Urban Planning and Wellbeing

Urban Planning and Wellbeing

Proceedings of the International Conference on Urban Planning & Wellbeing

May 16-17, 2019
Thimphu, Bhutan

དཔལ་འབྱོར་ཞིབ་འཇུག་ལྷན་ཚོགས།
Centre for Bhutan & GNH Studies

Urban Planning and Wellbeing: Proceedings of the International Conference on Urban Planning & Wellbeing

Copyright © 2020 Centre for Bhutan & GNH Studies

First published: 2020

Published by:
Centre for Bhutan & GNH Studies
Post Box No. 1111
Thimphu, Bhutan
Tel: 975-2-321005/321111
Fax: 975-2-321001
E-mail: cbs@bhutanstudies.org.bt
http://www.bhutanstudies.org.bt
http://www.grossnationalhappiness.com

ISBN 978-99980-35-07-2

CONTENTS

Preface vii

Finding A Path to Prosperous and Sustainable Cities: A Framework for Bhutan
David Mason 1

Methodology of Green Infrastructure Planning toward the Sustainability of Urban Environment: Comparative Study between Bhutan and Japan
Mikiko Ishikawa 30

Development of Carbon Neutral Scenario in Bhutan towards 2050 with Socio-Economic Development and Forest Carbon Sink Change
Kei Gomi, Yuki Ochi, Akio Ito, Tomoko Ishikawa and Shuzo Nishioka 48

Architecture for Coexistence of Rural and Urban Settlements in Bhutan
Divya Chhetri, Kinley Dechen, Sonam Choden and Dhurbaraj Sharma 55

Sustainable Riverfront Development in Bhutan: A Study in Thimphu City
Chimi and Arindam Biswas 107

Smart Happy Future Cities
Oualid Ali and Gustavo de Siqueira 146

Understanding Environment Impacts on People via Environmental Psychology: Three Basic Principles
Marino Bonaiuto 168

Evaluate the Quality of Urban Public Spaces Using the Sonic Perception of Visually Impaired People
Christina E. Mediastika, Anugrah Sabdono and Luciana Kristanto 202

Mass Transport Bus Route Proposal for Township Plan
Samhita 218

Green Infrastructure: Smarter Solutions for Small and Medium Towns in India
Iswarya Ramachandran and Abhinav Madhavanunni 234

A Vision for Livable Thromdes in the Democratic Bhutan
Dasho Kunzang Wangdi, Ugyen Lhendup and Kezang Wangdi 256

Asset-Based Community Development and Implications for Bhutan
Shawn McLearen 286

Contributors 330

Preface

In the face of rapid urbanization that Bhutan is experiencing along with other developing countries, the international conference on Urban Planning and Wellbeing was organized in Zhichenkhar, Thimphu to address the urban challenges. It was held from 16 to 17 May 2019.

Almost 100 international experts along with Bhutanese participants discussed a wide range of issues and shared their insights. The discussions were broadly grouped into six themes: sustainable and smart cities; built environment and infrastructure; planning issues; urban happiness; water, sound and waste management; and architecture and mobility. The selected papers included in this book, however, do not strictly follow the aforementioned order of themes.

The conference was organized to develop a framework for sustainable urban planning and happiness. This was greatly helped by the experts. While the conference obviously touched upon solutions to address urban challenges, it also underscored the need for planning, developing and maintaining a city that fosters happiness and wellbeing.

The organizers would like to thank the authors of the papers and all the participants for their engaging discussions.

1

Finding A Path to Prosperous and Sustainable Cities: A Framework for Bhutan

David Mason

Abstract

Despite its small absolute size and population, Bhutan is the most rapidly urbanizing country in South Asia. This urbanization has coincided with strong economic growth as the country shifts toward an economy based on contributions from manufacturing and services clustered in and around cities. Across the country, there has also been remarkable convergence in terms of infrastructure coverage, however the quality of services, as well as poverty and happiness levels vary widely between urban and rural areas. As detailed in the 12th Five Year Plan, Bhutan aims to balance sustainable development with decentralization for greater administrative authority to local governments. Yet there remain significant challenges to local governments in managing urban expansion, forces of congestion and pollution and ensuring affordability of housing and equity of access to services. Each of these factors can reduce the livability and potential for economic competitiveness in Bhutan's growing cities. Based on a review of policy documents, census and survey data, grey literature, satellite and mapping data the paper outlines a framework for a spatially-sensitive approach to balance manage urbanization to balance both quality of life measures and spur private investment and employment opportunity growth. It provides emerging findings and details areas of future study to inform urban policy.

Introduction

Bhutan has made remarkable achievements in economic growth and poverty reduction. The more than ten-fold growth in GDP per capita between 1980-2017 far exceeded the regional

average. The annual average growth rate, at 7.5 percent over the last three decades, is the third highest in the world. The country has made substantial advances in the eradication of extreme poverty, with the official headcount poverty rate dropping from 31% in 2003 to 8% in 2017. Bhutan also made significant advancements in human capital outcomes. For example, in a single decade, the primary school net enrollment rate increased from 59% to 89%, while infant mortality fell steeply from 186 per 10,000 births in 1969 to 27 in 2015, a figure that is well below the regional average of 43.

Yet, as a landlocked and mountainous small country, Bhutan faces unique challenges to its economy and growth model. Despite rapid growth, productive employment opportunities are scarce. Nearly 60% of all employed, and most of the poor, remain engaged in agricultural activities. Hydropower has driven the structural transformation of the economy. However, hydropower has limited direct job creation potential. After agriculture, the second biggest employer is the public sector; which attracts educated Bhutanese due to compensation, other benefits and social status, while quality job opportunities in the private sector remain limited.[1] Overall unemployment was just 2.1% in 2016, but this may mask high under-employment, such as subsistence agriculture and informal services in the rural areas. There is evidence that (in line with international experiences), younger people are gaining higher aspirations with better education, and opting to migrate to cities and bear period of unemployment to secure higher-quality jobs, rather than accept a subsistence lifestyle in rural areas; youth unemployment was 13%, but 23% in urban areas. Meanwhile, a substantial share of women has left the labor market; the female labor participation rate fell steeply, from 65% in 2009 to 54% in 2016.

A critical challenge is, therefore, how to advance Bhutan's structural transformation toward an economy driven by the private sector and based on employment in higher value and tradeable manufacturing and, services, with sustainable jobs for the educated, the skilled, the youth and women. In order to

[1] World Bank (2016) "Bhutan's Labor Market: Toward Gainful Quality Employment for All"

achieve this, and to proceed toward the RGoB's goal of balanced and equitable development, Bhutan needs to better understand the dynamics of its current Demographic-Spatial and Economic-Spatial transformations to better leverage the benefits of its economic shifts and spatial concentration of people.

This paper takes stock of recent trends in urbanization, economic growth and demographic change from a spatial perspective, using secondary data and geospatial analysis. First, it provides a brief review of the global experience on urbanization and spatial transformation. Second it reviews the changes urbanization, economic change and service delivery access in Bhutan from a spatial perspective. Then, it discusses the current policies and institutions involved in managing urbanization and regional development. Based on the analysis, it proposes a framework for guiding policy making to better target public investments to leverage the potential of urban areas for job creation and livability, while also addressing the needs of poorer small towns and less densely populated rural areas. This aligns with the Royal Government of Bhutan's (RGoB) overall goal of balanced and equitable development.

Spatial transformation in global perspective

Although Bhutan has unique economic characteristics, its experience of rapid urbanization and spatial concentration reflects global experiences. The rapid growth of developing and emerging countries in the past century has been accompanied by an intense concentration of production, jobs, and people in major cities. This reflects the importance of *agglomeration economies* in the modern economy: dense, large, markets offer a host of critical benefits to firms and households, such as access to diverse inputs (labor, materials, business services, and so on), consumers for their products, learning through knowledge spill-overs, higher-wage off-farm jobs, social and educational opportunities, and more efficient service and infrastructure-delivery. This urbanization and concentration have played an important role in the unprecedented growth and poverty reduction of the past century in many countries.

However, this virtuous density has also raised an equity problem. Agglomeration entails intense 'peaks' of economic

concentration and dynamism, surrounded by relatively less dense and concentrated 'plains' with much fewer firms and households, and often (though not exclusively) relatively worse welfare outcomes. This emerging *regional inequality* has become a major development challenge. Policy makers often respond to this challenge with attempts to 'flatten' the peaks of economic density and spread production more evenly across the country. The risk of this approach, however, is forgoing the crucial *benefits* of agglomeration economies for poverty reduction, job creation, and sustainable growth. Furthermore, attempts to flatten the peaks of density have typically failed, instead forcing activities in the leading areas into informality, exacerbating congestion and exclusion of the urban poor, while creating 'stranded' under-utilized assets in lagging areas at a high cost to both local and national governments.

Countries can reap the gains of agglomeration economies for job creation and poverty reduction, while ensuring these gains raise opportunities and living standards for people *everywhere*.[2] These gains can be materialized when the most dynamic cities 'pulling ahead' are properly supported to serve their function as engines of national growth, job creation, and poverty reduction, while places with lower economic dynamism and density are *integrated* into the success of major cities, and robust *social policies* ensure that people in even the most remote, disconnected, rural areas are ensured a decent basic quality of life, the health and skills necessary to access opportunities elsewhere in the country. Through this package of complementary policies, countries can pursue *unity* across a territory, without *uniformity* in production across places, for fast and inclusive growth. This global experience implies that settlements with different *sizes and densities* will serve different functions, and require different policy focuses.

Territorial development trends

Despite its land area approximately one quarter that of Bangladesh or Nepal, Bhutan has one of the smallest populations

[2] World Bank 2009. *World Development Report: Reshaping Economic Geography*

in the world at 727,145 according to the 2017 census.[3] Population density is thus very low by international standards, at around 20 people per km^2, compared to over 200 per km^2 in Nepal, and over 1,200 per km^2 in Bangladesh. This low average density masks important variation across the country. Around one percent of the land area of Bhutan is used for human settlement,[4] and the population is fairly dispersed among these settlements. Just 19.5% of the population resides in Bhutan's two largest municipalities, all other cities have less than 10,000 people, and 62.2% of the population reside in rural areas in 2017.[5]

The most substantial agglomerations of people and production are in two leading centers in the West and South – the cluster formed by Thimphu (the capital), Paro and Wangdue Phodrang, and the area around Phuentsholing at the Southern Indian border, as well as the corridor connecting these two clusters. Thimphu municipality comprises around 40 percent of the urban population, while the wider Thimphu district hosts 125,551 people (15% of the population). The next largest center, Phuentsholing, at the main trading post with India, hosts approximately 28,000. Other small centers (such as Gelephu at the central border with India, Samdrup Jongkhar at a South-Eastern Indian border, and central Trongsa) have fewer than 10,000 people and less than 4% of the national urban population each. The Eastern population and economy are much smaller, and more dispersed across smaller settlements. Figures 1 - 3 utilize nighttime lights data to estimate economic activity and population density. The peaks demonstrate the concentration of people and economic activity in and around Thimphu and along the southwestern border area.

[3] Population and Housing Census of Bhutan, 2017
[4] National Human Settlements Strategy, 2017
[5] Population and Housing Census of Bhutan, 2017

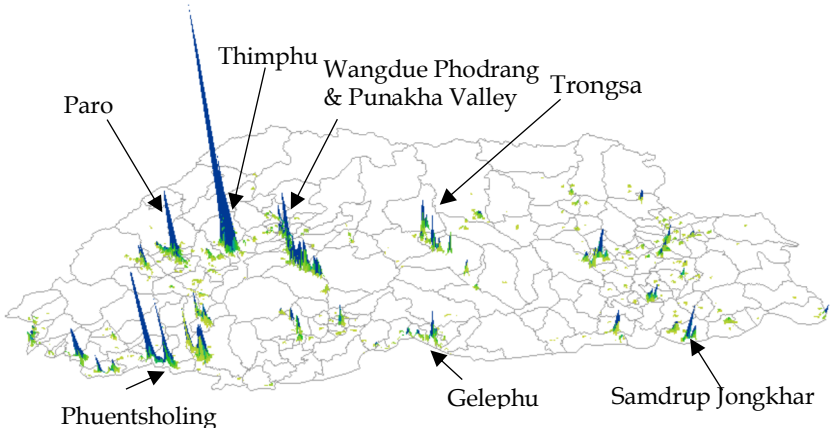


Figure 1. Economic Density Across Bhutan (Proxied by nighttime lights, VIIRS 2015).
Nighttime lights (VIIRS 2015) data provides a proxy to visualize the economic density across space, accounting for both urban and rural economic density. Here, we map economic density within Bhutan. This exercise highlights the primacy of Thimphu in the urban system.
Source. Authors' own, using VIIRS 2015 nighttime lights data[6]

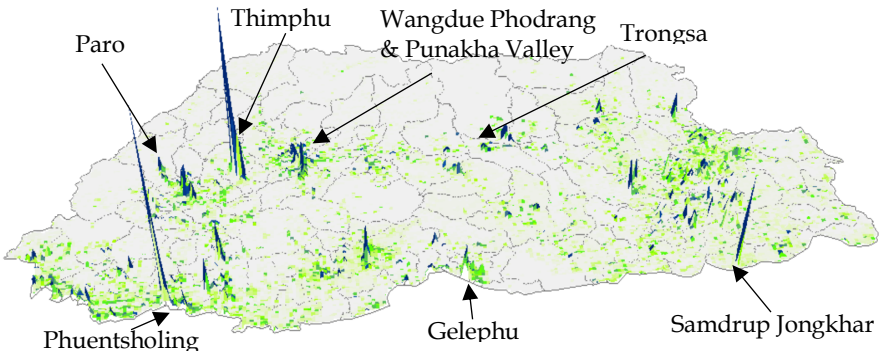


Figure 2. Bhutan Population Distribution (Landscan 2012)

[6] 1 VIIRS Day/Night Band Nighttime Lights (yearly VIIRS Cloud Mask - Outlier Removed - Nighttime Lights), Earth Observation Group, NOAA National Centers for Environmental Information (NCEI)

This map shows an estimate of population distribution across Bhutan, using 2012 Landscan data. Concentration in the same centers is observed, though as expected, compared to economic density, the population is more spread across rural areas, while certain secondary cities (such as Phuentsholing and Samdrup Jongkhar) have relatively high population density relative to economic density, suggesting a greater need for interventions to support growth in these cities.
Source. Authors' own, using Landscan 2012 population density data.[7]

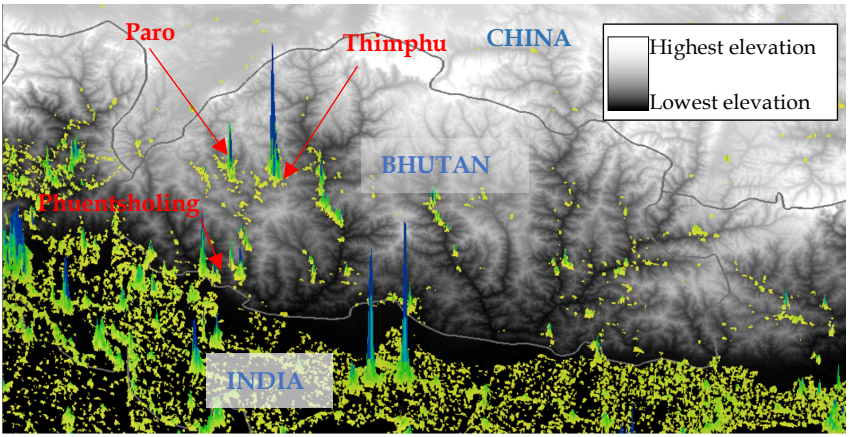


Figure 3. Economic density (nighttime lights) overlaid with topography.
This map overlays the former data on economic density across space with a topographical map, illustrating the general alignment of population and economic centers along valleys and areas of low elevation. This also highlights the advantage of the Southern border region, with far lower elevation and flatter land supporting greater agriculture and development of urban structures.
Source: Authors' own, using VIIRS 2015 nighttime lights data.[8]

[7] LandScan 2012 global population database. Oak Ridge, TN: Oak Ridge national laboratory. This is the most recent population dataset available for the LandScan analysis.
[8] As above, Version 1 VIIRS Day/Night Band Nighttime Lights (yearly VIIRS Cloud Mask - Outlier Removed - Nighttime Lights), Earth Observation Group, NOAA National Centers for Environmental Information (NCEI)

The distribution of urban settlements according their size and rank in the urban system suggests that Bhutan's case is reflective of other urbanizing and landlocked countries. In countries that are urbanizing, global experience shows that people and firms initially tend to concentrate in one city. These "primate" cities are typically home to the main concentration of industries, services, and government functions. These cities benefit from a large and more diverse pool of labor and skills, which encourages more rapid innovation and diffusion of knowledge and increasing returns to scale. Across the world, cities as diverse as Male (Maldives), Bangkok, Buenos Aires, Cairo, Jakarta, Kuala Lumpur, Lima, Mexico City and Tehran are examples of such primate cities.[9]

The primacy of Thimphu is proportionate to Bhutan's income level and urbanization. Global experience shows that the concentration people in a country's largest city tends to increase (up to around 40% of the national population) as per-capita incomes rise, until approximately US$10,000. After this per-capita income level, the total population share of the largest city tends to plateau or even decline as livability, economic diversity, and market access in secondary cities improve.[10] In more complex urban systems, secondary cities often begin to

[9] https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/List_of_primate_cities.html#cite_note-2

[10] Geographers have proposed that countries where the largest city is twice that of the second largest city are characterized by a condition of urban primacy (see Jefferson, M. 1939 "The Law of the Primate City"). Countries that are undergoing rapid urbanization typically have more extreme primacy conditions. Over time, primacy reduces as other cities become more specialized in economic production and population concentration in the main city slows (see Davis, J.C. and Henderson, J.V. 2001 "Evidence on the Political Economy of the Urbanization Process"). Some upper income countries still retain a degree of primacy, including Korea, Japan and the UK where the largest cities around three to four times the population of the second. In contrast, the United States, Canada and most Western European countries as well as China and India do not have urban primacy at the national level. Also see World Bank 2009, pg. 61; Ades and Glaeser 1995; Krugman and Livas 1992.

specialize in certain lower value-added industries, benefiting from 'spillover' growth as prices rise in dynamic leading hubs.[11] At Bhutan's current levels of per-capita income, private sector dynamism and diversity, and agglomeration, a system of robust secondary cities as alternative migration and investment poles is unlikely to emerge soon. Among international comparators, the share and total size of the population in Thimphu is relatively low (greater concentration may even be expected given the large travel times between settlements, and topographical limits on population dispersion).

Bhutan is undergoing a rapid spatial transformation, characterized by high rural-urban migration and migration from east to west. Bhutan experienced the fastest rural-urban migration rate in the South Asia region for the period 2000-2010 with an annual growth rate of 5 percent. Between 2005 and 2017, the share of the population that has migrated from their place of birth increased from 32.7 to 39.8 percent.[12] The eastern part of the country has been characterized by net out-migration, while the western region has been the main recipient. In some Western provinces, 40-50% of inhabitants are lifetime migrants from other regions. Overall, net urban migrants represent 47 percent of all urban residents.[13] From 2005 to 2017 the average annual population growth in rural areas was actually negative (-0.27 percent).[14] The districts with the highest rate of out migration (per 1,000 people) are concentrated in the central and eastern regions with high isolation from major domestic or international markets, including Zhemgang (-640), Lhuetse (-593) and Trashigang (-537) and Trashi Yangste (-518).

High rural-urban migration appears to be driven by 'pull-factors' – the opportunities cities offer, and higher aspirations of citizens – rather than rural desperation. High universal service

[11] World Bank 2009

[12] PHCB 2017

[13] Walcott, S. 2009. "Urbanization in Bhutan" *Geographical Review* Vol. 99, no. 1, pp. 81-93; Ellis, P. and Roberts, M. 2015 *Leveraging Urbanization in South Asia: Managing Spatial Transformation for Prosperity and Livability* World Bank: Washington DC.

[14] PHCB 2017 and PHCB 2005

delivery and rural land ownership suggest that migration may be driven more by positive pull-factors of urban areas, such as employment and education opportunities or family linkages, rather than by negative rural push-factors such as infrastructure scarcity, landlessness or conflict.[15] Bhutan's migration patterns are in line with global experience on wage-driven rural-urban migration. Overall, the most cited reasons for migration in 2017 is family move (17.8 percent), followed by employment (12.7 percent), and education (8.3 percent): this likely reflects both the 'pull factor' and the age profile of migrants. Young people are far more likely to migrate.

Service delivery and infrastructure access

Despite relatively concentrated production, Bhutan has made substantial advances to equalize welfare and service delivery across regions. Poverty fell from 31% in 2003 to 8% in 2017. Considerable spatial inequality in incomes remain, though income inequality is not excessive considering cross-country comparisons. Median household incomes in urban areas are 2.6 times those in rural areas (Nu 150,000 vs. Nu 57,00), and monetary poverty is 11.9 percent in rural areas, versus 0.8 percent in urban areas. [16] Income patterns also suggest considerable inequality within/between rural areas, however, with the top 20% of rural households earning slightly more (Nu 138,000) than the second richest 20 percent of urban households (Nu 124,000).[17]

On non-monetary deprivations, substantial differences remain between rural and urban areas. Multidimensional Poverty Index (MPI) is based on a composite index of deprivations including income, education, access to housing, electricity and water, and asset ownership. The main contributors to MPI include lack of education (32%), child mortality (23%), and school attendance (13%). MPI shows considerable variation between districts (map 1). The poorest districts - Dagana, Zhemgang and Mongar - have

[15] PHCB 2017
[16] World Bank 2017. Bhutan Poverty Analysis Report
[17] BLSS p. 64

multidimensional poverty rates up to 10 times higher than Thimphu (3.4 versus 46.6); however, from 2007 to 2017, MPI poverty has also fallen fastest in the poorest districts, reflecting strong convergence in welfare outcomes across places as reflected in Figures 4 and 5.

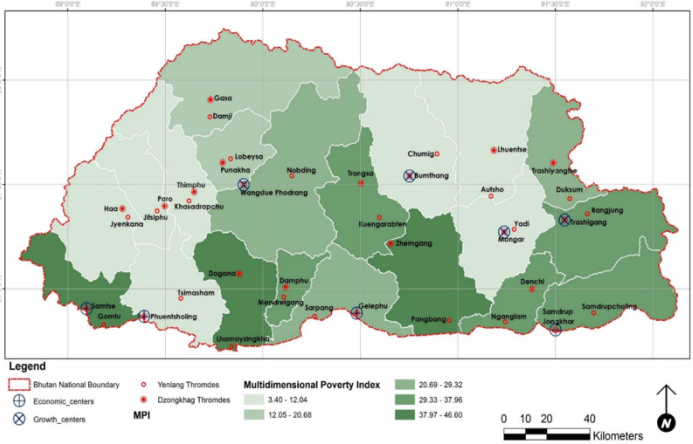


Figure 4. Multidimensional Poverty Index by District, 2017.[18]
Source. National Human Settlements Strategy, 2017.

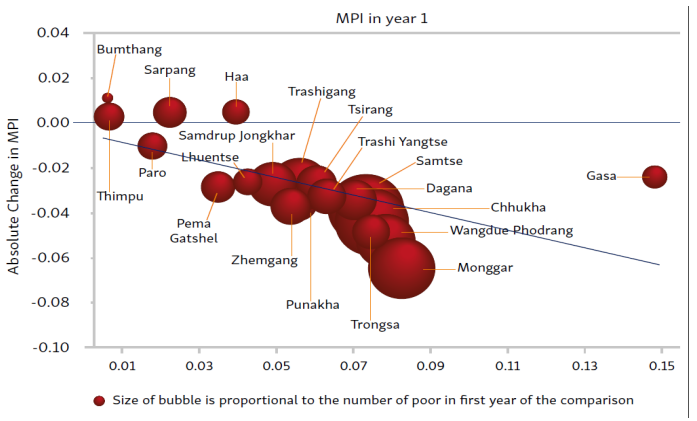


Figure 5. Poverty Reduction Gap in Districts, 2012-2017
Source. National Statistics Bureau and Oxford Poverty and Human Development Initiative (OPHI), 2017. "Bhutan: Multidimensional Poverty Index."

[18] Districts with darker green colors reflect areas with greater deprivations for the average household.

The MPI shows divergence of access to basic infrastructure between urban and rural areas. More than 95% of households has access to electricity and improved water, across urban and rural areas. However, quality gaps remain. The BLSS asked households the top actions government should take to improve their welfare, and in both the urban and rural areas, timely and continuous water supply was among the top three priorities mentioned; regarding electricity, 60% of households report power outages of at least an hour in the past 7 days, with the rate approximately 20 percentage points higher in rural area. Gaps in improved sanitation coverage are also substantial: 97.6% in urban versus 88.1% in rural areas overall, while 8 of 20 districts have under 80% coverage, with the lowest coverage rate just 55% in Gasa.[19] Considerably more urban households have piped water inside the dwelling than those in rural areas,[20] though the remaining rural households typically have piped water in their compound.

Despite overall improvements in human capital, divergence across districts remains substantial. Infant mortality has fallen from 186 per 1,000 births in 1969 to 25 in 2017.[21] In a single decade, from 2001-2012, the primary school net enrollment rate increased from 60% to 89%.[22] While the high overall primary completion rate is universal across the country, there is considerable inequality in secondary school attendance and completion across districts. In urban areas, the secondary school completion rate is around 90%, while the rate is 60% in rural areas. The net attendance ratio at district level ranges from 22.7% to 66.4% for middle secondary, and from 7.7 to 70.7% for upper secondary.[23] The national literacy rate is 66%. There is a 23 percentage point gap between urban and rural literacy rates

[19] PHCB 2017

[20] 75.6%, vs 31.5% in rural areas. Only 5% of Bhutanese lack piped water in their house or compound.

[21] World Bank, 2018. https://data.worldbank.org/indicator/SP.DYN.IMRT.IN?locations=BT. This is well below the regional average of 43.

[22] World Bank, 2018. https://data.worldbank.org/indicator/SE.PRM.TENR?locations=BT

[23] BLSS 2017

(81.7% vs. 58.3%);[24] and wide variation between rural districts (45.7% in Wangdue Phodrang) and more populous municipalities like Thimphu (84.2%), Gelephu (85.4%) and Phuntsholing (83.2%) [25], again underlining the urban-rural disparity in basic education and skills outcomes.

Connectivity to services and markets is a major challenge for households and firms across Bhutan, but with considerable subnational variation. Nationally, transport and communications are the largest nonfood household expenditure item (accounting for 25.2 percent of the nonfood budget, compared to, for example, just 15.4 percent for rent). According to the BLSS, road infrastructure improvements are the second highest priority for government attention and in rural areas, they are the first. In five districts (Gasa, Haa, Samdrup Jonghar, Trashi Yangste, and Zhemgang), at least 10 percent of households must travel over an hour to reach any road head.[26] Public transport use is low in part due to limited routes and frequencies, with just 3% of rural households and 16% of urban households using public transport daily.[27]

Institutions and policy framework

The Bhutan Vision 2020 outlines the country's long-term strategic development vision.[28] It is divided into FYP periods. The government has finalized the 12th Five-Year Plan (FYP) for 2018-23. Relevant for spatial development, a Comprehensive National Development Plan for Bhutan 2030 (CNDP) is also under preparation, aiming to address issues of rural-urban migration and regional imbalances in development. While past five-year plans have focused on infrastructure development, the 12th Plan places greater emphasis on strengthening *institutions* to maximize the benefits of existing infrastructure. One of the key objectives of the 12th FYP is "just, harmonious and

[24] Ibid.
[25] Ibid.
[26] PHCB 2017
[27] BLSS 2017
[28] Royal Government of Bhutan, *Bhutan 2020: A vision for peace, prosperity and happiness*, Thimphu.

sustainable society through enhanced decentralization." The 12th FYP aims to empower local governments through provision of greater financial, planning, and administrative responsibilities and capacities.

The government has attempted to temper the concentration of firms and population around Thimphu and Phuentsholing through recent FYPs. The 10th and the 11th FYPs prioritized spreading production and people across Bhutan's territory, away from Thimphu and Phuentsholing. The government identified urban areas to serve as hubs for economic development in the western, central western, central eastern, and eastern regions, and Sarpang and Samdrup Jongkhar towns were designated as further regional growth centers because of their proximity to the Indian border and hence perceived potential for trade-related growth. Similarly, the National Urban Strategy (NUS, 2008) and National Human Settlements Strategy (NHSS, 2017) aim to spread the population and economic activity more evenly across regions, focusing on placed-based approaches to attract firms and people to less concentrated places.

The Progress Report on the Formulation of CNDP presents three strategic development alternatives as follows:

i. Alternative A proposes to "*promote development of advanced economic regions such as Thimphu and Phuentsholing to return development profits to backward regions*." This alternative prioritizes the National Capital Region, the Southern Economic Corridor along the Southern East-West Highway and the roads connecting the two regions.
ii. Alternative B aims to promote organization of settlement areas "esteeming spiritual richness and local culture in order to reduce regional disparity nationwide... (S)ince *this development model requires improvement of basic living conditions in each Settlement Zone*, improvement of feeder roads connecting urban centers and rural settlements within each Settlement Zone should be prioritized."
iii. Alternative C encourages interaction between diverse sub-regions in order to balance development and conservation within each region. This emphasizes the development of *regional urban centers* of four longitudinal regions –

especially of the three regions of the East, Eastern-Centre and Western-Centre – and link-roads connecting regional centers and other smaller centers in each region.

It is important for the regional development strategy to distinguish goals and indicators regarding the economic production, on the one hand, and living standards and service delivery, on the other. These need not follow the same distribution across space – for instance, production can concentrate, while living standards and service delivery equalize. Spatial patterns of both production and living standards/ service delivery affect migration trends, urbanization rates, human welfare and human capital outcomes, and other critical development outcomes. This note provides a review of the key trends in the location and concentration of economic activity, as well as the distribution of living standards and service delivery, throughout the country, to provide a framework for structuring policy and strategic investment decisions.

A spatial framework for aligning investment and policy support

This paper introduction presented a framework for place-sensitive policy, informed by the assets and potential of each place. This recommends supporting existing and growing agglomeration economies in major cities and building on place-based endowments, while using social policy, education, and institutional strengthening to achieve convergence in well-being and access to opportunities everywhere. This framework differentiates between locations with higher density and market access, where more spatially-targeted investments can support firm growth and job creation, and areas of low density and relative isolation, where opportunities for growth and job creation are more limited, but welfare and education policies can ensure *people* have access to opportunities and a good quality of life, while place-neutral institutional reforms can unlock latent private sector development potential.

Investment priorities for all places

Institutions: All places require quality institutions as the foundation for productivity and citizens' well-being. While institutions are often national, they have profound effects on *subnational* outcomes and convergence. Social policy institutions (like taxes and transfers) can capture the benefits of agglomeration and redistribute to people in less advantaged places, supporting more equal welfare across space while production concentrates. Institutional reforms to the business environment also relieve bottlenecks to productivity, without placing expensive, fixed, capital investments in places with highly uncertain future trajectories.

People: Investment in human capital are also high priority for all places, even those with lower economic density and dynamism. Human capital gives *people* opportunities, without making risky bets on the economic future of the *place* in which they reside, by enabling people to access better income opportunities either at home or in other locations. Table 1 summarizes some sample place-based endowments for different settlement tiers. People-focused policies also include those addressing disparities in wellbeing directly, through basic public services such as health, education, local government services and basic neighborhood infrastructure.

Spatially-targeted investment priorities

- Access to Markets (connectivity): A key factor for local economic and social development is access to markets – including the size and connectivity of the *local* market, but also connectivity to larger, *external* markets. For firms, market access extends access to inputs, products, and value chain integration, and facilitates knowledge spillovers, and for households increases access to jobs, public services, and other goods and services. Connectivity entails not just roads, but logistics, ICT, transport services, and so on. However, as highlighted under 'trade-offs' above, investment in connective must be moderated according to the density and market size of the targeted place, and local demand for the infrastructure: over-investment in under-

utilized roads, railways, and airports with high operation and maintenance costs draining local budgets are a common, ineffective, approach to boost 'lagging regions'. As also discussed above, connective investments need to be coordinated with *complements* to address remaining bottlenecks to local productivity, particularly the quality of institutions and human capital, or risk deepening concentration away from the targeted places.

- Local Economic Development: As noted above, firms and investment cluster in major agglomerations, which offer multiple benefits for productivity. These agglomerations are the most promising place for the government to *complement* firms' demand with heavier investments in support of local economic development. This includes investments to manage the forces of congestion attendant on agglomerations (such as traffic management, grid planning, and land management) and to minimize adverse effects like pollution. Successful cities make investments informed by quality consultation with firms and households, to diagnose the most important bottlenecks they face, rather than applying 'one size fits all' solutions (such as Special Economic Zones for every town).

Table 1. *Summary of Endowments Along Above Dimensions for Select Districts*

District	Human Capital	Connectivity	Economic Specialties
Tier I			
Thimphu	Royal Thimphu College Khesar Gyalpo Medical School	East-West Highway Proximity to Paro Airport	Government administration Services hub Agriculture
Tier II			
Paro	Paro College of Education General Hospital facility	International Airport East-West Highway	Tourism, MICE [29] destination and facilities

[29] MICE refers to Meetings, Incentives, Conferences and Exhibitions which covers large planned gatherings and events for business, recreational or other purposes.

Wangdue Phodrang		East-West Highway	Agriculture hub Tourism hub Punatsangchhu hydro plant
Punakha	College of Natural Resources	East-West Highway connectivity	Agriculture hub
Samdrup Jongkhar	Jigme Namgyel Engineering College	Strategic position along Indian border	Agriculture and forest products hub Motanga Industrial Estate
Chhukha	College of Science and Technology Gaeddu College of Business Studies	Proximity to Indian Markets East -West Highway terminus	Industrial and logistics hub
Sarpang		Proximity to Indian markets Reliable electricity supply	Jigmeling Industrial Estate
Tier III			
Samtse	150-bed hospital	Border proximity to Indian markets	Proposed Damdhum Industrial Estate Agriculture and Forest resources
Trashigang	Sherubtse College	East West Highway terminus, Access to Yongphula airport	Tourism hub
Monggar	150-bed hospital	Gyelposhing-Nganglam Highway, Proximity to Bumthang and Yonphula airports	Bondeyma Industrial Estate
Trongsa	College of Language and Culture Studies	East West Highway Magde Chhu river	Tourism and cultural heritage Nikachhu Hydro Plants

Source. Adapted from National Human Settlement Strategy, MoWHS. 2017.

Following the above framework, informed by the extent of local agglomeration, Bhutanese settlements can be categorized into three broad 'tiers', each serving a different function and requiring different policy and investment priorities. These are summarized below in Figure 6, which includes illustrative examples of settlements for each tier. Bhutan can harness its existing dynamic, dense clusters – centers of firm growth and in-migration – as engines of growth and opportunities to address

the development challenges. Smaller towns and cities can benefit from integration with the success of larger external markets (both within and outside Bhutan), and build on any place-specific endowments and advantages. In more remote and rural areas with lower viability as centers of production, Bhutan can deliver opportunities and quality of life for all through a people-focused strategy – closing gaps in human capital and addressing barriers to migration and using social policy to ensure quality of life (while not neglecting bottlenecks to productivity in agriculture and so on). This framework entails different priority policies to support each Tier of settlements, as well as priorities relevant for the national portfolio of places.

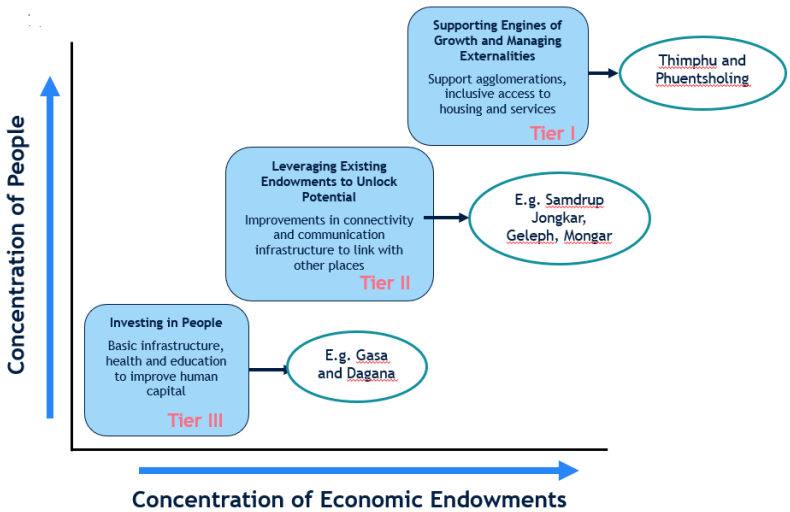


Figure 6. Framework for regional development approaches by settlement type
Source. Authors' own.

National level priorities

Synergies across regional development and other policy agendas: Spatial development requires a multidimensional approach, and is essentially cross-sectoral. Regional and spatial development policies should therefore be closely coordinated with economic, environmental, decentralization, and public investment policies at the national level. For example, alignment

with the decentralization agenda would entail agreement on the definition and identification of different settlement types, which affect transfers, decentralized responsibilities, and regional investment and policy priorities. A clear delineation of settlement types can also improve the monitoring of urbanization, internal migration, and rural-urban disparities in living standards. Similarly, more efficient, better targeted, public investments, subsidies, and intergovernmental fiscal transfers can improve regional development outcomes, as detailed further in the accompanying Municipal Governance and Finance Policy Paper.

Business environment: Certain business environment challenges can pose bottlenecks to productivity across all settlement Tiers. Priorities in Bhutan include insolvency procedures, permits and licenses, quality certification, customs procedures, immigration restrictions, property transfer, and taxation, among others. [30] However, while the national government must take the lead reforms here, it should also ensure that institutional quality improvements trickle down to regional hubs like Tier I and Tier II cities (such as by monitoring and modernizing local offices).

Coordination: Operating alone, local governments may tend to over-invest in connective and other productive infrastructure, and offer excessive incentives (like reduced taxes), to compete for investment. While a degree of competition can improve the business environment, the attendant risk is a 'beggar they neighbor' race to the bottom, with low-impact spending and large revenue foregone in tax breaks. The national government thus has an important role to *coordinate and prioritize* investments and regional development plans across the country.

Place-sensitive national planning: Decentralization can enhance the quality of local services thanks to local governments' greater sensitivity to local needs, although the attendant risk is low government capacity; appropriate ways forward are detailed in the accompanying note on decentralization. Beyond decentralization however, the sensitivity of policies to local needs can also be enhanced by better *spatializing national*

[30] World Bank 2017. Investment Climate Report.

economic planning and diagnostics, as exemplified in the case of Colombia. Appropriate data systems can strengthen the regional tailoring of national policies and investments, and enable coordination vertically between different levels of government and horizontally across ministries or local government entities within particular regions. These might include spatially disaggregated data on:

- Private investment, economic productivity, specialization, market prices, firms and firm performance;
- Government spending, finance, service-delivery, and assets such as land, schools, and hospitals;
- Land use, roads networks, public transit services, trunk infrastructure networks;
- Climate change and natural disaster hazard maps;
- Incomes, living costs, living standards, and human capital outcomes.

Tier I: Leading cities (supporting engines of growth and managing externalities)

Large and dynamic cities (Tier I), such as Thimphu and Phuentsholing, are most important engines of national production and job creation, and the main interface with the global economy. These cities offer a different scale of agglomeration benefits and attendant dynamism, which can be leveraged to create the off-farm and higher-wage employment increasingly sought out by the population, and to drive spill-over benefits for other areas. Harnessing their dynamism requires (a) 'growing the pie' for productivity and job creation and (b) managing congestion forces and pollution through stronger urban planning for inclusive and sustainable access to new urban opportunities.

For major agglomerations, it is less important to identify *which* products and services the city will produce, because the same fundamentals form the basis of productivity across a wide range of products. Whether a firm focuses on tourism, manufacturing, or transport and trade services, it will benefit from a dense, well-*connected* market of labor, suppliers, and customers (quality public transport, traffic management, land

use planning to reduce sprawl, and accommodation of new migrants), a secure and transparent *business environment* (including for small firms), *security*, efficient *land and property markets*, *skilled human capital*, reliable and affordable *electricity*, and so on. These fundamentals can enable a broad ecosystem of complementary firms and sectors to flourish, and new comparative advantages to emerge. All cities should focus on these foundations, though they are particularly important for Tier I settlements, the productivity of which derives from broad fundamentals and agglomeration economies rather narrower place-specific advantages.

Business environment reforms are the foundation for private sector development everywhere, but particular agendas have elevated importance in Tier I cities. In Tier I cities, it is particularly important to address regulatory barriers that prevent firms and households converting scarce urban land to its most productive uses. [31] Participatory urban planning institutions are also key. For example, evidence from 'Competitive Cities' across the world highlights that 'growth coalitions' – sustained, active, consultative forums between the private sector and city planners to inform policy – are central to shepherding strong and sustainable growth in cities.[32]

Poorly-managed urbanization can deprive cities of their potential economic dynamism and inclusivity, as well as imposing environmental and social costs. As a complement to policies to grow the urban economy, local governments need to effectively manage congestion forces, to promote good density and urban livability:

- The negative externalities of urban firms and households, such as air pollution, congestion, and waste challenges (including contamination of rivers with sewage, and upgrading landfill and recycling centers), need to be controlled. Environmental risks such as landslides and flooding are major risks for people, private property and

[31] World Bank 2017. Investment Climate Report.

[32] Kilroy, Mukim, and Stefano, 2015. Competitive Cities for Jobs and Growth.

infrastructure in Tier I cities. Infrastructure and the building stock, as well as planning and standards, should be strengthened to reduce susceptibility, and promote energy and resource use efficiency.

- Urban expansion is inevitable, but good urban planning can ensure Tier I cities are compact and connected. Grid planning and enforcement is a priority to facilitate orderly, dense, urban expansion and avoid costly 'retrofitting'. This can be supported by zoning to protect vulnerable or hazardous land, laying basic neighborhood infrastructure, and integrated land and transit planning. Mixed use development, and improving public and non-motorized transport, can reduce congestion and help ensure that firms and households are well connected to the opportunities, services and amenities (such as jobs, and health and education facilities) that drew them to the city. These efforts must be responsive to the needs of poor and vulnerable populations, who can benefit hugely from urban opportunities, but who can also most easily become excluded from the jobs and services cities offer, due to high costs versus purchasing power.

Human capital development is critical to create opportunities for people everywhere. However, Tier I cities are the most likely destination for highly skilled workers, where the returns to their skills tend to be far higher. Human capital is also particularly *important* to the productivity of Tier I cities, which should host more advanced and specialized firms requiring skilled human capital, and foster innovation through virtuous knowledge spillovers between their firms and residents. [33]

However, the supply of skilled labor for private sector employment in cities is a recurring challenge. As well as national solutions, cities may benefit from human capital interventions tailored to their particular circumstances, such as the mismatch that emerge between the demand for and supply of skills following a rapid influx of formerly rural workers. This may

[33] E.g. Moretti 2003. "Human Capital Externalities in Cities." NBER Working Paper Number 9641.

include training for recent adult rural-urban migrants to cities, or supporting small urban firms with business counselling or training vouchers for staff. Much learning within leading cities in fact occurs not through formal institutions, but informal and 'on the job' interactions. A key opportunity therefore lies in knowledge transfer from the large and diverse labor markets around Bhutan; addressing restrictions on the hiring of and investment by expatriates may help Bhutanese firms fill short-to-medium term skill gaps, while facilitating knowledge-transfer from immigrant co-workers and business leaders to local people and firms, as well as broader technology transfer.[34]

Given limited domestic market size, the sustainable and robust growth of Tier I cities will require connectivity to larger external markets. Bhutan's isolated location might make air transport important, but flights to Bhutan remain some of the most expensive in the world despite renovated airports, due to low volumes and technical challenges.[35] Thimphu's connectivity can be enhanced through strengthening linkages with Phuentsholing, and with larger border towns in India like Alipurduar and Cooch Behar. This connectivity can include hard infrastructure, but most important may be complementing existing hard infrastructure with softer measures, like addressing and frictions to border trade, quality certification, encouraging Indian-Bhutanese firm linkages and collaboration, addressing logistics and public transport bottlenecks, engaging in joint planning, and reviewing limits on traveler numbers to enable economies of scale. Specific investment climate reforms that could raise external connectivity of the Thimphu / Phuentsholing corridor include:[36]

- In addition to creating a national single-window system, establishing joint border facilities with India to reduce border queues and clearance times on transit between Phuentsholing and Kolkata.

[34] World Bank 2017. Investment Climate Report.
[35] World Bank 2017. Investment Climate Report.
[36] World Bank 2017. Bhutan Investment Climate Report

- Assessing the feasibility of a railroad connection between Phuentsholing and the Indian railway network, to enhance the dry port's potential.
- Automated customs clearance to reduce time and costs in customs processing.
- Considering further investments in the regulatory capacity of the Bhutan Civil Aviation Authority (BCAA) and in the operational capacity of the Department of Air Transport (DOAT).

Tier II: Secondary Towns (Leveraging Existing Endowments

Mid-sized towns such as Paro, Wangdue Phodrang, Gelephu, and Samdrup Jongkhar have some density of people, but low economic concentration. These Tier II settlements are smaller population centers – including clusters of linked settlements – often along major east-west or north south connections. These settlements tend to offer advantages including less expensive land and labor, and local advantages like tourism attractions, borders, or hydropower; however, outcomes are hard to predict or force. International experience is that lower private sector demand for these locations compared to leading cities makes land and labor relatively cheap in second tier settlements. This can constitute an attraction for private investors, depending on the importance of land and cheap labor (versus market access, skills, and quality institutions) in their production costs.[37] In Bhutan, some also have underlying location-specific economic advantages, such as tourist attractions, hydropower potential, international borders, or proximity to agricultural inputs. This can be seen, for instance, in the case of Gelephu and Samdrup Jongkhar, situated near to quality agricultural land and on borders with the larger Indian market; the Punakha corridor, with its hydropower resources and cultural heritage; or Paro and Wangue Phodrang, which enjoy relative proximity to the capital Thimphu but have key place-based infrastructure features (international airport and hydropower). However, outcomes in such smaller centers are harder to predict, and efforts to force or

[37] Venables and Duranton. 2018. "Place-based policies for development." NBER Working Paper No 24562.

incentivize firms to spread to secondary centers can come at the expense of national growth and job creation, and lead to large wastage in public expenditure.

It is important to diagnose and address the bottlenecks to greater private sector dynamism in Tier II settlements, ensuring investments reflect market demand and consulting well with the business community. For example, any investment in industrial estates should not be a means to initiate new industries, but should facilitate existing industries and demand. Likewise, emerging tourism hubs may have different priorities, such as improving land management and construction permitting to support development of suitable and sustainable hotels and attractions, or improved town planning to maintain cultural assets and public spaces.

Networking, branding, and investment promotion, supported by the central government, could help Tier II cities and their connected regions make the most of their potential. For example, in agribusiness, a recent report finds that Indian and Bangladeshi investors have few channels to interface with Bhutanese producers, which limits their knowledge of suppliers and market potential. This is particularly relevant for border towns such as Phuntsholing which are gateways for logistics and warehousing, but also for settlements of all Tiers with latent investment potential, such as in agribusiness, mining, and tourism. Tier II settlement growth can be unpredictable, and local planners should be prepared to accommodate any population growth, while ensuring equity and efficiency in access to services and labor markets. This means developing capabilities in land management, infrastructure, service delivery, capital investment planning, and financial management.

Given their smaller market size, and often specialized industrial structure, connectivity to external markets is critical to the success of emerging sectors such as tourism and agro-processing. This connectivity not only opens markets for final products, but also to access inputs, and integration into wider value chains. External connectivity can include domestic city clusters (such as Paro-Thimphu-Wangdue) and economic corridors (such as the Punakha Valley) that together raise the scale of the local market, urban-rural connectivity, and

connectivity to Tier 1 settlements for inputs and customers. Several Tier II cities in Bhutan are in fact better connected to large cross-border markets than other large settlements in Bhutan.[38]

Tier III: Rural hubs (Investing in people)

Economic development is challenging in isolated rural areas, due to their distance from major markets and inefficiency of extending quality public services. Development efforts here should put *people* first, accounting for the preference of many rural households to *migrate* to more major towns and cities, to access the greater employment, educational, and other opportunities. A 'people-centered' approach would improve people's access to these opportunities, addressing rural human capital gaps and challenges for cities to absorb new migrants in concert. Rural-urban migration can benefit remaining rural residents, through opportunities for land consolidation, trade with growing urban hubs, and domestic remittances; in Bhutan, this requires addressing barriers to the sale of rural land by out-migrants, and hard and soft connectivity challenges between rural and urban areas (such as internet connectivity, mobile banking, public transport, and so on). Overall, rural and urban areas should be managed *together* – addressing rural inefficiencies, alongside bottlenecks to rural-urban migration, and supporting the integration of rural migrants in more leading cities.

Rural towns can play an important role in service delivery for the surrounding rural areas, and through their higher amenity and density, as centers for the densification of the rural population through migration. While power and water access in more remote rural areas has improved greatly in recent years, there remain important divides in health, education, and poverty outcomes between urban and rural areas – such as the rural-urban divide in secondary school completion, literacy, and piped water and improved sanitation in dwellings. The isolation and small scale of rural settlements often makes public service expensive – from roads, sewage and water pipes, electricity and

[38] Such as Gelephu and Sarpang's connectivity to Bongaigaon, or Nalbari and other border towns in the case of Samdrup Jongkhar.

internet cables, to schools, hospitals, government services, and financial services like banking. Rural towns play a crucial role, as hubs for service delivery to which remote settlements can be connected, and as centers for the densification of the rural population through migration. Where barriers to migration and densification in rural hubs are insurmountable, more novel 'last mile', non-networked, service delivery models may be necessary. 'Last-mile' models for basic services (such as health, water, electricity and sanitation provision) may require additional investment in technology and capacity building at the local level

National social policies are particularly important for Tier III settlements, and should be calibrated to address poverty and service access and quality disparities. Universal policies not designed with a spatial lens – like progressive national taxes and transfers, pensions, social assistance, insurance, and education policy – can have powerful impacts on poverty reduction in rural locations, by redistributing wealth and incomes across places to ensure a basic level of security and standard of living, and funding local basic infrastructure and social programs.

Conclusion

In recent years, Bhutan has made great strides in reducing poverty and enabling more equitable access to basic services, though there remain a number of challenges to achieving the goal of balanced regional development. It is important to ensure that policy and investment plans are based on a spatially-informed approach reflecting specific local demands and economic conditions in each place. As this note has detailed, the country's urbanization presents a critical opportunity to support structural transformation toward a service-based economy with higher levels of growth and a more competitive private sector. Population and economic activity are likely to continue to concentrate in only a few large cities – Thimphu, and second-tier cities and corridors with the strongest market access or economic advantages, such as Phuentsholing. These need to be planned and managed effectively to provide infrastructure and basic services to the rapidly growing population, support stronger private sector job creation informed by private-sector-

government consultation, uphold environmental protection and connectivity (avoiding congestion challenges), and strengthen connectivity to external markets.

At the same time, it is important to ensure that there is continued convergence in quality of basic infrastructure, human capital, and wellbeing across the country. There continues to be persistent inequality between urban and rural areas in terms of income, education, and health indicators. An equity-based approach to investments in schooling, healthcare, improved water and sanitation and so forth in rural and remote areas can provide residents in these areas with better health outcomes and skills for entry into the service and manufacturing sectors. These investments can be complemented by a more spatially-informed targeting of transfers, subsidies and other welfare programs to poor households. Smaller regional cities and towns can serve as hubs for rural service provision, densification, and off-farm income, supported by rural-urban connectivity, connectivity to external markets, and addressing institutional and human capital bottlenecks to growth. This will contribute toward both increased overall economic growth and reducing spatial inequalities.

2

Methodology of Green Infrastructure Planning toward the Sustainability of Urban Environment: Comparative Study between Bhutan and Japan

Mikiko Ishikawa

Abstract

In the capital city of Bhutan, Thimphu, the rapid urbanization has taken place. It has been causing serious problems on the sustainability of city. In this paper, based on the extensive research from 2015 and analyses of governmental plan and assessment, the author discusses about the green infrastructure (GI) planning as a methodology to proceed the sustainable urban environment. The following four points has been considered.

The first is the environmental capacity. Since Thimphu has developed in limited valley, surrounded by steep mountains, excessive development could cause inevitable failures on its sustainability. In order to approach this issue, the methodology of watershed management should be introduced. TSP in 2001 has to be improved based on new frame of this methodology. The shortage of water is especially the serious issue to be solved. It is essential to introduce watershed management based on the preservation of forest and agricultural land.

The second is the natural disaster prevention. Owing to the rapid urbanization, steep slopes had developed and the alluvial flats of the river-side area had turned into urban areas. There is a strong tendency that the frequency of rain fall has been accelerated by the climate change. The estimation of the future rainfall is essential and the proper natural disaster planning should be prepared.

The third is the bio-diversity. Bhutan is world famous nation of bio-diversity. However, the city areas have been suffering from the destruction of wet land and riparian forest. How to

enrich urban bio-diversity is the fundamental issues that needs to be solved.

The fourth is the cultural landscape. Fortunately, in Tashichhodzong area, the project of creating Royal Park and Gardens had started as a symbol of Cultural Landscape in Bhutan.

Based on the above points, the author proposes GI Planning for corresponding with four categories of ecosystem services, provisioning, supporting, regulating, and cultural services.

Purpose of study

The rapid urbanization has taken place, especially in Thimphu. Himalayan countries, historically, have been maintained based on the balance between natural capacities and human activities. Therefore, how to proceed "sustainable regions and communities" is the urgent and fundamental issue, as mentioned in Sustainable Development Goals (SDGs) by United Nations General Assembly in 2015[1].

The purpose of this paper is to clarify the problems in Thimphu, caused by the rapid urbanization, and figure out the methodology of Green Infrastructure Planning, considering various methodologies which have been created in many places.

This paper will discuss about above themes by following four steps. The first step is to clarify the recent environmental problems in Thimphu, caused by rapid urbanization. The second step is to show the typical methodologies which have been internationally developed during 20th century. In this paper, I will take a case study on the relationship between the preservation of forests and urbanization in Kamakura City, Japan. Kamakura City used to be the ancient capital of Japan located in Metropolitan Tokyo (170,000 population). Since 1960's, rapid urbanization took place and various strategies introduced, and somehow, the harmony of urban development and the preservation of forests have been accomplished. In the third step, the author will consider about the fundamental strategies for

[1] United Nations Development Program. Sustainable Development Goals https://www.undp.org/content/undp/en/home/sustainable-development- goals.html

environmental management, for securing water resources, bio diversities, and cultural landscapes in Thimphu. Finally, the author will discuss about the frame work of Green Infrastructure Planning as a common methodology.

Environmental problems in Thimphu

Table 1 shows the population increase of Bhutan since 2005. Thimphu Thromde had been established as the capital of the nation in 1955, and now it counts 15% of the total population in Bhutan.

Table 1. *Population forecast in Bhutan*

Year		Thimphu	Other regions	Bhutan
2005		98,676	536,306	634,982
2010		104,217	591,605	695,822
2015		116,012	641,031	757,043
Population forecast	2020	—	—	809,397
	2025	—	—	850,976
	2030	—	—	886,523

Data Source: 2005 Results of Population & Housing Census of Bhutan
2010-15: National Statistics Bureau
Population Projection Bhutan 2005-2030

Thimphu Thromde is located in limited valley; therefore, urban developments have expanded to steep slopes of mountains and flooding areas along the Thimphu River.

Photo 1: Babesa, Semtokha, Lungtenphu, Changjiji and Changbangdu areas in 2003
Source: Google Map
MoWHS, RGoB (2018), *Strategic Environmental Assessment of the Thimphu Structure Plan*

Photo 2: Babesa, Semtokha, Lungtenphu, Changjiji and Changbangdu areas in 2017
Source: Google Map

Photo 3: Development on the steep slope

Photo 4: Development along the river

Photo 1 and 2 shows the changes in Babesa, Semtokha, Lungtenphu, Changjiji and Changbangdu areas from 2003 to 2017. Urban development on the steep slopes (Photo 3) could cause landslides and damage to the settlement areas, also disruption of water and power supply. Development to the alluvial flats in river-side would cause the risk of the damages when flooding occurs (photo 4).

These drastic changes of land use are causing the following problems.

1. Weakening the resilience of city towards the climate changes and disasters.
2. Decrease of urban bio-diversities which is regarded as the essential component for wellbeing in cities, and the treasure of the nation.
3. Destruction of cultural landscape as a symbol of the nation.

For solving above problems, I will briefly mention about the methodology of the green infrastructure planning which have been developed since the modernization took place around the world. Then, by showing the recent challenges of Kamakura City in Japan strategies are considered for Thimphu.

Historical evolution of Green Infrastructure planning

Definition of Green Infrastructure (GI)

There are many definitions on GI.

European Commission: GI is "the network of healthy ecosystems often provides cost-effective alternatives to traditional 'grey' infrastructure and offers many other benefits for both EU citizens and biodiversity. The EU promotes the use of nature-based green infrastructure solutions[2].

United States Environmental Protection Agency: GI is a cost-effective, resilient approach to managing wet weather impacts that provides many community benefits. GI uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier

[2] European Commission, Definition of Green Infrastructure http://ec.europa.eu/environment/nature/ecosystems/index_en.htm

urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water[3].

Min. of Land use and Transportation in Japan: GI is the supporting system to promote sustainable land use for the nation, utilizing various functions of natural environment[4].

The discussion on GI is now increasing in all over the world, reflecting the increase of risks caused from the climate changes. However, GI is not a new idea. It has been developed since ancient era. After the modernization since mid-19th century, GI had introduced in a process of city planning. The first challenge was to create "the Lung of City", which would provide the fresh air into cities. Big parks in London, Paris, Berlin and New York had been created as GI from the above context. The second is Park System as networking infrastructure in cities, created at Boston in 1870's and spread to Minneapolis, San Francisco and all over the world. The third is Green Belt. This is the controlling GI toward the expansion of cities, created in England. It had started from the concept of Garden City by Sir Ebenezer Howard and regional plan established in 1944 for Greater London Plan. The fourth is GI as a cultural landscape. The typical example is the central park in Tokyo, including Imperial Palace, which has been succeeded since 17th century.

Thus, we could understand that GI has been created based on the characteristics of nation, cities, and the needs of the society.

Challenge of Kamakura city for establishment of GI as urban strategy

Kamakura located in Metropolitan Tokyo, about 40km from Tokyo Station.

Kamakura had served as the capital city of Kamakura Baku Fu from 1192 to 1333. There exist many temples, shrines and

[3] United States Environmental Protection Agency, *Definition of Green Infrastructure*,https://www.epa.gov/green-infrastructure/what-green-infrastructure

[4] Min. of Land Use and Transportation, Japan (2017). *The Planning of Land Use, Japan,* Definition *of Green Infrastructure.* http://www.mlit.go.jp/common/001179745.pdf

historical districts, and more than 20,000,000 people in a year are visiting Kamakura. The population is 174,000 and city covers 39.53 sq.km, while under the jurisdiction of Thimphu Thromde, it covers 26 sq.km.

Kamakura is surrounded by mountains for the defense. Figures 1 and 2 shows the historical succession of the decrease of forests.

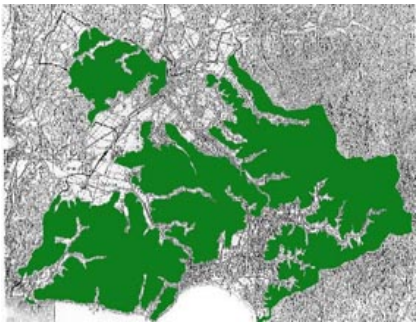


Figure 1. Forests in Kamakura (1946)

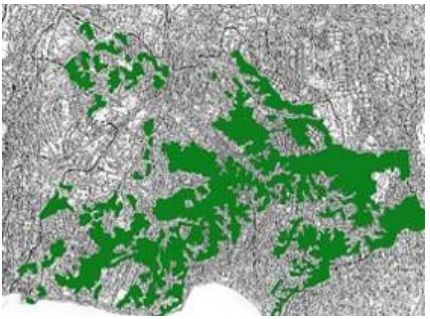


Figure 2. Forests in Kamakura (1973)

In 1960's, the strong citizen movement occurred for protecting forests from the rapid urbanization. Housing development had planned just behind Tsurugaoka-Hachiman Shrine which was the symbol of Kamakura. At that time, in Japan, we did not have any strong law to prevent the destruction of forest. The citizens collected money by themselves and purchased the small land from developer.

However, it was impossible to fight against the huge pressures of the development. They established small organization, called "Kamakura Scenic Preservation Association", and requested government to establish the Special Act for preserving Historical City. Kyoto, Nara and other cities had supported this movement.

Finally, in 1966, "Special Act for the Preservation of Scenic Areas in Historical City" was established and the fund for the preservation of forests was provided by sharing the cost between national government, prefectural government and local municipality. It took 10 years. However, this was the first step for the preservation of urban forest in Japan.

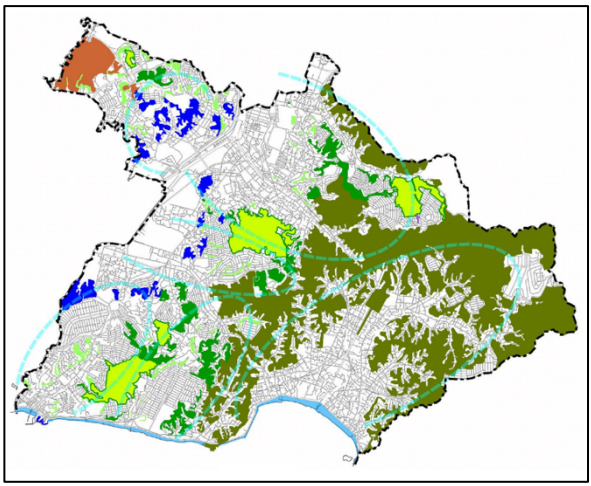


Figure 3. Green Infrastructure Map of Kamakura City (2011)

In this Act, urban forest was regarded as GI. Owing to the strong existence of GI, many people all around the world are visiting Kamakura, and it is providing the economic vitality in Kamakura. Figure 3 shows the present GI map in Kamakura. Dark Green areas are the designated forests by Special Act[5].

Methodology GI Planning for Thimphu

Analysis and recommendation of the Thimphu Structure Plan (TSP) by Strategic Environmental Assessment (SEA)

The *Thimphu Structure Plan (TSP) 2002-2027*[6] was established in 2001, covering an area of 26 sq. km. However, because of the rapid urbanization, it became difficult to implement. Therefore, *Strategic Environmental Assessment (SEA)*[7] was issued on August 1, 2018. Careful and extensive analyses was carried out, involving many stake-holders. SEA adopted the methodology of Scenario Approach. Based on the following two scenarios, SEA

[5] Kamakura City (1996), (2011), *Green Infrastructure Plan.*

[6] Department of Urban Development and Engineering Services, Ministry of Works and Human Settlement, Royal Government of Bhutan (2004), *Thimphu Structure Plan Revision.*

[7] MoWHS, RGoB (2018), *Strategic Environmental Assessment of the Thimphu Structure Plan.*

gave the recommendations for land-use, neighborhood nodes, slope analysis, water, sewerage, storm water drainage, solid waste, transport and mobility, housing, disasters, and governance.

1. Two population scenarios with a time horizon of 2027 i.e. a population of 160,000 as per the TSP projections, and a population of 200,000 as per the 2005 Population and Housing Census of Bhutan (PHCB) projections.
2. Focuses on the 26 km^2 area under the jurisdiction of Thimphu Thromde covered by the TSP, and also considers the wider network of influence areas within which it is situated i.e. settlements beyond the Thromde boundaries, and the Dzongkhags of Punakha, Wangduephodrang and Paro.

SEA, firstly, made the analysis and recommendation to Land-use changes.

Analysis: Substantial changes have occurred to land-use identified in the TSP including the reduction in forest, agricultural and environmental precincts, as well as green buffer zones along major streams. Open and green spaces have decreased, areas identified as Traditional Villages could not be maintained, and the desired limit of road coverage has been crossed. Conflicting use of land and developments continue in areas within the Thromde, and the city core has become crowded given additional building floors and parking along the roads.

Recommendation:

- Carry out plantations along the river and stream buffers in consultation with the Watershed Management Division (Ministry of Agriculture and Forests)
- Develop recreational, green and open spaces
- Relocate sawmills & BOD
- Protect hills, slopes, river basin and other ecologically fragile areas as enshrined in TSP
- Develop guidelines for identifying locations for schools within the Thromde
- Review and reduce the number of precincts category proposed in the TSP

Necessity of the creation of GI Planning to accomplish the recommendation of SEA (2018)

As mentioned in the recommendation of SEA, it is essential to work for the drastic changes of land use. Figure 4 is "Fragile Ecological Areas", shown in TRP (revised 2004) [8] for the protection. We could clearly understand many areas had already developed. The most critical problem is that planning areas had the limitation within the jurisdiction of Thimphu Thromde. Therefore, the forest has been cut abruptly by the line of jurisdiction and rivers had no consistency from upper to down.

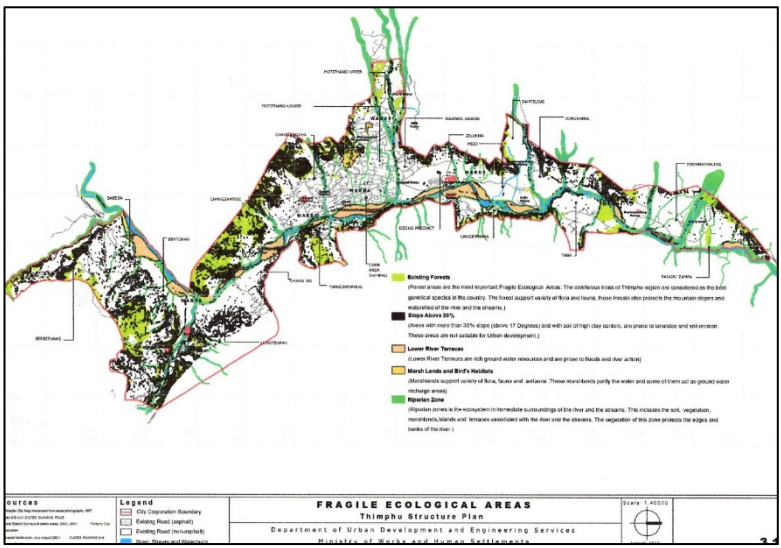


Figure 4. Fragile Ecological Areas in TRP (2004)

Considering ecosystem services as a basic principal for future land use in Thimphu namely, four broad categories should be created: provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and oxygen production; and cultural, such as spiritual and recreational benefits.

[8] Department of Urban Development and Engineering Services, Ministry of Works and Human Settlement, Royal Government of Bhutan (2004), *Thimphu Structure Plan Revision*.

Methodology of GI Planning in Thimphu

1. Structure of GI planning

Figure 5 shows the structure of GI planning in Thimphu. Firstly, planning areas should be identified based on the small watersheds adjacent to urban areas. Secondly, three important components of GI should be clarified. Thirdly, by combining the above process, GI map would be created. Introducing different scenarios, such as the one done by SEA, we could consider and evaluate the future of Thimphu together with many stakeholders.

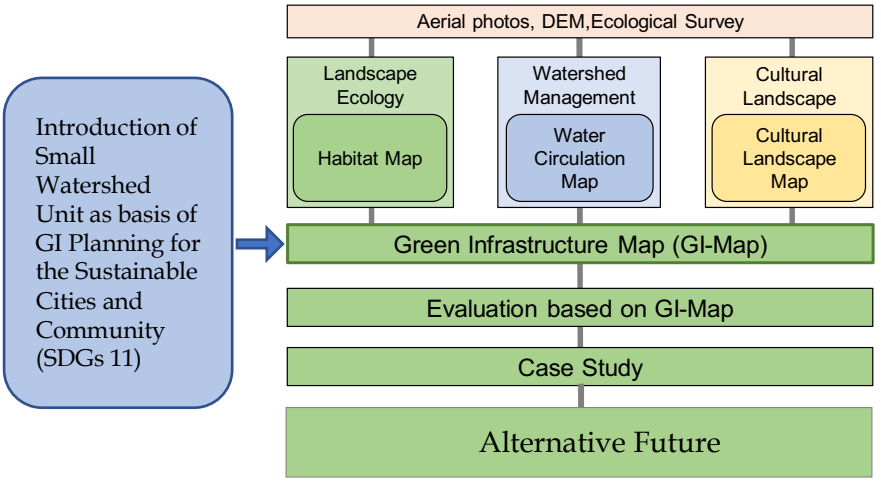


Figure 5. Structure of GI Planning

2. Planning Area

Figure 6 shows the proposal of planning area, including small watershed adjacent to the urban areas. In Bhutan, based on Water Act 2011, *A Roadmap for Watershed Management in Bhutan* has been created and *Wangchhu Basin Management Plan* was established in 2011. However, in order to work for urban planning, down scaling should be introduced. The author explains the importance of shifting planning frame from the governmental jurisdiction to watershed units, from the points of view of ecosystem services.

- Provisioning services: Sustainability of water resources is highly depend on the preservation of forests. Forests for the drinking waters, wet lands, springs, water recharge areas should be identified based watershed map. As for paddy fields, it is important for the food production, highly dependent on the irrigation system. Therefore, watershed analysis is essential for the sustainability of food production.
- Supporting services: Urban habitat is highly dependent on the surrounding environment. Therefore, new GI plan should include adjacent environment.

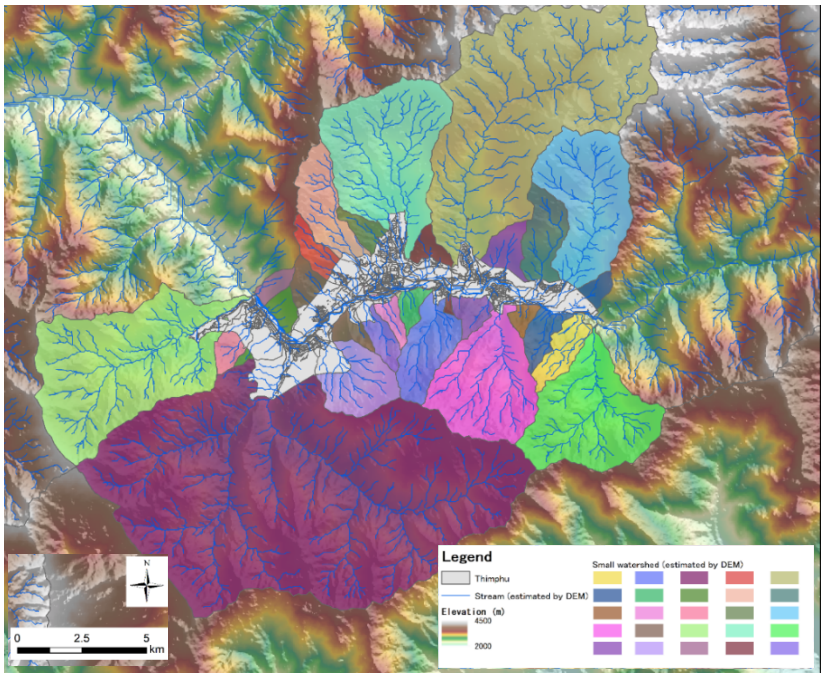


Figure 6. Planning Area for Green Infrastructure - including Small Watershed along the Thimphu River

Figure 7 shows 27 small watersheds along the Thimphu River. Narrow city areas developed in the valley have been supported by the watershed. As a basis of future sustainability in Thimphu, careful and precise analyses should be done for each watershed. Not only geography, soil, slopes, vegetation, wet lands, springs,

birds, animals, analysis of the management system, such as "community forest" is very important.

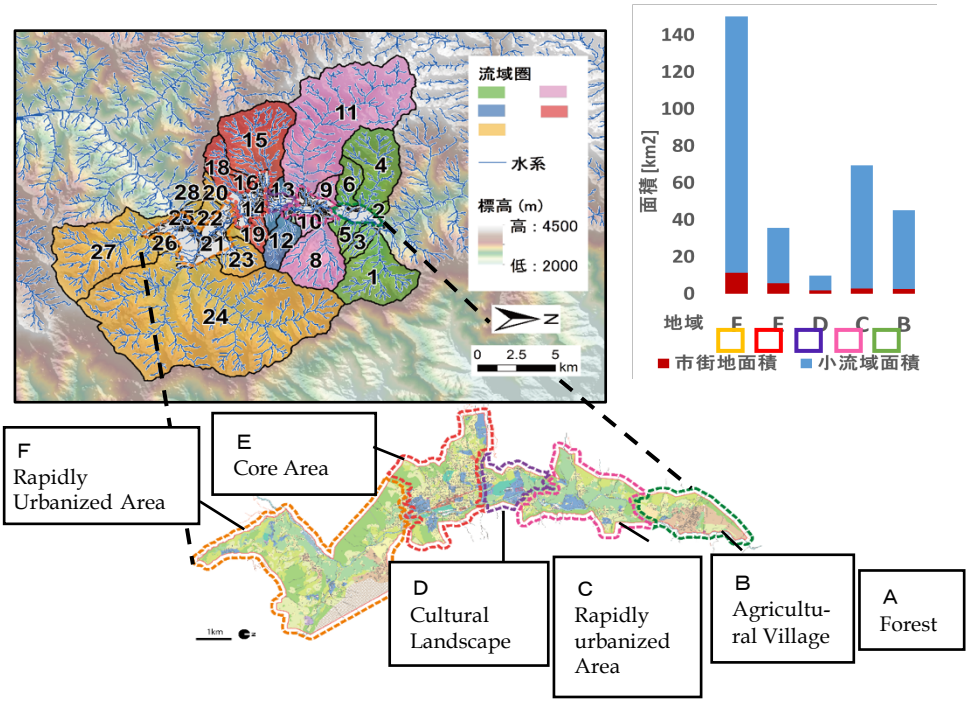


Figure 7. Characteristics of different district in Thimphu from the hinter land potentials

- Regulating Services: Figure 8 shows the study of the flooding depth of the Thmphu River by Wanchu Basin Management Plan in 2016, conducted by Asian development Bank[9]. Watershed management is essential for preventing flooding.

[9] Asian Development Bank (2016), *Wanchu River Management Plan*.

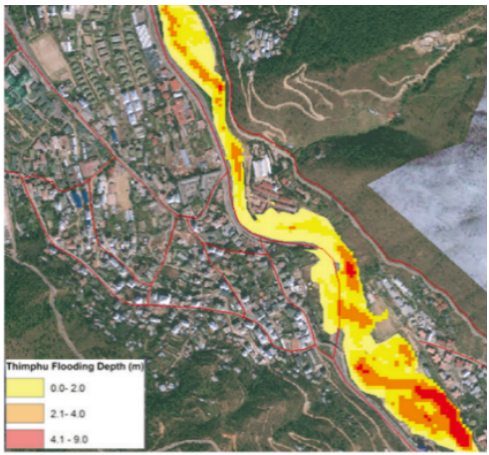


Figure 8. Thimphu Flooding Depth

3. Creating GI Map

Based on the new planning areas (Watershed Units), GI map, which correspond with urban planning scale, should be created. It should be created from the synthesis of habitat, water circulation, and cultural landscape. Figure 9 is the example of GI map in Tashichhodzong area and city core area, and Figure 10 is that of Kamakura in Japan.

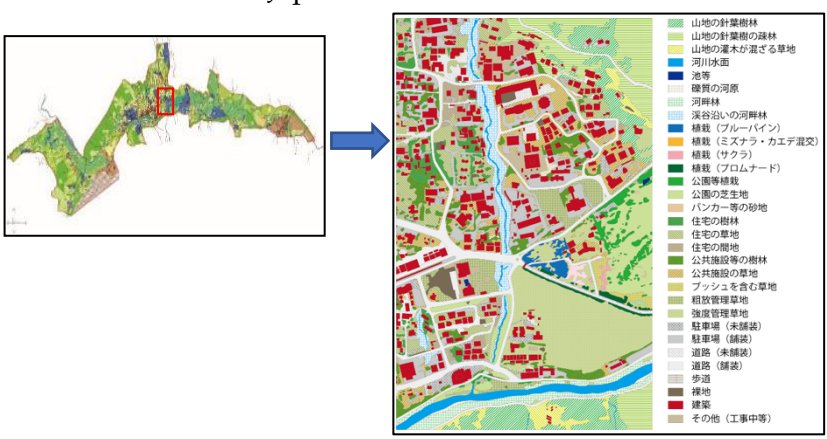


Figure 9. GI map in Tashichhodzong and city core area.

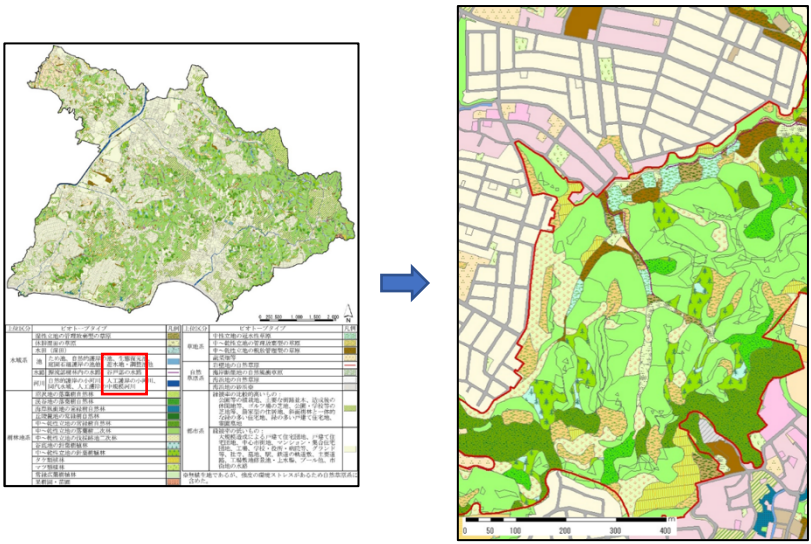


Figure 10. GI map in Kamakura, Japan

Preservation and renovation of cultural landscape

Finally, I would like to emphasis on the importance of preservation and renovation of Cultural Landscape in Thimphu. The capital city in the world has the symbol of central park in the midst of city. Figure 11 is Tashichhodzong area, and Figure 12 is the central park in Tokyo, including Imperial Palace. The central park in Tokyo counts 258 ha, whereas the central park New York is 330 ha. In Tashichhodzong area, fortunately, Royal Garden project is now going on, based on the proposal Figure 13 in 2017[10].

Tashichhodzong area is a symbol of the nation. It has Tashichhodzong, National Assembly, Ministries, Supreme Court, libraries, museums, traditional dance schools, paddy terrace, and the Thimphu river. Unfortunately, Golf course is occupying in the heart of this place, but if it will be included into the central park, the area will count approximately 1300 ha, including

[10] Mikiko Ishikawa (2017), Proposal of Royal Parks and Gardens in Thimphu, supported by Miharu-Bhutan Project, Technology Assistance in Floriculture and Landscape in to Bhutan, JICA

adjacent mountains as a green belt. It would be the biggest central park in the world.

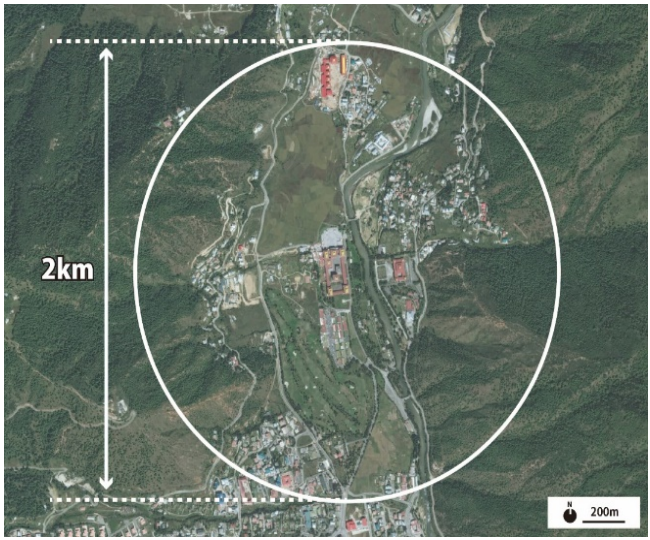


Figure 11. Tashichhodzong area

Figure 12. Central Park in Tokyo (Including Imperial Palace)

Photo 5. Symbol of Bhutan, Tashichhodzong and Paddy Terrace

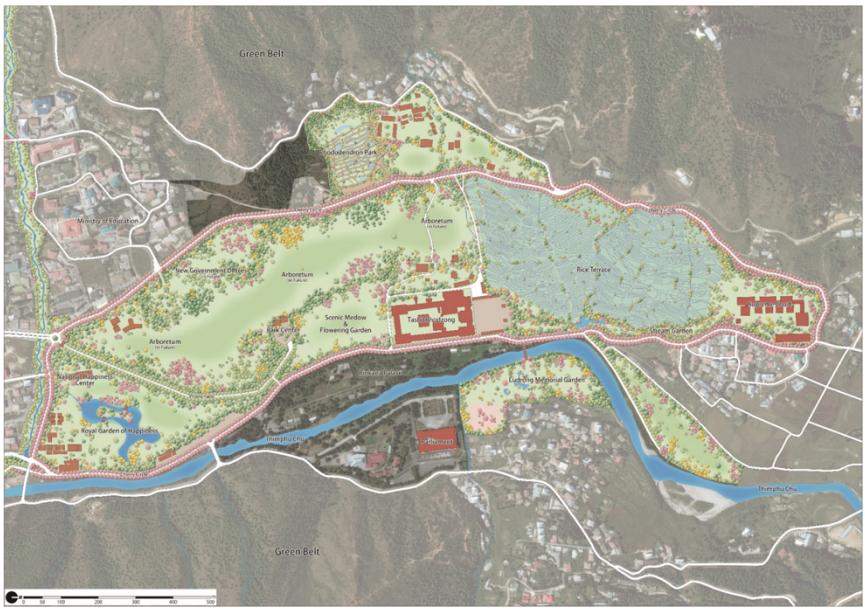


Figure 13. Proposal of Royal Parks and Gardens (Mikiko, 2017)

Conclusion

In this paper, the author discussed about the necessity of creating new planning frame work, i.e., Green Infrastructure Planning for the sustainability of the capital region, Thimphu. The following five points have clarified.

The first is TSP which had established in 2001 should be improved because of the drastic changes in land use, causing from the rapid urbanization since 2000's. As mentioned SEA, issued in 2017, extensive revises are necessary for land-use, slope analysis, water, sewerage, storm water drainage, disasters, etc.

The second is for solving above problems it is essential to create GI planning, considering ecosystem services.

The third is GI planning is highly dependent on the characteristics of each city. In case of Thimphu, it is surrounded by steep mountains and limited flat lands, to consider the adjacent watershed should be essential.

The fourth is by adopting the watershed units as the fundamental frame of GI planning we can develop strategies for corresponding with four categories of ecosystem services, provisioning, supporting, regulating, and cultural services.

The fifth is since Thimphu is the capital city of the nation cultural landscapes should be preserved and created by involving various stakeholders, citizens and international collaborations.

3

Development of Carbon Neutral Scenario in Bhutan towards 2050 with Socio-Economic Development and Forest Carbon Sink Change

Kei Gomi, Yuki Ochi, Akio Ito, Tomoko Ishikawa, and Shuzo Nishioka

Abstract

This study assesses the possibility for Bhutan to keep being carbon neutral by 2050 using quantitative scenario approach using formal models. Two scenarios, BaU (business as usual) and CN (carbon neutral) were developed. In BaU scenario, where climate actions are not implemented while economic growth and urbanization will continue, projected emissions exceed the sink in year 2030 and later. In CN scenario, with energy efficiency improvement, electric vehicle use, forest management, etc., Bhutan can be carbon neutral by 2050.

Introduction

The government of Bhutan announced that Bhutan shall continue to be a "carbon neutral" country throughout the future. Current GHG emissions in Bhutan is estimated around 2.1 million tons of carbon dioxide equivalent (MtCO2eq) in 2014 while the estimates of annual sink are around 6.3. This figure shows current emission is well below the sink; however, considering potential economic growth, it is not certain if Bhutan can keep its emissions under the level of current sink. The carbon sink in future can also differ because of land-use change caused by human activity and changes in vegetation and soil organic carbon driven by climate change. Considering this background, the objective of this study is to assess the possibility for Bhutan to keep being carbon neutral by 2050 using quantitative scenario approach.

Methodology

To assess the possibility of carbon neutrality in the future, we adopted two models for GHG emissions and carbon sink, respectively. GHG emissions were projected using ExSS (Extended Snapshot tool), one of the quantification models developed by AIM (Asia-pacific Integrated Models) group (Gomi et al., 2010). ExSS quantifies different future scenarios with different assumptions and socio-economic development and related policies. It describes population increase, economic growth, industrial structure change, agricultural production, transport volume, energy demand and supply, land-use change, waste generation and management, technology deployment, and GHG emissions and emission reductions in a consistent manner. It has been applied for several countries and regions for developing their low-carbon society scenarios (Gomi et al., 2009, Gomi et al., 2013, Mao et al., 2017, Simsion et al., 2013, Winyuchakrit et al., 2011, Yu et al., 2018). The model for Bhutan was developed using the data source shown in Table 1.

Two scenarios were developed to assess possibility of carbon neutrality in Bhutan by 2050. One is BaU (business as usual) scenario, in which population and economy grows according to the target and projection of the government of Bhutan, while energy technology, waste management, and land-use change pattern are fixed at current state. The other scenario is CN (carbon neutral), in which efficient energy technologies are deployed, more public transport and electric vehicles are used, recycling of waste is promoted, and land-use change from forest to the other land-use is mitigated. Setting of the two scenarios are summarized in Table 2.

Table 1. *Data source for model development*

Category	Source
Demography	National Statistics Bureau (2009), National Statistics Bureau (2019), Gross National Happiness Commission (2013), Ministry of Labour and Human Resources (2015), Ministry of Labour and Human Resources (2017), National Statistics Bureau and World Bank

	(2017), Centre for Bhutan Studies & GNH Research (2016)
Economy	National Statistics Bureau (2017), Gross National Happiness Commission (2013)
Transport	Ministry of Information and Communications (2018), National Statistics Bureau (2017)
Energy Demand	Department of Renewable Energy (2016), Department of Renewable Energy and United Nations Development Programme (2012), Jamtsho (2015), Bhutan Statistical Services & Environmental Consultancy
Energy Supply	National Statistics Bureau (2017), Ea Energy Analyses and COWI (2012)
Agriculture	Ministry of Agriculture & Forests (2016)
Land use	Ministry of Agriculture and Forests (2017)
Waste	National Environment Commission (2011)

Table 2. *Setting of the two scenarios*

	Indicators	BaU	CN
Demography	Population	Increase following to Eleventh Five Year Plan	Same as BaU
	Households	Household size will be smaller	Same as BaU
	Time Use	Same as base year	Working hours will be reduced
Economy	GDP	Increase following to Eleventh Five Year Plan until 2020 Growth rate become moderate after 2020	Same as BaU
	Economic Structure	Growth rate of energy industry is largest until 2020 because of hydropower development Commercial and service industry will be a main driver of economic growth after 2020	Same as BaU
Transport	Passenger	Use of private cars will increase as income increases	Modal share of public transportation will expand
	Freight	Traffic demand will increase by economic growth	Same as BaU
Energy	Energy Service Demand	Increase by urbanization and income increase	Increase but growth rate is smaller than BaU
	Energy Efficiency	Same as base year	Replaced by efficient technology
	Transportation	Same as base year	Fuel economy will be improved Electric vehicle will be diffused
	Fuel Share	Same as base year	Shift to electricity
	Electricity Supply	Same as base year	Renewable energy like solar, wind and biomass will be deployed as distributed Energy Resource
AFOLU	Settlement	Same population density as base year	Population density will rise
	Cropland	Same yield as base year	Shift to organic farming makes yield decline
	Forest	Decrease as settlement and cropland increase. Carbon sink per area is obtained from VISIT model with RCP6.0 of MIROC5.	Area of managed forest will increase. Carbon sink per area is increased from BaU.

While GHG emissions were projected by ExSS, carbon sink by forest is projected using VISIT (Vegetation Integrative SImulator for Trace gases), a process-based ecosystem model developed by NIES. The model is composed of an energy-water, carbon-cycle, and nitrogen-cycle schemes, and each carbon and nitrogen flow is parameterized in an eco-physiological manner. The carbon-cycle scheme is composed of five carbon pools (plant leaf, stem, root, soil litter, and humus) and flows such as photosynthesis, respiration, partitioning, litter fall, and decomposition (Ito, 2010). The model is driven by atmospheric CO2, temperature, precipitation, solar radiation, air humidity, and land-use transition data. Impact of global warming on carbon budget in Asia was evaluated with this model (Ito et al., 2016). Even though it is desirable to run the model with multiple climate model and multiple RCPs, as the first approach in Bhutan we employed climate data of a GCM, MIROC5, with RCP6.0 climate scenario.

Results and discussions

The result is summarized in Figure 1. In BaU scenario, GHG emission will be 3.8 MtCO2eq in 2030 and 6.4 MtCO2eq in 2050, a three-hold increase from 2014. The largest emission sector is transport. While car transport volume of both passenger and freight will increase rapidly with population and economic growth, energy source of this sector is dominated by oil. This is the reason why this sector will be the top emitter because the other sectors, especially residential and commercial, will use electricity (even in BaU scenario, it is carbon-free) as a main source of energy even if their energy demand grows significantly. Carbon sink by forest will, according to our first attempt of its projection, be less than the estimated current level of 6.3 MtCO2eq. It will be 3.8 in 2030 and 3.6 in 2050. As a result, GHG emission will slightly exceed the sink in 2030 and the net emission can reach 2.7 MtCO2eq in 2050. Bhutan will therefore no longer be carbon neutral after 2030 in the BaU. Even if current carbon sink, 6.3MtCO2, is maintained, the emission exceeds the sink in 2050. In CN scenario, thanks to actions such as improvement of energy efficiency, EV use, and the other technological and structural options, the emission can be less

than the sink. Figure 2 shows contribution to mitigation (emission reduction compared to BaU in CN scenario) by category of the actions. The highest contribution is from "forest management", which shares almost one third of total mitigation, followed by "efficient vehicle and use of public transport", which includes high share of electric vehicles (60%) of all cars in 2050.

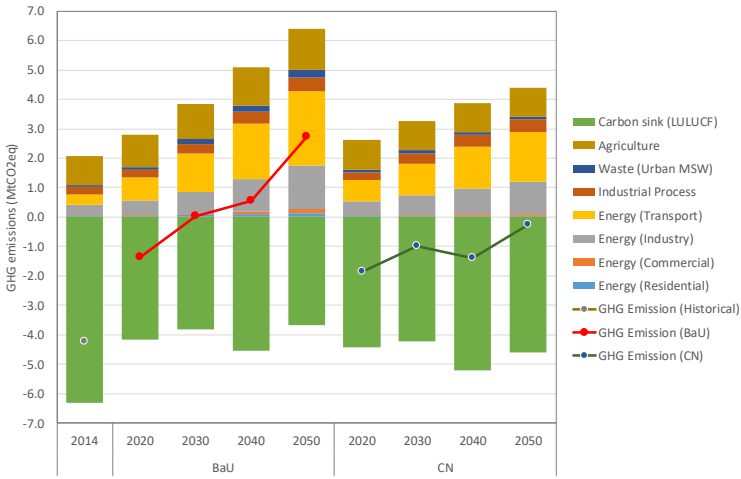


Figure 1. GHG emissions, sink, and net emission in Bhutan by scenarios

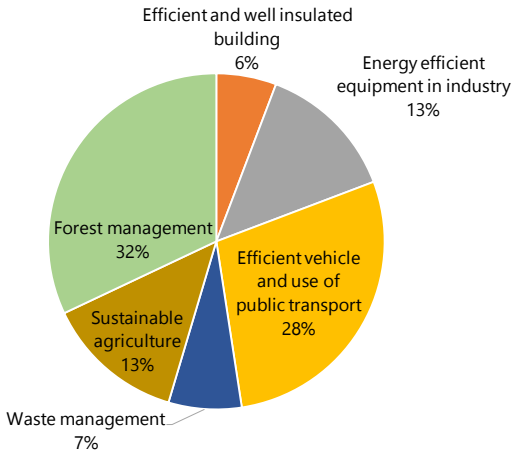


Figure 2. Contribution to mitigation by Actions in 2050

References

Bhutan Statistical Services & Environmental Consultancy (n.d.). *Assessment of Fuel Consumption and Baseline Health Impact Study in Bhutan*

Centre for Bhutan Studies & GNH Research (2016). *A Compass Towards a Just and Harmonious Society: 2015 GNH Survey Report*. Thimphu: CBS & GNHR

Department of Renewable Energy (2016). Bhutan Energy Data Directory 2015

Department of Renewable Energy and United Nations Development Programme (2012). Bhutan Energy Efficiency Baseline Study Final Report

Energy Analyses and COWI (2012). Bhutan. A national strategy and action plan for low carbon development Final report

Gross National Happiness Commission (2013). Eleventh Five-Year Plan. Thimphu: RGoB

Gomi. K, Ochi, Y., Matsuoka, Y. (2009). A concrete roadmap towards a low-carbon society in case of Kyoto city. *Journal of Renewable and Sustainable Energy*, *2*(3), 031004

Gomi, K., Shimada, K., Matsuoka, Y. (2010). A low-carbon scenario creation method for a local-scale economy and its application in Kyoto city. *Energy Policy, 38*(9), 4783-4796.

Gomi, K., Deshpande, A., Kapshe, M. (2013). Aligning Low-Carbon Society Scenario with City Development Goals in Bhopal, India. *Global Environmental Research, 17*(1), 129-138

Ito, A. (2010). Changing ecophysiological processes and carbon budget in East Asian ecosystems under near-future changes in climate: Implications for long-term monitoring from a process-based model. *Journal of Plant Research, 123*, 577–588

Ito, A., Nishina, K. & Noda, H.M. (2016). Evaluation of global warming impacts on the carbon budget of terrestrial ecosystems in monsoon Asia: A multi-model analysis. *Ecological Research, 31*, 459–474

Jamtsho, S. (2015). Energy Efficiency & Conservation Initiatives in Bhutan.

Mao, H., Matsuoka, Y., Gomi, K. (2017). A qualitative and quantitative design of low-carbon development in Cambodia. *Energy policy, 100*, 237-251

Ministry of Agriculture & Forests (2016). Bhutan RNR Statistics 2016.

Ministry of Agriculture and Forests (2017). Land Use and Land Cover Assessment of Bhutan 2016 Technical Report

Ministry of Information and Communications (2018). Annual Info-Comm and Transport Statistical Bulletin (9th Edition, 2018)

Ministry of Information and Communications. Current Status of National Transport Polices, Systems and Projects in Bhutan.

Ministry of Labour and Human Resources (2015). Labour Force Survey Report 2014.

Ministry of Labour and Human Resources (2017). Labour Force Survey Report 2016.

National Environment Commission (2011). Technical Basis for the Second Greenhouse Gas Inventory for Bhutan.

NSB (2009). Population Projections of Bhutan 2005-2030.

NSB (2017). National Accounts Statistics 2017.

NSB (2017). Statistical Yearbook of Bhutan 2017.

NSB (2019). Population Projections of Bhutan 2017-2047

National Statistics Bureau & World Bank (2017). Bhutan Living Standards Survey Report 2017.

Simson, J. J., Ho, C. S., Matsuoka, Y., Gomi, K. (2013). Planning Strategic Sustainable Development in Malaysia by Incorporating the Concept of Low Carbon Society. *Journal of Civil Engineering and Architecture, 7*(9), 1164-1176

Winyuchakrit, P., Limmeechokchai, B., Matsuoka, Y., Gomi, K., Kainuma, M., Fujino, J., Suda, M. (2011). Thailand's low-carbon scenario 2030: Analyses of demand side CO2 mitigation options. *Energy for Sustainable Development, 15*(4), 460-466

Yu, B., Wei, Y. M., Gomi, K., Matsuoka, Y. (2018). Future scenarios for energy consumption and carbon emissions due to demographic transitions in Chinese households. *Nature Energy*, 3, 109-118

4

Architecture for Coexistence of Rural and Urban Settlements in Bhutan

Divya Chhetri, Kinley Dechen, Sonam Choden and Dhurbaraj Sharma

Abstract

Bhutan's rapid urbanization is creating an arguable continuum of rural and urban areas, which can marginalize the settlements into two independent communities. The rural-urban dynamics have been addressed as one of the most pressing issues of urbanization in Bhutan over the years, leading to high unemployment rates, excessive energy demand, housing crunch in urban areas and abandoned village houses and agricultural land. Policy makers, planners and scholars have initiated numerous solutions to unscramble the rural-urban issue, but it is now crucial to re-examine it in the light of *Architecture*.

This paper will explore the idea of how architecture could be an avenue for coexistence of rural and urban settlements and how blurring these boundaries between the two could enable communities to function symbiotically while creating a balance between the modern and the contemporary. This paper presents the studies carried out it in an urban and a rural settlement in central Bhutan and shows how these settlements are coexisting. The study includes extensive studies on the architectural aspects such as the built environment, planning, livelihoods and developments that act as an interplay between the two settlements. The main emphasis is on how architecture plays a catalytic role in rural-urban linkages and draws out the qualities from the settlements that enable them to coexist, so that similar approaches can be applied in other rural-urban context as well. It conceptualizes the spatial planning systems that can enhance the coexistence of the two settlements. This study could also be an avenue to explore how our traditional settlements can still have their roots embedded into the vestiges of our rich cultural,

architectural and historical depths while still being able to meticulously weave in, the influx of urbanization.

Synopsis

Aim

To identify the types of linkages contributing to the coexistence of Rural and Urban Settlements in Bhutan and to propose an architectural intervention to it.

Objectives

The main objective of the study is to characterize the importance of linkage between rural and urban communities through case studies in two different settlements of Bhutan. The detailed objectives include:

1. To study and analyze the relationship between the selected areas through field study and data collection.
2. To highlight the concept of Rural-Urban Linkage and the significance of it in the growing towns of Bhutan.
3. To recognize the different types of rural-urban linkages that exist between the chosen rural and urban settlement.
4. To analyze how the linkage between the communities can solve the issues of rural and urban settlements in Bhutan
5. To propose an architectural intervention to promote a dynamic linkage between selected areas by conceptualizing certain measures that can be applied in other rural-urban settlements as well.

Rationale

The continuum of rural and urban settlements in Bhutan has begun ever since urbanization ventured into this landlocked country. The notion of "gap" between rural and urban communities is inevitable, by definition as well as by the nature of environment. However, without distinctive attention on the growth of cities and their impact on existing villages, rural and urban settlements could grow into two independent communities. This gap endangers the foundations on which both the societies are striving for food, shelter and livelihood.

The rural-urban dynamics have been addressed as one of the most pressing issues of urbanization in Bhutan over the years, giving rise to uneven distribution of population in rural and urban areas, and ultimately creating an imbalance in the distribution of resources. Most rural areas are being disregarded for the lack of opportunities, infrastructures and source of income. Rural-urban coexistence, a concept of linking the two communities for sustainability, is an important philosophy that can contribute to building coherent societies.

This paper will explore the idea of how architecture could be an avenue for coexistence of rural and urban settlements and how blurring these boundaries between the two could enable communities to function symbiotically while creating a balance between the modern and the contemporary. The study includes extensive studies on the architectural aspects such as the built environment, planning, livelihoods and developments that act as an interplay between the two settlements. The main emphasis is on how architecture plays a catalytic role in rural-urban linkages and draws out the qualities from the settlements that enable them to coexist, so that similar approaches can be applied in other rural-urban contexts as well. It conceptualizes the spatial planning systems that can enhance the coexistence of the two settlements. This study could also be an avenue to explore how our traditional settlements can still have their roots embedded into the vestiges of our rich cultural, architectural and historical depths while still being able to meticulously weave in, the influx of urbanization.

Scope

The study will be focused on the architectural aspects of both the settlements from the dated time of study along with brief discussions on the socio-economic aspects as well. Specifically, the study will be based on the following:

- Study on the connections between the two settlements on the basis of their built environment, planning, character zoning, and livelihood.

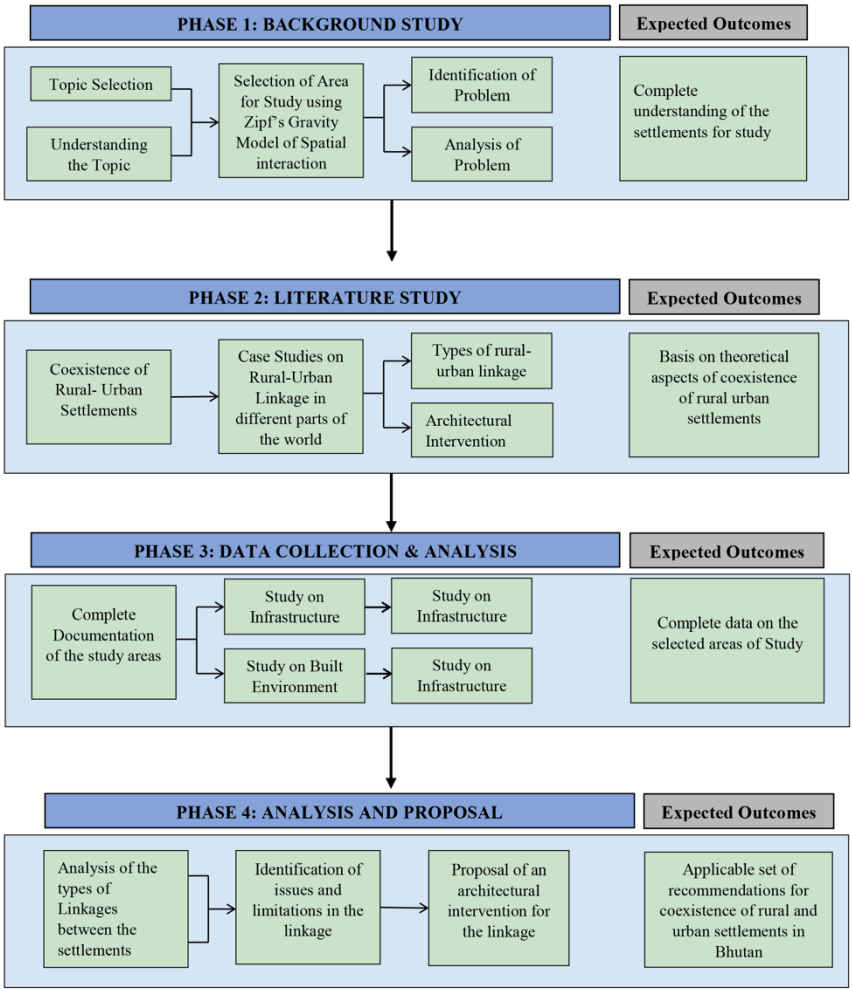
- Analysis of the building typology in the rural settlement as well as the urban, to compare how each of the two building types accommodate the present lifestyles of the occupants.
- Identification of the issues that hinder a healthy rural-urban linkage, the issues of rural and urban areas in general.
- Proposal of an architectural intervention that the settlements can adopt to enhance the rural-urban coexistence.

Limitation

- Rural-Urban Linkage is widely addressed as a socio-economic variable. The paper, in attempt to addressing it as an architectural aspect, has only a limited information on the economic perspective. Therefore, standpoints on economy, secular and the spatial flows may have been beyond our scope of study.
- Rural and urban interactions in Bhutan have not been studied extensively, or even specifically. Therefore, this study lacks literature reviews from Bhutanese context.
- The data collected and the observations made for this study were carried out during a specific time. Certain issues and observations could have been missed out due to this reason.
- The set of recommendations discussed may not be applicable to all the other rural-urban contexts and therefore, needs intend analyses.

Research approach and methodology

This study is based on the primary data collected from field records, measurements and surveys carried out in two settlements in the Western Bhutan - a rural settlement and an urban settlement.



Phase 1: Background study

This is the preliminary stage of the overall research where it includes the selection of topic for the research and analysis of the particular concept. According to the topic chosen, the site for study is selected based on the Zipf's Gravity model of spatial interaction. Two sites are chosen for the case study, one urban area and one rural area located in the central Bhutan.

Identification of problems is an important segment in this stage as it streamlines the main scope of this research.

The two settlements were chosen on the basis of *Zipf's Gravity model of spatial interaction*, a model used by social scientists for predicting the flow of goods, commodities, information and people from one region to another.

This mathematical paradigm is based on an analogical reference to Newton's Law of Gravitation and takes into consideration, the population size of two regions and the distance between them. Newton's law of universal gravitation states that the forces of attraction between any two bodies is directly related to the size of these two masses and inversely related to the distance between them. The Zipf's gravity model (1949) is a modified version of this law, for measuring the magnitude of interaction between any two settlements. The model portrays the intensity of interaction between any two communities as being directly proportional to the population size of these two regions, and inversely proportional to the square of distance between them. The mathematical expression is devised as follows:

$$\textit{The Gravity model index} = \frac{Population_1 \; X \; Population_2}{Square \; of \; the \; distance.}$$

$$\textit{The Gravity model index} = \frac{Population_{Bajo} \; X \; Population_{Rinchengang}}{Square \; of \; the \; distance.}$$

According to this model, the gravity model index between the two settlements is three hundred thousand which falls under the highest degree of interaction. It is understood that considering the only two variables of interaction, population and distance, there is maximum intensity of interaction. However, this result only stands as a theoretical statement and has no practical implication because there are numerous other variables on which the interaction between the settlements can rely on. Thus, this paper will explore these variables in detail.

The expected outcome of this stage is the complete understanding of the settlement and selection of the areas for study.

Phase 2: Literature study

This phase is solely apportioned for literature study. The reason being, that architectural intervention in a concept such as Rural-Urban Linkage is not given as much attention as social and economic interventions are. Therefore, in this phase, the concept of Coexistence of Rural and Urban Settlements is studied in depth. It also explores the various types of rural-urban linkages along with the case studies done in different parts of the world.

The expected outcome from this stage is to establish a basis on theoretical aspects of coexistence of rural urban settlements.

Phase 3: Data collection and analysis

In this phase, the complete data will be collected on the selected sites through field visit and records. The primary data basically presents the existing situation and issues of both the settlements. The secondary data mainly provides ideas for recommendation based on the concept of rural-urban coexistence. It is also the backbone of the study as it directs the collection of primary data as well as the analysis. This phase will present the overall scenario of the selected areas and thus will lead to the complete analysis section.

The expected outcome from this stage is a complete set of primary data prepared for analysis and recommendations.

Phase 4: Analysis and proposal

The last phase will be dedicated to intend analysis of the data collected from the field and literature. Land-use patterns, character zonings and building typology will be prepared for both the settlements using AutoCAD, Adobe Photoshop and Trimble Sketch up. The infrastructure and built environment of the rural and the urban will be analyzed in order to sort the differences, similarities, and ideas that can be adopted in either of the areas. The surveys will include questionnaires, both structured and non-structured, so that the occupants have options to express their concerns.

The expected outcome from this stage is an analysis that covers all the pros and cons of the settlements. An architectural intervention will also be provided to link rural and urban settlements.

Literature review

Concept of rural urban linkage

Urbanization can be defined as the physical, economic, environmental and social change of an area from a traditional society to a modern developed city (Ndabeni, 2016). With urbanization, rural people tend to migrate from rural areas to urban areas for economic reliance and better living standards causing urban issues (Ndabeni, 2016). Today, around 50% of the world's population live in cities leading to conversion of agricultural lands to towns and cities, excessive use of natural resources and absorption of labors to cities (Steinberg, 2014).

Rural urban linkages refer to the movement of people, flow of goods, ideas, technologies and services between rural and urban areas in order to maintain social, economic, cultural and political relationship between the two settlements (Ndabeni, 2016). It can be defined as the functional links (agriculture, industry and services) between two sectors (Tacoli, 2015). Rural urban linkage plays an important role in eradication of urban issues and mega trends which will ultimately lead to coexistence of communities.

Types of rural urban linkages

The types and pattern of rural urban interaction depends on various factors including the physical geography of the region, population density, infrastructures and social and economic conditions of both areas. Sule Akkoyunlu identified the types of linkages based on the various types of goods and services flowing between rural settlements and urban settlements in her thesis on Rural Urban Interaction (Akkoyunlu, 2015).

- Physical linkage: Physical linkage is determined by road network, condition of road, railway network, river and water transport network, availability of public transportation services, distance from nearest city and availability of market facilities.
- Population linkage: Population linkage refers to movement of people between two sectors for employment, services and

amenities. These movements can be either permanent or short term.

- Economic linkage: Economic linkage is determined by flow of agricultural goods and processed goods between urban and rural areas, consumption, expenditure and shopping patterns.
- Social linkage: Social linkage refers to social interaction between rural and urban areas through kinship, rites, rituals, religious activities and entertainments.
- Service delivery: Urban and rural areas are linked through flow of services including education, health, wastes, transportation and financial.
- Political administrative: Political linkage includes flow of administrative authorities, political influences and flow of budgets.
- Organizational linkage: Organizational linkage is determined by judicial services.

According to Lindile Ndabeni urban linkage can be classified into spatial flow and sectorial flow. Spatial flow refers to flow of people, goods, ideas, information, money, technologies and services while sectorial flow refers to flow of agricultural products from rural areas to urban areas and manufactured good from urban areas to rural areas (Ndabeni, 2016).

Reasons for rural urban linkages

Rural and urban linkage offer measures for development of rural and urban settlements without conflicting each other's identity and enhances the economic growth of both the settlements which ultimately leads to reduction of poverty and inequality (Ndabeni, 2016). The goals of increasing the production of agricultural products as well as manufactured goods which leads to income expansion in both rural and urban areas and reduction of economic diversification cannot be attained without a proper linkage between rural areas and markets in urban areas (Tacoli, 2015).

Healthy interaction between rural and urban areas plays a vital role in expanding employment, generation of income, eradication of economic gap and improvement in the quality of

life in both rural and urban areas which contributes to enhancement of sustainable development in both the settlements (Sule Akkoyunlu, 2013).

According to Deepa Ahluwalia's thesis, the interaction between rural and urban settlements needs to be studied to analyze how the settlements can benefit from each other for balanced development of both the regions which is economically, socially and environmentally sustainable (Deepa Ahluwalia, 2004).

Urbanization in Bhutan

Bhutan is located in eastern Himalayas at an elevation ranging from 200 m in the south to 7000 m in the north with a total area of 38,394 square kilometers (Ministry of Work and Human Settlement, 2016). The country has grown rapidly since 1961 after the first five-year plan was launched by the third king of Bhutan. According to Population and Housing Census of Bhutan (PHCB), the total population of the country increased by 16% from 634,982 people in 2005 to 735,553 in 2017(National Statistics Bureau , 2017). Rapid urbanism of Bhutan has caused huge impact on forest cover, land use, resources and population distribution.

Rural urban migration is one of key issues the country is facing due to urbanization. Urban issues such as housing crunch, inefficient resources, unemployment, increase in crime rate and growth of slums and squatter settlements are results of rural urban migration. People migrate from rural to urban areas for education, job opportunities and business and for better living standard. As per PHCB, the total population in Thimphu city in the year 2005 was 98,676 which increased to 1, 38,763 by 2017 (National Statistics Bureau, 2017). The population growth in urban areas increased from 30% in 2005 to 37% in 2017. The houses and the agricultural lands in most rural parts of Bhutan are abandoned while the building in urban areas are unable to suffice the housing needs.

Urbanization is causing an uncontrolled impact on the forest cover and even on agricultural lands. The country is losing its agricultural land and forest areas to building construction and infrastructure development especially in urban areas. The

agricultural land decreased by 7% between the years 2006 to 2013 while the built-up area increased by 8% (Yangchen, Thinley, & Wallentin, 2015). The reduction in the agricultural lands has caused insufficient food production which can further lead to poverty. In 2017, 6.2% of households are reported to experience food insufficiency (National Statistics Bureau, 2017). Housing crunch in urban area is another issue while the houses in rural areas are abandoned. The total number of households in Bhutan was counted as 126,115 in 2005 which increased to 163,001 by 2017. Thimphu dzongkhag has highest number of households while Gasa and Haa Dzongkhag has lowest number of households (National Statistics Bureau, 2017). This uneven distribution of population and reduction in agricultural land occurs due to lack of a proper linkage between rural and urban settlements.

Introduction

The Rural-urban continuum

The rural-urban continuum is expressed in various ways on the basis of how the two settlements differ in their settings. The distinctions between a rural area and an urban area is perhaps inevitable for various reasons and thus, it implies a dichotomy. The concept of rural-urban continuum infers a feasible range of settlements from rural to urban. The main idea being, that there is a clear division between ruralism and urbanism, creating separate or perhaps, independent societies. This continuum is also expressed in terms of a physical area where a rural land-use develops into a built-up urban centre (Samanta, 2005). The spatial connection between two different settlements can justify the gap between them by considering the geographical aspects that may/may not act as a barrier, and the establishment of infrastructure between the settlements.

The rural-urban continuum is clearly an outcome of urbanization which incorporates both spatial and sectoral dimensions. It has led to the creation of extreme differences and discontinuities between communities. Rapid and large-scale urbanization widens the gap between the rural and urban areas more than gradual urbanization (Uduporuwa, 2016). The

idealization of an area as rural and urban may depend on its regional context and population density. However, the common concept of a rural area is described as an area organized by a small society supported by sustenance farming, and an urban area is described as a large cosmopolitan and commercial area (Pacione, 1984). A rural and an urban settlement, as different as they are by definition and by context, are considered as two detached entities even in one particular region.

There has been a long-standing division between ruralism and urbanism owing to the difference in landscape, infrastructure, economy and livelihoods. Ruralism exhibits the significance of traditions, culture and ancient familyhood whereas urbanism is known for innovation, modernization and individualism. Besides, there are various other aspects which differentiate rural from urban such as settlement pattern, building typology and built environment. The very concept of rural-urban continuum is based on the fact that the two settlements are characteristically distinct.

Coexistence of rural and urban settlements

The existence of rural-urban continuum cannot deny that fact that rural and urban settlements are meticulously interlinked in multiple ways. Each connection can be dependent or independent of the other, and hence can affect the overall linkage. It is vital to study the elements of these linkages to acknowledge a healthy coexistence of the settlements, and moreover to understand the utmost necessity of it in the development of sustainable communities. Interactions between cities and villages are the basis for balanced regional development which is economically, socially and environmentally sustainable.

Even though rural and urban areas are considered as detached entities in regional development efforts, they are mutually dependent in their development. The mutual relationship between a city and a village is a driving factor in the development of both the areas and it also brings about positive impacts in the development of the overall region. This relationship is interpreted in various categories such as physical, social, economic, infrastructural, demographical and

environmental aspects (Uduporuwa, 2016). There are other factors contributing to this linkage that are intangible and indefinite, such as connection through ideas, connection through history and connection through religion.

Frankenberg developed a theory of social change where he said that the rural-urban continuum is not a static idea but a progressive development complimented by industrialization, urbanization and role differentiation (Frankenberg, 1966). The rural-urban linkages have been classified based on various aspects that includes networks and patterns of infrastructure, nature and people.

The term "Spatial Interaction" was first coined by E. L Ullmam. It is defined as the interdependence of two geographic areas that includes the flow of goods, people, money, information, ideas etc. Various elements of spatial interaction have been explored in this study.

Rural-urban issues in Bhutan

Rural urban migration is one of key issues the world is facing right now. Urban issues such as housing crunch, inefficient resources, unemployment, increase in crime rate and slums and squatter settlements are results of rural urban migration. In Bhutan, people migrate from rural to urban areas for education, job opportunities, and business and for better living standard. The total population in Thimphu in the year 2005 was 98,676 which increased to 114551 by 2017. The population growth in urban areas increased from 30% in 2005 to 37% in 2017 (Population and Housing Census of Bhutan, 2017). The houses and the agricultural lands in most rural parts of Bhutan are abandoned while the building in urban areas are unable to suffice the housing needs. This uneven distribution of population occurs due to lack of linkage between rural and urban settlements.

Case study

Background: The Gravity Model

The study identifies two settlements, a rural and an urban community, in the district of Wangduephodrang, and aims to define existing patterns of interaction between these two

settlements, which allows them to function as a cohesive unit. The two settlements were chosen on the basis of *Zipf's Gravity model of spatial interaction*, a model used by social scientists for predicting the flow of goods, commodities, information and people from one region to another.

This mathematical paradigm is based on an analogical reference to Newton's Law of Gravitation and takes into consideration, the population size of two regions and the distance between them. Newton's law of universal gravitation states that the forces of attraction between any two bodies is directly related to the size of these two masses and inversely related to the distance between them. The Zipf's gravity model (1949) is a modified version of this law, for measuring the magnitude of interaction between any two settlements. The model portrays the intensity of interaction between any two communities as being directly proportional to the population size of these two regions, and inversely proportional to the square of distance between them. The mathematical expression is devised as follows:

$$\textit{The Gravity mode index} = \frac{Population_1 \; X \; Population_2}{Square \; of \; the \; distance.}$$

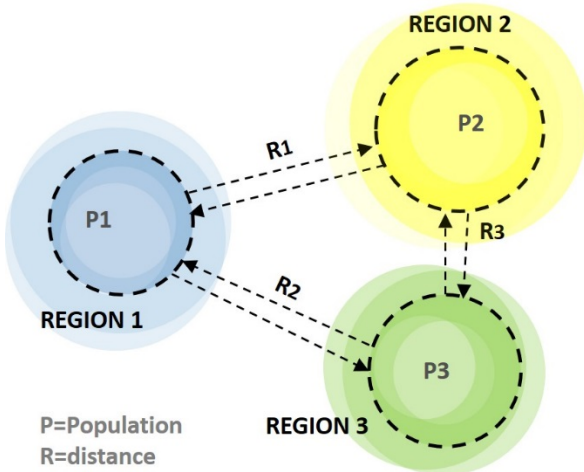


Figure 1. Zipf's Gravity Interpretation (Source: Authors)

$$\textit{The Gravity model index} = \frac{Population_1 \; X \; Population_2}{Square \; of \; the \; distance.}$$

$$\textit{The Gravity model index} = \frac{Population_{Bajo} \; X \; Population_{Rinchengang}}{Square \; of \; the \; distance.}$$

$$\textit{The Gravity model index} = \frac{5000 \; X \; 960}{4x4}$$

The Gravity model index = 300,000
= 3 (Hundred thousand)

The interaction index is thus, based on the idea that larger places, relatively, provide greater attraction of ideas, goods, and services than smaller places, and places spaced closer together also have a greater intensity of interaction between them.

Total Interaction Index

According to Ahliwalia, 2004, five interaction indices have been worked out as the basis to observe the degree of interaction between the settlements. The scores are in hundred thousand.

1. First Order: In this order, the interaction index ranges from 0 to 150.
2. Second Order: In this order, the interaction index ranges from 151 to 250.
3. Third Order: In this order, the interaction index ranges from 251 to 500.
4. Fourth Order: In this order, the interaction index ranges from 501 to 1000.
5. Fifth Order: In this order, the interaction index ranges from 1000 and above.

The index of interaction obtained from this model, however, depicts only a broad, generic level of interconnection between the settlements, since they are expressed by the two aspects of population and distance only (Ahluwalia, 2004). It does not take into account, various other physical, geographical, social, cultural and economic facets that are equally important in mapping out the linkages between settlements. Hence, field observations and theoretical analysis have been made to explore

more on these other levels of interrelationship that exist between these settlements, which may or may not be expressed tangibly.

Background: Defining the areas of study

Wangduephodrang, is characterized by a giant valley composed of several other small valleys, which are all carved by tributaries of the great Punatsangchhu. The valleys slope down towards the main river and stretch along the North-South direction. The valley is wider in the north and slightly narrows down towards the lower course of the river. Therefore, most human settlements are evident along the upper course of Punatsangchhu. The slopes on the western banks of the river, where Rinchengang village is located, are composed of alluvial deposits making it suitable for agriculture and farming, whereas the slopes on the eastern banks, where Bajo town is located, are steeper with few flat lands stretching down towards the river.

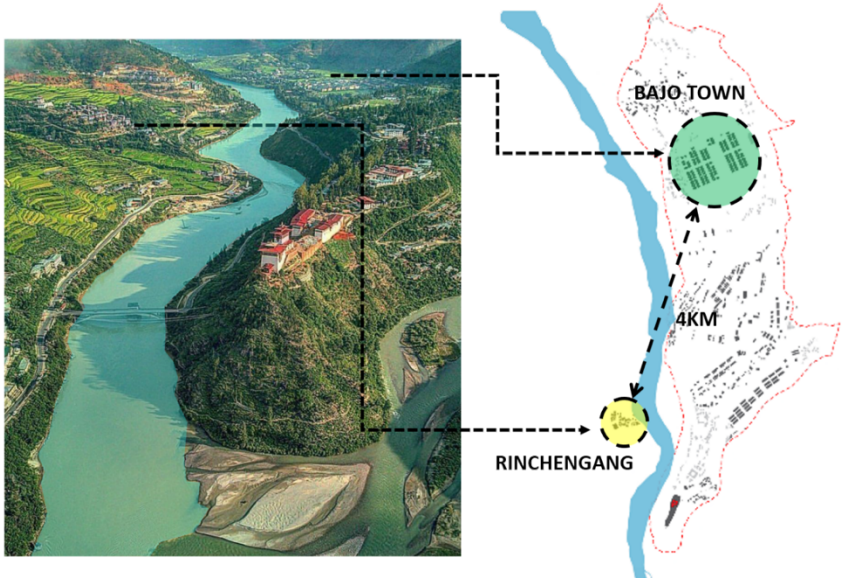


Figure 2. Defining the areas of the study
Source: Authors

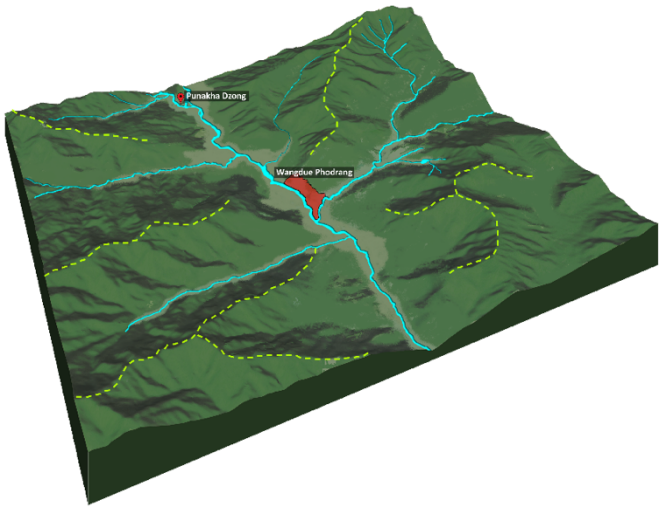


Figure 3. Wangdue Valley
Source: Urban Development Plan, Wangduephodrang

Rinchengang lies on the western bank of Punatsangchhu, on the fertile slope of the valley. Bajo, on the other hand, is planned on a portion of flat ground on the eastern slope of the valley. They are separated by a distance of 4km on the highway, and an approximately 1km of farm road. The two banks of the river are connected by the bridge, *Tsangmi Zam,* which acts as the junction for three highways towards Thimphu, Tsirang and Trongsa. Wangduephodrang dzongkhag shares its administrative boundary with several other dzongkhags as it is centrally located and thus, plays an important role in navigating the nation's socio-economic and political developments of the country.

I. Rinchengang

Rinchengang is located on the western bank of Punatsangchhu, where the slope is beautifully terraced into agricultural lands. The village originated in the 17th century, in the later years after the construction of Wangduephodrang Dzong in 1638. The settlement is about 400 years old and thus, is one of the oldest and most indigenous settlements of Bhutan. It features some of the most authentic form of architecture in

Bhutan and exhibits the character of strong preservation. Rinchengang sits amongst the developing urban areas of Wangdue, with the impacts from the Urban Core, Bajo Town. The settlement resists the fast urbanization around it and withholds the age-old tradition of community and architecture. Despite its geographic location being so close, or even within the urban core, Rinchengang thrives as a rural settlement.

The visual representation of the village certainly defines Rinchengang as a rural community. However, there are apparent explanations that can justify its ruralism. The population of the village is 960, residing in 54 houses shared between a number of families. This aligns with the general acceptance of rural population being below 1000. Furthermore, the main livelihood practice of the people of Rinchengang is agriculture and it is their primary source of income. One of the main characteristics of its ruralism lies in its architecture, which has been preserved since the 17th century. The materials used are vernacular such as timber, stones and mudbricks. The methods of construction are also vernacular and manufacturing of mudbricks is one peculiar skill that the community still celebrates.

It is a common fact that there are no individual land holdings in Rinchengang. The entire land parcel of 3 acres and 35 decimals in owned jointly by the whole community, under a single *Thram*. This tradition of shared land holding is perhaps one quality that the village has never evolved from, withholding the gift that their ancestors received from *Zhabdrung.*

II. Bajo

Bajo is located on the eastern bank of Punatsangchhu, planned on a flat portion of the steeper slopes. One of the largest projects in Bhutan, Punatsangchhu Hydropower Project, set a new accelerating growth of population in Wangduephodrang. Bajo township was thus established as a result of Wangdue's growing demand for a new commercial center. Therefore, in the year 2012, the town was established, where the inhabitants from the old Bajo town were also relocated.

Bajo is categorized under the urban core zone. The township has an area of 37 acres with approximately 55 acres of land left for future expansion. The current population is 5000 with a

density of 135 people in 1 acre of land. The main source of income of the inhabitants of Bajo is through commerce, while there are also people who work as civil servants in both government and private offices.

The overall image of the town is conceived as a compact and organized development. The buildings are 4-storeyed with an attic each and are placed linearly forming a grid. The planning in fact, is based on the Grid-Iron system, which is perceived to be a solution to urban issues such as traffic, infrastructure development and service delivery. All the buildings are mixed-use, with their commercial spaces on the ground floor and the residential spaces in the upper floors.

Today, Bajo town acts as the main commercial center for Wangduephodrang dzongkhag, catering to various groups of population from schools, offices and residents.

Case Study I: Rinchengang.

Background

Figure 4. Rinchengang (Source: Unknown)

Located in the central district of Wangduephodrang, Rinchengang initially known as Drinchengang (Grateful Village) under Tsedtsho gewog is one of the oldest settlements in the country. It is unique and compact agglomeration of mud-brick

houses etched on the sloping hillside on the ridge facing the Wangduephodrang dzong. It is about 4kms away from Bajo town connected to the highway by a farm road which is about a kilometer long (Rinchengang Village Documentation, CST, 2018)

History

The settlement dates back to the time of Zhabdrung's era in 17th century. During the construction of Wangduephodrang Dzong in 1638, the early inhabitants of Rinchengang were believed to be summoned from Cooch Behar by Zhabdrung for the construction works. This tiny parcel of land with an area of 3 acres and 35 decimals was rewarded by Zhabdrung as an acknowledgement for their exceptional hard work and great masonry skills during the construction of dzong. The entire land is single Thram, collectively owned by the community with no individual land owner (Urban Development Plan, Wangduephodrang).

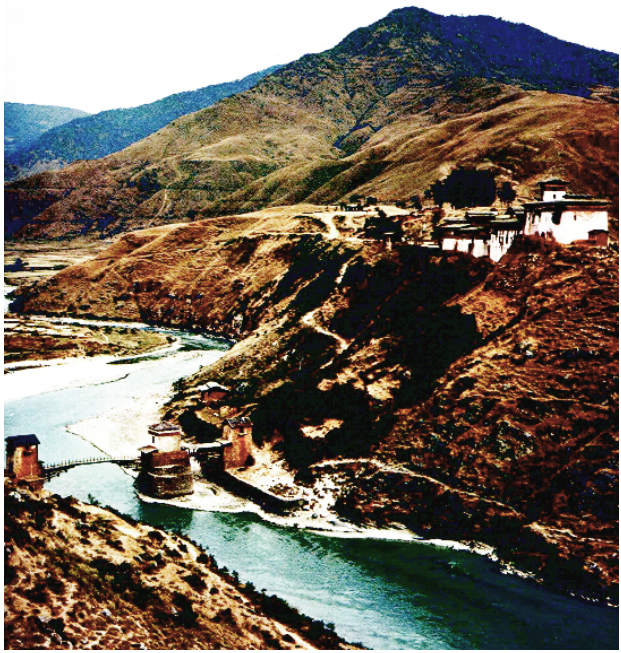


Figure 5. Wangduephodrang Dzong in the 1900s (Source: Unknown)

Population and livelihood

The total population of the village is 960 with 93 families residing in 54 households. Agriculture has been primary source of income for the villagers. Paddy is the main crop cultivated extensively in the fields surrounding the village. During the construction of Wangduephodrang dzong, Zhabdrung prophesied the involvement of masons from Rinchengang in construction of every dzong in future hence the practice masonry works is still prominent and alternative source of income (Rinchengang village, a cultural site of Bhutan, 2014).

Figure 6. Terraced Agricultural Lands of Rinchengang, April, 2019 (Source: Authors)

Social system

Mutual exchange of labour within the village and community cooperative system of labour (*woola*) was widely practiced Bhutan in olden times but with modernization and development, such practices are declining. Rinchengang still practices community cooperative system of labour for village activities including maintenance of irrigation channel, footpath, village lhakhang and community forest and cleaning of the surrounding. The agricultural works and construction of buildings are carried out through labour exchange.

Settlement pattern

Figure 7. Rinchengang as a nucleated settlement (Source: Authors)

Rinchengang is a type of clustered settlement that is unique in its architecture, layout and organic growth on the hillside. Resembling a typical Morrocan cluster, these mud brick houses are organically etched along the slopes of the hill. The settlement hierarchy is dictated by the village lhakhang which is located at the top of the village and agricultural lands lining the peripheral contours of the village. Due to scarcity of dry land in Rinchengang, the construction of new houses and extension of the village is restricted.

Figure 8. Sectional view of Rinchengang (Source: Authors)

Building typology

Most of the buildings of Rinchengang are built using local made mud bricks and timber with all the Bhutanese elements included. In olden days shingles and slates are used for roofing which are now replaced by CGI sheets. The buildings are usually two to three storied and are used solely for residential purpose. Since the construction of Wangduephodrang dzong, the villagers of Rinchengang are known for their excellent masonry skills which are still practiced. The buildings are constructed by the local masons and labours using traditional building materials and techniques. The locally made mud brick is the most prominent material used for construction of wall while timber is used for doors, windows and roof truss. In the past, the walls are left bare exposing the red mudbrick which often draws attention from visitors but now most of the buildings are plastered and painted.

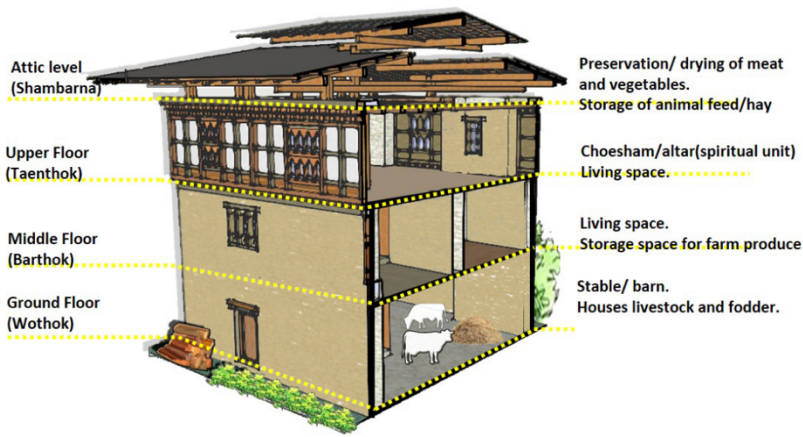


Figure 9. Typical Vertical Zoning of a single use farm house in Rinchengang (Source: Author)

Figure 10. Rinchengang in 2005 (Source: Pem Gyaltsen, Gandhara Designs)

Figure 11. Houses constructed with mud bricks (Source: Authors)

Infrastructure and services

Rinchengang is an organically growing settlement. It grew from a few houses in the later 16th century to a 54 houses settlement today. The growth and development of the village can be conceived purely as an organic settlement. Therefore, the settlement misses on planned and structured infrastructure such as connectivity, drainage, sanitation and waste management.

Figure 12. Rinchengang in the 1900s (Source: Chandra Chhetri)

i. Water supply

The main source of water is located above the village, established as a small reservoir. The mainline of the water is connected to these reservoirs and water is distributed to the village through gravity system. Effective water management is crucial due to the scarcity of the water supply. For effective irrigation water management, the households are divided into five groups namely Dungyep, Tshow Chem, Shingi Chem, Chu Tsep, and Gung Sarp for rights to access water. (Rinchengang village, a cultural site of Bhutan, 2014). Three to four houses share a common water tap for household uses.

ii. Sanitation

Although most of the household have individual toilets, multiple houses share single toilet. The reason could be because of the limited space for expansion and development. The construction of toilet, or any new structure is a challenge due to the compact organization of the settlement.

Figure 13. A typical toilet in the village (Source: Authors)

Most household in the village still use traditional pit toilets which are usually located far from their living areas. The toilets are constructed with mud bricks like the buildings, with temporary roofs and doors.

iii. Road and footpath

The village is connected by a farm road of about 1km from Thimphu-Trongsa highway. Initially the farm road was established till the base of settlement. Later they extended the road till the base of the Lhakhang and was paved in 2018. Thus, Rinchengang is accessible by vehicles from the highway. The compact organization of the settlement allows the footpaths to run along the walls of the buildings, running in an irregular pattern. Each household is connected by narrow footpath to the cement paved pedestrian pathway which is further connected to the farm road.

Figure 14. Footpath at the core of the village (Source: Authors)

iv. Waste management

Rinchengang receives the municipal assistance in its waste management. However, it lacks proper segregation and management of degradable and non-degradable wastes. The reasons could be due to less monitoring and coordination, also due to lack of awareness the villagers receive. All sorts of wastes are dumped together in the municipal waste bins located at the entrance of the village.

v. Drainage system

Due to the organic growth of the settlement on a steep terrain with no space for lateral expansion, infrastructure like drainage system is absent in the village. Rinchengang lacks proper drainage system due to which, surface run off is prominent. This can cause certain risk factors during the monsoon seasons.

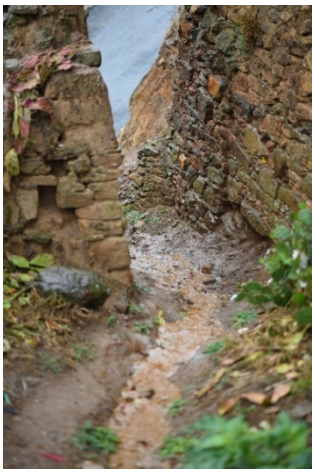


Figure 15. Pictures showing runoff during rainfall, April 2019 (Source: Author)

Case Study II: Bajo Township

Background

Figure 16. Bajo Town (Source: Author)

Bajo is a planned urban development in Wangduephodrang district, located about 4 kilometers away from the village of Rinchengang. While Rinchengang is seen as a natural and

organic growth of settlement, Bajo Township developed as a result of Wangduephodrang's growing demand for a new commercial center and township since the start of the early 1980's.

With the advent of modern development, the unplanned and haphazard growth of houses and settlements in the limited parcels of land around the Dzong area and the main highway needed an intervention, as it threatened the image of Wangduephodrang. This resulted in the demand of a new town which could cater to a modern and changing urban lifestyle, equipped with provisions of all basic and permanent urban infrastructure. The new township of Bajo was thus, established in 2012, with potential plans for future expansion and growth as well. With an approximate population of 5000, Bajo, today, makes up almost half of the population of Wangduephodrang district (Urban Development plan, Wangduephodrang, MOWHS). The town was built on parcels of vast agrarian land, adjacent to the old village of Bajo, and descends through a gentle gradient towards the Punatsangchhu River.

Figure 17. Thematic Sectional View of Bajo (Source: Author)

Settlement pattern

The town of Bajo follows a grid-iron street system plan with linear streets intersecting at right angles. A typical roundabout mark each primary node in all the avenues. Previously built on vast agrarian land, the topography is relatively flat and the site gradient slopes gently towards the Punatsangchhu side. The grid iron streetscape of Bajo is known for its efficient accessibility,

way finding, mobility and connectivity within the town, besides the advantage of an efficient system for distribution and management of services such as water supply, sewerage and solid waste. The suitable location of nodes also facilitates high accessibility and movement of pedestrian and vehicle throughout the street avenues.

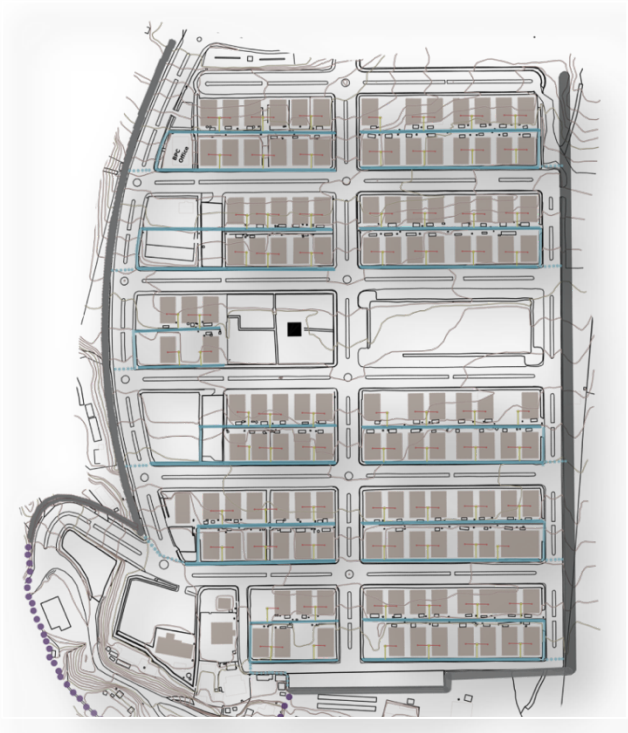


Figure 18. Bajo Town planning (Source: Author)

Social system

Bajo is a planned urban development that resulted from the need for Wangduephodrang to expand and establish a stronger commercial base. Hence, the social stratification of Bajo is usually formed of non-native residents working around Wangduephodrang, namely civil servants, shopkeepers and businessmen. Most of the plots are under individual land holdings and every owner usually owns a commercial outlet as

well. Moreover, employees and personnel working for the Punatsangchhu Hydroelectric projects (PHPA I and II), and the nearby Agriculture-based research and development centers also account for a significant portion of the town's growing population.

Building typology

Bajo town sees a dominating presence of mixed-use buildings in its planning with very few variations in its built form. Most of the buildings are four storied including the attic. This replicated mass of built form seems to weave in a rigid and monotonous skyline of its townscape, giving the same visual perspective from all major vantage points and avenues of the town. The ground floors of most buildings function as commercial outlets sharing equally accessible and discernable frontage. The first floor sometimes functions as an additional commercial floor. The rest of the floors are used for residential purposes. The spatial or functional hierarchy of a typical mixed-use building is illustrated in the diagram given.

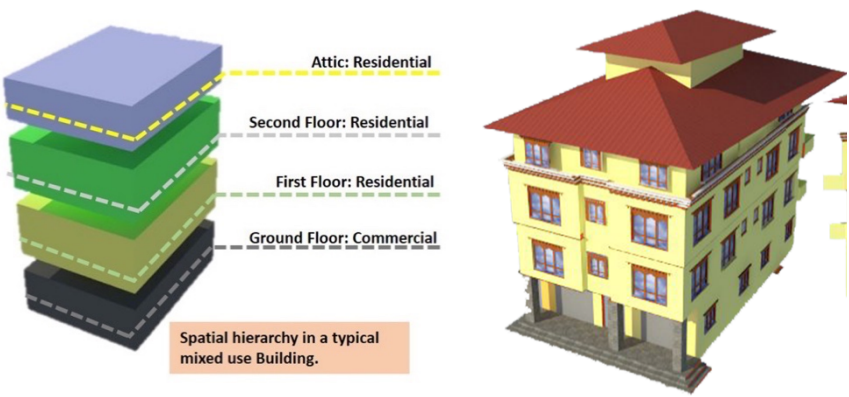


Figure 19. Pictures showing the spatial hierarchy of buildings in Bajo (Source: Author)

Figure 20. Typical plans of a mixed-used building (Source: Author)

Infrastructure

Being a structured and planned urban development, Bajo town is an authentic example of its kind to portray the efficiency and cost-effective aspects of a grid iron street planning system in the distribution of basic urban infrastructure and services such as water supply, solid waste and sewage. The entire town is connected by a well-designed network of roads with suitable location of nodes and avenues. This facilitates high accessibility and movement of both pedestrian and vehicles throughout the street avenues. The town also offers public transportation services to the regions of Thimphu, Phuentsholing, Gelephu, Punakha, and Phobjikha.

Drainage

The drainage pattern adopted closely resembles the Trellis Pattern where, it contains primary drains that are long, straight and parallel to each other, but perpendicular to the main drain. The natural topography of the site challenges the smooth

operation of the drainage pattern and it can be a huge issue in the long run. The primary drains run across the gradient to almost 120m of distance, to be able to connect to the main drain. This hinders the fast flowing of wastewater increasing the probability of blockage and depreciation of drainage fixtures. Moreover, the effluent from the main drains are directed to the river with no proper outlet and treatments.

Figure 21. Drainage Pattern of Bajo (Source: Author)

Analysis

Coexistence through physical linkage

The spatial connection in rural and urban areas are determined by physical linkages between them. Physical linkages are tangible aspects that bridge the gap between the settlements mainly through transportation links such as road, railways and waterways. These linkages enhance transportation and communication, ultimately leading to increased access, extended markets and faster developments (Rendinelli & Ruddle, 1976). Transportation initiates communication, marketing, employments, migration and services, which are the prime establishments of development.

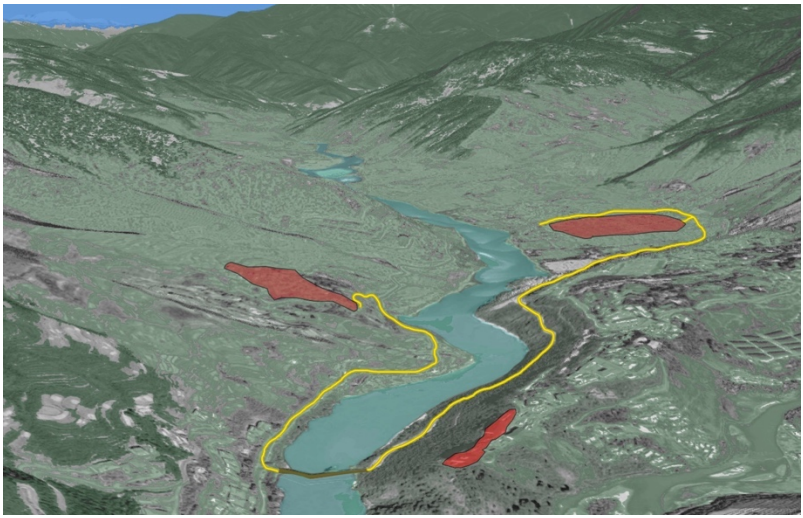


Figure 22. Coexistence through physical linkage (Source: Author)

The spatial integration of Bajo and Rinchengang can be understood through several physical aspects such as road network, visual connection and ecological interdependency. The two settlements are located on two different slopes on either side of the Punatsangchhu. While Rinchengang is situated on a steeper terrain on the western valley, Bajo town sits lowly on a gentler ground on the eastern side. The concept of these two settlements being physically linked is a vivid statement composed of natural and man-made elements. The physical linkage between Bajo and Rinchengang can be expressed in terms of the following elements.

i. Road network

Rinchengang is positioned on a higher terrain on the western valley of Punatsangchhu whereas Bajo town is on the eastern valley slightly on a flatter ground. They are located at a distance of 4km away from each other. The terrains are a lesser issue in connecting the two communities than the river, the great Punatshangchhu, which acts as the main barrier between them. The *Tsangmi Zam*, the main bridge at the feet of the Wangduephodrang dzong crosses over the river, connecting the two national highways which, spread into a number of

secondary roads. Rinchengang is accessed from a farm road connected from the Thimphu-Wangduephodrang highway, which leads to the *Tsangmi Zam* and to the Tashigang-Semtokha Highway where two secondary roads provides access to Bajo town. The road runs mostly in north-south direction, which also aligns with the river.

The settlements can be accessed by vehicles as well as by foot. The only form of public transportation on these roads is provided by the Punatsangchhu Hydropower Project (PHPA) for their staff, and there are no city buses servicing locally. School children from Rinchengang who go to Bajo Higher Secondary School travel by PHPA buses. Taxis are prominently seen besides private cars.

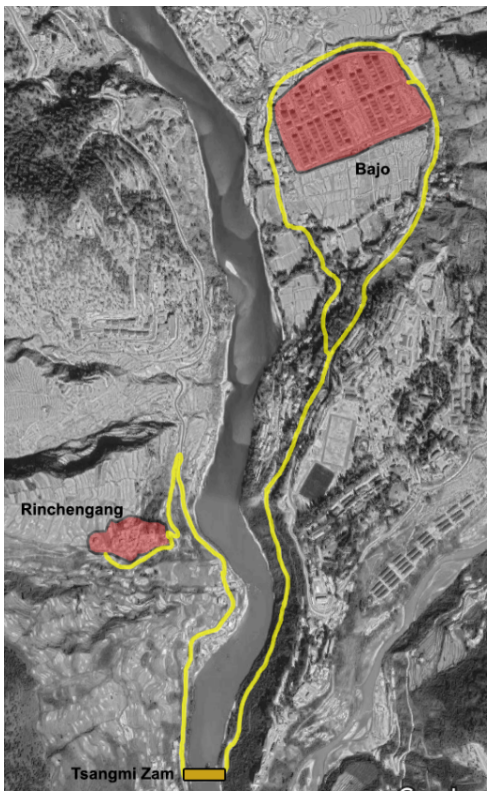


Figure 23. Road network(Source: Author)

ii. Ecological interdependency

Wangduephodrang is also home to the sweeping marshlands and plains of Phobjikha valley, the largest wetland site in Bhutan. A network of rivers carves through the varying gorges and ravines and meander through the valleys below. The main valley is carved by this major river, the Punatsangchhu. The slopes of the Punatsangchhu valley are characterized by a series of ridges which creates a valley and on whose either side lies the two settlements, Bajo and Rinchengang. Punatsangchhu creates an ecological corridor stretching from North to South between the two valleys, spreading its effect on both the sides. The settlements on the banks of the river share this ecosystem which is perhaps the prime foundation of these settlements.

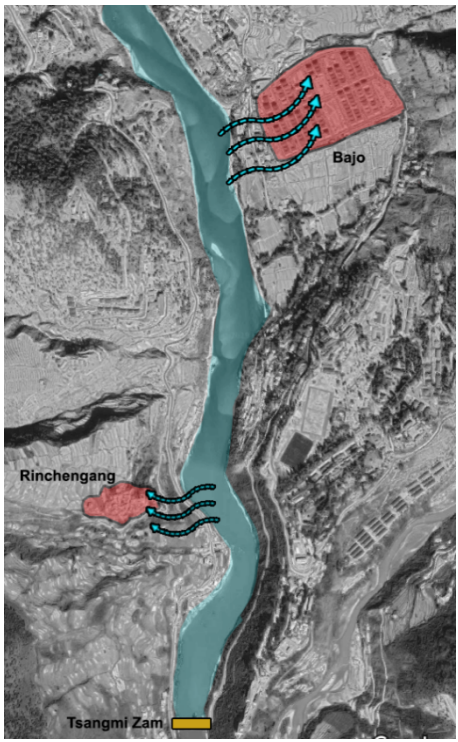


Figure 24. Ecological interdependency (Source: Author)

The diverse topography has produced a varying number of diverse settlements, where houses are dug deep into the

mountains in clustered units like Rinchengang. The terrains on the western banks are steeper whereas the eastern banks, consist of a wider expanse of alluvial deposits making it suitable for farming. The variances in elevation and the degree of exposure to saturated southwest monsoon winds determine the dominant vegetation, which varies from dense forest on the rain-swept windward slopes to alpine vegetation at higher elevations.

iii. Visual connection

Figure 25. Bajo town seen from Rinchengang (Source: Author)

The valley created by the Punatshangchhu offers a wide range of visual connectivity along its banks. Bajo and Rinchengang are visually connected and can be seen from either side. Visual connection between the settlements enhances the spatial interaction between them.

Coexistence through economic linkage

Economy plays an important role in the spatial integration of regions, in fact, it could be considered as the backbone of rural-urban linkages. An essential part of understanding the economy of a region is by recognizing the source of income. Villages characterize a type of economy that depends on agriculture and farming, and is enhanced by business opportunities offered by the cities (Tacoli, 1998). The cities, on the other hand, grow due

to tertiary activities where the rural communities participate as consumers. This linkage simply completes the economic sphere of the region by balancing the flow of goods and services between the settlements.

Cities and villages share an economic bond where the different livelihoods rely on each other to sustain and without the support from one another, one would not survive. The idea of coexistence of the regions depends greatly on the economic linkage between them. It is also vital to identify how economic linkage is conceived through various relationships.

i. Market Relationships between Bajo and Rinchengang

Market linkages are the foundations on which the commercialization of agriculture takes place along with diversification of products (Skinner, 1964). It helps in expanding the spatial system of exchange which compliments a healthy linkage between rural and urban areas. Marketing systems provide considerable benefits to the farmers in rural communities by increasing their market availability and competitiveness.

Agriculture is the main source of income for people of Rinchengang. Cultivation of rice has been their primary activity of livelihood and has also been given utmost importance by the government. Most residents now are able to harvest twice a year which provides them surplus for commercialization. Bajo, being the main town, offers a platform to commercialize the rural products from Rinchengang. Bajo, on the other hand, sustains on the villagers as they are one of the targeted markets.

The market relationship that Bajo and Rinchengang share is basically in pursuit of their livelihood. Market relationships can be improved through transportation networks which can enhance the accessibility to the consumers and producers. With the urban growth, rural production may grow as well because urban growth implies increased demand for food and services.

ii. Labour wages

The masonry skills of people of Rinchengang is not only praised and celebrated but have also been given opportunities to earn their living from.

Coexistence through social linkage

Social interaction could either be the basis, or the result of all the other linkages between rural and urban settlements. Improved transportation routes and facilities mobilize social interaction, and also brings about changes in the social structure of the village as well as in the towns (Dickinson, 1964). The growth and development of towns have considerable impact on the villages in many ways and thus share this flow of prevailing ideas, culture, trends and lifestyles. Urban growth has huge influences on the traditional balance of rural society and it requires certain protocols to keep them in equilibrium. The settlements may also share similar historical aspects due to which a common ground can be established.

i. Historical relationship

There is a chronological gap between Rinchengang and Bajo, due to which there is a sharp distinction in the context of the settlements. Rinchengang was formed in the late 16th century after the construction of the Wangduephodrang Dzong. It is known to be the village of the skilled masons who were responsible for the great piece of architecture on the hill of Wangduephodrang. Their village itself, is considered as one of the most significant cultural landscapes in Bhutan. The clustered settlement which is credited for the purest form of organic growth exhibits the skills of the architects and carpenters. Rinchengang sits on a steep terrain with limited space for extended growth. This is also a reason why it is believed that it takes special skills to plan or build on a terrain and space like Rinchengang.

Bajo, on the other hand, is one of the first well planned towns in Bhutan after the intervention of regulations in planning. It was completed in the year 2012 and experienced an exponential increase in the number of residents. Bajo town is planned based on the grid iron concept where the roads and pedestrian walkways create the grids dividing the space into regular boxes.

Rinchengang and Bajo share a significant role in Bhutan, one as an important cultural landscape and the other as a town planned in the modern era of Bhutanese development. Their

historical background being so noteworthy, makes it prominent to bring upon attention in various topics such as coexistence.

ii. Cultural relationships

There is no sharp cultural difference between Bajo and Rinchengang as the people share the same culture. People speak Dzongkha, the national language of Bhutan, expressed in a stronger accent, often referred to as *Ngalop.* The dress men and women wear are also same in both the areas, although modern trends in fashion have influenced them. The form of religion, rituals and rites carried out are based on the same principles and in no way do people divide faith. Due to the increased cultural interaction between the two settlements, it is valid to state the coexistence of Bajo and Rinchengang. In this context, they can be viewed as a single entity of Wangduephodrang.

iii. Population movement

The flow of information happens when people move from one place to another. The infusion of information and ideas are a result of frequent movement of people travelling for work, education and business. People of Rinchengang travel to Bajo for business purposes, for work and for leisure. There are students from Rinchengang who go to Bajo Higher Secondary School on a daily basis. These constant movement of population induces flow of information which promotes a strong social linkage.

Coexistence through administrative and political linkage

The functional linkages between settlements are integrated and developed mainly through administrative and political linkages. Bajo and Rinchengang is governed under Thedtsho Gewog, under one head, the Gup. Therefore, they are under the supervision of one jurisdiction and one political influence. The administrative linkage between any two settlements indicate the flow of public budget resources, administrative authority, interdependencies among specialized organizations and government jurisdictions (Rondenelli & Ruddle, 1976).

In the chosen study area, the influence of government is balanced regardless of ruralism and urbanism. Government

services are controlled from the Dzongkhag headquarters and also from the gewog centre through a proper hierarchical system. The organizational linkages in the two settlements are also efficient, uniform and functional.

Proposal: Architectural intervention in coexistence of rural and urban settlements

Background

From the urban end of the spectrum, Bajo town marks a significant transformation in the development of Wangduephodrang, from a stray conglomeration of houses on the highway to a well-structured town. However, Bajo town is also known for being a frequent topic of discussion in the domains of the urban forum. The town is seen as a striking contrast to an otherwise organic landscape of Wangduephodrang. The dense built form of Bajo town is mundane, monotonous and non-responsive to its surroundings. The major flaw in its planning is its failure to create a well-defined image and an identity for the township and the district too, as an intrinsic whole.

Rinchengang village, on the rural side of the spectrum, is a majestic piece of a living history. The mud brick facades exhibit the skilled craftsmanship of our ancestors while being tucked compactly into the hillside. However, due to the compact massing of its built form and due to acute land shortage, basic services including drinking water, sanitation and drainage do not match the required standards of living. This has also resulted in increased rural-urban migration issues. Old homes are neglected and fertile farmlands are left fallow in the village.

These flaws are symptoms that suggest the need to integrate the rural-urban interface through architecture and explore ideas that could actually be translated into some concrete working configuration to design a healthy coexistence between these two communities.

The following ideas are brief explorations into how architecture could help create a linkage to bridge the rural-urban divide:

Building typology

Figure 26. Building types in Rinchengang (Source: Author)

It is visually apparent how these two settlements of Rinchengang and Bajo, lack a coherent linkage through the architecture of its built form. Rinchengang village exhibits strong vernacular, traditional and skilled craftsmanship of its builders through the use special sundried adobe bricks. The organic growth of settlement is apparent in the way the houses line the contours of the village through a descending cluster.

The township of Bajo, on the other hand, fails to exhibit vernacular intelligence and response to its natural surroundings. There are very few variations in its built form. The building typologies seen in Bajo are a monotonous stretch of concrete mass that lacks any visual effect. Moreover, the use of hipped roofs creates a disproportionate look that deviates from our traditional roofing styles. The colour schemes adopted on the built forms are also discordant with the natural setting of the township.

Figure 27. Building types representation in Bajo (Source: Author)

According to the Building-Use Study carried out in Wangdue Urban Development Plan, 58% of the total number of structures in Wangdue are purely residential and 27% are mixed-use, primarily based in Bajo town. 14.09% of the structures cater as administrative and public structures, while the rest of them are

purely commercial. The highest density of buildings can be found in Bajo town where maximum of the structures are G+3 .

Building typology: Building identity

The principles of Neighborhood planning state one important section on a unique neighborhood identity. It states that each neighborhood should have a distinct identity to foster community pride and a sense of belonging (The City of Red Deer, 2013). Architecture plays an important role in expressing creativity and a distinctive identity of a building. It establishes relationships between buildings and public spaces, and thus enhances the livability of the community.

Rinchengang exhibits a strong architectural character that Bajo town somehow lacks. A strong linkage between the settlements can be established through the flow of this particular idea. The town could borrow the architectural aspects from the village to improve its urban design. The principles of neighborhood planning explain a number of design standards that could be adopted to enhance the identity of the neighborhood. These design standards include the following areas of attention:

1. Neighborhood features and themes
2. Heritage and cultural features
3. Built form and site design
4. Architectural elements

Building typology: Building materials

Buildings in Bajo are built primarily with concrete, steel and timber. Rinchengang, on the other hand, resisted the pressure all the modern materials of construction. The villagers still use mud bricks as their load bearing walls and timber for the facades, doors and windows. They are known for their excellent masonry skills and therefore, have been the pride of the village. The manufacture of mud bricks is still prevalent in Rinchengang. Moreover, a few households have also started commercializing the material to various places.

Figure 28. Mud Bricks as load bearing wall in Rinchengang (Source: Author)

Figure 29. Drying of mud bricks, 2019 (Source: Author)

Figure 30. Dried Mudbricks stored in temporary sheds (Source: Author)

The practice of using vernacular building materials is a strong statement of sustainability that the village is promising itself. In addition, it also holds a clear commercial potential for the mud bricks, in which case, Bajo could become the closest market. This would also benefit Bajo in various aspects such as minimizing the cost of construction, creating a unique building identity and ultimately strengthening the relationship with Rinchengang.

Building typology: To solve housing demand

The total population of Wangduephodrang is 12052 for now, out of which 4125 reside in self-sustained campuses. The rest,

7931 demands for housing which can be accommodated by 1762 units (Urban Development Plan, Wangdue). There are 1408 housing units in the town currently which indicates the limitation of 354 more units. This clearly shows that there is a demand for housing in Bajo. Therefore, Bajo should adopt measures to accommodate housing issues at present as well as in future.

A good example of accommodation even with scarce land and housing can be found in Rinchengang. 94 families live in 54 houses, which is not usual in self sustained houses in rural Bhutan. The building typology is designed in such a way that the families have separate entities for themselves even when sharing a common space.

Building typology: For tourism

The housing demand in Bajo is on the rise. The Urban Development Plan of Wangdue projected the housing demand for the following years:

Table 1. *Projected housing Demand (Source: Urban Development Plan, Wangdue)*

Year	No of housing units required	Deficit
2025	1749	341
2030	1978	570
2035	2238	830

Wangduephodrang is considered to be an important seat of Bhutanese history, which has made it an important tourist destination. This indicates a demand for lodging for tourism along with housing. Rinchengang is already an important tourist destination; moreover, it has a strong potential to provide accommodation for tourism through development of homestays, heritage homes and even local food courts.

A vibrant discussion among public in the recent years is to convert Rinchengang into a living museum. This can be feasible if the villagers response is positive and if there are necessary support from the government. This requires a further research and intent studies. For now, it is safe to say that the tourism can become the leading income source for Rinchengang, even

through simple exhibition of its architecture, culture and tradition.

Rural design for infrastructure development

Rural design is a design principle that was first founded by Dewey Thorbeck, the founder of Center for Rural design in 1997 at the University of Minnesota. The Centre for Rural Design (CRD) was established after studying the changes taking place in rural villages of United States (Troughton, 2016). The principles of rural design evolved as a result of establishment of CRD and is now rapidly emerging in many countries for assisting rural societies to mitigate the rural issues and develop living standard without hindering rural environment and culture. The principles of rural design include effective land use, planning and landscaping and enhancing economic development while preserving natural and cultivated landscapes.

Rinchengang has the potential to adopt these principles of rural design to enhance the community spatially.

Drainage system in Rinchengang

A sustainable drainage system should be adopted in Rinchengang. With change in climate and extreme weather patterns, it is viable to experience extreme rainfall. It is vital to adopt drainage designs to safe guard the buildings, environment and agricultural lands. Rinchengang is an organic settlement and with very limited space for lateral expansion, there is very little chance of adopting new plans. However, the sloping terrains offer the advantage of adopting a drainage system based on trellis pattern. The main drain can be connected to the tributaries which will cater to the households. The spaces between the houses create an irregular avenue which can be used for footpaths and drainage.

Spatial organization-An integration of two ideas

The main difference between Bajo town and Rinchengang is that Bajo developed as a result of a structured town planning where it incorporated all the aspects of city life. On the other hand, Rinchengang evolved naturally as an organic growth and hence the reason for lacking modern infrastructure.

However, there are two types of spatial organizations that can be integrated to form a coherent community. Bajo is designed on a grid-iron pattern, where the roads and walkways run horizontally and vertically, creating maze-like spaces. These spaces accommodate buildings whose frontal and backyards create spaces for utilities such as septic tanks and parking. The buildings face east-west, all in similar direction and aligned in common lines. The planning of Bajo induces a rigid sense of community for these reasons.

Rinchengang, on the other hand, evolved naturally, planned by ancient carpenters and masons. The houses are clustered and arranged in an irregular pattern. Although all the buildings face eastward, it marks identical styles to the buildings. The irregularity in the building placement hinders proper connectivity and friendly accessibility. However, these kinds of settlements induce a fluid sense of community through natural public spaces.

An ideal community would be an area with the integrated types of spatial organization. It will have proper connectivity and accessibility, along with better community spaces. A community with integrated spatial organization or rural and urban could promise sustainability.

Spatial connectivity

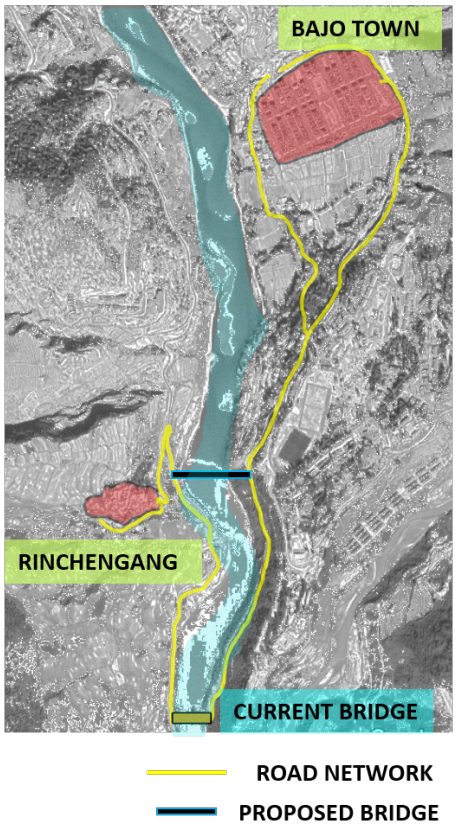


Figure 31. Proposed Bridge for spatial connectivity (Source: Author)

Currently, Bajo and Rinchengang are separated by a road distance of about 5 kilometers, and the main highway serves as the only means of access between the two communities. The highway routes through the Bridge, *Tsangmi Zam,* near the Dzong, and connects to a junction where the road finally has a separate diversion towards Bajo town. Although some residents and commuters from Rinchengang still opt to travel by walking via the main highway, major improvements could be made on enhancing the overall connectivity and increasing the walkable

distance between these two communities. A viable proposal would be to introduce another bridge, at a suitable location between the main bridge and the town of Mitsina, in order to connect the two opposite ends of the terrain. This could greatly reduce the travel time and distance between the two communities as commuters will not have to route all the way through the bridge near Wangduephodrang Dzong. This could additionally benefit not only the residents of Rinchengang, but also the dwellers and commuters in the nearby town of Mitsina too.

Waste management

Improvements could be made on the waste management system at Rinchengang. Although the Bajo municipality handles the waste generated at Rinchengang, the village lacks proper segregation and has a very poor management of degradable and non-biodegradable waste. The municipality could raise some awareness on such issues and provide at least two collection and segregation zones for waste, at the village's suitable peripheral locations. Community cooperatives and weekly campaigns could be planned and introduced to guide the residents better in managing the overall surroundings of the village. This could be initiated with the help of nearby schools students too.

Communal spaces

The two communities of Bajo and Rinchengang both lack proper communal spaces in their respective zones. Bajo has a park located centrally in the town but the use is limited to the residents nearby only. Rinchengang on the other hand has no communal zones in the region besides the main village Lhakhang at the hilltop. However, this Lhakhang has the potential to be further developed as the major communal zone of Rinchengang. The Lhakhang area could be developed further to include some landscaped areas to function as a reclusive buffer for the village. Moreover, the peripheral road connecting the main highway to the top of the Lhakhang entrance, could be developed to provide accessibility to commuters from Bajo as well. Certain village functions held in the Lhakhang could be a wonderful opportunity for dwellers in the region of Bajo and

Rinchengang to come together, interact, and foster community vitality. The same could be said for developing the central recreational zones of Bajo town. These parks could be modified and upgraded to hold functions, activities and events that can bring together people from both communities. Moreover, this could be a forum of social interaction between students too, to help them learn and develop an understanding of the rural-urban interaction better.

References

Ahluwalia, D. (2004). *Rural-Urban Interaction: A Case Study of Haridwar Development Region.* New Dehli-67: Jawaharlal Nehru University.

Akkoyunlu, S. (2015). The Potential of Rural–urban Linkages for Sustainable Development and Trade. *International Journal of Sustainable Development and World Policy*, 1,3,5.

Bar-Gal, Y. (n.d.). Book Reviews. In M. Pacione, *Rural Geography* (pp. 183,184).

Czischke, S. P. (2015). *Promoting Urban-Rural Linkages in Small and Medium Sized Cities.*

Datta, S. (2003). *Rural Urban Continuum: A Study Beyond The Southern Part of Calcutta Municipal Corporation.* Calcutta: University of Calcutta.

Division of Conservation of Heritage Sites, D. o. (2014). *Rinchengang Village, A Cultural Site of Bhutan.* Thimphu: Division of Conservation of Heritage Sites, Department of Culture,Ministry of Works and Human Settlement, Bhutan.

Imaah, N. O. (2005). The Interface between Architecture and Agriculture in Nigeria: An Environmental. *JASEM ISSN 1119-8362*, 123-125.

Kumar, K. S. (n.d.). *Rural-Urban Linkage and Role of Civil Society: A Successful Model for Good Urban Governance in Nepal.*

Lukesch, R. (2016). *Food sovereignty and urban-rural integration.*

Mahimkar, S. (2015). Internal Migrants in uUrban Villages: Co-existence and Conflicts. *National Conference on Urban Issues and Architectural Intervention 2015* (pp. 5-15). Pune: Sinhgad College of Architecture.

Ministry of Works and Human Settlement. (2016). *Urban Development Plan, Wangduephograng*. Thimphu: Ministry of Works and Human Settlement.

Ndabeni, L. L. (2016). *An Analysis of Rural-Urban Linkages and their Implications for Policies that Sustains Development in a Space Continuum.* 87 Hamilton St, Arcadia, Pretoria, 0001, South Africa: Cooperative Governance Traditional Affairs .

Pacione, M. (2003). Urban environmental quality and human wellbeing—a social geographical perspective. *Landscape and Urban Planning 65(*2003*)*, 19-30.

Samanta, G. (n.d.). *Rural-Urban Interaction: A Study of Burdwan Town and Surrounding Rural Areas.* University of Burdwan.

Second Year Architecture Students, C. o. (2018). *Rinchengang, A Documentation* . Phuntsholing: College of Science and Technology.

Sharma, V. K. (2002). *Administration and Rural-Urban Interface for Sustainable Development.* Himachal Pradesh: Himachal Pradesh University.

Stead, S. D. (2002). Urban-Rural Relationships: an introduction and brief history. *Built Environment, 28(4), 269-277*, 1.

Steinberg, F. (2014). *Rural–Urban Linkages: An Urban Perspective.*

Strong rural–urban linkages are essential for poverty reduction. (2017). *FAO Agricultural Development Economics.*

Tacoli, C. (2002). *Changing rural-urban interactions in sub-Saharan Africa and their impact on livelihoods: a summary.*

Tacoli, C. (2003). The links between urban and rural development. *Environment&Urbanization Vol 15 No 1*, 1-12.

Tacoli, C. (2015). The Crucial Role of Rural-Urban Linkages. *The Sahel and West Africa Week*, p. 1.

Tacoli, C. (2017). Why small towns matter: urbanisation, rural transformations and food security. *Briefng, Urban, food and agriculture*.

Third Year Architecture Students, C. o. (2018). *Bajo Town Urban Study.* Phuntsholing: College of Science and Technology, RUB.

Troughton, D. T. (2016). Connecting Urban and Rural Futures Through Rural Design. *International Conference on Peri-Urban*

Landscapes: Water,Food and Environment Security (pp. 45-55). Western Sydney : Water Science and Technology Library.

Uduporuwa, R. J. (2015). Rural-urban linkages and theoretical underpinnings of regional. *Sri Lanka Journal of Social Sciences 2015 38 (1):* 1-11, 1.

5

Sustainable Riverfront Development in Bhutan: A Study in Thimphu City

Chimi and Arindam Biswas[*]

Abstract

Rivers are one of the most necessary resources required by human being, environment and for the development of the country. It has been an essential element in shaping the livelihood of people living in and around its premises since early civilization of human being. As Bhutan embraced with modern philosophy of development with series of Five-Year Plans since 1961, it has observed that tremendous development has taken over in cities like Thimphu which is located along Wangchu river. This rapid growth of economic developments has its harsh negative impacts on environment despite having stringent national regulation and policies. The rapid urbanization of Thimphu city has underused and neglected the Wangchu river and its riverfront area, where it has been facing several environmental challenges such as pollution and degradation of the water quality due to direct disposal of untreated waste water. Many riverfront development projects around the globe not only revive the ecological and environmental health of rivers but also improve the social and economic wellbeing of urban dwellers. Therefore, this study aims to identify the issues and current practice of urban riverfront development and propose sustainable riverfront development strategies based on the case

[*] The authors would like the acknowledge the management of College of Science and Technology, Bhutan and Indian institute of Technology, Roorkee and Ministry of Work and Human Settlement for facilitating with necessary data and resources. The authors also would pay the gratitude for financial support from Annual University Research Grant (AURG) from Royal University of Bhutan and Center for Co-operation in Science and Technology among Developing Societies (CCSTDS), Government of India to carry out this study.

studies of successful waterfront development overseas. The strategies followed in this study could become a reference for architects, planners, engineers and other related decision makers to reconsider the ecological aspect of riverfronts while planning and creating the urban spaces along the riverbanks to ensure sustainability of the towns of Bhutan.

Introduction

Water is considered as one of the five essential elements that compose our body and whole universe in Buddhist philosophy and astronomy. River is defined as the last open valley of the urban terrain, where many re-establish their right of access and enjoyment (Yassin, 2011). It has have made a huge contribution to social vibrancy, to global transportation and a resource for production industry and biodiversity. It is also considered as the element in culture and traditions, where many places of worship are built nearby rivers (Costanza, 1999). It is been recognized as most valued natural asset from the time of early civilization until today as most of the settlements have grown along the river for agricultural activities and natural defense. And later it is used for transportation and trading during industrialization time (Hoyle, 2001). In this paper, a framework for river development along the Wangchu river is presented by identifying and integrating natural landscape and socio-cultural activities of Thimphu city. Ultimately, this can protect and conserve river ecosystems and water qualities using green infrastructure. This could also revitalize the urban fabrics by identifying sustainable land use pattern along river bank and harness socio-cultural expression of the people to create a tourism hotspot that reflect Bhutan's rich cultural heritage and natures beauty in a harmonious manner.

Literature review

Urban renewal

Urban renewal is defined as rebuilding, removal or rehabilitation of existing urban infrastructure in the city. It consists of three main approaches namely urban renovation, regeneration and redevelopment (Gounden, 2010). Today urban renewal concept has become one the frequent topic discussed as

urban areas grows larger and older with increasing amount building and land abandonment under economic and social pressure (Chan & Lee, 2008; Adams & Hastings, 2001). Most of these issues have happened due to relocation of industries in the urban periphery in search of better access to transportation of raw materials and factory products. The first large scale urban renewal was the renewal of Paris in 1980s but USA became first country to institute a national programme on urban renewal in 1930s (Grebler, 1964). According to Robert (2000) urban renewal is determined by economic transition, social and community environmental concerns, physical obsolescence and new land and property requirements.

Due to dynamic shift of industrialized based to serviced based economy of cities (Lehrer & Laidley, 2009), the success of city's development could be quantified by the quality of their city spaces. Therefore, the urban riverfront spaces plays vital role in its economic, social and environmental enhancement of cities which were degraded due to industrialization. The best example for the success of urban waterfront renewal is the Baltimore inner harbour redevelopment project, which has transformed city over past 35 years with immense positive impact on city development (Marshall, 2001). Its success has now influenced other cities to follow its footsteps in planning and creating social and economic viable city (Gounden, 2010).

Waterfront development

Waterfront area is a region of interface between urban fabrics and water bodies (Wrenn, 1983) that integrate land with water bodies providing natural attraction for human settlement and visitors (Costanza, 1999). These zones have the typical characteristics as below:

1. *Ecological:* A dynamic zone with highly productive and biologically diverse ecosystems for marine species with constant changing of biological and geological features.
2. *Economic:* The zone that significantly contributes directly and indirectly to human welfare and elevating the overall economic value place.

3. *Social:* The zone is socially significant for transportation, accessibility and shared property that unify people with diverse culture and religion.

According to (Breen & Rigby, 1996) waterfront development are classified into eight types based on their function and characteristic like commercial, cultural, educational and environmental, recreational and residential waterfront. Mega cities like Sydney, London, Hong Kong, Tokyo, etc. have undergone waterfront development process. Thus, it is important to understand the historical context of waterfront development as it influences today's modern development significantly. It is apparent that different cities have their own waterfront character and pace of evolution and development but the social and technological factors became common factor for all type of waterfront development (Yassin, 2011).

Evolution of waterfront development

Generally, settlements were located close to the water bodies from the early civilization period for fresh drinking water, agriculture practices and transportation of goods for trade and commercial activities (Yassin et al., 2012). Due to industrial revolution in 18th centuries, there is drastic change in goods production and commercial activities. Therefore, the cities have undergone major expansion creating congested city centers. By the end of 19th century, with improved shipping technologies and port facilities, the industries in the city centers began to migrate to outer periphery leaving behind unused, vacant and ruin structures along the waterfronts in search of larger spaces (Butuner, 2006; Breen & Rigby, 1993). Later, the abandoned spaces have been recognized by municipal government as an alternative potential to boost the socio-economic development of city. Moreover, with the change in urban peoples' lifestyle, there is huge demand for outdoor recreational space (Yassin, 2011). These factors reinforce the need of waterfront redevelopment and got started in 1960s, boomed in 1970s and got accelerated in 1980s (Ryckbost, 2005). The common goals of numerous waterfront redevelopment projects around the globe are to rejuvenate the waterfront space by creating urban image,

regeneration of the economy and improving social pattern of the city (Butuner, 2006; Sairinen & Kumpulainen, 2006). Today, it is observed that waterfront has changed in terms of layout, function and social patterns due to increasing demand for recreational activities. This determinant has forced the waterfronts to mostly design as new public open spaces with valuable features such as parks, walkways and recreational facilities (Tunbridge & Ashworth, 1992; Acosta, 1990). This shift of focus is due to more environmental awareness, historic preservation and higher demand of outdoor recreational spaces apart from tourist attraction (Gounden, 2010).

Waterfront development provide myriads of socio-economic development along with environmental benefits and due to its ideal location expand Central Business District and maintain its heritage and recreational spaces with proper connectivity (Fisher & Benson, 2004). The waterfront development not only provide monetary benefits but also offer a lifestyle that people often like to be a part of nature surrounded by water views and water related entertainment (Gounden, 2010). However, it is a difficult long-term task that requires a huge investment and lot of public participation, which sometime leads to the political upheaval. Therefore, such type of development requires substantial start-up funding (Fisher & Benson, 2004). It also poses threats to the aquatic ecosystem as it is not properly planned and executed (Fisher et al., 2004).

Sustainable waterfront development and management

Waterfronts has become one of the valuable possessions for countries with limited, precious and non-renewable assets (Yassin, 2011). It is observed that number of people migrating towards water edge has increased from 2 billion to 2.3 billion between 1990 and 2000 and it is projected increase to about 34% by 2025 (Duxbury & Dickinson, 2007). Therefore, with increase in population, there will be challenges related to space crunch and pressure on water quality and aquatic ecosystem. Thus to maintain its sustainability, a set of principles and strategies with a good governance system is necessary enhance its benefits and minimize the negative impacts on the environments (Post & Lundin, 1996). To mitigate the pressure on the waterfront, Lisbon

principles was developed in 1997 for the sustainable governance of waterfronts (Costanza et al., 1997). These principles are: responsibility; scale-matching; pre-cautions; adaptive management; full cost allocation and public participation which guides to administer the use of shared natural and social resources in achieving sustainable waterfront development. Clear farsighted and coherent policies are the main challenges to create waterfront cities a sustainable one. Therefore, it is very important have good collaboration and coordination among government agencies, stakeholders and institutions (Yassin, 2011).

Green Infrastructure (GI)

With rapid growth in urban built-up, today urban storm water management has become an urgent concern in cities due to disturbance on natural drainage pattern with increase in impervious surface area (Eaton, 2018). Therefore, GI technique has been revived as sustainable approach in monitoring storm water at a source due to its cost-effectiveness and adaptive management process (Chaffin, et al., 2016) with other short-term co-benefits such as improved public health and aquatic ecosystem (Berland & Hopton, 2014). GI is defined as an approach to sustainable development and mitigate climate change such as green energy generation, alternative transportation, habitat restoration, and storm water management (Moon, 2011). It is an integration of organic matter into any built up landscape of urban and rural areas (Benedict & McMahon, 2012) that has natural processes to collect, absorb, and filter storm water to reduce or offset the negative environmental impacts of urban development (Rowe & Bakacs, 2012). GI has now grouped under an umbrella of Storm water Control Measures that mitigate flooding and conserve water through decentralized methods (Fletcher et al., 2015).

Ecologically, GI's benefits are immeasurable like reducing peak storm water flow and frequency of run off compared to conventional methods (Li et al., 2017), as it manages storm water through the onsite treatment of runoff, however it is more efficient in smaller scale (Eaton, 2018; Jarden et al., 2015). It is found that the parking and pavement with porous materials

reduces the overall run off between 23% and 42% in low density area and 35-55% in high density areas (Eaton, 2018). Similarly, the bioswales functioned effectively in reducing the flowing speed of runoff about 52% in 30 m long swales (Lucke et al., 2014). Economically, GI are more cost-efficient compared to equivalent grey infrastructure (USEPA, 2014). It is found that a tree can reduce runoff by 3.2 - 11.3 kilolitre per year savings almost between $3 and $48 depending on the size and local cost of storm water management (Mullaney et al., 2015). Dunn (2010) has estimated that $10 billion investment in GI would create 150,000-220,000 green jobs, save 6.5-10 trillion gallons of water, and produce a $25-28 billion income output. However, due to lack of storm water financing with improper zoning, it will be a perceptual barrier to GI project development (Baptiste et al., 2015). Moreover, the poor design and unattractive finished from landscape design contributes to its hindrance of GI (Simons, 2017).

Urban green

Urban green spaces refers to spaces like parks, woodland, green roofs, sports complexes and community gardens which provides social, psychological and environmental services (Chiesura, 2004). Today many international agencies strive hard to preserve the large scale natural environment with bio-diverse area and endangered species but have paid very less attention to small-scale green areas in cities which is closed to where people work and live (Chiesura, 2004). Therefore, urban planners must emphasize on the protection and enhancement of urban nature that plays critical role in providing social and psychological benefits to urban dwellers through recreational and physical activities (Grahn & Stigsdotter, 2010; Lafortezza et al., 2009). It is found that one of the main contributors of limiting quality life in European cities is due to higher heat stress affecting the local climatic conditions (Nicholls & Alexander, 2007) which can be mitigated by developing more urban green spaces (Li et al., 2005) as it helps to create comfortable outdoor space for people by shading and evapotranspiration (Gomez et al., 2004; Shashua-Bar & Hoffman, 2003).

Green spaces enhance contemplativeness and provide peace and tranquility to people residing in urban area (Kaplan, 1983). Due to huge population with limited breathing space in urban areas, it breeds numerous illnesses and stress leading to incurable diseases like cancer decreasing individual's wellbeing (Kim & Jin 2018; Lewis & Booth, 1994). To mitigate such issues, urban green spaces plays a vital role in providing residents with physical and emotional benefits by serving as a platform for physical activities for relaxation (Kim & Jin 2018; Booth et al., 2012) to relieve from mental fatigue and provide quality life. Older citizens with good access to neighborhood open space are more likely do walking and physical activity (Fisher et al., 2004) and provide positive influence in their mental health by reducing stress and improving the feeling of wellbeing (Rodiek, 2002). Moreover, the strength of ties among urban dwellers depend on the availability and proximity of parks and green common spaces (Kweon et al., 1998). Studies have found that residents living in greener areas report lower level of fear, fewer incivilities, and less aggressive and violent behavior (Kuo & Sullivan, 2001); however, urban greens may encourage more crime, if it is not maintained as it affords a space for concealment.

Similarly, urban green also provide economic advantage to citizens and municipal authorities by reducing direct cost in pollution control and prevention through air purification and heat dissemination and indirect cost of providing medical services for no communal diseases. The green space would enhance the aesthetic and recreational value of city and attract more tourist generating more revenues and employments (Luttik, 2000). Furthermore, the natural elements like tress and water bodies increase the property values and increase its taxes. For example, (Kim & Jin, 2018) has found that in Seoul city, an individual household are willing to pay approximately $110 for 100sq.m increase for apartment nearby in urban parks. Similarly, in small cities of Finland, it was found that amount of green areas and proximity to water bodies increases the property tax by about 10% (Tyrvainen, 1997). Therefore, urban nature are considered as valuable municipal resource which is a key constituent for city's sustainability (Roovers et al., 2002).

Heritage and riverfront

Culture is considered as a framework of continuity of interconnectedness and represents memories and glories of the past, whereas heritage are places where the spirit of nature and culture meet (Singh & Rana, 2016). The heritage acts as medium to conceptualize the past that is associated with places and it is generally subcategorized into natural and manmade heritage. In manmade heritage, the interchange in human values are exhibited through monument and architectural expression in tangible form (Fisher, 2011). Natural and cultural landscapes of the cities are closely related with the traditional way of life that have potential to preserve and retain an active social role in modern society (Singh, 2004). Quality of life of people are also influenced by their psychological wellbeing which is enlivened by the monuments and sacred spaces. These spaces for social gatherings not only provide opportunities to interact with neighbours but also contribute in achieving and maintaining diverse and harmonized society through interaction between communities, enhancing social interrelation and community character (Rahman & Imon, 2017). Mills & Young (2009) have found that 80% of people acknowledge that conservation of heritage site improves their life quality, and 50% have impact on their personal quality of life. Heritage sites also create the sense of belonging and fosters the ownership and responsibility in maintaining the public space (Gražulevičiūtė, 2006) and generate more tourism and employments. Such type of cultural heritage conservation projects will protect environment through social engagement and gatherings (Rahman & Imon, 2017) and can provide the cultural and social settings beside natural and ecological setting along the water bodies (May, 2006).

Flood protection and rehabilitation

Flooding has been a leading environmental disaster around the world in terms of frequency and scale (Padawangi & Douglass, 2015) due to an outcome of heavy rains that cannot be channeled into city drains because of their inefficiency or overflowing. It was observed that increase in population and their occupation in riverbank areas by destroying or removing of

the natural vegetation might have accelerated erosion in recent years apart from other factors (Klaassen et al., 2005). To minimize the failure of river bank, riverbank embankment structures like groins, guide bunds, approach embankment and marginal embankments are constructed for deflecting the flow of the river towards or away from the riverbank. However, embankments incurs huge amount of investment and also disturb the riverine ecosystem if not planned properly.

Bio-engineering is a low cost bank erosion control structure which is more natural and environment friendly. Mangroves, reeds and grass sods have been already applied in bank protection. In addition to it, Vetiver grasses are also used for same due to its high-water retention capacity, grows at various level and fertility of land, at wet and dry conditions. Its root grows about 3m underground vertically and lives almost more than 10 year that requires less maintenance as it neither multiply its growth and yield seeds and bear rhizomes. Vetiver grasses can be also used as filtrate to filter the waste water before it is recharged back to underground or released to nearby water body. A combination of clay soil and Vetiver grass provides the best protection against erosion (Jaspers-Focks& Algera, n.d).

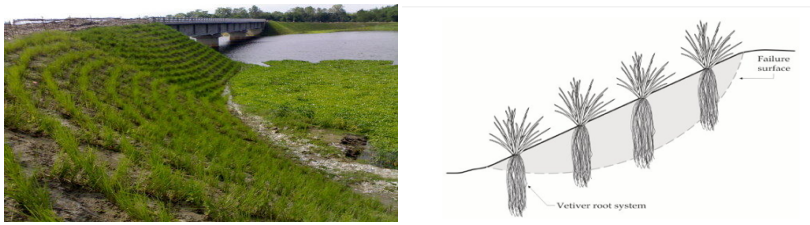


Figure 1. Soil reinforcement by Vetiver grass roots (Courtesy: Indiamart)

Case studies

Selected riverfront developments in different parts of the world have been studied and inferred the successful strategies that could be adopted in the planning of waterfront development in Thimphu city.

Shanghai Houtan Park

The 14 hectares and 1 mile long riverfront development project is located in Shanghai, Expo Park, China. This project was developed between 2007 and 2009 on a site of iron and steel plant and Houtan Ship Repair Plant. Before its construction, the site and its surroundings were polluted by wastewater and Pier storage yard. The project was conceptualized based on biological water purification, flood control system and cultural belief of water. The wetland has been divided into two zones based on its ecological purposes. This site purifies around 500,000 gallons of water through numerous biological process every day which could save half a million dollars compared with conventional method. This project also reduces the urban storm water flooding and rejuvenate all plants, bird and insect species that has almost disappeared for long time but it was observed that highly polluted Huangpu river was very difficult to purify into a clean water. Moreover, to restore the degraded environment is very challenging and the existing 22 feet high concrete floodwall to protect shoreline against 1000 years flood is not suitable as it is rigid and inanimate.

Figure 2. Master plan of Houtan Park (Courtesy: alsa.org)

Sabarmati riverfront development

The 202.79 hectares and length of 11.2 km Sabarmati riverfront development project in Ahmedabad, Gujarat, India is multidimensional environmental improvement and urban rejuvenation project initiated and constructed by Sabarmati River Front Development Corporation Limited (SRFDCL) on reclaimed land on both side of Sabarmati river by channeling it with a constant width of 275m (UDUHD, 2019). This urban

renewal project has redefined the identity of Ahmedabad city around the river and reconnects the urban fabric to it, which was left neglected for decades. The major components of the projects are embankment and land reclamation, construction of access roads infrastructures like water supply, sewer network, storm water drainage, resettlement and rehabilitation work, construction of promenades, garden and public spaces (UDUHD, 2019).

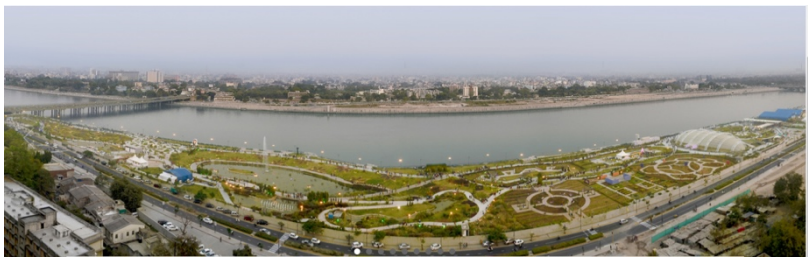


Figure 3. View of Sabarmati riverfront (Courtesy: sabarmatiriverfront.com)

After completion of this project, the surface water in the river is retained all year around recharging the ground with 12.5 million cubic meters of water annually. More than 250 MLD sewage is diverted from the river and its pollution was eliminated. The construction of diaphragm walls has protected the riverbank from scoring and embankments provides wide walkways, green space with tree plantation and many made easy access to the river water through ghats, stairs and ramps. Despite being an exemplary and landmark for urban renewal project in India, it has some limitations on design and planning strategies apart from the social and political loopholes (Shah, 2013; Rao, 2012). The riverfront is developed by embracing the modern technology without integrating the existing natural ecosystem and cultural appropriateness like concreting promenade and heroic channelizing the river has neglected the embodied ecological dynamics associated with river. Moreover, the usage of more hardscape and less amount of greens cape has dramatically affected the microclimate especially along the river edge.

Fargo riverfront development

Fargo riverfront Development of length 1.1 mile is located in Fargo, North Dakota, USA. It was developed between 1995 and 2001 by Fargo City Commission as Waterfront redevelopment and industrial revitalization project. This project was planned to establish a connection on 2nd Avenue North to the River as it act as the primary east/west connection between the Downtown, Civic Center Plaza and the Red River (Keepers, 2019). The selected stretch along the river are mainly focused to conserve the environment and to achieve greenery along the river while developing the riverfront area. It has also preserved the historical sites located in this area which dates back from 1850s.

Figure 4. Fargo riverfront development (Courtesy: Keepers)

The four important nodes in this area are selected for development based on existing uses and development, access, adjacent development, natural features, and planned improvements that play vital role in contribution of historic identity, economic hotspot and recreational open space. These nodes are then provided with a connectivity of 1.5miles and linked altogether that acts as corridor for people to move from one node to the other (Keepers, 2019). Fargo ensure that enhancements to the riverfront will protect the river's ecosystem, improve urban redevelopment, and contribute to expanded recreational opportunities. However, the most accessible area along the riverfront are most prone to flooding and the recurrent flooding hinders the thriving of vegetation at this location.

Tianjin Haihe riverfront

The 10km long Tianjin riverfront development with an area of 312 sq.km is one of the largest coastal cities in North China

along Haihe river. This project was developed between 2003 and 2004 to preserve and portray the age-old history and culture of the city and enhance service industries around the waterfront area. It was also aimed to protect the ecological environment in and around the site and promoted tourism and leisure industries along the riverside by creating a unique landmark feature. To meet these objectives, the projects has been sub divided into zones based on the zoning and their potentials to generate income and preserve the ecology. The Ribbon park zone controls the urban flooding through creating artificial ponds for filtration and purification before releasing to river as shown in the figure 5b. It acts as collection chambers during the Monsoon seasons, creating can artificial ponds where a number of recreational activities can be incorporated for the leisure time of the people.

Figure 5a. Ariel view of the Haihe City (Courtesy: Hough)

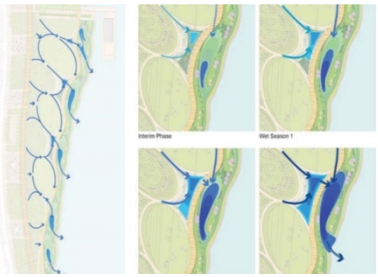


Figure 5b. Strom water accumulation and discharging process (Courtesy: Lopate)

Cheonggyecheon Restoration Project

The 100acres and 5.84km Cheonggyecheon Restoration Project is located in Seoul, South Korea. The project aims to improve the people's quality of life and conserving the riverfront ecosystems by creating ecological and recreational opportunities along the Cheonggyecheon stream. Apart from facilitating and motivating the economic growth, it also tried to interlink history, nature, and culture with urban settings. In CBD area, the waterfront park are developed with eco-friendly materials. In the middle of the city, it is planned with more nature and wetland which can serve as ecological conservation area. The natural

stones bridge and walkways for pedestrians in the stream helps to decrease water speeds. This project helps to accelerate the urban revitalization enhancing economic growth through tourism as well as has contributed significantly in improvement of ecology, air and water quality.

Figure 6. Conceptual site plan (Courtesy: landscapeperformance.org)

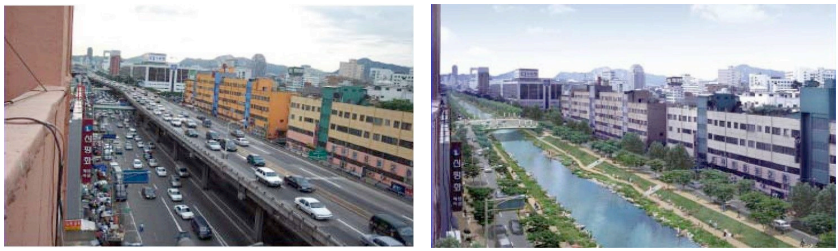


Figure 7. Before & After Comparison of Cheonggyecheon Stream (Courtesy: landscapeperformance.org)

Site study and analysis

Thimphu city

The 26 sq. km area of city stretches 15 km long and 3 km wide along the Wangchu river which starts from Dechencholing from the North and ends at Babesa in the South. It is located at 27°28′00″N latitude and 89°38′30″E longitude at an altitude between 2248 m and 2,648 meters above the mean sea level. Northern part of the city occupies left side of the river whereas the newer southern part of the city is developed in the right side of the river. The municipal boundary is limited halfway of the surrounding hillsides, where the density of population reduces

from flatter to steeper regions (Walcott, 2009). Thimphu city lies in the temperate zone with warm summer and cold winter (ICIMOD, 2016) with a maximum average temperature of 23˚C and minimum of 7˚C. It receives the total annual rainfall of 607mm. The heavy rainfall mostly occurred in the monsoon month of July (NCHM, 2017).

The capital of Bhutan was shifted from Punakha to Thimphu in 1955 and formally declared as capital city in 1961 by Third King of Bhutan, Druk Gyalpo Jigme Dorji Wangchuck (MoWHS, 2008). With rapid development of urban infrastructure, the first urban plan for the city was developed in 1964, however it could not be implemented. The first plan for Thimphu was prepared in the 1986, when the population was less than 15,000 people (MoWHS, 2008). This continued to serve as road map for Thimphu town through 1990s. In 2001, a new development plan for Thimphu city has started to prepare with an area of 26.132 sq.km after involving around 27 meetings and consultation with publics with a theme "Thimphu should serve as the dream city for all Bhutanese; culturally vibrant, environmentally sustainable and safe and resilient people friendly city." The 25 year-long "Thimphu Structure Plan 2002-2027" was approved by Council of Ministers in 2003 (MoWHS, 2015). Today the city is governed by the Thimphu Thromde headed by mayor locally referred as Thrompon under umbrella of Local Government Act 2009.

Land use

It was found that the urban area has increased by 28.62 ha from 1990 to 1999, most of the changes occurred from barren land to urban built up. The forest area was decreased by 261.82 ha which is about 2.37%; on other side urban built up has increased by 98.84ha from 1999 to 2007 and it has got almost double of 1990-1999 change. The study concluded that from 1990 to 2007, there was around 127.58ha or urban core was developed extending to the periphery of the city onto the slopes (Gosai, 2009). Currently, the municipal area is covered by forest, shrubs and meadows about 57.30% and agriculture land including orchards about 19.20%, barren land about 7.70%, built up of about 5.40% and water bodies of 0.40% approximately of total

municipal area as shown in Figure 8(a). The land use of the city was classified into various precincts according to Thimphu Structure Plan 2002-2027. The Environment precinct are prepared to protect the existing greeneries and create more green and open space, which acts as the breathing zones of the city. Since the place was blessed with rich culture and heritage sites, the Heritage precinct was provided for conservation, restoration, and improved access for old and religious section of population (UPD, 2015). Thimphu structure plan (2002-2027) has 22 themes, 10 principles of Intelligent Urbanism and 10 fundamental strategies (MoWHS, 2018; Thimphu Thromde, 2012).

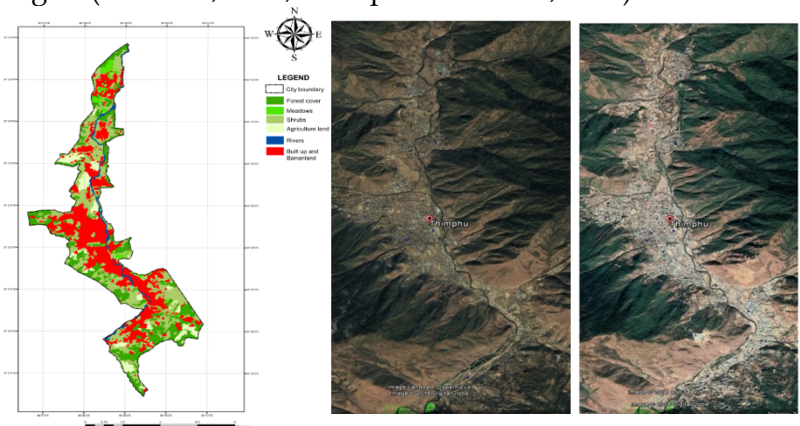


Figure 8(a). LULC map of Thimphu, (b & c) land use change 2003 and 2018 (Courtesy: Google earth)

Population and housing

Capital city Thimphu has highest population in Bhutan about 114551 with 51.5% male and 48.5% female constituting about 15.75% of country's population. The population density is around 17.71 people per acre (NSB, 2018). The growth rate is estimated at 5.2%. However, the Thimphu Strategic Plan approached are based on 5% growth rate. The density varies from 88 people per hectare to minimum of 15 people per hectare in 2008 (MoWHS, 2008). Total number of households is about 25408. The average household is 4 people in urban area. Currently it is found that 24090 household are present in city. The carrying capacity of household in Thimphu is 76,841 which

is states that the city can provide enough housing, if the vacant land are fully developed with current situation and regulation.

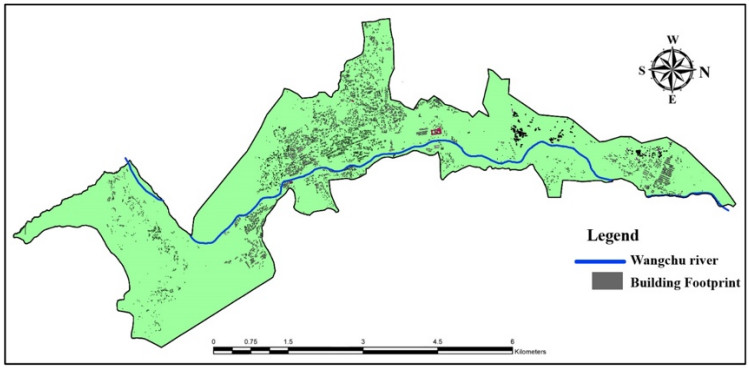


Figure 9. Building footprint

Water supply and waste water management

Currently, 22.1 mil.litre per day (MLD) of water is supplied to approximate population of 115000 from four stream sources and one from the bore hole near Changzamtog. However, in 2019, it is expected to receive 25MLD extra from two other river sources. Out of which 6.6 MLD (30%) is supplied as non-revenue water and 1.1MLD (5%) as fire-fighting purpose. The actual amount of water received by residents are about 14.4MLD. The actual water demand of city is 17.3MLD as per the water need of 150 litres/capital/day. With current population, Thimphu city is still short of 2.9 MLD.

As per the PHCB 2017, 98% of the households in Thimphu Thromde have access to improved sanitation of which 30% of total household are connected to the treatment plant. It was found both black water and grey water from the buildings flow to the sewerage system (Phuntsho et al., 2016). The other remaining household in low density are still relied on septic tanks and releasing grey water directly to drains unlike buildings connected by municipal sewer line. As of 2017, total capacity of sewage treatment plant is about 3.2 MLD located in various part of city. The oldest Lagoon system plant of 1.75MLD is located in Babesa commissioned in 1996. As per the Thimphu City Development Strategy 2008, the projections assumed that 80% of the water per capita consumption goes into waste water

generation i.e. 120 l/capital/day or 80% of 150 l/capital/day. It is estimated that currently, Thimphu generate 13.8 mil. litre/day. Therefore, the city still needs STP capacity of 106 MLD (MoWHS, 2008).

Storm water drainage

The TSP 2002-2027 has clearly identified all the natural waterways and there was no significant problem with regard to the natural drainage system given Thimphu's steep terrain, with water flowing along slopes and draining into the Wang Chhu as shown in Figure 10. However, the construction of buildings infrastructure have caused diversions to the natural watercourse. This concretization of Thimphu has now led to major surface run off and design of the existing drainage system is not able to cater to the discharge from the buildings especially during the monsoon season. The poor-quality drainage system leads to clogging caused by garbage and other wastes resulting in storm water running on the road and causing partial flooding. Moreover, dumping solid wastes into drains also causes stagnation and blockage due to immense pressure from population growth. In some cases, this drains also used to discharge the grey waters and septic tank overflow leading to stream and river pollution.

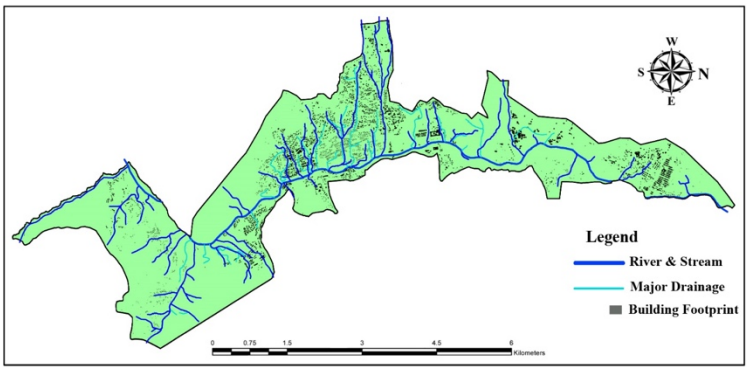


Figure 10. River, stream and main drains of Thimphu

Municipal solid waste management

With rapid increase in population and access to a variety of products in the country, the type and amount of wastes

generated exponentially. The waste ranges from biodegradable, non-biodegradable, hazardous wastes, medical wastes and e-waste. Due to insufficient infrastructure, facilities and services, all the efforts made by Thromde office seems to be minimal and overwhelmed by numerous issues that require urgent attention. According to National solid waste survey conducted by the MoWHS in 2008, it found that the average household waste generation in Thimphu Thromde was 50 metric tons per day which is about 0.62 kg/capita/day. The average non-household waste generation rates were 2.362 kg/day/commercial building and 1.439 kg/day/office which is equivalent to 0.329 kg/employee/day (Thimphu Thromde, 2012).

Air and river water quality

Emissions of air pollutants and greenhouse gases are among the most pressing environmental challenges faced by Bhutan. Both particulate and gaseous are in excess of their prescribed limit and causes harmful effects to human health. The local air pollutants are Particulate Matter (PM), SOx and NOx (NO, NO2), and Carbon monoxide (CO), which are emitted due to combustion of hydrocarbon fuels like coal, oil and natural gas. Thimphu's annual average PM10 measurements show increasing levels. However, the monitored levels are below the national standard guideline. The major source of these pollutants in Thimphu is due to vehicular emissions (MoWHS, 2018).

Similarly, it has discovered that there is a high presence of Escherichia coli at certain sections of the Wangchhu river and its tributaries, where contamination occurs due to leakage from septic tanks, direct discharge of untreated wastewater, etc. The study carried out by Giri & Singh (2013) in 2008 and 2009 has found that results at different sampling point between upstream at Dodena and downstream after Basesa with other intermediate sampling points are varying. The chloride and nitrate concentration and TDS values are below the highest limit set by World Health Organization though the value of concentration in sampling point at urban core and downstream are higher compare to upper stream. This is due to the overflow from septic tank, domestic waste and surface soil particles and other debris

into the river from the city fabrics (Tang et al.,2005; Ravindra et al., 2003).

Disaster and its management

Bhutan is prone to numerous natural disaster hazards due to its location in the fragile geological conditions, active seismic zone as per the Indian standard codes, steep terrains with great elevation difference. The hazards include earthquake, windstorm, forest fire/structure fire, landslides, flood and drought. Since Himalayan area are considered as young fold mountain and are prone to frequent earthquakes, Thimphu is located in seismic zone IV. Thimphu was hit by series of earth quakes since long time back. The recent recorded earth quakes are 5.5 magnitude in 2003, magnitude of 5.8 and 5.5 in 2006, 6.1 magnitude in 2009 and 6.9 magnitude in 2011 with its epicentre in Sikkim. All the structure built after 1997 are considered as seismic resistant building. (Lotay, 2014)

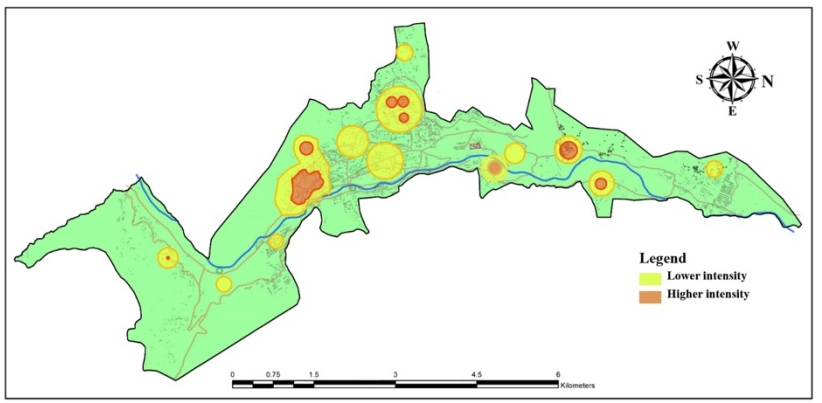


Figure 11. Seismic hazard map of Thimphu city

Similarly, Thimphu experienced the last major flood in 1968. In May 2009 city experienced inundation of rivers and streams as a result of Cyclone Alia. The maximum swelling occurred in Wangchu tributaries like Olarong Chhu. This could be attributed to the encroachment along the river buffer. Wangchu flows 135cumics in summer and 10cumics in winter (MoWHS, 2008). It is projected that the 100-year flood of magnitude 512 cu.m/s at Lungtenphug. It was found that a flood with return period of

100-year has 1% chance of occurrence in any given year. Low lying places near the river are most likely to get affected by the monsoon flood (NEC, 2016). Thimphu city does not pose threat to Glacial Lake Outburst Floods as of today (Lotay, 2014).

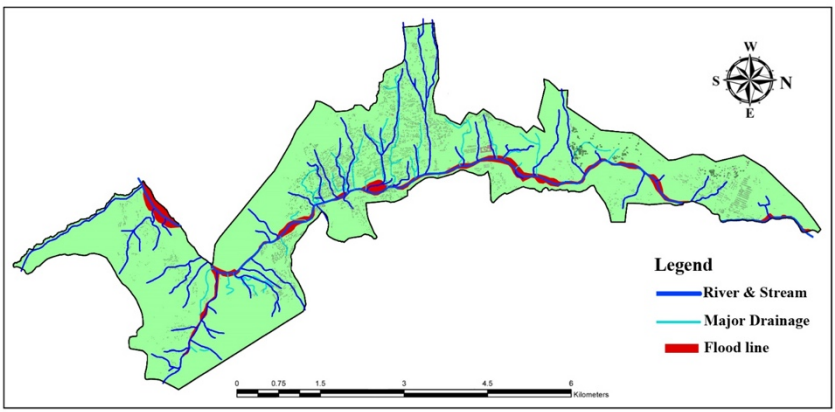


Figure 12. Flood hazard map of Thimphu city

Open garden and recreational park

Urban green spaces include parks, woodland, street tree and square plantings, green roofs, sports complexes, and community gardens. These green spaces and facilities not only provide the recreational area for the children but also contribute to personal physical and mental health by reducing stress, offering opportunities for restoration, and increasing physical activities (Grahn & Stigsdotter, 2010; Lafortezza et al., 2009). Thimphu today have parks in few areas such as Clock tower area in CBD; Motithang Park; Centennial Park; Thai pavilion; YDF Park; Chubachu stream Park; Olakha Park; Ludrong memorial garden and Royal Botanical garden. These parks are normally used by the children as the play area and for leisure time spends. However, these parks used very less by the elderly people, who prefer to spend the day near by the religious monuments and structure in and around the city. The most ideal place for the old people is the Thimphu memorial chorten.

Site planning and design recommendation

As discussed earlier this paper propose to revitalize the riverfront area from underutilized and degraded land to the

healthy and productive urban land in Thimphu that will help city to enhance its economic development apart from connecting natural environment to people's daily living. There are numerous small vacant or underutilized lands along Wangchu river and its tributaries like Ngabe Rong Chhu, Ola Rong Chhu, Chhubar Chhu, Samteling Chhu and Dechencholing Stream within the city municipal boundary. The proposals are made based on the analysis through literature reviews and case studies. The design includes seven nodes with different purposes like river access for watercrafts, interaction with water, green open space and increase habitat diversity. These nodes are connected by continuous footpaths and bicycle tracts to create a unified ecosystem. This project could serve as a prototype to other similar vacant or underutilized riverfront lands redesign in urban areas located in other part of the country of similar or smaller scale. Based on literature review and site context the five parameters are identified for this proposal namely:

1. Sustainability of social and economic value
2. Sustainable environmental development
3. Sustainability and promotion of spiritual monuments and heritages
4. Aesthetic value of the place, accessibilities and appropriate facilities required in the site
5. Development in compliance with Rules, Regulation & Guidelines of the place and nation.

In today's era, most of the riverfront developments are aimed for ecological improvements, more towards improving the water quality and reducing pollution (Redzuan & Latip, 2016). Therefore, the main four principles adopted are namely: General Principles, Planning Principles, Design Principles and Implementation Principles.

Regulations and guidelines

Rules and regulation are the key basis on which the developments are directed. There can be haphazard kind of development without rules and regulation. The waterfront development requires numerous considerations such as buffer

zone, ecological values, water protections, etc.; therefore, the main guiding regulation and guidelines are Bhutan Water Vision 2025, Environment Assessment Act, 2000, Thimphu Structure Plan, 2004, The Land Act of Bhutan 2007, Waste Prevention and Management Regulation 2012, Disaster Management Act of Bhutan 2013, Wangchhu Basin Management Plan 2016 and Forest and Nature Conservation Rules and Regulations of Bhutan, 2017. The main important guidelines required for the waterfront development in Thimphu are:

- Construction of buildings and other related infrastructure are not allowed with in 30m from the banks, or edge, of the watercourse and 15m from the edge of the streams.
- Footpaths and cycle tracks, vehicular bridges, footbridges, vegetable and flower gardens, nurseries, landscape elements like lamp posts, benches, gazebos, children's play equipment and litter bins reallowed to developed after 15m of the riveredge.
- Edge/Bank protection works for river and major streams shall be permitted with the clearance from the National Environment Commission and Nature Conservation Division (MoA).
- Certain stretches of the zone, which are not ecologically sensitive, shall be permitted to have recreational open spaces like parks, sports facilities and riverfronts, with the approval form National Environment Commission and Nature Conservation Division (MoA).

Site introduction and selection parameters

Wangchu river runs through the Thimphu municipal boundary covering around 12km, starting from Babesa in the south to Pangrizampa in the north. The river stretch is dived into two parts by the highly secured Tashi Chhozong complex, National Secretariat complex and Royal Palace. The northern trial stretches from Ludrong memorial Park near National Secretariat complex till Pangrizampa Institute of Astrology via Dechencholing Palace. The southern trail starts from Royal Institute of Management, Simtokha along Olarong chu stream and follow Wangchu till Tashichodzong complex as shown in

Figure 13. However, for the initial phase, southern stretches will be proposed to develop due presence of more residents reside toward southern part of city with populated central business district along with sports complex, bus terminals and numerous schools. Moreover, it also connects two important Dzongs with other important heritage sites as shown in Figure 14.

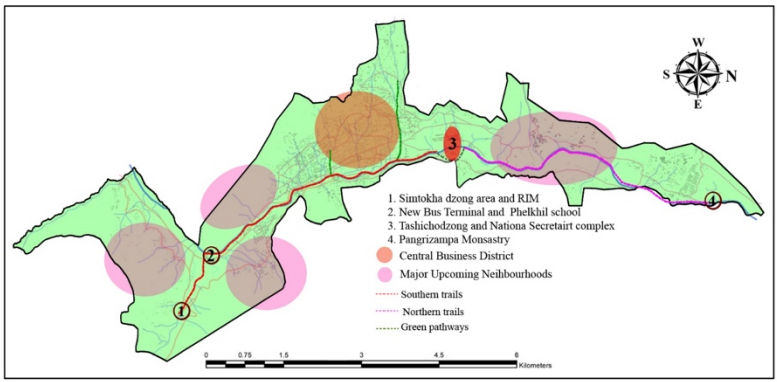


Figure 13. The trials stretches

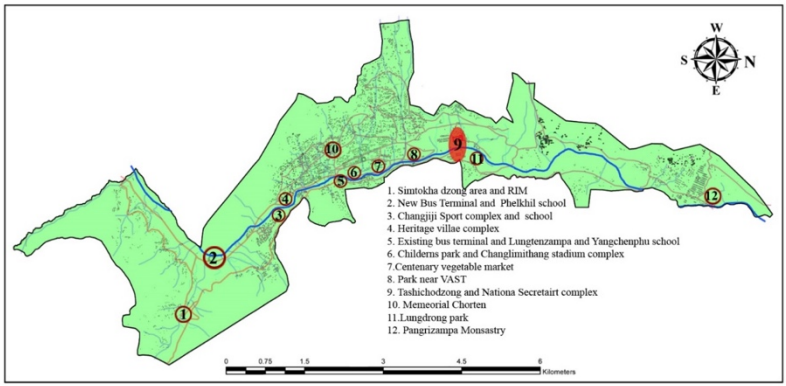


Figure 14. Important landmark spaces and buildings complex along Wangchu river

Proposal concept

To integrate the riverfront in to the urban fabrics, it has to be dynamic and vibrant where the urban dwellers could spend most of the leisure time and make city more livable. Therefore, riverfronts are considered to be a critical component of the city to shape it. But with mere development of it result in degrading

riparian environment and water quality. Therefore, planning and designing should focus on Revitalization and Sustainability, Safety and wellbeing, Connectivity and Social interactions, Cultural identity, Economic Vibrant and Ecological conservation. Similar to other successful riverfront development, Thimphu can be also divided into seven nodes which should be place where more social interaction could take place and located at walkable distance from the neighbourhood as shown in Figure 15. These nodes are selected based on proximity to the densely populated area; proximity to exiting park and sport area, proximity to heritage monuments and the sites are accessible by vehicle and availability of parking areas.

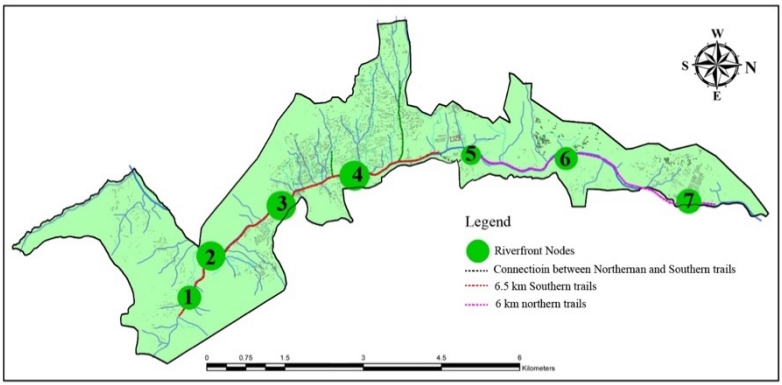


Figure 15. Identified nodes

These nodes are interlinked with continuous trails like green ways and bicycles tracts along the river edge which is ecofriendly and create buffer zone for riparian ecosystem from the threat of urban encroachments. These connections will also create a place for people to do their walking and jogging exercise before reaching to the sport complex, help the elderly people to walk up the religious site and students to their schools safely by themselves unlike today, where they need someone to drop creating huge traffic jam during peak hours.

Design features

The new design features proposed for different node and connections are site specific. This features not only revitalize

river where it has been underutilized but also upgrade and connect the existing features which are dispersed and isolated from each another. The proposed design features are: recreational parks, cultural monuments and features, bicycle tracts and riverside walkways, promenade, retaining walls, green infrastructure along with basic facilities like parking facilities, green space, plaza and amphitheater for multi-use infrastructure, informational kiosks, water feature and display area.

Recreational parks

There are very few parks in Thimphu. Coronation parks, park near VAST and Ludrong parks are located along the river; however, these parks remain empty most of the time except Coronation Park, where parent take their children to play and hang around. This is found due to less accessibility from the urban areas and lack of proper infrastructure. With the current proposal of connectivity with walking distance, it will encourage people to get connected to riverside. The park developed near river could convert the neglected riverfront area into productive usages and enhance the safety of school going children and old age people from vehicular movements. Moreover, people will inculcate value of the importance of the water body for the people and reduce pollution.

Figure 16 (a) Recreational park, (b) OAT, (c) Deck (Courtesy: Jin, 2018)

Cultural monuments and features

The riverfront should not only revitalize the exiting monuments like Lungtenzampa bridge and the heritages monument of Lama Phajo Drukgom Zhipo at the same site but also construct more monuments to pay homage to them for enhancing the psychological wellbeing of people. Currently very few elderly citizens visit the parks with their kids as there is lack of religious monuments in the parks apart from being away more than a walkable distance. Moreover, the upcoming project like Heritage village on the proposed stretch would also play vital role in educating people about the value of heritage but also attract more tourist. The religious monuments like stupa, Manidangrim, Manidungkhor can be constructed along the connection trails apart from existing monuments shown in Figure 17.

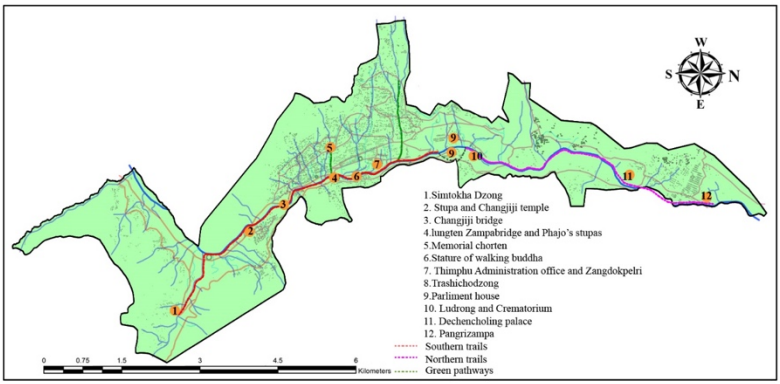


Figure 17. Existing Monuments and heritage sites in along the proposed riverfront stretch

Figure 18. Memorial chorten and Prayer wheel

Figure 19. Water prayer wheel nearby streams (Courtesy: FPMT)

Bicycle tracts and riverside walkways

Riverside walkway and bicycle tracts are trail along the river. The main aim of greenways is to serve as an access for the people and connects to the water/bluescape. It could also serve as the walking, jogging, relaxing, running and cycling pathways to connect neighbourhood and node. This proposal will help to implement the concept of pedestrian oriented city in Thimphu. These walkways should use porous material which will enable faster rate of water infiltration.

Figure 20. Cycling tract/walkways (courtesy: (a) the river Thames, (b) alamy

Figure 21. Proposed linkage along streams (Courtesy: Wusho)

Promenade and retaining walls

Promenade is a public place where people walk or spend leisure time for some social interactions. The promenades in this proposal offer opportunities to entrepreneurs to open up kiosk and food courts authorized by the related authorities to make living out of it

Bhutan being located on the Himalayan region with mountain terrains, there is threat of flooding due to climate change and uneven rainfall pattern. Therefore, it is very essential to propose the site specific retaining walls and river bank stabilization techniques to protect the proposed area from the danger of flood. The retaining walls are design as follows in the Figure 22 according to the site condition and space availability. In most cases, stone rip rap and bio engineering are preferred over the concrete wall, unless there is limited space for its design and construction because concrete degrades the vegetation cover and increases the storm water runoff. The propose design are as shown in Figure 23 and Figure 24.

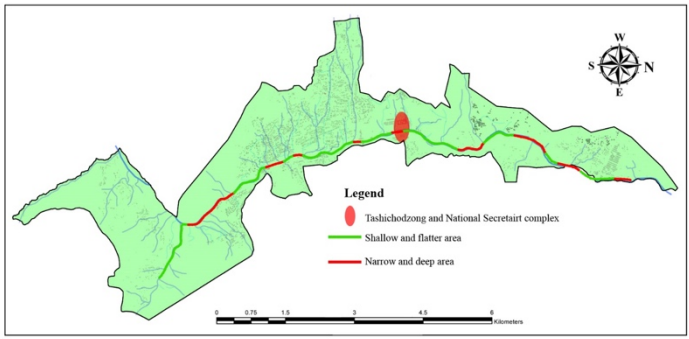


Figure 22. Map showing the area characteristics of the site

Figure 23. Retaining walls in the narrow sites (Courtesy: Hanson, 2012)

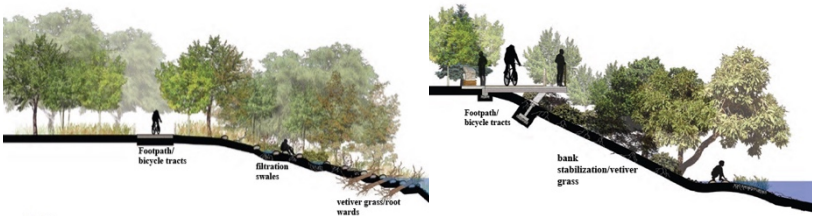


Figure 24. Retaining walls at plain and broader sites (Courtesy: Hanson, 2012)

Green infrastructure

Green infrastructure like bio-swales along the foot path, green and porous parking, rain water garden nearby sitting area as shown in Figures 26 and 27 enhance filtration of polluted water and recharge back to the ground. This could also minimize the storm water runoff and flooding. The green infrastructure also help in maintaining the micro climate especially in summer where Thimphu city also get heat up due to booming of concrete jungle and vehicles.

Figure 25: Green parking (Courtesy: pininterest)

Figure 26: Green infrastructure for water infiltration (courtesy: Irienergy solution)

Conclusion

Urban riverfronts have now become inseparable part of the human settlement. The water bodies together with their edges hold a special position within the urban fabrics where it partakes in forming a complex city organism along with features like streets and buildings. Unlike other public spaces, urban waterfronts are unique as it is point where the urban built form meets with water body reflecting the current social and cultural values of a place. Moreover with an increasing demand for recreational activities, waterfront development have been mostly evolved as new public open spaces in cities which are totally unique from parks creating a harmony with nature combining all people, nature and technology (Yassin et al., 2012).

Waterfront development project also face some challenges due to requirement of high capital investment and lack of federal support as political visions are shortsighted where such project takes longer period of time to execute and implement. The other major challenge is the risk of environmental damage done by such project as done in other part of the globe which is caused due to overlooking in the environmental planning process. With limited challenges, waterfront development has myriad of benefits. Few listed benefits among many are:

- Control flood damage and lower the costs of flood control;
- Decrease storm water management costs;
- Improve water quality and reduce costs associated with cleanup and drinking water treatment
- Reduce river bank encroachment
- Revitalize the riverfront with new opportunities for housing, offices, and commercial services
- Offer recreational opportunities, open space, and park amenities;
- Raise property values and generate new tax revenues; and
- It also acts as the evacuation area during earthquake, to which Bhutan is susceptible.

It was found from the study that successful waterfront development strategies can be referred and adopted but cities

cannot copy and paste the other successful water development project. It should be having its own unique character along with the site to resolve its site specific issues. Finally, it is realized that through the urban development process, it not only provides benefit to the end-user but also help in developing a organized and logical solution that should be integrated with the philosophy of urban planning, landscape ecology, environmental science, and hydrology Therefore, urban waterfront development is a place where social, economic and environmental sustainability can be achieved unlike other urban public features and spaces.

References

Acosta, M. C. (1990). Reclaiming the waterfront through urban designvguidelines: Case study of the Chicago River urban design guidelines. *Seventh International Conference on Making Cities Livable.* Carmel, California.

Adams, D., & Hastings, E. M. (2001). Urban renewal in Hong Kong: Transition from development corporation to renewal authority. *Land Use Policy, 18*(3), 245–258.

Baptiste, A. K., Foley, C., & Smardon, R. (2015). Understanding urban neighborhood differences in willingness to implement green infrastructure measures: a case study of Syracuse, NY. *Landscape and Urban Planning, 136*, 1-12.

Berland, A.,& Hopton, M.E. (2014). Comparing street tree assemblages and associated stormwater benefits among communities in metropolitan Cincinnati, Ohio,USA. *Urban Forestry & Urban Greening, 13*, 734-741.

Booth, F., Roberts, C., & Laye, M. (2012). Lack of exercise is a major cause of chronic disease. *Comprehensive Physiology, 2*(2), 1143–1211.

Breen, A., & Rigby, D. (1993). *Waterfronts: Cities reclaim their edge.* United State: McGraw-Hill.

Butuner, B. (2006). Waterfront revitalization as a challenging urban issue in Istanbul. *42nd ISoCaRP Congress 2006*, (pp. 1–11). Istanbul, Turkey.

Chan, E., & Lee, G.K.L. (2008). Critical factors for improving social sustainability of urban renewal projects. *Soc. Indic. Res., 85*, 243–256.

Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and Urban PLanning, 68*(1), 129–138.

Costanza, R. (1999). The ecological, economic and social importance of the oceans. *Ecological Economics, 31*, 199-213.

Costanza, R., Cumberland, J. H., Daly, H., Goodland, R., & Norgaard, R. B. (1997). An introduction to ecological economics. In R. Costanza, *Lisbon principles of sustainable governance.* Florida: St. Lucie Press.

Dunn, A. D. (2010). Siting Green Infrastructure: Legal and Policy Solutions to Alleviate Urban Poverty and Promote Healthy Communities. *Environmental Affairs, 37*, 41-66.

Eaton, T. T. (2018). Approach and case-study of green infrastructure screening analysis for urban stormwater control. *Journal of Environmental Management, 209* , 495-504.

EPA. (2014). *Boone Boulevard Green Infrastructure Conceptual Design* . Atlanta: Green Infrastructure Technical Assistance Program.

Fisher, J. (2011). The Four Domains Model: Connecting Spirituality, Health and Well-Being. *Religions, 2*, 17-28.

Fisher, K. J., Li, F. Z., Michael, Y., & Cleveland, M. (2004). Neighborhood-level infl uences on physical activity among older adults: A multilevel analysis. *Journal of Aging and Physical Activity, 12*(1), 45–63.

Fletcher, T.D. et al. (2015). SUDS, LID, BMPs, WSUD and More – the evolution and application of terminology surrounding urban drainage. *Urban Water Journal, 12*(7), 525-542.

Giri, N. & Singh, O. P. (2013). Urban growth and water quality in Thimphu, Bhutan. *Journal of Urban and Environmental Engineering, 7*(1), 82-95.

Gomez, F.,Gil,L. & Jabaloyes,J. (2004). Experimental investigation on the thermal comfort in the city : relationship with the green areas, interaction with the urban microclimate. *Building and Environment, 39*(1), 1077–1086.

Gosai, M. A. (2009). *Land use change in Thimphu, Bhutan from 1990 – 2007: Effects of cultural,Political and Economic Frameworks.* Greensboro: University of North Carolina .

Gounden, K. (2010). *Waterfront Development as a strategy for urban renewal- A case study of the Durban point waterfront development project.* Natal, Dirban: University of Kwazulu.

Grahn, P., & Stigsdotter, U. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning, 94*(1), 264–275.

Gražulevičiūtė, I. (2006). Cultural Heritage in the Context of Sustainable Development. *Environmental Research, Engineering and Management, 3*(37), 74-79.

Hoyle, B. (2001). Waterfront Revitalization in East African Port - Cities. *Cities, 18*(5), 297-313.

ICIMOD. (2016). *Bhutan: Climate +Change.* Thimphu: Bhutan Media and Communications Institute.

Jarden, K.M., Jefferson, A.J.,& Grieser, J.M. (2015). Assessing the effects of catchmentscale urban green infrastructure retrofits on hydrograph characteristics. *Hydeological Processes, 30*, 1536–1550.

Jaspers-Focks,D.J., & Algera,A. (n.d). *Vetiver grass for river bank protection.* Eindhoven: Delft University of Technology.

Kaplan, R. (1983). The analysis of perception via preference: a strategy for studying how the environment is experienced. *Landscape and Urban Planning, 12*(1), 161–176.

Keepers, R. (2019). *Riverfront Development Master Plan-City of Fargo.* Retrieved January 28, 2019, from Riverfront Development: https://www.riverkeepers.org/projects-activities/riverfront-development/

Kim, D. & Jin, J. (2018). Does happiness data say urban parks are worth it? *Landscape and Urban Planning, 178*(1), 1-11.

Klaassen,G.J., Pilarczyk, K.W., & San,D.C. (2005). River bank erosion and mitigation strategies in Vietnam. In V. B. Alphen, *Floods, from Defence to Management* (pp. 269-279). London: Taylor & Francis Group.

Kuo, F.E. & Sullivan, W.C. (2001). Environment and crime in the inner city. Does vegetation reduce crime? *Environment Behaviour, 3* (33), 343–367.

Kweon, B.-S., Sullivan, W. C., & Wiley, A. R. (1998). Green common spaces and the social integration of inner-city older adults. *Environment and Behavior, 30*(6), 832–858.

Lafortezza, R., Carrus, G., Sanesi, G., & Davies, C. (2009). Benefits and well-being perceived by people visiting green spaces in periods of heat stress. *Urban Forestry & Urban Greening, 8*(2), 97-108.

Li, C., Fletcher, T., Duncan, H.,& Burns, M. (2017). Can stormwater control measures restore altered urban flow regimes at the catchment scale? *Journal of Hydrology, 549*, 631–653.

Li, F.,Wanga, R., Paulussena, J. & Liub, X. (2005). Comprehensive concept planning of urban greening basedon ecological principles: a case study in Beijing,China. *Landscape andUrbanPlanning, 72*(4), 325–336.

Lotay, Y. (2014). *Bhutan Disaster Management.* Kobe: Asian Disaster Reduction Center .

Lucke, T., Mohamed, M.,& Tindale, N. (2014). Pollutant Removal and Hydraulic Reduction Performance of Field Grassed Swales during Runoff Simulation Experiments. *Water, 6*, 1887–1904.

Luttik, J. (2000). The value of trees, water and open spaces as reflected by house prices in the Netherlands. *Landscape and Urban PLanning, (3–4)*, 161–167.

Marshall, R. (2001). Waterfronts, development and World Heritage cities: Amsterdam and Havana. In R. Marshall, *Waterfronts in Post-industrial Cities* (pp. 137 -159). London and New York: SPON Press.

May, R. (2006). "Connectivity" in urban rivers: Conflict and convergence between ecology and design. *Technology in Society, 28*(4), 477-488.

McPherson, E., Simpson, J., Peper, P., Maco, S.,& Xiao, Q. (2005). Municipal forest benefits and costs in five U.S. cities. *Journal of Forestry, 103*(8), 411-416.

Mills, S., & Young. J. (2009). *Impact of HLF Funding, 2005-2009 Report.* London: BDRC.

MoWHS. (2008). *Thimphu City Development Strategy.* Thimphu, Bhutan: Policy and Planning Division, Ministry of Works and Human Settlement.

MoWHS. (2015). *Annual Information Bulletin- 2015.* Thimphu: Policy and Planning Division, Ministry of Work and Human Settlement, Royal Government of Bhutan.

MoWHS. (2018). *Strategic Environmental Assessment for the Thimphu Structure Plan.* Thimphu: Ministry of Works and Human Settlements, Royal Government of Bhutan.

NCHM. (2017). *Bhutan State of the Climate 2017.* Thimphu: Weather and Climate Services Division, National Center for Hydrology and Meteorology, Royal Government of Bhutan.

NEC. (2016). *Wangchhu Basin Management Plan.* Thimphu: National Environment Comission, Royal Government of Bhutan.

NSB. (2018). *2017 Population and Housing Census of Bhutan.* Thimphu: National Statistics Bureau, Royal Government of Bhutan.

Phuntsho, S., Shon, H.K., Vigneswaran, S., Ngo, H.H., Kandasamy, J. & Dorji, P. (2016). Performance of Waste Stabilization Ponds: Experience from Cold Climatic Conditions of Bhutan. *Journal of Water Sustainability, 6*(1), 1-16.

Rao, M. S. (2012). Sabarmati Riverfront Development-Alternative Perspective. *Landscape, 36*, 70-73.

Redzuan,N. & Latip, N.S.A. (2016). Principles of Ecological Riverfront Design. *Creative Space, 4*(1), 29–48.

Robert, P. (2000). The Evolution, Definition and Purpose of Urban Regeneration. In P. .. Robert, *Urban Regeneration: A Hand Book.* London: SAGE.

Rodiek, S. (2002). Influence of an outdoor garden on mood and stress in older persons. *Journal of Therapeutic Horticulture, 13*(1), 13–21.

Roovers, P., Hermy, M. & Gulinck, H. (2002). Visitor profile, perceptions and expectations in forest from a gradient of

increasing urbanization in central Belgium. *Landscape and Urban Planning, 59*(1), 129–145.

Sairinen, R., & Kumpulainen, S. (2006). Assessing social impacts in urban waterfront regeneration. *Environmental Impact Assessment Review, 26*(1), 120-135.

Shah, K. (2013). *The Sabarmati Riverfront Development Project: Great. But Much Needs to Change.* Retrieved January 27, 2019, from Daily News and Analysis: https://architexturez.net/doc/az-cf-166149

Simons, E. J. (2017). *Exploring roles for communities in Green Infrastructure Projects.* Massachusetts: Unpublished thesis, Urban and Environmental Policy and Planning, Tufts University.

Singh, R. P. (2004). The Ganga Riverfront in Varanasi, a Heritage Zone in Contestation. *Context: Built, Living and Natural, 1*(1), 25 - 30.

Singh, R. P.B., & Rana, P.S. (2016). Riverfront Varanasi, India: Interfacing Contestation. *Contemporary Geographer , 1*(1), 49-65.

Tang, Z., Engel, B. A., Pijanowski, B. C., & Lim, K. J. (2005). Forecasting land use change and its environmental impact at a watershed scale. *Journal of Environmental Management*, 35-45.

Thimphu Thromde. (2012). *Knowledge, Innovation and Capacity-Partnerships for Effective Municipal Service Delivery.* Bangkok,Thaiiland: Asia-Pacific Regional Centre, United Nationa Development Programme.

Tunbridge, J., & Ashworth, G. (1992). Leisure resource development in cityport revitalization: the tourist-historic dimension. In B. S. Hoyle, *European Port Cities in transition* (pp. 177-199). London: Belhaven.

Tyrvainen, L. (1997). The amenity value of the urban forest: an application of the hedonic pricing method. *Landscape and Urban Planning 3, 7*(1), 211–222.

UDUHD. (2019, January 23). *Sabarmati Riverfront Development.* Retrieved January 27, 2019, from Urban Development and

Urban Hosuing Department, Governement of Gujurat: http://www.udd.gujarat.gov.in/projects_sabarmati.php

UPD. (2015). *TSP and LAPs since 2002-An Update.* Thimphu: Urban Planning Division, Department of Human Settlement, Ministry of Work and Human Settlement.

USEPA. (2014). *Getting to Green: Paying for Green Infrastructure: Financing Options and Resources for Local Decision-Makers.* Washington, DC, USA.: Office of Wetlands, Oceans, and Watersheds.

Walcott, S. M. (2009). City Profile: Thimphu. *Cities, 26*, 158-170.

Wrenn, D. M. (1983). *Urban waterfront development.* Washington, D.C.: The Urban Land Institute.

Yassin, A. B. (2011). *Developing New Guidelines for Riverfront Development in Malaysia.* Christchurch, New Zealand: Lincoln University.

Yassin,A.M., Bond,S.,& McDonagh,J. (2012). Principles for Sustainable Riverfront Development for Malyasia. *Journal of Techno Social, 4*(1), 21-36.

6

Smart Happy Future Cities

Oualid Ali and Gustavo de Siqueira

Abstract

Since its emergence a hundred years ago, cities have been a magnet for people. Cities are sources of wealth and prosperity. However, they also present challenges for governments related to growth and urbanization such as traffic congestion, crimes, and waste management. In the 1980s, with the advancement of ICTs, cities started to benefit from these technologies to solve the urban challenges, then the concept of smart cities has seen the light. This concept has got more attention in the beginning of the 21st century because the urban challenges are intensifying. Unfortunately, most of the studies related to smart cities have focused on the use of ICTs and technology and missed the main aim which is enabling citizens' to live a great and happy life. This paper describes the evolution of the technology-centered paths of the smart cities studies. Subsequently, it presents a new approach to smart cities targeting a citizen-centric happiness goal. Additionally, case studies are described where cities and nations have achieved the goal of wellbeing by relying on technology or not.

Introduction

Cities are centers of economic activity and drivers of growth. They generate wealth and prosperity. However, they are also complex challenges for governments because along with the benefits they produce come negative effects such as uncontrolled development, traffic congestion, waste management, complicated access to resources, crimes, etc. American urban sociologists such as Wirth (1938), Durkheim (1893) and Tonnies (2001) have studied the negative side of urbanization and they have called it "malaise" or "unhappiness" (Okulicz & Mazelis, 2016).

In order to tackle these challenges, some cities experiment with new approaches to urban planning, design, finance, construction, governance, operations and services, sometimes under the broad banner of smart cities (Peris-Ortiz et al., 2017). Increasingly, cities that want to become smarter seek to harness the power of emerging technologies, and especially the Information and Communications Technology (ICT). These cities hold the promise to potentially make themselves more efficient, more tech-savvy, more wired with all that, they can hopefully improve the quality of life for their citizens.

History of smart cities

The symbiotic relationship between cities and Information and Communications Technologies (ICTs) began since 1990s, where ICTs has been used to solve the urban challenges and to support what is called the new "Science of Cities" (Batty, 2014). Many researchers have been pioneers in exploring the relationship between ICTs and urban areas. As example, we can mention Graham & Marvin (1996) in their book *Telecommunications and the city*. Other early research studies have discussed the same idea such as Graham & Marvin (1999, 2001, 2004), Graham (1997, 2000, 2001, 2002, 2004a, 2004b), Castells (1996) and Mitchell (1995, 1999, 2003).

Historically, the term "smart city" first appeared in 1992 in a book entitled *The Technolpolis Phenomenon: Smart Cities, Fast systems, Global Networks* (Gibson et al., 1992). Since then, smart cities have become the symbol of ICT-driven urban innovation and development and have attracted the increasing attention of researchers from universities, government, and businesses (Mora et al., 2017).

The field of smart cities has got more attention in 2007 when The United Nations declared that, "for the first time in history the urban population will be equal the rural population of the world" (UN, 2007; Peris-Ortiz et al., 2017). This was proved by the exploratory study which has been done by (Mora et al., 2017). Since 2007, many definitions of the smart city concept have been developed. Unfortunately, these definitions are divergent and lack cohesion; many of them overlap each other and sometimes contradict one another which makes it difficult to obtain a

common understanding and agreement as to what it means (Mora et al., 2017). As presented in Mora et al. (2017), the literature shows that smart city has followed two main dominant paths. These two paths are presented by Cohen (2015) in different 3 generations of smart cities. Cohen (2015) has studied smart cities since 2011. At the time he has conducted a review of early smart initiatives in several cities across the globe in an effort to understand what exactly a smart city is. As the idea has been embraced by several governments around the world, he has witnessed a transformation in how some cities manifest the smart cities concept. Cohen (2015) has realized that we have three distinct phases or generations of how cities have embraced technology. These are the 3 generations are presented within the two paths of smart cities (Mora et al., 2017):

- Path 1: Smart cities 1.0 and 2.0
  In this path, the studies related to smart cities have a corporate-vision. As example we can mention the studies that have been presented by Dirks and Keeling (2009) both researchers at IBM. The focus was almost exclusively on the singular role of ICTs in developing integrated platform of smart cities services. This same interpretation was supported by other studies such as Washburn et al. (2012) and Atzori et al. (2010). This path has been also presented in the two generations of smart cities presented by Cohen (2015):

  - Smart cities 1.0: In the first generation called "smart cities 1.0 (technology driven)", the smart city puts technology at the center of the "system of system" for managing growth and sustaining development. Technological companies were praising the potential of ICTs to transform cities into highly efficient, technologically driven heavens for innovators. The technology-centric vision of smart cities in this generation, certainly creates an environment that is appealing to urban technology innovators, who in turn have the potential to grow jobs and the economy. Smart cities 1.0 is characterized by technology providers encouraging the adoption of their

solutions to cities that were de-facto not equipped to properly understand the implications of the technology solutions or how they may impact citizen quality of life. It is also the underlying philosophy behind most of the bespoke smart cities projects proposed around the globe from PlanIT in Portugal to Songdo in South Korea. Thus, the future city vision has been driven by private sector technology companies. Townsend (2013) presents a thoughtful critique of smart city 1.0, arguing that tech-driven futuristic urban vision was missing out on the key dynamic of how cities interact with their citizens.

- Smart cities 2.0: The second generation of smart cities is called "smart city 2.0: technology-enabled", city-led city (Cohen, 2015). In this generation, the development of the city is led by itself, as opposed to technology providers. Thus, the city-led by forward-thinking city administrators take the lead in helping determine what the future of their city is and what the role is for the deployment of technology and innovation. In this generation, city administrators increasingly focus on technology solutions as enablers to improve quality of life. As examples of cities in this Rio in Brazil and Barcelona in Spain.

- Path 2: Smart cities 3.0
  In the second path the smart cities studies move the concept away from an excessively technological perspective, to more holistic and human-centric (Cohen, 2015). In this path, smart cities are not simply places with a high availability of ICTs, but they are composed of several dimensions including economy, people, governance, mobility, environment and living (Giffinger et al., 2007). This vision was also supported by Schaffers et al. (2011) and Hollands (2008) and it is presented by Cohen (2015) as the generation 3.0 of smart cities.

  - Smart cities 3.0: The third generation called "smart city 3.0: citizen-co-creation" where cities embrace citizen co-

creation models for helping to drive the next generation of smart cities. Thus, these cities have strong focus on citizen engagement to develop collaborative strategies. As examples of these cities we can mention Vienna in Austria, Vancouver in Canada and Medellin in Columbia.

In the latest generation of smart cities, the researchers focus on the use of ICTs with more focus on citizens in order to improve their quality of life. Unfortunately, in theses visions of smart cities, the concept of wellbeing and happiness of people was not included. As mentioned by Veenhoven (2001), the concept of quality of life is different from wellbeing and happiness. Thus, in this paper we present the fourth generation of smart cities which focus on the well-being and happiness of the citizens. This new generation is presented in the following section.

Smart cities 4.0: Smart, wellbeing and happiness oriented cities

The wellbeing and happiness of citizens should be central to any consideration of a city. Few smart cities across the globe have realized that. For example, the city of Dubai has recognized that emerging ICTs technologies are not sufficient to by themselves satisfy the multiple needs of their citizens and to make them happy. They realized that technology is not the end. Dubai wants to make sure that smart cities investments reflect the interests, aspiration, and happiness of its citizens. Another example is the smart city of Barcelona, as mentioned by its Chief Technology Officer and Digital Commissioner Francesca Bria who said her brief is "to rethink the smart city from the ground up, meaning to rethink technology, [focusing] on what it can do to serve the people, instead of a technology push agenda" (Tieman, 2019). Other cities do not rely on technology at all to be happy. For example, the city of Bogota preferred to invest in smart design and urban planning to develop smart cities around wellbeing and happiness (Montgomery, 2015) instead of concentrate efforts to deploy advanced technologies. Moreover, some nations like the Bhutan, which has the happiness in its DNA, has succeeded to make its citizens happy without neither technology nor urban

planning practices; it has used only wisdom, spirit, and culture to make this happen. In the following sub-section, we present all these successful cases.

a. Smart happy nation using lifestyle, culture, policies and regulations: The case of the Kingdom of Bhutan

"Smart" cities around the world aspire to maintain economic, social and environmental sustainability balance. They deploy smart innovations and technologies with the ultimate goal to make their people happy (social dimension), live great life with high quality (economy dimension), without hurting the environment (environment dimension). The best example showing that technology is just a tool and not an aim of smart happy city or nation, is the case of the Kingdom of Bhutan. The Kingdom has achieved the goal aspired by most of smart cities nowadays which is "making people happy, living great life and preserving the environment", without or with less-technology and innovation. It was accomplishment just with the right culture, via good and wise governance practices. Bhutan has three major goals called 3G's: wealth or Gross Domestic Product (GDP) to align with their middle-income aspiration, thus providing opportunities for employment; Greenhouse Gas emission (GHG) that are maintained at a carbon neutral level, which is beyond most national commitments; and Bhutan's renowned Gross National Happiness (GNH) index, which covers their socio-economic goals (see Figure 1).

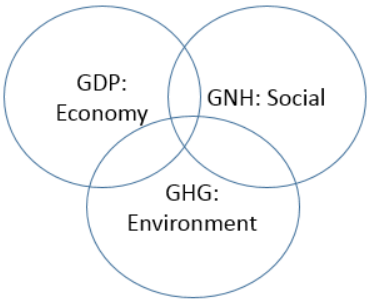


Figure 1. The 3G's – the three goals of Bhutan

The 3G's model elements are discussed as follow:

- Gross Domestic Product: the economy of Bhutan has undergone significant structural changes over the last decades. In other world, the contribution to GDP by the three major economic activities such as primary, secondary and tertiary sectors have changed significantly. For instance, the contribution of the primary sector (agriculture, forestry, and mining) to the stacking of GDP has decreased from 56% in 1980 to 16.5 in 2016 (Yangka et al., 2018). Conversely, the secondary sector which comprises the energy, construction, and manufacturing sectors, increased from 11% to 41%, while that of the tertiary sector remained constant to 33% (Yangka et al., 2018). These shifts in the structure of the economy show that Bhutan is gradually moving towards a market based modern economy from traditional agrarian and forestry-based economy. Moreover, over the last decades, Bhutan exhibited an average annual GDP growth rate of 7.6% that led to a steady increase in per capita GDP from US$834 in 2003 to US$2897 in 2016 (Yangka et al., 2018).
- Greenhouse Gas: Bhutan has a carbon-neutral strategy based on the declaration of the Royal Government of Bhutan. Moreover, Bhutan is the only carbon-zero nation on the planet and it used it forests as a sink for CO2. As early as 1974, Bhutan first instituted a minimum forest cover policy target of 60%, and this is now a statutory requirement enshrined in the Constitution of Bhutan. The latest National Forestry Inventory of Bhutan indicates a forest cover of 71% (Yangka et al., 2018).
- Gross National Happiness: The GNH was first discussed and adopted by the Fourth King of Bhutan in the 1970s, which is essentially a philosophy that measures the quality of a country in more holistic way [than GDP] and believes that the beneficial development of human society takes place when material and spiritual development occur side by side to complement and reinforce each other (Yangka et al., 2018).

Through its 3G's model, Bhutan has achieved the ultimate goal of smart cities. To prove that, we will present how the

"smart cities" model presented by Giffinger et al. (2007). Figure 2 is aligned with the 3G's model (see Table 1).

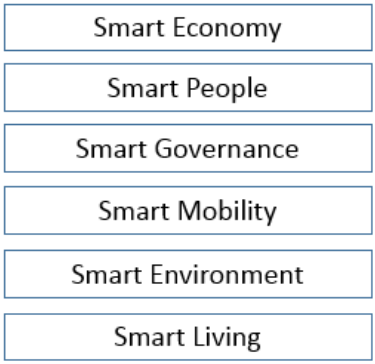


Figure 2. The Dimensions of smart cities (Giffinger et al., 2007)

Table 1. *Alignment between the 3G's model and the dimensions of smart cities*

Gross National Happiness (GNH) Index			Smart cities dimensions					
4 pillars	9 domains	33 indicators	Economy	People	Gover-nance	Mobility	Enviro-nment	Living
Preservation of culture	Psychological wellbeing	Life satisfaction		x				x
		Positive emotions		x				x
		Negative emotions		x				x
		Spirituality		x				x
	Time use	Work	x	x		x	x	x
		Sleep		x				x
	Community vitality	Donation (time and money)	x					x
		Safety	x	x				x

		Community relationship		x				x
		Family		x				x
	Cultural diversity and resilience	Zorig chusum skills (artistic skills)	x	x				x
		Cultural participation		x				x
		Speak native language		x				x
		Driglam Namzha (the way of harmony)		x				x
Conservation of environment	Ecological diversity and resilience	Responsibility towards environment	x		x	x	x	x

		Ecological issues	x		x	x	x	
		Wildlife damage	x		x		x	
		Urban issues	x		x		x	
Economic development	Living standards	Per capita income	x	x				x
		Assets	x	x				x
		Housing	x	x	x	x	x	x
	Health	Self-reported health		x				x
		Healthy days	x	x	x			x
		Disability	x	x	x			x
		Mental health	x	x	x			x
	Education	Knowledge	x	x	x			x
		Literacy	x	x	x			x

		Schooling	x	x	x			x
		Values		x	x			x
Good governance	Good governance	Fundamental rights		x	x			x
		Governance performance	x	x	x	x	x	x
		Political participation		x	x			
		Services	x	x	x	x	x	x
Gross Domestic Product (GDP)			x	x	x			x
Greenhouse Gas (GHG)			x	x	x	x	x	x

Bhutan has always been a smart country, by its people and not technology nor innovation. The Bhutanese people have extraordinary qualities which make them smart. These qualities, as mentioned by the King of Bhutan, are presented as follow:

- Sincere: People have integrity, no matter what they do, there is a degree of sincerity that is worthy of prize.
- Mindful: People are always mindful of their duties, responsibilities, obligations, and wellbeing – not just their own wellbeing but the wellbeing of everybody.
- Astute: People are very astute, and this is why they have built a country like Bhutan. They have worked with great ingenuity, perception, and wisdom. They have the intelligence and skills to be able to strengthen their country. They are clear minded and competent people.
- Resilient: People are well-tempered and strong, not afraid of suffering, not averse to hardship, ready to face problems and risks. Already the history shows how they have had the resilience to withstand the biggest challenges and threats.
- Timeless: People of Bhutan do not just live in the present but are aware of the future. They care, not only for this generation, but for different eras and generations to come. They understand that whatever they have has to be timeless. They realized that they are impermanent, that their children will inherit what they leave behind, and their country will be there for all times to come.

Bhutanese people always continue to nurture these wonderful qualities and remember every day, how they have defined them as a nation and as a people. They continuously remember that these qualities will help them navigate the 21st century and build an even better and happy place to live in. Also, the government always continue to build smart institutions, policies and regulations so that the people would remain smart. The Bhutanese government understood that the real wealth of the country is its human resources and everything should be built around people and their happiness.

b. Technology-free smart happy cities: Smart design and urban planning

Notably, while discussing the notion of a smart city, attention is usually driven to technologic subjects. However, a wider and more inclusive scope is worth considering. Whenever the concept accommodates a more democratic and comprehensive interpretation, smart strategies gain the capability to provide even less affluent cities with higher levels of wellbeing.

Smarter in that sense means a wiser use of resources. It is achieved due to the application of methods and techniques (including high technologies), for the broader benefit of all its stakeholders (Ghirarduzzi, 2019).

For Montgomery (2015) a truly smart city is one that responds to evidence from public health, behavioral psychology and other disciplines with smart design, urban planning, and system infrastructure. The basic fundamentals to achieve a comprehensive smart city experience are the planning procedures which lead to happiness (Montgomery, 2015). Technology should be considered a complementary part that takes advantage of the emerging ICTs and availability of data to enhance responsiveness which in turn must be reflected by a citizen-centered approach (Bin Bishr, 2018).

In terms of planning and design the attributes which contribute to the highest levels of urban experience are comprised by the theory of Walkable cities. Pedestrians have the fondest relation to urban environments (Montgomery, 2015).

Based on the review of over 200 studies, Talen and Koschinsky (2013) found that neighborhoods with higher levels of walkability are *healthier* as residents tend to engage more naturally to physical activities using walking as an active transportation modus. Walkable neighborhoods are also *wealthier* as property value increases and the local economy thrive. Also, more *social* interactions are more likely to occur as unplanned encounters are viable (Speck, 2010). The most commonly pointed drawback of walkable neighborhoods is that they cause displacement and distract the focus on more urgent subjects like affordable housing provision (Talen & Koschinsky, 2013).

One of the various and probably the widest accepted set of criteria for enabling active transport was coined by Ewing and Cervero (2010) as the 5Ds: Density, Diversity, Design, Destination access and Distance to transit.

Density, usually determined by the Floor Area Ratio (FAR), is calculated based on the sum of the gross area of all stores divided by the Plot area. It can also be measured using population density or, in some cases, job density combined with other factors. Higher densities are commonly considered beneficial to the livelihood of neighborhoods and to walkability as the use of spaces are intensified as they are shared by a larger number of users. Conversely, the results of a comprehensive study in 17 cities (Kerr et al., 2015) showed that the relation between perceived density and walking activities are described by a curve with the peak on medium density starting to decay towards high-density values (measured in that case in terms of population). On one hand, low-density dwellings constrain public activity and reduce the gatherings and pedestrian activity. On the other hand, extremely high densities enable a comprehensive transit network which is related to walkability but living in sky-scraper tend to disconnect to ground floor public life (Gehl, 2010) and reduce the happiness factor (Montgomery, 2013).

The Design attributes usually refers to in-travel studies focusing on street network characteristics but other design features also have a strong impact on travel behavior. Usually, the street network is determined by the road connectivity (the ratio of four-way intersections in the analyzed area) and intersection density. Further design measures usually referred to as crucial to support pedestrian activity are to reduce the number of setbacks or blank walls, to prefer more small shops than few bigger retails, higher on-street window density, small front yard gardens for privacy but not for isolation, etc. (Gehl, 2010; Speck, 2012). Design features as such cannot only contribute to pedestrianism but also to provoke contact and subsequently increase the trust in Neighbors and Neighborhoods essential to happy cities (Montgomery, 2013).

Diversity is often related to land-use mix but a social mix is also recognized as a key factor to keep neighborhoods alive with

higher entropy values indicating higher degrees of a mixture of functions represented in the area. More detailed studies sometimes refer to the Job-to-housing or Job-to-population ratios. Neighborhoods with diverse land-uses and social heterogeneity offer a wider variety of experiences and are therefore more likely to be active.

Ewing and Cervero (2010) found that the factors with the highest impact on walkability and transit use are design features such as smaller blocks and more street intersections, distance to stations and land-use mix. Newman et al. (2016) showed that pedestrian cities are denser and have a compact design whereas transit cities are middle density and more permeable to transport flow. This might, together with more detailed aspects, be a summary of the features necessary to plan a walkable happy city.

Notwithstanding the ways of planning one must consider a high level of citizens engagement to achieve happiness. Cities, as Portugali and Stolk (2016) stressed are complex structures depending on a Human-Artifact interaction. Those interactions create one of the most fundamental peculiarities of cities: the self-organization. It helps cities to evolve in a smooth way and to adapt to change. Centralized planning approaches which ignore that characteristic will potentially fail in providing citizens with their needs. As Jane Jacobs (1961) stressed: "cities have the capability to provide everybody with something, only because, and only when they are made by everybody."

Planning a happy city is to plan a human-centered environment; that means to provide with basic elements for an extended urban experience mainly comprised of walkable and transit-oriented approaches. Besides the method of planning a top-down act, will necessarily be community-based to allow it to respond to bottom-up manifestation. Otherwise a happy smart city, which provides its citizens with higher degrees of contentment and makes a smart usage of resources would not be viable.

In the specific case of Bhutan, a naturally conceived smart country, conserving and improving active transportation modes will help to preserve the 3G's goals consonant to the growth targets. A pedestrian-centered approach can combine economic development (Gross Domestic Product) based on a thriving

resilient local urban economy. Additionally, walking, cycling, and its complementary public transportation systems save more than one-third of emissions (Newman at al., 2016) enabling the green-house emission goals to be kept. Lastly, due to higher levels of social interaction, lively public spaces the ultimate goal of smart cities, Gross National Happiness, can be achieved overcoming challenges posed by growth.

c. Smart happy cities using technology and innovation: The case of Dubai City in the UAE

One of the smart cities which has leveraged emerging technologies for the wellbeing and happiness of its citizens is the city of Dubai in the UAE. Dubai's government opted for a strategy to focus efforts on transformation toward a world-class smart city, where technologies are seen as enablers toward the goal of happiness (Al-Azzawi, 2019). The primary step taken by Dubai in this endeavor is to deal with the definition of happiness. Thought at first this may seem challenging – trying to unpack various philosophical and psychological theories, some dating back to ancient philosophers – this may overcome by focusing on the well-established "well-being" literature and turning toward fulfilling the needs of city residents in such ways as to raise happiness (Al-Azzawi, 2019). Then, Dubai has used what is called the ABCDE model of needs that starts with subjective wellbeing (SWB). For more detail about this model please refer to Al-Azzawi (2019, p. 196). Dubai aims to increase the happiness of its citizens and residents by satisfying and facilitating these needs, thus creating more complete and holistic positive experience of the city. This is what is called the Happiness Agenda. The Happiness Agenda is composed of four portfolios: Discover, Change, Educate, and Measure. Each portfolio, in turn, is composed of programs that are focused on achieving the strategic objectives of the portfolio, with each program having a variety of specific projects to be executed. The ultimate goal of this Happiness Agenda is to make Dubai the happiest city on earth by embracing technology and innovation.

The proposed generation of smart happy cities (smart city 4.0) is completely aligned with Plato's assertion that the "City is what it is because our citizens are what they are". In this paper, we

have demonstrated that smart happy city can be achieved with or without technology.

Conclusion

As well mentioned by Wellington Webb, former Mayor of Denver and past President of the U.S Conference of Mayors: "The 19th century was a century of empires, the 20th century, a century of nation states. The 21st Century will be a century of cities". Cities are increasingly gaining attention, as they are a playground of opportunities but also a source for urban challenges. Currently, with the development of ICTs and emerging technologies of so-called "The fourth Industrial Revolution", the concept of smart cities is earning interest. Unfortunately, most of the research studies and projects related to smart cities focus on technology and miss the main objective which is to make people happy. In this paper, we proposed a new path aiming at making people happy. Thus, we have presented cases of cities and nations which succeeded to make themselves smart and their citizens happy relying or not on technologies. These cases demonstrate that technology is just a tool and not an aim in itself.

References

Al-Azzawi, A. (2019). Dubai happiness agenda: Engineering the happiest city on earth. In Samad W.A, Azar E. (Eds), *Smart Cities in the Gulf: Current state, opportunities and challenges* (pp.195-221) Chapter 11. Springer: Singapore.

Anthony Townsend, A. (2013). Smart cities: Big Data, Civic hackers, and the quest for a new utopia. W. W. Norton & Company.

Atzori, L., Iera, A., & Morabito, G. (2010) The Internet of Things: A Survey. *Computer Networks*, *54*(15), 2787–2805.

Batty, M. (2014). *The New Science of Cities*. Cambridge, MA: The MIT Press

Castells, M. (1996). *The Rise of the Network Society*. Oxford: Balckwell Publishing Ltd

Cohen, B. (2015). The 3 generations of smart cities. Retrieved from FastCompany.com:

https://www.fastcompany.com/3047795/the-3-generations-of-smart-cities

Dirks, S. & Keeling, M. (2009). *A Vision of Smarter Cities: How Cities Can Lead the Way into a Prosperous and Sustainable Future*. Somers, NY: IBM Corporation.

Durkheim, E. (1893). *The division of labor in society*. Simon and Schster.

Ewing, R. & Cervero, R., (2010). Travel and the Built Environment: A Meta-Analysis. *Journal of the American Planning Association 76*, 265–294.

Gehl, J. (2010). *Cities for people*. Washington, D.C.: Island Press.

Gibson, D.V., Kozmetsky, G., & Smilor, R.W. (1992). *The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks*. Lanham, MD: Rowman & Littlefield Publishers.

Giffinger, R., Ferter, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., & Meijers, E. (2007). *Smart Cities: Ranking of European Medium-sized Cities*. Vienna: Vienna University of Technology - Centre of Regional Science (SRF).

Graham, S. & Marvin, S. (1996). *Telecommunications and the City: Electronic Spaces, Urban Places*. New York City: Routledge.

Graham, S. & Marvin, S. (1999). Planning Cybercities: Integrating Telecommunications into Urban Planning. *Town Planning Review, 70*(1), 89–114

Graham, S. & Marvin, S. (2001). *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. New York City, NY: Routledge

Graham, S. & Marvin, S. (2004). Planning Cyber-cities? Integrating Telecommunications into Urban Planning. In S. Graham (Ed.), *The Cybercities Reader* (pp. 341–347). New York City, NY: Routledge.

Graham, S. (1997). Telecommunications and the Future of Cities: Debunking the Myths. *The International Journal of Urban Policy and Planning*, *14*(1), 21–29

Graham, S. (2000). Introduction: Cities and Infrastructure. *International Journal of Urban and Regional Research, 24*(1), 114-119.

Graham, S. (2001). Information Technologies and Reconfigurations of Urban Space. *International Journal of Urban and Regional Research, 25(*2), 405–410.

Graham, S. (2002). Bridging Urban Digital Divides? Urban Polarisation and Information and Communications Technologies (ICTs). *Urban Studies, 39*(1), 33–56

Graham, S., (2004a). *The Cybercities Reader*. New York City, NY: Routledge.

Graham, S. (2004b). Introduction: From Dreams of Transcendence to the Remediation of Urban Life. In S. Graham (Ed.), *The Cybercities Reader* (pp. 1–29) New York, USA: Routledge,

Hollands, R. G. (2008). Will the Real Smart City Please Stand Up?. *City: Analysis of Urban Trends, Culture, Theory, Policy, Action. 12*(3), 303–320.

Jacobs, J., (1961). *The Death and Life of Great American Cities*. New York: Penguin Random House.

Kerr, J., Emond, J.A., Badland, H., Reis, R., Sarmiento, O., et al., (2015). Perceived Neighborhood Environmental Attributes Associated with Walking and Cycling for Transport among Adult Residents of 17 Cities in 12 Countries: The IPEN Study. *Environmental Health Perspectives 124* (3).

Louis, W., (1938). Urbanism as a way of life. *American Journal of Sociology, 44*(1), 24

Mitchell, W.J. (1995). *The City of Bits: Space, Place, and the Infobahn*. Cambridge, MA: The MIT Press

Mitchell, W.J. (1999). *E-topia: Urban Life, Jim--but Not as We Know It*. Cambridge, MA: The MIT Press

Mitchell, W.J. (2003). *Me++: The Cyborg Self and the Networked City*. Cambridge, MA: The MIT Press

Montgomery, C., (2013). *Happy City: Transforming Our Lives Through Urban Design*. New York: Farrar, Straus and Giroux.

Mora, L., Bolici, R. & Deakin, M. (2017). The first two decades of smart-city research: A bibliometric analysis. *Journal of Urban Technology, 24*(1), 3-27

Newman, P., Kosonen, L., & Kenworthy, J., (2016). Theory of urban fabrics: planning the walking, transit/public transport

and automobile/motor car cities for reduced car dependency. *Town Planning Review, 87*, 429–458.

Okulicz, K., & Mazelis J. M. (2016). Urbanism and happiness: A test of Wirth's theory of urban life. Theory of Urban Life. *Urban Studies, 55*(2), 349-364

Peris-Ortiz, M., Bennett, D.R. & Pérez-Bustamante D. Y. (Eds.) (2017). *Sustainable smart cities: Creating spaces for technological, social and business development.* Series: Innovation, technology and knowledge management, Springer International publishing.

Portugali, J., Stolk, E. (Eds.), (2016). *Complexity, Cognition, Urban Planning and Design: Post-Proceedings of the 2nd Delft International Conference*. Springer Proceedings in Complexity. Springer International Publishing.

Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., & Oliveira, A. (2011). Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. In Domingue J., Galis A., Gavras A., Zahariadis T., Lambert D., Cleary F., Daras P., Krco S., Muller H., Li M., Schaffers H., Lotz V., Alvarez F., Stiller B., Karnouskos S., Avessta S., and Nillson M. (Eds.), *The Future Internet. Future Internet Assembly* (pp. 431–446). Berlin: Springer.

Speck, J. (2012). *Walkable City: How Downtown Can Save America, One Step at a Time*. Farrar, Straus and Giroux.

Talen, E. & Koschinsky, J., (2013). The Walkable Neighborhood: A Literature Review. *International Journal of Sustainable Land Use and Urban Planning, 1.*

Tieman, R. (2019). Barcelona: Smart city revolution in progress FT. Retrieved from https://www.ft.com/content/6d2fe2a8-722c-11e7-93ff-99f383b09ff9, 2019

UN (2007). *World Urbanization Prospects: The 2007 Revision*. New York: United Nations, Department of Economic and Social Affairs, Population Division.

Veenhoven, R. (2001). Quality-of-Life and Happiness: not quite the same. Retrieved from http://hdl.handle.net/1765/8753

Washburn, D., Usman, S., Balaouras, S., Dines, R.A., Hayes, N.M., & Nelson, L.E. (2012) *Helping CIOs Understand "Smart City" Initiatives*. Cambridge, MA: Forrester Research

Yangka, D., Newman, P., Rauland, V., & Devereux, P. (2018). Sustainability in an emerging Nation: The Bhutan Case Study. *Sustainability Journal, 10*(10), 1622.

7

Understanding Environment Impacts on People via Environmental Psychology: Three Basic Principles

Marino Bonaiuto

Abstract

Increasing evidence describes significant instances of urban environment impact on people. The field of environmental psychology aims to systematically study how the places people study, work, heal, and live in can exert crucial effects, by carefully detailing such consequences: from individual's cognition to her/his affect and behaviour. By briefly overviewing some of the main projects carried out or still ongoing at CIRPA, as well as examples from a broader literature, the aim is to show that when a specific urban place (whether workplace or school, hospital or residential neighbourhood, etc.) improves (vs impoverishes) a urban quality (whether natural, built, functional, social), specific positive (vs negative) consequences derive at various levels, by considering different target users too. The main option is survey, by means of questionnaire and multivariate analyses; in some cases, field or laboratory experiments test specific cause-effects relations. All the presented results demonstrate specific effects of urban planning and urbanization features on people well-being: sometimes these effects can be main and direct, some other times they can be mediated and moderated by other variables. A meaningful process and outcome framework for environment's features and person's features is proposed on the basis of three main principles characterizing the relevant scientific knowledge: 1) the structure of the environment-person effect - valence, generalizability, set (positive, general, simple vs. negative, relative, cumulative effects); 2) the process of the environment - person effect: direct and indirect (mediated) effects; 3) the timing of the environment-person effect - short and long-term exposure,

with immediate and chronic effects (spill-over and cross-systems). Some examples are offered to illustrate each case, across a range of different methods.

The global long-term trend towards urbanization and its effects

According to the UN, twelve years ago the amount of human population living within urban context surpassed the rest of human beings living in non-urban settings (in 2007, 3.35 *vs.* 3.33 billion, i.e., 50.16% *vs.* 49.84%; e.g., Ritchie & Roser, 2018). This is the result of a global and very long term historical process which started some tens of centuries ago and it has not decreased yet: it certainly went through some stagnation or even contraction periods sometimes somewhere (e.g., in Europe after the collapse of the Roman Empire, from 4th-6th century up to 9th-11th century about; and in the 14th century), but it accelerated in modern and contemporary society by reaching now a peak in present days globalization era: In the last two centuries, urban (vs. rural) population booms from 1% at the opening of the 19th century to 9.5% when the 20th century starts (according for example to Wikipedia, 2019), up to 30% in 1950 and present day 55% (UN, 2018) which of course is an average encompassing Countries specific features widely ranging from some minimum cases basically around 10% (excluding a very few tiny islands or atolls at 0%) up to several ones already at their 100% maximum (see also the CIA World Factbook with estimates from 2018).

Interestingly, while such an urbanization process started a few millenniums ago thanks to agriculture, in present time the percentage of urban population is inversely related to the percentage of employment in agriculture; while, at the same time, it is directly related to GDP per capita (e.g., Ritchie & Roser, 2018). This immediately and very simply illustrates that such a trend had been pervasive, both having affected the whole planet and having the power of exerting a really wide range of effects everywhere it happens. In fact, a wide range of positive and negative outcomes are associated to urbanization.

First of all, positive examples include a range of basic human needs satisfaction, such as (e.g., Ritchie & Roser, 2018, p. 28): "in nearly all countries electricity access is higher in urban areas than

in rural areas; access to improved sanitation is higher in urban areas; access to improved drinking water is higher in urban areas; access to clean fuels for cooking and heating is higher in urban areas; child malnutrition is lower in urban settings." Not to speak, of course, about cultural and social opportunities, from education to entertainment, as well as political and economic developments.

Secondly, urbanization benefits often are unevenly distributed, unfortunately: the UN (2018) stresses that, in order to ensures that "the benefits of urbanization are shared and that no one is left behind, policies to manage urban growth need to ensure access to infrastructure and social services for all, focusing on the needs of the urban poor and other vulnerable groups for housing, education, health care, decent work and a safe environment." This means that urbanization per se, therefore, is not a magic wand, as it requires certain conditions to be fully successful, as well as a proper design and management to optimize its effects on both the population and the environment.

Thirdly, urbanization deploys negative effects as well, at many different levels of the urban system. Negative effects include a wide range of individually and collectively undesirable threatening consequences for urban inhabitants (e.g., from stress to unsafety for the individual), for their places (e.g., from threats to heritage sites to disruption of local communities), and for the broader environment (e.g., from energy depletion to air, water, soil pollutions).

The possibility of such non-uniform positive or negative effects had been known since ever, as human beings were realizing the close interrelations among inhabitants and their urban environments, and therefore the need of taking care of urban planning and decisions by incorporating citizens' and users' point of view and needs (i.e., what is also currently called "social design" or "user-centred design"; e.g., Fornara & Campos Andrade, 2012). A few historical examples may help to illustrate this point.

A few examples for a brief historical excursus of social, user-centred design

Well before contemporary modern evidence, many historical examples testify that the urban environment was highly regarded for its effects on the inhabitants' experience; and that therefore the relevant decisions should take inhabitants into due consideration. Let's here just mention a couple of examples taken from the European history.

In ancient classical Greece, the temples' columns profile was not straight (e.g., in the Parthenon temple on the Acropolis of Athens): it was rather designed in order to optimize their perceptual image from the point of view of the citizens as they were approaching the temple. In fact each column profile was slightly curvilinear, convex, in its bottom part.

"The ideal of proportion that was used by ancient Greek architects in designing temples was not a simple mathematical progression using a square module. The math involved a more complex geometrical progression, the so-called Golden mean. The ratio is similar to that of the growth patterns of many spiral forms that occur in nature such as rams' horns, nautilus shells, fern fronds, and vine tendrils and which were a source of decorative motifs employed by ancient Greek architects as particularly in evidence in the volutes of capitals of the Ionic and Corinthian Orders.

The ancient Greek architects took a philosophic approach to the rules and proportions. The determining factor in the mathematics of any notable work of architecture was its ultimate appearance. The architects calculated for perspective, for the optical illusions that make edges of objects appear concave and for the fact that columns that are viewed against the sky look different from those adjacent that are viewed against a shadowed wall. Because of these factors, the architects adjusted the plans so that the major lines of any significant building are rarely straight. The most obvious adjustment is to the profile of columns, which narrow from base to top. However, the narrowing is not regular, but gently curved so that each columns appears to have a slight swelling, called entasis below the middle. The entasis is never sufficiently pronounced as to make

the swelling wider than the base; it is controlled by a slight reduction in the rate of decrease of diameter" (Fletcher, 1905, pp. 93-97 ca.).

Moving from the perceptual-cognitive to the social-political level, in Medieval and Renaissance Italy, artists, architects, and governors were striving towards the ideal city representation, also by means of comparing the prototypical features of the well-governed city *vs.* the ill-governed one. Specifically, for example, a series of frescoes entitled "L'Allegoria ed Effetti del Buono e del Cattivo Governo" ("Allegory and effects of good and bad government") by Ambrogio Lorenzetti at the Palazzo Pubblico in Siena (Italy, approx. A.D. 1337-1340) clearly links the way urban environment and community are managed with outcomes on both the urban and peri-urban environment. They were produced in order to inspire the work of the urban governors who were meeting in that room (the frescoes depict four scenes around a large rectangular room, the Sala del Consiglio dei Nove, o della Pace, in Siena). Notably the "Allegoria del Buon Governo" (Allegory of the Good Government) depicts on the main central wall a virtuous political management, then on the right wall the "Effetti del Buon Governo" (Effects of the Good Government) has two parts: one depcits its positive effects on the urban environment (at the architectural and urban-planning level, at the social-cultural level, at the economics level, and more broadly on the inhabitants' lifestyle and wellbeing) and the other one the positive effects on the countryside (again at various levels). On the right wall, the "Allegoria del Mal Governo" (Allegory of the Bad Government) is depticed with the "Effetti del Mal Governo" (Effects of the Bad Government) showing the negative effects on both the same urban and rural environments again at various different levels (space, economics, social-cultural activities, health and wellbeing, etc.). Moreover, interestingly, urban and rural places where always linked in their destiny, as part of a same social-cultural eco-system.

Urbanization gets its acceleration by the Industrial Revolution between the 18th and 19th century. This somehow facilitates the awareness for the delicate balance existing between the urban environment and its inhabitants. Under the influx of Enlightenment's and Socialism's ideas, some

entrepreneurs clearly understand that the urban living conditions of the inhabitants working in the factories are a crucial factor for their health and wellbeing and therefore for their workforce role within the enterprise. Some pilot experiences create therefore utopian communities based on the improvement of urban environment quality in order to capitalize on its impact on the inhabitants. For example, in UK, the entrepreneur Robert Owen improves a range of environmental features (physical, social, educational, financial) within the community of the workers and their family, at New Lanark (Glasgow, Scotland, early 19th century). A more advanced approach along the same venue happens in Italy one century later, in the first half of the 20th century, where the entrepreneur Adriano Olivetti, supported by an interdisciplinary teamwork approach, considers the urban environment his workers and their families are living in, also by taking care of their perspectives and needs and by integrating these within the general managerial perspective of the enterprise. This brings to the improvement of various relevant features of their places (both at work and outside the workplace, with regard again for many different issues such as spaces quality, social-cultural activities, etc.).

Towards a systematic approach for people-place transactions: Environmental psychology

Both positive and negative effects of the urban environment on people are currently well-documented, as well as their uneven distributions over different population groups and areas. Modern science and technology greatly help in identifying and carefully describe and predict urban environment effects on human beings. However, their core added value probably lies more in helping to elaborate explanations about why such effects happen. In other words, the fact that the urban environment can be a crucial determinant of inhabitants' health, wellbeing, and other relevant parameters, has been somehow known for centuries (as the historical examples briefly reported above can illustrate). What rather starts now to be accessible is a more detailed knowledge about the mechanisms behind such effects, that is, the "why and how" behind the "what" happens to the

person within the urban environment. Approximately from the second half of the 20th century – thanks to social sciences and interdisciplinary scientific efforts too – the existing awareness that urban inhabitants' fortunes and mis-fortunes can depend from their urban living places (residences, schools, workplaces, health cares, etc.) had been enriched by the identification of some possible mechanisms and processes governing such effects. A pivotal role had been played by the awareness that a scientific approach can be used to know the inhabitants' experiences of their urban places and this grants an access to the person's perception and cognitive evaluation of the urban environment, her/his affective reactions to it, her/his decisions and actions towards it. Such a level of analysis can thus scientifically inform both the design, the management, and the policies regarding the urban environment. An Evidence-Based Design (EBD) – as well as an Evidence-Based Management (EBM) and Evidence-Based Policy (EBP) – is thus possible, and desirable, with the aim of improving the urban environment design, management, and policy by considering a certain place users' and citizens' characteristics. As stated by Becker, Bonaiuto, Bilotta and Bonnes (2011, p. 115) "EBD has been defined as "a deliberate attempt to base design decisions on the best available research findings" (Hamilton, 2003, p. 19).".

Of course, social and life sciences play a crucial role in this endeavour, as they are devoted to study the person in her/his own individual and collective forms of life. Within them, psychology has a special role granted by the fact that it targets the person's behaviour in both its individual and small collective forms (social psychology). Moreover, psychology since its foundation as a modern science is a behavioural science, it namely targets the person's behaviour as the scientific object of its study. This means that it focuses on describing the person's behaviour by also addressing all the possible factors influencing it, in order to develop an understanding of it based on its explicative models. Human behaviour had been traditionally considered, within modern psychology, as the result of two major group of possible factors: personal ones, and contextual or environmental ones. This had been traditionally expressed by the lewinian well-known equation (Lewin, 1936).

$B = f(P, E)$

where Behaviour is a function of both the Person (i.e., personal factors) and the Environment (i.e., environmental, contextual factors), namely, of all the factors acting together within the psychological field at any given moment for that person (the so called, "life space"). It is therefore a basic social-psychological tenet that the environment can be a crucial determinant of human behaviour, although this may depend by its interplay with personal factors too.

A few decades later, this general concept had been expanded within a broader systemic view to include several layers of the context the individual is embedded in. Bronfenbrenner's (1979) ecological approach in fact argued that the relevant environment for a person is actually a complex system of different layers of settings, distinguishing among four different but interrelated systems: the microsystem, the mesosystem, the exosystem, and the macrosystem. This can apply to any kind of urban place, such as, the residential environment (e.g., Bonaiuto, Bonnes, & Continisio, 2004) or the hospital environment (Becker, Bonaiuto, Bilotta & Bonnes, 2011). As Becker et al. (2011) summarize, the microsystem includes the person immediate social and physical environment (e.g., family, peers, or coworkers). The mesosystem refers to different microsystems interconnections and their reciprocal influences (e.g., one's coworkers and workplace influence, and are influenced by, related microsystems such as the non-work domestic and friendship milieu). The exosystem captures organizations and social systems with which individuals may or may not have formal contact, but which are still part of and influence their actions and lives (e.g., the legal system and the laws and regulations that influence human behaviour). Finally, the macrosystem are all societal norms, expectations, and beliefs of the larger social environment in which the other systems operate (e.g., beliefs about the proper role of the federal government in the provision of healthcare, in case of the hospital environment).

Within a bronfenbrennerian perspective, therefore, the relationships among these interdependent, loosely coupled systems should be studied, over and above simple hypothesis

testing. This is easier to say than to do, but it is not an impossible endeavour (an empirical example is quoted later below, within this contribution): most of the times, it is more a conceptual rather than a practical barrier to prevent the use of a systemic approach in studying people-environment transactions.

The whole scientific psychology as a discipline entails the focus on the effects of environmental factors, among other ones, on human behaviour (though sometimes privileging in an unbalanced way the person term in the equation, or the environment one on some other occasions). In some cases, also, the environment term is considered within very different time frames with respect to the person term: from a mere synchronic occurrence to a diachronic lag which can span from milliseconds or seconds, up to a Time1 - Time2 delta equal to minutes, hours, days, weeks, months, years. Although the interest for the immediate or distal environment's effects on the person regards the whole psychological enterprise – across all its areas and paradigms in different forms (e.g., from Brunswick to Gibson, from Lewin to Barker, from Freud to Bronfenbrenner) – a specific psychological branch specifically devoted to such endeavour exists now. From the second half of the 20th century, environmental psychology explicitly and specifically focused on the study of people-environments relations and transactions (Stokols & Altman, 1987), by considering the various both physical and social features of the environment (e.g., Clayton, 2012; Gifford, 2014). This started originally mainly as an interest in the environment effects on the person – namely, establishing the role of the environment as a factor affecting human cognition, affection, and action – and subsequently included an equally important attention for the effects the person exerts over the environment too (with the rise of the sustainability issues linked to human behavioural choices impacting the environment; Bonnes & Bonaiuto, 2002). These two main broad areas of interests can of course be bridged together, within more complex paradigms where their reciprocal relations may be evidenced (e.g., Corral-Verdugo, 2012); or where different temporal dimensions as well as spatial and social dimensions can be taken into account within more complex systemic view, such as in the approach advocated by Bronfenbrenner (1979).

One important tenet in environmental psychology is the distinction between "environment" and "place", within the theory of place. While the concept of environment refer to the mere physical features of a setting, the concept of place includes such physical features as well as their evaluations from the point of view of the person, and the activates carried out in such environment by the person (e.g., Bonnes & Secchiaroli, 1992). Therefore, a person psychologically appropriates an environment by transforming it into a place, that is, by establishing a relation with such environment on the basis of certain activities and by developing cognitions about it and affective reactions to it. These processes are then connected to further important developments in terms of environmental psychology, such as the attachment the person may develop with one place or more places, and the place identity/identities she/he may develop on the basis of specific place(s) at various possible geographical scales. Place attachment refers to the bond the person develops with the location, which carries cognitive, affective, and conative components and implications. Place identity refers to the degree the location contributes to define the person: who the person thinks s/he is, how the person describes her/himself, how s/he would act towards the location under different circumstances, etc.

Of course, both place attachment and place identity are complex deep psychological developments which probably, most of the times, requires time and complex or special experiences to mature (e.g., Bonaiuto et al., 2016). Once developed, they can significantly affect human behaviour, by functioning as a part of her/his personal features. But it should be remembered that they are actually rooted in the environment, being the precipitates of previous person – environment interactions. Place attachment and place identity therefore well exemplify the fact that what at present time appears as a feature of the person, in the past it had been a feature springing from the interaction between the person and some environmental features (namely, a place): they now crystallize as a person's features referring to her/his own places, but they formerly emerged as properties of the encounter among a certain environment's features which may have or have not fitted a person's needs or

characteristics (e.g., Bonaiuto & Alves, 2012). In other words, today's person partly precipitates from the environment s/he experienced in the past; or, if this is perspectivally considered, the environment the person encounters today is already equally preparing that future person as well as that person's future. Of course, degrees of freedom can be provided in such a mechanism, provided the *hic et nunc* of present environmental features is considered, at any given moment: at that given moment, the present environmental features may either synergize or contrast with those past environmental features which can be appreciated solely in the way they sedimented in that person up to that given moment.

For the purposes of the present contribution, the focus here goes now more towards the environment's effects on the person, rather than on the other way around. But some of the examples offered below bring into the picture the person's impact on the environment too. The examples are not necessarily new, but they are organized within a framework which is specifically proposed for the present contribution: The present contribution yearns in fact to formalize three minimum basic principles summarizing any person – environment (or place) relation, at an environmental and psychology level of analysis.

Three basic principles in environment-person transactions

The 1st Principle is about the structure: valence, generalizability, set (positive, general, simple vs. negative, relative, cumulative effects)

The effects the environment can exert on people are different first of all in terms of their structure, which may be given by at least three parameters: valence, generalizability, set. First, the valence holds with respect to a number of individually and socially desirable more or less universal outcomes, such as a person's health, wellbeing, satisfaction, happiness, physical or intellectual development and performance, social relations, etc. Second, the positive or negative outcome of a certain environmental effect on a specific person can be general (i.e., constant and independent from other variables determining cultural, individual or other kinds of differences) or relative (i.e.,

moderated by such other variables): this means that the effect can either be more or less universal, or rather relative being bounded to certain conditions. Thirdly, such an effect can be a simple one, i.e., one single environmental feature positively or negatively affect certain outcome(s) in the person (either in general or for some of them or under certain conditions). Otherwise such an effect can be a composite or cumulative one, i.e., a constellation of environmental features positively or negatively affects certain outcome(s) in the person (again, either in general or for some of them or under certain conditions).

A couple of examples from the literature, both general and within CIRPA projects, can be briefly mentioned here just to illustrate the two above mentioned categories of environmental effects.

One of the classical problems with urbanization is the integration *vs.* segregation of nature within the city (urban green areas and urban nature). Present day hot topics such as urban "green infrastructures" are the reaction to such a traditional burden (see for example the renowned "Bosco Verticale", two buildings designed by Boeri Studio and realized in Milan, Italy, between 2009-2014, now spreading all over the world by means of many similar applications). It is well known that urbanization has traditionally been inversely related to natural spaces, and this is a problem since several evidences showed a direct relation between natural areas and human health and well-being within urban areas (for a very recent epidemiological large scale evidence, see Engemann, Pedersen, Argef, Tsirogiannisf, Mortensen, & Svenning, 2019). What epitomizes the positive single effect of the environment on the person is precisely this well-known effect of natural environments restoring human beings' psychological functions, primarily by specifically allowing stress reduction and cognitive restoration, but also more generally by prompting "positive affect, life satisfaction, happiness, feelings of vitality, and a sense of meaning and purpose in life" (e.g., Venhoeven, et al., 2018, p. 89). To put it simply, the passive or active experience of (i.e., viewing at or acting in) nature exerts physical and psychological positive effects. This is typically resulting from green areas (i.e., vegetation elements) but also from blue ones (i.e., water flows or

surfaces). Effects can be observed at many different levels, both social-psychologically and physiologically.

One classical research example is Ulrich's (1984) seminal study on hospital patients during their post-surgery recovery: visual on green (*vs.* built) area promotes both psychological wellbeing (measured in both self-report and other-report and manifest behaviour), and physical health (across different medical indicators such as required drugs dose and length of hospitalization). The implication is pretty straightforward: offering a simple window view over natural vegetation elements (*vs.* a bricks wall) helps to heal the patient in a quicker time, with less drugs, and more collaboration from the patient; this in turn necessarily means to save hospital money and to improve both patients' and staff's human and social experience during the recovery time.

A recent CIRPA research example is offered by Amicone, Petruccelli, De Dominicis, Gherardini, Costantino, Perucchini, and Bonaiuto (2018). Two studies shows the powerful effects of spending the school break during a primary class day (either in the morning or in the afternoon for 4th and 5th grade pupils) in a green area (*vs.* a built one). Here two main kinds of measurements were taken: a self-report scale, measuring the pupil perceived restorativeness by means of a standard questionnaire; and several standard cognitive performance tests measuring different attention components. Results show that 9-10 years old school pupils spending their daily recess time in a green (*vs.* a built) area not only describe themselves as psychologically more restored just afterwards, they also perform significantly better in the sustained and selective attention test, as well as in the working memory test. Given that this is a general, non-moderated (i.e., irrespective of age, gender, hour of the day, recess type sequence) effect, such a result has both design and managerial pretty clear and coordinated implications: it requires that school yards are designed with green areas, and it also requires that schools manage to let pupils spending recess time outdoor in such green areas. When this is the case, the environment facilitates the pupils' psychological condition, particularly in terms of cognitive recovering, thus putting them back in that proper cognitive functioning mode

required to cope with the subsequent (either in the second morning session or in the afternoon session) educational efforts, which are necessary to them for learning more and therefore for better pursuing their educational and intellectual development.

To offer an example of a negative and at the same time also composite effect, it is useful to turn to another big burden of contemporary urbanization: urban safety and security. The issue is far too complex, entailing many different factors and levels of analysis to be fully addressed here, therefore the focus is drawn on a facet which acquired growing relevance, namely the perception of urban safety and security and the related experience of urban well-being. Traditionally, the research focus has always been put on each feature – whether spatial or social (environmental factors and community factors, Gifford, 2014) – in order to weight it as a potential single risk factor capable to induce a negative effect on urban safety and security perception. By adopting a typical developmental psychology model, characterized by a systemic approach, a different stance implies to consider as a crucial factor not so much some intrinsic characteristic of a single feature which renders it a risk factor in terms of safety ad secutity, but rather the fact that more features, each one bearing its own risk potential, can be present together in a place: they therefore can cumulate their single effects on the person experiencing that place. This is called the Cumulative Risk Model (CRM): while no single risk factor by itself increases risk for a negative outcome, the presence of an increasing number of risk factors contribute to a correspondent increase in the negative outcome (Rutter, 1979). The effect of multiple risk factors is thus cumulative: as the number of risk factors experienced by an individual person rises, the likelihood of negative outcomes increases too (Evans, 2003, 2004). Since cities are multi-place complex environments (Bonnes & Secchiaroli, 1992) and the perception of urban security is influenced by a large series of factors, the CRM looks like an appropriate framework to study insecurity perception and well-being in the urban context.

In a CIRPA contribution (Bilotta, Ariccio, Leone, & Bonaiuto, 2019), such a CRM model had been applied to study urban perceived safety and security and well-being for the first time.

Rome inhabitants had been sampled from three different neighburhoods (pre-selected in order to represent neighbourhoods located at the lowest, intermediate and highest ranking in terms of perceived urban safety and security on the basis of a pilot study). Then, measures had been gathered regarding both the type and amount of single risk factors (spatial, social, etc.) perceived in the neighbourhood, on the one side (predictors), and the person's evaluation of her/his insecurity/fear of crime as well as her/his rate of one's own well-being/life satisfaction, on the other side (criteria). Two studies had been carried out in order to test the CRM on perceptions of insecurity/fear of crime and wellbeing/life satisfaction by means of two techniques: i.e., either just one sample or two independent samples for respectively measuring predictors and criteria. With both techniques, the result is stable and straightforward: there is a linear proportional relation between the number of (either subjectively or consensually) perceived risk factors in the neighbourhood and the perception of insecurity and fear of crime, as well as a linear inverse relation between the number of (either subjectively or consensually) perceived risk factors in the neighbourhood and the perception of well-being and life satisfaction. This double linear trend shows how the inhabitants can cope with the threat represented by a few risk factors in their own neighbourhood (up to 3 or 4), while they end up with a mostly negative outcome when the risk factors cumulate over and above a certain amount (from 4 or 5 onwards).

This seems consistent with the complexity and dynamic nature of the urban context, where, in the real life, it is unlikely to be confronted with one and only specific risk at a time or with a specific combination of risks, while it is more common to face a changing, unstable and dynamic number of risks of different seriousness and nature, within diverse urban contexts, in line with broader contemporary VUCA (Volatility, Uncertainty, Complexity, Ambiguity) scenarios.

Of course, within a Positive Psychology framework, such an environmental effect model can also be conceived in terms of positive valence, by assuming the cumulative virtuous effect of several environmental benefits added together (thus, a

Cumulative Benefit Model, CBM; see Becker et al., 2011). Further ongoing developments at CIRPA are in fact experimentally testing, within a laboratory setting, whether the careful manipulation of a mix of both negative and positive factors (imposed upon a neutral urban landscape serving as a framework) is capable of altering human beings automatic reactions (as measured by physiological parameters). Preliminary results show that as the ratio of benefit/risk factors increases, so do both emotional reaction and cognitive processing as measured respectively by Hart Rate and Galvanic Skin Response ratio (HR/GSR), and by estimating pleasantness from an Approach/Avoidance index via EEG (e.g., Piccinin, 2018). This kind of results speaks thus in favour of the fact that people immediately and automatically, within milliseconds, react to urban features in a negative or positive way, and that it is possible to quantify changes in urban landscapes in order to assess their impact on users and subsequently to understand which urban design and management choices could maximize urban features' positive impact on the inhabitants wellbeing.

The 2nd Principle is about the process: direct and indirect (mediated) effects

The effects the environment exerts on people differ in terms of the mechanism too, that is, according to the process by which an environmental feature succeeds in changing, positively or negatively, a person's feature. This link between a predictor and a criterion can be either direct or indirect: when direct, the mere exposure to the environment changes the person, under certain respects; when indirect, the environmental feature triggers a process involving more than one consequence, namely a chain of variables ordered in a (supposedly) causal sequence. Of course, in both cases it is possible to have either general effects, or rather effects which are conditional upon other factors (either of the environment or of the person), as argued in the previous paragraph when discussing the general vs. moderated effect. The issue of mediated effect is crucial not only from a merely scientific point of view, but also in terms of the applied implications of the scientific knowledge. In fact, knowing in greater detail the process by which a certain environmental

feature, or set of features, exerts a certain effect on a person characteristic, allows not only a better understanding of the causal links, but it also helps in planning possible interventions to transform such a knowledge into a practice, i.e., in creating Evidence-Based Design (or Management, or Policy). This is due to the fact that, by knowing via which other factors an environmental feature is capable to exert its effect on people, alternative ways for targeting the same final outcome can then be devised, if needed (e.g., for ethical, costs, time, pragmatic, or other kinds of reasons).

Obviously, a direct effect makes life easier, from the point of view of both the scientist, the designer, the manager, the politician. But this is not the norm, especially when dealing with urban environment and urbanization related phenomena. In principle, from a strictly scientific point of view, almost any direct effect can be decomposed into some kind of mediation, and direct effects are probably just a disciplinary theoretical simplification model imposed over much more complex real-life causal processes. However, at least within a more pragmatic approach (whether in designing, or in managing, or in creating policy for the urban environment), at a certain point such a potentially infinite regress towards scientific reduction can be suspended for the sake of deriving applied guidelines which are somehow useful for improving the urban environment (whether in terms of design, management, or policy-making).

Again, a couple of examples from the literature, both from the general one and within CIRPA projects, can be briefly reviewed here just to illustrate both direct and indirect environmental effects on the person.

A general example can be interestingly drawn from animal research, where of course environmental effects on the organism happens too (as abundantly stressed, for example, within several disciplines, such as from evolutionary biology, to ethology, to animal psychology). The reason for focusing on such an example is threefold. In general terms, it highlights that such processes are pervasive and pertains all living forms. Moreover, it offers conclusions at a higher degree of internal validity, since in animal studies the level of control for any other possible intervening variable is of course much higher than in human

studies, for both ethical and pragmatic reasons. Finally, and in more specific terms for the issue at hand, it shows how a reductionist approach can help to shed light over mechanisms which otherwise would remain obscure; and, at the same time, it does not mean to give up the comprehension of a complex system. Quite the contrary, deepening and detailing the mediation process at play can perfectly help in developing a systemic understanding about how the living environment can create conditions which favour a virtuous process for a more positive growth of the organism. In short, it helps our understanding of environment – person effects and transactions.

Maffei and collaborators used the paradigm of the so-called "enriched" vs. "standard" environments in order to study the effects of a better environmental quality (both in physical and social terms) on the organism's performance: for this purpose they tested laboratory mice, by keeping constant any other possible variable at both environmental and individual levels (e.g., Cancedda et al., 2004; Sale et al., 2004). Within such a paradigm the environment is manipulated by essentially comparing the mice's standard living environment – i.e., a laboratory Standard Cage (SC), providing all the necessary items for surviving) – with an improved cage – i.e., an Enriched Cage (EC), offering a more stimulating environment from both physical (exercising), intellectual (novelty exploration), and social point of view (appropriate crowding). In terms of the 1st principle above, it can therefore be described as a positive valence environmental effect due to a co-varying set or constellation of environmental features. The main measured outcome is the post-natal visual performance of mice pups in terms of two main criteria: Eye-opening observations after a few days from birth, and behavioral assessment of visual acuity in 12 months-old mice reared in EC or SC from birth.

As the Authors synthesize (Sale, et al, 2004, p. 649) "we examined Brain Derived Neurotrophic Factor (BDNF) levels in the visual cortex during development and showed that an increase occurs in the first week of life in enriched pups compared to standard reared pups; BDNF levels at birth were equal in the two groups. This suggests a postnatal rather than a prenatal effect of environment on BDNF. A detailed analysis of

maternal care behavior showed that pups raised in a condition of social and physical enrichment experienced higher levels of licking behavior and physical contact compared to standard reared pups and that enhanced levels of licking were also provided to pups in an enriched environment where no adult females other than the mother were present. Thus, different levels of maternal care in different environmental conditions could act as indirect mediator for the earliest effects of enrichment on visual system development. Some of the effects of different levels of maternal care on the offspring behavior are long lasting. We measured the visual acuity of differentially reared mice at the end of the period of visual acuity development (postnatal day 45) and at 12 months of age, using a behavioral discrimination task. We found better learning abilities and higher visual acuity in enriched compared to standard reared mice at both ages."

Elsewhere, they conclude that "Thus, rearing mice from birth in an enriched environment leads to a conspicuous acceleration of visual system development as ascertained at behavioral, electrophysiological, and molecular level." (Cancedda, et al., 2004, p. 4840).

Such results – obtained under extremely controlled experimental conditions and with the support of different kinds of measurement – speak in favour of strong and clear environmental effects on the single organism. These effects, however, are far from being direct: they are realized via a long mediation chain where the social group living within the same environment plays a crucial role and where the mediation and final effects involve a complex systemic interplay that goes across different levels: from the initial environmental enriched physical and social conditions, to the social behaviour of the other organisms towards the target organism living together, to the electrophysiological and molecular levels changes in the target organism, and finally to an improved visual performance in the target organism which later translate into a better learning performance. This process therefore let us understand that environmental changes (hopefully ameliorations) and corresponding changes in the individual (hopefully

improvements in some socially desirable criterion) are possible via specific processes involving a chain of mediations.

Cause-effect relations can therefore be established on the basis of the specific individual experience of the living environment, according to an open system logic. A couple of implications can be derived from this.

First, environmental psychology looks for this kind of evidence to understand why environmental features affect a person's feature. However, it happens that sometimes, environmental psychology conclusions overlap with those derived from other approaches. For example, the importance of green natural areas for human wellbeing is advocated for by different approaches too, such as Feng-Shui; but the explaining mediation mechanism can be totally different, by appealing to completely different epistemological logics, as in detail argued in Bonaiuto, Bilotta and Stolfa (2010). Of course, by assuming different explanation mechanisms, some of the practical implications could also be different if they target the mediation variables too. Therefore, these issues are not simply scientifically relevant, as they can change design, management and policy-making implication details too.

Secondly, human studies about the detrimental effects of poor urban everyday living conditions (e.g., in residential and school environments) on the individual development (e.g., at both cognitive, affective, and social level) show how they are mediated by psychological and physiological stress mechanism patterns (e.g. Evans, 2004, 2006). These conclusions, often achieved via correlational evidences, are therefore strengthened by parallel experimental evidences on animals. Moreover, by understanding relevant mediators, they open the avenue for elaborating alternative mitigating strategies, which could be used to act on the mediators whenever the main solutions are not viable because for example it is not possible to directly immediately address the environmental features which are at the origin of the effect.

A CIRPA example can be offered to illustrate how this second principle, regarding mediational effects, can also be conditioned by further factors which therefore can moderate the main mediated effect. Focusing on hospital environment, an important

feature of any urban environment, Andrade, Lima, Pereira, Fornara and Bonaiuto (2013) studied the effect of objective hospital environmental features on patients' satisfaction, considering the mediation of subjective perception of those environmental features. Results showed that indeed the hospital objective environmental quality affects patients' satisfaction through the mediation of their perceptions of those environmental qualities. However, patients' status moderates this relationship. In fact, "for inpatients, it is the perception of quality of the social environment that mediates the relationship between objective environmental quality and satisfaction, whereas for outpatients it is the perception of quality of the physical environment." (Andrade et al. 2013, p. 122). Therefore, a humanized, patient-centered, and high-quality design hospital is capable of improving patients' experiences in a delicate situation where their vulnerability is at stake. However, the specific experience the patient is doing, according to her/his clinical status, changes the weight s/he poses on different features of the same hospital: inpatients and outpatients therefore, by means of their specific place experiences, psychologically create two different environment-person fits in order to achieve the same outcome (place satisfaction) within the very same healing environment (one hospital). This means that the hospital needs to incorporate a range of different features (physical, social) so that by means of different personal experiences it may take into account different users' needs. This also very well exemplifies how the very same physical environment gets psychologically transformed into two different places by means of the way it is experienced, and appropriated, by each one of the two different categories of target users considered: it is therefore by the experiential encounter between a person and an environment that the place is differentially created on the basis of a specific fit between environment features (e.g., resources), on the one side, and person features (e.g., needs), on the other side. Such a broader idea had already been argued by Mead (1934, p. 131), discussing the socially constructed nature of reality and stressing how the specific encounter between a specific organism with a specific feature of the environment creates a certain reality which acquire meaning

and function only as a result of an organism-environment interaction. Gibson's (1979) affordance concept is on the same argumentative line too (see also the residential environment-person fit discussion in Bonaiuto & Alves, 2012).

Another line of research at CIRPA focused, with a wide range of contributions, on the Perceived Residential Environmental Quality Indicators (PREQIs), which can be used to measure how inhabitants perceive their own urban residential neighbourhood. They provide a standard tool with 19 indicators to cover all main features characterizing a urban neighbourhood from the point of view of its inhabitants (e.g., Bonaiuto, Alves, 2012; Bonaiuto, Fornara, 2017). Some contributions showed how they mediate in various way, in the inhabitant's urban experience, important urban wellbeing outcomes, such as the inhabitants' perception of urban residential satisfaction and their urban residential neighbourhood attachment (e.g., Bonaiuto, Aiello, Perugini, Bonnes, & Ercolani, 1999; Fornara et al., 2018)

The 3rd Principle is about the timing: short and long-term exposure, with immediate and chronic effects (spill-over and cross-systems)

A third way according to which environment's effects on people can differ is in terms of the temporal lag between the environmental exposure experience and the consequent effect on the person: the second one, relatively to the first one, can be delayed by a few milliseconds and seconds, or minutes, hours, days, weeks, months, years. This can also be related to the short or long-lasting human exposure to the environmental features: the person can experience the environmental feature for a very short time or s/he can experience it for a very long time (short- vs. long-term exposure). Probably three cases are possible: a short-time exposure having either immediate effects (case #1) or long-term effects (case #2); otherwise, a long-term exposure having long-term chronic effects, due to the temporal cumulative exposure (case #3). When a time delay exists, the case possibly subsists for what can be called as either a spill-over or a cross-systems effect.

In the first instance, the effect can happen in a different situation, or behavioural domain, from the one interested by the initial, original environmental exposure experience (i.e., spill-

over effect): such as, in terms of facilitation, when a person acquires a behaviour or habit in a situation (e.g., behaving sustainably at school) and later on s/he generalizes it to another context (e.g., behaving sustainably at home too; see De Dominicis, et al., 2017, discussed below). Otherwise, in terms of hindering, features of other parts of the broader system (e.g., infrastructure-related barriers, and cultural or normative barriers, in a city and at the local or national society), relating to very same behaviour (e.g., sustainable behaviour), can act as barriers for enacting that behaviour in the specific place, such as low carbon energy behaviours in a specific workplace organizational context (e.g., Dumitru et al., 2016).

In the second instance, (Bonaiuto, Bonnes, 1996; Bonaiuto & Bonnes, 2002; Bonaiuto, Bonnes, & Continisio, 2004), the effect observed on one behaviour within a certain context may be related to another behaviour in another context (i.e., cross-systems effect): such as, what a person does in a context (e.g., certain perceptions and uses of her/his urban residential neighbourhood, say regarding green areas) may depend on, or may relate to, other behaviours s/he does or does not in another context (e.g., certain urban uses s/he has of other sub-systems in her/his own city, such as the centre and the periphery, say regarding green areas or other areas too).

Therefore, in the spill-over hindering case above, the environment of context 1 (e.g., in the wider urban area) affects not only behaviours (e.g., sustainability actions such as recyclying, saving energy consumption, etc.) in context 1, but also the same behaviours in context 2 (e.g., at workplace). That is, the behaviour in one's own working organization is affected not only by the immediate environment (i.e., the workplace), but also by the distal environment (i.e., the urban place) which is connected to the first one by the person's commuting activities. A similar reasoning applies considering for example the facilitating case mentioned above, where the school environment (context 1) promotes pro-environmental behaviours which later on spread in the domestic place (context 2; see De Dominicis, et al., 2017, discussed below).

In the cross-system case, the environment of context 1 (e.g., urban non-residential sub-systems such as centre and periphery)

relates or affects to behaviours (e.g., neighbourhood perceptions and uses) realized in context 2 (e.g., urban residential neighbourhood). This means that urban neighbourhood perceptions and uses partly depend on their immediate environment (the residential neighbourhood), and partly depend on other related environments (the rest of the city's sub-systems) which are part of the same system being connected via the person's urban pragmatics (e.g., a multi-place urban pragmatic system).

Again, a couple of examples from the literature, both in general and from CIRPA projects, can be briefly reviewed here just to illustrate both direct and indirect environmental effects on the person.

When dealing with long-term exposure to a certain environment and to specific environmental features, of course contexts such as total institutions (e.g., long-term health care structures, correctional environments, or long-term residencies) epitomizes the case. In Goffman's (1961) terms, a total institution is a place – either for work, cure, (re-)education, residence, etc. – where a certain amount of similarly situated people are completely or partly cut off from the wider community for a considerable time: they basically run together an enclosed, formally administered round of life. One similar but less extreme example is offered by student dormitories and here an example can be mentioned of an older study where just one single simple design feature, such as the corridor length in a student dormitory, had been put under scrutiny to show how such a simple element can dramatically affect residents' social behaviour (Baum & Davis, 1980). Results show that such an effect does occur *in situ*, namely in the setting itself when the person is directly exposed to the environmental feature: in fact, the researchers monitored across several weeks the impact of living in a student residence with either a long corridor or a short one, assuming the second option should benefit social interaction rate by increasing it (i.e., positively impacting it and therefore producing a benefit for one of the major wellbeing features). Results clearly show that students' social behaviour rate keeps constant when they live in a short corridor residency; while it suffers a strong negative trend when they live in a long

corridor residency which basically halve it across three months. Moreover, if the environmental exposure persists over time, the person shows the very same effect when she/he is within a different neutral context too: in fact, students that lived for some months in the disadvantaged place, when located in a different setting for just a few minutes (a waiting room) show a lower rate of social skills across several behavioural indicators (interpersonal distance, social gaze duration, and posture discomfort). This means that a prolonged exposure (everyday for a few months) to a certain environmental feature (long vs. short corridor) produces a negative effect on interpersonal behaviour, which appears *in situ* during the exposure (thus showing a cumulative effect) and later on it generalizes across settings (from the residency to a neutral waiting room) and it lasts across time (after a few months). This shows that a specific environmental effect can chronicize, that is, the environment can exert chronic effects, namely effects that continue when the person is not directly exposed to the environmental influencing feature anymore. The individual thus suffer, or enjoy, environmental consequences over and above the mere environmental exposure, if this had been long or strong enough.

Some examples from CIRPA projects can be taken from recent years projects focused on studying the role of exposure to natural environment during childhood, in order to promote short-term and long-term psychological effects on participants' (at various relevant levels for their relationship with the natural environment). This idea can be paralleled to the social psychological paradigm of the so-called intergroup contact hypothesis, where making experiences of positive contacts with another group (an outgroup) improves the relationship with that group (e.g, in terms of both perception and action). By the way, there is also a specific literature regarding the positive impact of nature experiences on a range of psychological constructs, at least for urban inhabitants: not only in terms of immediate personal restorativeness, as widely recognized, but also in terms of emotional affinity towards nature, their ecological beliefs, and willingness to display ecological behaviours (e.g., Collado, Staats, & Corraliza, 2013).

Some effects can be in the medium term, such as across a few weeks or months; while some other effects could possibly span across a long-term timeframe. Of course, the first kind may be more easily studied and tested, while proving the second one is a greater challenge.

As an example of a medium-term effect, tested under a somehow controlled situation (a quasi-experimental paradigm), a CIRPA testing of an environmental education programme enacted by the Regional Agency for Parks of the Lazio Region (Agenzia Regionale Parchi, ARP Lazio) on primary schools can be mentioned here (De Dominicis, Bonaiuto, Carrus, Passafaro, Perucchini, & Bonnes, 2017). It was a long and large programme, involving several schools in different cities for several years. The study focused on one full school year to assess whether participating (vs. non-participating) in the programme was effective in promoting pro-environmental attitudes and self-reported behaviours. Data gathering was done before and after the participation (at school year start and at school year end) for both the pupils (direct participation) and their parents (indirect participation via their children) Results show that participating (vs. not) in the environmental education programme brings a number of improvements when comparing measures taken at the start and at the end of the school year: children who participated (vs. who did not) improve both pro-environmental attitudes and self-reported behaviours; and their parents improve too, but on attitudes only. Moreover, these effects appear in the urban sub-sample, not in the one living in small towns which are closer to rural environment, thus showing that this kind of nature experience is crucial for urbanized citizens.

When dealing with long-term effects, of course methodological choices typically tend to shift towards correlational paradigms. As an example, in a recent CIRPA study (Molinario, et al., 2020) correlation evidence has been used to test a path model where earlier experiences with nature, together with earlier relevant social norms on nature (both as remembered from childhood) predicts both general pro-environmental behaviours and sustainable food consumption choices in adulthood. Results show that childhood nature experiences and childhood exposure to pro-environmental social

norms (both remembered) associate to adulthood development of connectedness with nature and biospheric values; this, in turn, helps in shaping adulthood environmental self-identity ultimately influencing the enactment of sustainable food choices during adulthood. This pattern of results consistently emerged across two different data sets (having different target behaviours, different samples, different locations and different periods of the year). Of course they are based on correlational and not experimental evidence, still they are compatible with the assumption that both the physical (nature) and the social (norms) environment experienced in childhood may, some years later, associate to the development of individual psychological features, both cognitive and affective, favourable to a positive relation between the natural environment and the person; finally, these psychological features in turn associate with more positive individual intentions and behavioural choices in terms of sustainability (i.e., mitigating the human impact on the environment by opting for more sustainable fruit and fish).

Therefore, such examples show that, at least when dealing with early developing human beings, a person's former environmental experiences (in these specific cases with nature) have effects (positive, in these specific cases) later on in the life of those persons (either several months later, in the first example above, or several years or decades later, in the second example above).

Other examples from CIRPA relates to resiliency in perceiving and coping with natural environmental hazards (e.g., flooding): in general, past environment-person transactions seems to affect present ways of coping with the risk, showing another realm where a person's past environment (in terms of person-place relationships) can affect a person's present day environmental coping, again in terms of long-term environment-person effects. In some other cases, however, evidence also shows that it is possible to create short-term environment-person ad hoc experiences which may affect a person's present-day environmental coping, thus also showing the chance to get short-term environment-person effect (particularly with the aim of improving people resiliency to face hazardous contexts, in a nudge-like fashion).

Measurement levels: convergence and simplicity vs. divergence and complexity

From the range of examples reported above, it is clear that the effects the environment exerts on the person can be measured in many different ways. To sum up, the main categories of data origin from which then measures can be derived in order to finally test the effects of the environment on the person, can be synthetically organized as follows:

a) Self-report accounts
b) Observed behaviours
c) Bio-physiological parameters

Each kind can be standardized, and specific reliability and validity issues apply to all of them. The main difference is the source of the data they offer. The first kind relies on the person her/himself offering the data on the basis of the actor point of view (e.g., by means of replies during interviews, questionnaire, etc.). The second kind relies on either other persons (typically aided by standard performance tests), or audio-video technologies, offering the data on the basis of an observer point of view (e.g., by means of human or automatic observational coding schemes). The third type relies on a wide array of bodily functions offering the data on the basis of a standard set of parameters (e.g., regarding specific functions of the peripheral or central nervous system, or the cardiovascular system, or the neuroendocrinous system, etc.). None of these is intrinsically better of the other; moreover, sometimes their measurements converge while some other times they diverge. This calls in favour of multiple measurements whenever is possible and of complex models where different levels of analysis can sometimes offer convergent evidences, while in some other cases they may require more sophisticated theorizations to account for divergence existing among different levels of analysis. The interplay among different measurement levels can therefore result either in a methodological convergence, which can then be framed within theoretical simplicity; or in a methodological

divergence, which then needs some theoretical complexity to account for it.

Conclusions

The attention on the effects the urban environment exerts on people has a very old history. However, modern science approach benefited from interdisciplinary collaboration between social sciences and other sciences, design, and policy. Particularly, environmental psychology is claimed to have a special role in promoting evidence-based design, management, and policy for taking into account users', citizens', inhabitants' features and needs. Several kinds of data are useful for showing the environment effects on the person, and they can complement each other by offering different levels of analysis: self-report accounts; observed behaviours; bio-physiological parameters. Theoretical models can coherently integrate them. They frame environment's features and person's features within a meaningful process and outcome frame work, on the basis of three main principles characterizing the relevant scientific knowledge: firstly, the structure of the environment-person effect: valence, generalizability, set (positive, general, simple vs. negative, relative, cumulative effects); secondly, the process of the environment-person effect: direct and indirect (mediated) effects; and thirdly, the timing of the environment-person effect: short and long-term exposure, with immediate and chronic effects (spill-over and cross-systems). Some examples had been offered to illustrate each case.

References

Amicone, G., Petruccelli, I., De Dominicis, S., Gherardini, A., Costantino. V., Perucchini, P., & Bonaiuto, M. (2018) Green breaks: The restorative effect of the school environment's green areas on children's cognitive performance. *Frontiers in Psychology, 9*, 1579. doi: 10.3389/fpsyg.2018.01579

Andrade, C. C., Lima, L., Pereira, C. R., Fornara F., & Bonaiuto M. (2013). Inpatients' and outpatients' satisfaction: The mediating role of perceived quality of physical and social environment. *Health & Place, 21*, 122-132.

Baum, A., & Davis, G. E. (1980). Reducing the stress of high-density living: An architectural intervention. *Journal of Personality and Social Psychology, 38*(3), 471-481.

Becker, F., Bonaiuto, M., Bilotta, E., & Bonnes, M. (2011). Integrated health scape strategies: An ecological approach to evidence-based design. *HERD Health Environments Research & Design Journal, 4*, 114-129. PMID: 21960196

Bilotta, E., Ariccio, S., Leone, L., & Bonaiuto, M. (2019). The Cumulative Risk Model to encompass perceived urban safety and well-being. *Visions for Sustainability, 11*, 68-82.

Bonaiuto, M., Aiello, A., Perugini, M., Bonnes, M., & Ercolani, A.P. (1999). Multidimensional perception of residential environment quality and neighbourhood attachment in the urban environment. *Journal of Environmental Psychology, 19*, 331-352 (I.F. 1,172 / 2,056). DOI 10.1006/jevp.1999.0138.

Bonaiuto, M. & Alves, S. (2012). Residential places and neighbourhoods: Toward healthy life, social integration, and reputable residence. In S. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp. 221-247). New York: Oxford University Press.

Bonaiuto, M., Bilotta, E., & Stolfa, A. (2010). Feng Shui and environmental psychology: A critical comparison. *Journal of Architectural and Planning Research, 27*, 23-34. ISSN 0738-0895. DOI 10.1037/0003-066X.45.5.641.

Bonaiuto, M. & Bonnes, M. (1996). Multi-place analysis of the urban environment: a comparison between a large and a small Italian city. *Environment and Behavior, 28*, 699-747.

Bonaiuto, M. & Bonnes, M. (2002). Residential satisfaction in the urban environment within the UNESCO-MAB Rome Project. In J.I. Aragonés, G. Francescato, & T. Garling (Eds.), *Residential Environments: Choice, Satisfaction, and Behavior* (pp. 101-133). Westport, Connecticut: Bergin & Garvey.

Bonaiuto, M., Bonnes, M., & Continisio, M. (2004). Neighborhood evaluation within a multi-place perspective on urban activities. *Environment and Behavior, 36*, 41-69 (I.F. 0,795 / 1,463). DOI: 10.1177/0013916503251444

Bonaiuto, M. & Fornara, F. (2017). Residential Satisfaction and Perceived Urban Quality. In J. Stein (Ed.), *Reference Module in Neuroscience and Biobehavioral Psychology* (pp. 1-5). Oxford: Elsevier.

Bonaiuto M., Mao Y., Roberts S., Psalti A., Ariccio S., Ganucci Cancellieri, U., & Csikszentmihalyi, M. (2016). Optimal Experience and Personal Growth: Flow and the Consolidation of Place Identity. *Frontiers in Psychology, 7*, 1654. doi: 10.3389/fpsyg.2016.01654

Bonnes, M. & Bonaiuto, M. (2002). Environmental psychology: From spatial-physical environment to sustainable development. In R. B. Bechtel & A. Churchman (a cura di), *Handbook of Environmental Psychology* (pp. 28-54). New York: Wiley.

Bonnes M. & Secchiaroli G. (1992). Psicologia ambientale. Introduzione alla psicologia sociale dell'ambiente. Roma: Carocci. (Engl. Trans 1995).

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Cancedda L., Putignano E., Sale A., Viegi A., Berardi N., & Maffei L. (2004). Acceleration of visual system development by environmental enrichment. *Journal of Neuroscience, 24*, 4840-4848.

Clayton, S. (Ed.) (2012). *The Oxford handbook of environmental and conservation psychology*. New York: Oxford University Press.

Collado, S., Staats, H., & Corraliza, J.A. (2013). Experiencing nature in children's summer camps: Affective, cognitive and behavioural consequences. *Journal of Environmental Psychology, 33*, 37-44.

Corral-Verdugo, V. (2012). The Positive Psychology of Sustainability. *Environment. Development & Sustainability, 14*, 651-666.

De Dominicis, S., Bonaiuto, M., Carrus, G., Passafaro, P., Perucchini, P., & Bonnes, M. (2017). Evaluating the role of protected natural areas for environmental education in Italy.

Applied Environmental Education & Communication, doi: 10.1080/1533015X.2017.1322014

Dumitru, A., De Gregorio, E., Bonnes, M., Bonaiuto, M., Carrus, G., Garcia-Mira, R., & Maricchiolo, F. (2016). Low carbon energy behaviors in the workplace: A qualitative study in Italy and Spain. *Energy Research & Social Science, 13*, 49-59. http://dx.doi.org/10.1016/j.erss.2015.12.005 (SCOPUS 2-s2.0-84957437285

Engemann, K. Pedersen, C.B., Argef, L., Tsirogiannisf, C., Mortensen, P.B., & Svenning, J.-C. (2019). Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood. *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1807504116

Evans, G.W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology, 39*, 924-933.

Evans, G.W. (2004). The environment of childhood poverty. *American Psychologist, 59*, 77-92.

Evans, G.W. (2006). Child development and the physical environment. *Annual Review of Psychology, 57*, 423-451.

Fletcher, B. (1905). *A History of Architecture on the Comparative method*. Elsevier Science & Technology (2001, ISBN 0-7506-2267-9).

Fornara, F., Ariccio, S., Rioux, L., Moffat, E., Mariette, J., Bonnes, M., & Bonaiuto, M. (2018). Test of PREQIs' factorial structure and reliability in France and of a Neighbourhood Attachment prediction model: A study on a French sample in Paris (Vérification de la structure factorielle et de la fiabilité des preqis en France et test d'un modèle de prédiction de l'attachement au quartier : une étude sur un échantillon parisien). *Pratiques Psychologiques, 24*, 131-156.

Fornara, F. & Campos Andrade, C. (2012). Health Care Environments. In S. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp. 295-315). New York: Oxford University Press.

Gibson, J.J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Gifford R. (2014). *Environmental psychology: Principles and practice* (5th ed.). Colville, WA: Optimal Books.

Goffman, E. (1961). *Asylums: Essays on the social situation of mental patients and other inmates*. Anchor Books.

Lewin, K. (1936). *Principles of topological psychology*. New York: McGraw-Hill.

Mead, G. H. (1934). *Mind, Self, and Society: From the Standpoint of a Social Behaviorist*. Chicago: University of Chicago Press.

Molinario, E., Lorenzi, C., Bartoccioni, F., Perucchini, P., Bobeth, S., Colleony, A., et. al. (2020). From childhood nature experiences to adult pro-environmental behaviours: An explanatory model of sustainable food consumption. *Environmental Education Research* (revision accepted).

Piccinin, G. (2018). *Emotional urban scapes: neurophysiological measures of urban environment safety perception*. PhD Thesis, Sapienza Università di Roma.

Ritchie, H., Rosie, M. (2018). Our World in Data. Urbanization. University of Oxford, Global Change Data Lab. Retrieved May 4, 2019 from https://ourworldindata.org/urbanization

Rutter M. (1979). Protective factors in children's responses to stress and disadvantage. In M.W. Kent & J.E. Rolf (Eds.), *Primary prevention of psychopathology, Vol. 3: Social competence in children* (p. 49-74). Hanover, NH: University of New England Press.

Sale, A., Putignano, E., Cancedda, L., Landi, S., Cirulli, F., Berardi N. et al. (2004). Enriched environment and acceleration of visual system development. *Neuropharmacology, 47*, 649-660.

Stokols, D. & Altman I. (1987). *Handbook of environmental psychology*. New York: Wiley.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420-421. http://dx.doi.org/10.1126/science.6143402

United Nations, Department of Economic and Social Affairs, Population Division (2018). *World Urbanization Prospects: The 2018 Revision*, Retrieved May 4, 2019 from https://population.un.org/wup/Publications/

Venhoeven, L., Taufik, D., Steg, L., Bonaiuto, M., Bonnes, M., Ariccio, S., De Dominicis, et al. (2018) The role of nature and environment in behavioural medicine. In W. Bird & M. van den Bosch (Eds). *Nature and Public Health: The Role of Nature in Improving the Health of a Population* (pp. 89-94). Oxford: Oxford University Press. ISBN: 9780198725916.

Wikipedia (2019). Urbanization by country. Retrieved from https://en.wikipedia.org/wiki/Urbanization_by_country

8

Evaluate the Quality of Urban Public Spaces Using the Sonic Perception of Visually Impaired People

Christina E. Mediastika, Anugrah Sabdono and Luciana Kristanto[*]

Abstract

Most urban public spaces in Indonesia are not designed inclusively. Visually impaired people, who are considered the most vulnerable group, are involved in this study to map the sonic characteristic of public spaces in Surabaya, Indonesia. Because they use the sense of hearing more intensively than the sense of sight, their sonic perceptions are substantial to be studied in line with increasing environmental noise which decreases the quality of urban public spaces. A series of surveys to collect their sonic perception about parks and sidewalks were carried out, as these facilities generally do not have economic implications for users and visitors. Data were collected in two main parks (with eight segments) and on nine sidewalk segments in Surabaya using semantic scale questionnaires in a soundwalk method, where a sighted person accompanied a visually impaired participant. There were 280 data collected in the parks and 90 data on the sidewalks. Principal component analysis (PCA) was used for data processing. The PCA shows the visually impaired has six soundscape dimensions (dynamic, comfort, communality, direction, danger, and spatiality), which

[*] The research team sends deep gratitude to the funding institution and to YPAB community in Surabaya for supporting and participating in the survey. This study was fully funded by the Ministry of Research, Technology and Higher Education, the Republic of Indonesia under the scheme of Penelitian Kompetensi with contract number 002/SP2H/LT/K7/2017 Feb 26, 2018 (made through LLDIKTI VII) and Sabbatical Leave Program 2018 of Directorate of Career and Human Resource Competencies number 364.1/D2.3/KP/2018.

are found to be more complicated than the soundscape of sighted respondents. In parks, the dynamic dimension is found as the most important whereas on sidewalks, the comfort dimension is dominant. It means that within an area where the direction is free such as a park, the visually impaired need acoustic environment that may navigate them. However, when they have to walk down a particular route, they appraise the surrounding with the comfort factor. These findings will be referred to improve the public facilities for more inclusive users.

Introduction

There are many public spaces in the urban area. Two facilities which are free entry are city parks and sidewalks. Park is a place where natural sound is expected to emerge, and usually, the sound of vehicles is not preferred here. In the opposite, sidewalks which are located just beside streets are commonly flooded with the sound of vehicles. Nonetheless, both public facilities ideally serve to all users inclusively. In a developing country such as Indonesia, public facilities are mostly designed exclusively for those with normal abilities. It is then essential to investigate how people with disability perceive this condition. The paper reported here attempts to study the perception of urban public spaces especially parks and sidewalks by those with a visual disability using a soundscape method as was introduced by Schafer (1977).

Soundscape, determined as an acoustic environment as perceived or experienced and or understood by people in context (ISO 2014), is considered as an appropriate method to conduct this study, since among us are also people with visual disability who appraise their surrounding environment mostly using hearing sense and tactile. Even for ordinary people, in a study of parks in particular, Tse et al. (2012) showed that together with the visual comfort evaluation, acoustic comfort evaluation plays a vital role in park visitors' acceptability of the urban park environment.

People with visual impairment can be categorized as the most vulnerable group of community. They find it difficult to do normal activities since most activities of daily life are mostly done visually. However, blind people are more sensitive to

sound than the normal-sighted people (Gonzales-Mora et al., 1999), and they are also typically able to process acoustic information better (Lessard et al., 1998). These have positioned the blind people to be more attentive to acoustic information and dispose of more brain volume to process the sonic information (Rychtarikova, 2015). Hitherto, the use of soundscape surveys conducted by visually impaired people is beneficial to gain appropriate data of sonic perception of city dwellers inclusively as a reference to improve the urban environment.

Public facilities in Indonesia

According to Tsou et al. (2005), municipal public facilities may include parks, libraries, schools, markets, retirement centres, community centres, cemeteries, and other facilities such as station of public transport and hospital, and many more which may slightly differ between a city of a country to another. The definition was added by Loukaitou-Sideris and Ehrenfeucht (2009) with sidewalks. These features are important integral parts of urban life, but yet an underestimated element of the urban form, particularly in developing countries, where the existence of public spaces is less appreciated. In general, two primary functions of urban public facilities are to provide services to residents and maintain the environmental quality of urban living (Tsou et al., 2005).

Indonesia is a developing country which currently made much effort to improve the public facilities to come to the ideal ones. Many public facilities and public buildings in Indonesia cities were not designed inclusively, in particular regarding access and direction. The exclusive access and guideless direction are difficult to access by those with wheelchairs, walking sticks, and visually impaired. These are usually about limited dimension for wheelchairs manoeuvre, steep ramps, steps and stairs, unavailability of guiding blocks, etc. (Figure 1).

Figure 1. Four examples of sidewalks design in Indonesia cities which barely accommodate the need of the disabled, i.e., a steep ramp with blocking end, discontinued guiding blocks and narrow space for those with wheelchairs
Source: www.solider.id, news.detik.com, www.fokusjateng.com, and kilaskementerian.kompas.com.

Parks and sidewalks

Parks and sidewalks are two public facilities that are purely free opened for public. Unlike schools, hospitals, religious buildings, markets, etc. which are visited for a particular purpose and may have financial consequences, parks and sidewalks have no financial obligation to visit. Thus these two public features are ideally be designed freely and inclusively.

In this last few decades, Indonesia cities government has made an effort to provide and improve the conditions of these two features. Surabaya, the second largest city after Jakarta, the capital city, has played a vital role to instantiate other cities in the rigorous development of city parks and sidewalks. The current Surabaya mayor Madam Rismaharini had started the development of parks and sidewalks to boost the quantity and quality since ten years ago when she was the Chief of Cleanliness and Green Open Space Office. Surabaya has developed its park from none to more than thirty active parks, today. The sidewalks

are also upgraded regarding the width and material quality, from several kilometres only to 45 km in 91 street segments, today. Nonetheless, still the available parks and sidewalks do not adequately accommodate the need of community with a disability.

Figure 2. Flora park of Surabaya is acknowledged by the visually impaired people as a non difable-friendly
Source: http://pojokpitu.com.

Methodology

The study reported here is a series of two years of research. It was conducted both off-site and in-situ. The off-site surveys were carried to gather data to construct the questionnaire for the in-situ surveys and later to confirm the findings of the in-situ surveys. The first off-site stage consists of focused group discussion and open-ended questionnaire surveys. The second off-site stage was to confirm the finding of a close-ended questionnaire of the in-situ survey, with another open-ended questionnaire. The in-situ survey which positioned in between the two off-site surveys were conducted in Bungkul Parks, Flora Parks, Siola sidewalks, Bambu Runcing sidewalks, Darmo sidewalks, and Bintoro sidewalks. All are in Surabaya.

The participants

The study involves sighted participants (35 persons), who act as the accompanying persons, and visually impaired participants (35 persons). The sighted participants were Petra Christian University (PCU) whereas, the visually impaired participants were students of Yayasan Pendidikan Anak Buta (the Foundation of Education for Blind Children) or YPAB of Surabaya of 19 female and 16 male between 16 to 20 years of age. The official to partnering with YPAB was granted by the Body of National Unity, Politics, and Community Protection (Bakesbangpol), a body under Surabaya City Government licensed number 070/6619/436.85/2017 dated 19 July 2017 and approval letter by the Headmaster of YPAB dated August 1, 2017, including to publishing images taken during the project.

The off-site survey

The first off-site survey was carried out to develop the tool for the in-situ survey. It was conducted using focused group discussion and survey with an open-ended questionnaire. This stage resulted in attributes as shown in Table 1 and 2 to construct the close-ended semantic questionnaire with Likert's scale. Unlike the ordinary Likert's with five to seven scales, the developed questionnaire used three scales only with the consideration of the barrier of communication between the interviewer and the interviewee of the visually impaired. It is still debatable whether the use of three-point-scales are good enough (Jacoby & Matell, 1971) or misdoubted (Lehmann & Hulbert, 1972). Some may consider the three-point scales could not provide a sufficient in-depth analysis. However, using the standard scale would lengthen the question's reading by the interviewer, lengthen the time of interviewee to grasp the question, and lengthen the time to choose the accurate answer.

Table 1. *The attributes found from the off-site survey which are used to develop a semantic scale model of the close-ended questionnaire for the parks' survey*

Number	Sighted	Visually impaired
1	Crowded	Crowded
2	Calm	Calm
3	Nice	Nice
4	Disturbing	Disturbing
5	Comfortable	Comfortable
6	Clamorous	Clamorous
7	Noisy	Noisy
8	Fun	Fun
9	Rough	Rough
10	Unhurried	Unhurried
11	Natural	Natural
12	Dense	Safe
13	Good	Unclear Direction
14	Fine	Full
15	Full	Far
16	Silence	Slow
17	Neat	Recognize the location
18	Relax	Scary
19	Like	Spacious
20	Monotonous	-

Table 2. *The attributes found from the off-site survey which are used to develop a semantic scale model of the close-ended questionnaire for the sidewalks' survey*

No.	Attributes	Context
1	crowded	soundscape
2	comfort	soundscape
3	noisy	soundscape
4	fun	soundscape
5	rough	soundscape
6	natural	soundscape
7	safe	soundscape

8	unclear direction	soundscape
9	far	soundscape
10	slow	soundscape
11	know the position	soundscape
12	full	soundscape
13	scary	soundscape
14	spacious	soundscape
15	easy	access
16	slippery	access
17	clear route	access
18	near traffic	access
19	flat	access

The in-situ survey

After the questionnaire set, the in-situ survey using a walking soundscape method known as a soundwalk was carried. It was conducted in Bungkul Park and Flora Park in Surabaya city centre. The sidewalks survey was in nine segments of Siola, Bambu Runcing, Darmo, and Bintoro also in Surabaya city centre. The soundwalks were all carried on four days during the routine days of Surabaya. Each visually impaired participants were accompanied by one sighted person who then acts as the interviewer at the end of each section to help the respondents fill-in the questionnaire (Figures 3 and 4). There were five segments in Bungkul, three segments in Flora parks, three segments on Siola, two segments on Bambu Runcing, two segments on Darmo, and two segments on Bintoro sidewalks. The soundwalk was conducted in silence for each segment, so as the respondents may fully appraise the acoustic environment. The accompanying person will guide them and alert them when they are about to encounter danger. The questionnaire was filled after each segment.

Figure 3. Snapshots of the in-situ survey in parks.

Figure 4. Snapshots of the in-situ survey on sidewalks.

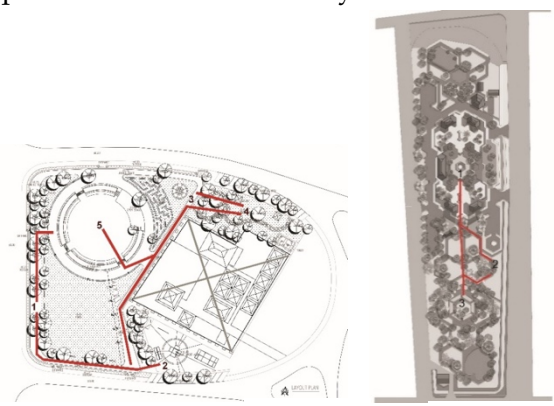


Figure 5. The five segments in Bungkul Park (a) and three segments in Flora Park (b) for the soundwalk survey (After Surabaya City Government of Bungkul Park blueprint, the cross-marked area is the graveyard of Mr Bungkul. It is within the park, but not functioned as a part of the park).

Figure 6. Map of the surveyed sidewalk segments. It consists of 9 segments, each of approximately 250 m length. Each segment represents different sidewalks condition and or different types of street-crossing methods. The area inside the box is the city center of Surabaya (after Google maps).

Result and discussion

The data were analysed at a time using principal component analysis (PCA) with a change of coordinates known as varimax rotation (Field, 2000) so that each variable can be associated at most one factor. Polychoric correlations are used instead of Pearson's correlation considering that ordinal data gathered is a three-scale bipolar data which tend to have strong skewness or kurtosis (Muth`en & Kaplan, 1985; Gilley & Uhlig, 1993 in Basto & Pereira, 2012).

Table 3 shows the data analysed from the visually impaired due to the soundwalk in parks. Here, six soundscape dimension emerged. The dominant soundscape dimension of component 1 is related to the perception of dynamic. This dimension explains 17% of the variation, which includes "crowded", "calm", "clamorous", "noisy", "rough", "slow", and "full". Component 2 explains 14% of the variation. It is related to the perception of comfort, which includes "nice", "disturbing", "comfortable", and "fun". Component 3 is related to the perception of danger. This dimension explains 8% of the variation, which includes

"safe" and "scary". Component 4 is related to the perception of direction. This dimension explains 8% of the variation, which includes "unclear direction" and "can recognise the position". Component 5 is related to the perception of space. This dimension explains 7% of the variation, which includes "far" and "spacious". Factor 6 is related to the perception of nature. This dimension explains 6% of the variation, which includes "nature" and "slow". In parks, the first soundscape dimension of the visually impaired is dynamic which is related to the acoustic environment. It differs to the first soundscape dimension of the sighted which is related to subjective preference (Kang & Zhang, 2010; Axelsson et al., 2010; Sudarsono et al., 2016). The study elicits the unique soundscape dimension of the visually impaired, i.e., the dimension of direction, the dimension of danger, and dimension of space which is not stipulated by the sighted. It seems the visually impaired people use their ears, not only to perceive the commonly held perception by the sighted people, but also to navigate, to detect danger, and to feel the environment.

Table 3. The PCA result of the parks' soundwalks (Kaiser-Meyer-Olkin (KMO) test = 0.846)

	Components					
	17% (1:dyna-mic)	14% (2: comfort)	8% (3: danger)	8% (4: direction)	7% (5: space)	6% (6: nature)
crowded-uncrowded	0.708	0.032	0.107	0.090	0.067	0.220
calm-agitate	-0.626	0.432	0.075	-0.002	0.119	0.130
nice-improper	-0.036	0.740	-0.097	-0.003	-0.052	0.054
disturbing-calming	0.346	-0.621	0.229	-0.048	0.085	-0.088
comfortable - uncomfortable	-0.283	0.754	-0.155	-0.033	0.181	0.016
clamorous-tranquil	0.753	-0.232	0.062	0.081	0.050	-0.069
noisy-quiet	0.803	-0.194	0.021	-0.012	0.014	-0.152
fun-boring	-0.107	0.729	-0.153	0.107	0.137	0.045
rough-smooth	0.597	-0.115	0.182	-0.144	-0.154	-0.370
slow-rush	-0.670	0.142	-0.181	0.103	0.217	0.173

natural-artificial	-0.218	0.053	-0.096	-0.110	0.107	0.616
safe-dangerous	-0.151	0.233	-0.711	0.144	0.065	0.117
unclear direction	0.088	-0.115	0.145	-0.791	0.023	-0.044
far-near	-0.076	0.080	0.055	-0.050	0.757	0.253
slow-fast	-0.137	0.127	-0.092	0.026	0.203	0.578
recognize the location-cannot	0.084	-0.058	0.055	0.810	-0.035	-0.066
full-empty	0.508	0.177	0.160	-0.083	-0.369	0.331
scary-soothing	0.066	-0.143	0.843	0.016	0.025	0.006
spacious-cramped	0.059	0.360	-0.146	-0.085	0.530	-0.329

Meanwhile, Table 4 shows the data analysed from the visually impaired due to the soundwalk on sidewalks. Four factors were declared. The dominant soundscape dimension of factor 1 is related to the perception of comfort which includes "comfort", "fun", "safe", "clear direction", "know the position", "soothing", "easy access", and "clear route". This factor explains 25% of the variation. Factor 2 is associated with the perception of dynamic, which includes "soft", "far", "slow", and "far traffic". This factor explains 11% of the variation. Factor 3 is associated with communication (10%) which includes "crowded", "noisy", and "full". The soundscape dimension related to the perception of contour explains 9% of the variation, which is related to the semantic scale of "flat".

Table 4. *The PCA result of the sidewalks' soundwalks (Kaiser-Meyer-Olkin (KMO) test =0.739)*

Attributes	Factors			
	25% (1: comfort)	11% (2: dynamic)	10% (3:commu-nication)	9% (4: contour)
crowded - uncrowded	0.392	0.127	0.667	-
comfort - uncomfort	0.642	-	-0.205	0.401
noisy - quiet	-	-0.200	0.832	-

fun - boring	0.621	0.130	-	0.405
rough - smooth	-0.217	-0.587	0.303	-0.126
natural – artificial	0.317	0.101	0.111	0.426
safe - dangerous	0.676	-	-	-
unclear direction - clear direction	-0.777	-	-0.107	-
far - near	-	0.722	-	-0.249
slow - fast	-	0.633	-	0.123
know - don't know the position	0.753	-	0.112	-
full – empty	-0.189	-0.271	0.713	-
scary - soothing	-0.714	-	0.249	0.137
spacious – cramped	0.145	-0.222	-0.138	0.461
easy - uneasy	0.733	-	-0.122	0.143
slippery -coarse	0.462	0.218	-	0.327
clear - unclear	0.765	-	-	-
near - far traffic	-	-0.706	0.174	
flat - up and down	-0.180	0.131	-	0.847

From the result, we learn that sonic perception of the visually impaired in parks differs from that of on the sidewalk. The sonic perception in parks is more complicated than that on sidewalks. In parks, the dynamic dimension is found as the most important. Whereas on sidewalks, the comfort dimension is dominant. It means that within an area where the direction is free such as a park, the visually impaired need acoustic environment that may navigate them. However, when they have to walk down a particular route, they appraise the surrounding with the comfort factor.

Conclusion

The study on the sonic perception of visually impaired people conducted in parks of Surabaya has come into conclusion as follows:

- The visually impaired participants explain the sonic environment of parks in six dimensions: dynamic, comfort, social, direction, danger, and space. It is more complicated than the soundscape dimension perceived by sighted people, which are found by the earlier studies as relaxation, communication, spatiality, and dynamic (Kang & Zhang, 2010) or pleasantness, eventfulness, and familiarity (Axelsson et al., 2010), or calmness/relaxation, dynamic/ vibrancy, and communication (Sudarsono et al., 2016).
- Three dimensions are added by the visually impaired compared to the sighted: direction, danger, and space.
- The dynamic perception is the first sonic dimension of the visually impaired, means that the sound environment is more important for the visually impaired than the subjective preference.
- The visually impaired perceived the soundscape of the parks better than the sighted, which is quite reasonable as the visually impaired has no visual expectation which may interfere with the aural perception.

Meanwhile, the sonic perception of visually impaired people conducted on sidewalks of Surabaya has come into conclusion as follows:

- The visually impaired participants explain the sonic environment of sidewalks in four dimensions: comfort, dynamic, communication, and contour.
- The dimension of comfort is affected by the easiness of the access and how clear is the sidewalk. The dimension of contour is not related to the first three dimensions and become one independent dimension.
- The fourth dimension of contour uniquely emerges in the study. This result indicates that it is possible to design a contoured sidewalk as long as the sidewalks are clear and easy to access.

These findings will be referred to improve the public facilities for more inclusive users.

References

Axelsson, Ö., Nilsson, M. E., & Berglund, B. (2010). A principal components model of soundscape perception. *The Journal of the Acoustical Society of America*, *128*(5), 2836-2846.

Basto, M. & Pereira, J. M. (2012). An SPSS R-menu for ordinal factor analysis. *Journal of statistical software, 46*(4), 1-29.

Field, A. P. 2000. Discovering statistics using SPSS for windows. SAGE, London

González-Mora, J. L., Rodriguez-Hernandez, A., Rodriguez-Ramos, L. F., Díaz-Saco, L., & Sosa, N. (1999). Development of a new space perception system for blind people, based on the creation of a virtual acoustic space. *International Work-Conference on Artificial Neural Networks* (pp. 321-330). Springer, Berlin, Heidelberg.

ISO 12913-1: (2014). Acoustics–soundscape–part 1: definition and conceptual framework

Jacoby, J. & Matell, M. S. (1971). Three-point Likert scales are good enough. *Journal of Marketing Research*, *8*(4): 495-500.

Kang, J. & Zhang, M. (2010). Semantic differential analysis of the soundscape in urban open public spaces. *Building and Environment, 45*(1), 150–157.

Lehmann, D. R., and Hulbert, J. (1972). Are three-point scales always good enough? *Journal of Marketing Research*, *9*(4), 444-446.

Lessard, N., Paré, M., Lepore, F., & Lassonde, M. (1998). Early-blind human subjects localize sound sources better than sighted subjects. *Nature*, *395*(6699), 278.

Loukaitou-Sideris, A. & Ehrenfeucht, R. (2009). *Sidewalks: conflict and negotiation over public space*. Cambridge: MIT Press.

Muth`en, B.O. & Kaplan, D. (1985). A Comparison of some Methodologies for the Factor Analysis of Non-Normal Likert Variables. *British Journal of Mathematical and Statistical Psychology*, *38*, 171–189.

Rychtarikova, M. (2015). How do blind people perceive sound and soundscape? *Akustika, 23*(1), 6-9.

Schafer, R.M. (1977). *The soundscape: Our sonic environment and the tuning of the world*. Inner Traditions International, Rochester.

Sudarsono, A. S., Lam, Y. W., & Davies, W. J. (2016). The effect of sound level on perception of reproduced soundscapes. *Applied Acoustics, 110*, 53-60.

Tse, M. S., C. K. Chau, Y. S. Choy, W. K. Tsui, , C. N. Chan, & S. K. Tang. (2012). Perception of urban park soundscape. *The Journal of the Acoustical Society of America*, *131*(4), 2762-2771.

Tsou, K. W., Hung, Y. T., & Chang, Y. L. (2005). An accessibility-based integrated measure of relative spatial equity in urban public facilities. *Cities*, *22*(6), 424-435.

9

Mass Transport Bus Route Proposal for Township Plan

Samhita

Introduction

India, one of the fastest growing economies in the world, is achieving a growth rate of 7.5% per annum. According to the Census 2011, at least 377 million Indians, comprising about 31% of the country's population, live in urban areas like Mumbai. The urbanization level in India is set to further increase and the urban population is expected to reach about 600 million by 2030. Unfortunately, today we are witnessing more and more congestion on the streets of our cities which is leading to problems like pedestrian and vehicular accidents, traffic delays, pollution, to name a few (Varshney, 2018).

While congestion of cities because of population growth is in itself a major problem, congestion related effects on public transport systems are visibly increasing too. With the dawn of city expansion and mass travel, a lack in the efficiency of the existing local road transport systems such as BEST buses in cities like Mumbai, for example, has been observed. This lack in efficiency has been arising due to the high demand and comparatively inadequate supply of good quality transport mechanisms. Mismanagement and ignorance to long sightedness has caused bus resources to be inefficient at times, to an extent such that common mass then turns towards other comfortable but unsustainable methods of travelling like individual car rides to and fro from work, taxi cabs, etc.

Hence, to bring back efficiency of the time friendly, convinient and sustainable method of mass trasport, the bus system, this study looks at the more population centric side of planning the bus transport. This means, allocation of the transit systems in locations convinient for the general mass spread across an area. This convinience in usage will help in developing

a image of comfort and reliability towards the bus system. Hence, encouraged use of it will further help in long lasting the sustainability achieved by choosing mass transport rather than individual vehicles.

Significance of the study

Having grown up in metropolitan cities, lack of planning and efficiency in public transport systems is something that has been personally experienced. In a city like Mumbai, 80% of the total journeys made in the city, i.e.11.2mn out of 14mn journeys per day are by public transport, mainly by suburban trains and buses. Public transport of the mass should be planned in as much detail as possible, by considering all segments of the society, to make it reliable for every type of citizen. This study deals with the population spread aspect to idealize locations of bus stops and routes across the area. The resultant system is spread across the entire study area in a manner such that it is beneficial and accessible to a traveler at any location in the plan. Also, prediction of the headcounts of travelers is very important so as to have timely and comfortable systems that efficiently transport the entire lot within required time frame. This kind of people centric planning will ensure more users of the facility, and hence promote sustainability, which should be a part of the goal for any planning (MCGM, 2006).

Aim

The aim of this paper is to estimate the suitable small scale transit mode like bus stands and routes across the study area depending upon location of other proposed and existing major transport facilities like metro and railway as well as the average population concentration retrieved from proposed and existing types of district land use of buildings like commercial, residential, entertainment hubs, tourist attractions, etc. for better access by citizens.

For this, the study will cover the type of travelers such as:

- In the day
  a) Working population travelling from major transit to commercial and industrial hubs

b) Residential population travelling from residential areas towards the major transit

- In the evening
  a) Working population travelling from commercial hubs to major transit
  b) Residential population travelling from major transit to residential areas
  c) Tourist population travelling to and fro the major transit and tourist areas, as well as among the tourist areas

Objective

- Minimum possible distance to be travelled in between land plots and suggested bus stop facilities.
- Maximum distance to be travelled to be no more than 400-500 metres.
- Proposing suggested facilities in areas such that at a time it can cater to maximum
- population.

Previous work

GIS provides the platform in which data for numerous transportation conditions can be created and merged. There are several papers that have developed other ways, tools and methods which makes the use of GIS to help plan public transport efficiently and also reduce pollution in the process.

The location of a bus stop is of utmost importance because to increase the use and accessibility, they must be located at convenient locations, at the same time, standards and criteria must be set especially in terms of distance between one another. Four hundred (400) metres bus stop interval on the major roads was established in that project so as to avoid cluster and at the same time serve commuters. Since there is good rail and metro connectivity in the study area, we opted for distance of 700m between consecutive bus stops. This results in well distanced bus stops, but at the same time, the walking to be done to get from one to another is not overwhelming. To this it can be added that walking distance from any point to its nearest bus stop must stay

around the radar of 400m to ensure accessibility (Olowosegun & Okoko, 2012).

Further, another criterion was picked up as bus stops attain their importance to the transit service from being the main points of contact between the passenger and the bus. The location of bus stops significantly affect transit service performance and passenger satisfaction, as they influence travel time in addition to their role in ensuring reasonable accessibility. Thus, achieving bus stop locations such that they are being readily available to mass population around itself plays a vital role in targeting audiences to opt for the convenience provided by the bus travel. Hence, the walking distance for higher areas of population to a bus stop must be lesser, is the idea that is derived from this work (Foda & Osman, 2010).

Study area

The area of study, owned by Mumbai Port Trust runs along the eastern coast of Mumbai and covers East of Raey Road, Cotton Green and Sewri areas on the harbor line of the city. This covers approximately an area of 3 sq km. The location of the mean center of the area in decimal degrees is 18.985868 N, 72.849761 E. The land is flung on the eastern side by the Arabian sea coast and on the North, South and West by the rest of the Mumbai city.

This area is currently utilized by large godowns and slum encroachments, with fishing and transportation practices carried out in the area. The MbPT partnered by CIDCO has planned to revamp the area into a completely new master plan that will consist of systematically divided zones for business, residence and entertainment. Large garden areas and historic places have been marked too. The roads have been planned perpendicularly and systematically with a grand boulevard zone included. Hence all in all, this area will see a rise in population of a mixed population type, and hence transport activities interconnecting the area must be looked into.

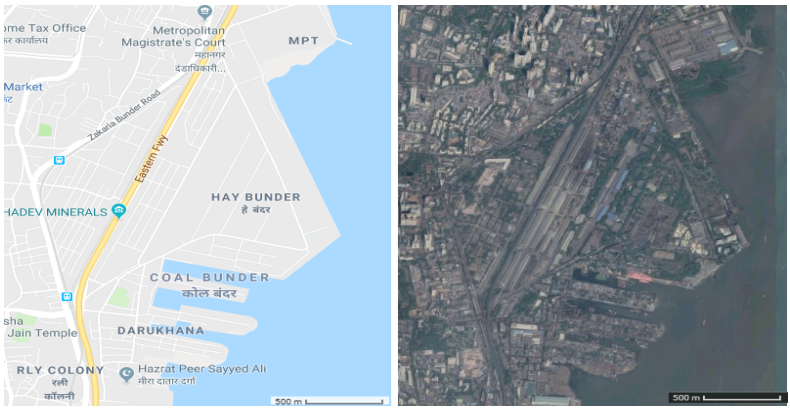


Figure 1. Satellite image of the study area.

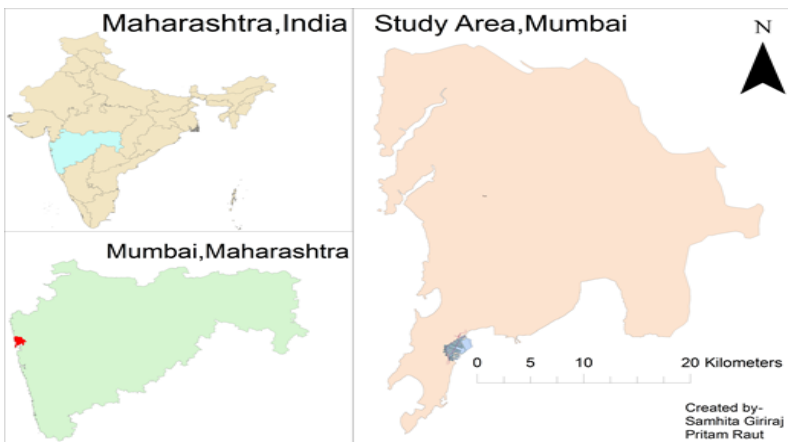


Figure 2. Layout of study area.

The zones that the study area has been divided into are:

1. Central Recreational Zone
2. CGO Zone
3. Financial Zone
4. Grand Boulevard Zone
5. Green Cover
6. Historic Zone
7. Industrial Zone
8. Maritime University
9. Promenade

10. Railway
11. Residential Zone
12. Roads
13. Tourist and Cultural Zone
14. Water Front Zone
15. Metro Stations and Railway stations
16. Metro Lines and Railway Lines

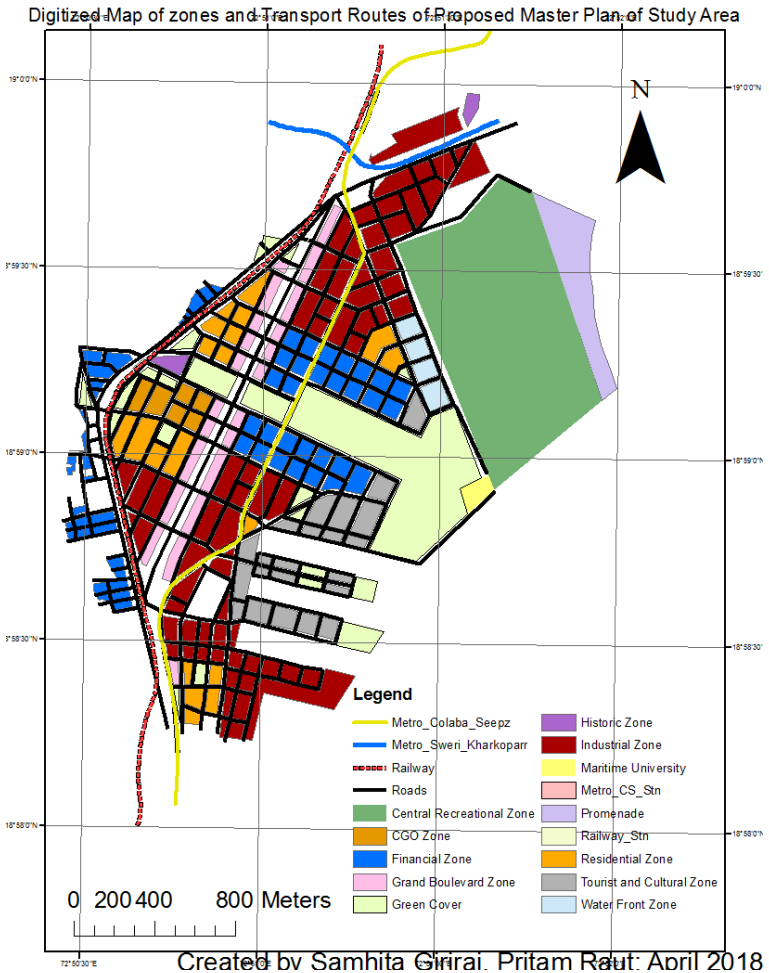


Figure 3. Digitized Map of Zones and Transport Routes of Study Area

Methodology

The Methodology of the project was carried out in two steps:

Literature review

The projects and reports made previously on similar lines of this topic were researched on the internet to find the guideline of work and the parameters considered while undertaking the suitability of the bus stop sites. Along with that, pertaining chapters from Volume 1 of the Urban and Regional Developmental Plans Formation and Implementation by the Ministry of urban Development was briefly read in order to get a glance of the urban planning aspect of the project. Extensive trial and error ideas and methods were thought of in order to make this project unique as well as feasible, till the final resultant methodology was decided upon. The rest of the work was completely software based.

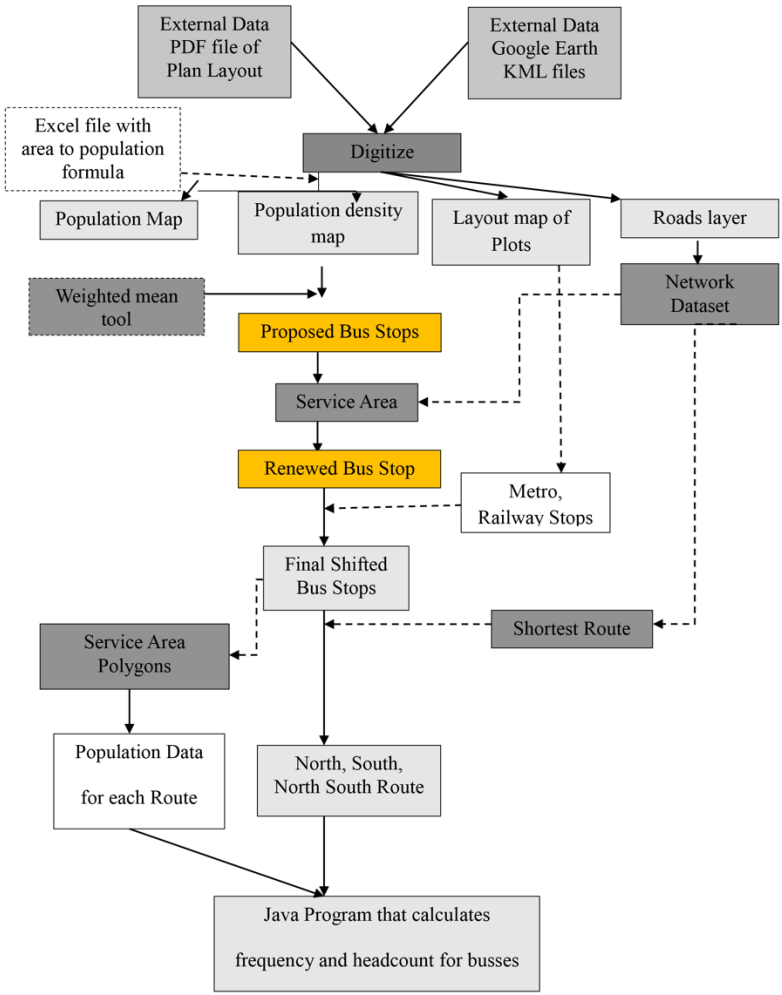
Laboratory work

From the digitizing of the plans, to the analysis, and final bus stop location generation to the prediction of travelers for each route and converting it into a java code was all done in the laboratory. Data of the masterplan is highly confidential and hence pdfs of the plan were shared with us. All of this data was converted into ArcMap 10.3 format by digitizing for analysis and result generation on the software. Once the analysis was complete, Java JDK and JRE were used to create a command prompt run java code to display attribute data of the result. During the analysis, population and population density maps were created using the regional fsi and plot area values, and the expected population per square meter. Microsoft excel was used for these calculations.

Softwares used are:

- ArcMap10.3
- Microsoft Excel
- Java | Notepad | Command Prompt

Methodology flow



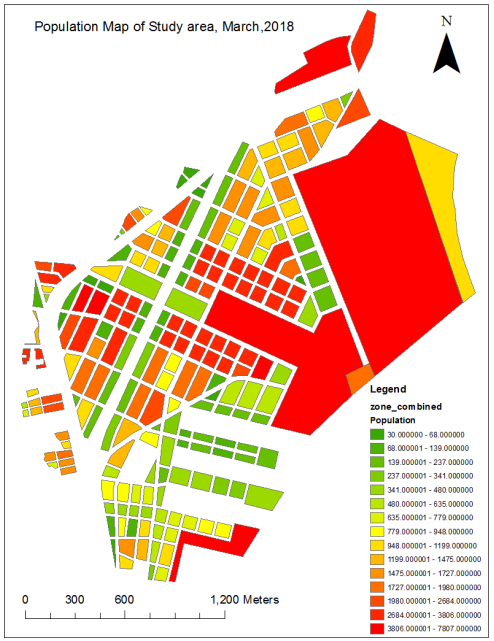


Figure 4. Population Map of Study Area.

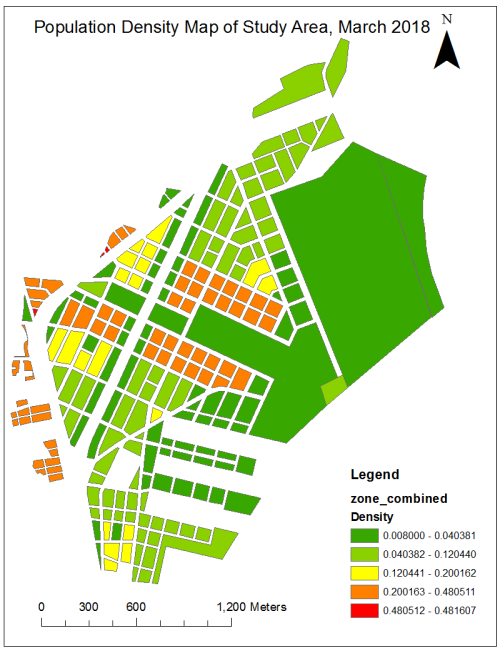


Figure 5. Population Density Map of Study Area.

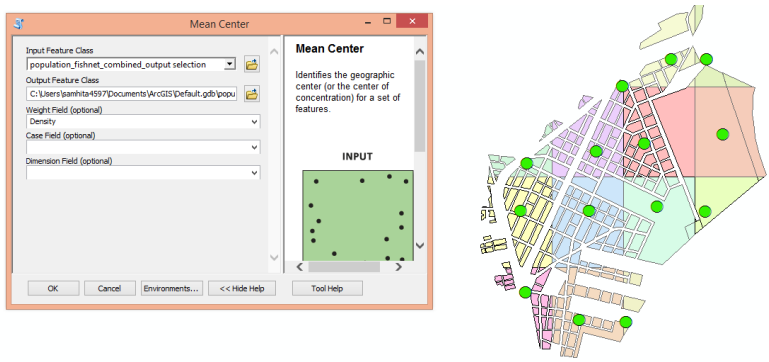


Figure 6. Mean center tool and mean center created

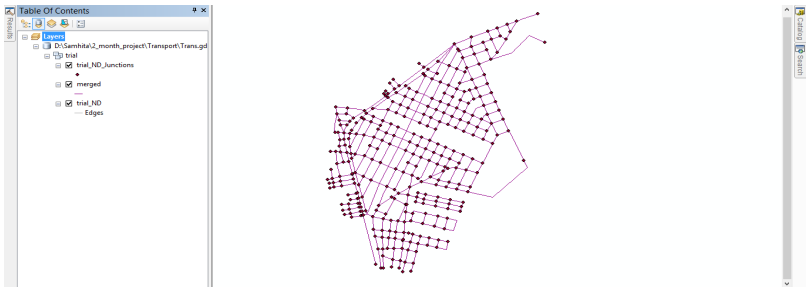


Figure 7. Network dataset

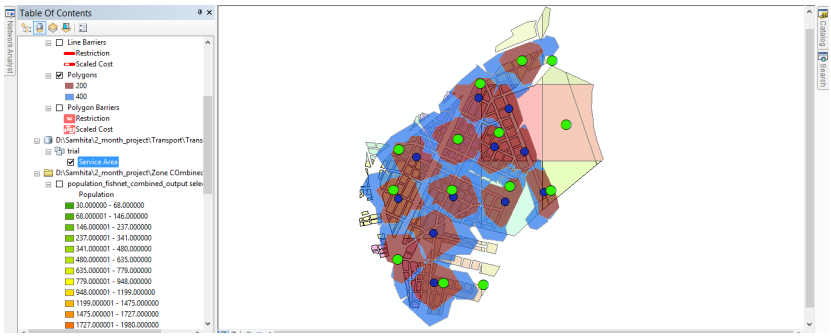


Figure 8. Moved bus stops & original mean centers (maroon: 200m, blue: 400 m walking radius)

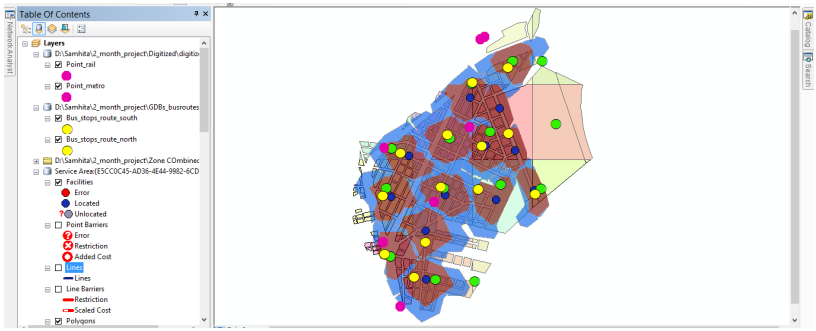


Figure 9. Shifted Bus Stops (maroon: 200m, blue: 400 m walking radius)

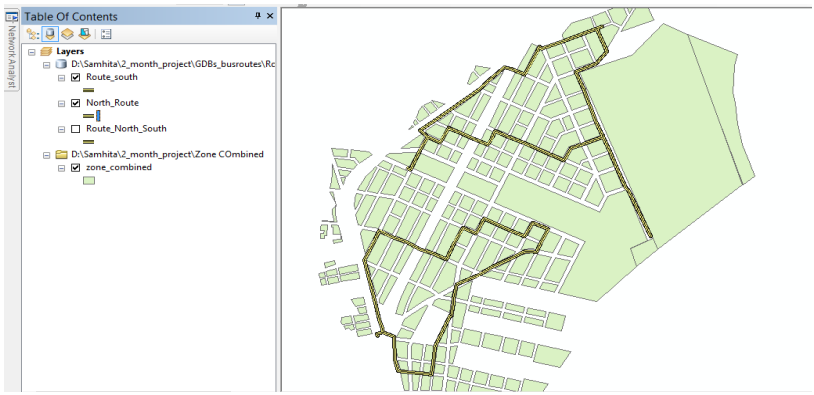


Figure 10. North South route

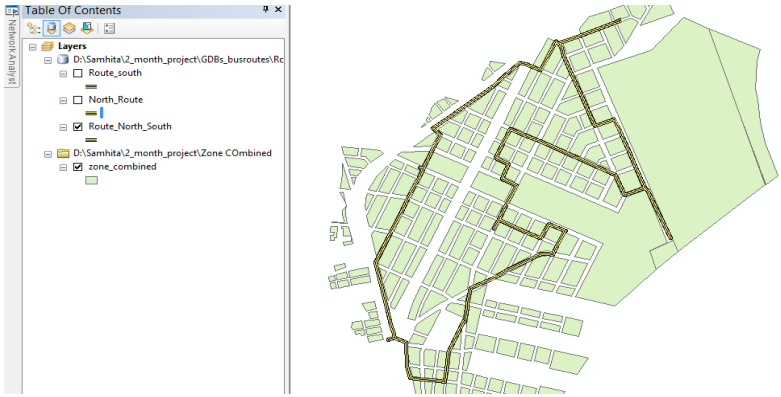


Figure 11. North-South route

Result and discussion

The final output result of the entire exercise resulted in formation of a total of 14 bus stops across the 500ha of area. It is seen that these 14 stops are adequate to cover the entire area using service area of 400m. These bus stops and their distribution was studied and it was visually interpreted along with the help of the external guide that the area already has a good north to south connectivity as the metro and railway stations and lines traverse north-south. Hence, the area needed a system that traverses east west from the rail and metro station to within the township. Hence, we proceeded with the creation of a north route, which goes in a circular shape across all the northern sectors and one similar for the south. This makes travelling for those who are definite of their source and destination a short and fast travel. Further, to maintain connectivity across the whole plan, even a longer north south route covering all 14 bus stops is created. The routes are all created using the network analyst shortest route creator, hence there are the distance wise shortest routes. This makes the travel fast.

Once the bus stops are generated, their accessibility is proved using the service area polygon generation. Next, the basic management of the bus schedules can be predicted by finding out the approximate expected headcount for each route. This is done by clipping the population map using service areas for each route. Hence, using summary statistics tool, we can find the number of people covered in a route, for each route.

As discussed earlier, the result of the prediction of traveler count is assumed different for morning scenario and evening scenario. The morning scenario consists of expected travelers from the zones of CGO, Financial, Business, Grand Boulevard, Maritime University, Industrial and Residential. This is because the working population will travel towards the town from the station, and resident of the areas may travel away to their work places from the town to station. The opposite logic is applied for the evening where workers will move towards station and residents will move towards town. Also, in the evening, tourists are also counted with the rest of the population as that is the time sightseers and entertainment are expected in the town.

Once this count for each route, for each time of the day is known, all this information is fed into the java program. The java program asks the user for input for a desired route, and a desired time of day. Further it asks the user how much percentage of travelers out of the entire population is expected to use the bus service. Then, using mathematical expressions fed in the system, the system then calculated the total number of buses trips required to carry that number of passengers, and that what must be the frequency of the buses so as to carry out transportation in a time frame of 3 hours. The number of hours is assumed as 3 because an inflow and outflow, basically, population flow during rush hours in Mumbai is seen across a span of averagely 3 hours.

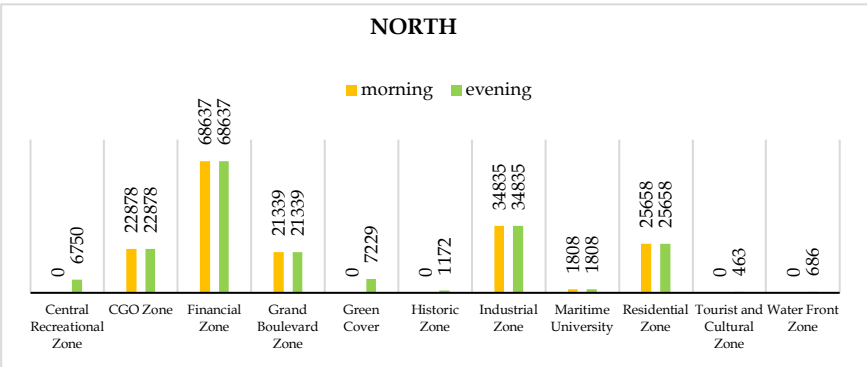


Figure 12. Population on the North Route.

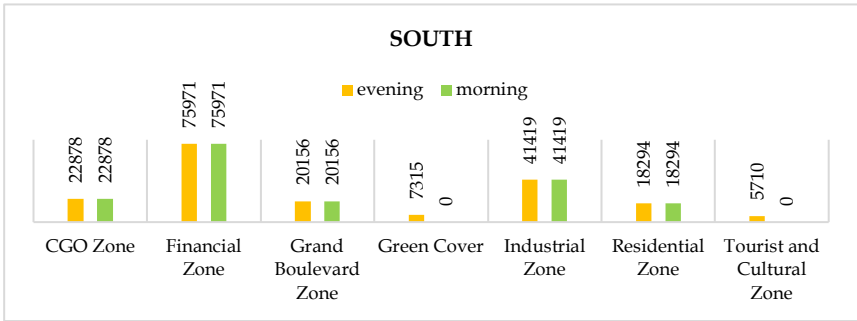


Figure 13. Population on the South Route.

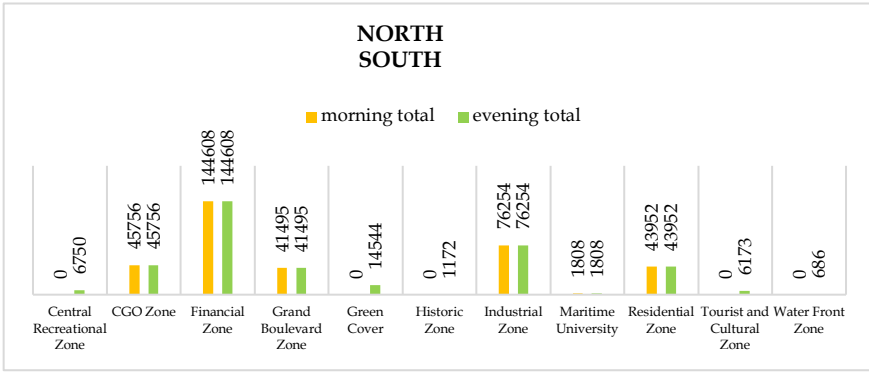


Figure 14. Population on both route

A screenshot of the java program discussed earlier is shown here. The user input preset data, and calculations as well as output logic can be seen in it.

```
Java Program:
import java.util.*;
import java.lang.*;
class demoone
{
 public static void main(String args[]){

  String routename;
  String time;
  int headcount;
  float coverage;
  int carriercapacity;
  float vehiclescount;
  float frequency;
  float count;
  float wqkh;

  Scanner sr=new Scanner(System.in);
  System.out.print("Enter route name
(options North/South/Northsouth)");
  routename=sr.nextLine();
  Scanner wq=new Scanner(System.in);
  System.out.println("What is the
percntage of population you expect to use
the service?");
  wqkh=wq.nextFloat();

  if (routename.equals("North"))
  {
   Scanner ti=new Scanner(System.in);
   System.out.print("Enter time (options
Morning/Evening)");
    time=ti.nextLine();
    if(time.equals("Morning"))
    {
     coverage=5897;
     carriercapacity=30;
     headcount=175155;
     count=(wqkh * headcount)/100;
     vehiclescount=count/carriercapacity;
     frequency=120/vehiclescount;
    }
    else if(time.equals("Evening"))
    {
     coverage=5897;
     carriercapacity=30;
     headcount=191455;
     count=(wqkh * headcount)/100;
     vehiclescount=count/headcount;
     frequency=180/vehiclescount;
    }
    else
    {
    System.out.println("Wrong input");
    }
  }
  else if (routename.equals("South"))
  {
   Scanner tii=new Scanner(System.in);
   System.out.print("Enter time (options
Morning/Evening)");
    time=tii.nextLine();
    if(time.equals("Morning"))
    {
     coverage=4155;
     carriercapacity=30;
     headcount=178718;
     count=(wqkh * headcount)/100;
     vehiclescount=count/headcount;
     frequency=180/vehiclescount;
    }
    else if (time.equals("Evening"))
    {
     coverage=4155;
     carriercapacity=30;
     headcount=191743;
     count=(wqkh * headcount)/100;
     vehiclescount=count/headcount;
     frequency=180/vehiclescount;
    }
    else
    {
    System.out.println("Wrong input");
    }
  }
  else if(routename.equals("Northsouth"))
  {
   Scanner tti=new Scanner(System.in);
   System.out.print("Enter time (options
Morning/Evening)");
    time=tti.nextLine();
    if(time.equals("Morning"))
    {
     coverage=9885;
     carriercapacity=30;
     headcount=305461;
     count=(wqkh * headcount)/100;
     vehiclescount=count/headcount;
     frequency=180/vehiclescount;
    }
    else if (time.equals("Evening"))
    {
     coverage=9885;
     carriercapacity=30;
     headcount=333459;
     count=(wqkh * headcount)/100;
     vehiclescount=count/headcount;
     frequency=180/vehiclescount;
    }
    else
    {
    System.out.println("Wrong input");
    }
  }


  System.out.println(
   routename+"is routename"/n +coverage
is + "coverage"/n + headcount is +
"headcount"/n + frequency is +
"frequency"/n+"number of vehicles
is"+vehiclescount);
  }
}
```

Figure 15. Java Program

Conclusion

As it is observed from the results of this project, the possible number of bus stops suggested are kept to a minimum to avoid clustering, at the same time maintaining good walking accessibility and spread throughout the township. It is seen that the bus stop location meets the criteria of less walking distance for higher population density areas; walking distance from majority location to nearest bus stop to be less than ~400m; and predicting in advance the different behavior of travelers statistics so that management planning can be more comprehensive and polished.

This creates a provision for development in the way that it encourages high density and mixed use development, overall reducing the travel demand and in turn reducing the carbon footprints otherwise caused by personal transport Mott MacDonald (2014).

One of the biggest problems that we encountered during this project was the estimation of population in tourist area and green cover areas. The population chosen for these areas for this project is the area of the plot divided by the per square per capita standard defined by the URDPFI guidelines. However, that is the population expected when the area is thought to be jam packed to the brim, which will not be the case always. Hence, the population expectancy in these areas is much higher assumed than it would be seen. However, we continued with these values as the plan is not yet constructed and hence it was not possible to collect data about average population expected in these areas.

Also, it would be beneficial if the road directions and the U-turns, turns for the roads would be known for the current plan so that it could be incorporated into the network dataset. However, since these have not been decided yet, we have assumed two way and U-turns at all junctions and turns at all junctions in our current network dataset.

A common problem we faced dealing with this plan is that it is one that currently is just on paper hence any kind of data collection for behavior understanding or any field visits were not possible, and every assumption was to be made based on further assumptions.

Over time we realized that certain things if done differently could add to this project and its quality, that are currently not incorporated. The current functioning of the Mumbai bus and other transport system and studying their patters and response, as well as the other parameters like traffic flow patterns, etc., should have been considered in this project too. That would make the prediction of use of this bus service even better. Also, a better study of functioning of advance tools in network analysis could help more. Further, the java program could be converted into a website and much attractive user interface if the analysis was completed earlier. However, the logic stays right.

References

Foda, M. A., & Osman, A. O. (2010). Using GIS for Measuring Transit Stop Accessibility Considering Actal Road Pedestrian Network. *Journal of Public Transportation, 13*(4), 23-40.

MCGM. (2006). *Mumbai City Development Plan 2005-2025.* Mumbai: MCGM.

Mott MacDonald (2014). *Urban and Regional Development Planning Formulation and Imlementation*.

Mumbai Population 2018. (2018). Retrieved from World Population Review: http://worldpopulationreview.com//

Olowosegun, A., & Okoko, E. (2012). *Analysis of Bus-stops locations using Geographic Information in Ibadan North L.G.A Nigeria.* Ibadan: Department of Transport Management Technology, School of Management Technology, Federal University of Technology, Nigeria.

Varshney, M. (2018). *Mumbai Transportation System Transformation*. Retrieved from IGLUS- Innovative Governance of Large Urban Systems: http://iglus.org/mumbai-transportation-system-transformation/

Wilson, E. (1995). The Use Of GIS In Environmental Assessment. *Impact Assessment*, 199-206.

10

Green Infrastructure: Smarter Solutions for Small and Medium Towns in India

Iswarya Ramachandran and Abhinav Madhavanunni

Abstract

Given the rapid rate of urbanization in India, there is an increased pressure on growth of medium and small sized towns, where existent access to nature and green components are diminished and converted into increasingly urban areas. Many of the medium sized towns which are being assisted by government missions for infrastructure development, while acknowledging their natural resources, place more emphasis on improved grey infrastructure than on innovative integration of green infrastructure into the urban environment which give a multitude of proven public health benefits. This study aims to investigate the importance of planning of Green Infrastructure as an effective way of dealing with mental health and wellbeing and its role in the quality of life and economic productivity in a city. The study highlights the case of Shivamogga city, a tier-III city situated at the foot of the hilly region of the Western Ghats, known for its lush greenery and plantations. The study enlists the proposed development measures that aim to improve infrastructure of the city, and find opportunities to integrate with them green infrastructure components from the scale of Rainwater Harvesting to Sustainable Urban Drainage Systems (SUDS) as an utility approach, to incorporating Water-sensitive Urban Design (WSUD) as a design approach for larger areas, to overarching green infrastructure policy for city development that takes to cognizance the need to ensure socio-economic and cultural benefits to its citizens.

Introduction: India's urbanization characteristics

India is one of the fastest urbanizing countries in the world. India's urban population has increased from 222 million (26% of

the population) in 1990 to 410 million (32%) in 2014 and is projected to soar to 814 million (50%) by 2050 (Randhawa & Kumar, 2017).

In India, a census town (an urban area) is any settlement that has a population of 5000, population density of 400 persons per sq.km, and more than 75% of the working male population involved in non-agricultural employment. Towns with population more than 100,000 are classified as Class I cities. Further, the cities are classified as Tier I having population of more than 5,000,000, Tier II having population between 500,000 and 5,000,000, and Tier III cities having population below 500,000.

The urbanization pattern in India has largely been skewed towards metropolitan cities, capital cities and agglomerations. India's urban structure can be characterized as top-heavy, where the percentage share of urban population in towns with population more than 100,000 is nearly 70% with 264.9 million persons, of which 160.7 million persons live in Million Plus towns or Urban Agglomerations (Office of the Registrar General & Census Commissioner of India, 2011). Projections claim that India will have the largest concentration of mega cities in the world by 2030 (Randhawa & Kumar, 2017).

The focus on the Tier I and Tier II begin with their significance as capital towns or historical port towns and trade settlements, or even religious centers, from the times of indigenous rulers, emperors, conquerors and colonial regimes. Most investments into infrastructure development and business development have been channeled into these cities, resulting in lopsided urbanization pattern where the smaller towns and the medium cities are neglected over a long period of time. Several scholars have mentioned trends of dysfunctional urbanization and urban accretion, resulting in higher concentration of population, both by natural increase and migration, in a handful of large cities even without a 'corresponding increase in their economic base' (Jayswal & Saha, 2014).

It is observed that the rate of provision of support infrastructure and services is unable to catch up with the rate at which population and industries are growing in the cities of the developing world, owing to limited resources, both material and

human. This trend has led to not only economic impacts, but also significant social and cultural impacts.

The issues of uncontrolled spatial expansion and sprawl, pollution, traffic, limitations in water supply and sanitation, lack of open and green spaces, public health woes, crime, affordable housing, unemployment, and squatter settlements are all too common in the rapidly growing metropolitan cities due to the gap in demand and supply of infrastructure services. This adversely affects the quality of life and hence the overall health of large populations with the triple threat (World Health Organization & UN-Habitat, 2016) of spread of infectious or communicable diseases, lifestyle related disorders or non-communicable diseases, crime and social inequality.

There is an enormous rise in non-communicable diseases, stress-related disorders, crime due to social instability and friction, and vulnerability to disaster events in Indian cities, which are invariably linked to rapid urbanization and misplaced focus on technology rather than on people.

To combat the manifold impacts, a developing economy like India needs to prioritize facilitating distributed urbanization by shaping the growth trajectory of Tier II cities and raising the quality of life in Tier III towns (McKinsey Global Institute, 2010). Planned efforts for sustainable growth and investments need to be channeled towards Tier II and Tier III cities to ensure that the old models of urban service delivery are relooked at, and people centric urban areas are built, where livability of the cities and wellbeing of citizens are not compromised.

Defining happiness and wellness

Happiness, wellbeing and quality of life are broadly synonymous concepts (Anand, 2016). The meaning of happiness is clear and precise whereas the meaning of wellbeing could be interpreted differently such as physical wellbeing, economic well-being etc. (Scollon, 2003). Even though GDP has been synonymous to the growth of national welfare over the last 80 years, it has been inaccurate in its use as a yardstick to measure society's wellbeing. Income has been the one of the most studied factors of happiness but Graham's studies have shown that there

is a high co-relation between happiness and three other factors such as health, unemployment and inequality (Graham, 2005).

One of the leading countries to apply theories of wellbeing into national policy is Bhutan. The constitution of Bhutan enforced that Gross National Happiness as a more appropriate measure of development and wellbeing than Gross Domestic Product. The concept is more than just a guideline and is used to define public policy which will enable the pursuit of Gross National Happiness. The Gross National Happiness Index includes several factors like psychological wellbeing, health condition, literacy and educational qualifications, cultural influences, balance of work and leisure, good governance, community vitality, ecological diversity and resilience and living standards. Out of these many factors, one factor that can act as a solution to urban infrastructure challenges are ecological diversity and resilience. The protection of the ecology will help to maintain the natural environment in urban areas and use the ecosystem services to cater to the infrastructure demands of the city. In this way, resilient infrastructure is built which will not only contribute to the access to nature but also increase the wellbeing of the society.

Green Infrastructure

Man has always responded to the needs and desires of society by creating, adapting and reshaping infrastructure of his world. Infrastructure, the underlying foundation on which growth of a community depends, reflects social priorities in different cultures. By the 20th century, the adverse effects of many infrastructure systems on the environment became apparent due to increasing population and unprecedented urbanization. In 1962, Rachel Carson in her book *Silent Spring* highlighted the dangers of chemicals in our world. It ignited the environment movement and there was a growing awareness about the impact of such growth on the environment. This unprecedented growth has decreased nature's ability to cope with the short-term and long-term environmental trends (Williamson, 2003).

In 1983, the United Nations' World Commission on Environment and Development brought together representatives of 21 countries to discuss sustainable

development on how to promote economic development throughout the world without adversely impacting the environment. The concept of sustainability requires mankind to tap into natural systems to improve the quality of life which also enhances the natural processes we rely on for our existence.

Green Infrastructure is an approach to building infrastructure which is inspired from natural systems. It is a multi-scale network of ecological features and systems which provides multiple benefits and a systems approach to planning and development that recognizes the value of ecosystem services. It also strives to integrate and enhance those ecosystem services within our built environment. Green infrastructure can be either be looked as a landscape network which includes open spaces or an ecological feature that manages water and both serve as complimentary strategies. It is not limited to a particular type of technology or a task rather it's a result of a wide network of institutions, agencies, organizations and citizens bringing ecosystem services back into planning and development. (Kimmel, Robertson, Hull, Mortimer, & Wernstedt, 2013)

Ecosystem services can be defined as the direct and indirect contributions of ecosystems to human well-being (TEEB, 2009). The TEEB Guide has classified ecosystem services into (TEEB - The Economics of Ecosystems and Biodiversity, 2011):

1. Provisioning services: Services that produce a material or energy output such as food, water and other resources.
2. Regulating services: Services which ecosystems provide by acting as a regulator such as the quality of water and soil or by the provision of flood control
3. Cultural services: Non-material service outputs such as recreational and aesthetic experience.
4. Habitat or Supporting services: Services that support all other services.

Why Green Infrastructure?

With increasing urbanization, the urban population of the world also has increased drastically. In 1800, 10% of the world population lived in urban areas whereas in 2000, the urban population increased to 50%. It is estimated that almost 75% of

the world population will live in urban areas by 2050. In the 21st century, cities have been known as the engines for economic growth. It accounts for 70% of all economic growth. People living in urban areas are 50% more productive than rural areas. On an average, per capita output increases by 30% for every 10% increase in a country's urbanization (Gleaser, 2011). Due to these trends, the way we design our infrastructure systems will have a huge impact on development (Sustainability, 2013).

Infrastructure, until recently, has been synonymous with engineered systems like transportation, energy, water, etc. The traditional infrastructure system is called grey because they ignore the green ecological system that preceded them (Belanger, 2010). Even though grey infrastructure offers immediate and high visibility impacts, they tend to be capital intensive to build, operate, maintain and replace. Green Infrastructure has emerged as a holistic approach to integrate ecosystem services into the built landscape and infrastructure development (Sustainability, 2013).

Relevance of GI in medium cities

Green Infrastructure has the capacity to provide social and ecological benefits such as increased access to green spaces, public health improvement and decreased urban heat island effects. The concept is gaining popularity in modern storm water management which makes use of ecosystem services for storm water management. The implementation of green infrastructure requires a paradigm shift from traditional centralized, pipe-bound conveyance system to decentralized nature-based system of storm water management (Lieberherr, 2018). Its benefits span over 3 overarching areas of water management:

Water supply regulation: water supplies invariably depends on the surrounding landscapes of watershed and aquifer. Since natural ecosystems are the foundation of water provision, GI solutions that impact hydrological process such as runoff and infiltration can be used to maintain or enhance water supplies. It can maintain the supplies through increasing water infiltration and recharge of aquifers. Droughts and other disasters can be avoided by increasing the water storage as groundwater, surface water etc.

Water quality regulation: water pollution comes from both point and non-point sources resulting in the major challenge of water-borne diseases from the contamination of water. Some of the infrastructure solution to these challenges are to create a water drainage infrastructure to capture wastewater and divert it into treatment facilities. GI can help purify the polluted water through filtration and chemical conversion and protects the groundwater by removing sediments and other pollutants.

Moderation of extreme events: Traditional flood management practices such as dams, levees etc. have been essential but they also contribute to great losses when the system fails. GI solutions can moderate flood events by increasing the ability of landscape to hold water and improve the abilities of the channel to convey water.

Shimoga City – Background

Shimoga or Shivamogga city is the district headquarters of Shimoga district, known as the rice bowl of Karnataka. Lying on the banks of the Tunga river, it is a hub of agricultural produce and agro based industries. It has a glorious history of being ruled by dynasties of the Kadambas, Gangas, Chalukyas, Rastrakutas, Keladi and Vijayanagar kings. Its lush greenery and natural beauty, along with icons of its rich tradition and culture, has made Shimoga into a tourist destination.

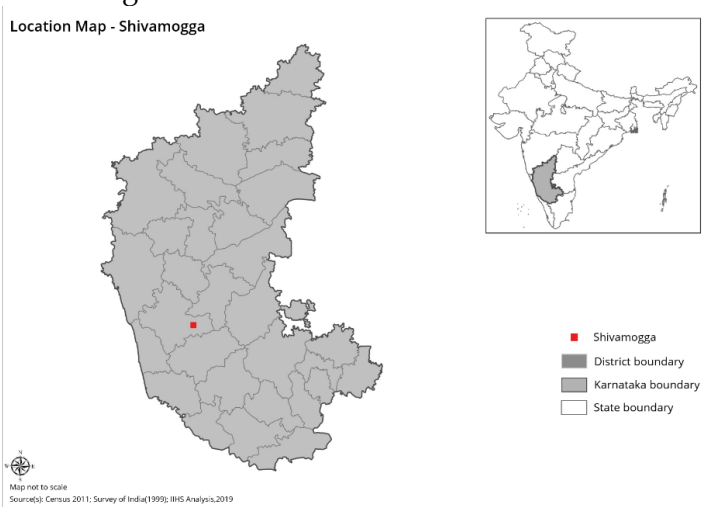


Figure 1. Location map, Shivamogga

This landlocked Tier III city is well connected through road and rail networks to the small and large towns of the state like its capital Bengaluru, and also to the neighbouring states of Tamil Nadu and Goa, thus strengthening its trade and commerce connections. Agro-based, automotive-based and engineering based industries are prevalent in Shimoga.

Shimoga is also an important academic centre in Karnataka and is one of the major economic drivers in the region for education, where two new knowledge cities are proposed. Along with its growing network of health and educational facilities, Shimoga attracts residents who work in industrial units in neighbouring towns as well.

Covering 50 sq. km, the city has a population of 322428 as per census 2011. The city's development was initially limited to the western side of the river Tunga in a compact form, but most of the new developments are proposed on the eastern side of the river, causing the expansion of Shimoga. Like any other town, the expansion areas have a leapfrog pattern of development and have low FSI, contributing to urban sprawl.

The land use analysis from a previous research that studies a larger development area around the city boundary indicates that urban land use has increased from about 13% in 1992 to 33% in 2010, while in the same time period, vegetation has drastically reduced from 30% to 6% (Ramachandra & Aithal, 2012). Shimoga shows a high degree of infill development, therefore reinforcing its compact core, but the urban fringe is largely disaggregated (Ramachandra & Aithal, 2012).

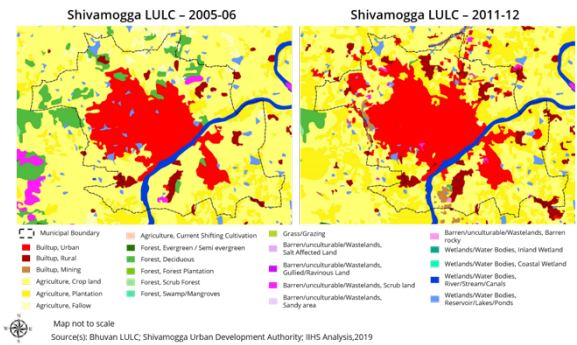


Figure 2. Comparison of Land Use Land Cover Maps, Shivamogga

Urban development projects in Shimoga city

The ongoing projects and proposals under various government initiatives provide an insight into the focus of developmental activity in Shimoga. These may outline both the developmental gaps in terms of infrastructure requirement of the city, as well as the local government's approach to the city's growth.

Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

AMRUT was launched in 2015 by the Ministry of Urban Development, GoI with a focus on infrastructure creation leading to better quality of living in cities with more than 100000 population. The mission places emphasis on water supply and sanitation, increase in a city's amenity value through its open and green spaces, and enhance mobility through provisions for non-motorized transport. Karnataka's first State Annual Action Plan outlines the infrastructure gaps and budget allocation for various cities to be funded by the mission. The sector-wise fund requirement distribution for the eligible 27 cities indicates requirement of 90% of the total budget to be allocated for water supply and sewerage projects and only 7% for storm water drainage. On the contrast, the specific fund requirement for Shimoga city alone shows an allocation of 42% of the city's funds for storm water drainage. Shimoga's coverage of storm water drainage network at the time of plan period commencement (as on April 2016) was a meagre 28.7%, and the target to be achieved at the end of mission period is 100% (Government of Karnataka, 2016).

Such low coverage of storm water drainage network is a vital indicator of Shimoga city's resilience to urban floods as well. In 2018, over 40 houses, a park and a private hospital in the low-lying areas of Shimoga city were affected by flash floods caused by swelling of River Tunga after a heavy rainfall over a period of 24 hours (The Hindu, 2018). This seems to be a recurring issue, as there were similar urban floods observed during 2006 monsoons as well (The Hindu, 2006). The design and planning of storm water drainage systems throughout the city should

have the capacity to deal with flash urban floods by reducing immediate impact on inhabited areas and to also add amenity value to neighbourhoods along with utility value.

About 0.03% of the city's total budget is dedicated for development of green spaces and parks (Government of Karnataka, 2016). Shimoga's existing green spaces and park area at the beginning of the plan period was only 0.48 sq. m. per person, and the mission target is to achieve 10-12 sq. m. of park area per person. Given the limited funding available and ever-expanding urbanization in the city, green areas should be integrated as much as possible in planning and design of neighborhoods to add utility value along with their amenity value.

Smart cities mission

The Smart Cities Mission was launched by the Government of India in 2015, with a purpose to drive growth and improve quality of life, not bound by any definition of a 'Smart City'.

The mission involves these main strategies: to provide core urban infrastructure – the components of physical infrastructure services and social amenities required to assure decent quality of life; to improve efficiency of this core infrastructure by integrating ICT enabled solutions; and a two-pronged approach to spatial urban development – Area based development and Pan city projects (Randhawa & Kumar, 2017).

The cities bidding for selection as one of the 100 Smart Cities in India have to prepare their own Smart City Proposal (SCP) with components of physical, social, economic and institutional infrastructure, based on needs of their local context and the availability of resources. The mission statement of Shimoga 'Smart City' is 'Ecological Transformation through Green Urbanism', and it commits to sustainable development hinged upon the larger themes of water and environment (Smart Cities Council India, 2019).

The flagship Area based development (ABD) project of Shimoga SCP is the Tunga Riverfront Development Plan. An 8.5 km stretch along the river bank is identified for development into several contiguous but distinct zones of recreational area, activity area, commercial area, environmental area and utilities.

By definitive projects that add more functions along the river, the city claims to leverage the guiding principle of 'Green Urbanism' to open new opportunities for socio-economic expansion. The riverfront, which is prone to flash floods during monsoons as discussed earlier, requires a sensitive and balanced approach to addressing storm water management, flood control and aesthetics. The true capacity of green infrastructure in the form of Water Sensitive Urban Design and Planning, to enhance efficiency of the utilities and to integrate social functions with ecological functions is left largely unexplored.

The city also recognizes the role of rapid urbanization in reduced rainwater percolation and increased storm water runoff. It acknowledges the need for active implementation of rain water harvesting in built structures of the city (Shimoga Smart City Limited, 2019). There is also mention of urban flooding due to the lack of pervious surfaces. The area based development proposal could have been more effective if this step was combined with rain water harvesting measures in the public domain by the use of green infrastructure.

It is notable that although Shimoga Smart city envisions its development to be centered around the broader themes of water and environment, there are no pan city project proposals addressing these domains directly. The emphasis is mostly on traffic and transportation and solid waste management, but no mention of the city's green spaces or storm water drainage system is made. A holistic approach tying these ideas could align more with the central idea of the city's vision.

Constituents of Green Infrastructure

There are several components under green infrastructure which work together to create a network of natural processes. These components vary in size and shape depending upon type and scale of the resource being conserved. The importance of these components determines the level of conservation required, and the sensitivity to human activity determines the level of interaction between man and nature.

Hubs: Acts as a place of variety of natural processes and provide an origin or destination for wildlife. Hubs include

reserves, managed native landscapes, working lands, parks and open space areas and recycled lands.

Links: Interconnecting the hubs to facilitate ecological processes. Links include conservation corridors, greenbelts and landscape linkages.

The interconnection of links and hubs is critical in providing landscape connectivity for ecological functions (Williamson, 2003).

Sustainable urban drainage system

The conventional urban drainage system focuses more on the quantity as it aims to avoid flooding incidents in urban areas. It has altered the natural flow pattern causing problems elsewhere in the catchment area. The quality of water has become an important issue as the surface run-off from the urban areas can contaminate the watercourses.

Sustainable Urban Drainage Systems or SUDs considers quality, quantity and urban flooding and are more sustainable than traditional drainage systems. It tries to mimic the natural drainage process where the storm water is treated, and the groundwater is recharged leading to increased biodiversity in the surrounding. The best practice is resulted by a combination of techniques.

Permeable pavements

Permeable pavements provide a surface which promotes water infiltration into the soil beneath. The water could also be released into a drainage system before it completes infiltration. There is no separate land required for these features as it can be incorporated in the road design. It removes the pollutants from water and reduces the run-off.

Filter strips

Filter strips are vegetated strips of land which accepts run-off from an upstream development and carries the water to a collection, treatment or a disposal system. They also promote settlement of particulate pollutants and infiltration (B Woods-Ballard, 2007).

Infiltration trenches/drains

Infiltration trenches are a shallow, excavated channel with a screen on top for blocking gross contaminants. The main purpose is to allow the run-off to filtrate into the ground. Infiltration drains carries the water through a narrow channel after it enters the trench.

Swales

Swales can be incorporated in the landscape areas. A swale is a grassed area of depression which provides storage, transport, treatment and infiltration of surface water. Swales provide an alternative construction method for roadside kerbs.

Bioretention

Bioretention areas are shallow landscaped depression with enhanced vegetation which removes pollutants and reduce run-off downstream (B Woods-Ballard, 2007).

Ponds and wetlands

Ponds and wetlands not only contribute to visual amenity but also form an important link in a network of sustainable urban drainage system. This has the potential to store various levels of water at different times which makes it deal with surface run-off and combat urban flooding.

Water sensitive urban design and planning

Water sensitive urban design and planning (WSUDP) deals with the effect of urban development on the hydrological cycle and the water sources. (CARMON, 1997) It is an approach that integrates and optimizes the use of existing water sources and completes the full cycle of urban water management. The following are the highlights of this approach:

Integrated approach: This strives for both physical and institutional integration. Proper linkages are made between water supply, wastewater and storm water through highly coordinated management.

Closed Urban Water Cycle: WSUDP focuses on re-use and recycling thus completing the urban water cycle loop. Water can be used multiple times through proper treatment.

Reduced demand: The demand can be reduced through conservation practices, rainwater harvesting and re-use. A decentralized system also results in leakage reduction.

Storm water as a resource: Storm water is collected and retained at source allowing it to infiltrate into the groundwater. The storm water infrastructure also enhances the landscape and has recreational opportunities.

Decentralization: The wastewater should be treated near the source with the aim of having a sustainable approach (Mahreen Matto, 2017).

Rainwater harvesting

Rainwater harvesting is the collection and storage of rain for a particular use from purpose- built catchment. It provides an ideal solution in areas with enough rain, but depleting groundwater and surface water resources. Collecting and storing rainwater assures a continued and reliable access to water when traditional sources are located far away. Once the rainwater is collected, it can either be stored for direct use or it can be used to recharge the groundwater and improve its quality. In urban areas, scarcity and high-water demand is a major problem and it can be reduced by rainwater harvesting. It indirectly reduces the storm drainage load and flooding in urban areas (Guidelines and Manual for Rainwater Harvesting in Maldives, 2009).

Rainwater harvesting is one of the oldest methods of collecting water for domestic purposes. It can be applied mainly for two purposes: storage for domestic use and recharge into the ground. The technology option depends on the purpose and the existing meteorological and hydrological condition.

Components of rainwater harvesting

Catchment: Catchment is the surface upon which the rain water is captured. It can be a paved (terrace or courtyard), unpaved (lawn or open ground) or a semi paved area (The Hindu, 2006)

Conveyance: The transport channels which carries water from the catchment areas to storage tanks or recharge wells. Gutters are used for horizontal channels and down-take pipes for vertical channels.

Storage/Recharge: Tanks where rainwater is collected and store or used to recharge the ground water through open wells, bore wells, percolation pits, etc.

How does GI contribute to wellbeing?

GI offers a range of opportunities to bring more greening to everyday places where people live, work, learn and play. Providing nature experiences across a connected system can generate a wider spectrum of benefit than site by site installation. Some of the benefits are as follows:

Active living

This is a simple way to improve health which includes walking and cycling along riverfronts, roadsides, etc. Studies show that having neighbourhood parks and green spaces boost activity levels of people. Outdoor activity also reduces depression, frustration, stress and anxiety. Delhi, the world's second most populous city, has experienced rapid, planned and unplanned expansion at the cost of its green cover in recent decades. In this study, we use satellite images from 1986, 1999 and 2010 to map changes in urban and green cover, assess the fragmentation of green spaces, and identify the drivers of change. We find that urban patterns of development have shaped the distribution and fragmentation of green spaces, with the city center containing more green spaces with less fragmentation compared to intermediate areas and the peri-urban periphery. Yet, the city core has also experienced the greatest degree of vegetation clearing and fragmentation over time due to infrastructural expansion, while the peri-urban periphery has shown an increase in vegetation and a decrease in fragmentation due to recent compensatory plantation in these peripheral areas. Forests, archaeological sites, and military and academic campuses have played a major role in protecting green cover and limiting fragmentation in the core and intermediate areas of the city. This research helps in advancing our understanding of the pattern-process relationship between urbanization and land cover change/fragmentation in India's largest city (Paul & Nagendra, 2015).

Stress reduction

Active living is directly related to stress reduction. Being active causes the brain to produce endorphins that improves mood and reduces stress (Hilton & Wolf, 2018). Research shows that being in a green environment enhances restorative effects of exercise which potentially boosts the frequency of a person's exercises. This further contributes to healthier behaviour, reduces stress and improves productivity and mental well-being. The body's positive response to nature is indicated by cortisol levels, blood pressure and heart rate. (Wolf, 2018)

Improved mental performance

As more than half of the people in the world living in urban areas and adopting urban lifestyles that impose increasing demands on our cognitive resources. (Heather Ohly, 2016) It takes great cognitive effort to manage the resources needed for our attention often leading to mental fatigue. This cognitive overload is known as directed attention fatigue. The Attention Restoration Theory, as described by Stephen and Rachel Kaplan, proposes that exposure to nature can help us improve focus and ability to concentrate (Hilton & Wolf, 2018).

One of the main components of theory is the element of fascination which is further divided into two:

Hard fascination: When your attention is held by a highly stimulating activity in which our mind gets completely absorbed but this is not necessarily restorative. For example, watching a movie or playing a sport can be a form of hard fascination.

Soft fascination: When your attention is held by a less stimulating activity which generally provides the opportunity to reflect and introspect. (Wolf, 2018) For example, watching a bird or looking out of a window can become a soft fascination where the activity may be mildly stimulating but still there is room of reflective thoughts, therefore improving the mood and restoring mental peace. Attention Restoration Theory (ART) suggests the ability to concentrate may be restored by exposure to natural environments. Although widely cited, it is unclear as to the quantity of empirical evidence that supports this. A systematic review regarding the impact of exposure to natural

environments on attention was conducted. Seven electronic databases were searched. Studies were included if (1) they were natural experiments, randomized investigations, or recorded "before and after" measurements; (2) compared natural and non-natural/other settings; and (3) used objective measures of attention. Screening of articles for inclusion, data extraction, and quality appraisal were performed by one reviewer and checked by another. Where possible, random effects meta-analysis was used to pool effect sizes. Thirty-one studies were included. Meta-analyses provided some support for ART, with significant positive effects of exposure to natural environments for three measures (Digit Span Forward, Digit Span Backward, and Trail Making Test B). The remaining 10 meta-analyses did not show marked beneficial effects. Meta-analysis was limited by small numbers of investigations, small samples, heterogeneity in reporting of study quality indicators, and heterogeneity of outcomes. This review highlights the diversity of evidence around ART in terms of populations, study design, and outcomes. There is uncertainty regarding which aspects of attention may be affected by exposure to natural environments. (Ohly, et al., 2016)

Creativity

Exposure to natural environment can boost walking and other physical activities. Walking demands executive function to handle the dual nature of walking while thinking and more creativity seeps in as a side effect. Walking also has a strong influence on the expression of associative memory. Ideas tapped into the unique associative network of the person leading to an increase in novelty as compared with other people's ideas. (Schwartz, 2014)

Healing and therapy

Public health services are major expenses not only for individuals but also for cities and states. Nature helps in reducing the cost. For example, hospital patients with views of nature display less severe pain, shorter hospitalization times, less anxiety, and higher hospital and room satisfaction (Ulrich, 1984).

Social cohesion

People need social interactions to be healthy and resilient. This dynamic is called social cohesion. Good social connections are linked to fewer symptoms of depression (Perez, 2015).

Conclusion

A developing economy like India needs an urgent boost in its infrastructure development. With the result of rapid growth and development in urban areas, the existing infrastructure is unable to cope with the growing population. As the activity of infrastructure building and provision is expensive, it is important that both long-lasting sustainable solutions as well as cost effective solutions are applied to bridge the ever-widening gap between demand and supply of infrastructure needs in the rapidly urbanizing cities. The paper highlights the relevance and importance of substituting conventional grey infrastructure systems with eco-friendly nature based green infrastructure systems for efficient urban service delivery while adding immense amenity value to the Tier II and III cities. Green Infrastructure is a broad concept of sustainable development which offer different solutions in different regions. Small and mediums towns which are undergoing the process of rapid urbanization can adopt nature-based practices for their storm water management and green spaces paving the way for the sustainable growth and development of the towns. While urban missions and government programmes aid specific projects targeting the results, it is important for the government to rethink the approach to be people and environment centric in nature. To this end, it is crucial to formulate policies that incentivise and mandate nature-based solutions for overall urban development and wellbeing of the citizens.

References

Anand, P. (2016). *Happiness, wellbeing and human development: The case for subjective measures.* UNDP Human Development Report. Retrieved from http://hdr.undp.org/en/content/happiness-well-being-and-human-development

Bélanger, P. (2010). Redefining Infrastructure. In M. Mostafavi, & G. Doherty (Eds.), *Ecological Urbanism* (pp. 332-349). Baden, Switzerland: Lars Müller Publishers.

Carmon, N., Shamir, U., & Meiron-Pistiner, S. (1997, January). Water-sensitive Urban Planning: protecting groundwater. *Journal of Environmental Planning and Management, 40*(4), 413-434. doi:10.1080/09640569712010

Diener, E., Scollon, C. N., & Lucas, R. E. (2003). The evolving concept of subjective well-being: The multifaceted nature of happiness. In P. Costa (Ed.), *Recent Advances in Psychology and Aging* (Vol. 15, pp. 187-219). Amsterdam: Elsevier. doi:10.1016/S1566-3124(03)15007-9

Glaeser, E. (2011, July 29). Cities, productivity and quality of life. *Science, 333*(6042), 592-594. doi:10.1126/science.1209264

Government of Karnataka. (2016). *State Annual Action Plan (SAAP) FY 16-17 under AMRUT in Karnataka.* Retrieved from AMRUT: http://amrut.gov.in/writereaddata/saap/Karnataka.pdf

Graham, C. (2005). Insights on development from the economics of happiness. *The World Bank Research Observer, 20*(2), 201-231. Retrieved January 20, 2020, from www.jstor.org/stable/41261416

Jayswal, N., & Saha, S. (2014). Urbanization in India: An Impact Assessment. *International Journal of Applied Sociology, 4*(3), 60-65. doi:10.5923/j.ijas.20140402.04

Kimmel, C., Robertson, D. R., Hull, B., Mortimer, M., & Wernstedt, K. (2013). *Greening the Grey: An Institutional Analysis of Green Infrastructure for Sustainable Development in the US.* Center for Leadership in Global Sustainability, Virginia Tech.

Lieberherr, E., & Green, O. O. (2018). Green Infrastructure through Citizen Stormwater Management: Policy Instruments, Participation and Engagement. *Sustainability, 10(6)*(2099). doi:10.3390/su10062099

McKinsey Global Institute. (2010). *India's urban awakening: Building inclusive cities, sustaining economic growth.* Mumbai: McKinsey & Company.

Millar, J. S., & Hull, C. (1997, January). Measuring Human Wellness. *Social Indicators Research*(40), 147-158. doi:10.1023/A:1006803426777

Ministry of Housing Transport and Environment, Government of the Republic of Maldives. (2009, July). *Guidelines and Manual for Rainwater Harvesting in Maldives.* Retrieved January 12, 2020, from World Health Organisation - South-East Asia: http://origin.searo.who.int/maldives/documents/Maldives__Guidelines_and_manual_of_Rain_Water_Harvesting_in_Maldives_2009.pdf

Office of the Registrar General & Census Commissioner of India. (2011). *Census of India: Urban Agglomerations and Cities.* India: Government of India.

Ohly, H., White, M. P., Wheeler, B. W., Bethel, A., Ukoumunne, O. C., Nikolaou, V., & Garside, R. (2016). Attention Restoration Theory: A Systematic Review of the attention restoration potential of exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B, 19*(7), 304-343. doi:10.1080/10937404.2016.1196155

Oppezzo, M., & Schwartz, D. L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory and Cognition, 40*(4), 1142-1152. doi:10.1037/a0036577

Perez, L. G., Arredondo, E. M., McKenzie, T. L., Holguin, M., Elder, J. P., & Ayala, G. X. (2015). Neighborhood social cohesion and depressive symptoms among Latinos: Does use of community resources for physical activity matter? *J Phys Act Health, 12*(10), 1361-1368. doi:10.1123/jpah.2014-0261

Ramachandra, T. V., & Aithal, B. H. (2012). Spatio-Temporal Pattern of Landscape Dynamics in Shimoga, Tier II City, Karnataka State, India. *International Journal of Emerging Technology and Advanced Engineering, 2*(9), 563-576.

Randhawa, A., & Kumar, A. (2017). Exploring sustainability of smart development initiatives in India. *International Journal of Sustainable Built Environment, 6*(2), 701-710. doi:https://doi.org/10.1016/j.ijsbe.2017.08.002

Rohilla, S., Matto, M., Jainer, S., & Sharda, C. (2017). *Water-Sensitive Urban Design and Planning: A Practitioner' Guide.* New Delhi: Centre for Science and Environment.

Shimoga Smart City Limited. (2019). *Rain Water Harvesting*. Retrieved May 1, 2019, from Shivamogga Smart City: http://shivamoggasmartcity.in/rain-water-harvesting/

Smart Cities Council India. (2019). *Shimoga plans projects to the tune of Rs 4.44 bn (tenders floated for Rs 2 bn)*. Retrieved from Smart Cities Council India: https://india.smartcitiescouncil.com/article/shimoga-plans-projects-tune-rs-444-bn-tenders-floated-rs-2-bn

Southampton City Council. (2009). *Guide to Sustainable Urban Drainage Systems: Practical guidance for developers on achieving high quality design and construction* . Retrieved from http://www.southampton.gov.uk/policies/guide%20to%20sustainable%20development_tcm63-366634.pdf

TEEB - The Economics of Ecosystems and Biodiversity. (2011). *TEEB Manual for Cities: Ecosystem Services in Urban Management.* Retrieved from www.teebweb.org

TEEB. (2011). *The Economics of Ecosystems and Biodiversity in National and International Policy Making.* (P. t. Brink, Ed.) London and Washington: Earthscan.

The Hindu. (2006, August 13). *Swollen Tunga causes flash floods in Shimoga*. Retrieved May 1, 2019, from The Hindu: https://www.thehindu.com/todays-paper/tp-national/tp-karnataka/swollen-tunga-causes-flash-floods-in-shimoga/article3089644.ece

The Hindu. (2018, August 15). *Outflow up, localities flooded in Shivamogga, Bhadravati*. Retrieved May 1, 2019, from The Hindu: https://www.thehindu.com/news/national/karnataka/outflow-up-localities-flooded-in-shivamogga-bhadravati/article24693530.ece

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420-1. doi:10.1126/science.6143402

Williamson, K. (2003). *Growing with Green Infrastructure.* Doylestown, PA: Heritage Conservancy.

Wolf, K. L. (2018). *Cascading Benefits: Designing Green Stormwater Infrastructure for Human wellness.* Seattle WA: The Nature Conservancy.

Woods-Ballard, B., Kellagher, R., Martin, P., Jefferies, C., Bray, R., & Shaffer, P. (2007). *Sustainable Urban Drainage Systems Manual*. London: CIRIA C697.

World Health Organization & UN-Habitat. (2016). *Global report on urban health: equitable healthier cities for sustainable development.* Geneva: World Health Organization. doi:http://www.who.int/iris/handle/10665/204715

World Health Organization. (1948). Constitution of the World Health Organization. *Basic Documents*. New York.

11

A Vision for Livable Thromdes in the Democratic Bhutan

Dasho Kunzang Wangdi, Ugyen Lhendup and Kezang Wangdi[*]

If we are as successful in maintaining the places where we live, it will be a truly commendable achievement. It is our collective responsibility to ensure that where we live remain clean, safe, well organized, and beautiful, for all times to come.

- Royal Address of His Majesty The King of Bhutan on the Auspices of the Commemoration of The 109th National Day Celebration at Trongsa

Abstract

Bhutan is known for pursuit of happiness and 'Happiness is a Place'. With rapid urbanization taking place across the country, timely and futuristic proper planning is crucial for debarring from creating too many old Delhi, Thimphus and Bajos. Despite design and planning having taken into consideration since the reign of Third Druk Gyalpo, and Thimphu being chosen for the first design, we have had issues of haphazard conduct in the planning and works of establishing communication, infrastructural, supply and distribution etc. Besides shallow drains, potholes, water shortage, drugs, deprivations of green parks and areas, limited parking etc. are few more examples, among others. With the increasing number of tourists and migration of people to urban areas, the airports and thromdes being the first sight of impression of Bhutan for any visitors, it is important that thromdes are built and operated as livable[1],

[*] Views in this are purely of the authors and does not represent any other authority or organization.

[1] Livable may be described as being able to live in a Thromde without having to struggle hard of basic human needs (cultural, economics, health, educational and social, livable and endearing home, a vibrant

aesthetically and economically friendly home for all people in towns. The Constitution and Electoral Laws of Bhutan provisions thromdes in every Dzongkhags. In view of this, the desk research study was carried and came out with observation to caution planners, builders and administrators from repeating the past mistakes and subsequently envision and recommend essential aspects for urbanizing Democratic Bhutan that shall be a true place of happiness and with balanced prosperity and well-being for all times.

Introduction

With the democratization and modernization of system of governance, cities which accommodate maximum residents need to be made livable, so that the city dwellers can live a peaceful and productive lives. In order to place major emphasis on wellbeing the sound and futuristic urban planning and development are inevitable.

From the review of the global urbanization status, it is evident that there has been phenomenal increase in the urban population resulting many challenges. The rapid increase in urban population has brought many undesirable consequences to the detriment on the wellbeing of the city dwellers. The United Nations (UN), World Bank, European Union (EU) and others report significant increase of urban population of 42.93% in 1990 to 53.86% in 2015[2] and 55% in 2018. It is further expected to increase by 68% by 2050[3]. The Population Division of the UN Department of Economic and Social Affairs (UN DESA) depicted a rapid growth of urban population from 751 million in 1950 to 4.2 billion in 2018. It has observed 90% increase in Asia and Africa.

---

and sustainable city, an active and gracious community, a city of life, on the basis of equity, inclusion, education, culture, and citizen cohabitation) to function as useful member of the society with capacity and reasonable support from the environment in bringing up a decent family.

[2] http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

[3] 2018 Revision of World Urbanization Prospects from https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html

In Bhutan, Thimphu is the first city to have been developed in the country. With the steady globalization and its impact Thimphu is also being viewed one of the rapidly urbanizing cities in South Asia with increase in urban rise by 56.8% by 2047 Thimphu alone is expected to have 30% (260,000) of Bhutanese urban dwellers.[4] This growth trend directly raises the need for the critical role, any *Thromde*[5] in facilitating and creating the quality of life and wellbeing of people living in urban areas. While the urban growth may not necessarily bring social ills or problems, unless we fail in establishing appropriate conditions and strategies for building livable thromdes.

Without any malice to old Delhi, it could not be helped remarking given the poor state of planning and development of Bhutanese Thromdes that we (Bhutanese) are building old Delhis in Bhutan but do we have space for creating New Delhis.

Considering the fact that the development of Thromdes will continue at the tremendous sacrifices to paddy and barley fields, and learning from the failures in building and management of the four existing thromdes viz., Thimphu, Samdrup Jongkhar, Phuentsholing and Gelephu to better thromdes, one expects the future to be build with greater sense of accountability and responsibility paving the way forward for livable cities that Bhutanese can be proud to be living in.

His Majesty the Fourth[6] King of Bhutan during the drafting of the Election Bill has remarked that with the provision in the Constitution to have Thromdes in every Dzongkhag enshrined He expected that with living standards and living conditions improved by elected administrations rural to urban migration if could not be stopped totally it would definitely slow down the number of people moving to bigger and crowded towns. Thus,

---

[4] 2017, Bhutan Housing and Population Report, National Statistical Bureau, 2017.

[5] City or Town in Dzongkha, Bhutanese National Language.

[6] His Majesty's vision was echoed no less succinctly in *'Life in the Suburbs of Ur.'* "Our property seems to me the most beautiful in the world. It is so close to Babylon that we enjoy all of the advantages of the city, and yet when we come home, we are away from all of the noise and dust." In Jonathan. F. P. Rose's *The Well-Tempered City*, Harper Wave 2016.

it was His Majesty the Fourth King's Vision that elected local governments will take it as their duty to plan and develop better urban facilities in all dzongkhags[7].

The deliberate disregard in the development and establishment of Thromdes in rest of the Dzongkhags with continuous increase in rural urban migration taking place, His Majesty the King appeared to be seriously concerned: "The people, especially the young, have been leaving their villages for towns in greater numbers. I am deeply concerned that they will encounter unemployment and other difficulties in urban areas, and begin to despair."

Horan. et. al. (2014) also resounded that people move to town from rural area and drains human capital, hollowing younger population and raising socio-economic and sustainability issues.[8]

While urbanization across the nation is become inevitable process, yet it is proper planning and development of the Thromdes be it Dzongkhag or Yenlag that would prevent creation of many old Delhis, Bajos etc. appear very remote.

Given the serious concerns of the state of our present thromdes, the Royal Research and Advisory Council (RRAC) with the hope to prevent more mistakes of Thimphus and Bajos[9]; and the urgency to caution planners, builders and administrators employed by the Royal Government and motivating them in the creation of aesthetically and functionally livable Thromdes, the Public Policy and Governance Unit (PPGU) undertook this study to look into aspects of urbanization that are perceived as truly

---

[7] 'Constituencies' referred in Bhutanese language in the Constitution and Electoral Laws of the Kingdom of Bhutan.

[8] E. Horan, J. Craven and R. Goulding (2014), 'Sustainable Urban Development and Livability' *European Journal of Sustainable Development*.

[9] Lyonpo Kinzang as the Chairperson of the Planning Commission and Minster for Works and Human Settlement to a question I had put as the member of the Technical Committee of the Planning Commission that *Bajo* was mistake and it would not have repeated last *chuzhing* to be used as urbanization on agricultural land. But now most of our *Thromdes* are located on *chuzhings*.

essential in planning and building of livable, and futuristic municipalities, that usher sustainable prosperity and wellbeing for our posterity.

Our concerns tend to become more meaningful due to the timely receipt of the copy of the wonderful book on building of twenty-first cities by Jonathan F. P. Rose entitled *The Well-Tempered City*. We owe our gratitude to Hon'ble Chairperson RRAC for making it available for reference.

Methodology and objectives

Since this paper draws the inspiration from The Willed Vision of His Majesty the King and Aspirations of Bhutanese for Sustainable, Just and Harmonious Society and given the importance and urgency of Visioning futuristic thromdes in Bhutan the study is more of a policy action study than academic one.

The data or information are based from secondary sources mostly from His Majesty's Addresses, The Constitution of Kingdom of Bhutan, The Electoral Laws, Local Government Acts which are found to be useful in understanding the definition and overarching vision of livable Bhutanese thromdes. The Government and Bhutanese medias, articles, reports and journals were useful for enlisting and understanding the evidential situations and aspiration of urban dwellers. The international literatures, books and reports are analyzed to understand the comparative context and scenarios of global urbanization.

Therefore, the study is of qualitative kind based on desk study and experiential learning than academic attempting directly answers following four questions/objectives:

1. How do/did we define our Thromdes/towns?
2. What/how are the today's Thromdes in Bhutan?
3. What ought to be livable and affordable Thromdes/How can we urbanize Bhutan? and
4. How can we make one or more livable and affordable Thromdes in Bhutan?

Definition of thromdes and livability

Livability of thromde or city has been most discussed topic today yet there is no universal understanding of livable thromde/city. Often today, the cities or thromdes are considered livable when it defines the place or area you live ushers the conditions of better quality of life and wellbeing. In 1980's to 1990's the concept of livability became more discussed related to urban communities on the context of challenges that faced with urbanization. In the *The Cities and the Creative Class*[10] Richard Florida accord to term it as 'people climate' where city have comfortable life fulfilling their needs and aspirations. Jonathan Rose in his book *The Well-Tempered City*[11] connotes livability in five integrated and wholesome qualities: Coherence, Circularity, Resilience, Community and Compassion (CCRCC). The International Conference of Urban Planning and Wellbeing[12] has in general acceptance livable cities concepts and terms such as 'smart city', 'safe city' 'intelligent city', 'global city', 'digital or techno city' 'future city', 'sustainable city', 'human/people centered city' etc.

However, in order to provide a clear understanding to this study, without any overlapping idea varying in terms and concepts agreed on simple and easier understanding by His Majesty the King as a place where it must '*remain clean, safe, well organized, and beautiful, (CSOB) for all times to come*'. With its character of CSOB, for Bhutanese context, the agreed legitimate definition of a Thromde is codified under the Constitution and Local Government Acts.

Thus, a Thromde, municipality or a City is a large and permanently planned and highly livable urban towns settled by human beings ensuring extensive systems for housing,

[10] Florida R. (2002), The Cities and Creative Class, Retrieved from http://creativeclass.com/rfcgdb/articles/4%20Cities%20and%20the%20Creative%20Class. Pdf

[11] Jonathan F.P. Rose (September 2016). *The Well Tempered City: What Modern Science, Ancient Civilizations, and Human Nature Teach Us About the Future of Urban Life*. Harper Collins Publishers.

[12] Organized by Centre of Bhutan Studies and GNH Research on 16-17 May, 2019 in Thimphu Bhutan.

transportation, sanitation, water, utilities, land use, communication, urban roads, street lights, urban parks, permanent green belts, green roofs, facilities, sewer, garbage management system, infrastructure and waste management system etc. Constructed and improved to enhance safety and promote community vitality and opportunities**.**

According to the Constitution of the Kingdom of Bhutan[13], Bhutan is to have one Dzongkhag Thromde and at least one Dzongkhag Yenlag Thromde in every Dzongkhag. The Drafting Committee of The Constitution of Bhutan have also forecasted the size and population of the future towns and used the word 'Thromdes' instead of 'Thromde' so that there are provisions of upcoming of more than one thromde in Dzongkhags.[14]

Situation of thromdes in Bhutan

Of all Thromdes, Thimphu was designed during the rule of Third Druk Gyalpo under the supervision of Lyonpo Chogyal, and most landmark structures built by Lyonpo Tamji Jagar. It appears that some basic concept of planning was applied but with the guiding norm that Bhutan is small and demarcation of small areas would be more than adequate. Successive plans did follow similar basis. As such, the natural growth over shot the pace of planning and capacity to control inciting the dilemma of happy or livable city.[15] As a consequence, almost all Bhutanese towns are already confirmed to face with many inadequacies.

The present state of structures and services speak for themselves. Moreover, the 2019 International Conference in Urban Planning and Wellbeing in Thimphu shared various challenges from philosophical to theoretical, methodological to evidential, aspirational to practical issues concerning thromde in Bhutan.

---

[13] Section 4, Article 1 of The Constitution of Kingdom of Bhutan.

[14] Justice Sonam Tobgye (retired) in The Constitution of Bhutan: Principles and Philosophies.

[15] Hussam Raouf in International Conference on Urban Planning and wellbeing at Thimphu, 2019 pointed that the multiplex factors and topics in city policies, plan and development happens disconnect to create happiness agenda and wellbeing of people.

Following are few common visible issues and concerns of today's thromdes in Bhutan:

1. Limited scope of growth and expansion

Thromdes always attract people. The population is expected to increase. We can see various construction being approved and creating a narrow concrete in haphazard orders pressuring cities resources and limiting scope for healthy expansion and growth. The areas demarcated are with very limited or with no scope for growth nor with clear and rational provision for vertical or horizontal growth.

A provision for growth and expansion can assist in managing the increasing population. While growth of past shall be maintained, we can have a choice to build new and better Thimphu, new Bajos, etc.

2. Shallow, narrow and open drains

Road/streets are not planned for efficient and economics. Drains are poorly built and are narrow and shallow. And every little heavier rainfall they get clogged and flooded risking epidemics and damage to life and properties.

3. Unpleasant and unsafe footpaths and treks

The footpaths and treks along these are very unpleasant sights and stinks of stench. In South Korea they have applied low cost methods to purify these to use drains as recreational places for picnics and relaxation while restoring ecology and ecosystem (flora and fauna). In Kanzawa, Japan Tamiki San proudly tells one "Here the drain water is safe to drink."

Owing to the preciousness of water and efficient use of wastewater, waste water can be properly managed and valued for the various uses by thromde. For example, through centralized system of thromde and decentralized system for every property owners and landlord rain water and sewage to be used in toilet flushing, car washing or irrigation etc. It was found that for a developing urban society, about 30-70 cubic

meter is generated as waste water in a year[16]. In Thimphu, a waste water generated would be good enough for irrigating or flushing toilets in Thimphu.

4. Unsystematic and ad hoc communication and infrastructural activity

The communication and infrastructural works are haphazard. Every new activity being undertaken is ad-hoc and unsystematic, resulting in digging up the roads and streets umpteenth times.

5. Potholes a common features and daily social media update

Potholes have become common features on all roads, and topics of daily discussion on social media while life and properties are put to unsafe and unpleasant experience. We have stopped being critical of the quality of infrastructures of other countries, as charity has to begin at home, a sage saying advices.

6. Primitive water supply distribution and lack of systematic monitoring

We are known to be aplenty country of water in the forms of fresh rivers, streams, lakes and ponds yet ironically limited to its accessibility and sufficiency. It is apparent that poor monitoring of distribution system and water supply and practices currently even at the capital is primitive and pathetic. A mere drive through the roads in the Thromde throws adequate evidence to vouch this truth. For example, the condition of perpetual leaking water pipes and distribution at Motithang Ozone park not only waste the natural resources but directly spewing up the thromde revenues. An ample and efficient water supply and distribution system is essential for Thromdes to grow. And the supply must strictly monitor and be pure as well as ample.

7. Stray dogs in town

There are increasing number of stray dogs in the country and Thimphu and has been nuisance and menace to both Bhutanese and tourists. There are also increasing number of cases of dog

[16] http://www.biologydiscussion.com/ecology/wastewater/wastewater-problem-and-its-treatment-ecology/70914

bites referred in hospital. The annual health bulletin 2018 has reported dog bite cases of 6,416 in 2017 from 5,573 in 2013. Thimphu Referral Hospital has reported over 1000 cases of dog bite with 83 cases reported every month. While it did not spare anyone, 312 students and about 8 tourist suffered dog bites in 2017 and they are highly victimized. Tourism Council was reported of complaints of dogs for long time now. Urban residents even stopped going for walk and jogging fearing the bite. Parliamentarians also shared the threat and fear of stray dogs during campaigns.

Although there are vaccination and sterilization programmes in place, thromdes and concerned authorities must come up with robust programme to manage ever longing dog issues.

8. Chronic affordable housing crunch

The serious crunch in affordable housing has been one of the major issues in Bhutan particularly in urban areas like Thimphu and Phuentsholing. While His Majesty's initiative for NHDCL housing construction to accommodate hundreds of Bhutanese from Jaigon was blessing and great relief, for lower- and middle-income earners, a cry[17] and plea of civil servants and urban dwellers have been evidential in social medias and others about the need of sufficient affordable housing in Thimphu as well. The Population and Housing Census of Bhutan (PHCP) 2017, pointed that with increasing rural-urban migration, increasing urban population and exorbitant rents hikes has made thromde expensive, where urban dwellers spend more than 50 percent of their income in housing. Studies shows that housing and income inequality causes social ills such as rape, crime, drugs, family disorder, corruptions etc. are plaguing thromdes[18]. Jonathan F.P. Rose, said "We have to develop strategies for the development of affordable housing. I believe we need to distribute affordable housing rather than build affordable housing clusters because

[17] https://www.facebook.com/groups/278156858950985/permalink/1476421302457862/

[18] http://www.kuenselonline.com/housing-crisis/

those become slums. The best way to distribute it is to have affordable housing included in all development."[19]

9. Lack of clarity in policies and strategies

There are no clear policies on retaining or creating agricultural, forestry and cultural properties in the urban areas. Areas designated for Thromdes are often narrow strip of lands deprived of forests, greens and rivers (where they exist within urban areas), are not satisfactorily managed often prone to fires and above all the probable consequences of global warming and climate change.

Thus, poor policies, haphazard structures, and poorly constructed and maintained roads. Dusty and narrow streets, rudimentary water supply distribution systems, narrow drains and winding streets do not bode well to be a homely Thromde.

All these are indicators of what is not right. There are a lot that need to done differently to make or rebuild our Thromdes to be livable, happier, healthier and more equitable ones.

There is, therefore, the urgency that a forward looking, a farsighted and futuristic plan need to be undertaken.

In doing so, it was necessary to take a policy decision that traditional agricultural land, should be avoided for use of urbanization while respect and honour all our natures gifts of rivers, ponds, lakes[20] and other assets and wonders of nature gifts inherited.

Even in town, agriculture as a part of urban agriculture and horticulture, urban farming and hydroponic systems be promoted as essential to meet the needs of residents. In effect encouraging unemployed to opt to become urban farmers making Thromdes green and regenerative cities.

---

[19]At two days Conference on 'The Well-Tempered City' retrieved from -http://www.bbs.bt/news/?p=106561

[20] Our ponds, lakes and rivers that fall within urban boundaries, as a landlocked nation, except those that are revered as out of bound for religious reasons, should be appropriated for the benefit of the people as frontage, recreational, transportation and economic as common right of the people.

Based on a complete nationwide aerial survey, non-agricultural lands, sites be identified for siting of future Thromdes, while existing ones to be revisited to revert or improve with lesser negative impacts on the immediate natural environment and traditional agricultural and horticultural fields.

A site demarcated should be over a bigger area that would have scope for different classification of lands, which a planner like an artist could treat as her/his canvas to create masterpieces (master plans).

What ought to be livable thromdes

According to Wynton Marsalis "The reason things fall apart is that people create things to celebrate themselves rather than embrace the whole."

The Section 4 of Article 22 of the Local Government Act 2009 clearly stipulates the broad vision of any Local Government is to:

a) Provide democratic and accountable government for local communities;
b) Ensure the provision of services to communities in sustainable manner;
c) Encourage the involvement of communities and community organizations in matters of local governance; and
d) Discharge any other responsibilities as may be prescribed by law made by Parliament.

To fulfill the above objectives, and subsequently achieve a sustainable and livable thromdes in Bhutan, some multifaceted factors may need to be addressed. Thus a livable thromde ought to contain and address all of these or at least most of these issues: lower cost of living, cheerful and smiley people, lively and healthy, safer and secure, learning and educating, accessible public places, citizen engaged, proud residents, efficient and effective services, standard only constructions, housing for all, appropriate architectural structures, Four-Rs (reduce, reuse, recycle, recover) waste management system, resident friendly-pubic transports, nature and environment friendly and green

city, built tough and disaster safe area with good coordination and sound administration.

Attempt is made to elaborate what each one of these issues are that can be incorporated in planning and development of Thromdes that grow into a livable urban haven.

1. Lower cost of living thromdes

A Thromde like Thimphu has been expensive for most of its residents who are employees of public services and corporate sectors and their dependents. Any resident can live happier life if the cost of living is brought down through improved and better built and managed city services and facilities. A Thromde needs to diversify sources of food, water, energy, and materials so that it is not overly dependent on any one. A Thromde must be able to generate resources within the city, which also has the benefit of creating more jobs.

In a modernized economy, maintaining a balance between what one earns and spends is a big challenge. Though Bhutan has a strong social welfare type of economy, it is a reality that the State cannot directly take responsibility for all, yet if the public services could be better planned and managed, these can indirectly create impact the individuals to enjoy lower cost of living in urbanized areas with mixed-income, service-enriched and mixed-use economies. Creating communities that are capable to maintain a balance between human and natural systems in order to increase wellbeing.

2. Cheerful and Smiley Thromdes

Our Thromdes are the places where majority of our people would likely reside and bring up families who will be our future citizens. It would then mainly depend on how our Thromdes are organized. It is necessary that we make it feasible for such a living culture through creation of integrated platforms that could support the growth of every child and a place where residents live with happiness and life of smiles. As in World's best cities, every Thromde in Bhutan has to balance prosperity, equality, and happiness to create wellbeing and satisfying way of living.

Our Thromdes could be made to have such an environment that helps radiate smiles with the public service providers

approachable and heart winning with no room for harshness and impoliteness.

We need to endeavor to have in place public spaces such that the environment and surroundings contribute to the residents being happy and satisfied with living a GNH inspired life.

3. Lively and healthy thromdes

Urban places are often associated with negative practices such as filthy, polluted and unhealthy. But residents and administrators all need to realize that such a state is result of us or that did not exist before people settled.

We need to commit to live, remain and enjoy a place where there is no room for pollution and uncleanliness. We need to commit to create our life-style and services to make it possible for all residents to breathe in clean air and drink safe water.

Given water shortage is an established situation, given the rate of growth of population, the demand for potable water is a serious one. Proven means and ways from places like Singapore to be tapped to put in place, efficient water supply systems soon in the county as a whole. Wastewater, rain and storm water may need to be tapped. As a child even in place like Ura rainwater was stored for use of washing and cleaning purposes.

For a Thromde to be, it must have provision for communal infrastructure for water, wastewater, and sanitation; mass transit systems; and parks and open spaces for all its citizens. It must establish policies to develop a wide range of housing that is affordable and meets the full diversity of residents' needs. It must require all citizens to be immunized against early childhood diseases, and undertake concerted efforts to prevent the spread of infectious, contagious and other rapidly spreading drug resistant superbugs, as the poor health of a few can threaten the health of all.

A healthy Thromde must have both strong, adaptable governance and a culture of collective responsibility and compassion.

4. Safer and secure thromdes

According to Judge Louis Brandeis "Sunlight is said to be the best of disinfectant; electric light the most efficient policeman."

Living a thromde life is generally viewed as being unconducive and stressful with all social ills and maladies. However, our towns can be created as ones with a difference from metropolis elsewhere. Administration and environment created to be conducive for a secure, safe and peaceful living. This can be possible with education of responsible citizenry, mutual co-existence and cooperation of all for common goals, purposes and ends. With decision making that facilitates inclusivity of all residents for shared responsibilities, creating a society responsible for caring and benefiting one and all.

While it may be reassuring to see some effective measures to combat crimes such as installing of CCTV thromdes as public place, there is need to institute greater sense of security so that issues of crime and enforcement of law and order become unnecessary.

Every successful thromde must have protective systems to secure itself from threats. Inter-weaving protection and compassion, cities can replace the concept of "stronger" with "better able to adapt."

5. Green and rejuvenating thromdes

It is evident that there is total lack of responsible urban planning and development. We find our own planners have completely neglected the importance of balance and harmony of environment and ecology with human living: focusing on green, wetlands or trees to benefit that can be derived by thromdes.

Approving a building of a single house without giving any regard to how it would fit in the colony and concentration only on concrete structures without regard for the health, natural environment and greenery are the perceived causes of the resultant messy urbanization of our thromdes. For people to enjoy fresh air in the towns, there is need to plant trees not only to provide shade and add beauty, but also supply oxygen, very essential for healthful livelihood and recycle foul airs and gases that are harmful. Trees help storm water absorption, clean the air

of particulates, reduce ambient summer air temperatures, and increase residents' sense of wellbeing.

Greenery must form integral part of urbanization from the clinical point of view. Such spaces are crucial for aesthetic as well therapeutic purpose for a healthy and happy living. Let the nature run the show of urbanization with man and nature coexisting in productive harmony, and fulfill the social, economic, and other requirements of present and future generations.

In modernization and urbanization, outlook especially in building thromdes, need to take into cognizance the essentiality of creating adequate and appropriate biodiverse space for recreation and relaxation; as biodiverse ecosystems provide important services to cities, such as purifying their water supplies, reducing flooding, and mitigating rising temperatures due to climate change. Every planner worth the salt need to note that the wellbeing of ecosystems and urban populations is deeply interlinked.

Facilities such as routes for cycling, jogging, walking etc., if created, have been proven to keep many residents out of cars as much as help cities stay cleaner too.

A thromde when infused with altruism can be more trusting, inclusive, and tolerant; have stronger, more diverse volunteer networks; are better able to plan for their future; and can take the necessary steps to carry out those plans effectively as trust is the soil from which adaptive capacity grows.

6. Spick and span thromdes

Poor designs and substandard constructions contribute to poor living habits of Bhutanese as accepted norm as they begin to live in urban areas. Most people who were used to live with a bit of biodegradable waste are now confronted with non-biodegradable, chemical and industrial wastes.

The issue of waste management is a grave one in urban areas more than in rural areas. Thromdes need to adopt a comprehensive master plan with strategies, that prevent import of harmful and non-manageable waste at source while have strategy and capacity built-in each thromde to address issue of

all types of the waste effectively. The Samdrupjongkhar initiative of waste by women is one good example.

7. Abode of heritage thromdes

Most places in Bhutan are dotted with places and structures including trees and rocks have certain spiritual significance to communities that are revered, feared and worshiped. For instance, Tashichhodzong was termed to be the symbol of Modern Bhutan by His Majesty the Third Druk Gyalpo. These are landmarks of heroic achievements and great deeds performed. All these must be preserved as of historical, cultural or religious importance and value. Any area where there are such heritage sites and monuments such as Lhakhang, Chorten, and religious or historic monuments as a policy must be restored and renovated to save from the risk of being lost forever.

Even in cases of notable recent structures such as the clock tower in Thimphu, care need to be taken to build it in a manner that reflects the rich culture of the country modeled on Mila Guru Stupa or Utses of Tashichodzong or Punthang Dechen Phodrang.

Above all, every thromde must keep the best of the past but where necessary they can innovate and move forward with dynamic environmental, economic, metabolic, social, and cultural systems.

8. Historically reminiscent thromdes

Over the years, we have lost many important names given to historical and legendary figures that were there within and in the periphery of towns. These need to be collected and reinstated so the historical names are retained for posterity.

Kalabazzar, Swimming pool, Zilukha, Babesa, Changbangdu, Chubachu, Kabesa, Hejo, Dechencholing Phodrang, Kawajangsa, Lungtenzampa, Buddha point etc. are names that are distorted and never signify history of Bhutan. It was when ancient and historical saints such as Phojo Drukgom Zhipo, Zhabdrung Rimpoche etc. visited and signified the very geography of Bhutan, in particular Thimphu, named almost every area with significance and reminiscent. For example, 'Hejo' was called as 'Lhadrong', 'Kalabazaar' as 'Chang gi

Dhaphug', 'Swimming pool' as 'Chang Gayngyen', Changbang Du' as 'Chang Bar Drong' etc.

9. Safe haven for youth thromdes

As society transitions from rural lifestyle to modern and urban culture, the resultant confusion between the old role vis-a-vis emerging cultures, has caused youth in between to suffer.

As such, our thromdes must grow into places that are sensitive to the challenges faced by the youth and have in place where they can seek support and counselling.

10. Theatre of festivities thromdes

Every Bhutanese village has a community Lhakhang that is a thriving cultural centre. Thromdes as our modern communities should replicate this as the best of our culture and our experience and in promoting the age-old festivals and activities in new settings, so residents can partake *tshechus*, *chams*, music, *chokus*, *pujas*, *rimdros,* sports, arts, literary and crafts e.g., the Annual Changjiji festival. It is important that people live a life of sharing and caring as well as celebrating it together as a homogenous community.

11. Home for aged and homeless thromdes

In the past aged and helpless received the support of the families and their communities. But with urbanization and better health and nutrition, number of such categories of residents is increasing beyond the number that was manageable conventionally in the thromdes.

So, in a new environment new arrangements to accept and care for the aged and helpless have to be institutionalized, for adequate, appropriate and timely interventions in the thromdes.

No individual would end up suffering from homelessness and for want of caregivers, if thromdes have affordable homes and services for them.

12. Friends of women thromdes

Bhutan is living in new communities but with culture of the old society adjusting to live under modern laws and values with traditional habits. With the increase in population of

females' unmarried, orphans and widows in urban and monetized economies, they face new challenges.

It becomes urgent that thromdes prepare to care and protect women in trouble and needs, so that every woman enjoys the respect, safety and dignity.

Every thromde should have facilities created such that every female and child feel safe and secure from all types threats and social ills.

13. Learning and educating thromdes

The 21st century is a century of great technological advancement. It is a time of great possibilities and opportunities for learning. The quality of education and teaching in primary schools in all thromdes are advisable to cover reading, writing, music, religion, life skills, and ethics.

Bhutan with its success in education has educated citizens who need choice and opportunity to take up higher positions and responsibilities as SMART Bhutanese (Sincere, Matured, Astute, Resilient and Time-less).

There is a need for public libraries and efficient Internet services in every thromde[21] to complement and supplement their qualification by being able to continue learning and educating themselves.

Access to schools, and quality education and good educational institutions in thromde are very critical for equality and harmony, as key element of human capital, growth and welfare.

14. Accessible thromdes

It is increasingly being observed that more and more persons with disabilities move in thromdes, in search of services that are only available in the urban areas. It is also true that the nascent thromdes are not aware of their needs such as the issue of

[21] The only public library in the capital is the Thimphu Public Library, Jigme Dorji Wangchuck Memorial Library and UN Depository. I started as a NYAB Volunteer, which needs to be separated and built as three separate entities.

accessibility [22] in public places. Most of these persons are confined or fully dependent on relatives and well-wishers for their basic needs.

Be it in obedience to the Constitution or as social obligation all Thromdes need to address the issue of accessibility to make life for them independent, self-reliant and meaningful living, since many differently abled people need special facilities like wheelchair etc.

15. Citizen engaged thromdes

Bhutan is democracy now; as such all decision-making that concern a thromde has to be democratic. That would mean seeking views, feedback and support of the all, or at the least that of the concerned and interested majority, where and when possible.

In order to fulfill such a requirement, all thromdes need to institute Thromde Hall meetings where people can be called or walk-in to discuss public issues that concern their lives or their communities.

Therefore, every thromde designate a Thromde Hall as venue for public meetings. This would also be a place for the common residents to have access to perform, showcase or entertain or get entertained as rightful residents.

Through the active and full participation, residents themselves can understand the likely future they will face, and accordingly be able to make informed choices to shape those futures. They would not need an emperor to strike the best balance between development and nature: the wisdom of the crowd can work well.

16. Proud resident thromdes

The major challenge at the moment in our current thromde is that most of residents are not registered residents and for the purpose of development. For the purpose of elections, there are

[22] The issue of accessibility has to be of two kinds one is for the ease of movement and livability of differently-abled. The other is ease of entry and exit from the Thromdes with minimal traffic and economic consequences and efficient management of disasters in and around the urban areas.

only few eligible voters exercising electoral franchise in the thromde constituencies. While Thimphu thromde has maximum populations, it has relatively less registered residents. This would tantamount the majority to be voiceless residents of the said thromde.

While it is not necessary that all residing in thromdes have to register their civil registration in a thromde, a thromde resident registered as a voter only can enjoy the right to vote and be a candidate in offices, which has immense bearing on their lives and properties.

17. Built to Standard[23] Thromdes

A well-built roads and drains may make urban life and living pleasant and safe from accidents and diseases and epidemics. Roads and drainage crisscrossing Thimphu thromde are poorly planned, designed, built and rarely maintained.

Any initiative to improve is in want of touch of professionalism. None of these can qualify and pass as standard city infrastructures. Parking facilities not conceived or constructed but not enforced resulting in one-way routes of short stretches of roads aggravating traffic[24] and resultant nightmares. Potholes are the common feature of our roads in all our towns. Water overflow from poorly built storm drains are regular predictable nature in monsoons. All these making driving and walking difficult and dangerous to all.

Our constructions are not harmonized and as a result one can witness motley of varied sizes and designs of structures, putting many genuine urban planners to shame. Thus, thromdes in Bhutan should commit to undertake standard constructions that would reflect the best of Bhutanese and international engineering and architectural standards and designs (including application of big data and GPS applications for becoming

[23] "Envision Utah defined a broad range of metrics-land consumption, air quality, economic development, infrastructure

[24] Harvard Professor Daniel Gilbert in *The Well Tempered City*, p. 117: "Driving in traffic is a different kind of hell every day."

SMART[25] thromdes.) Thromdes could apply for sister thromdes abroad for benchmarking their standards to global standards. SMART cities can turn to VUCA[26] world.

18. Home for all thromdes

With educated folks and others, looking for jobs every year, the fastest growing construction sector is unable to meet the demand for housing. Despite the Tenancy Act, enshrining regulatory provisions, house rents tend to exorbitantly soar high, with erratic and arbitrary rental raises.

A few landlords continue to exercise full monopoly of the limited housing and making the tenants suffer.

In this, thromdes, has to take full responsibility to find suitable sites for housing schemes to address acute shortage and promote construction of green affordable housing, transit-oriented development, green building and smart growth movements, to ensure the wellbeing of urban residents.

19. Dragon architecture thromdes

Applications of *zoric* to buildings for mere formality without regard the intrinsic traditional and functional values are economically and functionally purposeless. However, where aesthetically required a structure has to fully conform to traditional architectural designs.

As such, unless a building or edifice stands alone or facing a street road or lane, traditional architecture features need not be made compulsory as a mere formality. An ill-considered application of designs and *jamthos* covering water tanks has defeated the very purpose of imposing architectural requirements.

Architects, builders and planners are obliged as required by their professional codes to create structures that would

[25] A smart thromde uses digital technologies or information and communication technologies to enhance the quality and performance of urban services, to reduce costs sand resource consumption, and to engage more effectively and actively with its citizens. Songdo South Korea and Rio are forerunners.

[26] Volatility, Uncertainty, Complexity and Ambiguity.

conform to Bhutanese *zoric* yet be democratic, dignified and graceful for the 21st Century Bhutan.

20. Four-Rs (reduce, reuse, recycle, recover) thromdes

A thromde must recycle and reuse as much of its waste as possible. This reduces disposal cost while providing inexpensive local resources.

The issue of waste management, as His Majesty The King had pointed out during the 109th National Day, that Thimphu thromde alone collected over 300 tons of waste on a daily basis is a notable concern for every Bhutanese. Given the limited landfills better ways and means are explored urgently to manage waste gainfully in all thromdes.

Until very recently it did not dawn on me that Thimphu has shortage of drinking water throughout had it not been for water tanks installed for every house. It is also noted that rainwater that floods out areas have never been harvested. This is appearing to be the reality for all too soon if efforts are not made to recycle and harvest the waste/used waters and the rain and snow. Besides it would help in minimizing the dangers and destruction from flooding and inundation.

Therefore, every thromde with cooperation of its stakeholders must put in place, the system to Reduce, Reuse, Recycle, Recover wastes glass, metal, plastic, paper, water or chemical and industrial waste to the fullest preferable through adoption of ecological and circular economy.

All public facilities must mandatorily be required to have in place good working sanitation and drainage systems with gender and disability sensitive toilets and public conveniences at strategic locations.

All wastes generated from these also should have recycling arrangements for gainful economic usage as integral bio-complex systems. Efforts and incentive must go hand in hand to introduce means through which wastes is gainfully managed to generate employment as well as manufacture of products that can substitute imports of those that results in hazardous wastes.

21. Affordable comfort public transports thromdes

Bhutan does not produce its own fuel. And a lot of money has to be paid out to buy these fossil fuels.

In the absence of adequate and efficient public transport, many import four-wheel transports causing other avoidable inconveniences. Driving to town incurs expenditure that could have been avoided. Over and above, river rafts and boat transports[27] can be introduced or created where possible, so that use of vehicles and fossil fuels can brought down minimizing environmental damages.

A plan must have inbuilt requirement for promotion of eco-friendly and innovative and mass public transportation systems both underground and over ground, lateral, horizontal and vertical with rapid transports services and escalator services, while discouraging the use of fossil fuel public transports. Every thromde must develop a network of routes, footpaths, walking trails, treks, walkways, ped-ways, and passages throughout the breath and corner of a thromde.

The emphasis and priority need to be given to address the issue of with accessibility for all public places and structures, be it state owned or not.

The current infrastructure is heavily reliant on efforts and resources of individual residents that have drastic negative national cost implications, be it in the case of water supply or provision of other essential services.

Therefore, planners and administrators need to work on durable systems putting in place accessible, efficient and effective public transports that reduces stressful and wasteful urban living. Thromdes will need to begin thinking, planning, building, and operating their infrastructure differently bearing

[27] There are swift and calm river flowing in Thimphu such as Wang chhu running right across from Tango-Chari, Dechencholing, Thimphu market, Simtokha, Chhuzom, Punatshangchu, Manas, Tsirang etc. Olarongchhu and others that can be studied for use as recreational purposes and public river transport. Also, house can be built windows facing the river. These may help our river water stay cleaner and where possible recycle.

in mind that wise infrastructure investment has excellent economic returns.

Investment in infrastructure, human development, and restoration of nature will make thromdes much more resilient and refuges of prosperity, equality, and well-being. These require the will to make these possible that requires compassion (the desire to relieve the suffering of all beings).

22. Nature and environment friendly thromdes

Bhutan is a small nation and most of our land is filled with mountains, hills and cliffs except for a few valleys and low lands. The gullies and traditional path of rain and storm waters are already allowed to be built without any consideration and restraint inviting more havoc in the times of heavy rains and storms.

Most of the water were traditionally used mainly for agricultural purpose. While Bhutan imports everything from outside, however, most fertile arable land had been turned as sites for constructions and buildings e.g., the *Chhuzhings* of Olakha, Babesa, Jungshina, and Taba growing up concrete structures. There is strong warning that low lying cities Tokyo, New Orleans and Dhaka are likely to be under water. I believe developments at places like Khuruthang are already discouraged for fear of GLOF.

As such in thromdes, urbanization hereafter be avoided in land suitable for cultivation. For the purposes of recreation and greening, certain areas to be dedicated as parks and therapeutics needs of the urban dwellers. For this to happen, space utilization master plan for the whole country be taken up at the soonest possible time.

In effect the natural surroundings and the city could be made to fuse into each other to give a very scenic effect. The surround of the Disney World in South Korea was designed such that it gave one the feeling that whole valley and the surrounding mountains and vegetations has been transformed to be the integrated one with the Disney World. The trees on the mountain and valleys appear so much in harmony with fun of the world with the beauty of the surroundings. These could inspire growth of civic culture, cultural institutions, and civic virtue, spread

harmony among all classes, attract the wealthy, uplift the poor, and nurture the middle class.

People move to thromdes seeking opportunity, hoping to improve their lives, not to left behind in a lifetime of poverty. And if the thromde they reach does not have the economic, technical, political, and social structures needed to create communities of opportunity for these migrants, that Thromde will grow in numbers, but not in prosperity or wellbeing.

Parks, green-ways, wetlands and gardens, are found to be most cost-effective ways to simultaneously improve public health, create, climate resilience, and increase economic value. These provide people a place to exercise and recreate without having to pay for health clubs or other private services, reducing the most pervasive and costly expensive contemporary ailments, such as obesity, diabetics, heart disease, and cancer.

23. Disaster safe thromdes

Bhutan is situated on high-risk seismological zone. And everyone is aware that a big earthquake or any natural disaster could strike us any time. However, to counter such disasters, thromdes need to adopt mechanism, strategies and disaster management action plan to create minimum standards of modern safety measures required under laws to ensure the safety of all. For example, and fighters should arrive at the site of fire disaster, and tackle it effectively within bare minimum possible time.

Having observed that Bhutanese had in the past found residing on hill tops or slopes or higher grounds while they had flat and low lands used and not used. I began to realize they deliberately avoided the use of such places for building houses or human settlement for two reasons only. One is they need to grow crops to survive and the other reason to survive and be safe from national disasters.

Therefore, every thromde must have well-oiled disaster prevention and mitigation system in place. No longer would Bhutan take comfort and consolation in saying that we fare better in crisis.

24. Well administered thromdes

According to Jane Chermayeff "If you want to make a great city, design it to work for children."

As to the administration and management, as a saying goes "when it is everybody's, it may lend up being nobody's." Standard of municipality services are either non-existent or a few that are, the standards are far from being satisfactory and acceptable.

The Dzongkhag Thromde at the capital has to be supported and work closely with the national government and other local government functionaries, for provision of the best of municipal services.

Likewise in the rest of the Dzongkhag Thromdes, a good working relationship is vital between Dzongkhag Thromde with the Dzongkhag, Drungkhags and Gewogs. Similarly, Yenlag Thromde with Dzongkhag, Yenlag Thromdes and Gewogs.

Therefore, areas of responsibility and accountability, with clear lines roles of the National Government, Dzongkhag Thromdes, Yenlag Thromdes, Drungkhags, Gewogs and Chiwogs has to be defined to contribute towards building efficient and working thromde administrations.

Each Thromde adopt a vision supported with comprehensive plan that could help regulate land use as integral part of the overall Dzongkhag plan.

Above all while it is very essential that we have laws in place to build better thromdes it is very important thromde are manned by dedicated and qualified professional who believe in creativity and contribution, functional and appealing and endearing, more than mere undertaking of a project or work. These could be such ones that a thromde would in due course be known as theirs not by the name of place etc. like New Delhi is known as Lutyen's, Curitiba as Larner's etc.

Conclusion

According to Jonathan F.P. Rose "The purpose of our cities must be to integrate the science sought by Enlightenment with the harmony of Bach, to compose the conditions of fitness of their people, their neighborhoods, and nature."

Given that Bhutan is a small nation and relatively each thromde though small, needs of its residents are as diverse as any universal urban dweller. Under the constitutionally guaranteed rights and with evidence of benefits of the modernization in every part of Bhutan, more settlements inevitably will grow with more urgency for harmonization of humans with each other and with the mother nature.

The importance of establishing sound Thromdes in every Dzongkhag is thus more urgent than ever, as soon most of our villages outgrow and graduate as thromdes, when most Bhutanese have to have or find affordable and decent homes.

Therefore, a holistic approach and strategy for urbanization in Bhutan is never too early. It is expedient to look into present and foresee future challenges in building a friendliest, safest, greenest and harmonious Bhutanese thromdes.

Submissions

In view of the above, the Royal Research and Advisory Council most humbly begs to submit the following submissions:

1. Formation of non-partisan independent Urban Planning and Development Committee:

The government of the day must appoint an Empowered Committee whose members must be subject matter specialists with proven commitment to their field and non-partisan and with autonomy and authority to function without hindrance. It will serve similar to a Special Purpose Entity (SPE) as advisors to draft manuals, monitor and guides for planning and building modern thromdes. The mandate of the Committee could include but not limited to identification and demarcation of future thromdes but to provide technical advices to improve the existing thromdes.

2. Commission three renowned international experts

The Royal Government may consider commissioning three renowned international experts:

i. One Urban Planner who believes and capable of envisioning and planning beautiful, functional, serviceable and people

friendly towns yet sensitive to the best traits of our tradition and culture; and capable of envisioning and planning towns;

ii. Another an Architect who can develop architectural guidelines that would help build futuristic and architecturally practical designs evoking richness of our culture, heritage, purposes and values; and

iii. A Surveyor who has qualification and experience to carry out an aerial survey of whole Bhutan and designate non-arable areas as potential sites of urbanization, to prevent use of arable lands or disaster risk areas. A forest may be opened up for siting of a thromde, however, a tree may be cut down only if it is inevitable only with prior approval of a competent authority.

3. Carry out aerial survey and identify sites for thromdes, saving chuzhings

Site for thromde must be over a fairly reasonable geographical area with scope for growth and expansion becoming micro-replicas of nation-Bhutan, taking into account all the features of a thromde discussed in this paper.

4. Create a pool/institution of manpower for urban researchers, planners and implementors in place of bureaucratic functionaries

Bhutan may consider training a pool of urban planners and developers, who have potential to be Bhattarais and Alphonses of Bhutan creating legacies in urbanization, with no tolerance to compromises, but ever committed to build Thromdes forever-growing number of urban citizenries.

5. Effective coordination and collaboration with thromde residents and stakeholders

One of the main features' drawback of planning, development and operation in Bhutan is functioning as separate organization with minimal coordination and collaboration. The two-day International Conference at CBS has spell out that Thromde must look for organizing a robust and timely consultation both with international and national experts and agencies. It was learned that any big or small activity of thromde

must be put in mechanism to inform and discuss the matter with holistic approach engaging concerned individual and community.

6. Strict appliance to thromdes rules and regulations and contractors/citizens accountability and responsibilities

Without a displaced compassion and excuses to complying on existing rules and regulations, Thromde must strictly implement the existing rules and regulations. A person, contractor or community who are taking due consideration to dismantle or do whatever he like with thromdes/public goods and services such as digging roads, breaking water pipes etc. must be strictly monitored and made liable for repair without creating long or major discomfort to public.

7. For a symbiotic co-existence, built a དཀྱིལ་འཁོར་གླིང་བཞུགས། ***(Cosmic Mandala) Thromde***

As a rich culture and heritage in history and Buddhism, we can always create a thromde that resembles *Khilkhor Loaylang* (cosmic mandala). An overarching structure of a thromde in Cosmic Mandala can replicate and strongly symbolize to Bhutanese best structural design inclusive of cultural, spiritual and environmental landscape suiting to all the above features of Livable Thromdes. It can signify the best blend of surviving architectural ecology just as the living reminiscence of ancient Maya cities, landmarks of masonry and Charbagh.

12

Asset-Based Community Development and Implications for Bhutan

Shawn McLearen

Abstract

Bhutan today is facing a critical turning point – both internally and externally. Despite extraordinary progress, the pending graduation from its UN Least Developed Country status at the end of the current Five Year Plan (2023) will likely decrease the availability of capital, increase the cost of available capital, and exacerbate the urgency of the country's modernization goals. This so-called 'Bhutan Paradox' comes at a time of heightened global volatility across climate, economic, and political metrics – which exacerbate the planning let alone implementation of resilience and sustainability goals. This combination of internal and external transition underscores the need to engage local stakeholders in a meaningful capacity-building framework, in 'a bottom-up strategy for preparedness planning and resilience-building', and the urgent timeline for doing so. Put simply: the challenges of our development goals should be treated as an urgent opportunity to invest in the social capital of our communities. The following paper explores these issues through a lens of appropriate scenario projections, and the potential application of Asset-Based Community Development methods to mitigate risk.

Introduction

> …more than half of the carbon exhaled into the atmosphere by the burning of fossil fuels has been emitted in just the past three decades. Which means we have done as much damage to the fate of the planet and its ability to sustain human life and civilization since Al Gore published his first book on

> climate than in all the centuries – all the millennia – that came before.[1]

While globalization has proven one of the most ubiquitous forces of the modern era, and created extraordinary networks of value and opportunity which simply did not exist previously, some of the most resonant issues to arise from it include climate change and the so-called 'exogenous' nature of crises which are often incurred – unevenly – by entire communities at local and regional levels.

Indeed, such crises have become so acute, and our global capacity for perspective so advanced, as to bring the viability of the so-called 'modern project' into question. In such a context, the effort to assess and build consensus around risk and risk mitigation have taken on a level of collective existential urgency. Whereas under 'business as usual' conditions, dates like 2030, 2050, and 2100 may have been considered development milestones on the horizon, in the current climate they have become a driving timeline, "our itinerary,"[2] the *critical path* of a collective strategy which, to date, has not only eluded us, but will very likely be underwritten with increasingly limited and unevenly distributed resources.

That said, one might argue that the degree of impact from exogenous shocks is proportional to the degree of preparedness for them. Put differently, the proportionality of *exogenous* and *endogenous* hinges upon measures of preparedness; the relative strength of intangible assets like local traditions and heritage; our relative investments in 'social capital': So long as risk is assigned to an 'outside' system, there is less agency over and/or responsibility for that risk. Similarly, at some point in the cost-benefit analysis of development models is a reasonable assessment that the capacity for *mitigation* is directly related to the capacity for *adaptation*, and that these two streams are the DNA of any realistically achievable vision for such ambiguous terms as "resilience," let alone "sustainability". And while data plays a critical role in this regard – to extend the metaphor, DNA

[1] Wallace-Wells, D. (2019). *Uninhabitable Earth: life after warming*. Random House.
[2] Ibid.

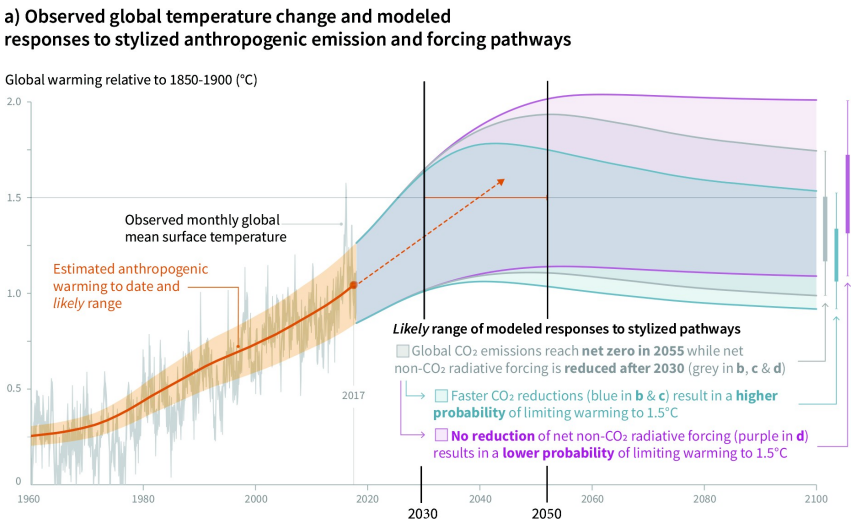
is both the materialization of and inherent limitations to a given dataset – an incomplete data set is no justification for inaction or denial. For decades now, we have been sufficiently informed about the threats of climate change to have prioritized them as an urgent organizing principle around which our development models "can and should" be coordinated. Sadly, we have dispossessed ourselves of what was arguably our greatest asset: a reasonable amount of time to advance our goals of mitigation and adaptation. Now, rather than mitigating human contributions to global warming and adapting to a different way of life that keeps us within the so-called "threshold" scenario (1.5° C – 2.0° C), of 'habitable' warming and unprecedented systemic losses, we are simply revising our mid- and long-term outlook to somewhere around 4.0° C[3], a kind of methodological denial that places entire asset classes, infrastructure and services at risk[4]. This failure of mitigation efforts raises urgent practical issues about adaptation strategies (*adapt to what exactly?*), and the limited value that *financial* resources can bring to resilience and sustainability goals. In such a context, the value of non-financial, social capital resources is enhanced. This is not to suggest an ideological framework, but a methodological one. As will be discussed later, there has been an evolution of theory and practice on multiple fronts that contribute to the current 'community development' sector and, when combined with the regime shift toward climate mitigation and adaptation resources, provide a practical framework for the advancement of local resilience and sustainability goals. In my experience, diversified forms of capital such as *community, political,* and *creative capital* are not only inherent to the relative performance of any

[3] UN World Meteorological Organization, Secretary-General Petteri Taalas Oct 2018, "We are not on track to meet climate change targets…if the current trend continues we may see temperature increases 3-5°C by the end of the century." https://public.wmo.int/en/media/press-release/wmo-climate-statement-past-4-years- warmest-record

[4] cf., Moody's Analytics: *Approach to Assessing Climate Change Risks for Sovereign Issuers* (2016), *Economic Implications of Climate Change* (2019); CBS News, *Farmers reckon with new reality in the heartland* (2019); Insurance Journal, California Commissioner and UN to Develop Sustainable Insurance Roadmap (2019).

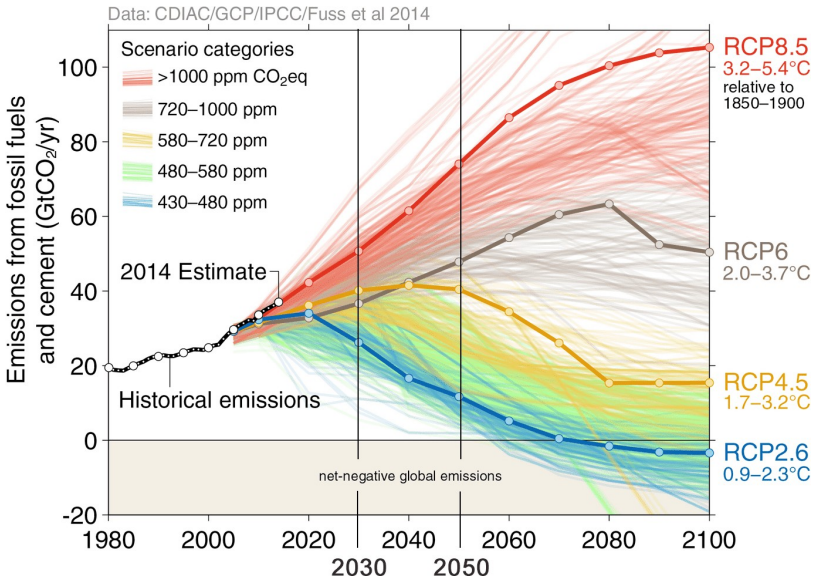
community asset, they are the DNA of its success – and limitations. Stated differently, in today's climate, these challenges and opportunities are increasingly interdependent. However, having dispossessed ourselves of sufficient time to avoid significant systemic risk, 'endogenous' resources are arguably the greatest assets we now possess. Mismanaging our community assets, and our limited pipeline of opportunities to invest in them, could prove to be the tipping point between a potentially catastrophic scenario and a catastrophic one. '*This* is our crisis. This is our work.'

Observed Global Temperature Change and Modeled Responses[5] (1.5° - 2.0° C)



[5] International Panel on Climate Change (IPCC,) 2018 In: Global Warming of 1.5°C. An IPCC Special Report (2030 and 2050 indicators mine)

Representative Concentration Pathway (RCP) climate warming scenarios (0.9° - 5.4°C)[6]



Sanjeev's clock

"The history of human development can be viewed as if on a clock, with the last several thousand years represented within the clock face. Let's say that the so-called developed world has advanced to nine o'clock and the so-called developing world is lagging behind at something like three o'clock with all sorts of stages of development between them. The thing is, the world is in such a state of crisis – unlike anything human history has documented before – that the entire enterprise of 'development' is in the throes of urgent debate. On the one hand you have the three-o'clock group doing everything in their power to accelerate and catch up with the more advanced groups on the path. On the other hand you have significant elements within the nine-o'clock group advocating that the path is not only unsustainable, but

[6] Global Carbon Project; retrieved from www.vox.com "The awful truth about climate change no one wants to admit." 2015 (2030 and 2050 indicators mine)

potentially uninhabitable *within our lifetimes*. They are measuring and rethinking where to go next and remain unclear about what that looks like. Generally speaking, it's a complete U-turn against the tide of oncoming masses who continue to desperately invest everything they have into a failed system. *This* is our crisis. This is our work."[7]

Bhutan today is facing a critical turning point – both internally and externally. Despite extraordinary progress, the pending graduation from its UN *Least Developed Country* status at the end of the current Five Year Plan (2023) will likely decrease the availability of capital, increase the cost of available capital, and exacerbate the urgency of the country's modernization goals. This so-called 'Bhutan Paradox' comes at a time of heightened global volatility across climate, economic, and political metrics – which, in turn, exacerbate the planning let alone implementation of resilience and sustainability goals. Not only are there limited resources available to traditional development models, there are significant additional costs to adaptation.[8] This combination of internal and external transition underscores the need to engage local stakeholders in a meaningful capacity-building framework, in 'a bottom-up strategy for preparedness planning and resilience-building', and the urgent timeline for doing so.

The following paper explores these issues through a lens of scenario projections, and the potential application of Asset-Based Community Development methods to build capacity and mitigate risk. Specifically, the paper begins with a brief look at *Bhutan Today* through the lens of existing conditions and perceived needs; *Bhutan in Context,* which situates Bhutan within a wider lens of regional and international trajectories; *Ex Ante,* which considers potential risk implications of comparative development model projections; *Diversified Capital,* which explores different types of capital and their aggregation within sustainable community development frameworks; *Case Studies,*

[7] Interview with Sanjeev Pradhan, Field Operations Director, Karuna Shechen, May 2019

[8] See: World Bank. 2010. *Economics of adaptation to climate change - Synthesis report*. Washington, DC: World Bank

which highlights a few potentially applicable models currently in practice; and *Implications and Recommendations,* which attempts to distill the above for consideration by local leadership and their stakeholders.

Bhutan Today

> Our nation's vision can only be fulfilled if the scope of our dreams and aspirations are matched by the reality of our commitment to nurturing our future citizens.[9]
>
> Improving conditions in rural areas is a fundamental priority. Doing so will also stem migration from rural to urban areas, that results in social dislocation and a decrease in 'belongingness'. It could improve employment, as rural areas experience labour shortages and urban areas, unemployment."[10]

Bhutan has been on a consistent path of modernization and decentralization since 1953, when the National Assembly was established by the third *Druk Gyalpo* ("Dragon King") Jigme Dorji Wangchuck. Subsequently, beginning in 1961, the country commenced the first of its now 12th Five Year Plans ("FYP"); established foundational economic institutions such as the Bank of Bhutan (1968), The Royal Monetary Authority (1982), and Bhutan Development Finance Corporation (1988); became member to international bodies such as the United Nations (1971), the International Monetary Fund (1972), the World Bank (1981), Asian Development Bank (1982), South Asian Association for Regional Cooperation (1983); and, through a series of formal measures including the FYP cycle, labor reforms[11] and Local Government Acts, the country has experienced an incremental devolution of power from central to local governance bodies.

---

[9] Druk Gyalpo Jigme Khesar Namgyel Wangchuck, quoted in *Short Guide to Gross National Happiness Index 2012*

[10] *Gross National Happiness Report 2015*. Executive Summary, p.8

[11] I am deeply indebted to Syoum Gebregziabher for his guidance on this paper. On his labor reform work with former Prime Minister Dasho Jigme Thinley, the Royal Civil Service and the UNDP, see his book *Symphony of My Life* (2012), Red Sea Press.

Due in part to its ascension to Least Developed Country ("LDC") status through the UN in 1971, and its subsequent access to low-cost debt through multi-party agreements with institutional stakeholders like those listed here, Bhutan has managed structural reforms through major investments in its infrastructure and a growing hydroelectric sector. As a result, the country became the only South Asian country with a power surplus for export to a region of neighboring countries facing significant deficits, while driving revenues, a ten-fold growth in GDP per-capita between 1980-2016, and a reduction in poverty from 31% in 2013, to 8% in 2017.[12] By any reasonable standards, these are extraordinary achievements which the Drukpa ("Dragon People") of Bhutan take great pride in.

To the Bhutanese, their country is known as Druk Yul ("Land of the Thunder Dragon"). Historically influenced by its neighbors Tibet and India, Bhutan is often described as the last Buddhist Kingdom in the world. Traces of this shared heritage can be seen in the importance of Dzongs, a network of fortified structures which served the kingdom's unification in the 17th century, and its dual system of spiritual and temporal administration ever since. Not only is the deep cultural heritage of these assets further reflected in the demarcation of Bhutan's districts ("Dzongkhags") and its language ("Dzongkha"),[13] the Dzong has even been described as the masterpiece of Bhutanese architecture. [14] A considerable number of Bhutan's Dzong structures remain, and their cultural heritage continues to generate social capital both as vital community institutions and the basis for potentially significant investments by multi-lateral institutions such as UNESCO.[15]

---

[12] World Bank Group, Bhutan Policy Notes, 2019

[13] Amundsen, I. (1999), *On Bhutanese and Tibetan Dzongs*, p.24

[14] UNESCO World Heritage Sites application 2012, Dzongs: the centre of temporal and religious authorities

[15] Ibid., "Many important historical events had taken place in these Dzongs. Several renovation, alteration and expansion works of the Dzong structure are still traceable and are evidence of crucial roles played by these Dzongs as the centre of government and culture in the course of history of Bhutan. They are the living witness to the successive social development and cultural evolution of the country."

Today, India's massive investments in Bhutan's hydroelectric energy sector is not only a means of addressing its own unprecedented shortages in electricity and water, they are a vital source of Bhutan's capacity to underwrite its own challenges of demographic instability, rural-urban migration, and a poorly-diversified economy. In a 2011 report, the Asia Development Bank, one of Bhutan's major institutional stakeholders, noted that, "Power exports account for more than 40% of national revenue and 25% of gross domestic product (GDP) in Bhutan. Hydropower infrastructure development also contributes another 25% of GDP through the construction sector. The revenue from power exports are the primary source for the government's socioeconomic development for health, education, agriculture and rural development. The hydropower development thus forms the backbone of Bhutan's economy and social lives."[16]

As recently described in its Country Statement to the United Nations Committee for Development Policy (UNCDP), "Bhutan is a small landlocked country located in the ecologically fragile Himalayan Ranges with a population of less than 700,000. Bhutan has a total 677 glaciers and 2,794 glacial lakes and has experienced no less than 21 glacial lake outburst floods in last 2 centuries of which 4 outbursts were reported in the last forty years. It lies in the seismic zones IV and V and is thus highly vulnerable to landslide, floods, wind storm and forest fires. Bhutan cannot escape its geographic reality of being a small landlocked nation with a small population surrounded by economic giants and the particular challenges as well as opportunities that these conditions pose."[17]

This statement is relevant for a number of reasons. As the international body which oversees member states' LDC status, the UNCDP serves as a gateway to eligibility for low-cost international funding streams such as Official Development

[16] Asian Development Bank (2011) Bhutan: Green Power Development Project II

[17] 2018 UNCDP Plenary Statement, page 1 (www.un.org/development/desa/dpad/wp-content/uploads/sites/45/CDP-PL-2018-Bhutan.pdf)

Assistance (ODA). In the case of Bhutan, "Government expenditure accounts for about 40 percent of GDP with high levels of expenditure on social sectors such as health, education and communications. A substantial portion of the capital expenditure is sustained through bilateral and multilateral ODA. In [Bhutan's 11th Five Year Plan (2013-2018)], more than 55% of the budgetary expenditure constituted ODA compared to 100% in the first Five Year Plan. The growth in the overall resource has been supported by a combination of large inflows of grants and increasing domestic revenue."[18]

The UNCDP Statement goes on to note that, "It is clear that while the Bhutanese economy is transforming, it is far from resilient. Efforts to build our resilience and increase our productive capacity is high on the national agenda and have been identified as key priorities for the 12th Five Year Plan, but these require significant investments. The UNCTAD Vulnerability Profile Report also clearly echoes this through what it has termed as the 'Bhutan paradox'. The reports asserts that, "while transformational progress is visible in Bhutan, making it a prime candidate for graduation, yet the risk of losing LDC treatment arises at a time when the resilience-building agenda of the country to alleviate its unique vulnerabilities is complex and costly."[19]

Two final notes on the Country Statement: not only should it be understood as part of a formal request to delay Bhutan's graduation from LDC status until then end of its 12th FYP in 2023 but, as will be come important later, an expressed indication of alignment between National plans and international development goals: "The 12th Five Year Plan will be our last plan as an LDC and shall address the last mile challenges in all sectors and ensure that Bhutan graduates on a sure footing with a strong economy. This will be achieved through an economic diversification drive that translates growth into jobs, increase resilience to exogenous shocks, broaden the base for government revenue and improve the prospects for future generation. The 12th Plan has identified 16 National Key Result Areas for

[18] Ibid, p.4
[19] Ibid, p.4

development. It presents a unique opportunity to mainstream the transition strategy into the national development plan and incorporate our obligation to fulfill the target of the 17 Sustainable Development Goals."[20]

What might this look like?

Bhutan in context

> Much of the time, changes in ecosystems and social-ecological systems are experienced as relatively slow and incremental, but from time-to-time dramatically large, persistent, and often unexpected changes take place. Such large, persistent changes are commonly referred to as regime shifts (Scheffer et al. 2001, Biggs et al. 2012). These shifts can have major impacts on human economies, security, and health because they affect the supply of essential ecosystem services on which human societies depend, such as crop production, flood regulation, and cultural identity (Millennium Ecosystem Assessment 2005, Crépin et al., 2012).[21]

Bhutan, and the international community as a whole, is in the midst of a major regime shift. As stated previously, Bhutan has managed extraordinary advances on behalf of its people and communities, putting the country on a trajectory of growth while contributing much needed stability to the region. As was also described, efforts to forecast Bhutan's mid- and long-term outlook underscore significant risk. Its impressive growth has led to a so-called "Bhutan Paradox", situated within a wider context of unprecedented systemic risks, and an increasingly formal "climate regime" (Keohane, 2010) of contingent requirements and resources that will impose ever-greater impact on its resilience and sustainability goals and, as such, should

[20] Ibid, p.5

[21] Biggs, R., G. D. Peterson, and J. C. Rocha. (2018). The Regime Shifts Database: A framework for analyzing regime shifts in social-ecological systems. *Ecology and Society*, *23*(3):9

inform its assessment of appropriate development models. Briefly:

"Climate Regime", developing countries, and availability of resources

Since its adoption in 1992, the United Nations Framework Convention on Climate Change ("UNFCCC" or "the Convention") has served as the legal cornerstone of a multi-lateral system, through which the international community has sought to address and combat climate change. Generally speaking, whatever the original framework lacked in scientific data, it made up for with unprecedented consensus around two interdependent streams of collective action: *mitigation* and *adaptation*. Parties to the Convention also adopted an Annex system of developed countries ("Annex-I Parties") and developing countries ("non-Annex-I Parties"). Through these categories, Annex-I Parties were recognized as having contributed a greater share of the emissions and, as such, were responsible to simultaneously lead the international community's efforts to reduce those emissions, and provide financial resources to non-Annex-I Parties who, meanwhile, were expected to contribute higher emissions as they continued to modernize their economies. It was hoped that the Annex system would result in sufficient resources to overcome the 'increased cost of adoption', and incentivize developing countries to be incubators of potentially scalable mitigation and adaptation strategies. To this end, the convention further integrated pre-existing frameworks such as LDC and associated requirements as a means of *coordinating* the challenges and opportunities of multilateral action. Since its adoption, Parties to the Convention have met annually to deliberate, monitor and advance the implementation of agreed goals. The international community has also utilized the Convention as the foundational document upon which subsequent agreements, constituted bodies, as well as *modalities, procedures and guidelines* are formed.

For example, in 1997, Parties to the Convention adopted a protocol to the Convention ("Kyoto Protocol" or "the Protocol"). Amongst other achievements, the Protocol built upon the Convention with enhanced modalities, procedures and

guidelines, as well as emission reduction targets for developed countries. As with the Convention, Parties to the Protocol have met annually to deliberate, monitor and further advance the implementation of agreed goals.

Similarly, in 2015 members of the international community adopted the Paris Agreement ("the Agreement"). By enhancing the Convention and the Protocol, the aim of the Agreement is to build capacity amongst the international community for multi-Party, coordinated action to combat climate change. Expanding upon the foundational DNA of mitigation and adaptation, the Agreement enhances the Convention and Protocol in the provision of specific data-driven goals (i.e., reducing global warming to 1.5° C – 2.0° C), associated requirements, and resources necessary to meeting those requirements.[22] As with the Convention and Protocol, Parties to the Agreement meet regularly to deliberate, monitor and further advance the implementation of multilateral goals.

Sadly, despite this extraordinary progress on the part of multilateral bodies, and a broadening popular acceptance that the climate crisis *has already arrived,* the paradigm of urgency has not necessarily manifested in the form of available financial capital.[23] If that current deficit of pledges and procurements weren't enough, consider a future downward trend in pledges and procurements resulting from a cascade of increased frequency and volatility of climate-related events, the loss of GDP through associated systemic disruptions, and the

[22] Paris Agreement, Decision 1/CP.21 "Adoption of the Paris Agreement"
https://unfccc.int/sites/default/files/resource/docs/2015/cop21/eng/10a01.pdf

[23] "According to the High-level Advisory Group on Climate Change Financing, Sustainable Development Goal (SDG) 13 on climate action aims to mobilize US$100 billion annually by 2020. This is needed to overcome the hundreds of billions of dollars in losses every year from climate-related disasters. Yet between US$3 trillion and US$4.5 trillion is needed annually to achieve the SDGs, while current investment is around US$1.4 trillion, creating a financing shortfall of about US$2.5 trillion." ww.undp.org/content/undp/en/home/blog/2019/islamic-finance-s-answer-to-sdgs-and- climate-change.html

redirection of remaining funds to mitigate existing damages and perceived risks.[24] In other words, the same interrelated effects of climate-related systemic risk that impact Bhutan's internal sustainability [25] simultaneously impact the rest of the international community, including previously industrialized nations whose own risks will force them to redeploy a greater share of available funds internally.

The emerging situation for developing countries and their communities has been described in such terms as "genocide," "climate apartheid," and "a gross inequality of burden." Its implications are stark: The combination of upward trends in climate-related systemic risk, and downward trends in available resources from both LDC transition and pledge / procurement deficits, puts Bhutan and other developing countries in a uniquely difficult position. Again, in such a context, and in consideration of potentially appropriate development models which *engage this risk*, the non-financial resources ('essential ecosystem services'/ 'community capital') necessary to resilience and sustainability projections become even more relevant.

In an age of urgency and limited resources, *coordinated planning and development* carries a premium. Stated differently, through the incremental scaffolding of a "climate regime," there has been an upward trend in a) "climate change" as an organizing principle, b) "mitigation and adaptation" as a general development model, c) "country- driven" plans as a means of implementing and aggregating multilateral agreements; and d)

---

[24] Centre for Research on the Epidemiology of Disasters (2018). Economic Losses, Poverty and Disasters 1998-2017 "The mean net present value of the costs of damages from warming in 2100 for 1.5°C and 2°C…are $54 and $69 trillion, respectively" Wallace-Wells (2019) extrapolates these figures for a 4.0°C increase to $551 trillion (see *Uninhabitable Earth,* p27; and Watson (2018) *The implications of global warming of 1.5°C and 2°C*, p.6).

[25] "We see a huge [potential] disaster developing from the mountain glaciers, which are retreating… This threatens people in settlements downstream, as well as the hydropower that we depend upon." Thinley Namgyel, *The Guardian* (2015) www.theguardian.com/environment/2015/dec/03/bhutan-has-most-ambitious-pledge-at- paris-climate-summit

"resources" that are increasingly contingent upon the alignment of developing countries' capacity-building efforts. As has been the case over the evolution of the paradigm, the adoption of "enhanced" measures within sequential agreements[26] is likely to continue, and the availability of associated resources will likely be tied to increasingly enhanced performance measures. Building on previous requirements such as "aligned" national plans / programs (i.e., NAP/A, NDC, NCP, etc.) and, as of 2005, corresponding incentives that such activities are eligible for funding,[27] new, enhanced 'modalities' such as Climate-Resilient Development Plans ("CRDP") and Monitoring, Review and Verification ("MRV") frameworks are accompanied by enhanced incentives for achieving them. Previously established funds such as the Global Climate Fund were given revised guidelines; new funds like the Pilot Program for Climate Resilience (PPCR) were placed in service – just two examples of the trend toward contingent 'bottom-up strategies for preparedness, planning and resilience-building'. When and if 'community development projects' are permitted to assign the challenge of these requirements to an 'outside' system, rather than adopting them as an opportunity to increase community capital – *this* is our crisis.[28]

---

[26] i.e., UNFCCC Article 6; Kyoto Protocol Article 10; Paris Agreement Article 12

[27] UNFCCC: "In 2005, Parties to the Kyoto Protocol decided that the capacity-building frameworks were also applicable to the implementation of the Protocol. They endorsed frameworks to guide capacity-building activities under the Kyoto Protocol in developing countries and countries with economies in transition." See: https://unfccc.int/resource/bigpicture/#content-the-paris-agreement

[28] Climate Investment Funds Bhutan page: "According to Namgay Dorji, Finance Minister of the Royal Government of Bhutan, The [PPCR] process will be used as a foundation to provide inputs in the 12th Five-Year Plan and help in translating the Intended Nationally Determined Contributions (INDC) into action. It will also examine the potential, merits, criteria and mechanisms for Bhutan to access, combine, and leverage climate finance opportunities to support a long-

Similarly, if Bhutan's graduation from LDC status in a context of increasing systemic risk represents a tangible challenge, how can existing community assets be leveraged to advance stated resilience and capacity goals such as improving conditions in rural areas, decreasing migration from rural to urban areas, increasing 'belongingness', and economic diversification? How can its significant previous investments in assets like the Gross National Happiness (GNH) infrastructure be enhanced? In a manner that not only increases the likelihood of 'enriched environments' and nurturing behaviors, but the resiliency of Bhutan's more vital indigenous assets like cultural heritage? How can the investments necessary to tangible challenges be seen as an *opportunity* to advance measurable indicators such as the 16 National Key Result Areas for development, and the UNs 17 Sustainable Development Goals ("SDG")?

Methodologically speaking, it will be increasingly important for local leadership that projects align with, internalize, and facilitate these issues. By utilizing a similar combination of contingent funding incentives, development models that integrate participation amongst stakeholders, and frameworks for the measurable implementation of milestones, local leadership can increase the likelihood of leveraging additional financial and non-financial resources. The value of bottom-up strategies and participatory development should not be underestimated – this *is* our work.

Meanwhile, over the last several years there has been an evolution of theory and practice on multiple fronts that contribute to the current 'community development' sector and, when combined with the regime shift toward climate mitigation and adaptation resources, provide a practical framework for the advancement of local resilience and sustainability goals. In my experience, diversified forms of capital such as *community capital, political capital,* and *creative capital* are not only inherent to the relative performance of any community asset, they are the DNA of its success – and limitations. In an age of climate change and crises of affordability, decision makers ranging from public

---

term series of transformational investments." https://www.climateinvestmentfunds.org/country/bhutan

officials to insurance providers are expanding their measures of impact, equity and 'sustainability' to reflect wider sets of data, and the interdependent capacity of stakeholders to address them. Briefly:

"Happiness"

The body of research that has been conducted around "Happiness," and "Wellbeing" suggests that the 'subjective life evaluations' of participants are methodologically viable, and can give rise to practical application in development.[29] Indeed, in a world of competitive resources, Bhutan's pioneering work as an incubator for a now internationally recognized, UN-sponsored Gross National Happiness index is itself an indicator of this viability and, given the extraordinary amount of work necessary to those surveys, underscores the value of soft infrastructure assets. But, to what end? Arguably, the success of the field built upon the Social Capital work before it and, as such, provides some guidance. As Helliwell (2001) put it, "The working definition of social capital that is emerging in an increasingly interdisciplinary literature refers to the networks, norms and understandings that facilitate cooperative activities within and among groups of individuals… its value to individuals within networks and outside them depends on the uses to which it is put… [and] make many aspects of life more enjoyable and more productive, in part by reducing the costs of dealing with risk and uncertainty."

"Belongingness"

Similarly, research into perceived residential environment quality and neighborhood attachment suggests that so-called "Enriched Environments" increase the likelihood of nurturing behaviors amongst participants.[30] How can this research guide development models to implement community aspirations?

---

[29] Helliwell, J. (2015), *World Happiness Report 2015* (p.19) "… the fact that life evaluations represent primary new knowledge about the value people attach to their lives means we can use the data as a basis for research designed to show what helps to support better lives."

[30] Cancedda L., et al (2004). Acceleration of visual system development by environmental enrichment. *Journal of Neuroscience, 24*, 4840-4848;

"Cultural Heritage"

On the one hand, the field once described as "the creative industries" evolved into a host of practical applications such as 'the creative class', 'the creative cities', 'the creative economy', 'placemaking', (etc.). While arguably enhanced by the cultural materialism of academics like Raymond Williams, critical assessments of the role of culture (cf., Chophel, 2011)[31], and creative practices such as action research, the success of the sector was built upon the hard work occurring within many communities to resist the displacement of their cultural heritage. This too was a regime shift: Not only were communities driving an increasingly explicit understanding of the value of local arts, indigenous crafts, cultural heritage; they were utilizing this value to take more ownership of the public sector's reliance on the revenues that 'creative economies' generate (i.e., SMEs, jobs, tourism, etc.). Increasingly, communities were deploying the value of cultural heritage and its unique forms of resilience and sustainability to stabilize neighborhoods in the face of increased risk, and leverage the additional resources necessary to the redevelopment of physical assets like buildings and neighborhoods. The implications for community development models also became clearer: How did creative communities compare to one-another? Why were some losing their creative leadership while others were gaining them? What happened when this migration occurred? Could it be prevented? Could it be harnessed? Networked?

"Impact Investing"

On the other hand, finance evolved. Building on multi-party innovations such as tax credits to fulfill the social contract, what was once regarded as Socially Responsible Investing ("SRI")

---

and Sale A., et al (2004). Enriched environment and acceleration of visual system development. Neuropharmacology, 47, 649-660. See also Bonaiuto, M. (2019) in this publication Understanding environment impacts on people via environmental psychology: three basic principles.

[31] Chophel, S. (2011) Culture, public policy and happiness. Journal of Bhutan Studies, *29*, 82-99.

became increasingly common and evolved from a tactic of protest to a means of measurable performance. SRIs became less about divestment *from,* than a means of contingent investment *in;* less about a regulatory overlay restricting the excesses of the private sector, than an enhanced deployment of resources *for* increasingly measurable ends. Generally speaking, the SRI trend reflects a desire to expand the lens of a cost-benefit analysis toward a more comprehensive set of metrics or outcomes necessary to long-term value, "resilience," and "sustainability". It too is exemplified by a host of ancillary applications such as the 'Triple Bottom Line' of *environmental*, *social* and *corporate governance* ("ESG"), B-Corporations, Social Impact Bonds, carbon credit markets, and the United Nations' contingent funds and Sustainable Development Goals. Whether or not one can reasonably argue that the impact investment sector is a cynical form of business as usual,[32] the fact of the matter is that the sector has grown in volume, sophistication and application across multi-policy lenses and increasingly aligned development models.[33]

"Localism"

The simultaneous rise of "Localism" is a strange hybrid of all of the above. It reflects a kind of organic view of socio-economic relations as an ecosystem, and the belief that there is an optimal size and/or behavior necessary to its sustainability over time. Ecology terms such as watershed, foodshed come to mind. As do cultural heritage; local customs and traditions; "authenticity"; eco-tourism and SMEs. Somewhere near the heart of this aggregate is a tension about scale, impact, urgency and strategy: small scale, family- owned, cooperative production. A rejection of an 'outside' system of consumerism in exchange for a more

[32] Giridharadas A. (2018) Winners take all: the elite charade of changing the world. Knopf Doubleday

[33] "The total US-domiciled assets under management using SRI strategies grew from $8.7 trillion at the start of 2016 to $12.0 trillion at the start of 2018, an increase of 38 percent. This represents 26 percent—or 1 in 4 dollars—of the $46.6 trillion in total US assets under professional management." USSIF (2018) Report on US Sustainable, Responsible and Impact Investing Trends; www.ussif.org/trends

internalized system of measurable supply chains and local participation. Somewhere near the heart of this lies direct investments in social capital; the urgency of resilience and sustainability strategies that community stakeholders have faced for generations.[34]

So, what *does* success look like?

> We define a regime shift as cascading when its occurrence may affect the occurrence of another regime shift.[35]
>
> When we can entrust local communities to look after what they need to do, then the rest of us are just catching up with the local communities – that's when local resilience is built.[36]

Ex Ante

> The lack of risk awareness largely explains the lack of disaster preparedness and response planning [at local levels]. In short, the capacity to mitigate the impact of possible disasters ex ante and to respond to disasters speedily and effectively when they occur is more or less non-existent. A bottom-up strategy for disaster preparedness and planning is therefore considered a priority by policy makers. They also know the cost of this strategy, and the challenge Bhutan will be facing if it undertakes an ambitious and costly resilience-building agenda of this nature while losing Least Developed Country status and the benefits associated with it.[37]

---

[34] cf., Jacobs, J. (1961). *The Death and Life of Great American Cities*. Vintage Books

[35] Rocha, et al., (2018). Cascading regime shifts within and across scales. *Science*, *362*, 1379–1383

[36] Chime Wangdi, Secretary General of Tarayana Foundation https://www.iied.org/how- are-ldcs-defining-new-sustainable-development-agenda

[37] UNCDP (2018) Vulnerability profile of Bhutan, p.18.

While underwriting projections and scenario planning for short-term (e.g., 5years), mid-term (e.g., 2030; 2050), and long-term (e.g., 2050; 2100) are limited by effective available data, in a world of climate change and 'climate finance,' scientifically validated patterns do exist and repeatedly indicate that: we are likely to miss previous multilateral targets (warming by 1.5° - 2.0°); that such targets have therefore become *best case* scenarios; that conditions are likely to become *worse* than we have been predicting (warming by 4.0°); and that volatility cascades are likely to occur *sooner* than we have been predicting. In other words, what was once a set of *potentially* problematic scenarios out on the horizon have, as a result of insufficient action, become *sufficiently likely* to require an entirely different set of scenarios, development projects, and underwriting projections. Stated differently, current forecasts of systemic risk (e.g., 2030, 2050) put us squarely within the financial underwriting periods and amortization schedules of traditional development models (e.g., 20-30 years), bringing the viability of entire asset classes into question.

As was also described, the combination of upward trends in climate-related systemic risk, and downward trends in available resources to address that risk, puts Bhutan and other developing countries in a uniquely difficult position. With this forecast in mind, and in consideration of potentially appropriate development models which engage that risk, investments in 'social capital' become increasingly material and operate as multipliers for better or worse. Depending upon timing and levels of investments made, social capital generates its own cascade of impacts: as productive assets or draining liabilities. In the interrelated world of climate change and climate finance, the comparative value of resilience and sustainability investments increases. Furthermore, the fact that incremental enhancements to the "climate regime" have resulted in the evolution of requirements and incentives such as CRDP and MRV suggests that in order to simultaneously advance credible planning efforts, fulfill multilateral requirements, and attract increasingly competitive resources, projects would be better served by adopting a combination of *worse-sooner* scenarios, a comprehensive framework for stakeholder coordination, and a

'bottom-up strategy for preparedness, planning and resilience-building.

Whatever scenario one underwrites, "the project" and its development model *should drive* comprehensive assessments and increase the value of other existing assets by being aggregated within a network of coordinated impact. *This* is our work. More specifically, underwriting projections that integrate a more comprehensive framework of metrics increase the likelihood that tangible and intangible assets will perform in a context of even accelerated, worse-sooner socio-economic cascades. Given the urgency of pressures facing even traditional community development projects, combined with the typical scale, timeline and restrictions of awarded funds, they are often viewed as a "generational opportunity" for local leadership to get the fundamental goals of the project right, leverage additional stakeholders across multiple policy and sector silos, integrate their resources, and ensure that vital community assets are placed *"in the service of"* measurable community benefit.

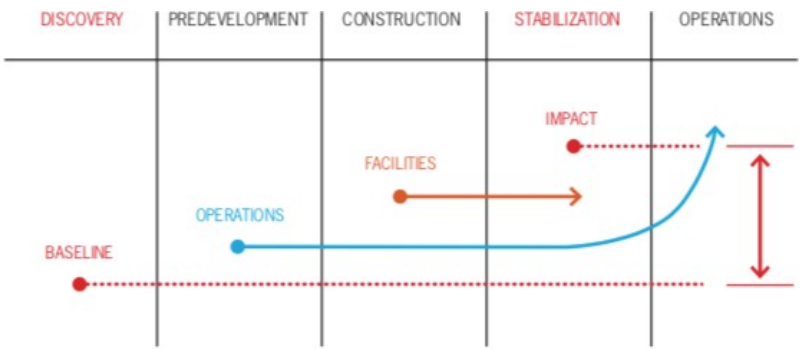
Critical path

In the Real Estate and Community Development sectors, a "Critical Path" refers to a set of inherent 'critical' milestones or goals that a project must meet along its development 'path' to success. Again, generally speaking, all projects are complicated data sets requiring consensus amongst stakeholders to accomplish their projected goals. At some point or another, this means, *ex ante,* "getting the simple right": if the goal of the project is to maximize profits, then the critical path and metrics of success should reflect that goal. If the goal of the project is to maximize community benefit, or community capacity, then the critical path and metrics of success should reflect that goal.

Traditionally, the three phases of a project's critical path were *Predevelopment*, *Construction* and *Operations* – each ideally laying a path of success (or lack thereof) for the next. During predevelopment, the project's financing assumptions and due diligence are conducted sufficiently to close a deal amongst key stakeholders, who thereby agree to a contractual set of terms for success that the project must then achieve moving forward. As

such, most of a project's DNA is embedded during its predevelopment period.

Generally speaking, if predevelopment is done well, the subsequent construction and operational periods have a higher likelihood of also going well, and delivering upon the project's development goals and underwriting projections. If, for whatever reason, this period is not comprehensive, does not integrate the right stakeholders, and/or does not take the appropriate mid-term and long-term factors into account, the critical path milestones that were missed will manifest as risk during the subsequent construction and operational phases, potentially driving the project away from its stated development goals (e.g., community benefit) and underwriting projections (e.g., time, budget). Increasingly then, development projects and their stakeholders are taking protective measures by investing in two additional critical path phases: a *Discovery* phase which informs the subsequent predevelopment capacity, and a *Stabilization* phase which informs the subsequent period of operations. Each phase is typically eligible for diverse types of capital from both public and private sources.



Asset-based community development

While collecting a community's own views about existing conditions and perceived needs is a pre-requisite to any community development process, the sustainability of that process – and the enhanced operations of the development anchoring it – should build upon existing assets and initiatives already located in the local / regional community.

This so-called "Asset-Based Community Development" model requires orienting the project's fundamental goals toward the inclusion of stakeholders and the generation of measurable community impact. At minimum, this means some form of local leadership having a legitimate seat at the table to ensure that community capital invested in other local initiatives and/or organizations is reasonably brought to bear rather than put at risk. Whether in the form of partnerships, satellite programs, formal networks, or appropriate disclosures and coordination, defining "a project" by its alignment with local aspirations can bring much needed expertise and networks to bear. Consider the potential downside: whether in the form of angry residents, review and approval delays, uninformed designs, or misguided underwriting projections that result in underperforming assets, the disregard of community stakeholders and associated social capital assets will inevitably manifest within the critical path of a project, putting it – and the community – unnecessarily at risk.

While the work involved in a project's *discovery*, *predevelopment* and *stabilization* phases are not as immediately apparent as construction administration, the importance of properly capitalizing those efforts should not be underestimated and, as described above, are increasingly eligible for significant funding streams. The upside? At minimum, informed decisions make it more likely that a project will reduce risk, increase operating margins, and transact on its comparative affordability by attracting potential end-users willing to advance local resilience and sustainability goals. *This* is our work.

Diversified capital

At state, federal and even international levels, the debate over whether impact finance, the creative economy, and placemaking are emergent economic multipliers or just passing trends without any structural connection to our local economies is playing out. These debates are also happening at the local level of our communities through the innovation of stakeholders like individuals, businesses, and legislatures. Whether it be the recognition by municipal bodies that there is a cascade effect to the size, connectivity and competitiveness of local economies (i.e., SMEs, arts, culture, tourism, etc.), their role in regional

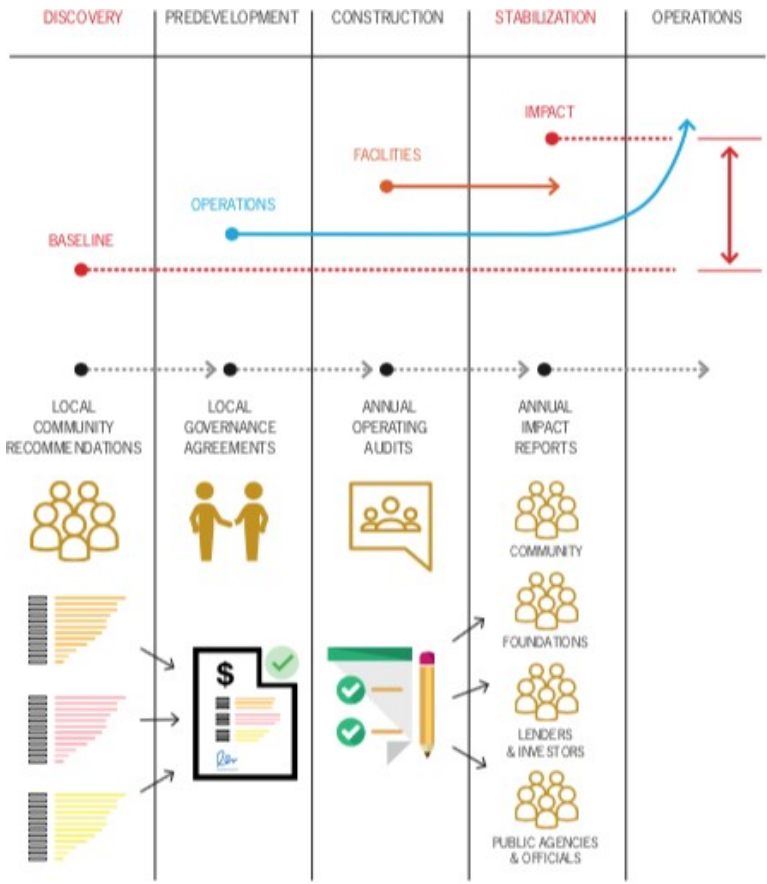
supply chains, food systems, and the social determinants of health, or increases in the quantity of community development efforts which meaningfully adopt the traditionally excluded voices of local residents, creatives, and small business owners within the decision-making frameworks of local land-use procedures ('placemaking'), projects are increasingly choosing or *being forced to integrate* a wider set of community impact criteria within their "critical path". And this is not simply to ensure the public approvals necessary to development rights. Increasingly, there is recognition that assets placed in the service of measurable community development goals can impact more issues and, as a result, have a higher likelihood of *eligibility* for diverse financing products that decrease debt, *operating* with better margins, and/or *mitigating* risk. In so doing, they increase the likelihood that community members thrive within their communities, contribute to the shared heritage of community and cultural capital, and increase essential ecosystem services over time. Increasingly, in an age of climate change and crises of affordability, decision makers ranging from public officials to institutional investors are expanding their measures of impact, equity and 'sustainability' to reflect wider sets of data, and the interdependent capacity of stakeholders to drive change.

Ex ante

In the effort to place Bhutan's extraordinary growth in a wider context and explore the emerging situation that developing countries face today, a number of questions have been raised – about reasonable projections, development models, and the resources necessary to resilience and sustainability goals. Specifically,

- Adapt to what exactly?
- What does success look like?
- How do we increase the likelihood that community members thrive within their communities?
- Can migration between communities be prevented, harnessed and/or networked?
- What would a more resilient ecosystem of local and regional partnerships look like?

- How can development projects invest in community capital, cultural capital, and essential ecosystem services?
- How can existing research frameworks be put into action for the measurable betterment of communities?
- How can significant investments in assets like the GNH infrastructure be leveraged?
- How can development models and projects simultaneously advance measurable indicators such as the 16 National Key Result Areas for development, and the UNs 17 Sustainable Development Goals ("SDG"), while leveraging additional regional and international resources?



Four interrelated dimensions of an Asset-Based Community Development model are briefly considered here:

1. Diversified capital;
2. Community recommendations ("Data Set 1");
3. Market analytics ("Data Set 2"); and
4. Local capacity.

1. Diversified capital

I am using "diversified capital" to refer to an overlapping set of financial and non- financial resources necessary to advance a development project's goals:

A. Sources of capital, i.e.,
resources necessary to a project's total development costs (often defined by terms such as "capital stack", and instruments such as project cost statement, sources & uses, etc.;

B. Types of capital, i.e.,
resources available to a project's underwriting projections (often defined by terms such as "capital spectrum", and instruments such as grants, low-interest loans, operating reserves, etc.;

C. Forms of capital, i.e.,
resources available to a project's fundamental measures of success and sustainability (often defined by terms such as "stakeholder equity", and aggregates such as Financial Capital, Community Capital, Political Capital, and Creative Capital).

To varying degrees, every development project has diversified capital (or a lack thereof) woven into its DNA and, by extension, its critical path. For example, from a financial capital perspective, if a project chooses to forgo the predevelopment work that is necessary to integrate public-private partnerships and/or philanthropic *sources*, then that project's eligibility for diversified *types* of capital will decrease, and its debt load and operating costs are likely to increase to make up for the loss of those financial sources. Similarly, a lack of community and political capital drive costly delays, requiring additional creative capital to generate unfunded solutions (eg., finance, design,

leasing, etc.). In each case, the eventual revenues necessary to overcome those hurdles, to cover those unforeseen costs, and/or incur the additional debt load will generate a corresponding increase to a project's operating costs – ultimately externalizing risk onto the community. Generally speaking, there is a direct, inverse relationship between operating costs and potential end-users: the higher the operating costs of a project, the lower will be the quantity of potential end-users – whether they be renters, businesses, or the combined purchasing power of a community. Simply put: a lack of diversified capital puts a project and its community at risk.

Traditionally, there are two fundamentally different models to consider: 'for-profit' and 'non-profit', or, put differently, 'market development' and 'community development'. It's important to note that these models, and their comparative measures of risk, success, and sustainability, are not mutually-exclusive: Well-crafted projects can simultaneously generate revenues, turn a profit, and provide measurable community benefit. The best projects do. The point here is not to suggest an ideological framework, but to reinforce a methodological one: by aligning a project's goals with community recommendations on one hand, and potential diversified capital partnerships on the other, "the project" is more likely to cultivate and manage expectations of *what the project can and should be expected to do, what we're building and why,* and how increasingly limited resources will be deployed for measurable impact over time.

2. Community recommendations ("Data Set 1")

In my experience, *discovery* and *predevelopment* efforts benefit from partnerships with project stakeholders to conduct a series of public workshops and events, during which the community provides their recommendations on two fundamental issues:

- "What is it the project can and should be expected to do?"
- "What are we building, and why?"

These community objectives can be broken out across multiple policy "impact areas," for example:

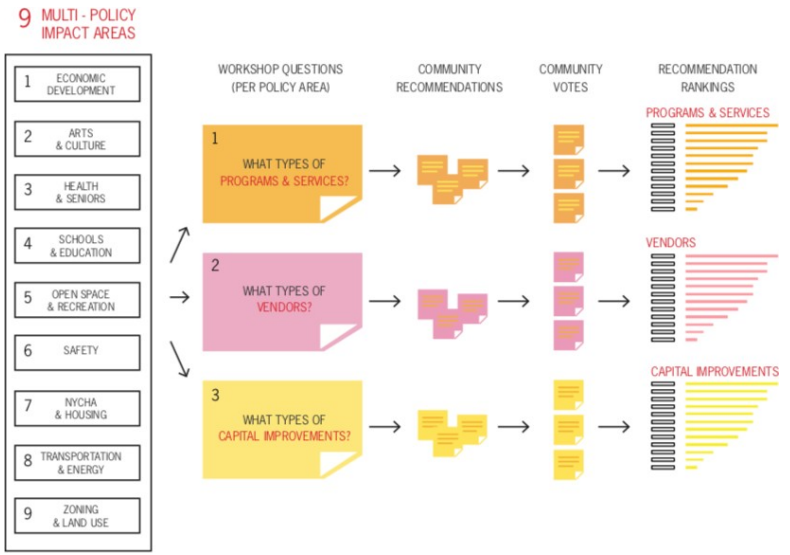
1. Economic development

2. Arts and culture
3. Health and seniors
4. Schools and education
5. Open space and recreation
6. Safety
7. Housing
8. Transportation and energy
9. Zoning and land use

Community objectives and impact areas can also be broken out across operational scenarios, for example:

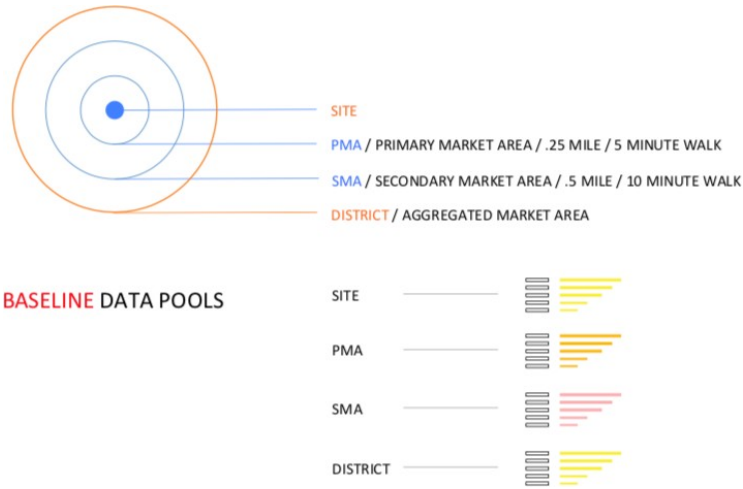
a. What types of *Programs & Services* do you believe should be conducted to advance the community's objectives?
b. What types of *Vendors* do you believe should implement those programs & services?
c. What types of *Capital Improvements* do you believe will increase the likelihood of those programs & services?

The following diagram provides an overview of how community recommendations can be compiled into aggregate rankings and actionable data:



3. Market analytics ("Data Set 2")

Traditionally, the goal of market analytics research is to develop an understanding of a community's socio-economic characteristics through data such as demographics, income levels, employment, and/or trends in areas such as existing industries, housing and retail. The information allows lenders and investors to better assess the viability of a development project and its underwriting projections. In my experience, it's also an effective way to assess potential uses and programmatic aspirations such as the development of targeted industries, while providing a baseline reference against which the community's recommendations and operational impact can be incentivized and measured. As such, it's helpful to divide the project's relevant catchment area into 'market area' segments. For example, the following diagram provides an overview of how community recommendations can be compiled into aggregate baselines:



4. Local capacity and governance

Traditionally, development projects are done in or around communities, not *with* them. Financial capital and political capital drive a critical path, with little if any measurable contributions of or obligations to community and creative

capital. In such development models, risk is deleveraged by property line with little if any consideration to a more comprehensive set of factors that are designated *outside* the boundaries and/or definition of "the project". However, in a context of heightened systemic risk, where existing assets are under review, where "resources" are increasingly contingent upon the alignment of developing countries' capacity-building efforts, indigenous resources become the most important assets we have. Engaging communities in 'a bottom-up strategy for preparedness planning and resilience-building', and the urgent timeline for doing so – *this* is our crisis; *this* is our work. Increasingly, in a world of climate change and climate finance, decision makers are targeting measures of impact, equity and 'sustainability' to include wider sets of data, and incentivizing stakeholders in multi-party agreements to drive change.

Given the urgency of pressures facing even traditional community development projects, combined with the typical scale, timeline and restrictions of awarded funds, they are often viewed as a "generational opportunity" for local leadership to get the fundamental goals of the project right, leverage additional stakeholders and their resources, and ensure that vital community assets are placed "*in the service of*" measurable goals which simultaneously benefit the residents of the community, and fulfill reporting requirements.

Methodologically speaking, this means, *ex ante,* "getting the simple right": if the goal of the project is to maximize community benefit, or community capacity,[38] then the critical path and metrics of success should reflect that goal. By utilizing a combination of contingent funding incentives, development models that integrate participation amongst stakeholders, and frameworks for the measurable implementation of community aspirations, local leadership can increase the likelihood of leveraging additional resources, and invest in projects that build community capacity over time.

From the perspective of *diversified capital*, an 'asset-based community development' model, or 'key performance

[38] cf., p7, notes 9, 10 above.

indicators' model is a very practical framework to simultaneously

- underwrite a project's total development costs conservatively, including soft infrastructure needs like social capital and essential ecosystem services;
- leverage additional resources necessary to a project's total development costs;
- invest in the stated needs of residents by operationalizing community aspirations;
- assign *appropriate* risk to community by engaging them early and incentivizing long-term involvement; and,
- allow leadership to periodically course-correct through a combination of annual audits and reporting on the project's community benefit over time.

More specifically, through an asset-based community development framework, a project's *critical path* is structured to identify with community needs during its *discovery* period, which increases eligibility for low-interest impact financing during *predevelopment*, reduces costs during *construction* by designing the site with intent, capitalizes reserves during *stabilization*, and generates higher impact and margins during *operations*. In other words, by investing in a project's capacity to define itself by and implement community aspirations, leadership has a higher likelihood of accessing diversified capital resources to engage the urgent issues facing local residents, design the site with intent, reduce costs, and incentivize vendors to be contractual parties to the project meeting key performance indicators over time.

Bottom line? By integrating a more comprehensive asset-based community development model, development projects have a higher likelihood of achieving tangible resilience and sustainability goals by providing measurable community benefit to local residents.

Case studies

Social capital and ecosystems: Cultural heritage, indigenous traditions, and community equity

Ise Jingu

Ise Jingu is an ancient Shinto shrine complex located in an ancient hinoki forest within the Mie Prefecture of Japan. Established in 690 AD, its architectural style, *shinmei- zukuri,* dates back even further to 250-538 BC. Every twenty years, the ritual cycle of *Shikinen Sengu* reconstruction commences, whereupon the combined dismantling of the existing shrine and construction of a new shrine to the same plan is conducted using traditional materials, means & methods. In this way, not only is the cultural heritage preserved, community capital is increased through a comprehensive development process of planning, procurement, construction and renewed operations. Since its establishment, 62 Sengu cycles have been conducted.

> The most important aspect of the entire management process is the transmission of skills and technologies to the next generation.[39]
>
> Like all rituals, [the cycle] acts as a tie binding past generations to future generations and renews and reinvigorates ties within the present generation. In the case of Ise, these ties are with the participant's community, with the shrine, and with the nation.[40]

The Mountain-EVO Project

"In Huamantanga, an Andes mountain village [of Peru], people still use a 1,400-year- old technique to capture rainfall in shallow canals made of rock called *amunas*. Now, for the first time, researchers have measured and modeled how restoring and using additional amunas [could be used], '*...to rescue and*

[39] Adams, C. (1998). Japan's Ise Shrine and Its Thirteen-Hundred-Year-Old Reconstruction Tradition. *Journal of Architectural Education*, pp. 49-60 See also, Umi Yama Aida (2014) https://umiyamaaida.jp/en/
[40] Ibid.

revalue indigenous knowledge to complement modern science to provide solutions to current problems.' "

> The local community members of Huamantanga ('comuneros') told us that their greatest challenge was 'their lack of knowledge', but we had actually observed they possess great knowledge and work willingness. We then understood that the Mountain-EVO was precisely an active research that could rescue and revalue ancient and rural knowledge, combine them with modern water science, and aim at reducing poverty. We worked for combining science with rurality and ancient with present.[41]

Minnesota Initiative Foundations

> Southern Minnesota Initiative Foundation [is one of six regional foundations that] works collaboratively to catalyze economic growth and strengthen regional vitality through three main focus areas: economic development, early childhood, and community vitality. [The Foundation] uses an asset-based approach to empower southern Minnesota citizens through facilitating collaborations, boosting regional philanthropy, and making early- stage investments to ensure a strong Greater Minnesota for both today and for future generations.[42]
>
> The thing that the Minnesota Initiative Foundations brought to rural Minnesota was the empowerment of local leaders. McKnight made us feel like we

[41] Ochoa-Tocachi, et al. 2019. Nature Sustainability, Vol 2, 584–593. Potential contributions of pre-Inca infiltration infrastructure to Andean water security; see also www.nationalgeographic.com/environment/2019/07/seeking-relief-from-drought-peru- capital-lima-looks-to-ancient-past; and https://sustainabilitycommunity.nature.com/users/262861-katya-perez/posts/50364- potential-contributions-of-pre-inca-infiltration-infrastructure-to-andean-water-security

[42] See https://www.greaterminnesota.net/southern-minnesota-foundation/

> already had the right answers, and with some help and encouragement, we could move mountains.[43]

In 1986, the McKnight Foundation established "Minnesota Initiatives" with a belief that real economic development in small towns happens through a regional approach (versus a town approach to regional development). After a statewide listening tour with local leadership (i.e., who's talking, who's listening, who's making decisions, and who owns it afterward?), six independent organizations were established to reflect and empower the state's six pre-existing regions. While independent of one-another and McKnight, what these new organizations shared was a set of guiding principles that informed the means & methods, and roles & responsibilities of their work. For example, each region had a different socio-economic history that was facilitated through community engagement, board development, entity structuring, formal financial systems, and the development of programs & services. This collaborative effort was accomplished by seeking out existing community assets, facilitating partnerships between them, and implementing an informal contingency funding structure of matching grants (i.e., funds beyond those provided by McKnight). The use of matching grants acted as a community organizing practice, acknowledging the practical value of local / natural histories which can be brought to bear through partnerships that are sufficiently resourced to address real issues.

> The brilliance of Minnesota Initiatives was about actually shifting power. Believing that communities know better than we do is the precipice I've seen all sorts of philanthropies walk up to – but not many are able to take the leap.[44]

---

[43] Ken Trom, community member. See: www.greaterminnesota.net/celebrating-30-years/

[44] Interview with Neal Cuthbert, former Vice President, McKnight Foundation, July 2019

Dudley Neighbors, Inc.

Established in 1984, the Dudley Street Neighborhood Initiative (DSNI) has become a nationally recognized model for long-term, sustainable community development. DSNI's mission is to *empower Dudley residents to organize, plan for, create and control a vibrant, diverse and high quality neighborhood in collaboration with community partners.* Through collective land rights, creative financing structures and properly resourced guiding principles such as Collective Resident Leadership and Control, Vibrant Cultural Diversity, Community Collaboration, and programmatic focus areas such as Development Without Displacement, Youth Voice, Neighborhood Development and Resident Empowerment, DSNI has, "created greater civic participation, economic opportunity, community connections, and opportunities for youth." In order to effectively advance it is mission, DSNI established a community land trust – Dudley Neighbors, Inc. – and has since transformed 30 acres of formerly vacant, blighted land into 225 new affordable homes, a 10,000 square foot community greenhouse, urban farm, a playground, gardens, and other amenities of a thriving urban village.[45]

Norandino

Established in 1995, Norandino is a secondary cooperative of "smallholder" agriculture producers in northern Peru, a community development organization, and a leader within the 'alternative trade organization' movement. The cooperative consists of 6400 producer partnerships. According to Santiago Paz Lopez,[46] Commercial Manager of Norandino, roughly 20% of the world population is living under the poverty line; 600 million people that live under the threshold for food security are farmers that can't provide adequate food to their family; and millions of disadvantaged producers and workers from developing countries are continually facing the problems of low

[45] See: www.dsni.org; www.dudleyneighbors.org/background.html; and the Dudley Street Anniversary 20th Anniversary Jamboree Video www.youtube.com/watch?v=SqSHZpDh014

[46] Santiago Paz Lopez, presentation, Equal Exchange Annual Summit 2019

and fluctuating prices for products, lack of capital, and inequality in commercial relationships. Through 640 organizations certified in 58 countries over 3 continents, three producer networks (CLAC, AFN, NAP) participate under the "Fair Trade" international label, 1.5 million producers and workers are direct beneficiaries of the label and, indirectly, the label improves the livelihoods of 7 millions of people.

By creating an alliance of development alternatives, strengthening smallholder organic farming associations, and recovering native plants/varieties to offer unique and high quality products, Norandino's cooperative partnerships are using existing market dynamics to simultaneously pioneer and implement practices which mitigate climate change, increase sustainable food production, and improve the livelihoods of all members of the cooperative.

> The first truth is that smallholders aren't begging for help. They are seeking fair business, fair commerce – [an idea of justice presented by] Mexican coffee peasants during the United Nation conference in 1964.[47]

Implications and recommendations

> Participatory Action Research (PAR) offers the unique ability to assess heritage while empowering communities. Moreover, within its framework, PAR assigns the expert to the specific role of facilitator in helping communities to control the gathering and presentation of their own built heritage meanings and values.[48]

[47] Santiago Paz Lopez, presentation, Equal Exchange Annual Summit 2019

[48] Wells, J. (2015). In stakeholders we trust. International Scientific Committee for Theory and Philosophy of Conservation and Restoration ICOMOS

> We are the first generation to fully understand climate change and the last generation to be able to do something about it.[49]
>
> Elect a clown, expect a circus.

I have taken the position that Bhutan is facing a critical turning point – both internally and externally. That despite extraordinary progress, its pending graduation from its UN Least Developed Country status at the end of the current Five Year Plan (2023) will likely decrease the availability of capital, increase the cost of available capital, and exacerbate the urgency of the country's modernization goals. I've also suggested that the so-called 'Bhutan Paradox' comes at a time of increasing systemic risk which, in turn, exacerbates both planning and implementation of resilience and sustainability goals. Not only are there limited resources available to traditional development models, there are significant additional costs to adaptation. I've tried to illustrate this combination of internal and external transition underscores the need to engage local stakeholders in a meaningful capacity-building framework, in 'a bottom-up strategy for preparedness planning and resilience-building', and the urgent timeline for doing so.

This paper has briefly explored these issues through comparative scenario projections and the potential application of Asset-Based Community Development methods to build capacity and mitigate risk. Specifically, *Bhutan Today* opened a lens of existing conditions and perceived needs; *Bhutan in Context,* situated it within a wider lens of regional and international trajectories; *Ex Ante,* considered the potential risk implications of comparative development model projections; *Diversified Capital,* explored different types of capital and their aggregation within sustainable community development frameworks; and *Case Studies,* highlighted potentially applicable models in practice.

Based on this preliminary research, the following *Implications and Recommendations* are offered for consideration by local leadership and their stakeholders. Briefly:

[49] UN WMO chief Petteri Taalas

1. Scenarios

Development scenarios reflect a project's fundamental short-term, mid-term and long-term outlooks. By capturing sufficient data to provide viable conceptual plans, scenarios allows stakeholders to better assess the viability of a development project and its associated underwriting projections. As described previously, it's also an effective way to assess potential uses and programmatic aspirations such as the development of targeted industries, while providing a baseline reference against which community's recommendations and operational impact can be measured. At some point this means 'getting the simple right' (e.g., aligning to profit development and/or community development) and building a framework of relevant metrics to assess performance over time;

a) Underwriting Assumptions

Tying a development project's conceptual plans to 10-20-30 years proformas and amortization schedules is required under any circumstances. However, given the fact that these timelines now place us squarely within the path of major climate markers (2030, 2040, 2050), and the current context of institutional investors and insurers revising the creditworthiness of municipalities and fixed assets, the stakes are significantly higher and underscore the need to take all available data and resources into account to plan accordingly;

i. Conservative forecasting
   Embrace 'worse-sooner' scenarios as a means of informing development needs, development models, and subsequent underwriting projections; assets developed to solve for conservative conditions have a higher likelihood of performing under better conditions – the reverse does not hold; not only is risk unevenly borne by the most vulnerable, underperforming social capital and/or fixed assets contribute negative indicators to resilience and sustainability goals; while often necessary, retrofitting is not an efficient use of resources;

ii. Alternative sources

Assume LDC graduation could result in a reduction of available financial capital, that other forms of capital (e.g., political/community/creative capital) will become increasingly important and, if managed properly, pay significant dividends over time, thereby addressing deficits and reducing the need for additional financial capital to fill gaps;

2. Models

a) Asset-based community development

Engaging communities in 'a bottom-up strategy for preparedness planning and resilience-building' is an undeniable opportunity for local leadership to get fundamental concept of a project right, leverage additional stakeholders and their resources, and ensure that vital community assets are placed "*in the service of*" measurable goals which simultaneously benefit the residents of the community, and fulfill reporting requirements; by aligning a project's goals with community aspirations on one hand, and potential diversified capital partnerships on the other, "the project" is more likely to cultivate collective ownership of *what the project can and should be expected to do, what we're building and why,* and how increasingly limited resources will be deployed for measurable impact over time;

i. Means & methods

(1) Critical Path

"Critical Path" refers to a set of inherent 'critical' milestones or goals that a project must meet along its development 'path' to success; in my experience, community development projects benefit from a five-phase critical path – *Discovery, Predevelopment*, *Construction, Stabilization,* and *Operations* – each ideally laying a path of success for the next; given that most of a project's DNA is embedded during its discovery and predevelopment period (forecasting, underwriting, conceptual design), it's important to capitalize *all* phases of a project's ability to build capacity;

(2) Participatory Research, Planning, Development and Operations
While the pathway of research to policy is relatively common, it's practical flow-through to inform contingent resources, development requirements, and the built environment are less so. These "scaling and mainstreaming" strategies are important to mitigation and adaptation goals, and resonate with competitive resources; therefore, invest in (action) research as an opportunity to drive policy and development by explicitly rewarding implementation; reduce the 'costs' of doing so by building upon existing participatory assets that advance planning (i.e. GNH surveys, public review requirements); further enhance the capacity of such assets by linking them with other nodes in an implementation network of additional developments that operate at regional and/or sub-regional levels (i.e., mixed-use community centers);

ii. Roles & responsibilities

(1) Local governance
What does success look like? What does 'resilience and sustainability' look like? What, then, do strategies for building resilience and sustainability look like? Somewhere near the heart of these questions are issues of scale, participation; somewhere near the heart of these are issues of ownership and equity; at minimum, this means some form of local leadership having a legitimate seat at the table to ensure that community capital invested in other local initiatives and/or organizations is reasonably brought to bear rather than put at risk;

(2) Impact partnerships
Incentivize end-users (i.e., vendors, tenants, program/service providers) willing to measurably implement community recommendations by providing a combination of resources, technical support, below-market rent, and low-interest and/or forgivable loans for build-out requirements, thereby reducing overhead in meaningful ways;

b) Diversified capital

As described previously, "diversified capital" refers to an overlapping set of financial and non-financial resources necessary to advance a development project's goals; every development project has diversified capital (or a lack thereof) woven into its DNA and, by extension, its critical path;

i. Financial capital

(1) Replicable precedents
Minimize losses from LDC graduation and maximize access to international finance by orienting investment goals toward measurable returns in community capital; while it may seem counter-intuitive to a financial capital strategy, allocating limited bandwidth to building relevant frameworks will set replicable precedents, deliver upon existing reporting requirements, and pay dividends over time;

(2) Match-funding
Ensure that public incentives are significant, by matching them with the resources of other stakeholders, and structured in a manner to make partnerships between the private sector, NGOs, and other program/service providers required or more likely;

(3) Capitalized Operating Reserves
A financial instrument that is funded ('capitalized') alongside a development's other projected expenses ('Total Development Costs') in order to increase the likelihood that a project's *stabilization* and *operating* phases are more resilient and perform on its development goals. A traditional requirement within the affordable housing industry, capitalized operating reserves are a unique and, if structured properly, effective means of driving multi-party investments in measurable impact;

ii. Political capital

(1) Treasury, review & approvals
Leverage the public sector's unique capacities of treasury and review & approval procedures (e.g., zoning, land-

use) to aggregate stakeholders and affect change; leverage the unique capacity of development plans and guidelines (e.g., 'Qualified Action Plans') to outline priorities, eligibility, and criteria for awarding development rights, and/or associated resources; codify resources, procedures and plans in a manner that make partnerships between the private sector, NGOs, and other program/service providers required or more likely;

(2) Reporting
Ensure that development rights and/or resources are paired with transparent reporting requirements which implement community aspirations and other required metrics (e.g., SDGs);

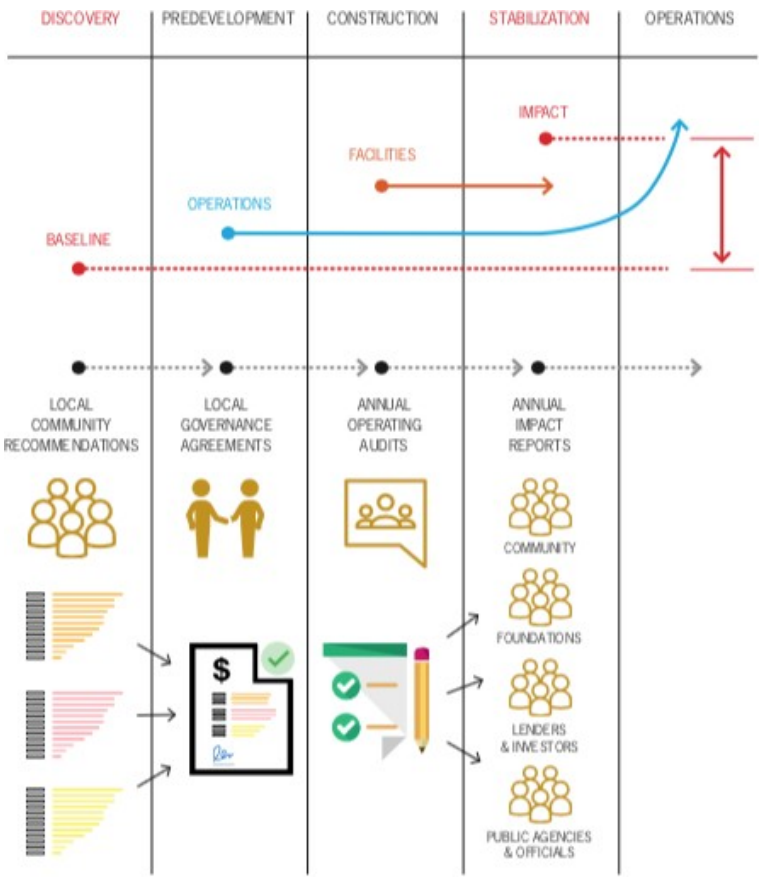
iii. Community capital

(1) Existing Assets
Leverage the unique capacity of local heritage to build capacity; utilize the challenges that existing stakeholders face as an opportunity to better plan, develop and operate fixed assets;

(2) Cooperatives
Further enhance and incentivize existing participatory / cooperative development models (i.e., land pooling, community land trusts) as a means of investing in social capital, equity, and capacity-building;

iv. Creative capital

(1) Embrace Change
Utilize community aspirations and subjective evaluations as methodologically viable roadmaps for defining success; incentivize and reward stakeholders willing to measurably implement those aspirations; include traditionally excluded voices within decision frameworks; empower artists, artisans, culture-bearers, and traditional local methods as uniquely qualified practices to affect change.


DISCOVERY
PREDEVELOPMENT
CONSTRUCTION
STABILIZATION
OPERATIONS
IMPACT
FACILITIES
OPERATIONS
BASELINE
LOCAL COMMUNITY RECOMMENDATIONS
LOCAL GOVERNANCE AGREEMENTS
ANNUAL OPERATING AUDITS
ANNUAL IMPACT REPORTS
$
COMMUNITY
FOUNDATIONS
LENDERS & INVESTORS
PUBLIC AGENCIES & OFFICIALS

Contributors

Abhinav Madhavanunni
Abhinav have a background in Urban Planning and has worked in the capacity building sector for urban practitioners for around three years. At IIHS, he works with the Urban Practitioners Programme to conduct Individual Capacity Building programmes for government officials across nine states, namely Kerala, Tamil Nadu, Karnataka, Gujarat, Rajasthan, Jammu and Kashmir, Jharkhand, Goa and Orissa under the AMRUT Mission. His teaching and research mainly focus on subjects like Green Infrastructure, state urbanization trends, urban transportation and National Urban Missions. Email: abhinavm@iihs.ac.in

Akio Ito
Akio Ito works at National Institute for Environmental Studies, Japan.

Anugrah Sabdono
Anugrah Sabdono works at Department of Physics Engineering, Institut Teknologi Bandung, Indonesia.

Arindam Biswas
Arindam Biswas works as Assistant Professor in Department of Architecture & Planning and Associated Faculty for Centre for Transportation Systems, Indian Institute of Technology Roorkee, Uttarakhand, India. He has completed his PhD from University of Tokyo, Japan in 2013, Master of City Planning from Indian Institute of Technology Kharagpur, India in 2009 and Bachelor of Architecture from Jadavpur University, Kolkata, India.

Chimi
Chimi currently works as Programme Leader for Architecture Programme, Civil Engineering and Architecture Department, College of Science and Technology (CST), Royal University of Bhutan, Phuentsholing. He has completed his Bachelor of Architecture from School of Planning and Architecture, New

Delhi in 2012 and Master in Architectural Design from SRM University, Chennai in 2016. Before joining to CST, has been working as Architect in United Consultancy and Intern Architect in Ghandhara Design and Integral Design, New Delhi.

Christina E. Mediastika
Christina Mediastika is a Professor in Architecture and a full-time professor at Petra Christian University Indonesia. Her research interests are acoustics in the built environment and soundscape. She has been working with the visually impaired people for the last three years to study the possibility in enhancing urban public spaces to be more user friendly inclusively. Her paper has been published in many indexed journals and local newspapers. She has also published four books in acoustics and sustainable built environment.

David R. Mason
David Mason is an Urban Development Specialist with the World Bank's South Asia Urban unit. Since 2013, he has provided analytical and operational support to the World Bank on affordable housing, urban planning, land administration and urban service delivery with regional experience in Latin America and East Asia. His previous research has appeared in the *Journal of Planning Education and Research, Housing Policy Debate, Urban Studies,* and the *Journal of International Development*. He has a PhD in Urban and Regional Planning from the University of California, Los Angeles. Email: dmason@worldbank.org

Dhrubarj Sharma
Dhrubarj Sharma is a Phd student in the School of Design, Queensland University of Technology, Australia. E mail: sharma.dhrubaraj@hdr.qut.edu.au

Divya Chettri
Divya Chettri is a 4th year architecture student at the College of Science and Technology, Royal University of Bhutan. E mail: 0215206.cst@rub.edu.bt

Gustavo de Siqueira
Dr. Gustavo de Siqueira is a Professor at German University of Technology (GUtech), Oman.
Email: gustavo.desiqueira@gutech.edu.om

Iswarya Ramachandran
Iswarya Ramachandran is a Senior Associate at Indian Institute of Human Settlements, Bengaluru. She works with the Urban Practitioners' Programme team, which focuses on providing continuing education and capacity building programme for practicing professionals in the urban domain. Iswarya is an urban planner-architect, and is engaged in curating Individual Capacity Building Programmes for government missions. Her work involves development of course content, research support and training delivery on subjects of urban and land use planning, urbanization trends, housing and livelihood in cities. Her research interests include land use-transportation integration, informal sector and resilience, and impact of planning policies. Iswarya has presented on healthy cities, policies and sustainable tourism development at International Conferences. She is an Indian Green Building Council Accredited Professional (IGBC – AP). Email: iswaryar@iihs.ac.in

Kei Gomi
Dr. Kei Gomi is a Senior Researcher in the Regional Environmental Renovation Section, Fukushima Branch, National Institute for Environmental Studies, Japan. His research activities have focused on comprehensive integrated modeling for development of low-carbon and sustainable society scenarios in countries and cities in Japan and in Asian countries. His recent research interests are integration of SDGs into planning process and prevention and recovery from disaster.

Kezang Wangdi
Kezang Wangdi works as a Research Officer under Public Policy & Governance Unit (PPGU), Royal Research & Advisory Council, His Majesty's Secretariat, Thimphu.

Kinley Dechen
Kinley Dechen is a 4th year architecture student at College of Science and Technology, Royal University of Bhutan. E mail: 0215214.cst@rub.edu.bt

Kunzang Wangdi
Dasho Kunzang Wangdi is concurrently serving as Member of the Royal Research & Advisory Council, His Majesty's Secretariat since October 2015. Amongst others, Dasho serves as Alternate Board Member (ABM) for The Global Fund to Fight AIDS, Tuberculosis and Malaria, Director representing Kidu Fund of His Majesty's Secretariat on the Board of Directors of Royal Insurance Corporation of Bhutan, Chairperson of Ability Bhutan Society (ABS). In the past, he had worked as the First Chief Election Commissioner of Bhutan under Royal Decree of the Fourth King His Majesty Jigme Singye Wangchuck in 2005 with the primary responsibility to establish the first Election Commission in the Kingdom of Bhutan and to conduct the First and Second ever Parliamentary Elections which heralded the transformation of the Kingdom to a Democratic Constitutional Monarchy in the year 2008. He served another term as the CEC upon introduction of the Democracy and successfully conducted the First Local Government Elections 2011 and the Second National Parliamentary Elections 2013 under the Decree of His Majesty Jigme Singye Wangchuck in 28th of April 2013. He served as Auditor General for the Royal Audit Authority during the period 2000-2006. He was one of the key officials involved in the establishment of the Royal Civil Service Commission and the Royal Institute of Management that guided the growth of professional and merit-based civil service. Dasho Kunzang Wangdi completed his undergraduate studies in English literature at St. Stephen's College, University of Delhi, India in 1977 and Masters in Public Administration (MPA) at the Institute of Public Administration, Pennsylvania State University, United States of America in 1980 where the focus of his studies was on setting up the merit-based personnel administration system in Bhutan. He was conferred the title of Dasho and awarded Red Scarf as rank of *Nyikelm* on 19th of June 2001 by His Majesty the Fourth Druk Gyalpo. Dasho Kunzang Wangdi is recipient of

Druk Thuksey Medal on 17th of December 2008 (Centenary Celebration) from His Majesty the King as well as *Coronation Medal* on 6th of November 2008 aside from receiving *Life Time Royal Civil Service Award* in 2015.

Luciana Kristanto
Luciana Kristanto works at the Department of Architecture, Petra Christian University, Indonesia.

Marino Bonaiuto
Marino Bonaiuto is Professor of Social Psychology, Faculty of Medicine and Psychology, Sapienza University of Rome, Italy; PhD board member at Department of Psychology of Socialization and Development Processes; and CIRPA director (Interuniversity Centre for Research in Environmental Psychology); and President of the master course in Psychology of Communication and Marketing. He was awarded Research Fellow IAAP (International Association of Applied Psychology). His expertise includes residential environments, healthcare environments, green and natural areas, working environments, both verbal and bodily, and organizational communication.

Mikiko Ishikawa
Mikiko Ishikawa is Professor of Chuo University, Tokyo and Professor Emeritus of Tokyo University. Email: ishikawa.27w@g.chuo-u.ac.jp

Oualid Ali
Dr. Oualid Ali is considered as one of the international well-recognized experts in the fields of Future foresight, Trends watching, Emerging technologies & innovations, Industrial Revolution 4.0, and Future cities (Smart, Sustainable and innovative Cities). He has participated in several projects related to these fields as a researcher, consultant, or trainer. Specifically, within the field of Smart cities, he has been involved in the planning and implementation of several future cities projects in various verticals such as "Smart mobility, Smart Education, Smart tourism, Smart energy, Smart health, Smart logistics, Smart waste management, Smart water management, Smart

security, Smart policing, Smart buildings & Infrastructure, etc." to mention few. He has given several training and seminars related to these fields. Dr. Oualid is a member of several organizations related to the area of Future and Smart Cities or Urban technologies. As a global speaker and world traveler, he has been invited, as keynote or guest speaker, to several local, regional and international events. Dr. Oualid is the Founder and President of the ecosystem platform FutureCitiesCouncil.org with members from the quadruple helix: government (cities), industry, academia and civic society and The Founder and CEO of the Future platform Future-is-here.co (http://www.Future-is-here.co). Currently, he is the Director of the Training and Smart Solutions Center (TSSC) at the German University of Technology in Oman. For more information about Dr. Oualid please visit his website www.dr-oualid-ali.com.
Email: Oualid.ali@Gutech.edu.om

Samhita
Samhita is a Master student at Symbiosis Institute of Geoinformatics studying Science in Geoinformatics, and current GIS Analyst intern at Geospoc. She has interned in Mumbai Bombay Port Trust in their urban planning department where they are revitalizing 380 hectares land on eastern water front of Mumbai through creation of sea transportation tourism hub.

Shawn McLearen
Shawn McLearen is currently President of placeful.org, a non-profit developer which invests in community space through socially responsible partnerships in finance, agriculture, education and the arts. Through his work, he has cultivated and administered over $100M of public and private impact funds necessary to advance multi-policy, community development and mission-driven real estate projects. These projects have won awards and, more importantly, the trust and stewardship of the communities around them. Partners, financing structures and regulatory requirements include private foundations, Tax Credit Equity, State Bonds, City and State agency programs, Federal and Congressional grants, as well as community development

banking products. By taking complicated development projects through early conception, financing, and stabilized operations, he has not only gained unique experience aggregating multiple stakeholders and their respective resources/requirements within a single, long-term community development agenda, he has also developed a proven track record mitigating risk through a responsible combination of positive investment returns, systems change and authentic community empowerment. Email: shawnmclearen@placeful.org

Shuzo Nishioka
Shuzo Nishioka works at the Institute for Global Environmental Strategies, Japan.

Sonam Choden
Sonam Choden is a 4th year student of Architecture at College of Science and Technology, Royal University of Bhutan. E mail: sonaamchoden000@gmail.com

Tomoko Ishikawa
Tomoko Ishikawa works at the Institute for Global Environmental Strategies, Japan.

Ugyen Lhendup
Ugyen Lhendup currently serves as Senior Research Officer on deputation at Royal Research and Advisory Council, His Majesty's Secretariat since 2015. Prior to his deputation he worked as Lecturer in research, public policy and management at Royal Institute of Management (RIM) since 2009. He also served in Loden Foundation as Coordinator and Tashi Commercial Corporation as Market Researcher particularly on studying the prospects of launching new brand of beer in Bhutan. He is passionate of social and community services and founded Zhenphen Tshogpa (a social service unit) as social engagement activities for trainee officers, faculty and staff at RIM in 2013.

Yuki Ochi
Yuki Ochi works at E-konzal, Inc., Japan.