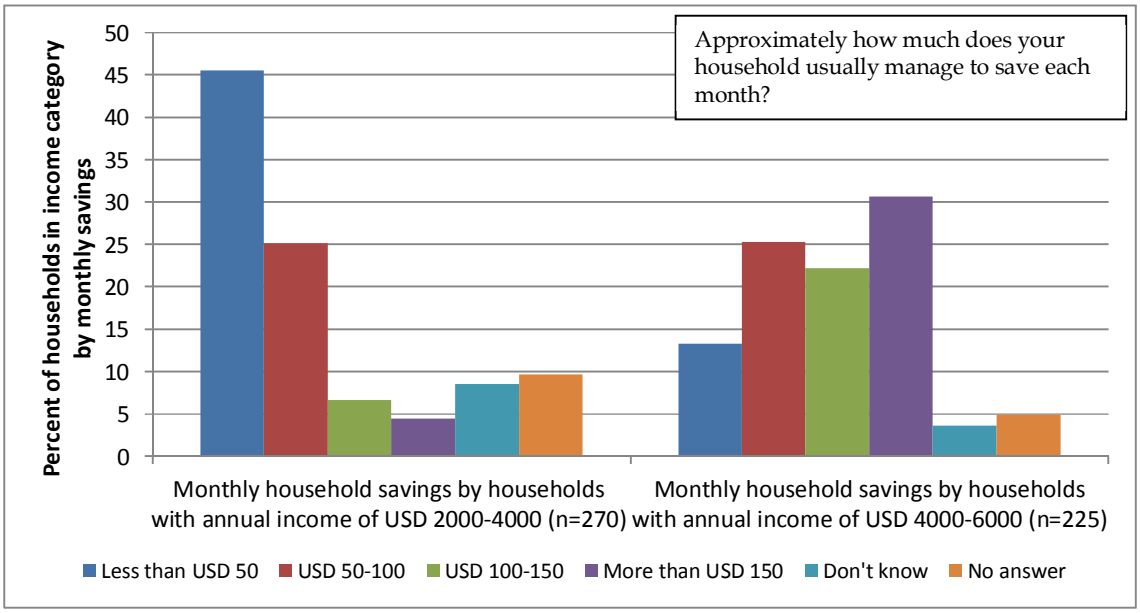
2. Lack of information about climate risks
3. Lack of information about housing / design technologies
4. Lack of technical knowhow for self-construction
5. Non-availability of land
6. Lack of skilled manpower
7. Lack of information about formal housing finance
8. Complex procedures for housing loan from bank

Several households in Kathmandu district said they were not interested in climate resilient housing as they did not face climate hazards.

Awareness about potential climate hazards is a very important motivating factor. If households do not feel that there is an imminent threat due to climate change – either structurally to their house and to their safety, or indirectly to their health – they will not be interested in going for climate resilient housing. Hence, **there needs to be greater awareness about the changing risks due to climate change and about the availability and costs of housing technologies and materials that would be more resilient to such risks.**

## 2.5 Ability to pay for climate resilient housing

**Savings are quite high among households with annual income of NPR 400,000-600,000 (i.e. USD 4000-6000)** (Figure 2.7)[12].



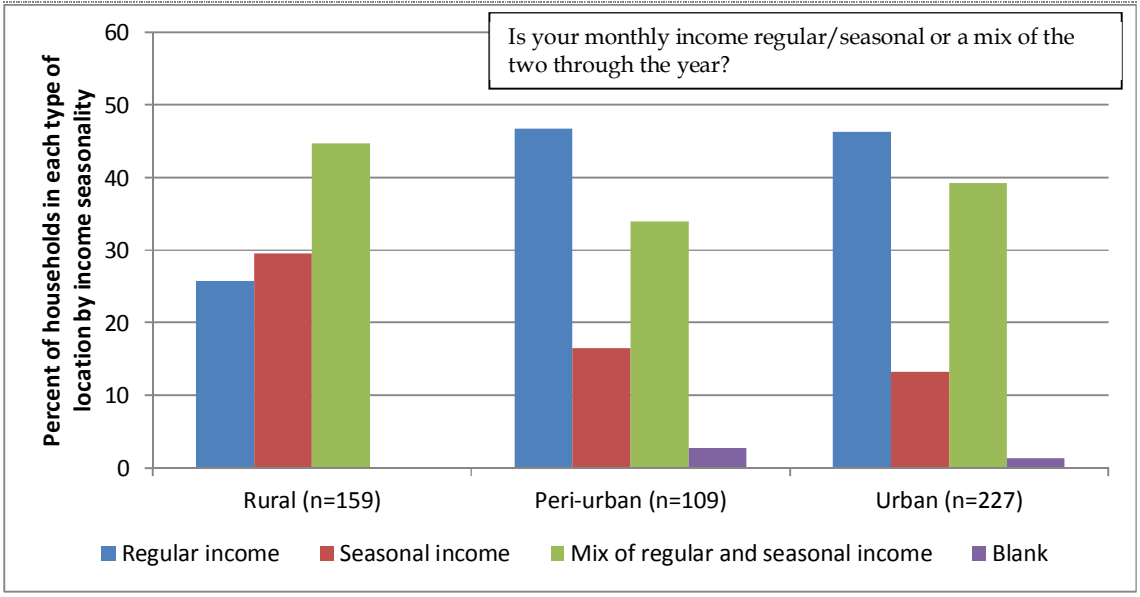

Note: Number in brackets on x-axis is the number of households surveyed in each income category.
Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

**Figure 2.7 Monthly household savings by households with (a) annual income of NPR 200,000-400,000 (USD 2000-4000) & (b) annual income of NPR 400,000-600,000 (USD 4000-6000)**

**Households with informal and seasonal income sources have an ability to pay on par with households with formal regular income.**

While most urban households have regular income streams, even rural and peri-urban households have regular incomes. Households in both rural and urban areas in Nepal have a seasonal component to their income (Figure 2.8).

[12] The national saving rate (gross national savings divided by gross national disposable income) in Nepal is 29%.



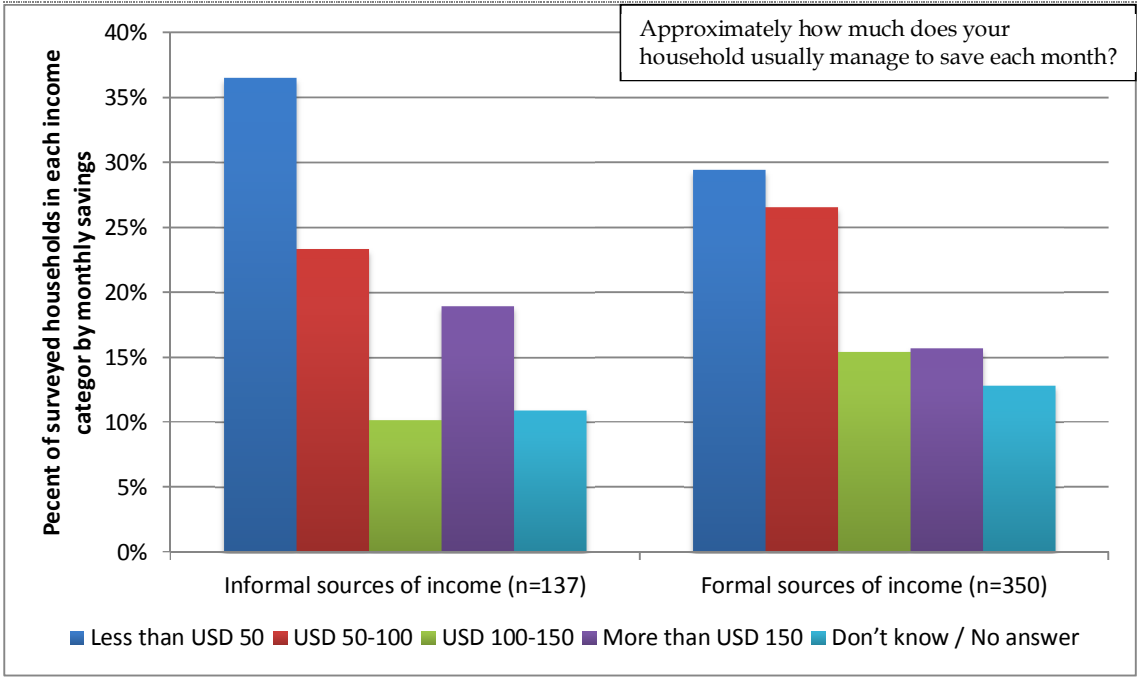

Note: Number in brackets on x-axis is the number of households surveyed in each type of location
Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI.

**Figure 2.8 Seasonality of income**

Moreover, households have formal sources of income, such as government employment, private employment, and self-owned businesses in the formal sector; and informal sources of income, which primarily include agriculture and self-owned businesses in the informal sector. Rental income and remittances are also included in informal sources of income.

**Even households with informal sources of income have significant savings** (Figure 2.9). 16% of households with formal sources of income (viz. government employment, private employment, or self-owned formal business) are able to save more than NPR 15,000 per month (i.e. approximately USD 150). Even 19% of households with informal sources of income (mainly relying on agriculture or informal businesses) are able to save a similar amount each month.

**Hence banks can try to include income from informal sources while assessing repayment capacity for housing loans.**




Note: Number in brackets on x-axis is the number of households surveyed in each category in terms of reported sources of income

Source: Primary survey in six districts of Nepal conducted in 2013 by HFHN and TERI

**Figure 2.9 Monthly household savings by households with formal and informal income sources**

Income, even if not correctly reported, is reflected in the ownership of assets such as TV, refrigerator, computer, phone, etc. The highest ownership of assets is among households from Kathmandu, followed by Sunsari and Banke (Table 2.3). **Households with a seasonal component to their income (e.g. from agriculture), have asset ownership that is almost as high as that of households with a purely regular source of income, and hence, offer significant market potential for climate resilient housing.**

**Table 2.3: Percentage of households in each district owning different types of assets**

| District | Basic assets | | | | | Productivity assets | | | Luxury assets | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Landline phone | Mobile phone | Cable TV | Electric heater | Water purifier | Computer/Laptop | Refrigerator | Two-wheeler | Car | Washing machine | Microwave oven | Air conditioner |
| Banke | 17 | 96 | 85 | 4 | 11 | 33 | 67 | 39 | 4 | 0 | 2 | 2 |
| Dhankuta | 30 | 100 | 80 | 5 | 5 | 35 | 40 | 15 | 0 | 0 | 0 | 0 |
| Kaski | 8 | 96 | 88 | 5 | 3 | 25 | 43 | 30 | 1 | 1 | 5 | 0 |
| Kathmandu | 39 | 98 | 95 | 15 | 6 | 67 | 56 | 53 | 1 | 1 | 3 | 0 |
| Rupandehi | 5 | 99 | 85 | 1 | 2 | 18 | 56 | 26 | 2 | 1 | 1 | 1 |
| Sunsari | 25 | 99 | 94 | 4 | 1 | 56 | 63 | 63 | 4 | 6 | 6 | 1 |

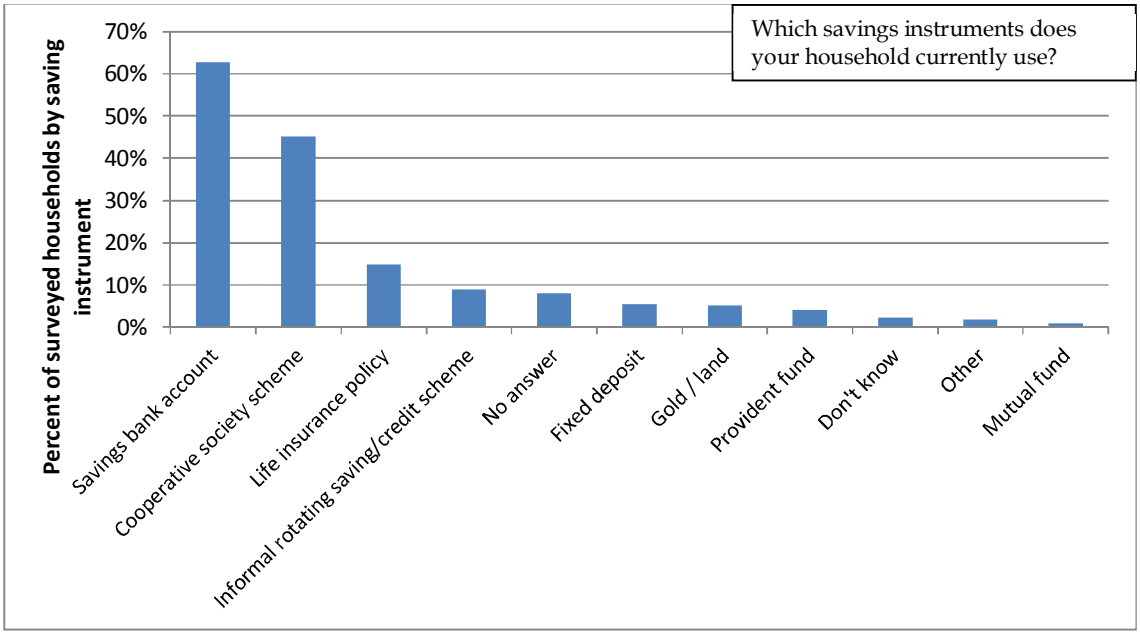
Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

## 2.6 Access to housing finance

**Financial inclusion and banking access are good in the rural and urban locations surveyed.** All households surveyed had either savings bank accounts or cooperative saving schemes.

**But there is scope for improvement.**

- In rural areas, 28% of households specifically said that their bank was located too far away.
- Only 5% households (27 out of 495 surveyed) reported having fixed deposits (Figure 2.10).



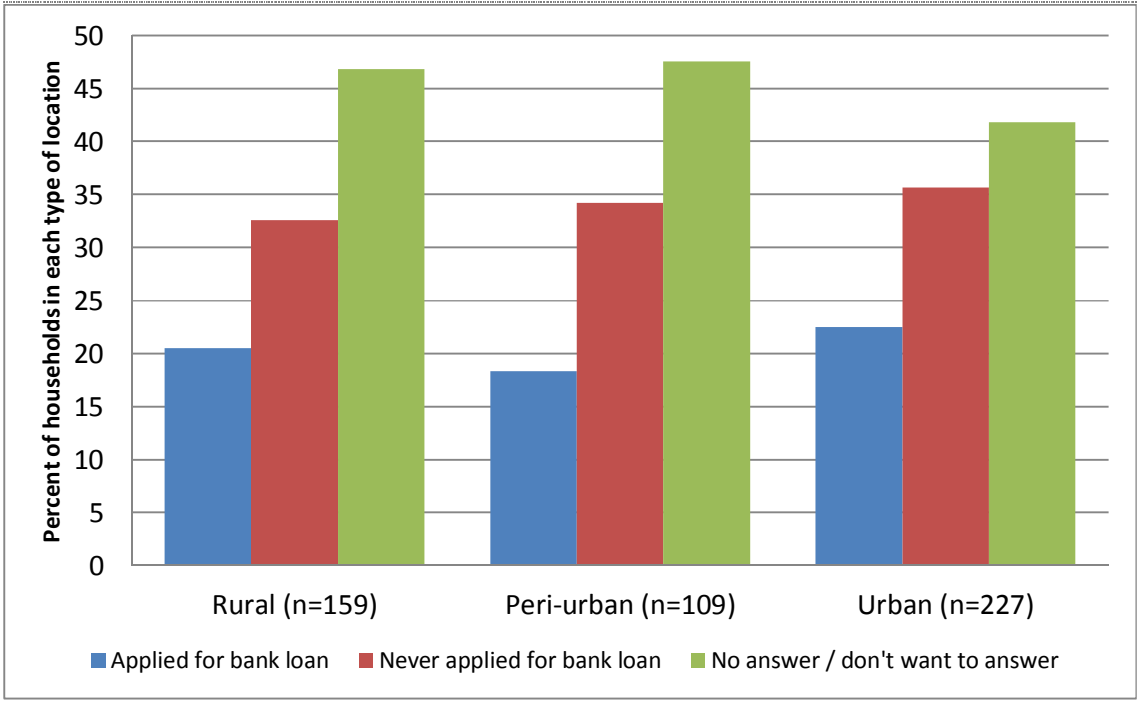

Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

**Figure 2.10 Savings instruments used by surveyed households**

**Although households are using banks for savings, they are not using banks for housing finance.**

- Even in urban areas, which have high penetration of banks, only 23% of households affirmed that they had applied for a bank loan (Figure 2.11). In rural areas, only 21% of households reported that they had applied for a bank loan[13].
- The most common means of financing house purchase or construction is personal or family savings – both in rural and in urban areas. Only 9% households (28 households of 306) combined their personal savings with a bank loan, while 9% households (29 households of 306) combined their personal savings with a loan from an MFI/cooperative (Figure 2.12).

[13] However a large fraction of the households surveyed did not answer this question.




Note: Number in brackets on x-axis is the number of households surveyed in each type of location
Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

**Figure 2.11 Percentage of surveyed households who applied for bank loan**

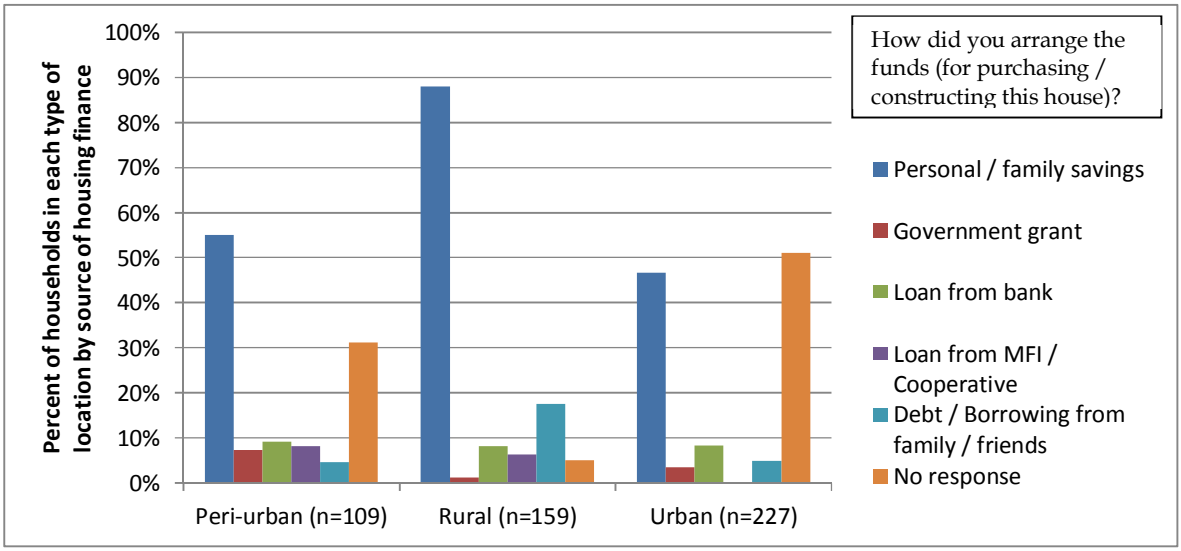



**Figure 2.12 Sources of funding for house construction or purchase**

Note: Number in brackets on x-axis is the number of households surveyed in each type of location
Source: Primary survey of 495 households in six districts in Nepal conducted in 2013 by HFHN and TERI

- Households who said that they were thinking of buying or building a house were planning to finance this through their own money or through a combination of own money and borrowing.
- Households raised the funds for house repair and reconstruction mainly through their own savings, through loans, and a combination of both.

- 150 households said that they had never applied for a loan because they did not feel the need to do so. A few households gave the reason as lack of income proof, lack of collateral and complicated procedures.

**Hence to tap the market potential for housing and housing finance, there is a need to simplify and promote housing finance products among savings bank account holders, and members of cooperative saving schemes or microfinance institutions.**

- Only 45% households reported having insurance of some kind; most of these were from Kathmandu. Although 27% of the respondents were aware of house insurance, only 2% had insured their dwellings.
- Around 20% of the respondents expressed their willingness to pay for insurance premia for transferring climatic risks but 77% were undecided or lacked sufficient information to make this decision.
- The reasons for not adopting insurance are lack of information, perceived high cost and perceived low frequency of climate risk.

**This points to the need to raise awareness about climate change and the use of insurance for risk diversification, and to offer develop simplified and affordable housing insurance products.**

# 3 Stakeholder interview, analysis and recommendations

Interviews with about 35 Stakeholders from various groups namely Government, donor agencies, NGOs, developers, financial institutes, MFIs and insurance organizations were carried out in Nepal to obtain qualitative sectoral information on market assessment of low cost climate resilient housing.

It has been confirmed through the consultation meets that the low cost housing resilient to multi-hazards has not been ventured into by the private sector in Nepal, and the key reasons for that has been high cost of land, high cost of capital available for housing, no financing models for low cost climate resilient housing and poor implementation of existing housing schemes. Though the market for low income climate resilient housing is unexplored, but all stakeholders during the consultation meets showed interest and were keen to participate. Recommendations given by all stakeholders are mentioned in the section.

## 3.1 Barrier Analysis

From the stakeholder consultations, barrier analysis was carried out by TERI to identify constraints in venturing into the low income climate resilient sector in Nepal. Detail interview notes are given in Annexure 4.

**Table 3.1: Barrier analysis**

| Barrier | Government |
|---|---|
| Policies and programs | • Climate resilient housing is not a government priority, however, National Shelter Policy reframed in 2012, has scope for integration of climate resilient housing. Policies to regulate land costs are missing. |
| Implementation (Codes/regulations) | • The *Nepal National Building Code* outlines guidelines for earthquake resistance. The code however, should also integrate recommendations for other climate vulnerabilities. Implementation remains a challenge due to lack of capacities. |
| Demand and supply | • There is no formal demand estimation for climate resilient housing carried out by Government. |
| Institutional capacity | • Awareness of climate impacts is very low and there is no institutional capacity planned to address the same. |
| Financing/Incentives | • Very low priority with minimal fund allocation, particularly to poor and low income families. |
| Technology | • There is no government effort towards research and development of climate resilient housing construction technologies. |

| Barrier | Financial institution (Commercial banks) |
|---|---|
| Policies and programs | • No policy to promote housing loan business for climate resilient low cost housing category. |

| Barrier | Financial institution (Commercial banks) |
|---|---|
| Implementation (Governing codes /standards/regulations) | • Bank limit their spending on deprived sector only to the extent as required by Nepal Rastra Bank requirement (3.5-4.5% of their loan portfolio), they lend it directly to MFIs @5-7%, but have no control on further lending by MFIs.<br>• No mandate on commercial banks towards pro poor lending. |
| Demand and supply | • Income bracket of 600000 NPR (USD 6000) and above serviced by this sector; thus most of the target group is out of scope of formal housing loan. |
| Institutional capacity | • Currently the level of knowledge on climate resilient housing and cost of such housing is very low. |
| Financing/Incentives | • Banks' strict lending conditions make housing finance inaccessible for lower income households.<br>• No incentive for borrowers in low cost housing segment or for bank to provide subsidized loan in this sector |
| Technology | • Financial institutes are not aware of climate resilient housing and have never explored the possibility of developing any financing scheme for the same |

| Barrier | Financial institutions- Micro Finance Institutes (MFI) |
|---|---|
| Policies and programs | • Absence of risk cover policies make this sector very vulnerable and they operate on a zero default basis which leads to cautious and limited lending at high rate of interest with low tenure. |
| Implementation (Governing codes standards/regulations) | • Usually high rate of interest (15-20%) or higher and low repayment period (2-3 years) puts this sector in a disadvantageous position. |
| Demand and supply | • Supply is only limited to borrowers with good track record of loan repayment and with previous good lending history with MFIs. Actual demand is much more than supply. |
| Institutional capacity | • No understanding or awareness on climate impacts on housing |
| Financing/Incentives | • Limited availability of fund and high cost of funds<br>• No financial incentives from government such as tax breaks etc. |
| Technology | • NA |

| Barrier | Insurance companies |
|---|---|
| Policies and programs | • No policy or regulation with regard to solvency, investments, priority areas are present. Property insurance, though mandatory for those seeking house building loans, is limited to the loan amount only and not to the value of the property.<br>• The Bima Samiti is supposed to play a crucial role in terms of development of the sector but the Institution seems to be lacking statutory rules (or de jure guidelines) and de facto operating as a stand-alone body. |
| Implementation (codes/ regulations) | • No driving code to insure property against climate impacts such as floods, landslides |
| Demand and supply | • No insurance product for climate resilient housing |
| Institutional capacity | • Currently no understanding of impact of climate resilient housing on life of a building and its valuation. |
| Financing/incentives | • Housing insurance is not currently perceived as a profitable sector and nor driven by any regulation and hence products are not available in insuring climate resilient low cost housing |

| Barrier | Insurance companies |
|---|---|
| Technology | • NA |

| Barrier | Non-governmental organisations |
|---|---|
| Policies and programs | • Increasing land costs and lack of land pooling and land acquisition policies is a major barrier,<br>• There is no policy support, role of NGOs are limited to specific pockets. |
| Implementation (codes/regulations) | • Limited to government obligations in case of disaster/calamity and limited schemes driven by multilateral/bilateral donor agencies such as UN HABITAT/HFHN |
| Demand and supply | • Habitat for Humanity Nepal has a mandate of providing housing for poor people. They have constructed 48,000 low cost houses in Nepal till now and they target to build upto 1 million low-cost houses by 2020.<br>• Lumanti works in facilitation and promotion of low-cost housing options primarily in urban areas and sometimes in rural areas including 19 cities/towns in Nepal. It also works with slum dwellers in urban areas. Some activities are also undertaken in response to disasters for example, 235 raised houses in Sunsari, Haripur were built after floods with a grant of less than 60K Nepali Rupees for construction - exclusive of land cost.<br>• Shelter and Low-cost Technology Development develops and disseminates low cost alternative technologies to enable people to build the houses by themselves. The organisation which was established in 1996 has also been working on several low energy, environmental friendly and cost effective building technologies to ensure safe and durable structures. All these efforts are replicable and much less in comparison to demand |
| Institutional capacity | • Need for Skilled masons, construction manuals, awareness programs for govt, and communities to increase their knowledge about low-cost climate resilient construction technologies. |
| Financing/incentives | • Habitat for Humanity Nepal HFHN receive donations from Global Citizen Network (GCN) countries<br>• Lumanti carries out grant based projects for UN-HABITAT, Government of Nepal.<br>• Shelter and Local Technology Development Centre also receives research grants. They are also advising a couple of developers in Kathmandu on the low cost technologies.<br>• These are niche efforts that are far less adequate than the actual requirement. |
| Technology | • Habitat for Humanity conducts site visits immediately after disaster, with a post-disaster resource management plan and provides emergency houses using locally available building materials and technologies. They use raised floor and light roofs which are suited for locations vulnerable to floods. They also recommend retaining walls using locally available slates and stones in hilly areas where landslides are quite frequent. Increase of room height is a preferred option by them in areas where high temperatures are found.<br>• Shelter and Low-cost Technology Development Centre has been developing precast building components like hollow blocks, by use of |

| Barrier | Non-governmental organisations |
|---|---|
| | which, they could save at least 50% of the construction cost.<br>• Lumanti Support Group for Shelter, have been building raised floor houses with lightweight roof in Sunsari which is vulnerable for floods.<br>• Centre for Integrated Urban Development (CIUD) is a Kathmandu based NGO who are majorly involved in providing basic infrastructure for urban poor. They have been working on projects related to water and sanitation, disaster management, information systems and transportation planning.<br>• There is need to make replicable models of these niche initiatives and large scale technology development/standardisation and prefabrication efforts are required to reduce costs |

| Barrier | Donors |
|---|---|
| Policies and programs | • Limited activity and low presence. Often driven by global agenda of sustainability |
| Implementation (codes/regulations) | • Driven by international Millennium Development Goals and rehabilitation in case of disasters. |
| Demand and supply | • Few Donor agencies operating in this space: United Nations Human Settlement Programme is addressing urban climate change agenda through cities and climate change initiatives (CCCI). Collaborating with European Union under SWITCH Asia call for sustainable consumption and production, UN- Habitat and partners are promoting sustainable housing in cities of Nepal.<br>• Nepal Red Cross Society is primarily a humanitarian organisation which mobilises relief, rehabilitation and recovery actions after a disaster takes place in a certain area. The organization is not able to build new and resilient houses for everyone due to limited funds and also due to the fact that relief actions receive maximum fund allocation resulting in limited funds for recovery activities like housing. Houses are built for only a few beneficiaries who are selected on the basis of predetermined criteria. |
| Institutional capacity | • Need for Capacity to develop recovery guidelines ; and for developing customized recovery models for different regions |
| Financing/incentives | • United Nations Human Settlement Programme UN- Habitat doesn't fund the housing programs directly. However they facilitate SMEs, developers and develop their capacity for sustainable housing projects<br>• Nepal Red Cross Society NRCS does not fund activities of other organisations. They mobilize internal funds that are allocated within activities. |
| Technology | • Marginal efforts made e.g. Red Cross society has made houses with raised plinth levels and with CGI sheets in place of thatch roofs |

| Barrier | Developers |
|---|---|
| Policies and programs | • Inadequate policies on land pooling, no government mandate on climate resilient and low cost housing. No incentive for low cost housing; |
| Implementation (Codes /standards/regulations) | • National building code has strict codes on earthquake resistance, mandatory requirements for rain water harvesting; other climate resilient features need to get integrated in the code. No developer has built climate resilient low cost housing projects. |

| Barrier | Developers |
|---|---|
| Demand and supply | • Developers are not operating in rural areas where the actual demand of climate resilience homes exists. |
| Institutional capacity | • Knowledge on implementing earthquake resistant housing exists, capacities on how to design low cost housing also exists. |
| Financing/incentives | • Lack of any incentives on special financing mechanism discourages the developer communities to construct low cost housing with climate resilient features. |
| Technology | • Only one developer (AARTI and co) reported to be using pre-fabricated technology. Thus need for developing technologies for cost optimisation and faster/cost effective construction shall give impetus to this sector |

Thus, it can be summarised that in Nepal the NGOs, Developers and Donors have construction technologies to implement low cost climate resilient housing, however, the main reason for private sector not currently being involved is due to lack of government policies and financial mechanisms. The insurance market in Nepal is underdeveloped and unexplored, hence proposing a framework for risk insurance in the context of low cost climate resilient housing, needs additional work, which is not in the scope of this project.

Countries which have been successful in implementing low cost housing due to government policies and financial mechanisms are mentioned in Boxes below. These set relevant examples for Nepal to study and replicate in local context.

**Box2 Examples of other countries with successful policy implementation of low cost housing**

**Singapore (Global Urban Development Magazine, November 2007)**

Public housing policy of Singapore is cited as one of the most successful examples of affordable housing production in Asian cities. The proportion of public housing is 85% (since 1985), with the majority owning the flat that they occupy.

Singapore Housing and Development Board (HDB) provided housing of sound construction and good design for lower income segment at rents which they could afford (HDB Annual Report, 1962) and also encouraged a property – owning democracy in Singapore to enable citizens own their homes. High rise public housing has provided solution to the growing population of the country.

Some important measures taken by Government are:

1. In 1960, only 44%of land in Singapore was owned by the government, while over 35% of population lived in squatter settlements. With effective legislation, in 1999, 85% of land is owned by the Government- while contributing to a ''captive'' market as public housing is offered as resettlement benefit.
2. Since housing is regarded as a public duty, the difference between the rent income and expenditure is covered by a grant from the State.
3. Under the homeownership scheme introduced in 1964, public housing is sold on a 99-year leasehold basis. Also the scheme allowed buyers of public housing to withdraw a portion of their savings in Central Provident Fund (CPF) for down payment (20% of purchase price) and mortgaged payment (remaining 80% of

purchase price is paid in instalments through a HDB assisted mortgage loan with interest rates set below the prime rate). Singapore's CPF for housing represents a lesson in housing finance.

4. Mortgage loan reschedule scheme included extension of loan term where the HDB considered allowing an extension of the 25 year loan term up to a maximum of 30 years or until the homeowner turns 65 whichever is shorter.

Thus in case of Singapore, it is observed that the government's commitment and intervention can greatly motivate and enable housing for lower income segment.

**Principles and Examples from Europe (United Nations Publication, 2006)**

***Social housing and land use planning of Italy, Switzerland and Austria*** *demonstrate* examples of local governments, where costs were reduced through land-use controls. Italy has long integrated social housing into land-use planning, this include acquisition of land for social housing at far below-market prices. Similar regulations exist in Switzerland and in Austria, public institutions are established, which play the role of price-reducing in the local land market.

***Financing social housing: Austria, Finland*****:** In Austria subsidies for social housing are given in the form of long-term low interest loans (former non-repayable grants) create revolving funds. In Finland, social housing sector accounts for 17% of the housing stock. Investors are either municipalities or non-profit organizations. The Housing Fund provides Direct subsidized financing. Loan period is 35 years. Securitization has been an important source of finance for social house financing through the Fennica Program. The Housing Fund diversified its funding sources in 2001 by negotiating and signing two loan agreements with EIB (European Investment Bank) and CEB (Council of Europe Development Bank).

***Construction of social housing in Germany***, social housing sector in Germany, is based upon conventions. A convention is a social and economic agreement. Conventions exist between municipalities and a wide range of developers or investors. In return for helping the municipality, to satisfy the demand for housing, the developer is granted assistance by the Land.

In Sweden, Housing is allocated by the Housing Organization. Almost every municipality has its own not-for profit housing organization.

# 4 Development of Feasible Business Models for Low Cost Climate Resilient Housing – Nepal

Based upon the household surveys and stakeholder interviews an understanding on existing housing finance and financial products available was developed. These formed the basis for developing feasible financial models, which shall attract private sector to venture in the low cost climate resilient housing sector.

The first step in the process was to define and identify design solutions for making homes disaster proof, establish cost of construction, additional cost of integrating climate resilient features, cost of land, existing home loan schemes and existing risk insurance schemes. This was collated from stakeholder interviews.

In order to propose feasible business models for private sector developers, buyers and financial institutions, iterations were carried out with varying built up area and cost of construction. There are models suggested for all the income segments targeted in this study, for Urban and rural locations.

Besides these models, one retrofit model for existing buildings to incorporate climate resilient features has been developed. One model on energy efficient products like Financing of Solar Water Heating in an existing home has been developed. These are product examples for MFI to get involved in financing small loan amounts required for retrofits and add on features to make homes climate resilient and energy efficient.

For the financial model, percentage of sanction amount, rate of interest and repayment period has been assumed based upon the current practices in Nepal that were highlighted during stakeholder interview with Financial Institutes, Developers and NGOs. For few income segments, where prevailing policies do not make an affordable case, rate of interest and extended repayment period has been recommended.

Based upon the identified climate resilient features, estimation of increment in cost for climate resilience was estimated, these acted as incremental cost in the financial models.

By reducing built up area and cost of construction through use of alternative construction technologies and alternate materials, business models were suggested, such that households could pay their EMI based upon their income levels and affordability.

In order to make the case financially attractive for Banks and other financial institutes, Life Cycle Cost Analysis has been carried out to compare the Life cycle cost of affordable homes without climate resilience features and energy efficiency vs. homes which integrate climate resilience and energy efficiency. Though in the latter case there is increase in initial cost, however, it is observed that by taking minimum 20 years life span of a project, savings are 3.5-4 times the initial investment due to reduced maintenance cost and reduced energy bills.

Guidelines for integrating these models and schemes in existing Government policies are framed.

## 4.1 Defining Climate Resilient Features and Proposed Business Models

Climate resilient design features make homes resilient to climate vulnerabilities, such that they maintain an acceptable level of functioning and structure. Table 4.1, below shows identified climate resilient design features for new construction and Table 4.2, shows features for improvements in existing homes, so as to make them climate resilient.

**Table 4.1 Climate Resilient Features Identified for New Housing Construction**

| District | Vulnerability | Climate Resilient Design Strategies |
|---|---|---|
| Kaski, Sunsari | GLOFs, Floods and Heavy rains | High plinth (Preferably 6"above last flood levels)/ raised floor on stilts , RCCpad foundation, RCC lintel & cill tie beams , overhangs above openings, plinth protection, damp proof course on top of foundation, water proofing on roof, homes with attached toilets. Avoid basements. |
| Dhankuta | Landslides | RCC lintel & cill tie beams, Buttresses, buildings should be symmetrical and simple forms, cut and fill should be minimized while building on slopes, buildings in mountain regions should be light weight, this puts less pressure on mountain slopes and also make buildings more seismic resistant. |
| Banke, Rupandehi | Heat stress | Solar passive architecture design principles, , cavity wall/ hollow cement blocks/ cement stabilized soil blocks, insulated roof, light coloured walls, shaded windows, |
| Kathmandu | Multiple hazards | All strategies defined above for flooding, solar passive architecture to obtain comfort in summer and winter months, comply for earthquake resistant design as per NBC (National Building Code) of Nepal |

**Table 4.2 Climate Resilient Features for Improvements in Existing Homes**

| District | Vulnerability | Climate Resilient Design Strategies |
|---|---|---|
| Kaski, Sunsari | GLOFs, Floods and Heavy rains | Overhangs above openings, water proofing on roof, water proofing at plinth level (grouting), attach toilets with homes, Storm water management/ Sustainable Urban Drainage Systems (SUDs). |
| Dhankuta | Landslides | Buttresses, cut and fill should be minimized around building on slopes. |
| Banke, Rupandehi | Heat stress | Insulate roof, paint walls with light coloured walls, shaded windows, Light colour reflective tiles on terraces. |
| Kathmandu | Multiple hazards | All strategies defined above for flooding, solar passive architecture to obtain comfort in summer and winter months, comply for earthquake resistant design as per NBC (National Building Code) of Nepal |

The above recommendations are identified for building scale, measures identified to design and construct settlements, climate resilient, are as follows:

**Table 4.3 Climate Resilient Features for cluster of buildings or Settlements**

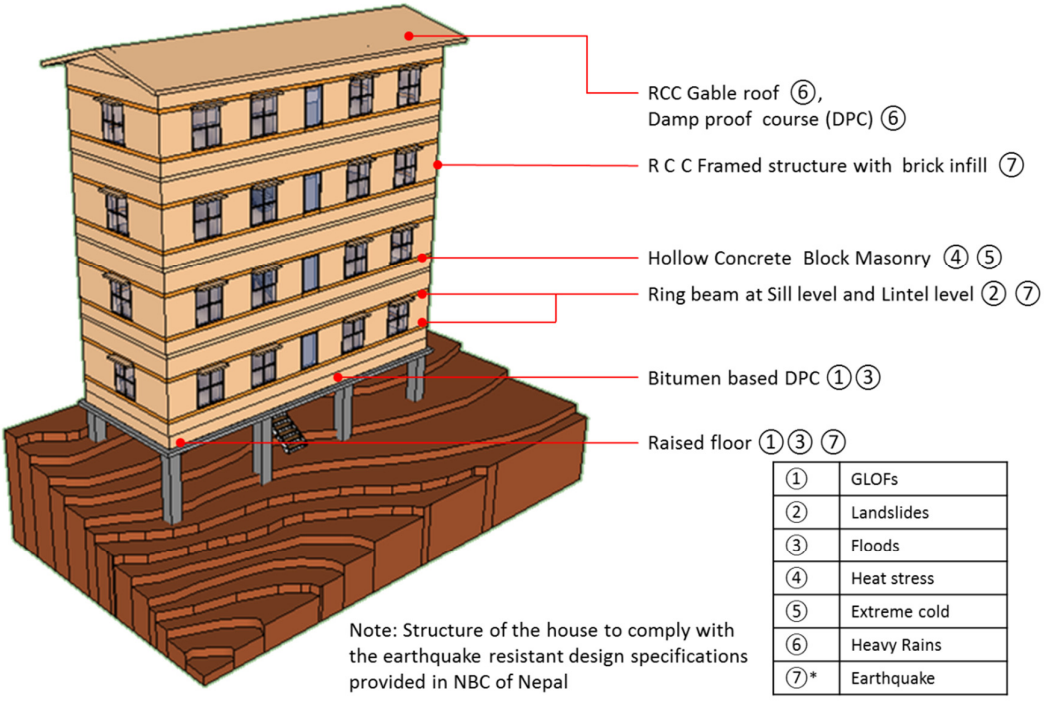
| District | Vulnerability | Climate Resilient Design Strategies |
|---|---|---|
| Kaski, Sunsari | GLOFs, Floods and Heavy rains | Development should adhere to natural site contour, reduce impervious pavement, Protect existing trees and vegetation, design efficient storm water drainage system- such as infiltration trenches, swales, retention ponds etc., installation of pumping systems and downstream flood control measures. In urban areas plan SUDS (Sustainable Urban Drainage System), erosion and sedimentation control measures should be installed. |
| Dhankuta | Landslides | Proper drainage system in the hilly terrain, retaining structures and stabilization of slopes using vegetation, roads should be placed parallel to the contour lines, minimise cutting of trees, cut and fill of slopes should be minimised while carrying out master plan development. |
| Banke, Rupandehi | Heat stress | Reduced impervious pavements, increase in vegetation in residential developments will help in maintaining cooler temperatures. Water bodies in the landscape design will also make microclimate cooler. |

Further details about low cost climate resilient design features are given in Annexure 6. In addition to above, below mentioned features are being recommended to construct climate resilient low cost homes that will be energy efficient as well

**Table 4.4 Energy efficiency features for new and existing homes**

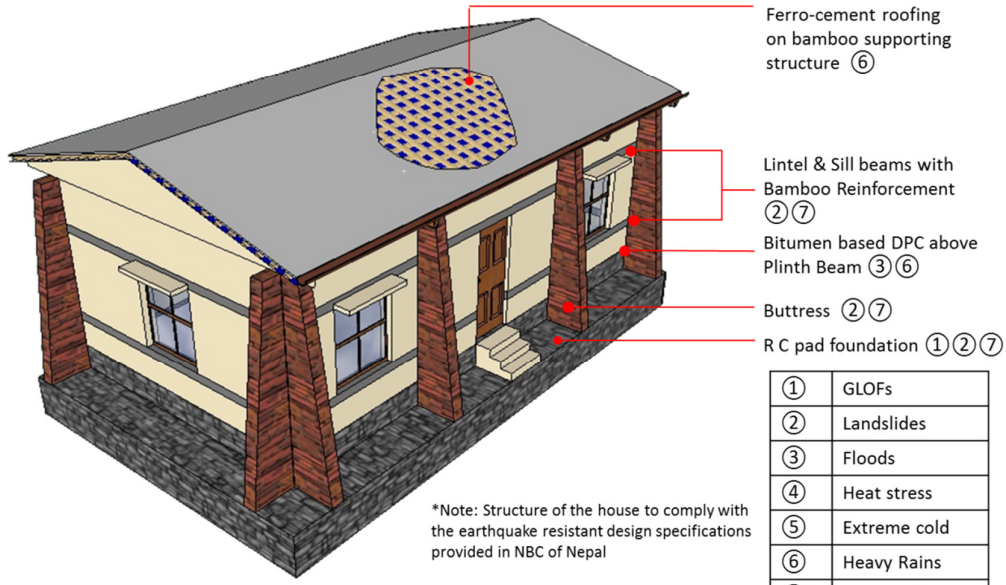
| District | Features |
|---|---|
| **Kaski, Dhankuta, Kathmandu** | Solar passive architecture to respond to extreme cold climate, including Trombe Wall, Energy efficient lighting (Lighting Power Density not to exceed 1W/ft2), Solar water heating panels |
| **Rupandehi, Sunsari, Banke** | Districts in the Terai Region which are vulnerable to heat stress need to integrate solar passive architectural design features to control the solar heat gains. This could be achieved with features such as insulated roof, walls that are built with stone/stabilized earth blocks which provide thermal storage etc., Energy efficient lighting (Lighting Power Density not to exceed 1W/ft2), |

Business models were proposed for developer made climate resilient low cost houses in urban locations and self-construction (low cost climate resilient) houses in rural as well as urban locations. These are shown in Figure 4.1. Based upon the affordability and savings data analysed during the household survey, different business models are being suggested for different income segments. Business models are also proposed for retrofitting existing homes to make them climate resilient. Similarly business models are proposed for integrating energy efficiency in homes.




| | |
|---|---|
| ① | GLOFs |
| ② | Landslides |
| ③ | Floods |
| ④ | Heat stress |
| ⑤ | Extreme cold |
| ⑥ | Heavy Rains |
| ⑦* | Earthquake |

**Proposed for Developer build Multi- Storey Climate resilient Home**




| | |
|---|---|
| ① | GLOFs |
| ② | Landslides |
| ③ | Floods |
| ④ | Heat stress |
| ⑤ | Extreme cold |
| ⑥ | Heavy Rains |
| ⑦* | Earthquake |

**Proposed for Self construction Climate resilient Home**

**Figure 4.1 highlights climate resilient features for Developer made multi-storey house and self-constructed – New Homes**

## 4.2 Estimation of cost of constructing developer made climate resilient low cost housing-New Construction

From the stakeholder interviews it was revealed that currently developers are only providing housing for the upper middle income group or for the high income group. Mostly developer made homes fall in the cost range of NPR 50-60 Lakhs (USD.50000-60000) for middle income group and NPR 1 Crore (USD 100000) and above for high end residential units.

During the stakeholder interviews, developers also said that they understand that the upper income market is saturated and that they understand that there is a huge market for lower middle income segment. Developers confirmed that with policy changes for land acquisition and use of alternate construction technologies, cost of residential units could be reduced to NPR15-20 Lakhs (USD 150000-200000) for 500-800sq.ft. home size. It is through conversations with developers it was realized that low cost housing in Nepal is possible for NPR2500-2600/sq.ft. (USD 25-26/sq.ft.) in urban locations like Kathmandu. This was considered to start the costing analysis in urban locations. For rural locations, construction costs were collected from NGOs. Below are various scenarios considered for construction cost. These are later used in framing business models for low cost climate resilient housing.

**1 Current cost of construction considered for developer made low cost housing in Nepal: NPR 2500/sq.ft.(USD 25/Sq.ft)**

**Table 4.5 Cost Distribution for a developer build Low Cost house in urban location costing: NPRs 2500/ sq.ft (USD 25/Sq.ft)**

| | Cost (in N Rs)/ Sq.ft | Cost (in USD)/ Sq.ft | Cost (%) |
|---|---|---|---|
| **Cost of Construction including Labour Cost** | 1800 | 18.00 | 72 |
| **Technical expertise/ consultants fee & Others** | 225 | 2.25 | 9 |
| **Developers Profit** | 475 | 4.75 | 19 |

**2 Cost of construction estimated for developer made low cost housing + climate resilience features in Nepal: NPR 2800/sq.ft.(USD 28/Sq.ft)**

**Table 4.6 Cost Distribution for a house costing NRs 2800/ Sq.ft (USD 28/Sq.ft.)**

| | Cost (in N Rs)/ Sq.ft | Cost (in USD)/ Sq.ft | Cost (%) |
|---|---|---|---|
| **Cost of Construction including Labour Cost** | 2050 | 20.50 | 72 |
| **Technical expertise/ consultants fee & Others** | 250 | 2.50 | 9 |
| **Developers Profit** | 500 | 5.00 | 19 |

12% increase in net rate

In order to construct low cost housing, alternate technologies were identified, these are mentioned below. These would help in reducing cost of construction after integrating climate resilient features.

**Table 4.7 Alternative/ Affordable construction features**

| Building Component | Conventional Practice | Alternative/ Affordable Construction | Cost Reduction (in %) |
|---|---|---|---|
| Foundation | Brick foundation | R C C Pad foundation | 37 |
| Wall | Brick wall | Cavity wall/ Hollow block wall | 20 |
| Roofing | R C C Slab | Filler slab/ Precast over inverted T Beams | 22-25 |
| Opening frames | Teak/ Hard wood Door/ Window frames | Pre cast RCC frames for Door/ Window | 30 |

Source: Low cost Housing by Bhubaneswar LalShresta, 2007; Alternative building materials and technology Dissemination by Suresh V, 2002.

**3 Cost of construction estimated for Developer made low cost housing using alternate technologies: NPR 2200/sq.ft (USD 22/Sq.ft)**

**Table 4.8 Cost Distribution for a house costing NRs 2200/ Sq.ft (USD 22/Sq.ft)**

| | Cost (in N Rs)/ Sq.ft | Cost (in USD)/ Sq.ft | Cost (%) |
|---|---|---|---|
| **Cost of Construction including Labour Cost** | 1600 | 16.00 | 72 |
| **Technical expertise/ consultants fee & Others** | 200 | 2.00 | 9 |
| **Developers Profit** | 400 | 4.00 | 19 |

**4 With the above technologies, the Cost of a Developer made low cost new house with alternate technologies and climate resilient features will be approximately NPR 2550/Sq.ft. (USD 25.5/Sq.ft)**

**Table 4.9 Cost Distribution for a house costing NRs 2550/ Sq.ft (USD 25.50/Sq.ft)**

| | Cost (in N Rs)/ Sq.ft | Cost (in USD)/ Sq.ft | Cost (%) |
|---|---|---|---|
| **Cost of Construction including Labour Cost** | 1860 | 18.60 | 72 |
| **Technical expertise/ consultants fee & Others** | 230 | 2.30 | 9 |
| **Developers Profit** | 460 | 4.60 | 19 |

2% increase in net rate

## 4.3 Cost of self-construction- climate resilient low cost housing-New Construction

In rural areas people carry out self-construction and hence profit margins of developers are not involved. Also, local people make use of local materials in self-construction homes. This reduces the cost of material, transport etc. Cost of construction of affordable housing in rural areas of Nepal is considered as NPR1000per sq.ft. (USD 10.00 per sq.ft)

On adding climate resilient features in these homes, it was calculated that the cost of construction increases to NPR1100/sq.ft (USD 11/Sq.ft). This cost has been considered for developing business models for self-construction.

However, with the below mentioned alternate technologies, cost of construction can be reduced to NPR 800/sq.ft (USD 8/Sq.ft). This cost has been considered for developing business models for self-construction in rural locations.

**Table 4.10 Alternative/ Affordable construction features for rural locations**

| Building Component | Conventional Practice | Alternative/ Affordable Construction | Cost Reduction (in %) |
|---|---|---|---|
| Foundation | Brick work | Stone masonry | 60-70% |
| Wall | Brick work | Hollow concrete block, Adobe | 50% |
| Flooring | PCC | Stone Tile/ Brick tile Soling | 30-40% |
| Roofing | C. G. I Sheets on Iron pipes | C. G. I Sheets on Bamboo | 40% |
| Openings | Wooden Frames (Teak Wood) | Aluminium Frames | 33% |

Source: Habitat for Humanity, Nepal 2014

**Thus, proposed cost of construction for low cost housing + climate resilience features in Nepal for self-construction using alternate technologies will be NPR 800/sq.ft. (USD 8/Sq.ft)**

**Table 4.11 Cost Distribution for a house costing NRs 800/ Sq.ft (USD 8/Sq.ft)**

| | Cost (in N Rs)/ Sq.ft | Cost (in USD)/ Sq.ft |
|---|---|---|
| **Cost of Construction including Labour Cost** | 800 | 8.00 |
| **Technical expertise/ consultants fee & Others** | 0 | 0 |
| **Developers Profit** | 0 | 0 |

## 4.4 Estimated cost for refurbishment of existing homes to add climate resilient features

**Table 4.12** Estimated Cost (in NRs) for retrofit features for making a 550sft existing house climate resilient

| | Kaski | Dhankuta | Sunsari | Banke | Rupadehi | Kathmandu |
|---|---|---|---|---|---|---|
| **Butresses** | | 35000 (350) | | | 35000 (350) | |
| **Water proofing at plinth level (Grouting)** | 5600 (56) | 5600 (56) | 5600 (56) | 5600 (56) | 5600 (56) | 5600 (56) |
| **Water proofing at terrace & reflective paint** | 36000 (360) | 36000 (360) | 36000 (360) | 36000 (360) | 36000 (360) | 36000 (360) |
| **SUDS** | 1600 (16) | 1600 (16) | 1600 (16) | 1600 (16) | 1600 (16) | 1600 (16) |
| **Sun Spaces/ Trombe wall** | 19000 (190) | | | | | 19000 (190) |
| **Efficient lighting (Energy efficiency)** | 8000 (80) | 8000 (80) | 8000 (80) | 8000 (80) | 8000 (80) | 8000 (80) |
| **Solar Water Heaters (Energy efficiency)** | 35000 (350) | 35000 (350) | 35000 (350) | 35000 (350) | 35000 (350) | 35000 (350) |
| **Total** | 105200 (1052) | 86200 (862) | 86200 (862) | 86200 (862) | 86200 (862) | 105200 (1052) |

Source: http://www.rep.com.np/Document_Uploads/Downloads/200807300534461.pdf; http://vyaratiles.in/products/paving-blocks/ecological-pavers/#; http://www.bmtpc.org/DataFiles/CMS/file/Publication%20New/usetips-6.pdf; http://cgwb.gov.in/documents/Manual%20on%20Artificial%20Recharge%20of%20Ground%20Water.pdf

Thus NPR 1,00,000 (USD 1000) has been considered, as an investment for a similar size house, to add climate resilient features in existing homes, while framing financial models for retrofit cases.

## 4.5 Framework of Business Models Proposed for Low Cost Climate Resilient Housing in Nepal

During the scoping study, financial models were framed to make it feasible for financial institutions to fund low cost climate resilient housing, developers to construct and buyers to afford owning a climate resilient low cost housing. Summary of indicators that shall make this feasible are given in tables below.

### 4.5.1 Business models for developer made climate resilient low cost housing – New Construction

**Table 4.13 Business models for developer made climate resilient low cost housing – New Construction**

| Income Range | NPR 200000 (USD 2000) | NPR 300000 (USD 3000) | NPR400000 (USD 4000) | NPR 500000 (USD 5000) | NPR 600000 (USD 6000) |
|---|---|---|---|---|---|
| Size of the house (sq.ft) | 400-500 | 500 | 500 | 600 | 600 |
| Construction cost (NPR /sq.ft) | 2200-2400 (USD 22-24) | 2500 (USD 25) | 2500 (USD 25) | | |
| Cost of climate resilient features | 10% of construction cost | 12% of construction cost | 12% of construction cost | | |
| Property price including land cost (NPR/sq.ft.) | 3146 | 3625 | 3625 | 3625 | 3625 |
| Loan amount sanction | 60% of property value | | | | |
| Non committed income | 10% of Annual income | 0 | 0 | 0 | 0 |
| Interest Rate (Discounted rate for low cost climate resilient) | 10% | 10.5% | 10.5% | 10.5% | 10.5% |
| EMI | Repayment period - 240 months | Repayment period - 180 months | Repayment period - 120 months | Repayment period - 120 months | Repayment period - 120 months |
| Monthly EMI paying capacity | 50% of monthly salary | | | | |

If monthly EMI paying capacity is considered as 30% of monthly salary. In that case following have to be considered

**Table 4.14 Business models for developer made climate resilient low cost housing – New Construction (EMI paying capacity – 30% of monthly salary)**

| Income Range | NPR 200000 (USD 2000) | NPR 300000 (USD 3000) | NPR400000 (USD 4000) | NPR 500000 (USD 5000) | NPR 600000 (USD 6000) |
|---|---|---|---|---|---|
| Size of the house (sq.ft) | 350 | 350-400 | 500 | 600 | 600 |
| Construction cost (NPR /sq.ft) | 2200-2400 (USD 22-24) | 2500 (USD 25) | 2500 (USD 25) | 2500 (USD 25) | |
| Cost of climate resilient features | 10% of construction cost | 12% of construction cost | 12% of construction cost | 12% of construction cost | |
| Property price including land cost (NPR/sq.ft.) | 3146 | 3625 | 3625 | 3625 | 3625 |
| Loan amount sanction | 60% of property value | | | | |
| Non committed income | 10% of Annual income | 10% of Annual income | 0 | 0 | 0 |
| Interest Rate (Discounted rate for low cost climate resilient) | 9% | 10.5% | 10.5% | 10.5% | 10.5% |
| EMI | Repayment period - 360 months | Repayment period - 360 months | Repayment period - 360 months | Repayment period - 300 months | Repayment period - 216 months |
| Monthly EMI paying capacity | 30% of monthly salary | | | | |

## 4.5.2 Business models for self-construction in urban location for climate resilient low cost housing – New Construction

**Table 4.15 Business models for self-construction in urban location for climate resilient low cost housing – New Construction**

| Income Range | NPR 200000 and above (USD 2000) | NPR 300000 and above (USD 3000) |
|---|---|---|
| Size of the house (sq.ft) | 400 | 400 |
| Construction cost (NPR /sq.ft) | 1000 | 1000 |
| Cost of climate resilient features | 10% of construction cost | 10% of construction cost |

| Income Range | NPR 200000 and above (USD 2000) | NPR 300000 and above (USD 3000) |
|---|---|---|
| Land cost | 400000/Anna | 400000/Anna |
| Minimum land area | 2.5 Anna | 2.5 Anna |
| Allowed FAR | 1.75 | 1.75 |
| Non committed income | 10% of Annual income | 10% of Annual income |
| Interest Rate (Discounted rate for low cost climate resilient) | 10.0% | 10.5% |
| EMI | Repayment period - 216 months | Repayment period - 180 months |
| Monthly EMI paying capacity | 50% of monthly salary | 50% of monthly salary |

In urban locations, owners (Annual income segment 200000-300000) with monthly EMI paying capacity equivalent to 30% of monthly salary, above financial model (Table 4.15) is not possible, as the property price includes both the cost of land and cost of construction. However, it is possible for households with annual income NPR 400000 (USD 4000) and above.

### 4.5.3 Business models for self-construction in rural location for climate resilient low cost housing – New Construction

From the household survey it was observed that most families in rural locations own their land. Hence for self-construction financial model in rural locations, cost of land is not considered. Below are the financial model details.

**Table 4.16 Business models for self-construction in rural location for climate resilient low cost housing – New Construction**

| Income Range | NPR 200000 (USD 2000) and above | NPR 200000 (USD 2000) and above |
|---|---|---|
| Size of the house (sq.ft) | 800 | 800 |
| Construction cost (NPR /sq.ft) | 1000 | 1000 |
| Land cost | 0 | 0 |
| Cost of climate resilient features | 10% of construction cost | 10% of construction cost |
| Loan amount sanction | 60% of property value | 60% of property value |
| Non committed income | 10% of Annual income | 10% of Annual income |
| Interest Rate (Discounted rate for low cost climate resilient) | 10.5% | 10.5% |
| EMI | Repayment period - 120 months | Repayment period - 300 months |
| Monthly EMI paying capacity | 50% of monthly salary | 30% of monthly salary |

If the monthly EMI paying capacity is considered to be 30% of monthly salary, in that case, the EMI repayment period increases to 300 months as seen in Table 4.16.

### 4.5.4 Business models for retrofit to integrate climate resilient features in existing buildings

As the loan amounts are smaller in size, these models could be adopted by financial institutions as well as by the Micro-Financial institutions. Hence the interest rates considered are higher (current MFI rates).

| **Income Range** | **NPR 200000 (USD 2000) and above** |
|---|---|
| Cost of retrofit (NPR) | 100000 |
| Loan amount sanction | 60% of property value |
| Interest Rate (Discounted rate for low cost climate resilient) | 16% |
| EMI | Repayment period - 36 months |
| Monthly EMI paying capacity | 30% of monthly salary |

### 4.5.5 Business models for Energy efficiency products like Solar Water Heating System

As the loan amounts are smaller in size, these models could be adopted by financial institutions as well as by the Micro-Financial institutions. Hence the interest rates considered are higher (current MFI rates).

| **Income Range** | **NPR 200000 (USD 2000) and above** |
|---|---|
| Cost of retrofit (NPR) | 35000 |
| Loan amount sanction | 60% of property value |
| Interest Rate (Discounted rate for low cost climate resilient) | 16% |
| EMI | Repayment period - 36 months |
| Monthly EMI paying capacity | 30% of monthly salary |

With the above financial models in place, it is estimated that in the next 10 years 0.7 Million new low cost climate resilient homes will be required for the target segment (Annual income USD 2000 to 6000). For detail calculation, refer Annexure 7.

This would mean an investment of approximately 7.35 Billion USD in construction industry sector in the next 10 years. As 60% of property value is sanctioned by Financial Institutions, FIs would need to have funds equivalent to 4.4 Billion USD for sanctioning loans for low cost climate resilient homes. With the insurance regulation in place, this would translates to 0.7 Million households demanding for home insurance throughout Nepal.

The borrowers for home loans will benefit as the savings in comparison initial investment is in the range of 3.1-3.5 times higher, with Internal Rate of return more than 16%.

# 5 Short Term & Long Term Levers to Achieve Climate Resilient Low Cost Housing

**This section of the report suggests levers that will help remove existing barriers and will accelerate implementation of business models proposed in the earlier section.**

**Key Levers for implementation of Low Cost Climate Resilient Housing in Nepal are:**

1. *Policies for Banks to lend to low income segment for construction of low cost climate resilient homes.*
2. *Policies by Government to allocate land for low cost climate resilient housing.*
3. *Incorporation of climate resilient housing parameters in National Building Code. This should include alternate technologies to reduce the construction cost.*

## 5.1 Short Term Levers to achieve Low Cost Climate Resilient Homes

Short term levers identified below are those which are foremost important to implement climate resilient low cost housing in Nepal. These are defined as short term also, because it is assumed that implementing these will not take long time. These levers are majorly related to Government legislations.

1. *Government of Nepal should introduce new land acquisition policies especially in disaster prone areas to build low cost climate resilient housing.*

The Land Acquisition Act empowers the government to acquire private properties for public purpose. As per this act, public and private land can be acquired with the provision of cash compensation. A map of zones that are most vulnerable to impacts of climate change such as floods, landslides, GLOFs and earthquakes should be prepared and demarcated. Land acquisition for such areas can be facilitated through the Land acquisition act. Parcels of land for development of low cost climate resilient homes should be allotted by Government.

2. *Land pooling for Low Cost Climate Resilient Housing Projects in disaster prone areas*

The Government of Nepal should introduce land pooling under, Public Private Partnership (PPP) mode. The Town Development Committees/ municipalities should pool suitable land parcels and then invite developers to construct Low Cost Climate Resilient Homes. Land owners should be provided with homes who participated in land pooling; as well the developer should be able to earn profit by selling a few homes to local people, residing in disaster prone areas.

3. *Road network in Nepal for Developers to access rural locations*

Only 43% of Nepal population has access to all weather roads. To involve private sector in the development of climate resilient homes, it is a requisite that the rural locations vulnerable to climate disasters have road access.

*4. Extension of People Housing Program (JantaAwasYojana)*

The next phase of People Housing Program should aim at constructing climate resilient low cost housing for urban and rural poor. The existing program aims at building low cost modern homes with the target of building 3,90,000 homes within 10 years through public and private institutions. It is proposed that, under the same program, Government of Nepal should integrate climate resilience as a mandatory feature.

*5. Policies for Banks to facilitate construction of low cost climate resilient homes.*

- Nepal Rastra Bank should mandate certain fraction of commercial banks' lending portfolio for low cost climate resilient homes.
- Banks should construct branches in the remote rural locations, for easy accessibility for rural population of Nepal.
- Banks need to make the application process for home loan for low income segment much simpler and approachable.
- Banks should account non committed income of low income segment, while processing home loans.

Policies to motivate Banks to invest in low cost climate resilient housing sector could be:

For example:

- Investment incentives for Banks like tax holidays.
- Government to subsidize to commercial banks, which will get transferred to lowering interest rates for Low Cost Climate Resilient Home owners.

*6. Incorporation of climate resilient housing parameters in National Building Code*

The National Building code of Nepal has extensive provisions for design and construction of buildings to be resilient to earthquake, which is considered as a major disaster to which Nepal is prone.

Revisit of National Building Code is required, to incorporate design and construction technologies for climate resilient housing to also address vulnerabilities such as floods, landslides, GLOFs, Extreme cold and Heat stress, for new construction and design options for retrofit of old building stock.

*7. Capacity building/awareness programs/recovery guidelines/training*

Capacity building and awareness programs on climate risks and mitigation measures should be organised for relevant Government departments. It is important to build the technical capability of concerned government officials in order to develop their engagement in climate change vulnerable activities. NGOs should be involved and engaged for training programs for public sector to increase their awareness and also to benefit each other.

Awareness needs to be increased among the public on the climate incidents and the housing requirement through public media. Announcements by public authorities on the need of climate risk proof housing, shall mention the data on the damage occurred during the climate change events. As television is one of the primary public media,

government should increase awareness on the need of climate resistant housing using the same.

Recovery guidelines need to be formulated and customized recovery models need to be developed for different regions.

Government should engage NGOs for the development of skilled masons, construction manuals and conduct awareness programs for the major stakeholders. A trained and skilled workmanship is very much required for the longevity of housing structures.

## 5.2 Long term Levers

Long term levers identified below are those which are important, however, will take longer time for their implementation. Also, in terms of priority, these will be classified as secondary.

1. *Infrastructure Development Projects should integrate Climate resilience features*

The town development fund (TDF) should play a role in climate resilient infrastructure. TDF is partially funded by the Government of Nepal under the TDF act passed in the parliament. A set of guidelines and norms should be developed for enabling resilience strategies within infrastructure development projects. E.g Mitigation of GLOF risks is possible through installation of drainage channels, proper pumping systems, and implementing downstream flood control measures.

2. *Revised Master Plan with proper land use planning, to control land price.*

A master planning exercise with enforceable land use planning is one of the steps to facilitate planned urban growth and to control land prices.

- *Allocation of Land for Climate Resilient Low Cost Housing in the Master Plan*

Climate resilient houses also have to be well served by public utilities and well connected to education and employment opportunities. It is not enough to build climate resilient houses, but they also have to be well served by public utilities and well connected to education and employment opportunities. For rural households, water and climate proofing are top priorities: these can be jointly addressed by integrating systems like rainwater harvesting into the design of climate resilient houses.

3. *Tax exemption to be provided for developers building low cost climate resilient housing, for the borrowers to incentivize them to go for this type of housing and to contractors to motivate them to construct low cost climate resilient housing in areas vulnerable to climate change*

Direct incentives in the form of income tax exemptions, tax holidays are recommended for climate resilient home construction. Particularly in the rural belt, the tax incentives should be higher, to motivate the developers undertake resilient housing projects in remote areas.

The borrowers of housing loans should also be offered tax incentives in the form of exemption and/ deductions. Nepal doesn't have any such provision in its Tax Laws as of now. Indian Income Tax law is pro-housing in nature and may be a good reference

point. Section 10 (13A) and Section 24 of the Income Tax Act could be referred for the same.

4. *Pilot projects*

Government should demonstrate pilot projects to implement climate resilient housing projects at large scale. NGOs are keen in developing construction technologies suited to climate change prone areas. They are also looking for opportunities from the concerned government departments to demonstrate the prototypes and scale them using these technologies. This helps to promote their technologies and increase awareness at the community level. Government should involve NGOs as Technology partners in implementing low cost climate resilient homes in Nepal.

## 5.3 Additional Generic Guidelines

1. *The government should enforce Law that for all the high end housing projects, there should be a percentage of built up area for Low cost/affordable climate resilient housing.*

Development Authorities should call for the earmarking of at least 20-25% of developed land in all housing projects (both public and private agencies) for Low Income segment category.

2. *Single window system/faster approval of low cost climate resilient housing.*

Provisions should be made to provide permits to low cost climate resilient housing in a shorter frame of time. This will act as an incentive, especially for the developer community.

3. *Climate resilient housing should be added in the local government framework, which has a set of 149 indicators, by the Ministry of Federal Affairs & Local Development.*

The Ministry of Federal Affairs and Local Development, Nepal has come up with environment friendly local governance framework to make individuals and families responsible for environment. With a set of 149 indicators covering areas such as natural resources conservation and efficient use, urban greenery and beautification, waste management, disaster risk reduction, it shall be implemented through local bodies and citizen's forum. Resilience as an agenda could also be promoted through this framework.

4. *Housing finance awareness should be increased amongst the target income groups along with an attractive interest rate and tenure.*

There are two housing finance sources: commercial banks and MFIs. The commercial bank executives have a notion that the target income groups for this study may not be worth exploring since they might not be able to afford the schemes they have in vogue. However, business models worked out by TERI indicate that, if the rate of lending is marginally reduced, it shall enable inclusion of the target group of the study within the ambit of bank's financing norms and eligibility. If this is done, surely banks will have the benefit of expanding their portfolios considerably by including the lower income borrowers for housing. Besides lower interest rates, financing low cost climate resilient house for low income segment group would also be possible by extending the repayment period, as well as considering the non-committed income during the time of sanction of home loans.

On the other hand it is also important that the banks should simplify and promote housing finance products amongst the saving bank account holders and members of cooperative saving schemes.

### 5. Government involvement in insurance design and enforcement

Mandatory insurance for low cost climate resilient property against big natural disasters like earthquake and flood should be considered by the finance ministry as an attempt to prevent major economic damage from an unexpected event. The Government should design incentives or provide benefits to those insuring house or property. Premium paid by the dweller should be subsequently tax exempted, given that the local govt. body endorses it to be climate resilient.

### *6. Creation of data bank*

Transparency in sharing data on disasters and loss experiences is needed. Surveyors need to be trained and follow uniform guidelines for risk assessment and payment of compensations (loss estimate)). The insurance industry in Nepal urgently requires two institutions: first, a society of actuaries and second, facility for insurance surveyors. The actuaries would help fixation of premium based on regional data and local experiences (since, mostly it is being advised by experts from India and other Asian economies). In addition, the facility for surveyors and loss assessors would advise ways to enhance home security or safety to avoid a further loss incident, identify aspects of the claim which the home insurance policyholder may have overlooked, streamline practices followed for repair etc.

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# Annexure - 1: Household survey on low-cost climate-resilient housing in Nepal

**Introduction** (Interviewer may please explain the following to the respondent)

We are carrying out a study to understand the housing needs of people in Nepal. This survey will cover 500 families across 6 districts: Kathmandu, Banke, Dhankuta, Kaski, Rupandehi, and Sunsari.

We are not from a government agency, and this survey is not related to any government scheme or project. The outcome of the study shall be recommendations on building safer and resilient homes for Nepal. It may lead to financial products that may support construction of such homes.

You have been randomly selected to be part of this survey. We would like to ask you some questions about your family and your house. The information we collect from you will be kept strictly confidential. This information will not be used directly, but will be combined with data from other families.

This survey will take 45-60 minutes. We request your valuable time and cooperation.

**Interview information** (to be filled by the interviewer)

| | | |
|---|---|---|
| 101 | Name of interviewer | |

| | | | | |
|---|---|---|---|---|
| 102 | Date of interview (DD/MM/YY) | | | |

| | | |
|---|---|---|
| 103 | Interview number (to be numbered consecutively by each interviewer) | |

| | | |
|---|---|---|
| 104 | District | |
| 105 | Village / Town / City | |
| 106 | Area / Locality / Settlement | |

| | | | | |
|---|---|---|---|---|
| 107 | House location (tick one) | Rural | Peri-urban | Urban |

| | | | |
|---|---|---|---|
| 108 | Type of house (tick one) | 1. Multi-storied apartment | 2. Individual dwelling |

***Request to interviewer***: Please try to take a photo of the house from outside – and if possible, from inside. You may request the respondent for permission at the end of the interview.

**Family details**

| | | |
|---|---|---|
| 201 | What is your name? | |

| 202 | What is the ownership of your house? (Please tick one) | | |
|---|---|---|---|
| 1. Own house | | 3. Government-owned rented accommodation | 5. Rehabilitation / resettlement colony |
| 2. Own house in identified social housing pocket | | 4. Others' owned rented accommodation | 6. Squatter settlement / slum / illegal development |

| **How many** members are there in your household? (By household I mean all the people who usually live in this house and eat from the same kitchen as you do.) | | |
|---|---|---|
| 203 | Elderly men (60 years or more in age) | |
| 204 | Elderly women (60 years or more in age) | |
| 205 | Men (more than 16 years and less than 60 years) | |
| 206 | Women (more than 16 years and less than 60 years) | |
| 207 | Boys (15 years or less) | |
| 208 | Girls (15 years or less) | |
| 209 | Total (Interviewer to add up and confirm with the respondent) | |

| 210 | What is the highest educational qualification in your household? (Please tick one below) | | |
|---|---|---|---|
| Not literate | | SLC Pass | 5. Bachelor's pass |
| Under Class 10 | | Plus 2 Pass | 6. Master's pass |

**3. Housing history**

| 301 | Have you always lived in this house, or did you move here from somewhere else? (Tick one) | 1. Yes, always lived in this house | 2. No, moved here from somewhere else |
|---|---|---|---|

If respondent answered "1. Yes", then SKIP questions 302 and 303, and GO TO Section 4.

| 302 | Why did you leave your previous house and move here? (Please tick as many as applicable) | |
|---|---|---|
| 1. Economic reasons – for education or work | 4. Personal reasons – marriage, family, old age, etc. | 7. Climate reasons – due to natural disasters |
| 2. Financial reasons – because of cost of living or housing | 5. Security reasons – to move to a safer house or neighbourhood | 8. Other (please specify) |
| 3. Ownership reasons – to move to self-owned house | 6. Liveability reasons – to move to a bigger house or better neighbourhood | 9. Don't know |

If respondent answered "7. Climate reasons", then GO TO question 303, else GO TO Section 4.

| 303 | Because of which climate risks did you leave your previous house? (Please tick as many as applicable) | |
|---|---|---|
| 1. Extremely hot days | 5. Flash floods | 9. Earthquakes |
| 2. Extremely cold days | 6. Glacier lake outburst floods | 10. Drought / rainfall scarcity |
| 3. Heavy rainfall | 7. Landslides | 11. Other (please specify) |
| 4. Flooding | 8. Heavy snowfall | |

**4. Housing details**

We would now like to ask you some information about the size and structure of this house.

| **How many** rooms does your household occupy? | | Enter number |
|---|---|---|
| 401 | Bedroom | |
| 402 | Bathroom / Toilet | |
| 403 | Living / dining room | |
| 404 | Kitchen | |
| 405 | Business | |
| 406 | Mixed use / Other | |
| 407 | Total (Interviewer to add up) | |

| | | |
|---|---|---|
| 408 | What is the size of your house?<br>(Please specify the UNITS) | |

| 409 | What is the main construction material used in the foundation of your house? (Tick one) | | |
|---|---|---|---|
| 1. Stone foundation with cement mortar | | 4. Wooden Pillars | 9. Don't know |
| 2. Stone foundation with mud mortar | | 5. Reinforced Concrete Pillars | |
| 3. Brick foundation with cement mortar | | 8. Other _____ | |

| 410 | What is the main construction material used in the outer walls of your house? (Tick one) | |
|---|---|---|
| 1. Cement bonded bricks / stones | 4. Bamboo | 7. No outer walls |
| 2. Mud bonded bricks / stones | 5. Unbaked bricks | 8. Other_____ |
| 3. Wood | 6. Straw bale | 9. Don't know |

| 411 | What is the main material used in the partition walls of your house? (Tick one) | |
|---|---|---|
| 1. Same as outside walls | 3. Straw bale | 8. Other _____ |
| 2. Gypsum boards | 4. No partition walls | 9. Don't know |

| 412 | What is the main construction material used in the floor of your house? (Tick one) | |
|---|---|---|
| 1. Stone with cement below | 4. Cement floor finish | 8. Other _____ |
| 2. Stone with concrete slab below | 5. Wood | 9. Don't know |
| 3. Tiles on concrete slab | 6. Mud | |

| 413 | What is the main construction material used in the roof of your house? (Tick one) | |
|---|---|---|
| 1. Straw / thatch | 4. Galvanized iron | 7. Stone |
| 2. Earth / mud | 5. Concrete / cement | 8. Other _____ |
| 3. Wood / planks | 6. Tiles / slate | 9. Don't know |

| 414 | Does your house have insulation in the walls or roof? (Tick one) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|
| 415 | If Yes, what is the material? | | | Don't know |

| 416 | Does your house have a false ceiling? (Tick one)<br>(False ceiling is another temporary ceiling partition below the roof slab.) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|
| 417 | If Yes, what is the material? | | | Don't know |

| 418 | What type of windows do you have? (Please tick as many as applicable) | |
|---|---|---|
| 1. No windows / no covering | 3. Operable glass windows | 5. Windows with wire mesh |
| 2. Opening with shutters | 4. Operable glass windows with shutters | 6. Windows protected with *chajja* / shade |

| 419 | Which one of the following is your TOP priority in terms of a house to live in? (Tick one) | |
|---|---|---|
| 1. Electricity | 4. Disaster and climate proof | 7. Location |
| 2. Water | 5. Size | 8. Other (please specify) |
| 3. Thermal (temperature) comfort in winter / summer | 6. Security / safety | |

**5. Climate risks**

We would now like to ask you some questions about whether / climate risks.

| 501 | In which months is your house uncomfortable to live in? (Please tick as many as applicable) | | | |
|---|---|---|---|---|
| 1. Baishakh | 4. Shravan | 7. Kartik | 10. Magh | 13. None |
| 2. Jeshth | 5. Bhadau | 8. Mansir | 11. Falgun | |
| 3. Ashadh | 6. Asoj | 9. Poush | 12. Chaitra | |

| 502 | Since you have been living here, which of the following climate risks have you experienced? (Please tick as many as applicable) | |
|---|---|---|
| 1. Extremely hot days | 5. Flash floods | 9. Earthquakes |
| 2. Extremely cold days | 6. Glacier lake outburst floods | 10. Drought / rainfall scarcity |
| 3. Heavy rainfall | 7. Landslides | 11. None of these |
| 4. Flooding | 8. Heavy snowfall | |

If the respondent selected any option from 1-10, then GO TO question 503, else GO TO Section 6.

| 503 | Did this house get damaged as a result? (Tick one) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|

If respondent, answered "1.Yes", then GO TO question 504, else GO TO question 509.

| 504 | What was the extent of damage? (Tick one) | 1. Major | 2. Minor | 3. Don't know |
|---|---|---|---|---|

| 505 | Which part of the house needed the most repair / reconstruction? (Tick one) | | | | |
|---|---|---|---|---|---|
| 1. Roof | 2. Walls | 3. Floor | 4. Foundation | 5. Windows | 6. Don't know |

| 506 | How much did you spend annually on repairs and reconstruction ? (Tick one) | | | | |
|---|---|---|---|---|---|
| 1. Less than NPR 10,000 | 2. NPR 10,000-25,000 | 3. NPR 25,000-50,000 | 4. NPR 50,000-1,00,000 | 5. More than NPR 1,00,000 | Don't know |

| | | | | |
|---|---|---|---|---|
| 507 | How many times have you had to repair / reconstruct your house in the last 5 years? (Tick one) | 1. Once | 2. Many times | 3. Don't know |

| | | | | |
|---|---|---|---|---|
| 508 | How did you raise the funds for repair / reconstruction? (Please tick one) | 1. Through own savings | 2. Through loan | 3. Both |

| | | | | |
|---|---|---|---|---|
| 509 | Have you ever had to leave/abandon your house because of any climate risks? (Tick one) | 1. Yes, permanently | 2. Yes, temporarily | 3. No |

| | | | |
|---|---|---|---|
| 510 | Which of the following impacts do you frequently experience (i.e. every year or every alternate year)? (Please tick as many as applicable) | | |
| 1. Roof leakage | | 3. Water logging inside house | 5. Contamination of drinking water sources |
| 2. Wall seepage / mould | | 4. Clogging / backing up of toilets | 6. Stagnant water around house |
| | | | 7. None of these |

| | |
|---|---|
| 511 | To cope with the climate risks that you experience, what measures do you take/ have you taken in your house? |
| | |

| | |
|---|---|
| 512 | What are the additional changes you think are needed in your house to make it more comfortable and safe? |
| | |

**5A. For Home OWNERS only**

**(For home renters, SKIP to Section 5B.)**

| | |
|---|---|
| 513 | What prevents/constrains you from making these changes in your own house? (Please tick as many as applicable) |
| | 1. High cost – cannot afford |
| | 2. Technical issues |
| | 3. Lack of information |
| | 4. Lack of manpower |
| | 5. Lack of time |
| | 6. Lack of material |
| | 7. Old house – difficult to make changes |
| | 8. Not interested |
| | 9. Other (please specify) |

**GO TO Section 6.**

**5B. For Home RENTERS only**

| | | |
|---|---|---|
| 514 | What is your current monthly rent? | NPR |
| 515 | Do you get income tax deduction for rent paid? (Please tick one) | |
| 1. Yes | 3. Not applicable – do not pay income tax | 5. No answer / don't want to answer |
| 2. No | 4. Don't know | |

| | | |
|---|---|---|
| 516 | Would you like to move to a rented house with features that can withstand weather / climate risks? (Please tick one) | |
| 1. Yes | 2. Yes – if the rent is right | 3. Yes – if other factors are suitable |
| 4. No – cannot afford | 5. Do not have information | 6. Not interested |

If the respondent selected options 1-3, then GO TO Question 517, else GO TO Section 6.

| | | | | |
|---|---|---|---|---|
| 517 | How much more rent would you be willing to pay to live in a house that can withstand weather/climate risks? | NPR | 3. Don't know | 4. No answer / Don't want to answer |

**GO TO Section 6.**

**6. Access to utilities**

We would like to quickly ask you about your access to public utilities.

| 601 | What is the main source of your drinking water? (Please tick one) | |
|---|---|---|
| 1. Piped water supply in house premises | 3. Covered well | 5. Hand pump |
| 2. Piped water supply outside house / in neighbourhood | 4. Open well | 6. River / spring |

| 602 | What is the main method of garbage disposal for your house? (Please tick one) | |
|---|---|---|
| 1. Collected by garbage truck | 3. Open dumping | 5. Dumped and used for fertilizer / Composted |
| 2. Private community collector | 4. Burned / buried | 6. Other |

| 603 | What is the disposal system for liquid waste from your house? (Please tick one) | | |
|---|---|---|---|
| 1. Underground drains | 2. Open drains | 3. Soak pit | 4. None |

| 604 | What type of toilet does your household use? (Please tick one) | |
|---|---|---|
| 1. Household – Flush (connected to municipal sewer) | 3. Household – Non-flush | 5. No toilet |
| 2. Household – Flush (connected to septic tank) | 4. Communal latrine | |

| 605 | What is the main source of lighting for your house? (Please tick one) | |
|---|---|---|
| 1. Electricity | 3. Kerosene | 5. Other |
| 2. Solar | 4. Biogas | |

| 606 | Which fuel is used most often for space heating / cooling in your house? (Please tick one) | |
|---|---|---|
| 1. Firewood | 3. LPG | 5. Solar |
| 2. Other biomass | 4. Kerosene | 6. Electricity |

| How much do you usually spend on fuel / electricity per month? (Please tick one in each column.) | | |
|---|---|---|
| In NPR per month | 607. During summer months | 608. During winter months |
| 500 or less | | |
| 501-1000 | | |
| More than 1000 | | |
| Don't know | | |

| 609 | Which of the following does your household have? (Please tick as many as applicable) | | |
|---|---|---|---|
| 1. Cable TV | 4. Car | 7. Microwave oven | 10. Mobile phone |
| 2. Computer / Laptop | 5. Two-wheeler | 8. Air conditioner | 11. Electric room heater |
| 3. Refrigerator | 6. Washing machine | 9. Landline phone | 12. Water purifier |

If the respondent selected any option from 1-3, please GO TO Question 610, else SKIP to Section 7.

| 610 | How did you get the TV / computer / refrigerator? (Please tick one) | | |
|---|---|---|---|
| 1. On rent | 2. As gift | 3. Bought second hand | 4. Bought new |

If the respondent selected "4. Bought new", please GO TO Question 611, else SKIP to Section 7.

| 611 | If bought new, how was it financed? (Please tick one) | |
|---|---|---|
| 1. Through savings | 2. Through loan | 3. In instalments |

**7. Income, expenditure and savings**

We would like to ask you some general questions about your income and expenditure pattern. This information will be strictly confidential, and will only be used to relate to our other questions about housing needs.

| 701 | What are the main sources of income for your household? (Please tick as many as applicable) (You can read out the following options to the respondent.) |
|---|---|
| 1. Government employment | 5. Agriculture |
| 2. Private employment | 6. Rental income |
| 3. Self-owned business (Formal) | 7. Remittance from family member working abroad |
| 4. Self-owned business (Informal) | |

| 702 | What is the approximate annual income for your household? (Please tick one below)<br>(You can read out the following income ranges to the respondent.) | |
|---|---|---|
| 1. Less than NPR 200,000 | 3. NPR 400,000-600,000 | 5. Don't know |
| 2. NPR 200,000-400,000 | 4. More than NPR 600,000 | 6. No answer / don't want to answer |

| 703 | Is your monthly income regular/seasonal or a mix of the two through the year? (Please tick one below) | |
|---|---|---|
| Regular | | 3. Mix of Regular and Seasonal |
| Seasonal | | |

| | | | | | |
|---|---|---|---|---|---|
| 704 | What is the minimum expenditure of the household every month? | NPR | | 3. Don't know | 4. No answer / don't want to answer |
| 705 | What is the maximum monthly expenditure that you have encountered? | NPR | | 3. Don't know | 4. No answer / don't want to answer |
| 706 | Are there any major borrowing commitments or expenditure commitments that you have taken or are going to take in the future? | 1. Yes | 2. No | 3. Don't know | 4. No answer / don't want to answer |

| | | | | |
|---|---|---|---|---|
| 707 | If Yes, what is the total amount? | NPR | 3. Don't know | 4. No answer / don't want to answer |

| 708 | Approximately how much does your household usually manage to save each month? (Please tick one below) | |
|---|---|---|
| 1. Less than NPR 5,000 | 3. NPR 10,001-15,000 | 7. Don't know |
| 2. NPR 5,001-10,000 | 4. More than NPR 15,000 | 8. No answer / don't want to answer |

| 709 | Which savings instruments does your household currently use? (Please tick as many as applicable) | |
|---|---|---|
| 1. Savings bank account | 5. Provident fund | 9. Other (please specify) |
| 2. Fixed deposit | 6. Cooperative society scheme | 10. Don't know |
| 3. Mutual fund | 7. Informal rotating saving/credit scheme | 11. No answer / don't want to answer |
| 4. Life insurance policy | 8. Gold / land | |

If the respondent selected "1. Savings bank account", please SKIP TO Section 7A, else GO TO Question 710.

| 710 | Why have you not opened a savings bank account? (Please tick as many as applicable) | |
|---|---|---|
| 1. No bank nearby | 4. Complicated | 7. Do not need |
| 2. Not aware | 5. Do not trust | 8. Don't have money / savings |
| 3. Do not have required documents | 6. Inconvenient | 9. No answer / don't want to answer |

SKIP to Section 7B.

**7A. Banking – For BANK ACCOUNT HOLDERS ONLY**

**(For others, please SKIP to Section 7B.)**

| 711 | How often do you use your bank account? (Please tick one) | |
|---|---|---|
| 1. Once a week | 3. Few times a year | 5. Rarely / never |
| 2. Once a month | 4. Once a year | 6. No answer / don't want to answer |

| 712 | What are the problems that you face with your bank? (Please tick as many as applicable) | |
|---|---|---|
| 1. None | 3. Inconvenient | 5. Do not trust |
| 2. Too far | 4. Complicated procedures / documentation required | 6. Other (please specify) |

| 713 | Does your bank give loans? (Please tick one) | |
|---|---|---|
| 1. Yes | 2. No | 3. Don't know |

If respondent selected "1. Yes", then GO TO Question 714, else SKIP to Section 7B.

| 714 | Did you ever apply for a loan from the bank? (Please tick one) | |
|---|---|---|
| 1. Yes | 2. No | 3. No answer / Don't want to answer |

If the respondent selected "1. Yes", then GO TO Question 715, else SKIP to Question 718.

| 715 | What was the purpose of the loan? (Please tick as many as applicable) | | |
|---|---|---|---|
| 1. Marriage / Family | 3. House | 5. Business / Work | 7. Consumption needs |
| 2. Medical | 4. Education | 6. Agriculture | 8. Travel |

| 716 | Were you ever refused a loan by the bank? (Please tick one) | |
|---|---|---|
| 1. Yes | 2. No | 3. No answer / Don't want to answer |

If the respondent selected "1. Yes", then GO TO Question 717, else SKIP to Section 7B.

| 717 | Why were you refused the loan? (Please tick one) | |
|---|---|---|
| 1. Incorrect | 3. Lack of collateral | 5. Other (please specify) |

| | | | |
|---|---|---|---|
| documents | | | |
| 2. Lack of income proof | 4. Lack of funds with bank | 6. Don't know | 7. No answer / Don't want to answer |

SKIP to Section 7B.

| 718 | Why have you never applied for a loan? (Please tick as many as applicable) | |
|---|---|---|
| 1. No need | 4. Do not have income proof / documents | 7. Do not trust |
| 2. Do not have collateral | 5. Complicated procedures / do not know procedure | 8. Other (please specify) |
| 3. Not eligible | 6. Inconvenient | |

**7B. Insurance – For ALL**

| 719 | Have you taken any of the following insurance (other than house/property)? (Please tick as many as applicable) | | |
|---|---|---|---|
| 1. Life | 4. Motor (Car / Two-wheeler) | 7. Industrial / Commercial | 10. Theft |
| 2. Health | 5. Fire | 8. Travel | 11. None |
| 3. Accident | 6. Agriculture / Crop / Livestock | 9. Micro insurance | |

**8. Finance - For HOME OWNERS ONLY**

**(For home renters, please SKIP to Section 9.)**

| | | | |
|---|---|---|---|
| 801 | How many years old is your house? | | |
| 802 | What was the cost of purchasing / constructing this house? | NPR | Don't know |

| 803 | How did you arrange the funds? (Please tick as many as applicable) | | | |
|---|---|---|---|---|
| 1. Personal/ Family savings | 2. Government grant | 3. Loan from Bank | 4. Loan from MFI / Cooperative | 5. Debt / borrowing from family / friends |

If the respondent selected option 1, then SKIP Questions 804 and 805 and GO TO Question 806.

| | | | | |
|---|---|---|---|---|
| 804 | What is the monthly repayment? | NPR | 3. Don't know | 4. No answer / don't want to answer |
| 805 | Do you get income tax deduction for loan repayment? (Please tick one) | | | |
| 1. Yes | 3. Not applicable – do not repay loan | | 5. Don't know | |
| 2. No | 4. Not applicable – do not pay income tax | | 6. No answer / don't want to answer | |

| | | | |
|---|---|---|---|
| 806 | If you wanted to buy a house just like this today, how much would you have to pay – including the value of the plot? | NPR | 3. Don't know |
| 807 | If someone wanted to rent this house today, how much rent would they have to pay each month? | NPR | 3. Don't know |

| | | | | |
|---|---|---|---|---|
| 808 | Do you rent out part of this house? (Tick one) | 1. Yes | 2. No | 3. No answer / don't want to answer |
| 809 | If Yes, how much do you receive as rent per month? | NPR | | 3. No answer / don't want to answer |

| | | | |
|---|---|---|---|
| 810 | Have you heard of house insurance? (Tick one) | 1. Yes | 2. No |

If the respondent selected "1. Yes", then GO TO Question 811, else SKIP to Section 9.

| | | | | |
|---|---|---|---|---|
| 811 | Have you insured your house? (Tick one) | 1. Yes | 2. No | 3. Don't know |

If the respondent selected option "2. No", then GO TO Question 812, else SKIP TO Question 814.

| | |
|---|---|
| 812 | Why have you NOT insured your house? (Please tick as many as applicable) |
| | 1. No need because the risk is low |
| | 2. Too expensive / cannot afford |

| | |
|---|---|
| | 3. Insurance is unprofitable |
| | 4. Not eligible |
| | 5. Insurance procedures are too complex |
| | 6. Do not trust insurance companies |
| | 7. Lack of information |
| | 8. No need because of government compensation / relief |
| | 9. Other (please specify) |

| | | | | |
|---|---|---|---|---|
| 813 | Will you insure your home if climate risks increase e.g. if floods, landslides, heavy rain become more frequent? (Tick one) | 1. Yes | 2. No | 3. Don't know |

**SKIP to Section 9.**

| | |
|---|---|
| 814 | Why did you insure your house? (Please tick as many as applicable) |
| | 1. Because insurance is mandatory for housing loans |
| | 2. To save income tax |
| | 3. To be safe |
| | 4. Advice of others |
| | 5. Other (please specify) |

| | | | | |
|---|---|---|---|---|
| 815 | Did you ever file for compensation? (Tick one) | 1. Yes | 2. No | 3. Don't know |
| 816 | If Yes, did you get it? | 1. Yes | 2. No | 3. Don't know |

**9. Buying / building climate-resilient house**

| | | | | |
|---|---|---|---|---|
| 901 | Are you thinking of buying / building a house? (Tick one) | 1. Yes | 2. No | 3. No answer / don't want to answer |

If the respondent answered "1. Yes", then GO TO Question 902, else SKIP to Question 908.

| 902 | How are you planning to arrange the funds? (Tick one) | | | |
|---|---|---|---|---|
| 1. Own money | 2. Borrowing | 3. Equally both | 4. Mostly own money | 5. Mostly borrow |
| 6. Other sources (please specify) | | | | |

| 903 | Would you like to buy / build a house that can withstand weather / climate risks? (Tick one) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|

If the respondent selected option "1. Yes", then GO TO Question 904, else SKIP TO Question 908.

| 904 | Will you be willing to use new and alternate building materials (like steel structures, prefab panels) that can make your house stronger and better able to withstand climate risks? (Tick one) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|

If the respondent answered "1. Yes", then SKIP TO Question **906**, else GO TO Question 905.

| 905 | Why not? (Please tick as many as applicable.) | | |
|---|---|---|---|
| 1. Cost | 2. Aesthetics | 3. Safety | 4. Lack of information |

| 906 | Would you pay more for such a house that can withstand climate risks? (Tick one) | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|

If the respondent answers "1. Yes", then GO TO Question 907, else SKIP to Question 908.

| 907 | How much more would you be willing to pay (than for a normal house)? (Tick one) | |
|---|---|---|
| 1. NPR 10,000-50,000 | 3. NPR 1,00,001-1,50,000 | 5. Don't know |
| 2. NPR 50,001-1,00,000 | 4. More than NPR 1,50,000 | 6. No answer / don't want to answer |

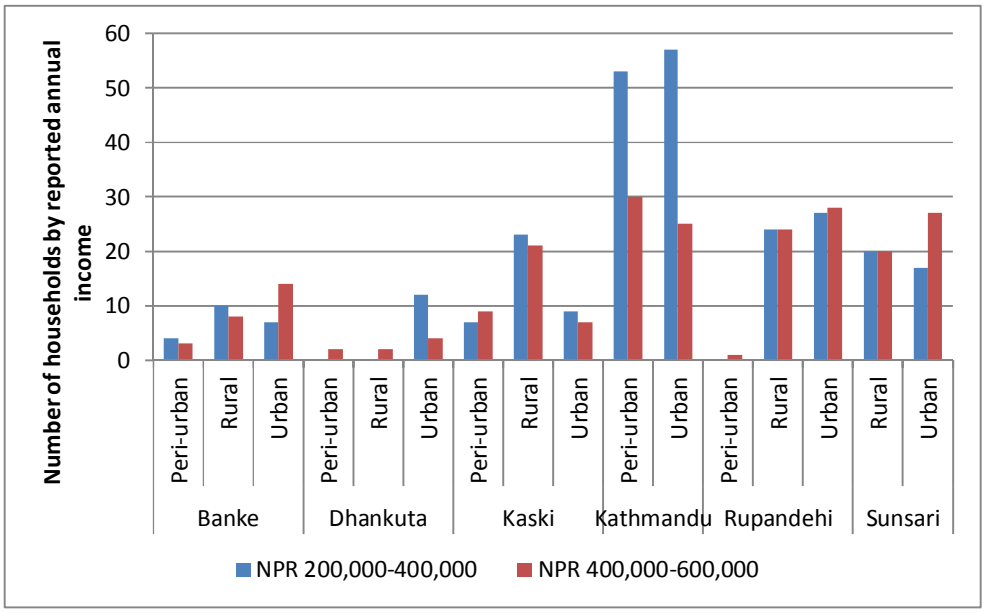
| 908 | What prevents/constrains you from buying / building such a house? (Please tick as many as applicable) |
|---|---|
| | *FINANCE-RELATED* |
| | 1. High cost – cannot afford |
| | 2. Prohibitively high interest rates |

| | |
|---|---|
| | 3. Lack of collateral / assets for housing loan |
| | 4. Lack of information about formal housing finance / housing loan from bank |
| | 5. Absence / unavailability of banks |
| | 6. Complex procedures / documentation for housing loan from bank |
| | *OTHER* |
| | 7. Lack of information about housing / design technologies |
| | 8. Lack of technical know-how for self-construction |
| | 9. Lack of skilled manpower |
| | 10. Non-availability of land |
| | 11. Lack of time |
| | 12. Lack of information about climate risks |
| | 13. Not interested |

**Thank you very much for your time and valuable inputs.**

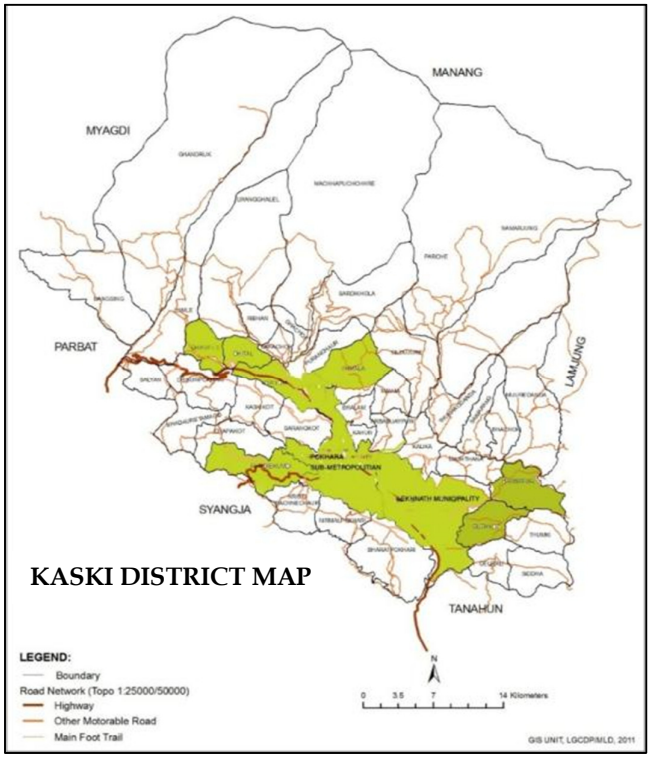
**Could we please take a photograph of your home? Thank you.**

# Annexure - 2: Distribution of survey sample by district, location, and income group




**Distribution of surveyed target segment households by annual income across survey locations.**

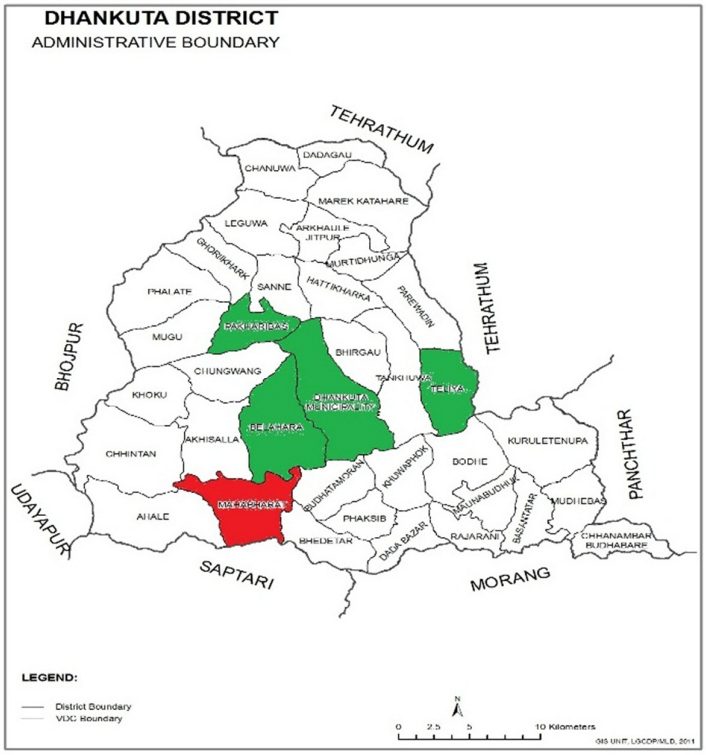
# Annexure - 3: Household survey locations and sample houses




**Areas in Kaski district where household survey was conducted**

Peri-urban house in Ban Pokhari, Lekhanath in Kaski district of household with annual income of NPR 4-6 lakh (USD 4000-6000)

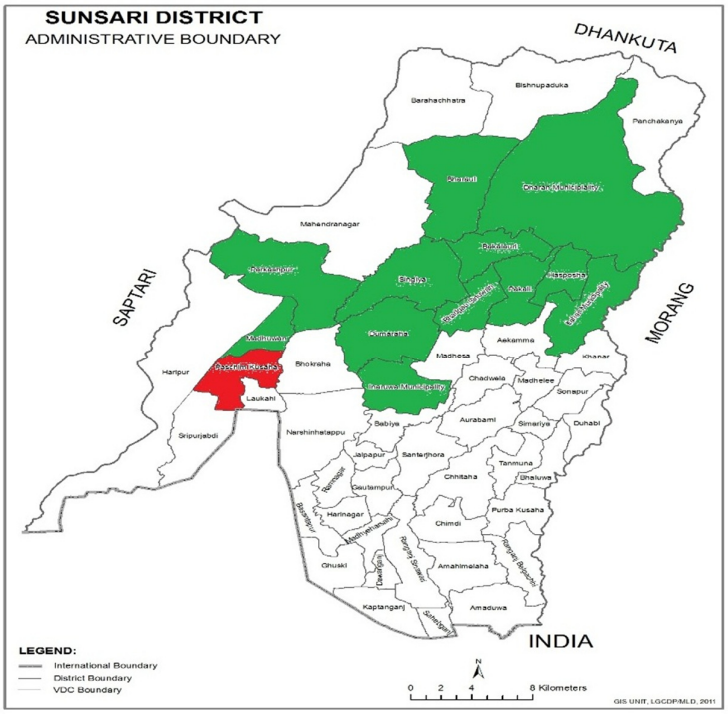
Rural house in Bhunpaire Lamachaur in Kaski District of household with annual income of NPR 2-4 lakh (USD 2000-4000)




Areas in Dhankuta district where household survey was conducted

Peri-urban house in Aadarsha Chowk, Parkibas, in Dhankuta district

Rural house in Guthitar, Belhara in Dhankuta district




**Areas in Sunsari District where household surveys were conducted**

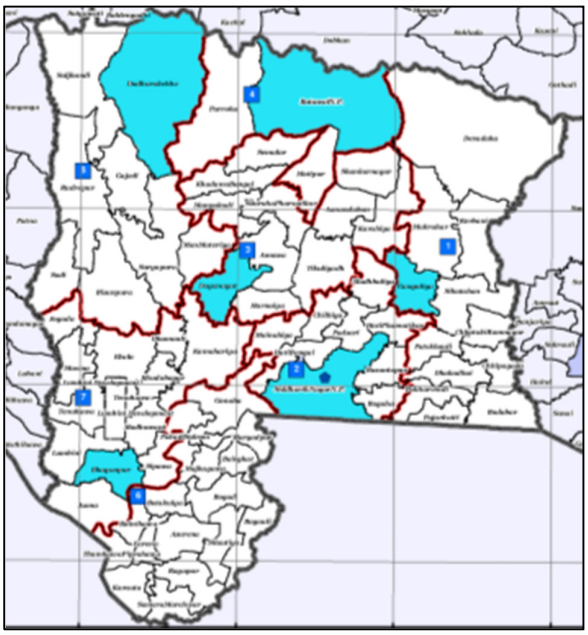
Urban House in Dharan in Sansari district, belonging to household with annual income of NPR 4-6 lakh (USD 4000-6000)

Urban House in Inaruwa in sansuri district, belonging to household with annual income of NPR 2-4 lakh (USD 2000-4000)


**Areas in Bank district where household surveys were conducted**

Peri Urban House in Kohalpur in Bank e district rented by household with annual income of NPR 2-4 lakhs (USD 2000-4000) of BhupiShashi

House in Banke District



Areas in Rupandehi district where household surveys were conducted

Rural house in Barkati, Durakshya in Rupandehi district belonging to household with annual income of NPR 2-4 lakhs (USD 2000-4000)

Rural house in Buddhanagar Durakhsya in Rupandehi district belonging to household with annual income of NPR 2-4 lakhs (USD 2000-4000)

Peri Urban house in Mulpani Kathmandu district owned by household with annual income NPR 4-6 lakhs (USD 4000-6000)

Apartment in Mulpani, Kathmandu district rented by household with annual income NPR 2-4 lakhs (USD 2000-4000)

# Annexure - 4: A summary of discussions with various stakeholder groups is outlined below:

## Government

*Organizations interviewed*

1 Ministry of Urban Development (MoUD)

2 Department of Urban Development and Building Construction (DUDBC)

3 Ministry of Federal Affairs and Local Development

4 Town Development Fund

Interview Dates: 17th -21st February, 2014

### Overview of the sector

The housing sector has predominantly remained as a neglected sector and a low priority sector in the country's national economic development plan. Housing is generally considered as a social service rather than a basic right for all. Allocation of government resources under different periodic plans since 1980 reveals that maximum allocation to housing is in range of 0.5% to 2.0% of total budget.

Review of existing policies and plans demonstrates that housing sector is never considered as an income generating sector in socio-economic context of Nepal. Mention of strategies such as 'Housing for All' in shelter policy does not translate into practice.

Nepal has been going through political instability for a long time. Formulation and implementation of policies in domain of housing has been limited. The problem of housing in Kathmandu valley is more imminent due to migration (for economic reasons). Ownership of land property is socially more desirable.

Over last few years, the urban sector has witnessed contribution of planned houses by the private sector, thus increasing the proportion of planned houses in Nepal. However, private sector intervention is limited to Kathmandu valley only. In other areas, houses are constructed by the house owner. The houses constructed by the private developers have to go through necessary legal approval process and compliance with building code is a mandatory requirement.

There are a lot of encroachments on unregistered and barren land and river bank, by migrants and landless population.

In general, the condition of rural housing is miserable. In the *Terai* and hilly/Himalayan region predominant material of construction is joint of stones and mud, wood, bamboo, for walls; hay and thatch, zinc sheets, concrete and tile for roof. Cemented walls are found in limited houses. Average area per housing units about is 500-540 sq.ft in land area of approximately 1500 sq. ft. Encroachment of barren and unregistered /uncultivated land by landless poor is also increasing.

The national shelter policy 1996 was developed to facilitate creation of new housing stock and repair/ maintenance of existing stock; to promote financial self-reliance in development

of housing; to introduce reforms in legal and institutional strengthening; to mobilise housing for economically weaken class and to minimize environmental impact of housing activities. This shelter policy of 1996 had some shortcomings which were addressed in the National Shelter policy of 2012.

Officials from Department of Urban Development and Building Construction (DUDBC), Town development fund (TDF) , Ministry of Urban Development (MoUD) and Ministry of Federal Affairs & Local Development were interviewed to get better understanding on government's vision towards catering to low cost housing in general and climate resilient housing in particular.

The DUDBC is the primary government agency that constructs government buildings, and is responsible for urban development projects (not covering educational and security buildings).DUDBC is responsible for urban infrastructure projects such as laying of sewage lines. Organizations such as ADB & IDA provide grants and loans for infrastructures projects in Nepal. DUDBC is also responsible for housing in Nepal. The National Shelter Policy 2012 is the overarching policy document that drives housing priorities in Nepal.

There are presently two government supported housing programs in Nepal one in rural and the other in urban area. The rural program namely People Housing Program (JantaAwasYojana) was initiated in 2009 to provide safe housing access to the poverty stricken and marginalized population. In 2009, provision was made to build low cost modern housing targeting 3000 households for marginalized castes such as Dom, Musahar, Dalit etc. equally distributed in Siraha, Saptari and Kapilvastu districts. DUDBC was responsible for implementing the programme. A lot of study and research preceded implementation. The initial budget for each house was NPR 100000 (USD 1000). A design competition was subsequently launched to evolve design and estimate for the housing programme. The design competition result suggested NPR 125000 (USD 1250) as cost of each house. Subsequent discussions happened after the competition. The initial specification for the housing was proposed to be upgraded to included brick as primary walling material. The revised cost of each house was NPR 150000 (USD 1500) for two room tenement plus attic, without toilet. The land had to be owned by the beneficiary household and there had to be a minimum of 10 dwellings /block of beneficiary household. IN 2010-11 additional marginalised categories were also included in the beneficiary list. The Govt assigned a total budget of NPR 10 crore (USD 1000000) @ NPR @ 150000 (USD 1500)/ house. **The National Shelter Policy that is underway aims at constructing 3,90,000 houses for poor and 16,10,000 houses for non-poor within 10 years through private and public institutions, as per the Ministry of Urban Development.**

In urban area such as in Kathmandu, government has introduced another housing scheme. There is a large segment of migrant and economically deprived population that comes to urban areas such as Kathmandu in search of job. Many of them settled in squatters along riverside. Govt tried resettlement scheme by registering these people and provisioning for resettlement in formal housing. With a low response to such a scheme, the Government subsequently assigned NPR 10 crores (USD 1000000) for constructing 233 apartments. However, policy for allotment of these houses is yet to be in place.

The town development fund (TDF) is potentially another organization that can have a role to play in climate resilient housing. TDF is partially funded by the Government of Nepal under

the TDF act passed in the parliament. Their key activities include facilitating & capacity building for infrastructure development projects (like drinking water and sanitation) for small towns in Nepal for which they receive funds from organisations like Asian Development Bank, World Bank and Department for International Development, United Kingdom. They support Municipalities, Water Users and Sanitation Committees of STWSSSP, Hospital and Health Centres through long term financing on social infrastructure and income generating Projects in the form of Loan, soft loan and grant within strict financial rule and regulations. Though housing is not currently included in its scope, it may be considered in future.

The Ministry of Federal Affairs and Local Development, Nepal has come up with environment friendly local governance framework to make individuals and families responsible for environment. With a set of 149 indicators covering areas such as natural resources conservation and efficient use, urban greenery and beautification, Waste management, Disaster risk reduction, it shall be implemented through local bodies and citizen's forum. Resilience as an agenda could also be promoted through this framework as well.

In general there is very less understanding and appreciation of climate change impacts in Nepal and climate resilient housing is completely an unknown subject. However, there is considerable attention given to earthquake as a disaster and Nepal follows a very stringent code in houses to make them earthquake resistant.

It can thus be summarised that:

1. There is minimal focus on provision of housing for poor at present but there is a vision to have an inclusive, environmentally sustainable and economically viable housing program in future.

5 Current housing programs are adhoc and have very less impact on the sector.

6 Climate resilient housing is an unknown subject and there is need to develop capacities among government and private stakeholders. Earthquake is the only disaster which the government is aware of.

7 Existing infrastructure funds can include provision for climate resilient housing.

8 Implementation of existing codes and standards is a challenge.

## Donor agencies

*Organizations interviewed:*

1. UNHABITAT
2. Red Cross

Interview Dates: 17th -20th February, 2014

Low-cost housing is of less priority despite the fact that houses need to be re-built after events such as floods and earthquakes. The organizations who are involved in providing/ supporting disaster relief programs are not able to build new and resilient houses for the entire affected population due to limited funds and also due to the fact that relief actions receive maximum fund allocation resulting in limited funds for recovery activities like housing.

Houses are built for only a few beneficiaries which are selected on the basis of predetermined criteria. The donor agencies do not fund activities of other organisations but they mobilize internal funds that are allocated within activities.

Nepal Red Cross Society was engaged in providing recovery support, through construction of low-cost houses, during the Koshi floods of 2008-09, landslides in 2011 and the earthquakes in recent years.

- Low-cost and locally available materials have been used in construction of the new houses.
- Adoption of technologies like building houses on raised platforms and using Corrugated Galvanized Iron sheets instead of thatched materials also led to climate resilience of the constructed house.

UN- Habitat is another organisation addressing urban climate change and promoting sustainable housing in cities of Nepal.

- It facilitates capacity building programs for green homes.
- It doesn't fund the housing programs directly, however supports these programs by facilitating SMEs, developers and develop their capacity for sustainable housing projects.

### Non -Governmental organisations (NGOs)

*Organizations interviewed:*

1. Habitat for Humanity – Nepal
2. Shelter and Local Technology Development (SLTD) centre
3. Lumanti Support Group for Shelter
4. Centre for Integrated Urban Development

Interview Dates: 17th -20th February, 2014

NGOs play a vital role in promoting and facilitating low cost housing in Nepal. They are currently involved in development of cost effective construction methods and making them available at a very affordable cost. They not only develop low cost alternative technologies but also enable people to build their houses themselves. They work with MFIs at rural areas to implement the housing projects in disaster prone areas.

Habitat for Humanity, a global organisation, operating from their regional centre in Kathmandu, Nepal has a target to facilitate the construction of 1 million low-cost houses by 2020 whereas the demand is 3 million.

In disaster prone areas:

- They provide emergency houses using locally available building materials and technologies.
- They use raised floor and light roofs which are suited for locations vulnerable to floods.
- They recommend retaining walls using locally available slates and stones in hilly areas where landslides are quite frequent.

Another organisation, Shelter and Low-cost Technology Development Centre has been developing precast building components like hollow blocks, by use of which, they could save at least 50% of the construction cost. Policies and help people for affordable housing at least in disaster prone areas.

Lumanti Support Group for Shelter works in facilitation and promotion of low-cost housing options primarily in urban areas. They have been building raised floor houses with lightweight roof in Sunsari which is vulnerable for floods. To make low cost housing possible, Lumanti approaches commercial banks and enters into contract guarantee for loans that are provided to low-income communities.

Centre for Integrated Urban Development (CIUD) is a Kathmandu based NGO who are majorly involved in providing basic infrastructure for urban poor. They work for communities partnering with other stakeholders including local and central governments. They have been working on projects related to water and sanitation, disaster management, information systems and transportation planning.

Summary of key observations and recommendations from various NGOs are as follows:

- High land cost is one of the key barriers and most of the low cost housing projects are low rise and require more ground coverage. Hence government should introduce land acquisition policies to acquire land at a fair price.
- Suitable financing options shall help the sector.
- It has been observed that there is a change in rainfall pattern due to unseasonal rains in Nepal. Water treatment projects become in-efficient due to urban flooding and improper drainage systems. Hence it is recommended to develop sustainable urban drainage systems as part of climate resilient programs.
- It was felt that the mind set of people needs to be changed towards acceptance of low-cost housing as the low cost doesn't mean a low quality construction.
- More awareness needs to be created for people in rural areas for accessing financing and new construction technologies. T
- Technical expertise needs to be improved in this area. There should be new forums to discuss activities in this area. Advocacy is important for effective implementation of existing and new policies.
- It is also equally necessary to form recovery guidelines and raise funds during the climate change events. New and comprehensive packages need to be developed based on the housing models suited for the respective region.

## Developers

*Organizations interviewed:*

1. Nepal Land and Housing Developers Association (NLHDA)
2. Society of Consulting Architectural and Engineering Firms (SCAEF)
3. Clean Developers Pvt. Ltd.
4. Aarati& Company

5. Civil Homes
6. The Comfort Housing

Interview Dates: 17th -20th February, 2014

The developer community has been active in Nepal only since last 10 years. The developers have been concentrating on the upper middle income group, as it is economically attractive. Also the major developers in Nepal are focusing their building activities in and around Kathmandu valley. They are not building housing projects in the areas where climate vulnerabilities are higher, as the infrastructure is very poor outside Kathmandu.

The developer community is aware that the upper middle income group housing market is already getting saturated, and they are aware that the market for middle income household is bigger.

**Reasons for not building affordable housing, given by developers are following:**

- High cost of land, as the land is acquired through direct acquisition. There is no Govt. land allotted for affordable housing in Nepal.
- High cost of capital, very high rate of interest for loans for housing projects.
- Developers need profit margins; due to above reasons affordable housing does not become economically attractive.
- Psychological reasons- new developers wish to first establish themselves with the upper income market, as it is then easier to enter the market for middle income and low income. Also, in Nepal, home buyers do not pay installations timely, therefore new developers wish to deal for the first few projects only with upper middle income group customers.

**Current costing and built up area provided by various developers:**

- Houses being sold to upper class are between NPR 2.5 Crore (USD 250000) to NPR 3 Crore (USD 300000).
- Middle income housing sold out at NPR 50- 60 Lakhs (USD 50000 – 60000).
- Low income housing sold between NPR15Lakhs(USD 15000) to NPR20 Lakhs (USD 20000) (The developers with whom interview was conducted, are not building these projects, however, they are aware that projects are being built for this cost)
- For Low income housing, the house size could be 300 sq.ft. (Segment with annual income NPR2,00,000 – NPR4,00,000) (USD2000 – USD 4000)
- For middle income segment, the house size could be 600-1000sq.ft.(Segment with annual income NPR4,00,000-NPR6,00,000)(USD2000 – USD 4000)
- Cost of construction for 300 sq.ft house less than NPR1000/sq.ft. (USD 10/sq.ft.)
- Cost of construction of 600-1000sq.ft house – NPR2500/sq.ft. (USD 25/sq.ft.)
- The developers commented that the Middle income housing for approximately 1000 sq.ft is possible for NPR 15,00,000 to NPR 30,00,000/.(USD 15000 to USD 30000)

## Financial Institutions

*Organizations interviewed:*

1. Nepal Investment Bank Ltd. (CB-A)
2. Nepal Housing and Merchant Finance Ltd. (DB-B)
3. Himalaya Bank Ltd.(CB-A)
4. Nepal Rashtra Bank (Nepal's Central Bank)
5. Bank of Kathmandu (CB-A)
6. Siddhartha Bank (CB-A)
7. Employees Provident Fund
8. Nirdhan Utthan Bank Ltd. (MFI)
9. Mahila Upakar Manch (MFI)
10. Forum for Rural Women Ardency Development – FORWARD (MFI)
11. Shreejana Development Centre Pokhra (MFI)
12. Solve Nepal (MFI)
13. Jana Utthan Community Bank (MFI).

CB- Commercial Bank

MFI- Microfinance Institution

Interview Dates: 17-20 February, 2014

The banking sector in Nepal is categorized under the following four heads .The banking and financial institutions are subject to the surveillance of the nation's central Bank- Nepal Rashtra Bank.

Categorization of Banks in Nepal

| Category | Nature | Chief Attributes | No. as on date |
|---|---|---|---|
| Class A | Commercial Banks | • Entitled to all banking activities<br>• Can mobilise deposits without limit | 30 |
| Class B | Development Banks | • Can mobilize deposits up to 20 times of core capital(Tier I)<br>• Not to participate in forex transactions. | 87 |
| Class C | Finance Companies | • Can mobilize deposits up to 15 times of Core Capital (Tier I);<br>• Not to participate in forex transactions | 58 |
| Class D | Micro Credit Development Banks | • Can't take deposits from public;<br>• Can take deposit from members only. | 35 |

There are two other categories of financial institutions namely, Savings and Credit Cooperatives and Non-government Organizations, licensed by NRB. However, these institutions are not relevant for our study and hence not covered. The big banks in Nepal are

in home loan business. The individual limit to loan is generally restricted to NPR. 1 crore (USD 100000).However, the average home loan size is found to be around NPR 50 Lakh (USD 50000). The loan period is generally for 15 years. Default rate is around 1%. The home loan portfolio on an average consists of 3-5% of their total loan portfolio.

**NIB (Nepal Investment Bank),** Basel II compliant, provides finance for housing sector. Loans are granted for readymade homes/apartments/bungalows, construction of homes and also for renovating or extension of buildings.

The borrower should be a Nepali citizen with minimum age criteria of 18 and should be able to repay the last EMI before attaining 60. One of the conditions for sanction of loan is motorable road by the side of the site. Loan is generally approved upto 60% of property value or NPR 1 Crore (USD 100000), whichever is lower. The bank has empaneled valuators to evaluate the property value. Loan repayment period is maximum 15 years, interest rate charged is 10-12%, and processing fee by the bank is 1% flat on loan amount.

Housing finance default rate is around 2%, prepayment penalty is 2%, unscheduled payment charge is 1% on the amount to be paid. The bank usually approves loan within 7 working days, provided all checks and verifications are fine.

Currently housing loan constitutes 3.8% of the loan portfolio of the bank. The bank is keen on low cost climate resilient housing finance business, provided it is financially attractive.

**Himalayan Bank (HB**), Basel II compliant, provides finance for housing sector. Loans are granted under three schemes: Purchase (HLP), Construction (HLC), Extension (HLE).

The borrower must be 25 years and above, the age of the borrower and the tenure of loan period collectively should not exceed sixty five years. The applicant should have a regular source of income and minimum three years of work experience. Another condition for sanction of loan is motorable road by the side of the site and should fall within the Bank's criteria for collateral mortgage. Loan is generally approved upto 80% of property value or NPR 1 Crore (USD 100000), whichever is lower. The bank has empaneled valuators to evaluate the property value. Loan repayment period is maximum 15 years, interest rates vary depending upon the tenure. Upto 10 years @9-10.5%, above 10 years @9.5-11% , for fixed rate @ 8.25%, and processing fee by the bank is 1% flat on loan amount.

Housing finance default rate is around 2%, prepayment penalty is 1-2%, 3 defaults would transfer the loan to NPA account.

Currently the bank does not have a specific plan for deprived sector, however, if support from Government and Nepal Rashtra Bank is extended they would include low cost climate resilient housing loans in their portfolio. They also informed that bank will be keen if it will be financially attractive.

**Bank of Kathmandu (BoK),** similar to Himalayan Bank, differences are in the interest on loan at floating rate of 13-14% p.a. Home loan portfolio of the Bank is NPR1.5Billion (USD 150000) Rate of default in housing loan is 1%, Total NPA of the Bank is 1.3% of the portfolio. Similar to the above banks, BoK, expressed interest in financing low cost climate resilient homes, provided projects are attractive and support from Government and Nepal Rashtra Bank is provided.

**Sidhartha Bank (SB),** Loan is generally approved upto 60% of land and value or NPR 60 Lakhs (USD 6000), whichever is lower. Loans are granted for purchase of land, building of residential/commercial buildings, for renovation, to pay off personal debts incurred while acquiring land or constructing, purchase of readymade apartments.

The borrower must be a Nepali adult citizen. Another condition for sanction of loan is motorable road by the side of the site and should fall within the Bank's criteria for collateral mortgage. The bank has empaneled valuators to evaluate the property value. Loan repayment period is maximum 20 years, though the preferred tenure is 15 years. Interest on loan at floating rate is 12-13%p.a. Processing fee for the bank is 1% of the loan amount.

Rate of default in housing loan is 1%, 3 defaults would transfer the loan to NPA account. The bank confirmed that financing low cost climate resilient homes is possible, provided projects are attractive and support from Government and Nepal Rashtra Bank is available.

The Bank informed that currently also they have specific activities under low income financing, they have their own Micro Finance wing, named Mero Micro Finance, through which it channelizes its deprived sector loan fund, which is 4.5% of the loan portfolio. The Bank is also having CSR activities, under which it is working with UNDP and Government of Nepal to increase the level of banking habit amongst Nepalese women.

**Nepal Housing and Merchant Finance Ltd. (NHMFL),** is not a commercial bank, as per the NRS classifications, it is a Banking company belonging to B category. The company provides finance for housing sector. In February, 2014 when the interview was carried out, the outstanding home loans were worth NPR 1.3 billion (USD 13000000). The company provided loans to Nepali citizens only. Loans are sanctioned up to 70% of the property value, which is ascertained by registered valuators.

Loan repayment period is maximum 15 years. Rate of interest is 16-17%p.a. The company's default experience has been stated to negligible. Income, expenditure, family size etc. are considered while sanctioning a loan. Capital adequacy maintained is 11%.

The company has estimated that NPR 10-15 Lakh (USD 10000 – 15000) is required to construct a low cost disaster proof house, and they also suggested that the people of Nepal prefer individual homes over community apartment.

**NIC Asia Bank Ltd.**, Basel II compliant, provides finance for housing sector. 4.5% of lending goes to the deprived sector. Loans are granted for plot purchase, purchase of apartment, renovation, construction and also equity finance against property.

Home loan size is NPR500,000 (USD5000) to 10 Million NPR (USD 100000), lending is sanctioned to households with annual income above NPR6,00,000 (USD 6000). Another condition for sanction of loan is motorable road by the side of the site. Loan is generally approved upto 66% of collateral value. Loan repayment period is maximum 15 years, floating interest rate for home loan is 11% p.a, and fixed rate is 9.99% p.a.

Housing finance default rate is around 1-2%. EMI instalment not to increase above 50% of monthly salary.

Currently the bank does not lend money to below NPR 600000 (USD 6000) income segment, however, if support from Government is extended they would include low cost climate resilient housing loans in their portfolio.

Summary of home loan portfolio of various banks is given below.

| Banks | Home loan sanction amount | Loan repayment | Interest rate on home loan | Processing fee | EMI/ month | Deprived sector portfolio | Are you keen to participate in Low Cost Climate Resilient Housing Finance? |
|---|---|---|---|---|---|---|---|
| NIB | 66% of collateral value | 15 years | 10-12% p.a. | 1% | Max. 50% of monthly salary | 4.5% of loan portfolio | Yes |
| HB | 80% of property value | 15 years | Upto 10 yrs. : 9 – 10.5%, Above 10 yrs. : 9.5 – 11%, Fixed Rate : 8.25% p.a. | 1% | - | - | Yes |
| BoK | 80% of property value | 15 years | Floating rate is 13 – 14% | 1% | - | - | Yes |
| SB | 60% of collateral value or upto max. NPR 60 Lakh (USD 60000) | 20 years | Floating rate 12-13% | 1% | - | 4.5% of loan portfolio | Yes |
| NHMEL | 70% of property value | 15 years | 16-17% p.a. | - | - | - | Yes |
| NIC Asia | 66% of collateral value | 15 years | Floating rate : 9.99% | - | Max. 50% of monthly salary | 4.5% of loan portfolio | Yes |

**Employees Provident Fund (EPF)**: Employees Provident Fund (EPF) manages Provident Fund (PF) for government, public and private sector employees in Nepal, on behalf of the Government. Besides managing PF of contributors, they also provide the social security benefits like Accident Indemnity, Funeral Grant, Employees Welfare Scheme (Insurance) and participation in profit.

Housing is one of the most prioritized and secured sectors of investment to EPF. The EPF Act allows mobilizing of EPF funds in housing either undertaking housing projects independently or jointly with other institutions; or establishing or operating company for the operation of housing projects.

Members with annual income of 2 to 6 Lakhs (USD 2000 – 6000) are the target income group for EPF for implementing these projects. EPF initiated the low cost housing scheme for its

members by constructing 112 core houses in 1.5 hector of land in Pokhara out of which 109 house were sold to its members on instalment (EMI) basis. The cost of the house varied between 3 to 5 lakhs (USD 3000 – 5000)with 850sft of plinth area.

Currently, EPF is in the process of implementing a housing project where in 1100 residential houses outside the ring road of Kathmandu Valley and 500 in other districts will be constructed. The project is focused towards the lower and middle level income group of its members. After the completion of the project, the constructed house will be distributed to its members on a soft loan. They have not considered any climate resilient features in this program. In the context of climate change, although they don't insure their housing projects, they insist the contractor for certain liable period.

## Insurance companies

*Organizations interviewed:*

1. Everest Insurance Company Limited
2. Himalayan general Insurance Company Ltd.
3. Sagarmatha Insurance Company Ltd.
4. Shikhar Insurance Company Ltd.
5. NLG Insurance Company Ltd.
6. BimaSamiti – Insurance Board

As already highlighted in the review of literature, the insurance industry in Nepal is underdeveloped. Although, there are large number of participants in the industry (almost every major business house or a commercial bank has independent insurance operation), the stakeholders are concerned about the slow pace of growth and lack of policy initiatives. The BimaSamiti is supposed to play a crucial role in terms of development of the sector but the Institution seems to be lacking statutory rules (or *de jure* guidelines) and *de facto* operating as a stand-alone body. Given the proximity of the insurance companies to other financial institutions (both banking and non-banking activities), they seem to be interested in innovating and supplying new risk products in the market. However, they are hesitant because of the lack of awareness of the insured or the population outside the insurance umbrella, non-existent guidelines in pricing, data limitation and information asymmetry, among other things. Statistics of the industry would reveal their financial strengths and weaknesses. Although the assumption is that the market is highly competitive; it may be an oligopoly, few competitors aware/sharing business strategies. The insurance industry in Nepal needs to adapt to international practices. Absence of an actuarial society (for training and development), surveyor institutes, insurance councils/committees, grievance redresses mechanism, separate risk-specific insurance pools, data management and sharing, etc. would prohibit innovation. Information technology is being used by some of the insurance companies and this may create further insurance demand since most part of Nepal are underserved due to impossible geographical terrain.

Some of the important issues that emerged during the discussion are as under:

- Whether it is the largest insurance company or the smallest one in terms of market share, the premium rates are at a low level to sustain in a risky business.

- Property insurance is a mandatory requirement for those seeking house building loans from financial institutions, categorised into four different types by Nepal Rastra Bank. The premium paid by individuals is only for the loan amount of such borrowings from financial institutions and there is no provision for insuring the value of the building. Few insurance companies also extend insurance services (both life and property and liability insurance) through micro-finance institutions and under micro insurance. Public establishments (like hospitals, etc.) have special preferences for insurance as per a Circular from the BimaSamiti.
- In the absence of proper regulation (solvency, investments, priority areas, etc.) and guidelines (stipulation on claims ratio, retention ratio, etc.), monitoring is a big problem. There is no special legislation in the field of insurance or it may be the case that awareness is limited.
- Reinsurance is mostly provided by foreign reinsurers through brokers who are operational in the country. Following incidence of major disasters and high claims ratio in certain line of business (especially motor vehicle insurance), the global reinsurers are hesitant to provide insurance for products addressing perils related to climate change. The cost of operation in such a case increases as well as the basis risk in the overall business portfolio.
- Insurance business in Nepal is eyed as a profitable business and companies avoid offering insurance products in lines of business where claims have been historically higher. The demand for insurance products in general and "insurance for house (or property)" in particular is very low. Majority of the business in the line is centered in Kathmandu valley.
- The branch penetration of insurance companies is very poor but it was noted that all insurance companies interviewed have either a branch office or a representative office in the selected areas where our household survey is on-going (Kaski, Rupandehi, Kathmandu, Sunsari, Dhankuta and Banke).
- The insurance companies are not interested in providing insurance services to low-income households. However, if there is an opportunity to insure a "group" of households, certified by an agency stating the robustness of the infrastructure (and building materials, in case to be repaired/retrofitted due to partial damages), probability of providing insurance is higher. Such package insurance products would be heavily dependent on the information regarding the number of members in such a groups, size of household, range of the value of the house (of under finance for a certain period of years), location (terrain characteristics), etc.
- Government initiative in construction would motivate insurance industry to venture into innovating insurance for the low cost climate resilient housing. Role of local bodies (including Municipality) will further influence growth. The insurance companies prefer either a subsidy scheme (sharing premium for such products) or a compensation scheme (those with such insurance policies pay less taxes) to promote such products.
- Nepal has a defined "Terrorism Pool" (created keeping in view the insurgency and period of political unrest). Taking into account the climate change predictions and the fact that Nepal is highly earthquake prone, there is an urgent need for developing

a catastrophic insurance pool. Lessons in this direction can be directly learned from Japan and Turkey, who have earthquake insurance in place. Some insurance companies feel that selling insurance under this head may fuel demand than loosely defining an insurance product for "climate resilient low cost housing".

- It is important to involve academic and research institutions for conducting research and collection of data on catastrophic events. Although there are records kept by few official departments on figures related to number of victims, life and livestock mortality, losses due to disasters, etc. but there are no figures regarding "insured losses" or on losses which could have been potentially insured. One of the Institutes working on earthquake disaster risk management, National Society for Earthquake Technology (http://www.nset.org.np/) was mentioned in this context.

The stakeholders pointed out several barriers towards implementation of a program around climate resilient housing; the barriers have been classified under broad sections namely:

- Policies and programs
- Implementation (governing codes/standards and regulations)
- Institutional capacity
- Demand and supply
- Financing /Incentives
- Technology

# Annexure – 5: Thermal comfort analysis for household in Nepal

## Thermal Comfort Standard as per National Building Code of India 2005

Desirable wind speeds for thermal comfort conditions

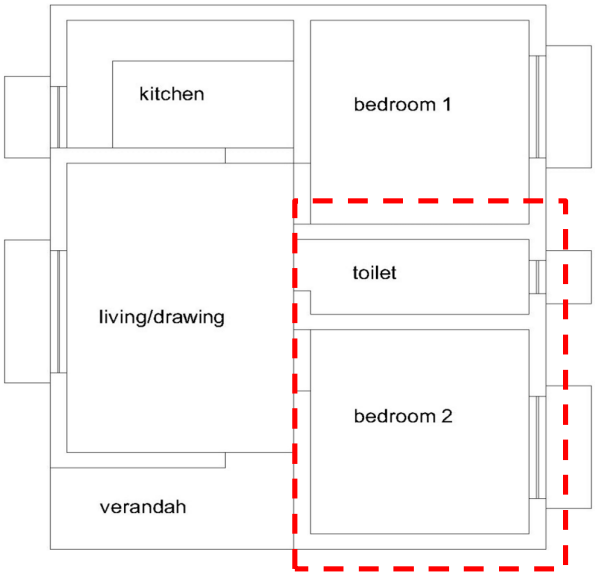
| Dry bulb temperature (deg C) | Relative humidity (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 28 | * | * | * | * | * | * | * |
| 29 | * | * | * | * | * | 0.06 | 0.19 |
| 30 | * | * | * | 0.06 | 0.24 | 0.53 | 0.85 |
| 31 | * | 0.06 | 0.24 | 0.53 | 1.04 | 1.47 | 2.10 |
| 32 | 0.20 | 0.46 | 0.94 | 1.59 | 2.26 | 3.04 | ** |
| 33 | 0.77 | 1.36 | 2.12 | 3.00 | ** | ** | ** |
| 34 | 1.85 | 2.72 | ** | ** | ** | ** | ** |
| 35 | 3.20 | ** | ** | ** | ** | ** | ** |

* none ** higher than those acceptable in practice

For winter season, temperatures below 15degC are considered as uncomfortable.

## Thermal simulation:

A typical residential design with 550 sq.ft of built up area was considered for thermal comfort evaluation in Kathmandu City. Bedroom 2, which is located in the SW corner, was chosen for thermal comfort analysis.




Model for energy simulation

Following design input data was considered for simulation using Trnsys engine

Design input data: Base case

| Sl.no | Parameter | details |
|---|---|---|
| 1 | Space area | 96.25 Sq.ft |
| 2 | height | 10 ft. |
| 3 | Window to wall ratio | 13.2 % |
| 4 | Wall specification | 230mm brick wall, U value 2.019 W/m$^2$K |
| 5 | Roof Specification | 150mm RCC slab, U value 3.066 W/m$^2$K |
| 6 | Window specification | Single glaze unit with U value - 5.6 W/m$^2$K |
| 7 | Window shade | 0.54 shade factor |
| 8 | Ventilation rate | 3 ach (air changes per hour) |
| 9 | Weather data | Kathmandu |
| 10 | Peak summer day | 21$^{st}$ June |
| 11 | Peak winter day | 12$^{th}$ Jan |
| 12 | Schedule of operation | 24Hours |
| 13 | Occupancy | 5 persons |

With the above mentioned input data, simulation was carried out in the bedroom 2 of the residence. Similarly, several parametric simulations were carried out using various strategies to reduce discomfort in summer and winter months. The zone dry bulb temperature and relative humidity was extracted from simulations for each strategy and compared with the base case scenario. After the comparison across various strategies, following envelope specification with ventilation strategies were concluded:

Recommended Envelope:

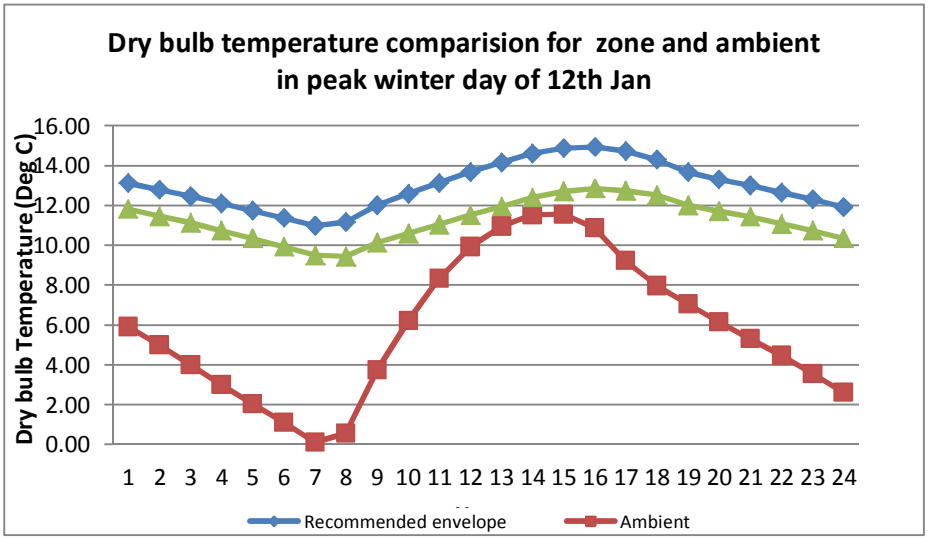
| Roof | Flat RCC roof | Thickness (mm) | |
|---|---|---|---|
| Layers | Plaster | 6 | 3.066 W/m$^2$K |
| | RCC | 150 | |
| | Mortar | 20 | |
| | tile | 20 | |
| External Wall | | | |
| Layers | Plaster | 12 | 2.018W/m$^2$K |
| | CSEB (Cement Stabilized Earth Block) | 230 | |
| | plaster | 18 | |
| window | 43% WWR on south side (More glazing on South facade) | | |
| Ventilation | 3 ach | Summer | |
| | 0.8 ach | winter | |

The discomfort hours for the recommended envelope were compared with the base case envelope:

Discomfort hours for the recommended envelope compared with the base case envelope

| Simulation Case | Discomfort hours in Summer | Discomfort hours in winter | Reduction in discomfort hours | |
|---|---|---|---|---|
| | | | summer | winter |
| Base case Envelope | 15 | 1517 | 0 | 0 |
| Recommended Envelope | 15 | 953 | 0 | 564 |

Following graphs depicts the change in temperature profile for recommended envelope with respect to the ambient temperature and base case envelope




Dry bulb temperature comparison for zone and ambient in peak winter day of 12th Jan

## Conclusions

Solar passive building technologies that are affordable and climate resilient should be an integral part of homes in rural as well as urban locations. It is observed that during peak winter months by use of thermal mass through stabilized soil blocks or insulated block masonry in urban areas through affordable cement blocks increase in the internal air temperature in peak winter months is observed by 10-12 deg when outside is measured at 0deg C or lower. This will have benefits in terms of lower energy bills in urban locations and better indoor environment in rural areas as habitats will not burn wood to keep the home warm.

# Annexure - 6: Climate resilient low cost housing design guidelines

## Background

By global standards, Nepal is ranked 23rd in the world in terms of natural hazards. A UN report shows that out of 75 districts in the country, 49 districts are prone to floods and or landslides. (Source: GRIP). The construction practices used in Nepal especially in rural areas are local; these conventional practices are not able to provide resilience to households in case of disasters. Thus there is a need to understand alternate technologies which will use local building materials but at the same time provide resilience to climate change disasters that Nepal is vulnerable. Following section highlights these technologies.

From the Household survey, it is also understood that people are not comfortable inside their house. People have changed homes due to climate risks that they experience, the most common have been: heavy rainfall, floods, landslides, earthquake, extremely cold winters and in the Terai region extremely hot summers. Due to these climate vulnerabilities, people frequently experience-roof leakage, wall seepage, water logging inside the house, clogging and stagnant water around the house.

This section of the report provides guidelines for construction of climate resilient low cost housing. Specific design guidelines are given for vulnerabilities like floods, landslides, heat stress and very cold regions. Guidelines for earthquake resistant structures are not a part of this report. Guidelines for earthquake resistant structures should be referred in National Building Code of Nepal.

## Generic Guidelines for Construction of climate resilient low cost housing

### *Foundation*

#### Shallow foundation with RCC pad

R.C.C pad foundation helps to check the unequal settlement and distribute the load of the building uniformly in the foundation soil.

Buildings should not be built on land steeper than 20deg. Stepped strip footing should be made for foundations on sloping land. The minimum depth of foundation from finished ground level should not be more than 750mm.

Foundation design should be as per the Nepal National Building Code

### *Wall construction*

#### Stabilized soil blocks

Mud is the oldest and cheapest building material available in Nepal. It is also an energy efficient material as it provides better sound and heat insulating properties, thus providing comfortable conditions inside for both cold climate districts and hot climate districts.

Stabilized soil blocks are stronger and function better in many ways. The stabilizer could be lime, cement, and bitumen. Cement as a stabilizer for example is good to get better strength and durability.

### Hollow Cement Block

These are pre cast cement concrete blocks with holes/cavities. These blocks are more energy efficient due to reduction in material used. The cavity acts as an insulating property which is advantageous in Nepal for both Mountain regions as well as Terairegions. The handling of hollow blocks is easier due to its light weight. Hollow cement blocks are cheaper than stone masonry blocks.

### Strengthening masonry walls

Bamboo is a common local material used for walls and roof in Nepal. Bamboo however, can be damaged by insects and hence usually its life is only for 5 – 10 years. SLTD Centre has developed methods for strengthening construction using Bamboo where the life of bamboo can be more than 25 years. They chemically treat the bamboo and placement of members is done in such a manner that bamboo is not in contact with soil and moisture and hence the durability is increased.

## *Roof/floor slab construction*

### Partial Pre-Cast R.C.C works

This construction comprises of composite system, where both pre cast units as well as cast in situ concrete is used. Bottom half of the structural member is precast and top half is laid with cast in situ concrete. The zone which lies in between these two layers will have no stress to face and can be hollow or some cheap material like bricks or stabilized soil blocks could be filled in. The system is cheaper in comparison to cast in situ concrete slabs. Also, provides good insulation against heat and cold.

### Bamboo reinforced soil roof, coated with stabilised soil

Bamboo reinforced soil roof is another simple and cost effective technique which can be executed by the villagers by themselves. Construction of this roof consists a bamboo rafter rested on the building wall which is covered with a polythene sheet and a bamboo mat. Mud mixed with cow dung and fibre of empty polythene cement bag is covered on this bamboo which then dried and plastered with cement stabilised soil slurry. The bamboo used in this kind of roof shall be seasoned either using smoke method or chemical method. This roof has a good insulation property for extreme weather and noise. It is done using local materials and also environmental friendly. (Fig 4.1)

Installation of bamboo reinforced soil roof.
(Source: Bhubaneshwar Lal Shrestha)

## *Door and Window Materials*

### Opening size

Large openings for doors and windows should be avoided as the lintel, chajja, frame, shutters,

glass, painting, polishing make them costly. Ferro cement lintels along with chajja is economical than RCC lintel.

(Source: Guidance for House Builders, Building Materials & Technology Promotion Council, Govt. of India)

### Masonry projection frame for doors and windows

As per the literature review carried out, the most economical technique of providing frame for doors and windows is through masonry projections, plastered in the shape of frame. Pre cast cement concrete bricks with hinges is required for this purpose. During masonry construction, projection is made all round the opening, which is plastered in the shape of frame, pre-cast concrete bricks are placed where hinges are required and conventional shutter is fixed.

This method of providing frames is environmentally friendly, protects forest resources and is very economical.

### Ferro-cement Doors and windows

An economical alternative for door shutters in place of wood is ferro-cement shutter. Bhubaneswar Lal Shrestha from SLTD Centre has worked on these and calculations show that these doors are 1/6$^{th}$ cost of wooden shutters. Ferro-cement shutters do not need frame.

### Particle Board Shutters

Particle board shutters are also an economic alternative to wood shutters.

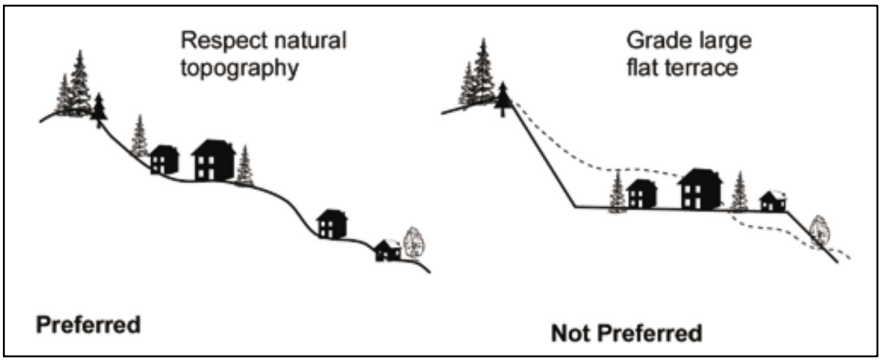
## Design guidelines for districts vulnerable to floods

Rising temperatures, melting down of snow, increase in precipitation cause floods. Impervious surfaces around developments further enhance the risk by preventing rainwater from percolating into the ground. Areas where drainage capacity cannot cope with heavy precipitation will be at high risks.

While developing housing in districts that are vulnerable to floods, following guidelines should be followed:

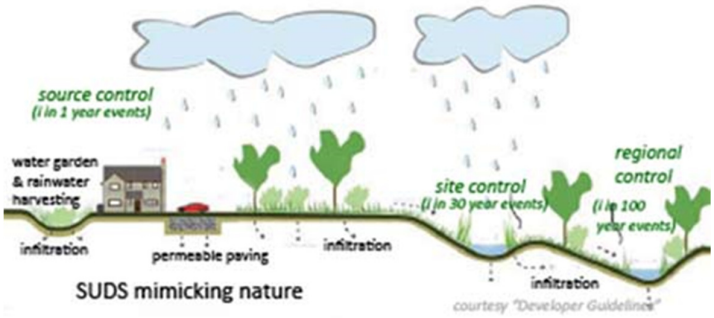
Managing flood and guidelines at neighbourhood scale

- Developments should adhere to natural site contours and reduce impervious paving.
- Natural drains are critical in maintaining natural water flow across the sites, thus, construction in such areas should be avoided.
- Vegetation / tree cover on site are extremely important natural features on site. Development on site should be planned in a manner dense tree clusters are left undisturbed and protected during construction.
- Key topographical features like steep slopes, earth mounds, hillocks should be preserved and protected.
- Grading large flat terraces on hillside sites should not be allowed. (figure 4.2)
- Establish contours and gradients that resemble the naturally occurring terrain




Earth work and grading (Source: Steep Slope Development Guidelines, City of Nanaimo)

- Developments should provide for an efficient storm water management system.
- A range of techniques as part of Sustainable Urban Drainage System (SUDS) allow designers to select techniques that are best suited to a particular site. Some examples of SUDS include: infiltration trenches, infiltration basins, filter drains, swales, retention ponds, wetlands etc.
- In urban areas advantage of planning SUDS is, they help in containing and managing run off from the site, thereby reducing flooding.




SUDS, Source: (http://sd.defra.gov.uk/2011/05/surface-water-management-and-future-water-supplies/)

- Storm water drains should be sized for higher capacity.

Reduce impervious paving on site this will reduce storm water runoff. Pervious paving is recommended which allows water to penetrate in the ground and also reduce heat island effect.

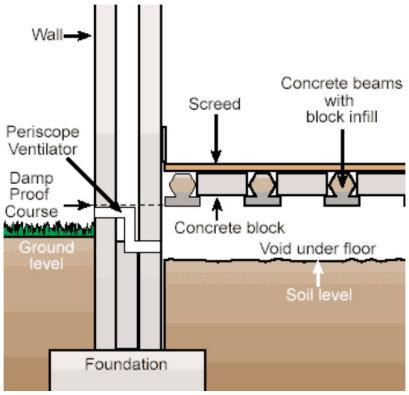
Image showing pervious paver

- In parks and green spaces, infiltration ponds should be constructed.
- Erosion and sediment control measures should be installed, as it has been observed that erosion and loose soils are majorly responsible for floods and landslides. It is therefore, imperative to implement erosion and sedimentation control measures during and after construction. These could include swales, sedimentation pit, vegetation and grass growth on exposed soils in combination with mulching.

Managing floods and guidelines at building level:

- Raised floor level to prevent flood water entering inside homes.

Example of a dwelling with raised floor




Another section showing raised floor example

- Plinth protection should be provided if raised floor is not an option.
- Constructing the house on stilts/higher level for further safety against inundation.

- Apply damp proof course on top of foundation.
- Water proofing on roof and properly designed overhangs above openings.
- Basements for new constructions should not be allowed in urban areas prone to flooding.

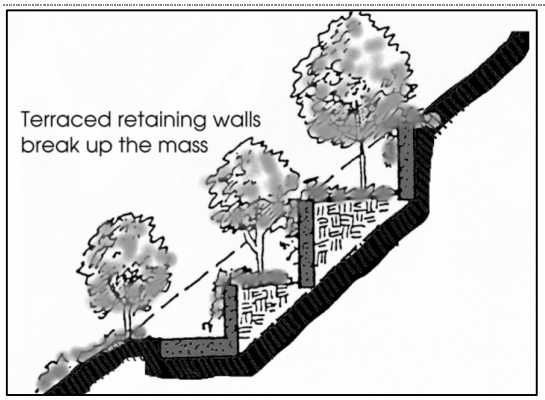
Strategic flood risk assessment and a sequential approach to development in the floodplains are necessary. Increase in temperatures due to climate change, high precipitation and melting down of glaciers could increase the flood risks further and hence the decision makers should also think about moving vulnerable settlements into a safer place.

## Design guidelines for districts vulnerable to Landslides

As per Nepal NBC, on contoured sites, areas frequently experiencing landslides should be avoided for development and construction. Indication of sustained stability of a slope is the upright standing of trees; they would be inclined downwards in case unstable slopes. Soil slopes upto 20% are stable and good for construction. Steep slopes are most unstable and if disturbed are less forgiving of construction errors. This causes damage not just in the vicinity but lead to soil erosion, trigger landslides and hampering the development in the valley.

*Following steps should be followed while developing housing in landslide vulnerable areas:*

- Stabilization of slopes and land should be the top priority. Proper drainage system in the hills can provide much safer places to build structures.
- Field survey which shall include topographic survey, soil sampling and hazard mapping. This should be followed by contour maps, analysis of slope stability, soil thickness and ground water level.
- Design of drainage, retaining structures and stabilization of slopes using vegetation should be then followed.
- Placement of roads parallel to the contour lines in the site.
- Carry out geotechnical investigations prior to earthwork.
- Minimise cutting of trees
- Design the house with split levels to minimise disturbance to hill slopes, thus controlling erosion and earth slip.
- Cut and fill should be minimized while building on slopes. Cuts are preferable to fills as they are more stable and have generally less impact on surrounding vegetation and off-site views. The problem with fill is that it has a tendency to return to the natural grade and is therefore less stable. Re – vegetation of exposed slopes should be done as quickly as possible to prevent soil erosion and landslides.
- Retaining walls




Terraced retaining wall

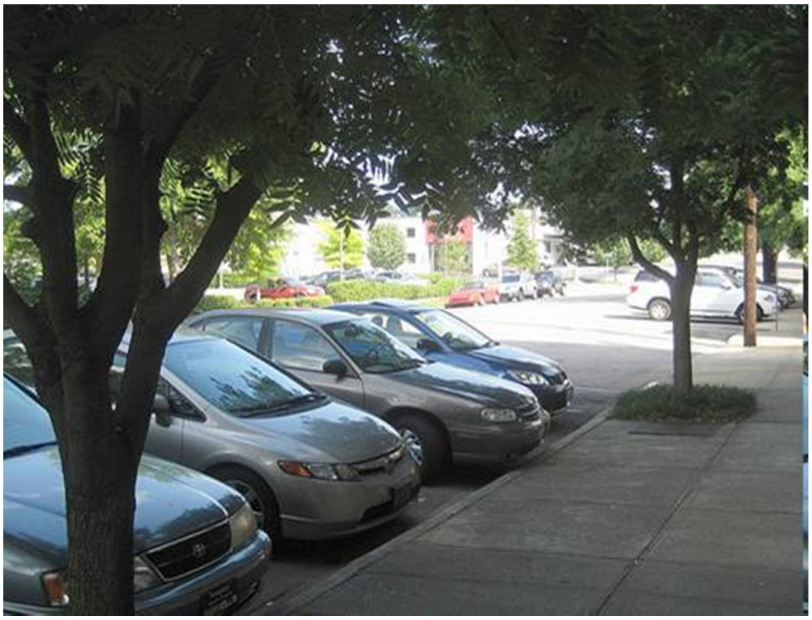
- Placement of foundation at a sufficient depth to minimise erosion and provide lateral restraint.
- Use of engineered retaining walls in the site based upon the mapping and also within the split level of the house.
- Erosion and sediment control measures should be installed, as it has been observed that erosion and loose soils are majorly responsible for floods and landslides. It is therefore, imperative to implement erosion and sedimentation control measures during and after construction. These could include swales, sedimentation pit, vegetation and grass growth on exposed soils in combination with mulching.
- Buildings should be symmetrical and simple forms.
- Buildings in mountain regions should be light weight, this puts less pressure on mountain slopes and also make buildings more seismic resistant.

## Design guidelines for heats stress Terai

Flat plains of Terai are exposed to both floods and heat stress. In the recent years the temperatures have gone as high as 45 deg.C. Increase in ambient temperatures is making homes dependent upon air conditioning which has higher electricity demand and hence this results in further increasing the gap between electricity demand and supply. It is thus, important to design and plan residential developments which are able to maintain comfortable micro climate at neighbourhood level as well as at building level through low cost design interventions.

### Guidelines at neighbourhood scale

Reduce Urban Heat Island Effect (UHIE). In urban areas impervious surfaces like roads, parking lots, pavements, buildings, dark coloured surfaces result in increased urban ambient temperatures. Thus, reduced impervious pavements, increase in vegetation in residential developments will help in maintaining cooler temperatures without any additional cost interventions.



Shaded parking

(Source: http://farm4.static.flickr.com/3121/2566157698_518a192d76.jpg?v=1213052321

- To reduce UHIE, shading of paved areas is also useful.
- Use of high reflective paints on roof also helps in reducing the microclimate temperature.

## Guidelines at building scale

### *Solar passive features*

- Solar control strategies including shading, orientation and building morphology shall play major role in reducing external heat gains and maintain comfortable indoor conditions.
- Increase in vegetation/tree planting around the house helps in shading the house without any cost interventions.
- Increasing ventilation through optimization of window size and positioning shall enhance thermal comfort.
- Cool roof treatment/roof garden are recommended to reduce heat gains from roof.
- Light colour external facades of the buildings and green walls to reduce external heat gains.
- Use of thermal storage through building materials like stones and stabilized earth blocks which absorb heat during hot periods and dissipate it outside when it is cooler is recommended.

### *Summary of guidelines*

Various guidelines recommended in section above for various vulnerabilities are summarised in table below.

| District | Vulnerability | Climate Resilient Design Strategies |
|---|---|---|
| Kaski | GLOFs | Drainage channels, elevated structures, RC strip as a foundation, solid floor with membrane, ground water recharge pits. |
| Dhankuta | Landslides | Site planning as per topography, minimised cut & fill, vegetation to minimize erosion, Lintel &cill tie beams using bamboo, RC lintel &cill tie beams, Butresses |
| Sunsari | Floods | SUDS, drainage channels, elevated structures, RC strip as a foundation, solid floor with membrane, ground water recharge pits, RC lintel &cill tie beams, pervious pavements, well shaded openings, plinth protection, damp proof course and water proofing |
| Banke | Heat stress | Permeable pavement, shaded pavements, solar passive architecture design principles, water body, cavity wall, insulated wall, wooden plank insulation, RCC roof with reflective paint, wooden framed windows, cement slabilised soil block flooring with wax polishing, mud roof with bamboo reinforcement |
| Rupandehi | Heat stress | Permeable pavement, shaded pavements, solar passive architecture design principles, water body, cavity wall, insulated wall, wooden plank insulation, RCC roof with reflective paint, wooden framed windows, cement slabilised soil block flooring with wax polishing, mud roof with bamboo reinforcement |
| Kathmandu | Multiple hazards | All strategies defined above for flooding, solar passive architecture to obtain comfort in summer and winter months, earthquake resistant design as per NBC of Nepal |

Climate resilient strategies for different climate risks. For earthquake resistant design, National Building Code of Nepal should be followed.

## Design guidelines for construction of solar passive low cost homes in cold regions of Nepal

In the mountain regions during winters, the house hold survey shows people are not comfortable due to very low temperatures inside the house. In rural Nepal either wood or dung is used to heat the homes. In urban areas, electric heaters is used, this results in increased use of conventional energy. Use of wood has environmental disadvantages, and hence it is important to integrate low cost solar passive techniques inside the house for achieving thermal comfort. For this reason it is important to build solar passive affordable homes.

A solar passive building in the context of cold climate zones is defined as "a building in which the various components are arranged in a manner that maximises the collection of solar heat. It is then stored and finally distributed into the space without any expenditure of conventional energy (Flavin 1980)."

One way of making solar passive buildings is by storing the heat. This can be done by use of building materials that have capacity to hold heat. When sun sets the thermal mass slowly radiates the heat inside, making the inside warmer. Traditional building materials that have high heat capacity are: Brick, concrete, stabilized mud blocks and stone.

Another easy and affordable manner of heating a space is to provide window openings with glass on South facade of the house.

Trombe wall is another simple and economical solution of naturally heating the house during winter season. In this system, heavy masonry facing towards South orientation is used painted dark colour from the outside. Behind the wall on the outside, a glass panel is fixed, the gap should be sealed. Sunlight passes through the glass, heat the gap in between and dark coloured mass, which begins to heat. The heat is later radiated inside the room.

## Thermal Performance Analysis of a Low Cost Climate Resilient House in Kathmandu: Quantifying value addition through resilience

Using some of the above technologies for a typical individual house thermal comfort analysis was carried out to predict the benefits. Due to availability of weather file for 8760 hours for Kathmandu, presently analysis is carried out for Kathmandu. TRNSYS software was used to predict the thermal comfort conditions inside a house by use of different building materials.

Benefits have been quantified in terms of reduction of discomfort hours inside the house, as this would result in lesser usage of heaters, thus reducing electricity consumption. To define thermal comfort inside a house, National Building Code of India Thermal Comfort Standards was referred, since Thermal Comfort Standards are not defined for Nepal. Also, Nepal and India have similar construction technologies, similar adaptive nature and culture; hence Indian Thermal Comfort Standards are referred.

Details of the assumptions considered for analysis is given in Annexure 5. The output of the simulations show that during peak winter months by use of thermal mass through stabilized soil blocks or insulated block masonry in urban areas through affordable cement blocks increase in the internal air temperature in peak winter months is observed by 10-12 deg when outside is measured at 0deg C or lower. This will have benefits in terms of lower energy bills in urban locations and better indoor environment in rural areas as habitats will not burn wood to keep the home warm.

# Annexure – 7: Potential for Low Cost Climate Resilient Homes

Potential for Low Cost Climate Resilient Homes

1. Existing households in Nepal (Source: Census 2011) – 5423297
2. New homes constructed in last 10 years (Reference: Literature Review Chapter) – 1000000
3. Hence, assuming the same rate of growth in the next 10 years, new homes that will be built will be - 1000000
4. Households falling in the target segment (Annual income USD 2000to USD 6000)= 200000 (Reference: Literature Review chapter)
5. Thus, in the next 10 years, new homes which will be built for the target segment and that will need to be climate resilient is – **200000**
6. From the Existing building stock, households falling within the target segment will be equivalent to - 1084659
7. From the existing building stock, 30% of homes are more than 15 years old (Reference: Household survey conducted under this study), and hence they also give a potential for either refurbishment of homes into climate resilient or demolition and construction of new climate resilient low cost home. This is equivalent to – 325398
8. Rented homes in the target segment of existing building stock which also contributes to potential market for low cost climate resilient homes is considered as 13 % of existing building stock (Reference Household survey conducted under this study)- 141005
9. Total potential from old building stock: (32398+141005)= 466404 homes
10. Total potential of building low cost climate resilient homes in next 10 years (200000+466404) = **666404**

## *The Energy and Research Institute (TERI)*

### *Sustainable Building Science: Overview*

*One of the prime areas of activity within the Energy Environment Technology division is adoption of efficient and environment-friendly technologies in new and existing buildings. The activities of this area focus primarily on energy and resource use optimization in existing buildings and design of energy efficient sustainable habitats.*

*The Centre for Research on Sustainable Building Science (CRSBS) comprising architects , planners, engineers , environmental specialists , specialised in urban and rural planning, low energy architecture and electro-mechanical systems, water and waste management and renewable energy systems has been offering environmental design solutions for habitat and buildings of various complexities and functions for nearly two decades. The group also undertakes LEED facilitation for buildings.*

*The Green Rating for Integrated Habitat Assessment (GRIHA) cell, also comprising professionals from the above-mentioned fields is actively involved in facilitation of green rating for buildings under the GRIHA framework. Inputs from CRSBS feed into the processes undertaken at GRIHA cell. The different services offered by the Sustainable Building Science (CRSBS and GRIHA) are as follows:*

#### *Environmental design consultancy*

- *Specialised environmental design consultancy and building performance analysis are conducted. A wide range of computations and simulation tools including DOE2, TRNSYS, ECOTECT, RADIANCE, FLOVENT, AGI32, LUMEN DESIGNER, BLAST, Phoenics, RETS creen are used to assess the environmental and cost impact of the design decisions.*

#### *LEED and GRIHA facilitation*

*The team has experience in technically facilitating LEED accreditation [LEED India for New Construction (LEED India NC) and LEED India for Core and Shell (LEED India CS)] for buildings. The group also assists and administers GRIHA, an indigenous green building rating system for buildings, developed at TERI. GRIHA has now been now endorsed by the Ministry of New and Renewable Energy, Government of India, as the national building rating system for India.*

#### *Energy audits and energy management programs*

*Energy conservation studies for a large number of buildings are conducted. There exists a vast experience in conducting energy audits and evaluating a whole range of building upgrade options including envelope retrofit and system retrofit or changes in operational patterns. In addition to establishing operating efficiency of electrical, HVAC, lighting and thermal systems, recommendations to improve upon the same by suitable retrofit measures or by refinement of operational practices are also offered. The group also has expertise in development of energy management programs for service industries like hotels and the corporate sector.*

#### *Capacity building*

*Capacity building for architects, building developers and service engineers on issues such as energy efficiency in building envelopes and systems has been undertaken. Over 1000 architects, developers and engineers in the area of green buildings, energy efficiency and sustainability aspects of built environment have been trained through training programmes, refresher courses, seminars and workshops.*

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The Energy and Resources Institute
www. teriin.org