



Planning for affordable housing during densification in Kathmandu

Lessons from four settlements

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LUMANTI- Support Group for Shelter was registered in 1993 as a non-government organization dedicated to alleviate urban poverty in Nepal through integrated approach of improving shelter conditions. Lumanti with its approach of providing housing for urban poor is now working for onsite upgrading of settlements with the provision of secure tenure, support in the construction of housing and improved access to sanitation and water supply and credit facilities. Lumanti promotes all these activities through community led finance mechanisms by strengthening of saving and credit programs and cooperatives.

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Preface

This working paper was in press when a devastating earthquake struck Kathmandu on the 26th of April 2015, and then a second struck on the 12th of May. The current priority is recovery. The authors of this paper are now busy conducting post-earthquake building assessments and providing low cost house design and construction supervision for people building transit homes. Going forward, much more will need to be done to provide better housing for the residents of Kathmandu, and to reduce the risks they face from future earthquakes and other environmental hazards. This is also a daunting task that will need to be faced with courage. The paper takes a broad look at the challenges posed by Kathmandu's rapid population growth and densification. It extends its focus to the poorest and most vulnerable residents, and seeks out ways of addressing the shortfall in affordable housing while reducing risk and building resilience. Hopefully this will contribute to a safer and more liveable Kathmandu in the future.

Kathmandu faces serious urban planning and housing challenges. Most development is occurring beyond the legal limits of zoning bylaws and building regulations in response to housing shortages. As settlements densify haphazardly, affordable housing options are increasing, but living conditions, services and crowding are worsening. The potential consequences for low-income residents are disastrous given the danger of an imminent earthquake. This paper examines four types of settlements in Kathmandu to understand the impacts of densification. It then presents conceptual reimaginings of these settlements to apply the lessons for planning affordable housing in densifying settlements without compromising unduly on safety and liveability.

Contents

Executive summary	5	4 Case studies	14
1 Introduction	7	4.1 Naradevi: Traditional settlement	14
2 Transformation of Kathmandu	8	4.2 Sankhamul and Bansighat: Informal settlements	22
2.1 History of planning practices in Kathmandu	9	4.3 Khusibu: Land-pooling project	29
2.2 Current trends in residential development	9	4.4 Chabahil	37
2.3 Rental housing in Kathmandu	10	5 Conclusions	45
2.4 Kathmandu: An urban density study	11	5.1 General conclusions and recommendations	45
3 Methodology	12	5.2 Conclusions and recommendations for the four case studies	48
3.1 Site selection	12	References	50
3.2 Preparation of questionnaire	12	Appendix 1	51
3.3 Sampling method	12	Appendix 2: Questionnaire	67
3.4 Field observations	13	Appendix 3: List of Survey Team Members	71
3.5 Data handling	13	Appendix 4	72
3.6 Data analysis	13	Related reading	74
3.7 Hypothetical replanning exercise	13	Acronyms	75

Executive summary

Kathmandu is experiencing rapid urban growth, with its population nearly doubling in the past decade. This trend has been accompanied by densification in inner-city traditional settlements and in newer peripheral settlements facing urban growth and expansion pressures.

However, most urban growth and densification are being accommodated haphazardly in the absence of appropriate and enforceable zoning bylaws and building regulations. In practice, land owners and private developers often build beyond legal limits in response to housing shortages, particularly among low-income renters. Consequently, informal rental markets have grown, whilst living conditions, service provision and crowding have worsened.

Haphazard densification has potentially disastrous consequences for Kathmandu given the danger of an imminent earthquake. This applies especially to low-income households living in inadequate housing. A number of actions can be taken to avoid these consequences by planning and managing urban growth more effectively and equitably. These actions must be grounded in an understanding of local realities and the reasons formal regulations have been so ineffectual.

To develop this understanding, this study has three objectives:

- a) To better understand how different types of settlements in Kathmandu have developed and densified over time
- b) To better understand how these development processes have impacted on urban form and on social, economic and environmental conditions, and
- c) To identify and apply the lessons that these settlements present for planning and developing affordable housing in densifying settlements.

To provide a way forward, hypothetical replanning exercises have been undertaken for each settlement to illustrate how these lessons, applied retrospectively, could have been translated into planning and design. The four types of settlements and their hypothetical redesigns are outlined below.

Naradevi is an inner-city traditional settlement that is densifying outside of official rules and regulations through the addition of storeys to existing structures; the construction of new, taller buildings; and the subdivision of jointly owned properties. Densities are currently as high as 2,112 people per hectare. The original owners who can afford automobiles have begun to migrate to suburban areas where vehicular accessibility is better. This has made the area more affordable to lower-income households and renters; however, living conditions and crowding have worsened, particularly in rental spaces. These conditions have also intensified the settlement's existing vulnerability to earthquake and fire risks.

The hypothetical replanning exercise for Naradevi explored four approaches. The least exclusionary approach would involve protecting the area's historically and culturally significant courtyard systems. It would also examine options for promoting fire safety, earthquake-resistant measures and heritage conservation, without imposing prohibitive costs for land owners or driving up rents for low-income groups.

Sankhamul and Bansighat are informal settlements housing some of the poorest residents unable to afford rental spaces in other parts of the city. Because these settlements are located along rivers, they are vulnerable to flooding and erosion. They are also under constant threat of eviction due to insecure tenure. Despite these risks, Sankhamul and Bansighat offer residents access to employment opportunities, basic services and public facilities in central areas they might not otherwise be able to access.

In Bansighat, the hypothetical replanning exercise explored relocation and resettlement options due to the settlement's location in a ten-year floodplain. However, such options would need to be determined in partnership with the community to ensure that its needs, priorities and affordability requirements, particularly among the poorest renters, are considered.

In Sankhamul, the hypothetical replanning exercise explored on-site redevelopment options. High land values meant that houses on plots as small as 30m² would be unaffordable for low-income households. Thus, higher-density two-storey walk-up apartments

were explored to reduce the cost of land and public infrastructure provision. The construction of individual houses, which are cheaper to build than apartments (in terms of construction, but not land cost), was also explored as an alternative, but further study is required to assess both of their social, economic and environmental implications. Ultimately, these options should be seen as a response to environmental and eviction risks and not as a replicable contribution to addressing the affordable housing shortage in Kathmandu. Addressing this shortage will require a broader housing strategy that is capable of reaching the poorest renters. These renters would likely not be able to afford apartments or individual houses without significant public subsidies, which are not guaranteed.

Khusibu is situated on the periphery of the city and was historically protected for agricultural purposes. In 1995, the government initiated a land-pooling project to readjust irregularly shaped agricultural land so that it could be redeveloped for residential uses.

Over time, Khusibu has evolved into a mixed-use settlement, reflecting broader socioeconomic dynamics in Kathmandu. The area also provides affordable housing for renters who work in the city centre. As in other parts of Kathmandu, most housing growth has been accommodated by new builds and incremental additions violating bylaws and regulations. With densification, other problems involving road congestion, infrastructure deficiencies, pollution, and earthquake risk are emerging.

The hypothetical replanning exercise explored alternative spatial reconfigurations involving gridiron layouts and traditional courtyards to address some of these problems. New building plans were also devised to illustrate the potential to accommodate high densities within smaller plots without compromising unduly on liveability and safety. Given that most bylaws are violated, land-pooling projects were also highlighted as opportunities to test deviations from current bylaws and to discuss their impacts and implications for future developments.

Chabahil is a spontaneously developing settlement on farmland located outside the old city. The area is home to a diverse population living in various housing types, ranging from single-family bungalows to more compact rental spaces. Although the settlement remains predominantly low-rise, it is beginning to densify. This presents an important opportunity for local authorities to guide the process. The hypothetical replanning exercise emphasises the opportunity to learn from potential experiments conducted in land-pooling projects.

The replanning exercise also examined designs that would support Chabahil's development into a compact, mixed-use, walkable and more functional settlement. Also considered was the need to develop more appropriate bylaws and regulations to guide this process whilst promoting rental markets and risk reduction.

Key lessons and conclusions

The lessons identified across the five settlements reveal a common tension between enforcement and affordability. There is a clear need to ensure that bylaws and regulations are adopted by land owners and private developers accustomed to evading regulations, and affordable to lower-income groups accustomed to living informally. If this tension is not addressed, it is unlikely that existing bylaws and regulations (let alone new bylaws and regulations supporting, for example, earthquake safety) would be followed.

One potential action area for local authorities would be to partner with a local NGO, such as the Lumani Support Group for Shelter, that has experience working with land owners, private developers and low-income groups. The purpose would be to establish a platform where discussions around how a more appropriate and enforceable regulatory framework could be achieved. This platform could also serve as a basis for discussing how the potential lessons learnt from land-pooling projects could be shared and applied more widely, and how appropriate earthquake-resistant measures could be incorporated into a regulatory framework that is more likely to be followed.

Ultimately, the development of a more appropriate and enforceable regulatory framework (including one that increases safety and reduces risk) will depend largely on whether the tension between enforcement and affordability can be reconciled. If it can, the planning system will have a real chance of addressing the affordable housing shortage as the city continues to grow and densify.

1

Introduction

This study seeks to understand how planning can better respond to Kathmandu's affordable housing shortage as the city grows and densifies. To develop this understanding, the paper examines four distinct types of settlements that represent different ways in which growth and densification are being accommodated in Kathmandu. It also identifies the lessons these settlements present for planning affordable housing in densifying settlements and applies them to hypothetical replanning exercises for each type of settlement. These replanning exercises are intended to illustrate how affordable housing could be planned and designed, still allowing organic development and without compromising on safety and liveability in Kathmandu. They also indicate the regulatory reforms that would be required to achieve this.

This study is comprised of five sections. Section 2 examines the transformation of Kathmandu, with a focus on urban growth and expansion trends. Section 3 outlines the methodologies used by the study. Section 4 examines each type of settlement, with a focus on urban growth and densification trends, lessons learnt, and the hypothetical replans. Section 5 concludes by discussing the key issues and lessons that need to be considered when planning and developing affordable housing during densification in Kathmandu.

2

Transformation of Kathmandu

The Kathmandu Valley, historically a lake, has a recorded history of settlements since the 2nd century AD, after the lake was drained by the mythological figure Manjushree. Covering an area of 654.7 km² and lying in the Bagmati River watershed, the valley is gifted with rich soil and a temperate climate, which has attracted migrants to settle in this valley ever since. Over time, with numerous ruling dynasties, it has undergone various social, political and physical transformations. A marked change was witnessed in 1768, when the valley was conquered by the Shah dynasty, which declared Kathmandu the capital of Nepal. After much-awaited democratisation in the 1950s, the valley underwent drastic transformation from agricultural to urban due to the influx of migration and the introduction of vehicles (Haack and Rafter, 2006).

At present, the valley is administratively divided into five municipalities and 94 rapidly urbanising Village Development Committees (VDCs), of which Kathmandu Metropolitan City is the most populated. Kathmandu, once a magnificent city with a history visible in its architecture, has in the last half-century turned into a sea of people housed in clustered concrete structures. It has attracted people from all over the country due to centralised development, as the valley serves as the economic and administrative capital of the nation. Migration in search of employment opportunity and high-end services, coupled with the insurgency period between 1996 and 2006, has resulted in a rapid population influx into the city and the valley.

Rural to urban migration together with natural population growth is doubling the population of Kathmandu at a rapid pace. According to the 2011 National Population and Housing Census, the population of Kathmandu

grew by 61 per cent in the last decade. The city of Kathmandu has experienced mounting population growth at a rate of 4.8 per cent from 1991 to 2001 and 4.1 per cent from 2001 to 2011. The Kathmandu Valley had an average growth rate of 4.63 per cent in 2001–2011, compared to the national average of 3.43 per cent.

The increase in population also points towards an increase in density. In 2001 the average density of Kathmandu City was 136 people per hectare (ppha), which increased to 197 ppha in 2011. The dense core area of the city has a ward density of up to 1,181 ppha. Population growth and densification have also been marked by the enlargement of the built-up area manifested by urban sprawl. This has been especially evident in the rapidly urbanising VDCs around the valley, whose population growth rates are as high as 14 per cent per year (Central Bureau of Statistics, 2002 & 2012).

Urban sprawl has been the major driver of land-use change in Kathmandu, where agricultural land is rapidly being converted into built-up areas as a result of haphazard development. The built-up area in the municipalities grew from 38km² to 999km² between 1990 and 2012, an almost threefold increase. The built-up coverage has changed from 5 per cent to 16 per cent, while agricultural land has decreased from 58 per cent to 47 per cent. The areas of mixed residential and commercial land have increased six fold and the residential land four fold (Genesis Consultancy, 2013). This growth is clearly visible in the valley's peripheral areas, with significant development extending up into the hills.

2.1 History of planning practices in Kathmandu

With rapid demographic, spatial and social transformations, physical development of the Kathmandu Valley has also been approached with various policies and plans, as an attempt to address growing urban issues and to guide urban growth. In many cases, the intention has been to plan the Kathmandu Valley in an integrated way, rather than as a series of individual municipalities. Many planning documents have been prepared. The Physical Development Plan of the Kathmandu Valley, 1969 was one of the initial attempts to plan the development of the valley. It sought to preserve the valley's environment and rich agricultural land by guiding development to the western and south-western areas, thereby reducing population pressures in the central and eastern regions.

Another significant planning document, the Kathmandu Valley Physical Development Plan, 1972, was formulated to respond to the geographical structure of the valley. It proposed development in the plains (*tar*) and the preservation of wetlands (*do/*) for agriculture. It was followed by the Land-use Plan of Kathmandu Valley, 1976, which introduced extensive land-use zoning for the valley together with building regulations. This divided the valley into three categories: the inner core, its adjacent area and the sparse new settlement area. One of the significant outputs of the document was the establishment of the Kathmandu Valley Town Development Committee, which still exists in the form of the Kathmandu Valley Development Authority.

The Urban Development and Conservation Scheme, 1988, was launched under the leadership of the Ministry of Housing and Physical Planning, which introduced land pooling and land development programmes in the valley. The Kathmandu Valley Urban Development Plans and Programmes, 1991, stressed the densification of the Kathmandu and Lalitpur municipalities, with development of an inner ring road to preserve agricultural land and reduce the impacts of urban sprawl. The Environment Plan and Management of Kathmandu Valley, 1999, had a similar intent, and envisioned Kathmandu as an eco-town. It proposed to redefine Kathmandu's physical boundaries, conserve traditional settlement, and upgrade and extend the road and sewerage network.

The latest significant planning document, the Long Term Development and Conservation Plan of Kathmandu Valley, 2000, considered the regional context of the Kathmandu Valley, treating it as a development node

and looking forward to 2020. The intention was to support a holistic approach to urban development, with efficient integration of land-use and transportation planning, conservation of agriculture and public land through the demarcation of a city growth boundary, as well as adequate infrastructure facilities supporting the increased carrying capacity of the valley.

Though many planning documents have been prepared, they have not achieved anything like their ambitions and have had very few impacts. Most of the documents have stressed the preservation of agricultural land and ecology of the Kathmandu Valley, due to its fragile geological conditions, but these plans have existed mainly on paper. Major impediments to plan implementation have included: lack of synchronisation between projects and plans; lack of coherence between building regulation and land-use planning; and lack of a strong legal basis, political will and institutional capacity for plan implementation.

2.2 Current trends in residential development

With changing urban form and growth in residential units, a number of identifiable housing trends have emerged in the valley. They are:

- Class-based gated communities and group housing, including high-rise apartments targeted to upper-middle and higher-income groups
- The rapid decay of the historic core area, with an influx of low-income migrant renters and the relocation of natives to peripheral/suburban areas
- Urban sprawl and rapid unplanned development of peripheral/suburban areas, including an increase in mixed residential units
- Initiation of land pooling projects in some areas to adjust the configuration of land and provides services, and
- The undocumented rise in squatter settlement along the river banks and public land, due to migration of the rural poor in search of a better life.

These development trends reflect failing land-use control and building regulations, declining living conditions among particular segments of the urban poor, emerging segregated class-based settlements, and rising demand for rental housing to accommodate the growing migrant population.

2.3 Rental housing in Kathmandu

The rapid growth in population, coupled with physical constraints on expansion posed by the Kathmandu Valley's natural boundaries, explain the unprecedented rises in land and housing prices. Rising prices have been further augmented by the lack of an effective land information system and transparent land market. A distorted land and housing market has emerged, controlled by a land mafia, brokers and speculators more concerned with future land prices than with current land uses.

The city's housing prices have outpaced the economic capacity of all but the wealthiest in Kathmandu. Though the National Shelter Policy 2012 affirms 'shelter for all' as its goal, the National Shelter Plan 2070/71¹ indicates that this goal is far-fetched, as the projected number of housing units required in urban areas is 1,300,000, with about 900,000 new units required to be constructed by 2023. However, UN-Habitat (2010) has projected housing unit production from 2011 to 2021 to be 35,039 annually. Based on this UN-Habitat study, for a family to build a minimum standard house of 54m², it needs an average monthly income of NPR 60,471 (US\$610) to afford a loan that is 40 per cent of the total income. This means "more than 75% of the urban population does not have sufficient income to afford the minimum standard 50 m² self constructed house on 80 m² plot in the outskirts of a city and 95 percent cannot afford to purchase a readily built property". As a result, the lack of affordable and secure housing for the urban poor has become one of the most problematic planning issues for Kathmandu. Neither the government nor the private development sector has formulated appropriate housing options for Kathmandu's poorest citizens.

Public housing is non-existent mainly because of the excessive cost of land, and owner-occupiers are in the minority. Renting at least one or two rooms is affordable for the vast majority of the population (90 per cent), while only 40 per cent can afford to rent a basic four-bedroom apartment in the outskirts of the

city (UN-Habitat, 2010). More than 48 per cent of the urban population is renting space from individual homeowners, who often live in the same building. Much of this demand for rental units is being met by informal markets, which provide affordable housing options to low-income residents willing to accept overcrowded living conditions and inadequate basic amenities, light and ventilation. These conditions create unhealthy living environments, particularly where overcrowding is combined with inadequate water and sanitation.

The need for rental housing units is clearly visible in the Kathmandu Valley, where the proportion of households living in rental units significantly increased from 33 per cent in 2003 to 48.5 per cent in 2011 (Central Bureau of Statistics, 2012). With almost half of the population living in rented space, it is high time for Kathmandu to incorporate the rental sector into its planning efforts.

There is also a clear need to reassess zoning regulations and other land-use controls. For example, limitations to floor area ratios (FAR²) currently restrict the amount of floor space that can be legally developed, thereby exerting downward pressures on housing supply and upward pressures on housing prices in formal markets. The unreasonably strict regulatory framework often ends up being ignored by private developers and informal settlers, contributing to the formation of informal markets. If formal rules and regulations were strictly enforced, then a large share of Kathmandu's population living in illegal non-conforming structures,³ including informal settlements, would be forced to move out of their homes, exacerbating the housing scarcity.

Recent studies in Asian cities, including Karachi, Pakistan (Hasan et al. 2010) and Bangkok, Thailand (Usavagovitwong et al. 2013), show how density can be used as a tool for planning and developing affordable housing, as the construction of additional units at smaller sizes can reduce the cost of land and increase the efficiency of providing basic infrastructure and services. This study therefore aims to explore how density can be used as a tool for planning and developing affordable housing in Kathmandu.

¹ This refers to the year 2013–2014 in the internationally conventional Gregorian calendar.

² FAR refers to the ratio of a building's total floor area to the size of the plot upon which it is constructed.

³ Illegal non-conforming structures have been developed or expanded beyond the legal limits of the prevailing zoning bylaw. In contrast, legal non-conforming structures were developed or expanded before the current zoning bylaw made the development or expansion illegal.

2.4 Kathmandu: An urban density study

This study has three main objectives:

- a) To better understand how different types of settlements in Kathmandu have developed, densified and consolidated over time
- b) To better understand how these development processes have impacted on urban form and on social, economic and environmental conditions, and
- c) To identify and apply the lessons that these settlements present for planning and developing affordable housing at high density.

To achieve these objectives, this study examines four distinct types of settlements that represent current development and expansion trends in Kathmandu. It also identifies lessons and recommendations for planning and developing affordable housing at high density in these and other settlements in the city. As a hypothetical exercise, a series of hypothetical redesigns are presented to illustrate what these settlements could possibly look like. The four forms of settlements are:

1. The densification of traditional settlements, which currently house a significant proportion of Kathmandu's population. However, given current density levels, the scope for continued development in this form is limited. The settlement examined is Naradevi.
2. The development of informal settlements on marginal land. Informal settlements currently house 3–4 per cent of Kathmandu's population, but a larger share of the city's low-income residents. The settlements examined are Sankhamul and Bansighat.
3. Land-pooling and housing projects in peripheral areas, which are an increasingly important housing form and which also accommodates low-income tenants. The settlement examined is Khusibu.
4. The spontaneous and incremental conversion of farmland into housing, which currently accounts for a large and growing share of Kathmandu's population. The settlement examined is Chabahil.

The conditions of these sites are compared in Appendix 1.

3

Methodology

3.1 Site selection

A study site within each of the four settlement groupings was demarcated using local roads. Each study site encompassed approximately 700 to 950 houses. However, due to the relatively small size of the squatter settlements, only 110 and 115 houses in Sankhamul and Bansighat were included, respectively.

3.2 Preparation of questionnaire

In each study site, primary data were collected through a questionnaire designed to capture both the physical and social conditions of the settlement, as perceived by the dwellers (including home owners and renters). The questionnaire was framed in seven sections: household information; social condition; environmental condition; housing information; details of renters; opinion regarding the current neighbourhood; and preference for housing type in an existing or relocated area. However, due to people's reluctance to share financial information, data on income and willingness to pay could not be obtained from most interviewees across the four settlements. Appendix 2 contains the questionnaire.

3.3 Sampling method

Different teams, each with a team leader, were formed for each of the study sites (Appendix 3). A systematic random sampling method was used to select 100 in each settlement, such that a consistent interval was maintained between selected houses. This interval varied depending on the morphology of the settlement, such that, for example, every sixth house was selected in Khusibu while every second house was selected in Sankhamul. Both owner-occupiers and renters were interviewed during the survey for each site. However, the main purpose of the surveys was to provide a general socioeconomic picture of the area using the most systematic methods possible rather than to necessarily achieve a representative sample. It should be noted that since only one respondent from each building was selected for the questionnaire in each settlement, respondents in buildings with multiple households may be under-represented.

3.4 Field observations

Surveys were coupled with field observations to incorporate a professional analysis of the settlement, including a focus on building conditions and the overall physical and social environment. Key elements on the observation list were:

- Current physical environment
- Sociocultural relationships; existence and functions of community organisations like a *Guthi*⁴ and tole-lane organisation (TLO)⁵, sports clubs, religious festivals, schools and health services, and
- Economics of land and housing, job markets and transport issues.

3.5 Data handling

The surveyed houses from each study site were plotted in Google Maps to map the settlement for future analysis. EpiData software was used to systematically enter, code and analyse the survey data.

3.6 Data analysis

Results from the survey were analysed and compared to draw conclusions for better planning and more appropriate development across the settlements. Data from each settlement helped in identifying lessons learnt and in guiding the hypothetical redesigning exercise.

3.7 Hypothetical replanning exercise

Hypothetical settlement and house plans were developed for the four settlement groupings based on the lessons and recommendations identified for each. The results of the redesigning exercise were compared with the existing situation to show envisioned changes in, for example, density, land coverage and land-use patterns. (Appendix 4 presents the results of these comparisons.) These exploratory plans are intended to inspire planning and policy for similar settlements as they grow and densify. As reimaginings rather than prescriptions, they are not being proposed as formal redevelopment plans to be implemented in the selected settlements.

⁴ *Guthi*: traditional caste-based community organisation / group formed for a specific purpose.

⁵ Tole-lane organisation (TLO): community organisation formed at ward level.

4

Case studies

4.1 Naradevi: Traditional settlement

4.1.1 Naradevi: Then and now

The study area comprises a section of the ancient traditional settlement in Kathmandu that flourished during the Malla Dynasty between 1200 and 1768.

The Mallas superimposed a grid pattern around the Kathmandu palace complex. The area grew into a dense, compact settlement, stratified by caste, with higher-class groups living closer to the palace and lower-class populations living towards the area's outskirts. Similar hierarchies were maintained in the streets and open spaces, with major open spaces and wider streets converging towards the palace square (Figure 1).

Figure 1. Naradevi location map



The residential areas were traditionally compact and dense, delimited by the city walls and walkable. Extended families belonging to same caste lived in clustered residential blocks comprised of three- to four-storey buildings surrounding courtyards, facing either the street or an open court (Figure 2). Mud, brick and wood were the local materials used in the valley, giving the buildings a vernacular aesthetic. The buildings were for private use while the ground floor opening towards the street had provisions for shopfronts and other business activities. The open residential courtyards were used for communal gatherings, household chores, playing, and similar uses, and were adequately ventilated and lit due to moderate building height.

The study site is centred on a residential block close to the city's major markets and to the main trade route with Tibet. The reason for investigating urban density in a traditional settlement is to capture the mechanisms used to attain high density in low-rise settlements with mixed uses. At present, the traditional morphology of the settlement is still intact within clusters of residential blocks and street grid patterns. However, the area has undergone significant transformation in its physical form, composition of dwellers and use of buildings. With native families preferring to live in the suburbs, these

settlements are becoming affordable rental units for low-income families.

However, there are serious issues of proper access, light, ventilation and toilets in these rental spaces. With increased density achieved in part through crowding, a lack of maintenance in old buildings, and inaccessibility to emergency vehicles, Naradevi is increasingly vulnerable to earthquake and fire. In addition, most of the new construction has not followed the height restriction according to the bylaws, which has also increased vulnerabilities. The older buildings have either been modified through vertical increments by using modern materials or have been completely replaced by new concrete structures). The use of modern materials to incrementally increase building heights to more than five storeys has in many instances disrupted the traditional aesthetic of the area and undermined the role of open spaces in maintaining ventilation and sunlight.

The population density of the Kathmandu Valley has increased drastically in as little as one decade due to immigration from other parts of the country during the insurgency period. It has also become heterogeneous; once a cluster of households from an extended family belonging to the same caste, the area is now

Figure 2. Courtyards in contemporary Naradevi



home to a mixture of people from different castes, speaking different languages, and holding various economic statuses.

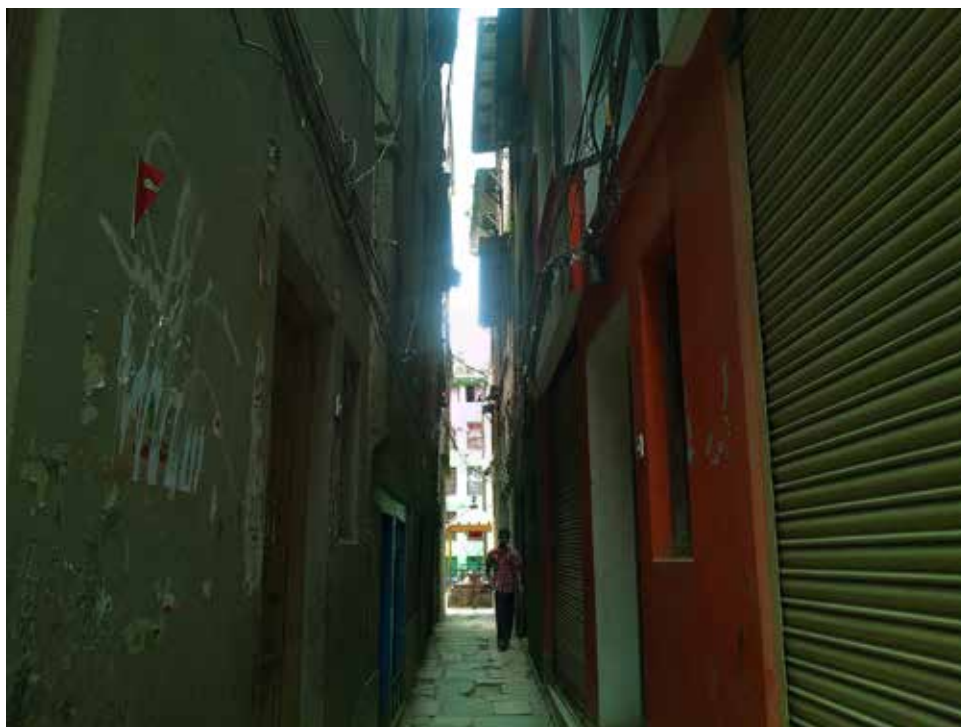
A team of five conducted surveys of a total of 100 households in the study site. The study site was bounded between the junction of Bhedashing and Bangemudha on the Y-axis (north–south) and extending parallel in the western direction, joining the junction with Tunche Galli, a street near the famous Naradevi temple. The boundary of the study area was also defined based on the approximate number of houses within the defined boundaries. To estimate the total number of houses within the area, a rectangular space was selected from the junction of the Naradevi temple to about 39.6m north and 51.8m east. Every house within the enclosed area, which is 1/14th of the total study area, was counted. As there were 67 houses within the area, the total number of houses in the study area was estimated to be approximately 940.

Both local owner-occupiers and renters were interviewed. Based on systematic random sampling, the team sought to interview every fifth house along the area’s main streets. But as inner courts were irregular in shape, the interviews were based on estimated proximity, so that a consistent distance was maintained while conducting interviews with two houses sharing a courtyard.

Walking through the streets at the present time is still a privilege as one can capture the ambience of traditional morphology with deep-rooted planning and building philosophies. However, as noted above, the picturesque quality of the streetscape has undergone visible changes as the homogeneity of buildings is disrupted by modern structures. Today, streets are narrower and courtyards are darker due to increased building height (Figure 3). In other instances, pedestrian streets with stone and brick pavement have radically changed into roads for two- and four-wheeler vehicles. This has resulted in conflict between pedestrians and vehicle users, accompanied by externalities associated with pollution and congestion.

Mixed uses with shops, medical clinics, small offices and compact residential units have infused diversity into the settlement. The current density of Naradevi is as high as 2,112 people per hectare, which excludes the population renting shops and office spaces but not residing in the area. According to the survey, 33 per cent of renters prefer to live in the area due to job opportunities and access to local businesses. Also, proximity to facilities, such as markets, hospitals, schools, and transportation (often within a 3-minute walking distance) has added value to the locality. Mixed uses with small shops and street vendors, religious temples at the street intersections, and narrow lanes opening to shared courtyards maintain the residential scale.

Figure 3. Narrow paths in Naradevi



By studying the streetscape, one can identify buildings of various types, some traditional, some modern and some a mixture of both. According to the field observations, 36 per cent of the buildings are new concrete structures, which have replaced traditional ones. 68 per cent of the buildings have mixed uses, for either commercial or rental purposes together with residences. Also, 20 per cent of traditional houses have signs of incremental growth. As the traditional compact residences could not cater to the spatial needs of residents, increasing height or reconstruction has been supported by more than 50 per cent of the total population. This has not only disturbed the physical homogeneity, but has obstructed light and ventilation to the central courtyard, creating a feeling of congestion. Therefore, the relationship between open spaces and buildings is a major factor determining the aesthetic and environmental value of the place.

Open courtyards within the traditional settlement are still the main socialising areas; one can observe people washing their clothes, children playing and elderly people sunbathing. The study site is comprised of 65 per cent built-up area, 9 per cent streets and 26 per cent open space in the form of courtyards. Children

in 58 per cent of households surveyed play in these courtyards, which are also actively used during feasts and for parking vehicles. Whilst these shared open spaces once belonged to extended families of the same caste, they are now shared by owner-occupier and rental populations of different castes, age groups and genders. Though some open courts are less maintained than others, most are well maintained by the surrounding community. According to the survey, 38 per cent of people prefer to live in the area due to its social environment and 40 per cent still prefer to live in houses around courtyards in new settlements. The value of open courtyards is evident; these have not only increased the physical value of the community, but have also contributed to a collective sense of social tolerance and inclusivity.

The inner streets within the study site are mostly for pedestrian use, with access by two-wheelers, while the main street passing through the area has four-wheeler access. Main doors of the houses opening towards the inner streets have prevented the creation of dark corners in the narrow alleys. However, these narrow alleys prevent access of emergency vehicles like fire trucks, ambulances, etc., which presents a clear threat to safety

Figure 4. Narrow access points under houses in Naradevi



during times of crisis. In some cases, the streets are too narrow, obstructing flow of more than one person at a time. The only access points for many open courts are narrow passageways underneath houses (Figure 4). Earthquake risk within the Kathmandu Valley calls into question whether these streets and passageways can be used as evacuation routes or rather are likely to trap people on their way out. Also, frequent maintenance of sewerage and water supply lines block the way, creating a nuisance for commuters. Surprisingly, 39 per cent and 37 per cent of those interviewed rated road access as good and moderate, respectively, even in the absence of direct road access. Along the main outer streets, pedestrian and vehicular movement is dense, with shops opening directly onto the street and with sporadic vendors obstructing traffic flow and creating conflicts between people and vehicles.

According to the survey, 50 per cent of respondents think their houses are not earthquake-safe and 12 per cent do not know about the condition of their houses, which is indicative of low levels of perceived safety in these areas. Field inspection showed direct risks from the imminent threat of an earthquake in the form of narrow streets, unauthorised incremental growth, narrow access to courtyards from underneath houses and degrading traditional houses (40 per cent of all the buildings were assessed to be in moderate condition and 12 per cent in poor condition). Many owners have moved to the valley's suburbs, with some renting deteriorating traditional houses to low-income renters. Moreover, land conflicts over ancestral property have led some owners to stop using them and allow them to fall into disrepair. There are many jointly owned properties that are subdivided and reconstructed. At times, these subdivisions are too small and left in dilapidated condition due to the lack of commercial return. These deteriorating and abandoned buildings, inhabited by renters seeking low rents, are considered a threat to their inhabitants and to people living nearby while also reducing the aesthetic value of the area.

Only 34 per cent of households had members involved in social groups and organisations, showing that the traditional *Guthi* system is dissipating, which may be due to relocation of the native population. However, new groups like youth clubs are emerging, which reflects the area's changing social composition. The survey shows that 38 per cent and 54 per cent of respondents gave high and moderate ratings, respectively, to the current social environment.

4.1.2 Lessons learnt and way forward

Based on the survey and field observations, a number of lessons can be learnt from traditional settlements. The list below summarises these lessons for both enhancing the physical and social ambience of traditional settlements and for developing new settlements in the future.

- As the housing preferences of higher-income families shift towards suburban areas, traditional settlements are becoming affordable to growing numbers of lower-income families and renters.
- Increased density (achieved in part through crowding), combined with inadequate access, light, ventilation and sanitation, is a growing concern in rental spaces. The need to improve living conditions must be balanced against the need to ensure that rental spaces remain affordable to lower-income groups.
- Crowding combined with a lack of maintenance in older buildings and limited accessibility to emergency vehicles has increased risk to earthquake and fire in traditional settlements. Risk reduction measures (eg integrating earthquake-resistant technologies into building codes and standards) are clearly required. But the measures must be made enforceable in a setting where private developers are accustomed to evading regulations, and the costs and subsequent rent hikes must be affordable to low-income groups.
- Future reforms to regulatory frameworks should consider what private developers and local residents (including owners and renters) are willing and able to afford. This could be determined through their engagement in participatory planning processes led by local authorities with the support of local NGOs.
- Densification can be accommodated in traditional areas where courtyards provide adequate sunlight and ventilation, but only where incremental building and new development do not overshadow courtyards or exceed other basic infrastructure and service capacities. Conversely, arguments for limiting or reducing density in crowded and overburdened settlements must not overlook the reality of housing scarcity.
- Courtyards are an important social and cultural amenity that can be used as a structuring element for developing new settlements that are dense, liveable and socioculturally appropriate.
- Mixed uses offer various economic and social opportunities as well as access to community facilities (eg hospitals, schools) and markets within walking distance.

- Incremental housing construction is an important practice among low-income households, as it addresses the economic and spatial needs of growing families. To improve incremental construction practices, built environment professionals should provide technical assistance to local builders on issues ranging from building regulations to fire safety and risk reduction, with the support of local authorities.
- Vehicular movement into the mixed-use, compact areas should be limited by preventing through traffic to encourage and increase the safety of pedestrians wherever possible.

The study's results have helped to formulate four approaches for addressing current issues in the settlement. Though all four approaches have pros and cons, they should help to frame discussions on how other traditional settlements in the Kathmandu Valley might be addressed by future planning efforts.

1. A radical way to create a disaster-resilient settlement is to demolish and redevelop the area through house/land pooling. However, this would have severe social, economic and environmental impacts. While potentially attracting the rich and middle-class, the process would also likely drive away poor renters and transform parts of the settlement from mixed-use to commercial uses.
2. A less radical way to reduce disaster risk in the settlement would be to lower density by strictly enforcing bylaws such that additional floors beyond permissible building heights would be demolished (in this case, those beyond 5 storeys). If these bylaws were strictly enforced, then the density of the settlement would be reduced from approximately 2,133 to 1,805 people per hectare. However, from a housing perspective, this approach has clear limitations because it overlooks the housing scarcity and the need to find alternatives to evictions for people living in illegal, non-conforming structures. This approach thus needs to be weighed against other approaches, including those promoting appropriate and affordable building retrofits.
3. A conservation plan that assesses the heritage value of the buildings and squares is a possibility. This would provide protection and regulatory guidelines for renovation and reconstruction to conserve and develop the area as a tourist destination, while minimising the displacement of the local population and service providers.
4. A much simpler solution is to protect the communal courtyards and adapt the bylaws to protect the

wellbeing of the existing low-income residents without causing unaffordable rent increases. This would involve new structural regulations for incremental building. It would also seek to reduce seismic and fire vulnerability of the traditional settlements to galvanise affordable solutions.

4.1.3 Hypothetical replanning of Naradevi

The study site lies in the cultural heritage conservation zone and is designated as a combination of the Preserved Cultural Heritage Sub-Zone, the major streets, the mixed old residential sub-zone and the residential cluster. Considering the area's close proximity to a UNESCO World Heritage Site, its economic potential to support a tourism-based economy deserves to be exploited. However, among the four recommendations outlined above, the fourth option is the most suitable for addressing the housing needs of Kathmandu's low-income majority. It focuses on fire and earthquake safety, height restriction and gradual upgrades while reducing density to acceptable limits, without undermining the liveability of this already dense area. If tourism development is prioritised in some parts of the area, this would likely lead to the displacement of low-income residents. However, if a mixed strategy is deployed, tourism development could provide local employment opportunities, while a more supportive policy environment for affordable low-income rental housing could limit the exclusionary pressures.

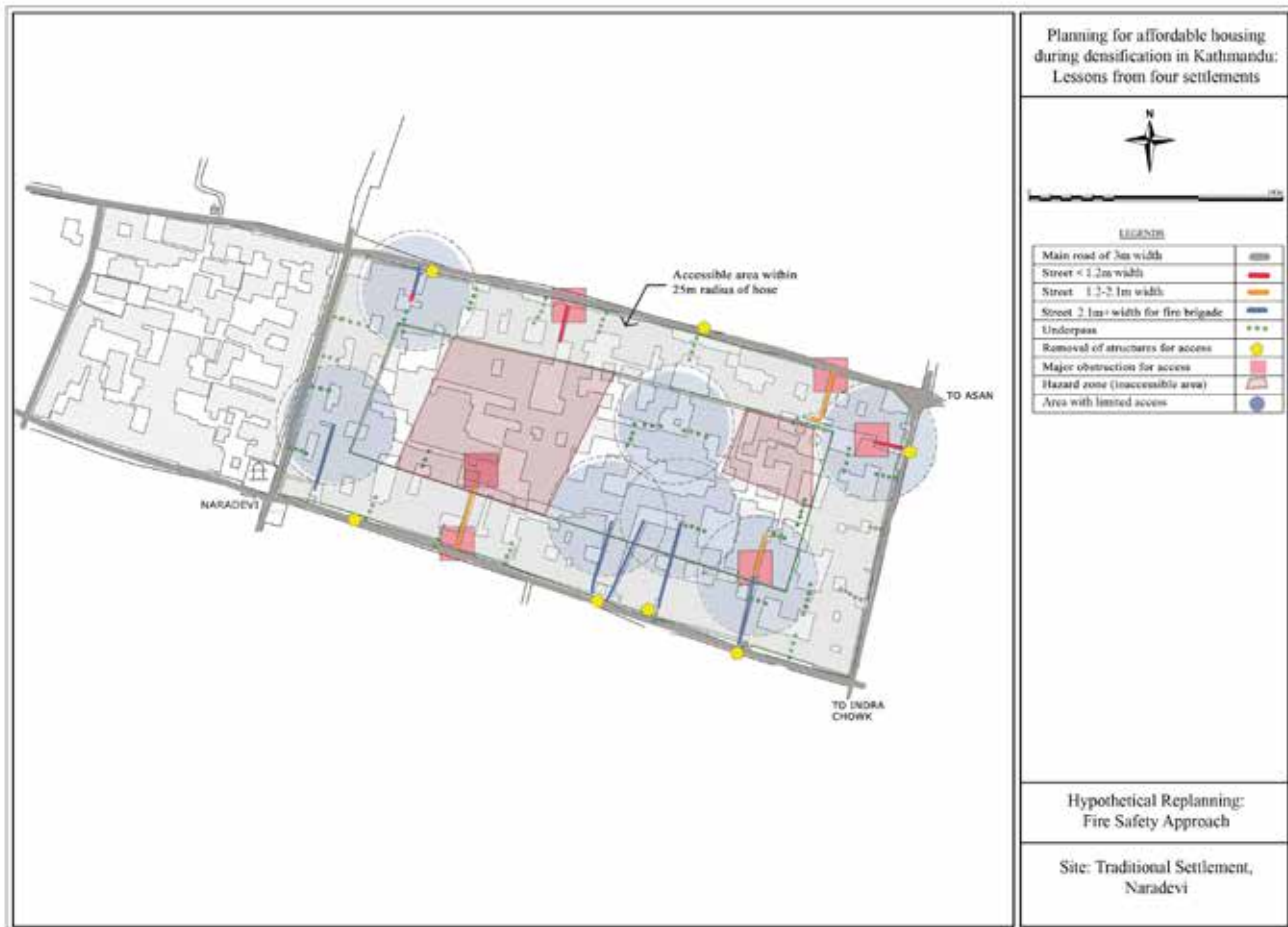
To support this option, a number of guidelines have been developed:

i) Fire safety approach

Based on the information from the Fire Brigade of Kathmandu Municipality, the minimum length of a water hose is 25 metres. Capacity and sizes of the fire engines also vary, ranging from 400 to 4,000 litres, with a minimum width of 1.7m.

Map 1 demarcates the area accessible within the range of a 25m-long water hose, which is thus a relatively safer zone. However, narrow inner streets and insufficient turning radius prevent a large fire brigade vehicle of 2.1m or above in width from entering the inner streets. So a smaller vehicle of 1.7m width and 400-litre capacity is the available option, which requires a minimum street width of 2.1m. Therefore, in this hypothetical remapping the inner streets have been divided into three categories: 2.1m+ width, 1.7m to 2.1m width and less than 1.7m width.

Map 1. Conceptual fire safety plan for Naradevi



The structures obstructing access to the 2,1m+ wide streets are identified, which include a small single-storey shop made of corrugated metal sheeting, a private shrine, private walls, a raised plinth, an uneven street level, a cow shed, and single houses with access to a wider street and a larger courtyard. These streets give access to some sections of the inner part of the block, which otherwise would not be accessible by the fire brigade. However, some major obstructions, like a series of interconnected buildings along the inner streets, block access to the inner courts, creating hazard zones that cannot be accessed by the fire brigade. Therefore, future planning efforts in the area need to allow access by fire brigade vehicles at a minimum width. Map 1 identifies some of the specific areas where future attention is required.

ii) Earthquake safety approach

In the area, there is an urgent need to properly assess the structural vulnerability of both old and new structures during seismic activity. Different types of retrofitting measures (eg reconstruction, addition of structural elements, reduction of loads, etc) can be explored to improve the earthquake resistance of buildings. For safety, communal open spaces and underpasses need to be given special priority while

retrofitting, as they are used as escape routes during earthquakes. Map 2 identifies major communal open spaces and underpasses that are likely to be used by local people, who will search for open space for evacuation and safe shelter during earthquakes.

Based on a study done by Ritsumeikan University, Japan and the Institute of Engineering, Kathmandu (2012), two simple techniques (as shown in Map 2) of strengthening load-bearing buildings have been proposed. These are: i) addition of vertical timber posts as an additional structural element along the inner walls at regular spacing, connected with horizontal timber beams at floor level, and ii) addition of horizontal concrete bands at lintel and beam levels in each storey, which are inserted as a structural element by partially cutting out the walls and tying the additional concrete bands to the walls with hooks. Columns are placed at the corner to support the concrete bands.

Similarly, research on strengthening reinforced concrete row buildings of four storeys or more and a single bay suggests an increase in wall thickness to 9 inches on all floors along the longer span of the building. Also recommended is replacement of masonry walls by reinforced concrete shear walls (walls with braced panels to resist horizontal loads) in the traverse direction

Map 2. Available open spaces and potential earthquake-resisting techniques in Naradevi



(Dixit and Shrestha, 2008). The cost per square metre of floor for such retrofitting was estimated to be US\$104 for the year 2008. With an average built-up area of 225m² (based on an average of 44.1m²/floor and 5.1-floor height), the total cost of retrofitting a typical house is about NPR 2,300,000, which is very high. Though the cost of retrofitting depends on the level of intervention, high cost is one of the major impediments that discourage people from adopting these techniques. In addition, since most buildings have been rented to low-income migrants by owners who have relocated to other places, the general absence of a sense of ownership and responsibility for the safety of dwellers makes expensive retrofitting techniques even more implausible. There is thus a clear need to develop more appropriate and affordable technologies for retrofitting in traditional settlements and new developments.

iii) Urban regeneration approach

As one walks along the streets of the study area, one can see many foreigners walking past, taking pictures of vendors, local shops and the bustling people of the area. The study area lies near a UNESCO World Heritage Site, and its ambience has significant potential to attract tourists. Since the buildings along the major street lie in the Preserved Cultural Heritage Sub-Zone,

there are specific bylaws to guide building restoration and reconstruction. Regeneration efforts could be initiated in a section of this zone through public-private partnership. Potential incentives could include the introduction of small grants and loans (subject to available public finance) for investing in building restoration in accordance with the bylaws. This could also encourage other tourism-related activities (eg lodging, restaurants, etc) and provide employment opportunities, among other spillover effects.

Urban regeneration should also address three critical issues inherent within the traditional mixed-used residential clusters:

1. Vertical division of the ancestral house between sons reduces the efficiency and value of the space. In addition, insensitive vertical division and reconstruction of half of the once intact single structure make these buildings structurally unsafe and architecturally incoherent. Therefore, either new property ownership mechanisms (which are now based on land only) or plot-size restriction should be used to discourage vertical division of the buildings.
2. In the study area, one can find old buildings in dilapidated condition, which are structurally

vulnerable, degrade the ambience of the place, and restrict use of valuable space. Institutional arrangements are needed that establish guidelines and a technical support system for regeneration of old structures, so that these buildings can be reused and rehabilitated to cater to various functions tied to the local economy. Similarly, financial incentives such as tax rebates, low-interest loans, infrastructure services and facilities can encourage local people to maintain and keep the old structures intact and functional.

3. The regeneration effort should also set guidelines to delineate spatial requirements for liveable conditions, services required, and minimum physical standards that need to be maintained to inhabit the structure. However, experimentation is needed to ensure that this will not result in housing unaffordable to low-income renters.

iv) Replication of mixed-use courtyards

Mixed use and high densities in traditional settlements can be replicated in other places, as this is economically viable in terms of provision of services, pedestrian friendly and socially inclusive.

1. Open spaces in traditional settlements have been successful in maintaining social harmony, and are actively used as public spaces. Such communal open spaces can be replicated in development of new settlements. Taking the case of the smallest plot of land of 80m² (2.5 Nepalese *aana*), and adhering to the regulations for other residential zones, such as 80 per cent ground coverage and 1.75 FAR, results in a 2.5-storey building. However, if the ground coverage is fixed at 60 per cent and FAR at 3, it results in four- to five-storey building with a ground floor area of 47.7m². If the land is plotted in a 1:2 width-length ratio, with width of 6.3m and length of 12.6m, the open space shared by the building in front will be 3.7m and at back 1.4m. If two buildings facing an open space contribute 3.7m each and the developer contributes another 1.8m, then the length of open space becomes 9.1m. This is more than sufficient as according to the light plane requirement of 63.5 degrees, a five-storey building of 2.7m floor height needs open space of around 7m in length for appropriate light penetration.
2. Bylaws on beautification of the buildings should be introduced to maintain scale, texture and external space for harmony in the built environment. However, they must take into consideration the affordable housing requirements of low-income groups to avoid any potential exclusionary impacts.

4.2 Sankhamul and Bansighat: Informal settlements

4.2.1 Sankhamul and Bansighat: Then and now

As people migrate to cities in search of a better life, they look for affordable homes. But in their absence, some are forced to live informally on vacant land without basic urban provisions. Eventually, these settlements expand in size and are called squatter settlements.

A small share of Kathmandu's population amount to more than 12,000 people live in 40 informal settlements, accounting for only 3–4 per cent of the city's population, but a significant share of the low-income populace (UN-Habitat, 2010). Most of these settlements are in high-risk areas, such as riverbanks and steep slopes vulnerable to flooding and erosion. Sankhamul and Bansighat are two of 13 informal settlements along the Bagmati River. They were chosen for this study to examine alternative housing options for low-income residents and how high-density housing can be achieved on small plots of land.

Sankhamul, also known as Buddha Marga, is one of the oldest informal settlements in Kathmandu. People have been living there since the mid-1960s. Before its settlement, the land was used as pasture during winters and would become flooded during the rainy seasons. In 1965, the area was occupied by 45 families that were not able to afford rental space in the city. They built their shelters using bamboo, plastic sheets and jute bags. At present, 110 houses comprise the settlement, which is in a rapidly growing urban pocket just 3.5km away from one of the major city centres of Kathmandu (New Baneswor and Thapathali). With the Bagmati River and the traditional cremation area to the west, Sankhamul has a mixed residential and commercial zone to the east. As a whole, the settlement encompasses an area of 2.1 hectares, with a blacktopped road separating it from the surrounding formal settlements in the east (Figure 5). The current density of the study area is 377 people per hectare, which also includes the rental population. According to the survey, respondents preferred to live in the area due to job opportunities, close proximity to facilities (within a five-minute walking radius) and adjacent schools, despite the looming threat of eviction.

Figure 5. Sankhamul location map



Bansighat is a comparatively newer settlement where people have been living since the late 1980s. The settlement is located next to the traditional cremation area with historical monuments, which has raised some concerns among government officials and conservationists. Compared to Sankhamul, Bansighat is more organic and haphazard, with the Bagmati River towards the south and an institutional and commercial area towards the north (Figure 6). The settlement occupies an area of 1.87 hectares with 115 houses. The current density of Bansighat is 432 people per hectare, which is higher than that of Sankhamul. As in the case of Sankhamul, respondents in Bansighat preferred to live in the area due to job opportunities, proximity to facilities (within a five- to ten-minute radius) and schools, even though they face a constant threat of eviction. Due to proximity to the city centres and lower rent, growing numbers of families are renting rooms in Bansighat.

A team of three was formed to conduct household surveys and interviews in Sankhamul and Bansighat. Both owner-occupiers and renters were interviewed during the survey. One hundred houses were surveyed out of 110 and 115 houses in Sankhamul and Bansighat, respectively. Using systematic random sampling methods, the team sought to interview every second or third house.

In Sankhamul, the houses are arranged in a row that opens out into the main road. At first glance, most of the houses appear small and dilapidated. However, the temporary structures are gradually being replaced by more permanent reinforced cement–concrete construction materials (Figure 7). According to the field observations, 14 per cent of the buildings are new concrete structures, while the remaining 86 per cent are either temporary or semi-permanent structures. With long narrow plots between 1.5 and 5 *aana* (48 to 159m²), the houses extend up to 20m towards the riverbank from the road. As families grew in size, people started adding rooms in the backyard, resulting in long, narrow houses. With small frontages and rooms aligned one behind another, all houses lack adequate lighting and ventilation. According to the survey, 16 per cent of the houses have signs of vertical incremental growth, which is likely to increase. This will contribute to overcrowding and other environmental issues and risks, which will be difficult to address at a later stage.

Compared to Sankhamul, Bansighat is a more compact and haphazard settlement, with narrow streets and houses of one or more rooms built in an area ranging from 1 to 3 *aana* (32 to 95m²). Temporary and semi-permanent structures, made with bamboo or brick walls and corrugated galvanised iron sheets as roofing material, are predominant. Most of the houses are

Figure 6. Bansighat location map



Figure 7. Concrete structures in Sankhamul



single-storeyed, while a few residents have refurbished their houses to semi-permanent double-storeyed structures without any structural considerations. According to the survey, 56 per cent and 31 per cent of the houses are of a temporary and semi-permanent character, respectively, while only 10 per cent of the houses are permanent structures (Figure 8). Fear of eviction is a key factor preventing investment in structures.

Sankhamul has a linear layout, with a single row of houses extending across the entire length of the settlement along the bank of the Bagmati River. On the other hand, Bansighat is a compact settlement with organic, narrow streets sitting on the riverbank. As an informal settlement, every square foot of land off the street is occupied with buildings, which results in a lack of open space within the settlement. There are, however, open spaces along the riverbanks that have become the main socialising areas for people. These spaces, besides being used by children as playgrounds, are used for household chores like washing clothes as well as sunbathing and chatting. According to the survey, children in 92 per cent of households interviewed in Bansighat and 70 per cent of those in Sankhamul play in these open spaces along the bank of Bagmati River, while 34 per cent children in Sankhamul and 15 per cent children in Bansighat play in the streets.

In Sankhamul, all the houses are aligned along the 5m-wide blacktopped road, with a few renting out the front room for commercial activities. In contrast, Bansighat has narrow and unpaved inner streets accessible to pedestrians and two-wheelers only, while the main street surrounding the area is wide enough for four-wheeler access. Despite the road conditions, 47 per cent and 43 per cent of people in Bansighat rate road access as moderate and good, respectively, while 32 per cent and 52 per cent of people in Sankhamul rate road access as moderate and good, respectively. All families in both informal settlements have access to electricity, communal water supply and toilets. However, sanitation and solid waste disposal systems need improvements because sewage lines in Sankhamul are directly connected to the river, while Bansighat lacks a solid waste disposal system.

With availability of most basic facilities, easy access to public transportation, prosperous markets, job networks and affordable rent, these informal settlements are also attracting low-income renters. 75 per cent of renters in Sankhamul and 60 per cent of renters in Bansighat are paying less than NPR 2,000 (US\$20) per month to rent a room. Another important aspect of these settlements is the social organisation and sense of community. 89 per cent of people in Sankhamul and 42 per cent of people in Bansighat are involved in social groups like women's groups, clubs or saving groups. This high percentage of resident involvement in social groups is

Figure 8. House made from temporary materials in Bansighat



indicative of strong social bonding and NGO activities. In addition, settlement committees have been formed to address social issues and bring programmes and training to the people.

With the threat of eviction looming, people do not see flooding and seismic hazards as major threats. According to the survey, most people think their houses are safe from earthquakes, and few said they were not aware of the condition of their house. Thus, 59 per cent and 44 per cent of people in Sankhamul and Bansighat, respectively, believe that their houses are safe from earthquakes. During field inspection, however, narrow streets, incremental growth and substandard construction raised issues of the community's high vulnerability to seismic hazards. According to residents, flooding is rare in both settlements, though experts disagree as Bansighat lies within a ten-year floodplain area (an area with a 10 per cent probability of a flood occurring in any given year).

4.2.2 Lessons learnt and way forward

The survey and interaction with people from informal settlements have helped to reveal the lifestyle and space requirements of lower-income people. Based on the survey and field observations, there are many lessons learnt for addressing housing and living conditions in informal settlements and for developing new settlements with the needs of lower-income groups in mind.

- Informal settlements play a key role in providing accommodation for people unable to afford rental space in other parts of the city. Whilst these people represent a small minority (3–4 per cent) of Kathmandu's population, they represent a significant proportion of the lower-income populace.
- Areas that offer easy access to economic opportunities (particularly livelihoods and markets), social networks, and basic services and facilities (eg hospitals and health clinics, schools, public transportation) within walking distance are top priorities for people living in informal settlements.
- Lack of secure tenure is a major obstacle for improving living conditions through upgrading housing and providing basic infrastructure and services. Tenure insecurity can thus undermine long-term planning, development and risk reduction objectives.
- Upgrading and resettlement options ought to be seen more as a means of resolving land disputes (particularly in situations where tenure is insecure) and less as a means of providing significant quantities of new affordable housing.
- Incremental housing construction is an important practice among low-income households, as it addresses the economic and spatial needs of growing families.

- Planning and regulatory frameworks are likely to continue to have exclusionary impacts on housing access so long as the needs and affordability requirements of lower-income groups are not taken into account.

4.2.3 Hypothetical replanning of Sankhamul

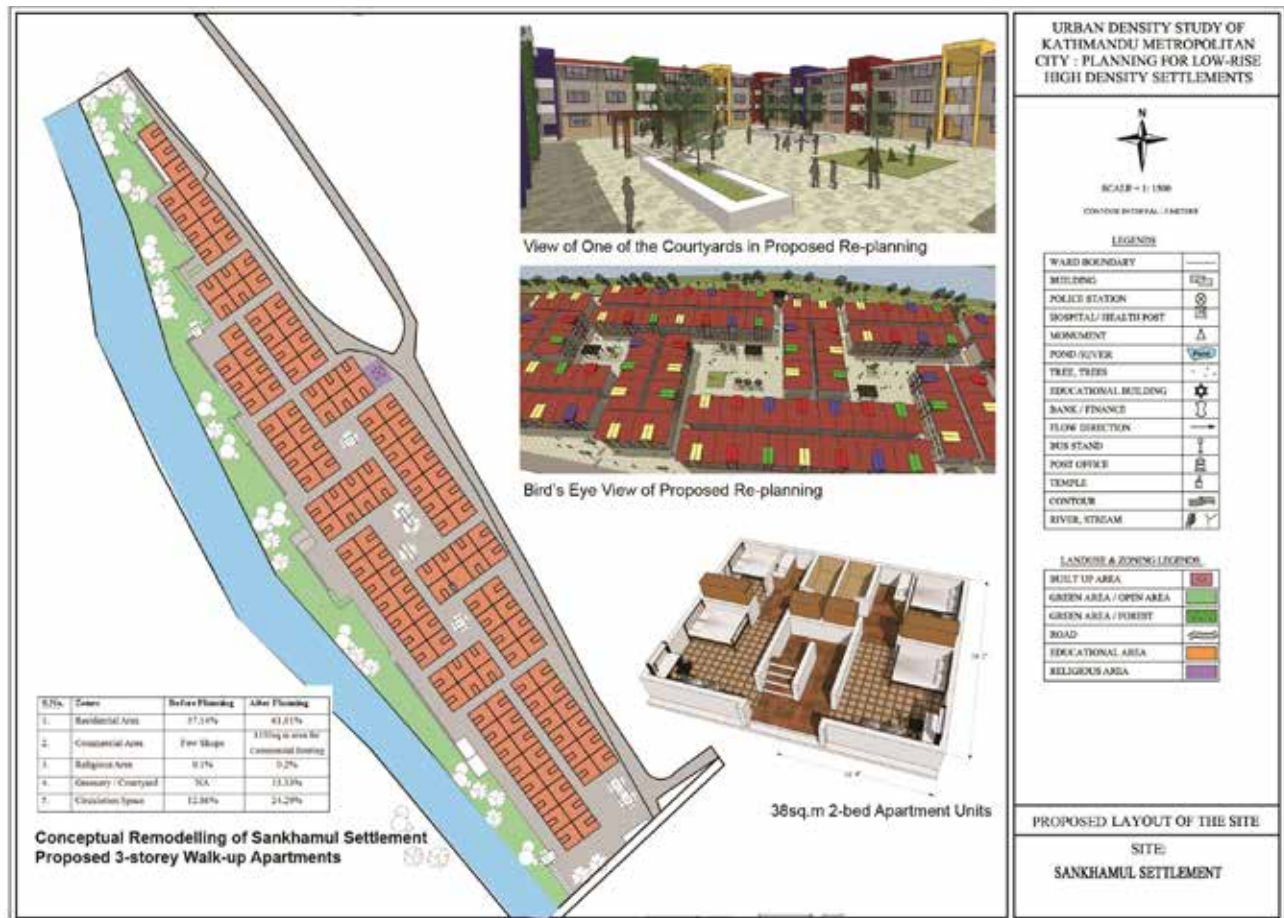
Sankhamul and Bansighat represent two of many informal settlements that are threatened with eviction, in part because of flood risk, but also because of the perceived threats these settlements pose to the nearby river and heritage sites. There is an immediate need for alternative housing options for residents of these communities. In settlements that are safe from natural hazards, such as flooding and erosion, alternative spatial and architectural arrangements can be explored in line with on-site upgrading, land sharing and densification. Based on the study results, a hypothetical re-envisioning exercise has been undertaken for Sankhamul and Bansighat to show how it may be possible to achieve risk reduction, river environment protection and upgrading. This remodelling is intended as a response to the particular combination of environmental and eviction risks, and not as a replicable contribution to addressing the shortage of low-cost housing in Kathmandu.

According to conservationists, the religious cremation area as well as surrounding historical monuments needs to be renovated and conserved by relocating the informal settlement from Bansighat. The settlement's location in a ten-year floodplain also makes it vulnerable to flooding during rainy seasons. Hence, a relocation plan to a safer location is one potential solution. However, this plan would need to be determined in partnership with the community to ensure that the needs, priorities and affordability requirements of low-income groups are taken into account.

Sankhamul is located on higher ground, decreasing the risk of flooding, and does not have historical monuments nearby. Thus, on-site approaches (eg upgrading, land sharing and densification) would be possible. However, the area's high densities and poor environmental conditions would make such approaches especially difficult. An alternative on-site option could include comprehensively redeveloping the area to include a new spatial and architectural arrangement featuring low-rise high-density building typologies, river environmental upgrading, strategically located open spaces and new services.

However, due to high land prices, individual houses on plots even as small as 30m² would become unaffordable for low-income households. A more affordable option could include higher-density ground-plus-two-storey walk-up apartments with floor areas between 30

Map 3. Conceptual replanning exercise for Sankhamul



and 40m². These apartments would be affordable to low-income households if adequate public subsidies were made available. Since Sankhamul is located near a riverbank, mid-rise apartments taller than three storeys would not be acceptable due to the low bearing capacity of riverbank soil.

Given this constraint, Map 3 provides a conceptual rendering of the densities that could be achieved by constructing three-storey walk-up apartments in Sankhamul. However, since these apartments are not guaranteed to be affordable for low-income groups unless subsidized, there is a clear need for a broader housing strategy that supports other options and approaches.

i) High density walk-up apartments

The objective is to achieve a mixed-use high-density plan that increases economic and social opportunities for inhabitants of Sankhamul. According to the survey, most inhabitants prefer a gridiron pattern, while few wish to live in courtyard houses. Courtyards are small open spaces surrounded by houses, which can effectively bring together people as a community, as seen in the traditional settlement above. Thus, during the hypothetical remodelling of Sankhamul, an effort was made to integrate courtyards into gridiron planning to

achieve a mixed-use compact courtyard plan that could also potentially increase the efficiency of supplying basic services. With facilities like schools and hospitals already available within walking distance, the project seeks to integrate local shops along the main street. The plan also maintains a 20-metre setback from the current riverbank, where a riverfront park and sewage treatment plant could be developed as a part of river environment upgrading.

This option could be supported by following guidelines for:

1. Open space: Courtyards can support circulation and the need for communal open spaces. The streets have been reconfigured in an attempt to facilitate pedestrian movement and non-motorised circulation to limit automobiles. As the sense of community is strong and the presence of an empowered and active community organisation is a special characteristic, providing open spaces to strengthen social interactions and provide a platform for people to come together is vital in these areas. Due to limited land availability and high land values, streets are a vital space that can be used by the community. Streets as public spaces can serve people of different age groups, such as play areas for children

and sitting areas for elderly people, which helps in bolstering social tolerance and creating a healthy social environment. Streets that promote pedestrian flows, street-level activities and mixed uses can also serve as a passive surveillance mechanism for helping to enhance safety and sense of place.

2. **Space allocation:** Based on field observations, the site lacks proper road access and open spaces. In replanning, the circulation area increases from 12.86 per cent to 24.29 per cent to ease accessibility within the site for serving a high-density area. On the other hand, with social public space a basic necessity, greenery/courtyard spaces have been integrated into the planning, which covers an area of 13.33 per cent. However, space was not allocated for educational purposes because the planning is being done in an area as small as 2.1 hectares and there are already schools available within walking distance. 38 ground-floor units along the main street are made available for commercial purposes.
3. **Population density:** One of the reasons to conceptually remodel the Sankhamul settlement into walk-up apartments is to achieve higher density, while integrating quality open spaces in the form of courtyards. In the proposed planning, 760 apartment units (38 ground-floor units to be turned into shops) have been achieved in 266 walk-up apartments, which can accommodate 760 families compared to 150 families that are currently living in 110 plots. The population density (residential population) of the area has increased from 377 people per hectare to 1,907 people per hectare.

Average family size = 5.27

Total number of residential units = 760

Total residential population = Number of residential units x average family size = 760 x 5.27 = 4,005.2 people

Total area of site = 2.1 hectares

Proposed residential population density =

$$\frac{\text{Total residential population}}{\text{Total area of site}} = \frac{4005.2}{2.1} = 1,907.24 \text{ people per hectare}$$

4. **Disaster-resilient planning:** Minimising the effects of disaster is one of the most important aspects to consider while planning and designing walk-up apartments in Sankhamul. A setback of 20m from the riverbank has guided planning for the settlement outside of the ten-year floodplain. In addition, creating a park in the setback area helps upgrade the river environment while protecting the

settlement from flooding and landslides. Earthquake-resistant planning and construction based on the National Building Code needs to be followed to ensure minimum damage during earthquakes, although this code may need to be reassessed if it imposes prohibitive costs that effectively price lower-income groups out of planned developments. Courtyards together with parks, aside from being socialising spaces, will serve as evacuation routes during earthquakes.

5. **Land regulations and building bylaws:** The current bylaws of 5 per cent ground coverage and 3 FAR, with minimum 4m setback, support mid- to high-rise apartments. However, the survey suggests that people prefer three- to four-storey walk-up apartments and individual houses. With high land prices in Sankhamul, individual houses on even small plots are unaffordable. Thus, we have proposed three-storey walk-up apartments with a minimum setback of 1.5m. This would require amendments to the bylaw to permit:

Ground coverage = 60%

FAR = 3

Minimum setback = 1.5m

Maximum height = 13.7m

6. **Housing design:** As noted above, walk-up apartments may be affordable to low-income groups if certain financial subsidies are provided. The proposed replanning supports 133 three-story apartment blocks with 760 apartment units and 38 commercial units. Each apartment with an area of 38m² has two bedrooms (containing two beds each), a kitchen and a toilet, as shown in Map 3.

ii) Individual houses:

According to the survey, the majority of people in Sankhamul (84 per cent) and Bansighat (79 per cent) prefer to live in three-to-five room houses on 50–100m² plots, while few people prefer to live in walk-up apartments. Thus, the option proposed above does not conform to what the residents consider most desirable. However, as previously mentioned, high land prices mean that individual houses on plots as small as 30m² would be unaffordable, unless sufficient subsidies were made available.

On the other hand, individual houses could have a number of advantages: i) it is cheaper to build houses (the average apartment cost is US\$5,000, to be repaid by owners over time); ii) people can build on their own or participate in the building process, which could foster community cohesion; iii) residents can carry out economic activity in their homes more readily; and iv) future maintenance of the property would be easier

as it would be the responsibility of one family rather than several.

Constructing individual houses would yield lower densities than low-rise apartments. After deducting a circulation space of 25 per cent, 234 double-storey homes could be accommodated on plots as small as 32m². At 5.27 persons per family, this would yield a density of 1,233 persons per hectare. However, owners would have the option of incrementally building a second floor (as a rental or for additions to the family), thus increasing the density to a minimum of 1,708 persons per hectare. The pros and cons of houses versus apartments need to be further studied through a design exercise that takes social, environment and economic factors into consideration.

4.3 Khusibu: Land-pooling project

4.3.1 Khusibu: Then and now

The Khusibu study site is situated on the outskirts of the urban core and was historically protected by the fortified walls of the city for agricultural purposes (Figure

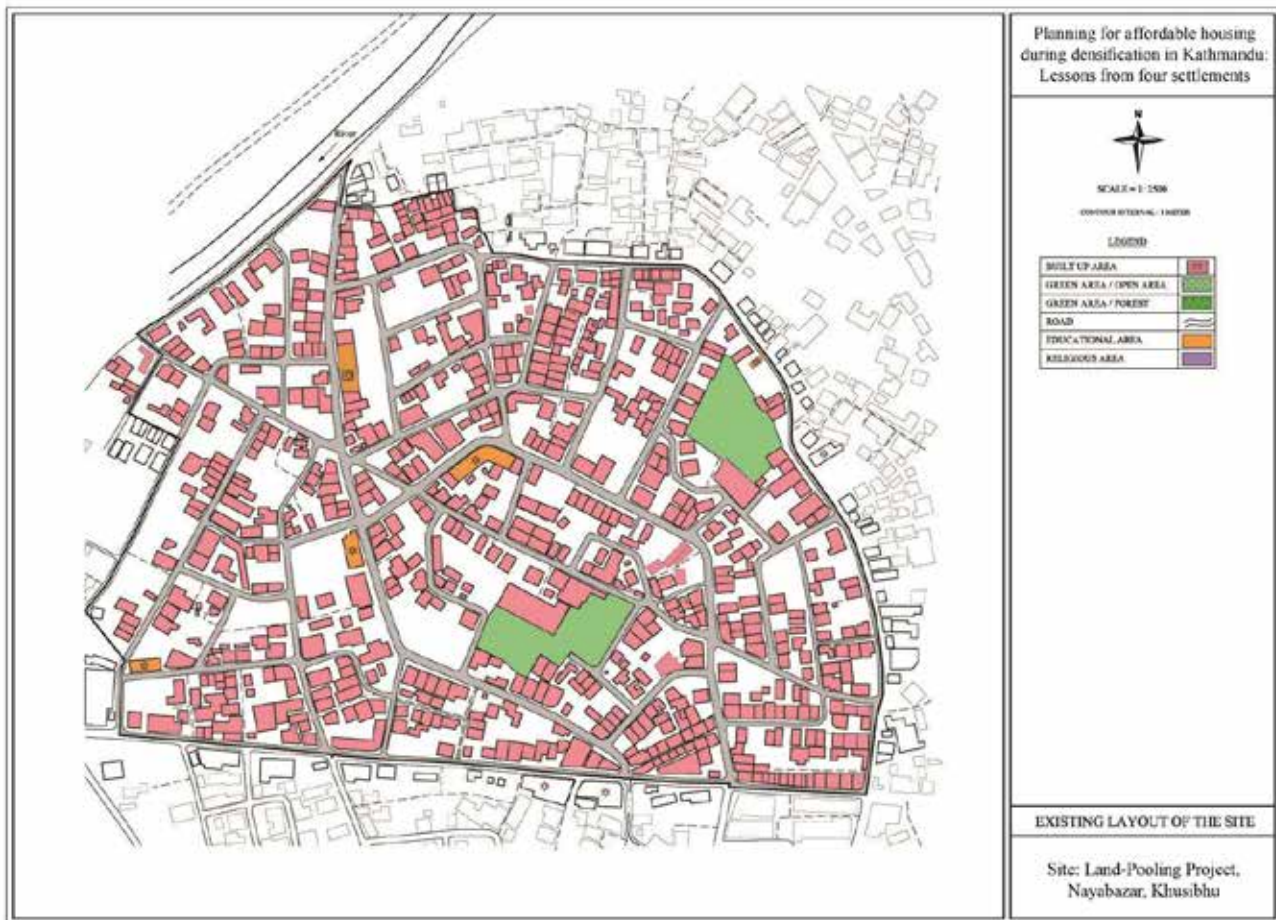
9). Even before 1995, when the land readjustment project began, the site was still used for cultivation. With few houses in the area, infrastructure was not developed except for a 3m-wide east–west road and a 3.5m peripheral road. The increasing pressure of urban growth and proximity to the city centre naturally led to the land of Khusibu absorbing urban sprawl. Foreseeing the pressure of urbanisation, the government initiated a land readjustment project for the planned development of the area.

The Khusibu Land Readjustment Project (NLRP), which was scheduled for three years, was accomplished in five years at an approximate cost of US\$1 million (Pradhan, 2000). The project area spreads over 42 hectares within ward numbers 16 and 17. Following the principles of land pooling, the project was initially designed to regulate plot shape and size with road access, followed by other facilities, depending upon the land contribution from the individual landowner. Prior to the project, there were 393 houses and 1,051 land parcels. The plot size ranged from 130 to 150m², with some plots as small as 90m². 95 per cent of the plots had private owners, who were traditionally farmers. 58 per cent of the owners and their families were the sole inhabitants of their houses, while 31 per cent rented out rooms.

Figure 9. Khusibu location map



Map 4. Khusibu existing settlement



When categorised by function, 85 per cent of houses were used for residential purposes while 12 per cent were used as residential–commercial buildings. After land readjustment, 70 per cent of the land was adjusted into regular-sized plots, 21 per cent was developed as roads, 4 per cent was allocated as open space (as per regulation) and another 4 per cent was assigned for development of services (Map 4).

The planning was governed by existing infrastructure – ie peripheral and east–west axial roads and some existing houses served to guide the readjustment process. Hence, a concentric plan was devised with access roads at regular intervals. At present, about 60 per cent of plots planned for residential purposes have been developed while other plots have been held for speculation. Few old houses are still standing in the area, and most new houses are four–five storeys tall. Though a discernible architectural style is largely absent, certain elements have been repeated in almost every house, like a peaked roof, slopes, parapet design, aluminium windows, etc (Figure 10).

A gym was built to serve as the central communal space and a playing field demarcates the edge of the site. Except for these two communal facilities, space has not been allocated for educational or recreational purposes.

However, a large number of private educational institutions emerged following the readjustment project.

Once a homogeneous society of Maharjans (the farmer group), the area is now a heterogeneous society with people from different castes, speaking different languages, and from different socioeconomic backgrounds. The proximity to the city core and lush green hills in the distance has attracted people to this locality even though NLRP has increased the price of the land by 1.8 times.

This land-pooling site was selected for the study to better understand the level of densification that can be achieved without compromising on living standards and to assess the implications for accommodating Kathmandu's future urban growth and expansion. The study area spreads across 20.35 hectares and is delimited by the peripheral road and the main public road along the east–west axis that separates two wards. The area has a total of 710 houses, but also many unbuilt plots.

A team of three members conducted surveys for a total of 100 households. Both owner-occupiers and renters were interviewed. Using systematic random sampling

Figure 10. Row houses in Khusibu



methods, the team sought to interview every sixth house in the study site.

Based on the field observations, the area has mixed uses, including shops, small offices and rental units. The region is also located close to the main tourist centre, Thamel, and retains an active traditional marketplace. Furthermore, it provides housing for renters whose jobs are in the city centre. According to the survey, 40 per cent of renters prefer to live in the area due to job opportunities. Similarly, proximity to facilities like markets (within three minutes' walk), schools and transportation is significantly appreciated by the dwellers. Mixed uses with small shops and street vendors, as well as minimal vehicular traffic (except along the main public vehicle route), are among the settlement's most desirable features. Current trends show that settlements designed for single purposes (eg residential) gradually transition into mixed-use settlements, which reflect broader social and economic dynamics in the city. However, the project seems to be guided by the landowners' demands for land along major commercial streets. Field observations revealed a general lack of sufficient separation among residential, educational and commercial streets, resulting in widespread through traffic. In addition, the lack of landmarks and the presence of monotonous streets make navigating the area confusing.

According to the survey, 96 per cent of the buildings in the study site are concrete structures and 18 per cent of houses have signs of incremental growth, mostly vertical. In addition, most of the buildings have violated the building bylaws (Figure 11). Most buildings

are three–five storeys, with shops on the ground floor, renters on the first and second floors, and owners on the top floor. The current FAR for residential building in the land-pooling area is 2, while maximum ground coverage is 80 per cent. However, three- to five-storey buildings have FAR as high as 4. Informality in the rental market has provided the additional floors as rental space for the lower-middle and lower-income groups. Almost all of the surveyed buildings have 80 per cent ground coverage with 20 per cent open space, merely for minimum setback from the road. Most of the houses lack a proper open and green area within the compound, and even roads lack trees, which has led to a dry and grey appearance.

The study site lacks open spaces that serve for socialising. 46 per cent of children in households surveyed play inside houses, 28 per cent on the streets, and 8 per cent in playgrounds. People also use the empty plots and road for sunbathing, chatting, parking, etc. The only public space available is a football ground, which is mostly used by youth. There are no parks or playgrounds for children and older people. Only 4 per cent of the total area is allocated to open space. The only available greenery comes from trees planted near riverbanks and residences with rooftop gardens. According to the survey, 34 per cent of people prefer living in the area due to its social environment, which does not appear to be limited by the absence of open spaces.

After land readjustment, almost 21 per cent of the total area was allocated for roads. The main roads are 8m

Figure 11. Examples of building bylaw violations in Khusibu



wide and the secondary roads vary from 2.5m to 6m. In the surveyed area, 4.6km of 8m-wide road, 2.3km of 6m-wide road, 1.5km of 4m-wide road and 0.6km of 2.5m-wide road exist. The roads lack demarcation for pedestrian and green areas, which has resulted in conflict between vehicles and pedestrians and has increased usage of the road for parking. The condition of the paved road is also unpleasant as dust and dirt have degraded the area's environment. During the survey, 19 per cent of the interviewees mentioned air pollution and 12 per cent pointed to poor road conditions as the major problems. Drainage is also causing irritation as surface water drains overflow and roads with potholes become inundated during the monsoon season (Figure 12).

Road access to every house is a major pull factor as 67 per cent of people consider road access in the area to be good, despite their condition. Also, public transport facilities within ten minutes' walk is a plus as 29 per cent of people like the public transportation facilities in the area. Public transport remains popular along the east-west road connecting Sorhakhutte to the other side of the Bishnumati River. Lastly, the easy walk to the city's centre makes the area a desirable place to live.

A land readjustment plan requires land to be acquired from the owners. A successful land-pooling project thus entails co-operation among owners, local dwellers, community organisations and the government. Social organisations have important roles in the land readjustment process in representing the voice of local people. According to the survey, 23 per cent

of the people are involved in social groups and organisations. However, only 7 per cent are involved in the neighbourhood committee, which may be due to floating populations – ie most of the people in the area are renters who are not involved in land pooling and may feel excluded from organisations set up during the process. Interestingly, 11 per cent of respondents are involved in co-operatives, 4 per cent in *Guthi* and 3 per cent in women's groups. The youth group looks after a local gym, which serves as the main community building. A separate building has been built as the community centre, mainly for special gatherings and feasts, but most residents are unaware of this development due to the building's off-centre location.

Of the respondents, 41 per cent think their houses lack earthquake resistance and 13 per cent do not know about the condition of their house. 46 per cent believe their houses to be safe from earthquakes even though they are not built with earthquake-resistant technology. Also, during field observations, 68 per cent of the houses were deemed to be in good condition and only 3 per cent of the houses were in deteriorating form.

4.3.2 Lessons learnt and way forward

In general, the land-pooling projects have both positive and negative externalities. The aim here is to build on the community's strengths for planning better settlements in land-pooling areas.

Figure 12. Drainage problems in Khusibu



Advantages of land pooling

- Reduces infrastructure cost compared to providing infrastructure in a spontaneous settlement
- Provides an opportunity to combat unmanaged urban sprawl by avoiding 'leapfrog development' in which land on the periphery of an urban area is developed, leaving large land parcels between the periphery and the city centre vacant. In this way, land pooling projects can also play a role in shaping the densification and consolidation of peripheral areas
- Clarifies land ownership, which can lead to increases in public revenue collection through municipal taxation
- Increases access to plots if administered with the affordability requirements of all income groups in mind
- Caters to physical and social infrastructure despite varying income status, and
- Provides opportunities for government officials and residents to discuss whether bylaws and regulations are appropriate and realistic for all income groups.

Disadvantages of land pooling

- Increases land values through the conversion of agricultural land into urban uses, which could displace lower-income groups
- Encourages land speculation (in the study site, only 60 per cent of plots have been constructed since 1995)

- Requires human resources in terms of both numbers and qualifications as land readjustment requires private–public co-operation and negotiation, and
- Increases the potential difficulty of upholding the rights of all stakeholders (particularly where renters and other floating populations are prevalent) given the variety of interests involved.

Lessons learnt

Based on the interviews and field observations, there are many lessons to be learnt for planning future land-pooling projects, which may also be relevant to other new developments in the Kathmandu Valley.

- Increased property values in land-pooling areas could make land less accessible to lower-income populations. This highlights the need to ensure that bylaws and regulations do not work to further price low-income groups out of new developments.
- Social organisations represent the voice of local residents and thus have important roles to play in the land readjustment process. However, renters tend not to be involved in such organisations in part because they may feel excluded from the process. As a result, renters may need to be actively sought out and encouraged to participate to ensure that their needs and affordability requirements are considered.
- Bylaws and regulations are often violated to build additional storeys. These storeys provide rental units for lower-middle and lower-income groups that might

not otherwise be able to afford housing in land-pooling areas.

- Given that most bylaws are violated in Kathmandu, land-pooling projects present opportunities to test deviations from current bylaws and to discuss their impacts and implications with land owners, private developers and local residents. Such experiments could yield valuable lessons and innovations that could be applied to the implementation of more appropriate and realistic bylaws in future land-pooling projects as well as other developments. They may also yield insights into how communities and private developers can be engaged in more participatory planning processes.
- Areas that offer easy access to economic opportunities (particularly livelihoods and markets), social networks, and basic services and facilities (eg hospitals and health clinics, schools, public transportation) within walking or reasonable commuting distances are top priorities for residents in land-pooling areas.
- Mixed uses with high density and small- to regular-sized plots can enhance the cost efficiency of providing infrastructure (eg electricity, sewerage, water, roads). However, infrastructure investments

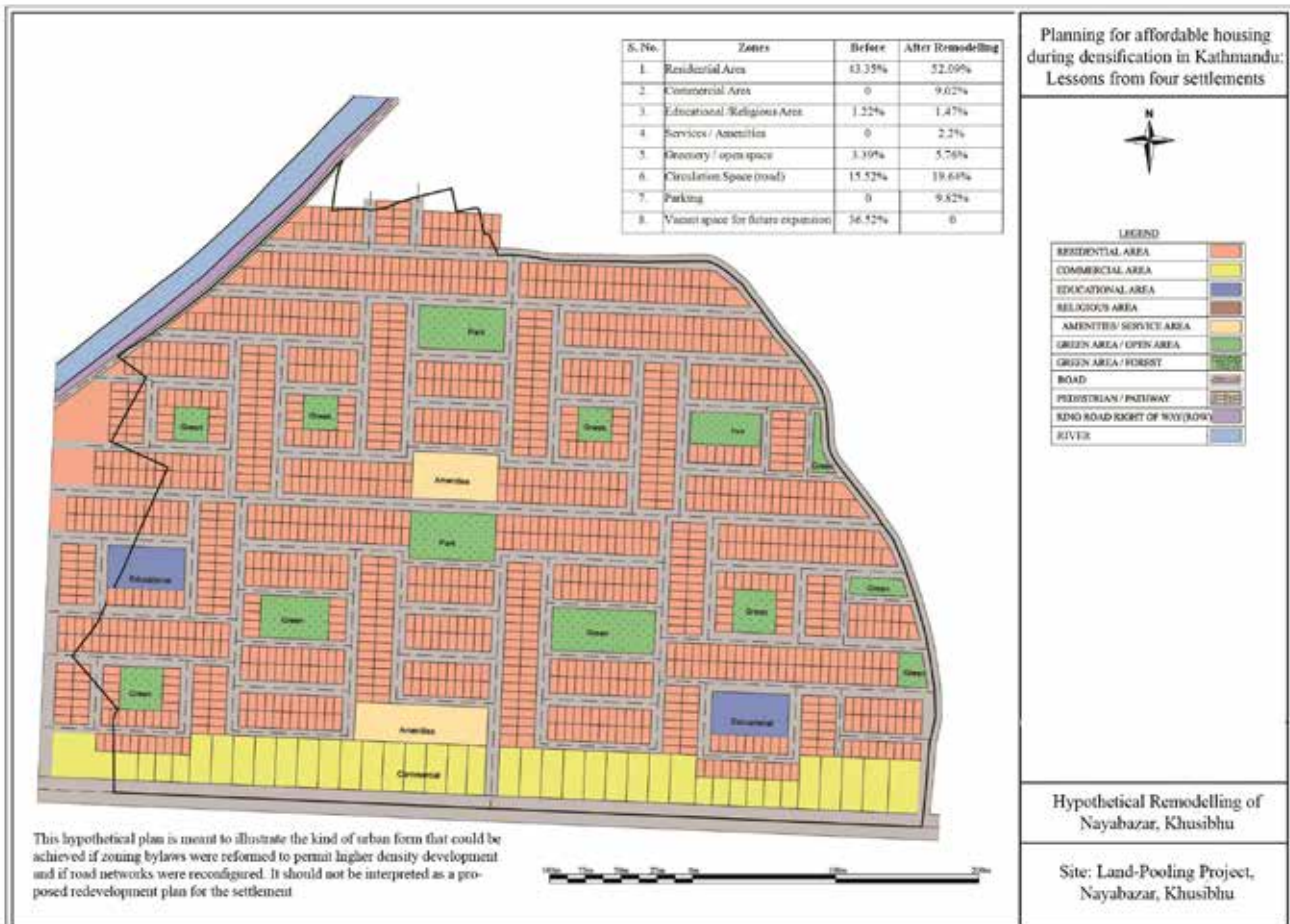
must anticipate future demand, particularly related to incremental growth.

- Incremental growth meets the spatial needs of growing low- and middle-income families. To improve this practice, built environment professionals (eg planners, architects, engineers) should provide technical assistance to local builders on important issues (eg building regulations, fire safety, disaster risk reduction) with the support of local authorities.
- Rather than allocating large open spaces, small-scale communal open spaces integrated within neighbourhoods (eg courtyards) can meet the social needs of the community.
- Hierarchies of roads are needed, with segregation of commercial plots along the main streets and residential plots along the secondary streets without heavy traffic.

4.3.3 Hypothetical replanning of Khusibu

The main objective of this exercise is to plan a low-rise high-density settlement that can provide affordable housing, including for renters, without compromising overall living standards. The conceptual remodelling,

Map 5. Conceptual replanning exercise for Nayabazar



informed by the lessons outlined above, has envisioned altered spatial patterns, plot sizes and space allocation in the study area (Map 5). There is no expectation that the area will be redeveloped to conform to the recommendations of this replanning exercise, but only that this will provide lessons both for the Khusibu area and for future replanning exercises.

i) Planning pattern

According to the survey, most of the people preferred gridiron patterns, and some preferred courtyard planning. Hence, a gridiron pattern in combination with integrated courtyards has been selected for this remodelling exercise. The main aim is to promote an asymmetrical gridiron pattern to break monotony through non-repetitive blocks, as illustrated by Map 5. For promoting social interactions, public open spaces are integrated within the blocks. Revenue-generating commercial spaces are allocated towards the main transportation axis, while a residential zone occupies the rear side. The survey found that people preferred to walk five–ten minutes for shopping. Hence, within the residential zone, formally commercial public spaces (kiosks, cafes) are allocated at walking distance to promote mixed-use planning.

ii) Circulation

The main access to the site is from three roads – namely Ropeway Sadak (parallel to Bishnumati link road), Indrayani Sadak (road adjacent to the Bishnumati River) and Pahikwo Sadak (peripheral road segregating the land-pooling area). During remodelling, the width of the main commercial road (Ropeway Sadak) was increased to 18m and the existing Indrayani Sadak remained unaltered, as this road is located parallel to the Bishnumati Riverbank.

The remodelling of three major circulation roads is assigned for this specific residential zone: first, the road alongside the river; second, the central road in between the residential areas; and third, the peripheral road, as shown in Map 5. The internal residential streets are retained at widths of 9m and 6m. The 9m-wide roads also accommodate a paid parking lane. The land coverage of roads located within the study area after readjustment was augmented from 16 per cent to 19.6 per cent due to the increment in road width.

iii) Space allocation

In existing conditions, space allocation and use are inefficient. One of the major drawbacks of the existing planning scheme is the restriction of residential planning with no space for commercial activities. Clearly, roads attract commercial activities. Hence, shopfronts should have been developed along the street converting the residential land-pooled site to mixed-use. So keeping this in mind, a mixed-use residential plan is developed conceptually that restricts the major commercial space

alongside the main vehicular road (Ropeway Sadak), as the commercial zone contains traffic and congestion, as illustrated in Map 5. 9 per cent of the total area is assigned for commercial use. This excludes the small kiosks and cafes inside the residential area. This commercial space acts as a revenue generator that would serve the population. Also, the road system has been redesigned to restrict the sort of traffic likely to support high levels of commercial activities from the residential areas away from the main road, as shown in Map 5. This can also be done by creating cul-de-sacs.

The residential zone is on the rear side of the commercial zone, which is planned for low-rise high-density development with three families per plot. This helps to increase the total built-up area from 34 per cent to 57.42 per cent. Also, the main point of remodelling is to increase accessibility of societal amenities and open spaces. Hence, instead of a large portion of open space located on a corner, open/green spaces are allocated in every neighbourhood block. The coverage of open space is increased from 3.4 per cent to 5.7 per cent.

Similarly, educational facilities are allocated to two corners considering a minimum walking distance of two–five minutes from each neighbourhood. According to the survey, 21 per cent of the population is below 16 years old and 43 per cent of the population is 16–35. The average number of people per plot is 14. There are 1,433 plots in total. So the total population on 20.38 hectares is 20062 people. Hence, 4,072 are below 16 years old who go to school. As 1.5m² space is the standard area required for a student, 6,108m² of total area is required for the 4,072 children who are under 16s. With three-story buildings, there is a need for approximately 2,019m² of educational area and in the conceptual replanning, a 2,996m² area has been allocated for educational purposes.

The central circulation axis has demarcated the residential zone into two neighbourhoods. Hence, a park and community block is designated in each neighbourhood. For better usage, parks and social amenities are centrally located. The educational facilities and amenities are increased in this exercise from 1.22 per cent to 3.67 per cent. The modifications in space allocation before and after remodelling can be better observed in the table on Map 5.

iv) Population density

The total number of residential plots is increased from 710 to 1,385. Assuming 14 persons per plot, the residential density of the area is increased from 526 people per hectare to 1,046 people per hectare.

Based on survey, average family size = 4.57

Total number of residential plots is increased to 1,385

Proposed families per plot = 3 (1 house owner's family and 2 renting families)

Number of proposed people per plot = $3 \times 4.57 = 13.71 = 14$

Total residential population = Number of residential plots \times proposed people per plot = $1,385 \times 14 = 19,390$ people

Total site area = 20.38 hectares

Total site area excluding commercial space = 18.53 hectares

Proposed residential population density = 1,046.41 people per hectare

Based on survey, existing residential population density = 526.48 people per hectare

Hence, the imagined redevelopment of Khusibu would considerably increase the residential density of this area by 519.93 people per hectare. This suggests that more people would have access to better infrastructure and diversity in land uses. Middle-income groups would be able to buy the land and build houses with rental flats for lower-income groups.

v) Disaster-resilient planning

There are various natural disasters that severely threaten the longevity of a project such as earthquake, fire, landslide, flood, drought, etc. Disaster-resilient planning approaches support the coping capacity of the system in the face of sudden shocks and stresses. Among these disasters, earthquakes present an impending threat for Nepal. Preparedness and awareness amongst local residents along with effective implementation of the National Building Code can rectify the effects of earthquake to some extent. Hence, green spaces are planned in such a way that they would be fit to serve as collection and recovery sites in case a disaster strikes.

Total residential population = 19,390 people

Collection site area = $3.5m^2$ per person = $67,865m^2$ required for all

Evacuation site area = $10m^2$ per person = $193,900m^2$ required for all

Provided area for collection site = $31,759m^2$ = area serving 9,074 people (47% of total population)

Since the site is not large enough for an evacuation area, it is recommended that the road adjoining the Bishnumati River be used as the evacuation area.

vi) Land regulations and building bylaws

As per the current building bylaws and land regulation,

$FAR = 2$

Ground coverage = 60% to 80%

Minimum plot size = $80m^2$

Minimum frontage of plot = 6m

But the survey indicated ground coverage up to 90 per cent and FAR of 3–4.

Hence, in the conceptual remodelling the FAR is increased to 3 so as to escalate revenue generation for the local authority and maximise rental space. The minimum plot size is decreased to $72m^2$ (with frontage of 6m and depth of 12m) to maximise the plot numbers and density. These interventions reduce the cost of land and increase the number of plots needed to better serve the population.

As per the proposal, with a minimum setback of 1.5m on either side of a plot (front and back), the maximum ground coverage possible is $54m^2$ out of a $72m^2$ standard plot size. Furthermore, provision for three families per plot – the ground and first floors for renters and the remaining second and third floors for owners – suggests a maximum of a four-storey building. This will require a new FAR and ground coverage.

So according to our proposed building bylaws:

Ground coverage = 75%

$FAR = 3$

Proposed plot size = $72m^2$

Maximum permissible total floor area = $216m^2$

vii) Individual house plan

The survey indicated that the majority of people desire a house of $92.9m^2$ with three bedrooms. Hence, a minimum plot size of 6m x 12m ($72m^2$) is allocated and a row house (also known as a terraced house or townhouse) was designed to show that higher density can be achieved on smaller plots without compromising on liveability (Map 6). As the average family size is 4.57, and three families would inhabit each plot, a maximum of 14 people could inhabit each building. This suggestion for two renter families with four people each and an owner family with five–six people requires a building of three–four storeys. Two floors would be rented and the remainder would be used by the owner for a residence. A simple two-bedroom home with an attached – kitchen per floor was designed. The ground floor includes a porch, a staircase, two bedrooms and a hall kitchen. The second floor includes three bedrooms and a hall kitchen. The remaining two floors have spaces to be allotted as per the comfort of the owner.

Map 6. Conceptual floor plan for Nayabazar



4.4 Chabahil

4.4.1 Chabahil: Then and now

Chabahil holds a significant place in the history of the Kathmandu Valley. It is named after Charumati, daughter of King Ashoka, who in the 3rd century BC built the oldest Buddhist stupa in the Kathmandu Valley. The location is still a site of worship by the city's patrons and attracts pilgrims every year (Figure 13). The presence of a popular Hindu temple in the proximity of a rapidly developing settlement reflects the importance of taking account of social harmony and religious tolerance in guiding Kathmandu's development. Historically located on the outskirts of the city, Chabahil is now a bustling area that has captured the spillover impacts of population growth and urban expansion (Figure 14). It

is now located at the periphery of the ring road, which was created in an attempt to ease traffic of the core city by having a road around the city boundary. In the land-use plan of Kathmandu, Chabahil lies in the Urban Expansion and Residential Zone and Other Residential Sub-Zone. Due to population pressures, the city has grown past the ring road and yet another outer ring road is currently being formulated. Currently, Chabahil can be regarded as a part of the city centre that reflects the spontaneous and haphazard growth of the Kathmandu Valley, driven by rapid urban growth coupled with poor planning practices.

The study site is a part of the Urban Expansion Zone adhering to the periphery of the ring road. The reason for studying urban density in Chabahil is to analyse whether it would have been possible to attain higher density and better living conditions than is emerging

Figure 13. Chabahil location map



Figure 14. Chabahil landscape



through Chabahil's haphazard development through planned interventions, with or without land pooling. The area is irregular in shape, bounded by the ring road along the west, with the Chabahil junction to the northwest, while a forest borders the southeast corner. The remaining three sides follow the winding roads to demarcate an area of 22.57 hectares with 844 buildings.

A team of four members conducted household surveys of 100 households in the selected area. Systematic random sampling methods were used to interview a respondent from every seventh house, and if the building was institutional, the building immediately next to it was sampled. Both owner-occupiers and renters who lived in the area were interviewed.

Chabahil underwent unplanned growth early on; therefore roads are irregular in size and non-linear, attempting to serve land of irregular sizes and shapes. Houses are built along the road in a haphazard manner, creating a cluster of settlements that lack a pattern and are confusing to navigate (Figure 15). Based on the survey, the average number of people living in a plot, with two households per plot, is 11.02. As there are approximately 840 households, the total population is roughly 9,257 and the population density is 410.14 people per hectare. The population is still on the rise as more than one fourth of the land is still vacant and serves as the Urban Expansion Zone that attracts both locals and migrants. According to the survey, only 25 per cent of the landowners inherited land. In general, 22 per cent chose to live in the area due to its close proximity to their workplace; 16 per cent due to their friends and family living nearby; 12 per cent due to availability of physical facilities; and 10 per cent due to the Pashupatinath Temple nearby.

The residential area has an overlay of commercial, institutional and industrial uses. Based on the survey, 11 per cent of the buildings have commercial uses and 52 per cent have rental units together with residences. The total ground coverage by buildings is calculated to be 35.03 per cent, the public open area 2.81 per cent, the educational and religious area 3.26 per cent, private open spaces around the houses to meet the bylaws 18.39 per cent, circulation space (roads and

streets) 11.66 per cent, and vacant plots (temporary structures, open land, etc) 28.86 per cent. Present land-use data give us a clear picture that public space is largely absent in the area. Expansion in vacant plots can increase the population of this site.

The main asset of the study area is its proximity to the holy temple of Pashupatinath and its conserved forest area, listed as a UNESCO World Heritage Site. As it is within 10–20 minutes' walking distance, local residents use the area for religious, cultural and recreational purposes. As for other needs, 88 per cent of people shop within a 15-minute walking range. There are a few schools and colleges within the site and its ten-minute walking distance buffer. However, the area lacks designated playgrounds for children. According to the survey, 47 per cent of children play inside their homes and 31 per cent play in the streets. This reflects the lack of designated open spaces in this new Urban Expansion Zone, which is only partially compensated for by the conservation forest around Pashupatinath. 82 per cent of respondents were also unaware of any community centres in the vicinity. With the area's moderate level of safety, more than 80 per cent have a moderate preference to live in the social environment of the area as most of them have adapted to the environment.

The study area follows an organic pattern, with predominantly isolated buildings along the inner streets. However, the main roads consist of row houses with

Figure 15. Haphazard development in Chabahil



Figure 16. Bustling main road in Chabahil



shopfronts that work to maximise efficient usage of the available area, although congestion is often a problem (Figure 16). Physical infrastructure like drinking water and solid waste management is in moderately good condition. However, problems with rain water drainage currently plague the area. Air pollution is at a moderate level and noise pollution within the site is low. Though more than 50 per cent of dwellers indicated that road access and public transportation facilities were good, traffic congestion and a lack of public parking space are the major problems identified by residents. Based on the survey, almost 79 per cent of respondents had a moderate preference for living in the current physical environment.

As the area is in the Urban Expansion Zone, which is growing rapidly, the buildings are comparatively new and constructed with modern reinforced cement concrete (RCC). From the field observation and survey, it was established that almost 95 per cent of the buildings are permanent structures in visually good condition. RCC is the major construction technique, used for 67 per cent of total construction, with load-bearing structures comprising 31 per cent. Though there are no visible signs of incremental growth, more than 50 per cent of the respondents referred to future plans for incremental extensions. Though the houses are currently in good condition, almost 50 per cent of respondents did not know about the capacity of their buildings to resist seismic forces. While 35 per cent feel their structure is safe, 18 per cent considered their buildings to be unsafe in the event of an earthquake. Most of the houses

have flat roofs used for sunbathing in winter, as well as drying and washing clothes. The flat roofs of the modern concrete houses partially serve the purpose of courtyards found in traditional settlements.

Based on the survey, 51 per cent of the households are engaged in one or more types of community organisations: 32 per cent are engaged in traditional groups, 28 per cent are involved in neighbourhood committees and 20 per cent are involved in co-operatives. The results show that a sense of community is still maintained in new settlements, as people have either continued their participation with old social groups or formed new ones.

4.4.2 Lessons learnt and way forward

Based on the findings of the surveys and field observations, there are many important lessons that can be drawn from this clustered organic settlement. Similarly, there are opportunities to improve the living conditions of residents and to enhance the built environment of the area. A summary of the lessons learnt and means of better development of planned settlements is given below.

- Bylaws permitting only residential uses do not reflect the needs or preferences of residents, who often circumvent these bylaws by establishing local businesses in their neighbourhoods. Living in close proximity to sources of employment and local markets for meeting basic needs (eg food, clothing) benefits residents by reducing their daily trips and transport

costs, which also presents opportunities for achieving broader city-planning objectives (eg promoting active modes of transportation and reducing traffic congestion). These objectives could be supported by introducing bylaws permitting mixed uses.

- Areas with low-rise buildings that are beginning to densify spontaneously (including through incremental growth) present an opportunity for local authorities to guide this process by working with local NGOs to engage local builders and private developers through, for example, providing technical assistance on building regulations, fire safety, disaster risk reduction, etc.
- Densification presents another opportunity to enhance the efficiency of providing and/or upgrading basic infrastructure and services to cope with future population and incremental growth.
- Currently, the area is low-rise and low-density, and is gradually becoming denser. As there are no density limits in the area, Chabahil is evolving organically. Therefore, guided development with density limits depending upon infrastructure limits should be introduced in the near future.
- The construction of buildings that do not follow regulations has resulted in haphazard growth and the lack of proper monitoring is another factor in un-regularised development. Informal developers should be provided with technical advice and managerial guidance from an NGO and/or a specially created government department so as to prevent haphazard growth.
- The settlement's heterogeneous nature is contrasted by the prevalence of buildings surrounded by gated boundary walls. There is a concern that these boundaries are instilling a sense of insularity that could weaken social linkages.
- Vehicular movement has been given priority in these settlements. Almost all homes have vehicular access. However, vehicular traffic on residential roads is very low as people use them for playing, gathering, etc. The function of open space is partially fulfilled by these roads. Therefore, streets can also be developed as a multi-functional public space, but safety issues would need to be considered in the design process.
- Social bonding should be increased through participation in neighbourhood committees, which have traditionally been supported by the *Guthi* system. Local NGOs can play a key role in supporting and mobilising communities (including low-income and other marginalised groups) to participate in planning processes.

The study's results have helped formulate an approach to address the issues related to the settlement. The approach's aim is to promote discussions about

planning for other organic and planned settlement in the Kathmandu Valley.

The process of growth should be guided by developing appropriate bylaws and guidelines that are capable of addressing current as well as future problems related to urban infrastructure decay and deficiency due to population growth and densification. If these problems are not averted through proper planning, then people may start migrating to other locations that are better serviced. On the other hand, residents unable to afford the costs of housing elsewhere would be forced to cope with declining environmental conditions. The ability to maintain and improve basic services as the area continues to grow is thus key to ensuring adequate living conditions, particularly among lower-income residents.

One potential approach would be to test new bylaws and regulations in land-pooling areas, as outlined above, and to apply the lessons learnt in peripheral areas as they continue to grow, consolidate and densify. Identifying relevant lessons and applying them in these and other settlements (including traditional settlements), where applicable, could be aided by a local NGO working in partnership with local authorities. This partnership would seek to engage private developers and residents (both owners and tenants) in discussions regarding the appropriateness of existing bylaws and regulations, along with the potential revisions that could make them both more realistic and enforceable. This discussion would have to reconcile a recurring tension between enforcement and affordability. That is there is a clear need to ensure that bylaws and regulations are adopted by building owners and private developers accustomed to evading regulations, and affordable to lower-income groups accustomed to living informally. If this tension is not addressed, then it is unlikely that existing bylaws and regulations (let alone new bylaws and regulations that would impose additional costs) will be followed.

One potential action area for local authorities is to identify and partner with a local NGO like Lumanti Support Group for Shelter that has experience working with low-income groups around housing and infrastructure-related issues, with the aim of establishing a platform for these discussions. This platform could also serve as a basis for discussing how appropriate earthquake resistant technologies could be incorporated into a regulatory framework that is more likely to be followed. To inform the development of this framework, a university or research organisation that has experience working on these technologies could be engaged. Such engagement would present opportunities for future action research as part of a larger and more inclusive community of practice around urban planning and development in Kathmandu.

4.4.3 Hypothetical replanning of Chabahil

This hypothetical replanning exercise takes a radical approach to identify the level of density that could potentially be achieved in the area as it continues to densify while maintaining adequate living conditions (Map 7). Various measures that would lead to increased density have been conceptualised, and their expected impacts have been estimated. They are described below.

i) Planning concept

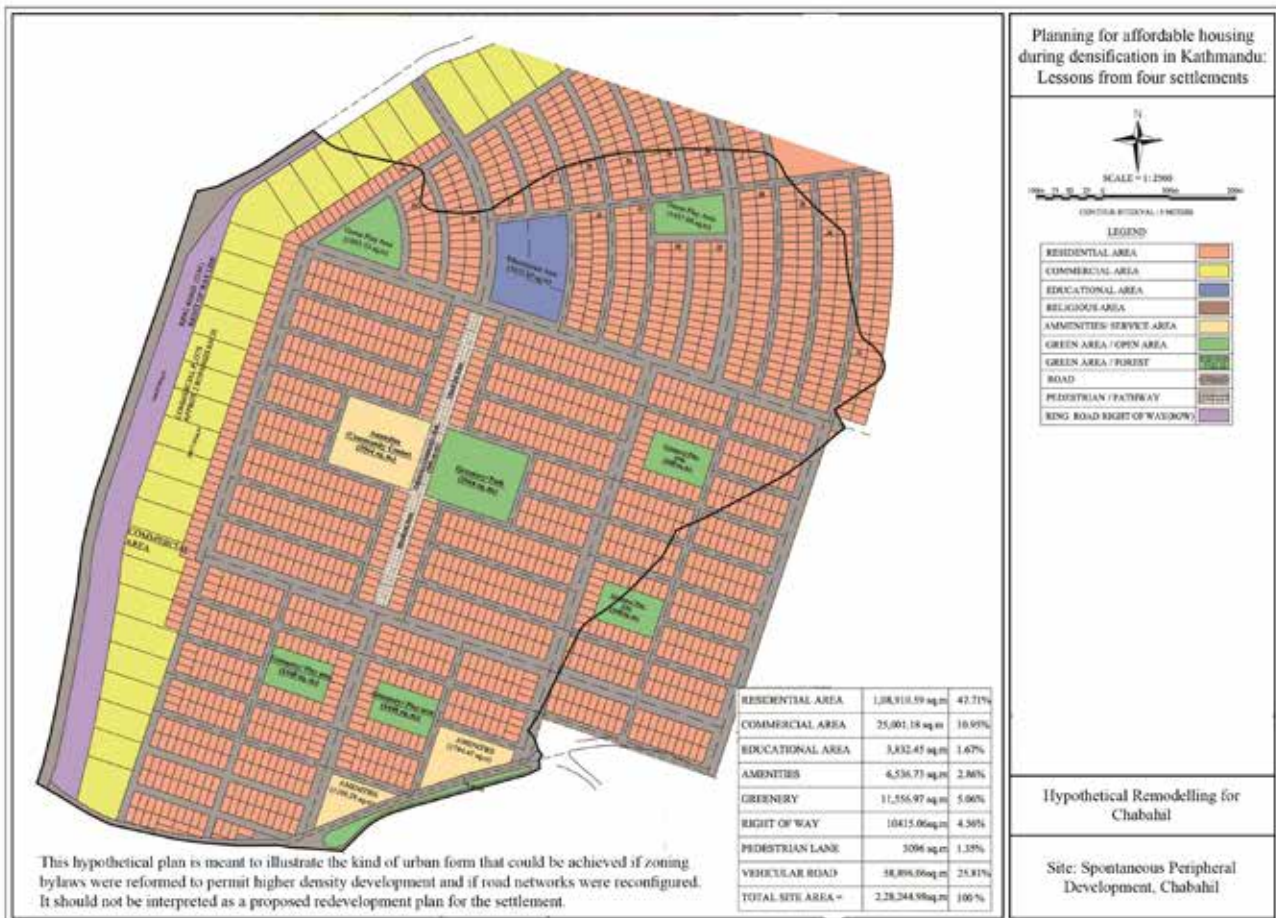
The replanning exercise imagines a compact walkable settlement in a low-rise high-density environment. Surveys showed that the inhabitants walked only a 15-minute distance for shopping, which is within the radius of 500m. Given this trend, it is anticipated that mixed uses will emerge in the central area, which could be supported by the creation of shopfronts facing 12m-wide pedestrian lanes. These pedestrian lanes could serve as public open spaces within a 400m radius from the site boundary used for walking, sitting, eating, shopping, etc. This would encourage community

interaction throughout the area, responding to residents' current concerns. Circulation of three quarters of the site is conceptually replanned in a gridiron pattern whereas one quarter of the site is planned in a radial pattern. 11 per cent of the site area is assumed to end up being used for business and commercial purposes. This is located linearly along the existing ring road, with a right of way extending 31m along both sides from the road centre.

ii) Circulation

The site can be accessed from three sides, with the ring road and a four-lane highway with a 31m setback defining the western border. In replanning, intersections with the ring road have been limited in two locations to avoid nodal development and to ease traffic flow. Both pedestrian and vehicular access has been planned for complementarity with an inner ring road serving major vehicular circulation, while a straight, linear pedestrian lane provides easy access by pedestrians. A 12m-wide pedestrian road could also provide spaces for social activities. The hierarchy of the roads is maintained by the different road widths: 12m, 6m and 3m.

Map 7. Conceptual replanning exercise for Chabahil



iii) Space allocation

Based on field observations, the site lacks proper road access and footpath demarcation, which has affected vehicles as well as pedestrians. In conceptual replanning, the circulation area increases from 11.66 per cent to 31.72 per cent to ease accessibility within the site for serving a high-density area. A high percentage of the road coverage is also due to the 31m right of way for the ring road, which accounts for more than 17 per cent of the total road coverage. In residential areas, each plot can now accommodate three families. The commercial area is concentrated along the ring road, which makes up 11 per cent of the total area. The cost of infrastructure improvements to the project will be covered by sale of these commercial plots at higher prices than residential plots.

According to the survey, 24 per cent of the population is below 16 years old and 70 per cent of the population is between the ages of 16 and 55. With an average family size of 5.66 and 1,480 plots generated from replanning, the total population on 22.82 hectares of land is 25,160. Therefore, 24 per cent of the population is below 16, meaning the population of this demographic comes to 6,038. As 1.5m² space is the standard area required for a student, 9,057m² of total area is required for the 6,038 children who are under 16s. With three-story buildings, there is a need for approximately 3,019m² of educational area and in the conceptual replanning, a 3,832.45m² area has been allocated for educational purposes.

With social public space a basic necessity, the central space has been envisaged as the community space (west side), along with the park (east side) on both sides of the pedestrian lane. This pedestrian lane could also serve as a community space, with storefronts and community-based markets and restaurants within the mixed-use zone. There are pockets of green play spaces for children in various places, which cover 5.06 per cent of the total site. Two spaces for service amenities are placed on the southern part of the site. Future expansion has also been anticipated in this reimagining and combined with the existing residential and commercial areas.

iv) Population density

Based on survey, average family size = 5.66

Total number of residential plots after conceptual replanning = 1,480

Families per plot = 3 (1 house owner's family and 2 renting families)

Population per plot = 3 x 5.66 = 16.98 = 17

Total residential population = Number of residential plots x proposed people per plot = 1,480 x 17 = 25,160 people

Total area of site = 228,244.98m² = 22.82 hectares

Proposed population density = 1,102.54 people per hectare

Existing population density = 410.14 people per hectare

Hence, after redevelopment of the Chabahil site, the density of this area will increase significantly by 692.4 people per hectare. High density will help in efficient and cost-effective planning of infrastructure and will increase accessibility to land and housing units for prospective buyers and renters alike.

v) Disaster-resilient planning

To minimise the impacts of an earthquake, the development of a socially and technically appropriate building code is fundamentally required. The focus should be on the development of an appropriate and enforceable bylaw, as outlined above. Planning for disaster response is equally important and requires identification and demarcation of evacuation areas. In the study, open green spaces are planned to act as collection points in case of earthquake.

Total residential population = 25,160 people

Density of residential population = 1,102.54 people per hectare

Collection site area = 3.5m² per person = 88,060m² area required for all

Evacuation site area = 10m² per person = 251,600m² area required for all

Provided area for collection site = 11,556.97m² = area serving 3,302 people (13.12% of total population)

Since the site is insufficiently large for evacuating community members, it is recommended that the area adjoining the site, ie open space of the Pashupatinath forest area, be used as the evacuation area.

vi) Land regulations and building bylaws

*Minimum size of plot allowed = 79.52m²
(0 – 2 – 2 – 0)*

Minimum width of plot = 6m

*Standard ratio of length to width of plot is 2:1,
ie L = 2B, or 3:1, ie L = 3B*

Considering the standard ratio, 6m x 13.253m = 79.52m² is the standard minimum area required. By simplifying the size to L = 2B, a 6m-wide and 12m-long plot yields a 72m² area. Furthermore, the proposed area of the minimum allowable plot is 72 m².

As per building bylaws, the site lies in a Residential Zone, Other Residential Sub-Zone. In this sub-zone, a site smaller than 127.24 m² will have the following parameters:

Ground coverage = 80%

FAR = 1.75

Proposed plot size = 72m²

Maximum permissible ground coverage area = 57.6m²

Maximum permissible total floor area = 126m²

During replanning, buildings are realigned as row houses that require a 1.5m setback in the rear and a 1.5m setback at the front. Residents would thus have parking as well as a lawn in every plot, a plinth area of 6m x 9m = 54m² and a building of 2.5 storeys. This would provide three habitable rooms on the ground floor with parking; four habitable rooms on the first floor; and a *puja* (Hindu worship) space, laundry and store on the top floor. These would be three–four-bedroom houses in which only one family could live. However, analysis from the survey shows that on average two families live in one house and the average family size is 5.66. So in total 11.02 people live in one house. The replanning proposes that three families inhabit one house. This requires a 4.5-storey building to accommodate three families with 16.98 = 17 people per plot.

Hence, the proposed parameters for replanning:

Proposed ground coverage = 80%

Proposed FAR = 3.5

Ground floor area = 57.04m²

First floor area = 57.31m²

Second floor area = 57.31m²

Third floor area = 57.31m²

Fourth floor area = 10.73m²

Total floor area = 239.7m² maximum

Maximum proposed ground coverage area = 57m²

Maximum proposed total floor area = 252m²

Typical house plan:

The ground floor of the suggested housing plan contains one car parking area, two bedrooms, one kitchen-cum-dining area and one toilet. The second floor contains two bedrooms, one kitchen-cum-dining area, one toilet and one extra bedroom. The kitchen has one small balcony. The second and third floors follow the first floor plan.

5

Conclusions

A number of general conclusions and recommendations can be drawn from the findings of the report. These can be divided into two sections: one, general conclusions and recommendations; and two, case study-specific conclusions and recommendations.

5.1 General conclusions and recommendations

Rentals as a housing option: Land in Kathmandu, even on the periphery, is far too expensive for the poor. Therefore, almost all housing being constructed is for middle- and, at best, lower-middle income groups. The only option left for the poor is to rent in other people's homes, including in informal settlements. The market has responded to this need and rental accommodation is available, not only in new middle-income schemes, but also in the ancient inner city of Kathmandu. Much of this rental accommodation is not planned as rentals and as such is haphazard, congested and poorly serviced. It is also argued that it is affordable to the poor because it is of poor quality.

Building, especially for rentals, is not an economically viable option. The cost of land and construction is so high that it cannot be recovered in fewer than 20 years from the rents. Therefore, people building homes for themselves rent out rooms that they construct as part of their house for this purpose. This also guarantees them an extra income. How this can be done through appropriate architectural design remains an issue.

To overcome the haphazard and congested nature of rental units, it is recommended that a process is developed in making house plan alternatives available to those who are constructing a house/commercial activity. As outlined above, this could be done by engaging an existing NGO, or establishing a new one, whose agenda is to create a platform for engaging builders, developers and residents in the production of plans, providing technical advice, and facilitating discussions around how a more appropriate and enforceable regulatory framework can be achieved. A government department or NGO–government–academia partnership could also be created for this purpose.

The importance of rentals for low-income groups is important. Therefore, some incentives to promote rentals would help in increasing them and improving their quality. Such incentives could be tax rebates, better loan facilities for construction, and other legal and financial instruments.

Squatter settlements: Because of the cost of land combined with the unavailability of state land, squatting is not increasing except within existing squatter settlements, which remain relatively small in size. They have a total population of only 12,000 living in about 40 settlements. Their future is uncertain and their resettlement or upgrading is required. Attempts at demolition and resettlement have not been very successful (Box 1).

BOX 1: FACING EVICTION: THE EXPERIENCE OF THAPATHALI

On 9th May 2012, as children from Thapathali squatter settlement in Kathmandu were getting ready for their school and men were hurrying for work, their normal life was brought to a halt by Nepal Government's four bulldozers. 251 houses in the settlement were bludgeoned with the help of 2,200 security personnel from Nepal Police, the Armed Police Force and the City Police. The government had plans to relocate the settlement to safer areas away from the river. As people were not willing to go, they were evicted. However, government was not been able to find appropriate location to relocate the Thapathali settlement because of people's unwillingness to live away from the city centre and protest from the locals where the government tried to relocate. Thus, the people come back to Thapathali and starting building their houses with the debris. Three years after the eviction, the Thapathali settlement is still there.

A law is required for regularising existing squatter settlements. However, this would have to be a political decision, which civil society could lobby for. This law may provide ownership rights to existing residents and support a process of upgrading and/or redevelopment. Redevelopment could entail medium-rise apartments and/or individual houses on small plots, as proposed. Prioritising these options should be based on residents' needs, preferences and affordability requirements. However, whilst apartments can achieve higher densities, houses have the advantage of supporting incremental growth and other modifications to meet the needs of growing families.

Present form of settlement creation: The present form of development involves conversion of farmland into housing. This is done in two ways. One, farmers start building houses for themselves on their farms adjacent to the city. Other people join in by purchasing land to build their own homes. In the process, settlements arise informally. Two, developers purchase land from the farmers and convert it into housing. The second process is increasingly replacing the first. In both processes, government bylaws and zoning regulations are not followed.

To ensure that the development plans of the farmers and the developers are 'environment-friendly', advice can be provided to them. For example, the Orangi Pilot Project (OPP) in Pakistan has given such advice to informal developers and also developed plans for providing infrastructure in informal settlements. It has

lobbied local government to finance and build the 'off-site' infrastructure to support these plans, allowing communities to finance and develop the 'on-site' infrastructure with OPP technical assistance. A similar process with the support of a local NGO could be followed here.

Land pooling: The government carried out a land-pooling exercise for one settlement in 1995. Problems with its planning have been identified in the case study on Khusibu. To make optimum use of expensive land, the owners of the houses have violated government bylaws and zoning regulations, especially FARs. In addition, even after 18 years, 40 per cent of the plots remain unoccupied. The plots are held for speculation, distorting the real estate market. To control land speculation in pooling schemes, a non-utilisation fee for land should be imposed. Land pooling offers a way out by providing planned development for housing and should be encouraged.

Seismic considerations: Kathmandu is in a high-activity seismic zone. Much of its old construction and almost all of its more recent buildings are not earthquake resistant. Retrofitting these buildings is beyond the financial capacity and technical capability of building owners or the state. Finding alternatives to improve the safety of these buildings is essential. In addition, it is necessary to provide technical support to make new buildings earthquake resistant and to ensure sufficient spacing and access to facilitate evacuation and emergency response.

Retrofitting must be approached by examining more appropriate technologies since conventional engineering methods are far too expensive. Determining which technologies are most viable (particularly for lower-income groups) can be investigated through discussions on how a more appropriate and enforceable regulatory framework can be achieved. Such discussions should also consider other approaches, including, for example, the integration of disaster risk reduction into school curricula. However, the barriers to accessing education, among other basic services in Kathmandu, are particularly high among poorer families, which often force their children out of school and into work (Brown and Dodman 2014). These barriers are also evident in the tension between the enforcement of bylaws and regulations, and the ability of lower-income groups to afford their associated costs. Ultimately, the development of a more appropriate and enforceable regulatory framework (including one that increases safety and reduces risk) will depend largely on whether this tension can be reconciled.

From a practical perspective, simple rules of thumb in the Nepali language, along with illustrations, need to be developed for new construction projects. A process whereby local masons can be trained and house builders can be encouraged to use these has to be

developed. Ideally, this should be a joint venture of local government, relevant NGOs, local community-based organisations and academia. For example, Lumanti – a local NGO engaged in housing and infrastructure issues facing the urban poor – is currently using these rules of thumb in its housing projects.

Bylaws and zoning regulations: The existing bylaws and zoning regulations do not support the levels of density that land values justify, nor do they address the housing scarcity and commercial needs of the city. For this reason, they are violated in almost all cases. A revision of the bylaws and zoning regulations, especially FARs, is required. In addition, it is not possible under the bylaws to divide property horizontally. This has adverse repercussions, both architectural and environmental, on the built environment.

There is also a serious need to revisit bylaws, zoning regulations and the National Building Code so as to accommodate positive trends in the built environment of Kathmandu. Two issues have emerged from the case studies as particularly important to consider. One, all settlements gradually become mixed-use settlements; and two, regulations related to FAR are violated by incremental growth. An important issue is the nature of commercial/economic activity that should be permitted in the settlement and in which location.

Social transformation: A transition is taking place in Kathmandu whereby caste-based settlements are being converted into heterogeneous settlements. Caste-based settlements used to have traditional community organisations that managed the infrastructure and its maintenance in the settlement, along with settling family and community disputes. At present, heterogeneous community organisations are rare, except where NGOs have intervened to promote them.

There is no option but for communities to participate in managing their own settlements in partnership with local government. The NGO effort to create community organisations has to be encouraged and the local government should be advised on negotiating with them and building relationships based on such negotiations. In the case of Lumanti, these relationships are already being built.

Conservation issues: Kathmandu is an ancient city with a large volume of built heritage. This heritage is gradually being destroyed through reconstruction and ad-hoc building additions. To address these issues, it is necessary to have a rational conservation plan that takes into consideration existing trends of densification and that can provide technical help and managerial guidance to property owners interested in demolition, reconstruction, additions and modifications to existing structures.

A conservation plan already exists in the Heritage Act. However, old buildings are being demolished to create new and denser neighbourhoods with more floors. Also, vertical subdivisions of buildings are taking place without any architectural or design advice. The creation of a platform as described above that provides such advice is necessary. Further research, discussion and advocacy are needed concerning the role of this platform and its institutional powers and structure (eg which government agency or civil society/academic institution should host it).

Land markets: The land market in Kathmandu is not transparent. There are a number of informal dealings and hidden costs in property values and ownership. Existing land-use plans are also not followed due to institutional weaknesses. There is a need to make property ownership, rentals and current land-use information easily accessible. This will have a positive effect on the market.

Renters: In land pooling areas and in squatter settlement upgrading/redevelopment, the rights of existing renters are an issue that is not addressed in planning. There are many renters, including agricultural workers, who live in land-pooling areas where farmlands have been converted informally into urban settlements. The pros and cons of potentially accommodating these renters in the replanning process need to be assessed.

Institutional arrangements: To support the conclusions and recommendations given above, new institutional arrangements are required. Such arrangements will be supported and/or contested by different groups for different political and economic reasons, including those related to the control of turf. Effective institutional arrangements can thus only be created if civil society can come together to frame the necessary proposals and to promote them with the political parties and government bureaucracies. Certain steps can be taken by NGOs through pilot projects. These pilot projects could eventually feed into government policies and procedures and lead to the creation of relevant institutional arrangements.

5.2 Conclusions and recommendations for the four case studies

5.2.1 Naradevi

Different approaches: The replanning of Naradevi has been looked at through different approaches: i) fire safety; ii) lower density; iii) earthquake safety; and iv) urban generation. All four can be assimilated into the urban generation approach through a conservation plan.

Conservation plan: The conservation plan can list buildings in three categories: i) buildings of high heritage value that need to be preserved; ii) buildings in which alterations and/or additions can be made while conserving the facade, scale and texture; and iii) buildings that can be demolished and reconstructed according to conservation-consistent bylaws that need to be developed. These bylaws must ensure that the scale, texture and external space in Naradevi are maintained. Scale does not mean height but is related to the manner in which fenestration (windows and other openings) is applied to the facade. These bylaws must necessarily balance architectural and conservation objectives with the affordability requirements of low-income groups.

Traffic management: Naradevi is overcrowded, with a major difference between day and night density. As such, one of the proposals for it looks at the possibility of de-densifying the area. Through this hypothetical process, the density of Naradevi has been reduced from 2,133 to 1,805 per hectare, or by 15.4 per cent. Though this will improve congestion, it is not a viable proposition and can only be achieved if more attractive locations for tourism and businesses are developed. In addition, it has been noted that 20 per cent of houses have signs of incremental growth.

One of the major reasons for congestion, which will also make an earthquake disaster less manageable, is the absence of traffic management. Therefore, a traffic rerouting and management plan is essential. This can improve both the physical and the social environment. However, it can only be effective if it is a part of a larger traffic management plan for Kathmandu.

New construction: New construction on the site of demolished buildings must follow some conservation-consistent bylaws. To prevent vertical subdivision of plots and buildings, horizontal division of buildings must be made possible through a change in laws.

Additional floors: The area is densifying with the addition of floors to existing buildings. There is a clear need for these floors given the shortage of affordable housing. The possibility of adding two floors with lightweight materials should be examined. Simple

bylaws related to sun angles could help determine if floors should be added.

Disaster-related recommendations: The proposals for mitigating the effects of fire and earthquake disasters by developing new bylaws and regulations that take into consideration what land owners, private developers and informal dwellers would be willing and able to afford are strongly recommended in this report.

5.2.2 Sankhamul and Bansighat

Relocation of Bansighat: Bansighat is a settlement along the river next to a location of religious significance. It is also prone to flooding. For this reason, it has been proposed that the settlement be relocated. The upgrading of the religious site (which is in a poor state at present) will also raise land values and exert pressure for relocation. However, such options would need to be determined in partnership with the community to ensure that its needs, priorities and affordability requirements, particularly among the poorest renters, are considered.

Apartments versus houses: Sankhamul has a density of 377 persons per hectare living in 110 houses. It has been proposed to convert the settlement into 760 low-rise (ground floor plus two) apartments with a density of 1,907 persons per hectare. Given the number of apartments, households from Bansighat and other settlements could potentially be shifted to this location.

According to the survey findings, people prefer living in individual houses rather than apartments. However, further research is required to weigh the costs and benefits of each option and their social, economic and environmental implications.

5.2.3 Khusibu

Replanning proposals: Khusibu is a land-pooling site. The proposals have taken into account the preferences of the existing residents, which are for mixed land use, more commercial plots, and higher FAR, which has been increased from 1.75 to 3 and in some cases to 4. As a result, density has increased from 710 to 1,385. The commercial plots have been placed on the main road in keeping with research findings. Car parking was also seen as a problem; this has been overcome by providing 9.82 per cent of the site for it.

Conflict between regulations and practice: The layout has two-to-three-storey houses but given the demand and current practice, the houses are often four or five storeys. Future planning must accommodate these trends; otherwise the space for providing rentals will be limited. In addition, given that most bylaws are violated, land-pooling projects have also highlighted as opportunities to test deviations from current bylaws and to discuss their impacts and implications for future developments.

Need for multi-class settlements: For creating a mixed-class settlement, at least 30 per cent of plots should be of 80 square metres or smaller. Their cost should be subsidised by a higher cost for commercial and larger residential plots. Criteria for ensuring that low-income households most in need are able to access these plots should be developed and a process for preventing speculation should be put in place.

Traffic planning: Effective segregation between pedestrian and vehicular movement and between through and local traffic should be created to ensure security and safety, and to mitigate pollution.

5.2.4 Chabahil

Density: Chabahil is a spontaneously developed settlement on farmland. It is haphazardly laid out. It has a density of 410 persons per hectare and it has been replanned to a density of 1,103 persons per hectare.

Planning advice: Settlements such as Chabahil and those developed by developers from land purchased from farmers call for planning advice, which could be informed by the lessons learnt from land pooling projects. The house owners also need house plans and technical advice for supporting appropriate and affordable earthquake-resistant construction practices and adequately serviced rental units. This advice can be given as detailed in Section 5.1 above.

Accommodation of trends: For future planning, mixed land-use trends and increase in FAR should be accommodated in a manner that does not damage the physical and social environment or come at the expense of living conditions, particularly among low-income renters.

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Appendix 1

Comparison of environmental, housing and socioeconomic conditions for five sites

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
HOUSEHOLD INFORMATION AND SOCIO-ECONOMIC CONDITIONS						
Average household size	4.99	5.66	4.57	5.27	4.87	Urban household size: 4.88 (Population Census 2011, CBS). This implies that nuclear families are rising.
Average number of men per household	2.48	2.87	2.34	2.48	2.33	
Average number of women per household	2.51	2.79	2.23	2.79	2.54	
Average number of children below 15	0.94	1.125	1.11	0.84	1.04	Significant percentage of population is children, almost 1/5 in all settlements.
Average number of people above 60	0.48	0.6	0.25	0.25	0.27	
Average number of working members per household	1.75	1.87	1.79	1.96	2.48	Nearly half of the family members are employed. Informal settlements have more earners compared to other settlements.
Dominant age groups	16–35	16–35	16–35	16–35	16–35	There is higher percentage of youth in all settlements, thus the settlement planning needs to cater to their needs like youth/ community centre, parks, etc. (the percentage is even higher in informal settlements).
	39% – 16–35 yrs; 32% – 36–55 yrs; 19% – less than 15 yrs; 10% – more than 60 yrs.	36% – 16–35 yrs; 34% – 36–55 yrs; 20% – less than 15 yrs; and 10% – more than 60 yrs.	43% – 16–35 yrs; 27% – 36–55 yrs; 24% – less than 15 yrs; and 5% – more than 60 yrs.	50% – 16–35 yrs; 28% – 36–55 yrs; 17% – less than 15 yrs; and 5% – more than 60 yrs.	46% – 16–35 yrs; 27% – 36–55 yrs; 21% – less than 15 yrs; and 6% – more than 60 yrs.	
Average occupancy age	45.16 years	18.85 years	6.39 years	29.4 years	13.4 years	There has been a significant increase in population within last 20 years (mostly due to migrants during insurgency period) in all settlements. Naradevi is loosing its native population and number of renters is increasing.
	36% of the population (native population) has been residing for more than 70 yrs, 46% for less than 20 yrs (insurgency period: rental population), and 18% for 20–50 yrs.	29.63% < 10 yrs, 37.04%: 10 – 20 years, 24.69%: 20–50 years and 8.64% >50 years.	13% residing for more than 20 yrs and 77% less than 10 yrs (previously agricultural community).	67% of the population has been residing for 40 yrs.	33% of the population has been residing for more than 20 yrs.	

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
HOUSEHOLD INFORMATION AND SOCIO-ECONOMIC CONDITIONS						
Average monthly income per household	NRs 20,005	NRs 40,687	NPR 34,315	NRs 14,932	NRs 12,418	Average income of families in traditional settlement is low compared to new formal settlements, which may be due to increase in renters and transient population, relocation of native population, or replacement of traditional occupation and people's inability to adapt to current needs.
Saving of monthly income (%)	77% families save less than 10% of their income while 9% didn't answer.	72% families save less than 10%, 23% families save (10–40)% of their income while 5% didn't save (31% did not answer).	76% families save less than 10% of their income.	70% families save less than 10% of their income while 14% didn't answer.	52% families save less than 10% of their income while 38% didn't answer.	
Monthly transportation expenses	NRs 1,288 92% of people answered the question.	NRs 4,971 69% of interviewees answered this question.	NPR 2,570 84% of interviewees answered this question.	NRs 1,839 59% of interviewees answered this question.	NRs 1,110 60% of the interviewees answered this question.	One of the main reasons for the increase in low-income renter population in traditional and informal settlements is the easy access to public transportation, market, jobs and facilities, which can be related to their lower transportation expense than those of new formal settlements (a pull factor). Higher income families prefer to live away from city-core.
Place for savings	27% in bank, 27% in home, 26% finance, 6% cooperative. 93% of the interviewees answered this question.	45% in banks, 24% finance, 18% at home and only 10% in cooperatives and 3% don't save. 93% of the interviewees answered this question.	38% in bank, 17% in finances and 17% kept their savings at home. Interestingly 99% of the interviewees answered this question.	77% in cooperatives, 10% in bank. 89% of the interviewees answered this question.	42% in cooperatives, 29% in finance. 60% of the interviewees answered this question.	Families from traditional city-core still prefer to keep their saving in their houses. Middle class people trust banks while cooperatives are quiet active in informal settlements (bank is not always accessible). Cooperatives function within the settlements and are formed by local group of people.
Place of shopping	98% within 10 mins walk (1km) – 2.76 mins on average.	30% within 5 mins, 41% within 10 mins, 17% within 15 mins and 12% greater than 15 mins.	42% within 15 mins walk and 44% within 30 mins walk near city centre.	77% within 10 mins walk (1km) – 9.6 mins on average.	60% within 15 mins walk (2km) – 13.5 mins on average.	Core area and proximity to old market place of Ason shows higher level of business activities in Naradevi (a pull factor). However, all settlements have commercial area for shopping within walking distance.

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
HOUSEHOLD INFORMATION AND SOCIO-ECONOMIC CONDITIONS						
Place of recreation	68.3% within 10–20 mins walk (1–3km) – play ground, Kathmandu Palace Square and Malls.	53% within 30 mins walking distance (Pashupati Temple Area), 34% more than 30 mins vehicular distance (Boudha, New Road) and 13% usually don't go anywhere.	36% didn't go anywhere, 22% within 30 mins walk. Most people go to the city centre of Kathmandu.	52.8% within 20 mins walk (2–3km) – Play ground, Patan Palace Square, Zoo.	73.5% within 30 mins walk (2–4km) – Malls, Kathmandu Palace Square, Movies, etc.	Core area and proximity to recreational place, shows easy access to social and recreational spaces for Naradevi settlement. In other settlements, people have to travel 30–40 mins to visit parks, temples or other entertainment area.
Schools	Within 13.65 mins walk on average (schools in neighbourhood).	10.05 minutes average among 55 HH with kids (school in neighbourhood).	44% children study in nearby school within 5–10 mins walk.	Within 10.5 mins walk on average (schools in neighbourhood).	Within 5.6 mins walk on average (schools in neighbourhood).	Each settlement has an educational area (mostly kindergarten and primary schools) within the boundary.
Play area for children (under 14)	Good 58% play in courtyard; 26% inside house and 6% on the streets.	Moderate 47% of the children play inside their home; 31% play in the streets; 17% don't have play area and 5% play within their compound.	Bad 46% children play inside the home, 28% on the street and 8% in the playground.	Good 52% of the children play in the nearby open space; 34% play in the streets.	Moderate 70% of the children play in the nearby open space; 15% play in the streets.	Shows lack of open and playing spaces for children in new comparatively less denser settlements. This keeps the children within their home preventing them from social interaction, which can make them more reserved. However, the courtyards in traditional settlements have retained their major characteristics of providing open spaces for children to play. New settlements have higher % of private open space but less areas for social mingling.
Usage and availability of open space	Good 25% use for feast, 21% for playing and walking, 16% use it for parking, 14% use it for washing clothes.	Bad 11% use the open spaces for morning walk, playing etc; while 81% interviewees said that they don't have open spaces within their settlement.	Moderate 60% interviewees mentioned playground as the only open space.	Good 91% use open space for playground, sunbathing, feasts.	Good 85% use open space for playground, sunbathing, feasts.	In traditional and informal settlements, the open spaces are shared, so there are overlaid functions of these spaces, where as in new formal settlements, these open spaces have not been developed and designed to cater to multiple needs of people. Ground in Khusibu land pooling area is mostly occupied by youth as a playground.

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
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HOUSEHOLD INFORMATION AND SOCIO-ECONOMIC CONDITIONS

Community centre and its use	Moderate 39% agree on presence of community centre, 27% use for feast, 24% for social meetings, 18% use it for waste management purpose for the neighbourhood.	Bad 82% don't have community centre or they are not aware about it or they don't use it; 8% use it for feast; and 6% for ceremony.	Bad (only 15% know there is a community centre) Most of the people are unaware of the existence of the centre. Most of the people termed neighbourhood office and gym centre as community centre.	Good 47% use it for meetings while 33% use it for health check-ups and trainings.	Good 40% use it for meetings while 34% use it for health check-ups and 17% use it for tuitions.	Sense of community is stronger in informal settlements, where they have communal spaces for fulfilling various social needs. In traditional settlements, the new youth clubs, old <i>guthi</i> buildings and communal courtyards have still been able to provide spaces for various activities, whereas in new developing settlements, these spaces are clearly lacking. (Denser settlements with strategically located open courtyards can promote social bonding compared to sparse settlement with individual houses and private open space.)
Engagement in social groups	Only 34% are involved in social groups (<i>guthi</i> , neighbourhood committee/Youth group).	51% of households are involved in various social groups (among them 32% <i>guthi</i> / religious / cultural groups; 28% neighbourhood community; 20% savings and cooperatives).	23% are involved in social groups (11% in cooperatives, 7% in neighbourhood, 4% in <i>guthi</i> and 3% in women's group).	89% are involved in social groups (women/ housewife and saving/ cooperative groups).	42% are involved in social groups (women/ housewife and saving/ cooperative groups).	Surprisingly, lower percentage of people in traditional settlements are involved in social groups, which may be due to decreasing engagement in traditional groups and increase in renter population. Higher percentage of people involved in social groups in informal settlement shows stronger bonding. With escalating renter population in Khusibu, the involvement in social groups is decreasing.
Safety	Good 47% said safety level is high and 37% said it is moderate.	Moderate 72% said safety level is moderate and 20% said it is high.	Moderate 53% said safety level is moderate and 21% said it is high, while 18% have relatively lower feeling of safety.	Good 46% feel their neighbourhood safety level to be high while 32% feel it is moderate.	Moderate 53% feel their neighbourhood safety level to be moderate while 27% feel high.	Level of safety is moderate in all settlements, which is comparatively high in the denser settlements. Denser settlements encourage more social interactions which makes people feel safer.
Relationship with neighbours	Good Though the frequency of lending/ borrowing money and household items is low (28%), 60% have good and 10% have very good relationship with their neighbours.	Good Though the frequency of lending/ borrowing money and household items is very low, 50% have good and 49% have moderate relationship with their neighbours.	Good Though the frequency of lending/ borrowing money and household items is very low, 20% have very good, 51% good and 27% moderate relationship with their neighbours.	Good Though the frequency of lending/ borrowing money and household items is very low, 54% have good and 32% have very good relationship with their neighbours.	Good Though the frequency of lending/ borrowing money and household items is very low, 46% have good and 42% have moderate relationship with their neighbours.	Bonding with neighbours is high in all settlements, which shows level of acquaintance and social trust.

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HOUSEHOLD INFORMATION AND SOCIO-ECONOMIC CONDITIONS

Preference of living in the same social environment	Moderate	Moderate	Moderate	Moderate	Moderate	Most of the people are quite happy with where they are living, but higher preference to live in same location in informal settlements suggest strong communal bonding or also lack of options to move to other locations.
	54% have moderate preference to live in the current location, while 38% have high preferences.	80% have moderate preference to live in the current location, while 14% have high preference and only 6% have low preference.	71% have moderate preference to live in the area while 23% have high and 6% have low preference.	56% have moderate preference to live in the current location, while 42% have very high and high preference.	71% have moderate preference to live in the current location, while 21% have high preference.	

ENVIRONMENTAL CONDITIONS

Zoning	Mixed old residential sub-zone	Urban expansion zone	Planned residential sub-zone	River bank	River bank	
Settlement layout	Compact courtyard planning with buildings arranged around courts and aligned along the street. Organic morphology with narrow inner streets.	Cluster pattern with major predominantly isolated houses. Main streets have row housing along the streets.	Planned settlement with grid iron pattern.	Long plots with 3–4m width are arranged in a row along the main street with river-bank on the back side.	Cluster pattern with very narrow access; and river-bank and main street on either side.	
Water-supply services	Bad	Moderate	Bad	Good	Moderate	Water supply system in general is not sufficient in Kathmandu valley. Water scarcity is higher in traditional/dense settlement, while new pooled area also have similar problem. But in informal settlement (with no municipal connection) though the scarcity is similar, their perception and attitude towards water availability is different from those in formal settlement.
	53% and 22% rate water-supply services as bad and very bad respectively (1 hour water supply once in every six days). Identified causes: increase in population, old system.	45% moderate; 32% bad and 21% good. As Drinking water corporation provides water once in every 5 days for 1–2 hours each.	33% rate water supply service as moderate whereas 38% as bad. And 14% as worst. There is intensive use of boring and buying water despite the municipal connection.	41% and 48% rate water-supply service as moderate and good respectively though they have to buy water and use under-ground water (no municipal connection).	46% and 30% rate water-supply respectively though they have to buy water and use under-ground water (no municipal connection).	
Electricity	Moderate	Bad	Bad	Moderate	Good	Load shedding is a blanket problem in Kathmandu, which is shown by the response of people in formal settlement. However, in informal settlements, their perception of having access to electricity is positive.
	52% and 43% rate electricity service as moderate and bad respectively. Load shedding and transformer break down being major issues.	46% and 12% rate electricity services as bad and very bad while 36% say moderate.	39% termed the electricity service as good and 57% as bad.	55% and 34% rate electricity service as moderate and good respectively.	48% and 52% rate electricity service as moderate and good respectively.	

ENVIRONMENTAL CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Solid-waste management	Good 48% and 32% rate solid-waste management as good and moderate respectively. However, one can see scattered plastic bags and small heaps of garbage in street corners.	Moderate 44% and 42% rate solid-waste management as moderate and good respectively while 11% say bad.	Good 67% are satisfied with the waste management service provided. 25% think the service is moderate. With vacant lands nearby, dumped waste is seen in some.	Good 43% and 30% rate solid-waste management as good and moderate respectively. No garbage dump seen on the streets. Some NGOs have given solid waste management trainings.	Good 52% and 46% rate solid-waste management as good and moderate respectively. No garbage dump seen on the streets. Some NGOs have given solid waste management trainings.	People are more actively managing their waste themselves in informal settlements, while in other formal settlements waste is still seen dumped in streets and vacant lands even if there is availability of waste collectors from municipality. People rate the current system of solid waste management as moderate to good.
Rain-water drainage	Moderate 39% rate rain-water drainage as bad and 36% rate it as good and 21% as moderate. Depends on location in the neighbourhood.	Good 46% and 40% rate rain-water drainage as moderate respectively, while 14% say bad.	Good 53% rate rain drainage as good and 27% as bad. Drainage system can't tolerate the heavy prolonged rain.	Good 55% and 27% rate rain-water drainage as good and moderate respectively though there is the problem of water-clogging during rainy season.	Good 54% and 27% rate rain-water drainage as good and bad respectively though there is the problem of water-clogging during rainy season.	Drainage system is comparatively good in developing formal settlements. In case of traditional settlements, the older systems are overwhelmed by increasing population, which has decreased its efficiency. Whereas prolonged rainfall cause problems in both settlements. In case of informal settlements, drainage system is managed locally and they consider it to be good except for rainy season.
Sanitation	Moderate 40% rate sewerage system as good and 24% rate it as moderate and 33% as bad. Major problem: frequent drainage blockage.	Good 48% and 42% rate sanitation as good and moderate respectively while 9% say bad.	Good 71% rate sanitation as good and 17% as moderate.	Good 34%, 30% and 32% rate sanitation as good, moderate and bad respectively though.	Good 59%, 12% and 27% rate sanitation as good, moderate and bad respectively.	Sanitation is a problem in traditional settlement as capacity is overwhelmed by growing population, whereas it is better in new developing areas. Informal settlements consider sanitation provisions to be good, which may be direct disposal to rivers.
Air quality/smell	Moderate 51%, 25% and 21% rate air quality as moderate, bad and good respectively. Problem of air pollution along the main street.	Moderate 48%, 28% and 15% rate air quality as moderate, good and bad respectively. Problem of smoke from vehicles along the main road.	Bad 37% and 40% rate the air quality as moderate and bad. Major problem of smell from Bisnumati river nearby. Dusty road after rain.	Moderate 28%, 42% and 23% rate air quality as good, moderate and bad respectively. Problem of smell from river.	Bad 22%, 37% and 41% rate air quality as good, moderate and bad respectively. Problem of smell from river and dust from road.	Air quality and bad smell are major externalities faced by people in all settlements. Major pollutants are vehicles on the road, dusty roads, and foul smell from river (natural barrier of trees can help).

ENVIRONMENTAL CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Noise level	Moderate 42%, 31% and 20% rate air quality as high, low and moderate respectively. Problem of noise along the main street.	Low 41%, 25% and 25% rate noise level as low, moderate and high respectively. Problem of noise along the main road.	Low 31% thinks the level of noise pollution is moderate and 50% consider it to be peaceful.	Low 37%, 34% and 18% consider noise level to be low, moderate, and high.	Low 54% and 40% consider noise level to be low and moderate respectively.	Noise level is high in the traditional settlement with high density, proximity to market places and other facilities. The main streets of new formal settlements also have similar noise issues.
Road access	Good 39% and 37% rate road access as good and moderate respectively even though houses in the inner courts lack direct access.	Good 63%, 19%, and 9% rate road access as good, moderate and bad respectively. Most of the site have motorable road except three alleys.	Good 67% consider the road access good whereas 17% think it is moderate. As it is designed in grid iron pattern, every house has an access road.	Good 52% and 32% rate road access as good and moderate respectively as every house has access to main road.	Moderate 47% and 43% rate road access as moderate and good respectively though there is absence of proper roads.	Having direct access to vehicular road is not the only factor deciding locational benefit as people on average are still satisfied with not having direct access to motorable streets (especially in traditional settlement).
Access to public transportation	Good 38% and 39% rate access to public transportation as good and moderate respectively. Proximity to Ratna Park (main transit hub in Ktm).	Good 56%, 26% and 10% rate access to public transportation as good, moderate, and very good respectively. The main ring-road is at the maximum of 15 mins walking distance. Chabahil – Mitrapark Road.	Good 76% and 14% rate the transportation reach as good and moderate respectively. Although there is bus stand in 5–10 mins walk, people didn't consider it as very good.	Very Good 68% and 21% rate access to public transportation as very good and good respectively. There is a mirco-bus stand in 5 mins walking distance.	Good 33% and 39% rate access to public transportation as very good and good respectively. There is a mirco-bus and bus stand in 10 mins walking distance.	Public transportation is available close to all the settlements. However, people in informal settlements are more satisfied with access to public transportation near their settlements.
Traffic condition and parking for cars	Congested traffic on the main road with no clear demarcation of pedestrian and vehicular ways. Two way traffic overlapped with pedestrian pathways and hawkers have crammed the streets. No defined area for public parking.	Congested traffic on the main road with no public parking for cars except for private parking.	Moderate; Lower traffic as residential area, house with compounds had car porch, no communal parking area as such.	Traffic flow is low with space for bike parking.	Traffic flow is low.	Higher traffic flow is related to congestion in both Chabil (in the main ringroad area) and Naradevi (settlement planned for pedestrians only).

ENVIRONMENTAL CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Landscaping, parks and vegetation	Traditionally non-green urban landscape, with no greenery or parks within the vicinity of the study area.	Mitra-park and Pasupative conservation area are notable parks with greenery just outside the settlement	No green areas or parks within the settlement except some restricted private garden. However, there are trees on the river banks and some religious spots nearby that also serve as public space and park	Green area along river banks and open space (controversial land) in front of the settlement	Green area along river banks	Non-green area in traditional settlement is a drawback which is replicated in new land-pooled area too. Though presence of green spaces around the settlement in Chabil, the use of these open spaces is still bad as these spaces are walled.
Preference of living in the current environment condition	Moderate 69% and 16% have moderate and high preference for living in the current environment condition respectively.	Moderate 79% and 16% have moderate and high preference for living in the current environment condition respectively with 5% having low preference.	Moderate 15% highly prefer the living environment and 83% have moderate preference. Interestingly, 65% of interviewees are migrants.	Moderate 52% and 39% have moderate and high preference for living in the current environment condition respectively.	Moderate 69% and 15% have moderate and high preference for living in the current environment condition respectively.	People in all settlements have moderate preference to live in current environmental condition as the problems they are facing are not unique to their location. However, higher preference for informal settlements suggests that their perception and attitude towards their settlement is positive.

HOUSING CONDITIONS

By-laws	Mixed-old-residential Sub-zone; Ground Coverage: 80–100%; FAR: 4–4.5; Max. height of building: 45ft; Max. number of floors: 5	Other-residential Sub-zone; Ground Coverage: 60–80%; FAR: 1.75; Min. plot size: 80sq.m	Planned-residential Sub-zone; Ground Coverage: 60–80%; FAR: 2; Min. plot size: 80sq.m; Min. width of plot: 6m			Lack of flexible by-laws is not helping to promote low-rise high-density settlements.
Average plot size	500 sq.ft (0-1-1-3.4)	2305.41 sq.ft (0-6-3-0)	1646.17 sq.ft (0-4-3-1)	865 sq.ft (0-2-2-0.5)	786 sq.ft (0-2-1-0.8)	Plot sizes in Khusibu and Chabahil are much bigger than min. plot size of 80sq.m. Most of the land owners own their land as ancestral property.
Ground coverage	94.85%	65.84%	78%	75.78%	91.80%	Average house size of low income families: 54sq.m (2010, CIUD).
Layout of houses	Compact, clustered courtyard houses.	Isolated in general area and row in street façade.	Rectangular/square isolated and row houses.	Long elongated houses.	Compact cluster type.	
Average household size	4.96	5.66	4.57	5.27	4.87	
Average number of people per plot	9.1	11.02	15.09	7.2	7.02	Number of people per plot in land pooled area is quite high due to increase in migrant and rental population in the area.

HOUSING CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Average number of floors	5.1 (added floors in old houses and most of the new ones above 4 floors).	2.99 (2 to 5 storey buildings).	3.6 (3 and 4 storey buildings).	1.27 (1 and 3 storey buildings).	1.42 (1 and 2 storey buildings).	In all the formal settlements, most of the houses have ground and/or first floor rented out for commercial use which has not been considered while calculating the population density.
Reason for living in the current location	For 58% ancestral property, for 33% near to work or operating business in the area, and for 9% education for self or for children were the top three reasons for living in the location.	25% ancestral property; 22% near to work; 16% near friends and family; 12% due to physical facilities; 10% due to religious pashupati area.	13% have their ancestral land, 40% have their workplace nearby, 20% people have their relatives and friends nearby while 12% like the open and calm environment.	Because for most (34%) land was available when they migrated to Kathmandu, while other reasons being job availability, cheap rental space, near to work place.	Because for most (28%) land was available when they migrated to Kathmandu, while other reasons being poverty, job availability, near to work place and public facilities.	Ancestral property is a key reason in traditional settlement and in development of settlement outside ring road. Also, near to work and presence of close kins in the area have made them settle down in that very location. For informal settlement, availability of land, access to it are main reasons.
Size of rental units	40% rent 1 room, 39% rent 2 rooms and 15% rent 4 or more rooms. Predominantly low and lower-middle income families are the renters).	33% rent 2 rooms; 32% rent 2 rooms; 27% rent 4 or more rooms 8% rent only 1 room.	Predominantly (32%) 2 room rental units, 11% rental units have 3 rooms while 12% have 1 room only.	Predominantly (71%) 1 room rental units. Predominantly low income families are renting the rooms.	Predominantly (50%) 1 room rental units. Predominantly low income families are renting the rooms.	With higher density and lower number of rooms per plot, the owners rent out as less numbers of rooms to more number of rentees. Thus, the trend of renting out 1 room is high in traditional and informal settlement. High rental price and economic condition of renters is another important factor related to families renting min. space. (Average house size of low income families: 54sq.m – 2010, CIUD)
Average per month rent	55% pay rent between Rs 2000–5000 per month.	55% pay rent between Rs 2000–5000 while 41% pay more than Rs 5000 per month.	53% pay more than NPR 5000 and 42% pay between NPR 2000–5000 per month.	75% pay less than Rs 2000 per month.	60% pay less than Rs 2000 per month.	Lumanti's Rental Housing-1 has 24 units (each unit is 180sq.ft which includes kitchen corner, attached toilet and verandah). The rent is Rs 3000 per month much cheaper and have more facilities than current rentals in Kathmandu.

HOUSING CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Renters opinion regarding rental space	43% think rental price is moderate, whereas 39% think it to be high for the space.	36.36% complain about lack of water, 18% have livable good rooms, 13.64% have light and ventilation problems (narrow rooms, small room sizes, no parking and social behaviour each have 4.55% votes)	35% consider rent price moderate while 17% say high (Rent increases every 1 year by 10–20%)	Most renters (86%) find the rental price moderate (rent increase by 10% every year)	Most renters (56%) find the rental price moderate while 33% find it high (rent increase by 10% every year)	Current rental price is affordable for almost 50% of the population. However, some perceive it to be higher for small areas rented out.
Use of house	Residential 32% is owner's residence, 22% for residence and commercial activities, 29% for residence and rental residence and 17% for rental only	Residential + Rental 52% residence + rental for residence; 31% owner's residence only; 11% residence + commercial and 6% rental only.	Residential + Rental 41% are residential + rental for residence and 23% are owners' residence only (61% interviewees are renters) what percentage is rental only?	Residential 62% owner's residence, 31% residence + rental, 2% residence + commercial, and 5% rental only	Residential 48% owner's residence, 42% residence + rental, 6% residence + commercial, and 4% rental only	Predominantly, houses in all the settlements either have space for commercial activities or space for renters.
Type of house	68% of houses are permanent and 26% are semi-permanent	95% houses are permanent structure (pakki).	98% houses are permanent	40% temporary (kachhi), 46% semi-permanent and 14% permanent (pakki)	59% temporary (kachhi), 31% semipermanent and 10% permanent (pakki)	Higher density of people where percentage of permanent structure is low shows vulnerability of people to disasters. In addition, it also suggests various pull factors that is encouraging people to choose to live in those areas. In case of informal settlements, lack of tenure security is discouraging families to invest in their houses.
Construction type	20% are still traditional houses, 29% are load bearing (semi-traditional), 15% are traditional with modification and 36% are modern pillar system	67% Houses are R.C.C. Frame structure; 31% houses are Load bearing structure.	96% houses are pillar system and 3% load bearing	52% load bearing brick masonry and 36% mud-bamboo-CGI construction	31% load bearing brick masonry and 58% wood or mud-bamboo-CGI construction	
Incremental growth	20% of houses have signs of incremental growth (mostly in traditional buildings)	Though there no sign of incremental growth, 56% families have plans for future expansion.	In 18% houses some signs of incremental growth observed (vertical growth)	Only 16% houses have vertical incremental growth while mostly add rooms on the backyard of their houses	Only 6% houses have incremental growth	Vertical increment is sought by people to cater to spatial need of increasing population. On the other hand, informal settlements have horizontal increments due to structural restrictions.

HOUSING CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Physical condition of house	40% in good, 40% in moderate, 12% in bad condition.	73% in good condition; 20% moderate, 6% very good, 1% bad.	15% houses are in very good condition while 53% houses are in good, 29% in moderate and 3% in bad condition.	77% houses are in moderate condition while 14% and 9% houses are in good and bad conditions respectively.	72% houses are in moderate condition while 10% and 18% houses are in good and bad conditions respectively.	Most of the structures are not constructed following the earthquake safety codes. Comparatively, structural integrity of houses in denser settlements are less safe. Also, having confidence of earthquake safety over these structures increases their vulnerability.
Do you perceive your house to be safe from earthquake?	38% feel safe, 50% feel unsafe and 12% don't know about condition of their houses.	47% are don't know about their home being safe from earthquake; 35% feel safe and 18% feel unsafe.	46% believe their houses is safe whereas 41% think theirs are not and 13% are unaware.	59% feel their house to be safe from earthquake while 29% feel their houses are not safe and 12% don't know (though houses are not built with earthquake resistant design).	44% feel their house to be safe from earthquake while 32% feel their house is not safe and 24% don't know (though houses are not built with earthquake resistant design).	
Use of streets, open space and courtyards	Used for washing clothes, playing, parking vehicles, feasts.	Streets used by children as play area.	Children's play, parking.	Children's play, sunbathing and feast.	Children's play, sunbathing, washing cloths and feast.	Open spaces in all settlements are mostly used for playing. In traditional settlements, it is even used for washing and feasts. In khusibun it is also used for parking.
Overall building materials	Traditional buildings have mud bricks with mud mortar. However, vertical increments are of modern material. Most of the traditional buildings have been replaced by modern RCC structures.	Modern construction materials: cement, brick, wood, steel/ iron rods, glass etc.	Modern construction materials: Brick, concrete, steel, glass etc.	Brick, concrete, bamboo, wood, mud and CGI sheets.	Brick, concrete, bamboo, mud and CGI sheets.	Modern construction materials are replacing traditional construction materials and people are either not aware or not interested in cost-effective building materials and technologies.
Roofing	Traditional houses (20%) have sloped roof with terracotta tiles or corrugated sheets. Modern RCC houses (36%) and remaining traditional yet modified houses have flat roof of RCC slab.	Most are flat RCC roof which the residents use for sunbathing, drying cloths, etc.	Most are flat RCC roof which the residents use for sunbathing, drying cloths, etc.	Most of the houses have CGI roofs with gentle slope while few families have built more permanent structures with flat concrete roof.	Most of the houses have CGI roofs with gentle slope.	In absence of adequate communal open space in new formal settlements, roofs have become an important space for families, where people sun bask, dry cloths and children play.

HOUSING CONDITIONS

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Flooring	Traditional houses mostly have mud floors and RCC structures have cement punning or marble floors.	Mostly cement punning and few marble floors.	Mostly cement punning and few marble floors or even tiles.	Mostly mud-floors with few cement punning.	Mostly mud-floors with few wooden floors and cement punning.	
Façade treatment	Traditional houses have brick façade with wooden windows, Traditional yet modified houses have either brick façade or cement plaster. RCC structures mostly have cement plaster and few with brick exposure.	Mostly contemporary building with plaster and paints.	Plaster and paints.	Most of the houses are brick-exposed, while few have plastered and painted their houses.	Most of the houses are either brick-exposed or bamboo and timber finishing, while few have plastered and painted their houses.	
Boundary walls	Almost none of the buildings have boundary walls except for few	Brick wall with plaster and paints mostly.	Brick wall with plaster and paints mostly.	No boundary walls.	No boundary walls.	Because of security reasons, houses in new formal settlements are built as fortresses with boundary walls. However, as one comes out of the house, the streets are vacant not safe. People in denser traditional settlement of Naradevi feel their area is safer compared to those in Chabahil and Khusibu.
Privacy	Moderate	High	High	Moderate	Low	Denser the settlement, lesser is the sense of privacy but more is the security.
Livability of the locality / opinion regarding current neighbourhood	Likes: 28% social environment, 16% facility (accessibility to market, hospital), 11% physical facility, 10% location and proximity.	25% ancestral property; 22% near to work; 16% near friends and family; 12% due to physical facilities; 10% due to religious pashupati area.	Likes: 34% social environment, 29% public transportation, 29% location, 20% like facilities.	Likes: social environment (24%); public facilities like transportation and infrastructures (31%); natural environment (16%); and location (12%).	Likes: social environment (23%); public facilities like transportation and infrastructures (39%); and location (24%).	Most of the people like the social environment and physical facilities of the settlements are they are living in. Hence, for being a good residential area, it is important to have good infrastructures, public facilities and good social environment.
	Dislikes: 25% water supply, 13% noise pollution, 10% social problems (population, disputes), 8% waste management, and traffic.	Dislikes: 20% don't have anything particular, 18% noise pollution, 20% social problems (population, disputes), 11% waste management and traffic.	Dislikes: 50% water supply, 19% air pollution, 12% road condition and traffic, 10% noise pollution, and 10% insecurity.	Dislikes: bad-smell from river (26%); no land ownership (26%); unhealthy environment (28%); and social problem (12%).	Dislikes: unhealthy environment (28%); bad-smell from river (18%); no land ownership (18%); and social problem (15%).	Water supply, air pollution and noise pollution are the common problems in every settlements.

PREFERENCES

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshigat)	Remarks
Savings for new house	45% are saving money for new house.	32% are saving for their new house.	22% had savings for new house.	34.1% are saving money for new house.	23.1% are saving money for new house.	
Preferable location to live	63% prefer to relocate to new place.	56% prefer same location, while 43% prefer to relocate in better place.	59% want to relocate to new place.	84% prefer to leave in current location, while others prefer to relocate.	51% prefer to leave in current location, while others prefer to relocate.	Even with all the problems, most of the informal settlers want to live in the same location, while in other settlements many people want to relocate. Fear of forceful eviction and other political reasons may have influenced the answers of families from informal settlement and their preference to live in current location.
Preferable shelter type	96% prefer to live in individual house.	96% wants individual houses.	88% prefer individual home.	84% prefer to live in individual houses, while 16% prefer walk-up apartment.	79% prefer to live in individual houses, while 19% prefer walk-up apartment and 2% prefer highrise apartment.	Even with high cost of land, predominantly people still prefer to live in an individual home (large or small) rather than apartment (may be due to our social lifestyle where house is a matter of pride and investment).
Settlement planning type	40% prefer to live in courtyard planning, while 37% prefer clustered settlements and 23% prefer grid pattern.	44% prefer grid iron pattern settlement with individual houses; 39% – Cluster / organic.	79% like grid iron planning and 13% courtyard plans.	95% prefer to live in grid pattern with row-house and wide roads, 5% prefer courtyard planning.	86% prefer to live in grid pattern with row-house and wide roads, 12% prefer cluster/organic planning.	People from Naradevi prefer clustered settlement with courtyards, while others predominantly prefer grid-iron planning.
Plot size	57% – 3–5 ana, 22% – 1–2 ana, 14% 6–9 ana.	40% wants 6–9 annas; 26% 9–16 annas; 24% 3–5 annas.	68% prefer 3–5 ana and 19% prefer 6–9 ana.	75% prefer 3–5 ana (1026–1710 sq.ft.) plot size, while 18% prefer 1–2 ana (342–684 sq.ft).	67% prefer 3–5 ana (1026–1710 sq.ft.) plot size, while 19% prefer 1–2 ana (342–684 sq.ft).	3 to 5 ana land (1–2 ana being second preference) with individual houses of 3 to 5 rooms is the most optimum space and size preferred by the people.
Size of house	72% – 3–5 rooms, 15% – 2 or less, 13% more than 5.	72% need more than 5 rooms and 27% 3–5 rooms.	60% prefer 3–5 bedrooms and 26% more than 5 bedrooms.	80% prefer to have 3–5 rooms, 16% prefer more than 5 rooms, while 4% prefer 2 rooms.	72% prefer to have 3–5 rooms, 16% prefer more than 5 rooms, while 12% prefer 2 rooms.	
Willingness to pay (in lakhs)	31% are willing to pay less than 10 lakhs, 25% – 10–30 lakhs, 22% – 31–50 lakhs, and 14% – 51–70 lakhs.	50% are willing to pay 31–50 lakhs.	27% are capable of paying 31–50 lakhs and 20% prefers 71–90 lakhs houses.	56% are willing to pay 10 to 30 lakhs, while 37% are willing to pay less than 10 lakhs.	48% are willing to pay 10 to 30 lakhs, while 40% are willing to pay less than 10 lakhs.	People are willing to pay from 10 to 50 lakhs for housing (30 lakhs on average) nearly one third of the average cost of a house.

PREFERENCES

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Space for economic activities	41% require space for economic activities.	52% don't want space for economic activities, while 48% want commercial-rental space.	51% want space for renting in their home.	88.1% want space for economic activities in their new house.	81.3% want space for economic activities in their new house.	Having provision for economic activities or space for renting is preferred by people.
Preferences while buying or building a house	Public facilities/ infrastructures, disaster resilient structures, property safety.	Public facilities/ infrastructures, property safety, access to transportation.	Plot and shelter size, public facilities/ infrastructures, property safety.	Public facilities/ infrastructures, job opportunities and property safety.	Public facilities/ infrastructures, job opportunities and transportation.	Most of the families give high preference to public facilities / infrastructure; property safety; and availability of transportation, market and job compared to better neighbours, public spaces and better environment for their children.
	Good neighbours, environment for children, public spaces.	Plot and shelter size, job opportunities, disaster resilient structures.	Public spaces, good neighbours, environment for children.	Plot and shelter size, transportation and disaster-resilient building.	Disaster-resilient building, plot and shelter size and property safety.	
	Access to transportation, job opportunities, plot and shelter size.	Environment for children, neighbours, public space.	Job opportunity, access to transportation, disaster-resilient structures.	Environment for children, neighbours and public spaces.	Environment for children, neighbours, public spaces.	

PHYSICAL FEATURES

Total Area of settlement (hectares)	4.05	22.57	20.35	2.1 (Including proposed road along the river bank and excluding green space along river bank)	1.87 (Excluding green space along river bank)	
Total number of plots with houses (occupied)	940	844	710	110	115	
Average family size	4.99	5.66	4.57	5.27	4.87	
Number of families per plot	2.04	2	4.26	1.37	1.44	Number of household per house is more than 2 (on average) which shows the increase in the population of rentees. Number of household per house was 1.52 (Population Census 2001, CBS).
Average number of people per plot	9.1	11.02	15.09	7.2	7.02	In Khusibu, number of people per plot 15.09 is less than average family size (4.57) * number of families per plot (4.26).
Total population (residential)	8554	9301	10714	792	807	In Khusibun, if we take average people per plot 4.57*4.26, total population will be 13822.

PHYSICAL FEATURES

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Population density (Number of people per hectare)	2112.10	412.09	526.48	377.14	431.71	The density calculated is residential population density. (Population density in all formal settlements is higher than the derived number as rental population using ground and first floor for commercial purposes are not included in the Household). The informal settlements have lower population density compared to other settlements because there are predominantly one storey buildings in these informal settlements.
Average residential plot size	500 sq.ft. (0-1-1-3.4)	2305.41 sq.ft. (0-6-3-0)	1646.17 sq.ft (0-4-3-1)	865 sq.ft (0-2-2-0.5)	786 sq.ft (0-2-1-0.8)	In case of Sankhamul, the average plot size from calculation is 1701sq.ft (0-4-3-3.5).
Average market price of one built unit	Land cost: 15–70 lakhs for 500sq.ft; Building cost: 15–50 lakhs; Total cost: 30–120 lakhs; Average cost: 75 lakhs.	Land cost: 50–150 lakhs for 2305.41sq. ft; Building cost: 40–80 lakhs; Total cost: 90–230 lakhs; Average cost: 160 lakhs.	Land cost: 40–100 lakhs for 1646.17sq. ft; Building cost: 30–60 lakhs; Total cost: 70–170 lakhs; Average cost: 120 lakhs.	Land cost: 20–50 lakhs for 565sq.ft; Building cost: 1–12 lakhs; Total cost: 21–62 lakhs; Average cost: 41.5 lakhs.	Land cost: 15–35 lakhs for 786sq.ft; Building cost: 1–8 lakhs; Total cost: 16–43 lakhs; Average cost: 29.5 lakhs.	Land in Chabahil and Kushibun seems to be as expensive as in Naradevi. This implies a new commercial centre is being developed in outskirts itself leading to decentralized Cental Business District concept. This may be useful to cut off relatively high density from central core areas.
Average market price of a house (land and house) to annual income ratio	31.24	32.77	29.14	23.16	19.8	Very high (probably because income may be more than what is told). According to CIUD, 2010, house price to annual income ratio: 3.9 which is little too low.
Total built-up area (residential)	63.7% (2.58 hectares)	35.7% (8.06 hectares)	34.01% (6.92 hectares)	37.14% (0.78 hectares)	42.25% (0.79 hectares)	Even with comparatively less built-up area, open spaces in Chabahil and Khusibu does not meet the minimum requirement. Increasing min. communal space required while reducing minimum plot size and allowing more ground coverage and FAR can be a strategy to encourage quality communal space while achieving higher density.
Total open area (courtyards, parks, play area, greenery)	25.43% (1.03 hectares)	3.9% (0.88 hectares)	3.39% (0.69 hectares)	No communal open space within the settlement	9.63% (0.18 hectares)	

PHYSICAL FEATURES

Case Study	Traditional settlement (Naradevi)	Settlement outside ring-road (Chabahil)	Land-pooling site (Khusibu)	Informal settlement (Sankhamul)	Informal settlement (Banshighat)	Remarks
Empty plots (number and area)	0.5% (0.02 hectares)	28.44% (6.42 hectares)	36.52% (7.43 hectares)	No empty plots to be occupied unless some families allow houses to be built in their backyard.	Some empty plots still seen.	There are still areas for construction in Khusibun and Chabahil, which means possibility of increase in population density in these areas.
	4 empty plots that may develop later.	18.72% can turn into built-up area after the remaining empty plots are developed.	28.49% can turn into built-up area after the remaining empty plots are developed.			
Total circulation (roads, streets and alleys)	8.89% (0.36 hectares)	11.46% (2.59 hectares)	15.52% (3.16 hectares)	12.86% (0.27 hectares)	11.77% (0.22 hectares)	Khusibu has greater percentage of roads compared to other settlements because it is planned in grid iron pattern.
Educational/ Religious area	1.48% (0.06 hectares)	2.08% (0.47 hectares)	1.22% (0.25 hectares)	Small temple (40sq.m)	Not available	
Other spaces around houses	NA	18.39 % (4.15 hectares)	9.34% (1.9 hectares)			
Total road length (rm)	5m wide road: 807m; 3m wide road: 96.5m; 6m wide road: 106.4m; 1.2m alley: 655.17m	17m wide road: 466m; 4.5m wide road: 2136m; 3m wide road: 1069m; 2m wide road: 512m; 1.5m wide alley: 1561.75m	4590.06m of 8m wide road, 2295.47m of 6m wide road, 1497.94m of 4m wide road, 625.07m of 2.5m wide road	8m wide road: 419m; 4m wide road: 253m; 3m wide road: 169m	8m wide road: 290m; 4m wide road: 460m; 1m wide alley: 210m	
Total sewerage line length (rm)	1665	5745	8907	Sewage line directed into river (toilets are at the rear of plots).	Sewage line directed into river (some even don't have toilets).	
Total water lines length (rm)	1665	5745	8907	Communal water tanks.	Communal water tanks.	
sq.m of road per plot	3.81	22.66	26.44	24.55	19.13	Cost of infrastructure can be reduced by planning compact settlements with smaller plots and communal open courtyards.
r.m of main water line per plot	1.76	5.03	7.45	NA	NA	
r.m of main sewage line per plot	1.76	5.03	7.45	NA	NA	

Appendix 2: Questionnaire

LUMANTI SUPPORT GROUP FOR SHELTER			
Survey Questionnaires for the research titled Urban Density Study of Kathmandu: Planning for low-rise high density settlements			
Name of surveyor:		Date:	
Time interview started:		Time interview concluded:	
Ward number:	Name of tole:	House number:	
Name of respondent:			
1. HOUSEHOLD INFORMATION			
1.1 Living in the house since:		1.2 Caste/Ethnic group:	
1.3 Number of household members:		1. Male:	2. Female:
1.4 Age of household members:		1. Less than 15 years old:	2. 16–35 years old:
		3. 36–55 years old:	4. More than 60 years old:
1.5 Occupation of household members:			
SN.	Relation with household head	Occupation	Location of work
1.6 Total monthly household income:			
1.7 Saving of monthly income (%)		1. Less than 10%	2. 11% – 30%
			3. Above 30%
1.8 Where do you keep you savings?		1. Banks	2. Finances
		4. Home	3. Cooperatives
		5. Lend to others	6. Others ()
1.9 Monthly transportation expenses:			
1.10 Are HH members engaged in social groups?		1. Yes:	2. No:
1.11 If yes, type of social group/activities:			
		1. Neighborhood Committee	2. Saving/Cooperative groups
		3. Guthi/Religious/Cultural groups	4. Youth/Sports groups
		5. Women/Housewife groups	6. Others ()
1.12 Total number of people living in the house (including renters):			

2. SOCIAL CONDITION:

2.1 Do you lend or borrow money from your neighbors?	1. Yes:	2. No			
2.2 If yes, how often do you lend or borrow money? (freq.)	1. Very high	2. High	3. Moderate	4. Low	5. Very low
2.3 Do you lend or borrow HH items from your neighbors?	1. Yes:	2. No			
2.4 If yes, how often do you lend or borrow HH items?(freq.)	1. Very high	2. High	3. Moderate	4. Low	5. Very low
2.5 Do you leave your home and children to neighbors?	1. Very high	2. High	3. Moderate	4. Low	5. Very low
2.6 If yes, how often you do leave them to neighbors? (freq.)	1. Very high	2. High	3. Moderate	4. Low	5. Very low
2.7 What is the level of relationship with your neighbors?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
2.8 What is the level of safety in your neighborhood?	1. Very high	2. High	3. Moderate	4. Low	5. Very low
2.9 Where do children (under 14) play?	1	2	3		
2.11 How far do you need to go for shopping?					
2.12 How far do you go for recreation?					
2.13 Is there a community centre in your settlement?	1. Yes:	2. No			
2.14 If yes, what do you use it for?	1	2	3		
2.15 Do your children go to school in neighborhood?	1. Yes:	2. No			
2.16 If yes, how far is the school?					
2.17 Are there open spaces in your neighborhood?	1. Yes:	2. No			
2.18 If yes, what do you use open space for?	1	2	3		
2.19 Do you think that the available open space is enough?	1. Yes:	2. No			
2.20 Overall preference of living in the current social environment	1. Very high	2. High	3. Moderate	4. Low	5. Very low

3. ENVIRONMENTAL CONDITION:

3.1 How do you rate water-supply services?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.2 How do you rate electricity services?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.3 How do you rate waste management services?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.4 How do you rate drainage system during rain?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.5 How do you rate sewage services?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.6 How do you rate road access to your home?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.7 How do you rate access to public transportation?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.8 How do you rate air quality in your neighborhood?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
3.9 how do you rate level of noise pollution in your neighborhood?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad

4. HOUSING INFORMATION:

4.1 Plot size:					
4.2 No. of storeys:					
4.3 Ground coverage:					
4.4 Current use of house	1. Owner's residence	2. Residence + Commercial			
	3. Residence + Rental for residence	4. Rental only			
4.5 Status in current house	1. Owner	2. Renting			
4.6 Why did you choose to live/rent in this location?					
4.7 Are you migrant to the city?	1. Yes:	2. No			
4.8 If yes, what is the main reason for migration?	1	2	3		
4.9 Type of house (tick by observation)	1. Temporary (Kachhi)	2. Permanent (Pakki)	3. Semi-permanent		
4.10 Construction type (tick by observation)	1. Traditional Newari house	2. Load bearing construction			
	3. Modified traditional house	4. Pillar system			
	5. Mud, bamboo, and CGI sheets	6. Others			
4.11 Are there indicators of incremental growth?	1. Yes:	2. No			
4.12 What is the physical condition of the house?	1. Very good	2. Good	3. Moderate	4. Bad	5. Very Bad
4.13 Do you perceive your house to be safe from earthquake?	1. Yes	2. No	3. Don't know		
5. Details of renters: (to be asked to renters only, if interviewing owners, jump to question no. 6)					
5.1 Number of families living (including owner):					
5.2 Total number of people living:					
5.3 Size of rental units:	1. 1 room	2. 2 rooms	3. 3 rooms		
5.4 How much do you pay for rent?	1. Less than Rs. 2000	2. Rs. 2000-5000	3. More than Rs. 5000		
5.5 How do find the rental price?	1. Very high	2. High	3. Moderate	4. Low	5. Very low
5.6 What kind of problems do you face while renting?					
5.7 How often does the rent increases?					
	1. Every six months by %	2. Every year by %			
	3. Every two years by %)	4. Every three years by %			
5.8 Can you be asked to leave the place without prior notice?	1. Yes	2. No			

6. OPINION REGARDING THE CURRENT NEIGHBORHOOD:

6.1 What do you like about the overall living condition of the place?

- | | |
|---|---|
| 1 | 2 |
| 3 | 4 |

6.2 What do you dislike about the overall living condition of the place?

- | | |
|---|---|
| 1 | 2 |
| 3 | 4 |

7. PREFERENCES

7.1 Are you saving money to buy or construct a house? 1. Yes 2. No

7.2 Where do you prefer your live? 1. Current location 2. Relocate to other place

7.3 Where do you prefer to live? 1. Individual house 2. Highrise Apartment 3. Walk-up Apartment

7.4 What kind of settlement planning do you prefer to live? 1. Courtyard planning 2. Grid pattern with row-houses and wide roads 3. Cluster / Organic planning

7.5 Preferable plot size 1. 1–2 anna 2. 3–5 anna 3. 6–9 anna
4. 9 anna–1 ropani 5. More than 1 ropani

7.6 Preferable size of house 1. 2 or less rooms 2. 3–5 rooms
3. More than 5 rooms 4. 4 or more rooms

7.7 How much are you willing to pay for the land & housing? (in lakhs) 1. less than 10 2. 10 to 30 3. 31 to 50
4. 51 to 70 5. 71 to 90 6. More than 90

7.8 Do you require space for economic activities or for renting? 1. Yes 2. No

7.9 Select you preferences over the following items:

Preferences	High	Moderate	Low
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Preference on plot and shelter size

Preference on public facilities (sanitation, electricity, water, waste, drainage, etc)

Preference on public spaces

Preference on neighbors

Preference on community and property safety

Preference on living environment (esp for children)

Preference on job opportunities

Preference on transportation and communication

Preference on disaster-resilient building construction and settlement planning (earthquake, flooding, erosion)

Appendix 3: List of Survey Team Members

Amit Bajracharya
Pragya Pradhan
Bhagawat Bhakta Khokhali
Poonam Amatya
Sabina Shrestha
Prajina Karmacharya
Rubina Manandhar
Sujata Shakya
Shreedhara Bajracharya
Nijula Singh
Subik Shrestha
Alok Bajracharya
Looza Shakya
Siddhartha Gautam
Sameer Poudyal
Shreejay Shrestha

Appendix 4

Physical comparison with new proposals

PHYSICAL COMPARISON WITH NEW PROPOSALS								
Case study	Traditional settlement (Naradevi)	Naradevi after re-planning	Settlement outside ring-road (Chabahil)	Chabahil after re-planning	Land-pooling site (Khusibu)	Khusibu after re-planning	Informal settlement (Sankhamul)	Sankhamul after re-planning
Total Area of settlement (hectares)	4.05	4.01	22.57	22.57	20.35	20.38	2.1 (Including proposed road along the river bank and excluding green space along river bank)	2.1
Total number of plots with houses (occupied)	940	940	844	1480	710	1433	110	760 apartment units
Average family size	4.99	4.99	5.66	5.66	4.57	4.57	5.27	5.27
Number of families per plot	2.04	1.6	2	3	4.26	3	1.37	NA
Average number of people per plot	9.1	7.7	11.02	17	15.09	14	7.2	NA
Total population (residential)	8554	7240	9301	25160	10714	20062	792	4005
Population density (number of people per hectare)	2112.10	1805.00	412.09	1102.32	526.48	1082.68	377.14	1907.24
Average residential plot size	500 sq.ft. (0-1-1-3.4)	500 sq.ft. (2305.41-0-6-3-0)	774.72 sq.ft. (0-2-1-0)	1646.17 sq.ft. (0-4-3-1)	775 sq.ft. (865 sq.ft. (0-2-2-0.5)	786 sq.ft. (0-2-1-0.8)		
Total builtup area (residential)	63.7% (2.58 hectares)	63.7% (2.58 hectares)	35.7% (8.06 hectares)	38.59% (8.71 hectares)	34.01% (6.92 hectares)	41.67% (8.49 hectares)	37.14% (0.78 hectares)	50% (1.05 hectares)
Total open area (courtyards, parks, play area, greenery)	25.43% (1.03 hectares)	25.43% (1.03 hectares)	3.9% (0.88 hectares)	5.06 % (1.15 hectares)	3.39% (0.69 hectares)	5.76% (1.17 hectares)	No communal open space within the settlement	13.33% (0.28 hectares)
Total circulation (roads, streets and alleys)	8.89% (0.36 hectares)	8.89% (0.36 hectares)	11.46% (2.59 hectares)	31.72% (7.24 hectares); and 25.65% if we do not count 466.37m ring-road	15.52% (3.16 hectares)	19.64%(4 hectares)	12.86% (0.27 hectares)	24.29% (0.52 hectares)

PHYSICAL COMPARISON WITH NEW PROPOSALS

Case study	Traditional settlement (Naradevi)	Naradevi after re-planning	Settlement outside ring-road (Chabahil)	Chabahil after re-planning	Land-pooling site (Khusibu)	Khusibu after re-planning	Informal settlement (Sankhamul)	Sankhamul after re-planning
Educational/religious area	1.48% (0.06 hectares)	1.48% (0.06 hectares)	2.08% (0.47 hectares)	1.67% (0.38 hectares)	1.22% (0.25 hectares)	1.47%(0.3 hectares)	Small temple (40sq.m)	Small temple (0.01 hectares)
Other spaces around houses	NA	NA	18.39% (4.15 hectares)	9.54% (2.17 hectares)	9.34% (1.9 hectares)	10.42% (2.12 hectares)	NA	11.91% (0.25 hectares)
Total road length (rm)	5m wide road: 807m; 3m wide road: 96.5m; 6m wide road: 106.4m; 1.2m alley: 655.17m	5m wide road: 807m; 3m wide road: 96.5m; 6m wide road: 106.4m; 1.2m alley: 655.17m	17m wide road: 466m; 4.5m wide road: 2136m; 3m wide road: 1069m; 2m wide road: 512m; 1.5m wide alley: 1561.75m	12m wide road :1725.17m; 6m wide road: 5509.22m; 3m wide road: 96m; 12m wide pedestrian lane: 234m; 31m c/c ringroad = 466.37m; 11mc/c strategic road= 99.57m.	4590.06m of 8m wide road, 2295.47m of 6m wide road, 1497.94m of 4m wide road, 625.07m of 2.5m wide road	565.25m of 18m wide road, 6159m of 9m wide road, 1315.5m of 6m wide road, 209.63m of 5m wide road		
Total sewerage line length (rm)	1665	1665	5745	7564.39	8907	7684.13		
Total water lines length (rm)	1665	1665	5745	7564.39	8907	7684.13		
r.m of main water line per residential plot	1.76	1.76	5.03	5.11	7.45	5.36		
r.m of main sewage line per residential plot	1.76	1.76	5.03	5.11	7.45	5.36		

Related reading

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Acronyms

FAR	Floor Area Ratio
NLRP	Nayabazar Land Readjustment Project
NPR	Nepalese Rupee
OPP	Orangi Pilot Project
ppha	People per hectare
RCC	Reinforced Cement Concrete
VDC	Village Development Committee

Kathmandu faces serious urban planning and housing challenges. Most development is occurring beyond the legal limits of zoning bylaws and building regulations in response to housing shortages. As settlements densify haphazardly, affordable housing options are increasing, but living conditions, services and crowding are worsening. The potential consequences for low-income residents are disastrous given the danger of an imminent earthquake. This paper examines four types of settlements in Kathmandu to understand the impacts of densification. It then presents conceptual reimaginations of these settlements to apply the lessons for planning affordable housing in densifying settlements without compromising unduly on safety and liveability.

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