# Data Collection Survey on Urban Development and Environment in the Kingdom of Bhutan

## Final Report

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Japan International Cooperation Agency

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PADECO Co. Ltd.

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# Abbreviations

| | |
|---|---|
| ADB | Asian Development Bank |
| BNUS | Bhutan National Urbanization Strategy |
| BOD | Biological Oxygen Demand |
| BRT | Buss Rapid Transit |
| CASBEE | Comprehensive Assessment System for Built Environment Efficiency |
| CBD | Central Business District |
| CWS | Community Water Supply |
| DANIDA | Danish International Development Assistance |
| DBO | Design Build and Operate (Contract) |
| DES | Department of Engineering Services |
| DHS | Department of Human Settlements |
| DLAC | Dzongkhag Land Acquisition Committee |
| DMA | District Metered Area |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| EOI | Expression of Interest |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GLD | Guided Land Development |
| GNH | Gross National Happiness |
| GNHC | Gross National Happiness Commission |
| IEE | Initial Environmental Examination |
| IFC | International Finance Corporation |
| JICA | Japan International Cooperation Agency |
| LAP | Local Area Plan |
| lpcd | Liter Per Capita Per Day |
| MoA | Ministry of Agriculture |
| MoWHS | Ministry of Works and Human Settlements |
| NEC | National Environmental Commission |
| NLC | National Land Commission |
| NTU | Nephelometric Turbidity Unit |
| PAVA | Property Assessment & Valuation Agency |
| PPP | Public Private Partnership |
| RGOB | Royal Government of Bhutan |
| RMA | Royal Monetary Authority |
| RSTA | Road Safety and Transport Authority |
| SASEC | South Asia Sub-regional Economic Cooperation |
| TCDS | Thimphu City Development Strategy |
| TWS | Thromde Water Supply |
| UFW | Unaccounted for Water |
| WB | World Bank |
| WHO | World Health Organization |
| WTP | Water Treatment Plant |
| WWTP | Wastewater Treatment Plant |

1. Exchange Rates (May 1, 2013 – October 31, 2013 Averages)

| | |
|---|---|
| Yen/US Dollar | 99 Yen/Dollar |
| Ngultrum /US Dollar | 60 Nu./Dollar |

2. Coding for Development Needs and Issues

The needs and issues listed in the Report are coded with the format as follows;

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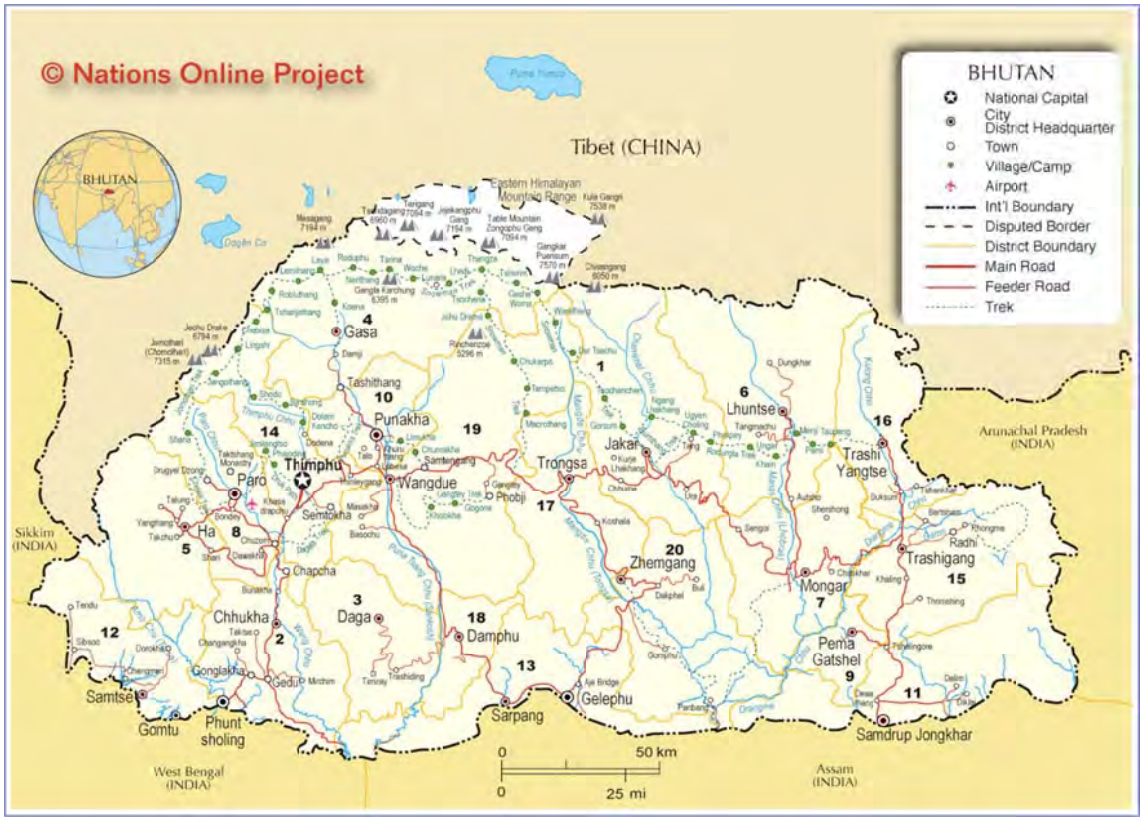
The first alphabet represents the location;
N: National Government
T: Thimphu
P: Phuentsholing

The second alphabet represents the sector that is related to;
I: Institution
U: Urban Development/Planning
T: Urban Transport
W: Water Supply
S: Sewerage/Drainage
E: Environment

Example: TU－1 Thimphu Urban Development/Planning Issue -1




Source: Nations On Line Project: http://www.nationsonline.org/oneworld/map/bhutan_map.htm

**Figure 1 Map of Bhutan**

# Executive Summary

## Chapter 1: Study Outline

The main objectives of the study are to collect, analyze and find the solutions for problems and development needs in a rapidly urbanizing Bhutan. The target cities are Thimphu and Phuenthsoling with the counterparts from Ministry of Works and Human Settlement (MoWHS), Thimphu Thromde, and Phuentsholing Thromde. The Survey Team undertook three field missions during the period of July 21 through November 5, 2013. The team collected and reviewed the secondary data from the governments but also undertook supplementary investigations including simple water quality tests, traffic count surveys and GIS database analysis. Discussions were held with the counterparts on the bottlenecks and strategies as well as potential projects. The feedback seminars were held both in Phuentsholing and Thimphu.

## Chapter 2: Urban Development and Environment in Bhutan

This chapter covers general background including institutions, laws, population, urban planning system, and environmental clearance procedure.

### (1) Laws

The Constitution adopted in 2008 that marked the transition from a monarchy to a democratic monarchy also transformed local governance. The Constitution stipulates not only the basic founding principles of the nation and national legal framework but also basic framework of government institutions, establishing three levels of governance, the central government, Dzongkhag, and Thromde/Gewog. It mandates the electoral selection of the head of Thromde/Gewogs. It prescribes the post of Dzongda, i.e., the head of Dzongkhag, as the appointment by the King based on the recommendation by the prime minister, maintaining overall centralized control over local governance. *Local Government Act 2009* combined laws that regulated urban local governments and ones that regulated rural local governments under a unified umbrella. *Thromde Rules 2011* and *Thromde Financial Policy2012* further elaborate administrative procedures.

### (2) Institutional Setup

The central government has 10 ministries, out of which, the Ministry of Works and Human Settlement is responsible for urban development. The main departments of MoWHS are Road Engineering, and Human Settlement Departments. Dzongkhag (District) administrations are composed of 20 districts; each headed by Dzongda (governor or Dzongkhag administrator); Dzongkhag Tshogdu (Prefecture Assembly) is the decision making body of Dzongkhag. Thromde (Dzongkhag capital cities) have two classes of A and B: Thimphu, Phuentsholing, Gelephu, and Samdrup Jongkhar classified as Class A and others classified as Class B. The Thrompon (Mayor) of Class A is elected, and Class B cities are under Dzongkhag administration. Gewog (Village or Block) administrations of 205 Gewogs headed by Gewog headman called Gup.

Another ministry related to urban development is National Environmental Commission (NEC), which gives clearance to all the investment projects in principle and also administers water rights allocation. NEC has transferred clearance authorities to line ministries and agencies due to increased workload.

### (3) Urbanization

The first population census was undertaken in 2005. The total population of Bhutan was 634,982 with annual growth rate of 1.28%. Thimphu had a population of 79,185 and Phuentsholing: 20,537. Bhutan National Urbanization Strategy used three scenarios for the estimation of urban population for the year 2020 with the share of 50%, 60%, 70%. 50% urbanization by 2020 is tantamount to 4.6% annual growth from 2005, 60% urbanization 5.9% annual growth, and 70% urbanization corresponds to 7.0% annual growth respectively. Compared to the growth recorded during the period of 2000 to 2005, every scenario is more moderate but still 7% growth may be on a high side. The Structure Plan of Thimphu uses an annual population growth of 5% starting the year 2000. In this survey's review, the annual percentage growth of 5% will be adopted for general review.

### (4) Urban Development Planning and Development System

The urban planning system of Bhutan follows a similar framework adopted in Great Britain. Each Thromde has to have two layers of plans, i.e., Structural Plan that covers the entire city and Local Area Plans that cover each community of 50-200 ha. The Structure Plan takes a rational approach of first setting up goals, second, analyze the current conditions and third, proposing action plans for land uses, open space, urban amenities and major infrastructures with investment plans. The Local Area Plan is more of design for implementation. Based on land pooling agreement, the LAP defines the exact boundaries of plots, access roads and utility plans including water supply and sewerage. The LAP adopts an EIA for clearance and prepares the base for actual procurement.

Development control is achieved through the law, *Bhutan Building Rules 2002,* with additional control set forth by Development Control Regulations and land use controls within the Structure Plan.

The most commonly used method in Bhutan for public land acquisition is *land pooling* stipulated by *Land Act of Bhutan 2007* and further elaborated by *Land Pooling Rules*. Land contribution from landowners ranges normally between 25% and 30% and 75% of the landowners need to agree to make the agreement effective. Direct acquisition needs to obey the public land prices set by the Property Assessment & Valuation Agency (PAVA), but the divergence from the on-going market rates make it almost impossible to conclude the transaction.

### (5) Development Needs in Urban Planning

The development needs in urban planning are as follows;

**NU-1** Lack of Funds for Urban Infrastructure Development: In Bhutan the land pooling ratio is restricted up to 30% and development of infrastructure is financed by the government.

**NU-2** Lack of Urban Infrastructure Planning: The weakest point in the Structure Plan is the lack of linkage between overall population planning and long-term infrastructure planning such as water supply, sewerage and urban transportation.

**NU-3** Lack of Quantitative Monitoring of Plans: MoWHS has a mandate to follow through the implementation of Structure Plans and but it was not easy to monitor the progress of the Structure Plan. MoWHS is now contemplating the introduction of CASBEE into the monitoring of the urban planning and development. CASBEE developed in Japan is a certification program for environmental compliance with standard evaluation templates that can be applied easily to buildings and cities.

**NU-4** Community Participation in Planning: Based on the experiences of land pooling in involving local communities, more proactive participatory planning is needed in Bhutan. Japan has a long history of involving communities for local development through O*ne Village One Product Movement*, *Michi-no-Eki, Farmers Market*, and *Revitalization of Central Shopping*

*Street*.

### (6) Environmental and Social Protection System

*Environmental Assessment Act* of 2000 has stipulated the establishment of NEC. The system of environmental assessment was defined by Regulation for the *Environmental Clearance of Projects and Regulation on Strategic Environmental Assessment* of 2002. The additional provisions by the *National Environment Protection Act of Bhutan* of 2007 and the *Environmental Assessment Guidelines* of 2012 further elaborate the administrative procedure of environmental assessment.

## Chapter 3: Urban Development in Thimphu

### (1) Public Administration

In Thimphu Thromde the total staff number of the Thromde is around 249, comprising administration, engineering, environment, customer service, development control and urban planning. Its budget is in deficit which is financed by the central government. The capital expenditures are financed by the central government, ADB and World Bank loans. For its fiscal year 2012−13, the current account expenditure is around Nu.160 million while the revenue is Nu.1 30 million with Nu. 30 million deficits. ADB provided Nu.380 million and WB, Nu.150 million.

Institutional Development Needs

**TI-1** Development of Management Information System: As described in (1) above, there is an urgent need to renew the database system for residents and customers.

**TI-2** Development of Planners for Water Supply and Sewerage Systems: As described in (1) above, there is a need to develop capacity in water and sewerage engineering in planning for the adoption of optimal technologies.

**TI-3** Lack of Urban Planners: Lack of urban planners due to a high turn over rate is a major challenge in Thimphu. At present, the major work for urban planners in Thimphu is to coordinate land pooling which is time consuming discussion with landowners with less professional attainment. Given low salaries, lucrative job offers from outside as well as workload, it is difficult to retain experienced urban planners on the job. There may be two ways to solve this problem. One option is to reduce work loads in land pooling. It may be an option to let a cooperative or special purpose company to undertake the land pooling work to share the workload with the city. Another option is to provide more professional incentives by giving scholarships for study abroad to those who have contributed to the work over a certain number of years.

### (2) Urban Population

According to the population demographics survey conducted in 2000, the population of Thimphu was 43,479 persons in 2000. The National Population Census conducted in 2005 revealed that the population in Thimphu was 79,185 persons in 2005. These results suggest an extraordinary growth at an annual rate of 12.7% during this time.

On the other hand, the Thimphu Structure Plan calculates the additional population that can be absorbed through strategies such as densification and new development on public land and vacant land, and indicates the total population that can be accommodated by each Urban Village. The results suggest that an additional 64,330 persons can be accommodated to the existing 43,479 persons, resulting in a total population that can be accommodated at 107,809 persons.

The population that can be accommodated is lower than the future population projection of 2027; however methods to fill this gap are not addressed in the Structure Plan.

The population of Thimphu in 2005 was 79,815 persons, and in these 5 years, the population has increase 80%. It is difficult to maintain this growth, hence, a long term forecast based on the 2005 population is applied. Bhutan's natural population increase is at an annual rate of 1.28%, hence it can be said that the annual growth rate for the urban population at 5% on the high end and 3% on the low end is a valid assumption. With the assumption of annual growth rate at 3%, the population is 97,388 in 2012 and 151,727 in 2027. At an annual growth rate assumption at 5%, the population is 111,421 in 2012 and 231,637 in 2027.

In the 2005 National Population Census, the population has not been aggregated by Urban Villages within the City, and there is only one population for each city. Due to these reasons, it was not possible to understand the population dynamics within the city boundary[1], and the population distribution at Urban Village level was purely estimated. The results of the population distribution by Urban Village are shown in Table 3-6.

### (3) Urban Development

The building layers from 2001 (shown in red) and 2012 (shown in blue) of the GIS database owned by Thimphu Thromde are compared to visualize the development of urbanization. This growth is vividly illustrated in the Urban Villages of Motithang, Lungtenphu, and Samteling, and new development is extending outside of the city boundaries.

The Urban Village with the largest rate of increase of building area is Changzamtog/Chang Gedaphu at 176%, followed by Chang Bangdu/Chang Jiji 118%, Simtokha 118%, Taba/Jongshina 117%, Upper Motithang 116%, and Babesa 110%. There is significant increase from the central to southern area of the city, but not much increase can be seen in the northern area. As an absolute value of building area distribution, from the highest Core Area (+89,719$m^2$) and fifth highest Changzamtog/Chang Gedaphu(+56,962$m^2$), all are local in the city core.

As explained in 2.1.2 (2), the economic structure of Bhutan necessitates import to grow faster than the rates of economic growth while the export being less responsive. As a result, the economic growth widens the trade imbalance. In 2012, the economic growth led to Rupee Crunch whereas the foreign exchange reserve had dwindled.

One of the main driving forces behind identified was the construction boom since 2009. The construction materials required for multi-storied buildings such as cement are mainly imported from India. Thus the ROGB ordered a 15-month effective stoppage of housing construction loans. Furthermore, the Royal Monetary Authority (RMA) has given directives to financial institutions to maintain housing loans below 20% of their total loan disbursement, leaning to a limited liquidity for construction loans.

#### Urbanization Outside of Thimphu

With the Babesa-Thimphu Expressway axis, there is significant residential development in Southern Thimphu. In response ADB is assisting the implementation of the urgent 4 LAPs in the south. In the areas out side of the control of the Structure Plan urbanization is taking place more vigorously. These areas are Debisi in the south and Kabesa in the north which are under the jurisdiction of Thimphu Dzongkhag. To control development, the Dzongkhag has adopted the LAP for Debisi and some work has commenced for water supply with Indian assistance but only topographic survey has started for Kabesa.

1 As the understanding of population dynamics within the city boundary is critical to urban planning, this should be revised in the next National Population Census.

## Thimphu Structure Plan

The TSP is a long-term plan set for 25 years, formulated with the primary objective in cultural and environmental protection. Existing data on land, geological formation, landscape, land use and other have been uniquely collected and analyzed, and plans have been formulated with its development vision. Upon identification of urban issues, action plans which include funding and implementation plan, and detailed proposal has been presented for each of the urban sectors (i.e. transport, water supply, drainage and sewerage, solid waste management, housing, and other).

A majority of the sections of the TSP are spent on the presentation of the conceptual vision. On the other hand, land uses called Precincts are designated in the Plan. Furthermore, detailed building codes only applicable to Thimphu City called the "Development Control Regulation" are formulated as a regulatory supplement. The Precinct designations and building code supplements are actually incorporated in the criteria for building permission, and thus is legally binding.

On the contrary, road design standards and other standards have also been established in the Plan, however, in reality, there are many roads that do not comply with these standards, and it is hard to say the system is functioning as hoped. An Urban Transport Circulation Plan and Water Supply and Sewerage Plan have been prepared, however they are not developed based on data on detailed geographic distribution. This signifies that the plan is not applicable as face value, and is the biggest weakness of the Structure Plan.

## Progress in Local Area Plans

16 Urban Villages of Thimphu are further divided into 27 local areas for Local Area Planning. During the period between 2003 and 2006, 10 Local Area Plans were adopted. So far, 12 LAPs have been adopted and 2 more are now underway. There are 13 LAPs yet to be planned. Out of 12 adopted LAPs, 6 LAPs have been funded by external donors as shown in Table 1.

**Table 1 Local Area Plan Progress**

| # | Local Area | LAP Status | LAP Implementation |
|---|---|---|---|
| 1 | Serbithang LAP | Planned | Not Yet |
| 2 | Babesa LAP | Planned | ADB |
| 3 | Simtokha LAP | Planned | ADB |
| 4 | Lungtenphu LAP | Planned | ADB |
| 5 | Changbangdu LAP | Planned | ADB |
| 6 | Core Area | Planned | Not Yet |
| 7 | Langjophaka LAP | Planned | WB |
| 8 | Hejo-Samteling LAP | Planned | Not Yet |
| 9 | Jongshina LAP | Planned | Not Yet |
| 10 | Taba LAP | Planned | Not Yet |
| 11 | Dechencholing LAP | Planned | WB |
| 12 | Changzamtog LAP | Planned | Not Yet |
| 13 | Lower Changzamtog LAP | On-going | Not Yet |
| 14 | Upper Changzamtog LAP | On-going | Not Yet |

Source: Thimphu Thromde

Land pooling consensus among landowners ranges between the lowest Hejo-Samteling and Jongshina with 65% and the highest Dechencholing 98%, in general with strong support of the communities. The land pooling rate ranges between the lowest Serbithang with 15% and the highest Hejo-Samteling and Jongshina with 29.5%, all within the regulatory limit of 30%. The

central areas require a higher contribution in general.

Development Needs in Urban Planning

**TU-1 Revision of Population Forecast:** There are discrepancies between the population projection and population accommodation capacity estimates in the Structure Plan. Even larger gaps are present between estimates in the Structure Plan and ones done by on-going projects. It is most desirable to reset the official population projection by utilizing the 2015 decennial national census results.

**TU-2 Urbanization of Peripheral Areas:** Urbanization is creeping into Kabesa and Debisi showing an urban sprawl. There is no physical constraint to north south urban extension to Thimphu. Liner development leads to less efficient investment.

**TU-3 Urbanization of Hills:** Urban development is now progressing in an environmentally protected zone of E-4 precinct. Conflicts between urbanization pressure and environmental protection are manifesting itself as political pressures for encroachment.

**TU-4 Application of Urban Planning to Peripheral Areas:** The areas such as Kabesa and Debisi, indicated in TU-2, require an immediate LAP formulation, land use zoning and other development controls.

**TU-5 Delay in Urban Infrastructure Development of Central Areas:** Thimphu has yet to establish another 13 Local Area Plans out of the required 27 and need to implement 21 LAPs The peripheral LAPs have been given more priority in order to convert rural land uses into urban plot and road design to realize more efficient urban structure for the future. As a result, the central areas have been left without proper upgrading of urban infrastructures.

**TU-6 Lack of Funds for Implementation of Local Area Plans:** Bhutanese land pooling is restricted at 30% which is just sufficient for public space acquisition with no extra funds generated from land pooling itself. In reality, the development funds for LAP implementation depend on external funding and the availability limits the overall financing of LAPs.

**TU-7 Delay in Development of Beautification and Open Spaces:** Development of urban infrastructures to enhance urban amenities is essential for the promotion of tourism, an important sector for Bhutan in job creation and foreign exchange earning. However, as indicated in 3.3.11, the implementation of plans for beautification and open spaces is much delayed.

### (4) Urban Transport

Road Network

In the Thimphu Structure Plan 2004 (TSP), the Thimphu road network plan was proposed at four levels of road is specified in the plan: Urban Corridors (Width: 24m), Primary Roads (18m), Secondary Roads (10m) and Access Street (6m). However, most of the sections of primary road have not been developed yet. It is mainly because that there are already buildings along the planned roads in the central area and it is difficult to secure enough right of way in such areas. Major roads connecting east and west sides of the city are less developed compared with north-south roads because of steep terrain and the river. Instead of road extension and expansion, the city adopted one-way traffic control on major roads in the core area of the city as a remedy. Planned roads in the north area have not been developed. There are still some missing sections and bridges on the urban corridor in this less populated area. Roads in the southern parts are comparatively well developed and attract residential development but lacks in lateral cross roads over or under the Expressway in the suburban areas.

## Traffics

According to a person trip survey conducted in 2009, the percentage of walking accounts for 48.5% of the all trips made in the city. This percentage is significantly high and represents a unique urban structure of Thimphu where most functions are concentrated in walking distances in the compact urban core. Focusing on motorized trips, car and taxi are majority (61% + 16%) and the share of bus remains at 15%. Trips by motorcycle and truck are few in the city. According to the origin-destination (OD) data of trips in Thimphu Urban Transport Study, a quarter of OD are concentrated in the Core Area where most of offices and commercial facilities are located.

## Projection of Traffic Generation

There are two existing demand analysis studies of Thimphu; Thimphu Urban Transport Study in 2009 by Department of Urban Development and Engineering Services (DUDES) under MoWHS; and Bhutan Urban Transport System: System Selection and Eco-Friendly Feasibility Report in 2011 by IFC.

According to the result, demand grows especially on Expressway between the Core Area and Simtokha in the south and it will exceed the road capacity in ten years to 2022. Simtokha is a junction of two inter-city roads. Demand in the north area also grows on roads in both sides of the river.

## Public Transit

"City Bus" operated by Bhutan Post Ltd. is a trunk service of public transport in Thimphu. There are 8 bus routes reaching the terminal in the Core Area from 6 AM in the morning to 8 PM in the evening. Radial routes for north-south movements in the city have frequent services in response to higher demands compared with circular routes. Three private operators also provide bus services on the routes between core and suburbs to capture growing passenger demands. According to Bhutan Post, demand between the core and suburb keeps growing in the recent years. Data in Thimphu Urban Transport Study tells that 27% of bus users are commuters and 30% are students. Buses run beyond the full capacity for passengers in morning and evening peak hours.

IFC carried out a feasibility study on urban transport system in 2011 and recommended phased introduction of BRT system along with growth of passenger demand. According to the study, initial Pre-BRT stage will introduce 8 low emission fleets and operate frequent services on bus priority lanes by utilizing existing roads. GNHC has allocated Nu.150 million for the introduction of BRT in the 11$^{th}$ Five Year Plan Budget, but no funding source is ascertained.

## Parking Space

The Core Area of Thimphu was formed before motorization and the city did not prepare sufficient parking space to accommodate a large number of vehicles. Under this condition, the roadside space is used as on-street parking, and it results in reduction of road capacity. Thimphu Thromde manages 1,500 slots of on-street and off-street parking and outsources the collection of time based parking fees to private companies.

IFC has proposed development of 5-storied multi-car parking building on a Public-Private Partnership (PPP) scheme on public land. Securing enough parking spaces is needed in both Core Area and surrounding areas, but it should be planned jointly with public transport and demand control of vehicle traffic. Experiences in other countries indicate that solely increasing

parking space prompts more traffic, often aggravating the situation.

Lungtenzampa Bridge

According the traffic survey undertaken by the JICA Survey Team, the highest vehicle concentration is observed at the entering point of Norzin Lam, where vehicles flow into from Expressway, Chang Lam (turning), bridge and Dzongchen Lam Road to the hillside in the west. Most of the traffics over the bridge are short-distance traffics and just turn around after the bridge, and there is much less traffic on the road in the east side compared with that on the bridge. Traffic in the weekday concentrates on peak hours in morning and evening, and it accounts for a quarter of 12 hours traffic.

Traffics over the bridge on a weekday is around 4000 trips for the surveyed 12 hours and 16,000 on Norzin Lam Street which is one way. The bridge has other concern on safety. During the peak hours, there are more than 2000 pedestrians who are mostly students where the sidewalk is narrow without guardrails. The bridge itself was constructed with Indian assistance 20 years showing age and wear.

Urban Transport Development Needs

**TT-1 Traffic Congestions at Entry Point to the Core Area:** Current transport bottleneck is roads around Lungtenzampa Bridge where large volume of traffic concentrates into the complicated intersection. More efficient layout of the area should be examined based on detailed traffic flow analysis.

**TT-2 Lack of Parking Space:** As indicated in 3.4.8, the parking space in Thimphu during the daytime is saturated. Searching vacant lots at low driving speeds exacerbates traffics on main streets of the city. IFC has proposed the construction of a multi-storied parking under PPP. Experiences in other countries indicate providing more parking space often induce more traffics to the area, thus only provides a short term relief.

**TT-3 Future Traffic Increases:** Traffics in Thimphu is increasing steadily in pace with the growth of automobile ownership. It will not be long before the city sees the traffic paralysis with the continuation of the current trends. Overconcentration of traffic demand into the Core Area is an issue of Thimphu, and commuting vehicles flow into limited access roads in peak hours.

**TT-4 Poor Pedestrian Environment:** Although the number of vehicle is increasing, percentage of walking trip is still high in Thimphu and should be sustained into the future. It is reasonable to enhance vehicle free environment in the city where there is limitation of new development of roads and bridges in terms of topography.

**TT-5 Undeveloped Major Road System:** As indicated in 3.4.12, the most of the major roads planned by the Thimphu Structure Plan are not yet implemented. The only portion completed is the southern portion of the Urban Corridor.

**TT-6 Undeveloped Public Transit:** As indicated in 3.4.2, buses share only 15% of the automobile based person trips in Thimphu. Widening of existing roads and construction of new roads are very limited in Thimphu due to space constraints. It is obvious that future traffic increase while retaining the current modal share would lead to transport paralysis of the central areas of the city.

### (5) Water Supply

Water supply services in Thimphu consist of following two categories: Thromde Water Supply (TWS) and Community Water Supply (CWS).

Among 15 urban villages in Thimphu Thromde, 9 urban villages are covered by TWS, in

population-wise 59,887 among 111,421 of a total population of Thimphu Thromde, accounting for 49% of an estimated total population.

While the maximum water intake potentials of Jongshina WTP, Megypang WTP (ADB Project) and Dechencholing WTP (World Bank Package II) are considerably larger than the design intakes, the design intakes for the other WTPs are approaching the maximum potentials. Branch streams of Wang Chhu near Thimphu are relatively small with narrow catchment area; accordingly it has a low water source development potential and a large flow fluctuation, resulting in instability as water source.

Wang Chhu itself has an estimated water source capacity of approximately150,000 $m^3$/day (assuming catchment area of 480 $km^2$ and specific runoff of 0.4 $m^3$/sec/100 $km^2$) at the north part of Thimphu, which is equivalent to a half to one million of the population.

The present production rate is 13,200 m3/day, including the wells. Although both design capacity of Motithang and Jongshina WTPs are 6,500 m3/day, presently Jongshina WTP is operated at the significantly lower rate due to the shortage of water transmission capacity. On the other hand, Motithang WTP is operated at the over-loaded rate to supplement the shortage of the Jongshina WTP production.

Total capacity of the reservoirs is 4,480 $m^3$ and counts 32% (equivalent to 7.5 hour consumption) of the water supply rate. Since fluctuation of water consumption rate in small water supply systems like TWS is higher, it is recommended to have 50 to 100 % of total capacity of reservoirs to absorb the fluctuation. Such shortage of the reservoir capacity may be one of the factors of the intermittent water supply.

The unaccounted-for-water (UFW) is less than 25% which is within an acceptable range on a global scale. Compared with the performances in the south Asia, it belongs to an excellent group.

The production cost of water ranges between 1.6～1.7 Nu./$m^3$, very low levels. The tariff levels of 3.1～3.5 Nu./$m^3$ are equally low. It is a rare case in water supply that both producers and consumers are both enjoying the benefits. According to the analysis of ADB[2], the current water charges is about 3% of the monthly income of low income class (Nu.2,462) which is acceptable level.

## Development Needs in Water Supply

**TW-1 Lack of Long-term Supply Capacity:** As discussed in 3.5.6, Thimphu Thromde will face the considerable water supply shortage in near future. There will be future shortage expected for the northern part (Taba-Jongshina and Dechencholing) and the city core. There is a limit in further development of the present system because of aged facilities and water source capacity. It will be required to construct a new system and it would be reasonable to construct it in the north part from the land availability and topographic conditions.

**TW-2 Lack of Water Supply Master Plan:** The weakest point in the Structure Plan is the lack of long-term infrastructure planning especially for water supply, and sewerage. There is no technical evaluation for water source alternatives or optimization of distribution network. There is no area-wise demand and supply network examination and consequent city-wide long-term planning. The planning of water supply or sewerage is left to each local area plan which only covers one $km^2$. These disjointed additions of water supply and sewerage schemes poses a risk of creating overall inefficiency of utility schemes.

**TW-3 Long-term Water Supply Costs Increases:** The financial situation of water supply and sewerage sector is in a good condition with a low tariff. However if the on-going project are implemented as planned, the operation cost will be increased drastically due to capital-intensive technology with the small scale level.

[2] ADB TA 7630 Urban Infrastructure Project Progress Report ANNEX 4.2

**TW-4 Intermittent Water Supply:** Intermittent water supply is adopted in almost all the Core Area. Intermittent water supply causes not only inconvenience in daily water use but also contamination risk with poor distribution system. As demand and supply capacity is balanced at present, the reason of intermittent water supply is suspected to come from poor distribution system, such as shortage of reservoir capacity. The distribution system can be improved independently from future production plan.

**TW-5 Improvements in CWS:** CWS should be resolved as expeditiously as practicable since it is an interim measure. The problems of CWS are high turbidity and bacterial contamination risk due to no treatment and disinfection. While removal of the turbidity needs an ordinary treatment plant, the improvement of the contamination risk can be achieved by disinfection at the water tanks.

### (6) Sewerage/Drainage

The sewerage project for Thimphu was funded by DANIDA. Those plants use lagoon system (Stabilization Pond Process) which requires a large area of land. The service population is 10-15% of the population; the current treatment is already at 80% - 90% of the designed capacity. The rest of the households use the septic tank system.

Drainage system is developed in urbanized area along with urbanization of town/city. Natural streams connected to a main river are utilized to drain storm water in urbanized area.

Wastewater operation is even more excellent. The operation and maintenance cost for sewerage ranges between 0.5～0.7Nu./$m^3$ while the average tariff ranges between 1.5～1.8 Nu./$m^3$. The surplus level is around 60%.

There is no significant problem on drainage system due to the steep slope, except drain clogging by garbage and other waste which causes storm water running on road and a partial flooding. A problem is that these drainage systems are used for gray water discharge from residences in Motithang area and the neighborhood, and in some cases overflows from septic tanks are discharged into drainage. These drainages were natural streams originally, and are supposed to be converted into green corridors according to Structure Plan for city beautification, tourism promotion.

The water quality deterioration of Wang Chhu is particularly significant near city center to lower reach. Especially BOD at sampling points IV and V during pre-monsoon season indicates nearly 8 ㎎/l, which exceeds the WHO permissible limit of 6 mg/l for drinking water.

Development Needs in Sewerage/Drainage

**TS-1 Water Pollution in Water Bodies in City:** As indicated in 3.6.8, water bodies including drainage within the central part of Thimphu are increasingly getting polluted.

**TS-2 Delay in Development of Green Corridor along Drainage:** As indicated in 3.3.11 (2) and 3.6.7, lack of sewer connections in Motithang area is the biggest impediment to the development of green corridors along drainage in the central part of the city that have been planned by the Structure Plan.

**TS-3 Lack of Wastewater Treatment Capacity:** As indicated in 3.6.3 and 3.6.10, the current treatment capacity is less than 15% of the total population of the city. As a result, there are areas without sewer connections, even in prime locations such as Motithang.

**TS-4 Increase in Long-term Wastewater Treatment Cost:** As indicated in 3.5.8 and TW-3 in 3.5.9, the present low tariff while maintaining sound financial performances would not be sustainable after the introduction of the capital-intensive technologies currently under implementation. Increased operation costs will necessitate government subsidies.

**TS-5 Lack of Sewerage Master Plan:** Similarly to water supply planning, planning for sewerage systems is carried out on a local area plan level. Given the fact a local area plan has a

boundary of one $km^2$ on the average, the area in consideration is too small to achieve overall economic efficiency. Before setting a sewerage plan of specified area, a city-wide comprehensive sewerage plan is required to avoid planning with a multitude of concepts.

## Chapter 4: Urban Development in Phuentsholing

### (1) Public Administration

Phuentsholing Thromde has 7 divisions totaling 87 people. Its budget is in deficit which is financed by the central government. The capital expenditures are financed by the central government, ADB loans. For its fiscal year 2012−13, the current account expenditure is around Nu.56 million while the revenue is Nu.50 million with Nu.6million deficits. ADB provided Nu.43 million.

### (2) Population

The population of Phuentsholing in 2000 was 12,625 persons. According to the 2005 National Population Census, the population increased to 20,537 persons in 2005. The estimated population for 212 is 23,915 persons[3]. This suggests that during the five years between 2000-2005, the Phuentsholing experienced an annual population growth rate of 10.2%, however, during 2005-2012; the growth rate remained at 2.2%.

The current draft Phuentsholing Structure Plan (PSP) uses two scenarios for its population forecast at an annual growth rate of 3% and 5%. The population in 2037 is estimated at 50,066 for the 3% scenario and 80,975 for the 5% scenario.

According to the Structure Plan, the total population that can be accommodated is 57,416 persons. However, a majority of this population is proposed to be dependent on the accommodation capacity of the Am Mo Chhu River Reclamation. Both in Toorsa Tar and Am Mo Chhu planned reclamation areas, approximately thirty thousand people are planned to be accommodated.

### (3) Urban Development

Phuentsholing is located at the intersection of the Phuentsholing – Thimphu Highway, which connects the North to South of Western Bhutan, and the planned Southern East West Corridor which connects the southern border cities of Samtse – Phuentsholing – Sarpang – Gelephu – Samdrup Jongkhar, and further economic activities are anticipated in the future. Phuentsholing's advantageous location in terms of economic activity is "strength" for the city. On the contrary, the limitation of land for development is considered a "weakness."

Structure Plan

The Phuentsholing Structure Plan (2013-2028) (PSP) was formulated in 2013 and the draft was submitted for approval in July and is currently under Government approval. The structure plans reviews the future growth and development demand due to rapid population increase and economic growth. The Phuentsholing Structure Plan covers approximately 1,680 Ha of land, including areas beyond the Phuentsholing city boundary (approximately 186 ha) such as rural areas and the Pasakha Industrial Estate.

Progress of Local Area Plans

Currently, there are three Local Area Plans (LAP) for the areas of Kabreytar, Rinchending,

[3] Source: http://world-gazetteer.com & http://www.countrywatch.com

and Dhamdara which are completed, on-going or in the approval process. Phuentsholing City plans to focus on housing development in these areas in order to accommodate the population growth in the near future.

Relocation of Farmers' Market

There is a small farmers' market near the Om Chhu Bridge. The market was transferred to this location after the river flooded in the city core to destroy the original market at what is now a truck parking during the incident of 2000 August Flood. However, this market has to be relocated again for the construction of the ring road.

Development Needs in Urban Planning

**PU-1 Structure Plan Population Forecast Revision:** The PSP applies a 3% and 5% compound annual growth rate on the existing population based on the 2005 National Population Census to estimate the future population. 8 years has passed since the 2005 National Population Census, therefore, a review of population forecast based on updated population trends and urban environment conditions is necessary.

**PU-2 Overdependence on Reclamation Project for Population Absorption:** The Structure Plan envisages that almost all population to be accommodated in the greenfield development sites of Am Mo Chhu, Toribari, and Toorsa Tar, hence the actual accommodation of future population remains as a major challenge. In the case that these Greenfield developments are not realized, and urban conditions remains as current, there is a need to establish alternate strategy for population absorption such as densification including conversion of government lands and densification of low density lands. As described in 4.3.7 and 4.3.8, urban development is progressing rapidly in the three LAP areas; the provision of adequate urban infrastructures is much needed.

**PU-3Relocation of Farmers' Market:** As indicated in 4.3.10, the current farmers' market is going to be relocated due to the construction of the planned Ring Road. The relocation should be viewed as an opportunity to upgrade the market to Michi-no-Eki for the development of unique local products and brands.

**PU-4Development of Southern Hub for Commerce and Tourism:** The development vision stated in the Phuentsholing Structure Plan is to "Develop Phuentsholing into a commercial, business and tourism hub of the south"; however, in terms of urban environment, there is still room for improvement. It is important to incorporate tradition and culture uniquely Bhutanese, utilize the advantages of the natural environment, and build on the economic activities unique to the border town in order to establish a growth strategy for the southern hub.

### (4) Urban Transport

Phuentsholing locates on Highway No. 1 which connects India and inland Bhutan. This highway runs through the territory of Bhutan but is managed by an Indian road agency called DANTAK. On the highway, there is an immigration check point of Bhutan before the junction of branch road to industrial area in east of the city, Pasakha. New access roads to Pasakha and Samtse are planned as primary road standard (18m wide). Pasakha access road will be assisted by ADB and part of new Samtse highway is under construction by RGOB.

A large number of trucks pass through this border town. Both heavy freight trucks and passenger vehicles are concentrated on the two lanes major road connecting the border gate and highway to Thimphu through the central area. This causes congestion and invites a variety of related problems such as loss of time for travel, increase in accident risks, pollution of the air, increased emission of CO2 and deterioration of road pavement.

As there is only one vehicle bridge on the Om Chhu River, the majority of vehicles travelling between north and south of the city are concentrated on it. The bridge has to bear heavy freight trucks and buses accessing inter-city bus terminal beside the bridge. This bridge is getting damaged rapidly due to unexpected growth of heavy traffic, though it was constructed on 2003. Citizens have expressed a concern about safety of the bridge.

There is no public transport service inside the compact urban area of Phuentsholing, and a certain portion of trips is made on foot. According to the data of household survey in 2003, two thirds of commuting trips are on foot.

Development Needs in Urban Transport

**PT-1 Bypassing of Cargo Traffic**: The biggest issue to be addressed in Phuentsholing is control of inflow of freight trucks into the central area. Early implementation of ADB's ring road project can alleviate congestion in the city.

**PT-2 Improvements of Damaged Road and Bridges:** Pavement and structure of transport infrastructure are already deteriorated in Phuentsholing where there are heavy vehicle traffic and heavy rainfall over steep terrains. The bridge over Om Chhu River is one of the most damaged road facilities.

**PT-3 Economic Linkages to Road and Terminal Facilities:** Transport environment in Phuentsholing will improve drastically after the completion of big projects such as the ring road. The areas along the new trunk road and terminal facilities should be utilized strategically to generate positive impact on economy. For instance, introduction of "Michi-no-Eki" concept can create new business opportunities and benefit for farmers around the city.

**PT-4 Reinforcement of Pedestrian Environment:** Although the number of vehicle is increasing, the percentage of walking trip is still high and should be sustained into the future. It is reasonable to enhance vehicle free environment in the city where there is limitation of new development of roads and bridges in terms of topography.

### (5) Water Supply

In Phuentsholing, all the city area is covered by water supply operated by Thromde and some adjacent areas also covered by the water supply by Thromde.

Thromde Water Supply is a water supply service provided by Phuentsholing Thromde. Water is produced at North WTP, South WTP, Kharbani WTP and bore wells, distributed to users through distribution network. Water supply facilities were enormously damaged by August 2000 Flood. While the water supply has been almost satisfactorily restored, it still remains only capable of intermittent supply in the most areas.

For the expanded Thromde areas, The Draft Structure Plan proposes 10 decentralized water supply systems considering land use and topographic conditions and water use patterns of the supplied areas.

The catchment area of Am Mo Chhu at Dorokha Bridge is 3,040 $km^2$ and it has a 10 year draught runoff of 2,000,000 $m^3$/day with an assumption of 10 year specific draught runoff at 0.73$m^3$/sec/100$km^2$. Om Chhu has a catchment area of 21 $km^2$ at Phuentsholing with an estimated 10 year draught runoff of 13,000$m^3$/day. Dependence on the groundwater is high.

Design production capacity of WTPs and wells is 13,692 $m^3$/day and the ratio of surface water contribution to groundwater contribution is 3:7. The actual production rate is reported to be 8,000$m^3$/day[4]. Population in 2012 is estimated at 23,915 based on 2005 Census and per capita water consumption is calculated at 292 l/capita/day.

A total capacity of the reservoirs in the transmission/distribution system is 3,080 $m^3$, which is less than 22% of the total design production capacity (13,694 $m^3$/day, total of Tables 4.16 and

[4] Phuentsholing Structure Plan (2013 – 2028) and Interview with Thromde

4.17). Since fluctuation of water consumption rate in small water supply systems like Phuentsholing is higher, it is recommended to have 50 to 100 % of total capacity of reservoirs to absorb the fluctuation. Such shortage of the reservoir capacity may be one of the factors of the intermittent water supply.

A total length of transmission/distribution pipe is 27 km. Most of transmission/distribution pipe was installed in 1990's and mostly galvanized pipe. The unaccounted-for-water would be 35%-40%, which is above a global average. The leakage level needs to be investigated through proper water auditing to ascertain the problem. Given the fact that 90% of the distribution network is comprised of galvanized iron pipes of over 13 years in age, the pipes are likely to be corroded and leaking in many places.

The operation account has approximately 10 % deficit. The main reasons behind higher operation costs is the requirement of water lifting for water supply and sewage pumping which add significant costs to the operations.

Development Needs in Water Supply

**PW-1 Risk of Potable Water Contamination:** Intermittent water supply would induce negative pipe pressure during the stoppage time of water supply, letting outside water into the pipe from a damaged area; a major public health risk. From demand/supply balance, a major cause of the discontinuous water supply is considered due to distribution capacity.

**PW-2 Lack of Water Resource Development Plan:** Am Mo Chhu has an enough water source development capacity, augmentation of the water supply capacity for the existing area relying on Am Mo Chhu is reasonable. It is required to establish a concrete plan for the restoration of water intake from Am Mo Chhu.

### (6) Sewerage/Drainage

The sewerage project for Phuentsholing was funded by DANIDA. The construction of the sewerage system commenced in December 1993 and completed in 1996.

Sewerage system in Phuentsholing is basically separate sewer system, covering 60% of the population. The treatment plan is a lagoon system (stabilization pond) and the current treatment volume is about 50% of the designed capacity. This is because there is some defects to the trunk sewer directly outside of the lagoon. The city plans a remedy bypass in 2014. 2000 August Flood damaged the main trunk crossing the Om Chhu but was restored. Grey water is disposed through the side drains of roads.

Development Needs in Sewerage/Drainage

**PS-1 Lack of Long-term Wastewater Treatment Capacity**: The present treatment capacity is no more than 60% of the present population of Phuenthsoling, requiring expansion in a mid-term.

**PS-2 Lack of Long-term Master Plan**: The sewerage master plan must incorporate city planning, water environment and sewerage management as well as meeting the growing needs of the increasing population and maintain sustainable management of sewerage works.

**PS-3 Selection of Optimal Wastewater Treatment Technologies:** There is no technical evaluation for the selection of technologies, appropriate zoning for sewer collection, the land plot size available for the treatment plant site will make possible to select appropriate technology more economically.

**PS-4 Utilization of Flood Plain:** Am Mo Chhu river has an immense riverbed. With less land restrictions it is possible to select more economical technology.

### (7) Environment

The most serious issues facing Phuentsholing Thromde is landslides and floods caused by heavy rain, weak soil, and earthquakes. When the southwest monsoon hits the towering Himalayan Mountains in the north, it brings heavy rains of more than 4,000mm per year. In addition, as the Himalayan orogeny is active as the Indian Shield submerges under the Tibetan Shield resulting in frequent earthquakes. Combined with the weak soil, the land is unstable. The Om Chhu has a length of only 10km but its average grade is 13% and around 25% in its upstream. There are frequent landslides, riverbed scouring, and erosion of embankment. The remedies by the city are no more than temporary relief. The feature of the river is quite similar to those of rivers in Japan. Sabo technologies are quite applicable to this type of river.

There was a heavy rain of more than 1,000mm during August 1 to 3, in 2000. This heavy rain caused the food of Am Mo Chhu and Om Chhu. The city was paralyzed for several days; the market was washed away; the sewerage system was damaged; and the casualty was more than 40 people in Pasakha area. No more serious floods have happened but could happen in any year.

Development Needs in Environment

**PE-1 Cyclic Floods:** Most serious issue is the Om Chhu floods that occur in every 10 to 15 years. Flood prevention thus is the key factor for urban safety. It is important to control sedimentation and scouring by stabilization of the riverbed.

**PE-2 Frequent Land Slides:** Landslides frequently happen around Phuentsholing. Kabreytar where the Local Area Plan is completed also have several locations with past landslides, rocky dried river, and loss of foundation by scouring.

**PE-3 Urban Encroachment into Hazard Prone Areas:** Phuentsholing where land is scarce urban encroachment is occurring into to dangerous higher places despite the warnings of the city.

**PE-4 Lack of Flood / Landslide Control Technologies:** Bhutan has developed its engineering technology by importing Indian technologies. However, for such river as shown in southern Bhutan, Japanese so called “Sabo” technology is more appropriate.

## Chapter 5: Development Strategies and Recommendations

### (1) Constraints to Urban Development in Bhutan

The fundamental cause of problems associated with urbanization is rapid social migration into large cities. However, no social system historically succeeded in halting urbanization. The only solution is a coping strategy to conserve urban environment and traditional culture while maintaining economic and social vitality brought by urbanization.

One of the largest constraints to urbanization in Thimphu and Phuentsholing is lack of land. Shortage for land becomes intensified over little space available within the cities. Increases in land prices further fuel speculation for land. As a result of urbanization pressures against less available land in central parts of cities, urbanization is now finding its way into agricultural lands in peripheries and hillside. As the expansion of public transport lags behind urbanization of peripheries in Thimphu, dependency on automobiles will increase as peripheral urbanization progresses. Urban expansion manifests itself as problems associated with localized water shortage and water pollution by sewage disposal. The development of urban infrastructure becomes more urgent to cope with these problems and the funds required for such development becomes larger and larger. The most critical bottleneck in urban development in Bhutan is lack of finance. Since the RGOB is always short of development finance, the construction of urban

infrastructure in Bhutan is now totally dependent on external donor financing. The technical planning for urban infrastructure is left to *Local Area Planning,* which has no more than one square kilometer jurisdiction, leading to piecemeal planning process of infrastructure network planning of water, sewerage and road, escalating the costs of operations.

### (2) Thimphu Development Strategies

The *Bottleneck Strategy* is a collection of projects that provide immediate relieves to deficiencies caused by rapid urbanization in Thimphu. One of urgent issues in urban planning is *TU-2 Urbanization of Peripheral Areas*, expansion of urban areas to outside of Thimphu. Land use control and plot adjustment from rural to urban conversion is an immediate urgency for the city structure of Thimphu. The corresponding scope is proposed as part of the proposed ***T-1 Structure Plan Revision***. The proposed ***T-2 Lungtenzampa Bridge Reconstruction*** project aims at realignment of the major crossing roads to the bridge as well as the construction of a new bridge in order to eliminate *TT-1 Traffic Congestions in Entry to Core Area*. ***T-4 24 x 7 Water Supply*** project addresses the issue of *TW-2 Intermittent Water Supply* in view of public health for water supply. ***T-3 Motithang Area Wastewater Treatment*** is proposed to solve *TS-1Water Pollution in Water Bodies in City* and *TS-2 Delay in Development of Green Corridor Along Drainage* at the same time.

The core proposal of this Master Plan Strategy is ***T-1 Structure Plan Revision*** which is basically a technical assistance project including 1) assistance to the national population census of 2015, 2) the incorporation of urban plan monitoring system of CASBEE developed in Japan, and 3) undertaking of Local Area Plans in central areas and city-wide infrastructure plans. ***T-7 Water and Sewerage Master Plan*** addresses the most critically missing element within the Structure Plan of water and sewerage master plans. ***T-8 Begana Water Supply Project*** would provide the ultimate solution for *TW-1Lack of Long-term Supply Capacity*. Capacity development components should be included to create synergy by utilizing more local resources and providing training opportunities to address the issues and needs identified as *TI-2 Development of Planners for Water Supply and Sewerage Systems, TI-3 Lack of Urban Planners,* and *NU-3 Lack of Quantitative Monitoring of Plans.*

There are many areas that require urban infrastructure development such as Jongshina (this area already has a Local Area Plan); there are many unutilized plots including open space, underutilized military lots etc.（*TU-5 Delay in Urban Infrastructure Development of Central Areas.*）*Compact City Strategy* will limit uncontrolled expansion of city boundaries to enhances not only efficiency of public administration but also of residents, thereby increasing the city-wide productivity. The core project for the Compact City Strategy is ***T-6 Local Area Planning and Implementation for Core Thimphu*** which undertakes planning and implementation of Local Area Plans in central areas of Thimphu.

Urban transport is increasing becoming heavy in Thimphu as indicated as（*TT-1 Traffic Congestions at Entry Point to the Core Area, TT-2Lack of Parking Space*）; however, due to lack of land availability, the issues such as *TT-5Undeveloped Major Road System, TT-2Lack of Parking Space* cannot be easily resolved in Bhutan. No action may see paralysis of central parts of the city by *TT-3 Future Traffic Increases. Transport Demand Management Strategy* is to implement combined measures to suppress automobile transports including reinforcement of public transit, infrastructure development for pedestrians and bicycles, penalization for parking and automobile use in central areas, and traffic calming. The next 11$^{th}$ Five Year Plan for Thimphu includes a budget for the introduction of BRT. The largest contributor to Greenhouse Gas Emission is transport sector in Bhutan with its share of 44%. Therefore this *Transport Demand Management Strategy* should constitute mitigation measures for global warming as indicated in *NE-1 Global Warming Mitigation Measures*. ***T-9 Transport Demand Management (TDM) Project*** is a proposal to combine the provision of public bus systems together with a technical assistance project to promote modal shift to bus trips. Addition of a technical

assistance component will enable to make an interactive implementation of TDM measures by monitoring the impacts on modal shifts to arrive at an optimal policy mix.

Thimphu has many traditional architectures, and private footpaths that run between buildings that offer potential tourism attractions. As the urban population grows, the consequent job creation needs are growing in large cities. *City Tourism Development Strategy* will be one of the focal policies to meet these needs. The participation of communities is essential to fully capture the potentials in Thimphu, so termed as *Participatory Community Development Strategy*. ***T-5 Footpath Development and City Beautification*** is a technical assistance project proposal that provide trainings and exposure trips to communities in Japan with successful participatory community development, consultancy to pedestrian space development planning, and pilot project implementation. Many communities, local governments, and commercial associations have rich experiences in participatory development, thus offer a chance of grass root level technical cooperation.

### (3) Phuentsholing Development Strategy

The major threat to the city of Phuenthsoling is human life risks by floods of Om Chhu (*PE-1Cyclic Floods*) and the landslides (*PE-2Frequent Landslides*) at urban encroachment into floodplain and hillsides (*PE-3Urban Encroachment into Hazard Prone Areas*). As described in 4.6.1, the most suitable technologies for *Disaster Prevention Strategy* is so-called Sabo technologies developed in Japan for flood and landslide control. *Sabo* is a collection of mitigation/prevention technologies to tame landslides, floods and rock/debris flow with measures including forest protection, erosion control, river flow control, riverbed stabilization, and embankment. Since topography and hydrology of Phuentsholing are more akin to those of Japan, *Sabo* technologies will have direct applications to prevent the flooding and landslides in Phuentsholing. The core project proposed to fulfill this Strategy is ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies***. Sabo encompasses technologies riverbed stabilization, water course stabilization, and slope stabilization. Sabo technologies should be localized to reduce the investment and maintenance costs of Sabo by utilizing locally available materials such as wood and rocks.

*Bottleneck Strategy* in Phuentsholing is needed for *PU-3 Relocation of Farmers' Market* in urban development due to relocation necessitated by the construction of the planned ring road. The most critical transport problem in Phuentsholing is the passage of long distance trucks through the center of the city as described in 4.3.1 (*PT-1 Bypassing of Cargo Traffic.*) The Ring Road and mini-dry port projects planned by ADB are expected to solve this urgent problem. The old bridge would require the replacement in a few years (*PT-2 Improvements of Damaged Road and Bridges.*) The corresponding project proposed is ***P-5 Om Chhu Bridge Renovation.*** Intermittent water supply poses *PW-1 Risk of Potable Water Contamination*. Therefore, the restoration of continuous water distribution is an important measure in protection of public health. ***P-3 Water Supply System Rehabilitation*** aims at the restoration of 24 x 7 continuous water supply by improving the distribution networks.

As is the case in Thimphu, Phuentsholing adopts Structure Plan – Local Area Plan System for urban infrastructure planning which creates a void in city-wide master plan of urban infrastructure (*PW-2 Lack of Water Resource Development Plan, PS-2 Lack of Long-term Master Plan.*) Phuentsholing is endowed with a large unutilized space in the flood plain of Am Mo Chhu. The investment that induces minimum risk for loss of lives is the expansion of wastewater treatment plant (*PS-3 Selection of Optimal Wastewater Treatment Technologies, PS-4 Utilization of Flood Plain*.)

**P-2 Wastewater Treatment Expansion** or P**-3 Water Supply System Rehabilitation** should include the city wide master plan element to serve both *Bottleneck Strategy* and *Master Plan Strategy*. **P-2 Wastewater Treatment Expansion** first investigates an option of combining three separate wastewater treatment zones proposed in the Structure Plan into one to achieve

economy of scale and evaluate the most technically and economically suitable technologies with different size of plot availability.

Phuentsholing is the gateway to India from Bhutan. The survival tactics for Phuentsholing is to develop higher value-added products and services including hotels, shops and recreational facilities (*PU-4 Development of Southern Hub for Commerce and Tourism*.) The Ring Road under planning will divert most of the heavy trucks from passing through the core part of the city. With the project, the amenity of the city will improve but there is a risk of losing commercial opportunities as well. Another new corridor is the highway connection to Samtse which is now under construction. Phuentsholing Thromde must concentrate to induce schemes to capture economic opportunities arising from new traffic flows (*PT-3 Economic Linkages to Road and Terminal Facilities*.) A project proposal to address these needs is ***P-4 Relocation Upgrading of Farmers Market to Michi No Eki***, which aims at maximizing the economic opportunities from passing traffics on new roads. According to experiences in Japan, successful Michi-no-Ekis are initiated with community participation for the identification of local resources and potentials leading to the development of unique local products and branding. P-4 aims at the development of local capacity of internal voluntary development departing from traditional government led development efforts as part of *Participatory Community Development Strategy.*

### (4) Project Formulation

The proposed candidate projects have been formulated by the JIC Survey Team through discussion with local experts and field observations. Any of the projects is not yet officially endorsed either by Bhutanese governments or JICA. The list of projects rather aims at aiding the future discussions between two governments in formulation of specific aid projects instead.

At present, WB is undertaking *Bhutan Urban Development II* (loan approval 2010, US $12 million.) Under this program, RGOB is implementing two LAPs for Dechencholing and Langjophaka. WB is planning to take up another Urban Village for implementation; the candidate area is Taba. ADB is undertaking *Urban Infrastructure Project* (Loan Approval, Nov. 2011, US$19,870 thousand) to develop urban infrastructures such as water and sewerage, roads for four cities of Thimphu, Phuentsholing, Samdrup Jongkhar, and Nganglam. In Thimphu, the Program started to construct water supply and sewerage systems for four southern LAPs. ADB's SASEC Road Connectivity Project (Approval forthcoming, US$ 50 million) aims at financing the development of east-west highway on the southern belt of Bhutan. As a part of this project, ADB plans to finance the Ring Road in Phuentsholing.

Bhutan has developed a solid urban planning and implementation scheme but at the same time, there are several aspects to be improved in monitoring. On a national scale, the current Structure Plan should incorporate a quantitative monitoring system using CASBEE and also inclusion of urban infrastructure planning in depth. The Structure Plan of Thimphu has become outdated in population targets and corresponding city area or land uses, therefore there should be updated. Therefore the revision of Structure Plan is included as part of Thimphu Projects.

### (5) Thimphu Project Formulation

Table 2 shows the nine proposed priority projects for Thimphu. The details of the projects including objectives, scope, environmental and social considerations are detailed in Appendix A-1.

**Table 2 Priority Projects for Thimphu**

| No | Project Title |
|---|---|
| T-1 | Structure Plan Revision |
| T-2 | Lungtenzampa Bridge Renovation |
| T-3 | Motithang Area Wastewater Treatment |
| T-4 | 24 x 7 Water Supply Improvement |
| T-5 | Footpath Development and City Beautification |
| T-6 | Local Area Planning and Implementation for Core Thimphu |
| T-7 | Water and Sewerage Master Plan |
| T-8 | Begana Water Supply Project |
| T-9 | Transport Demand Management (TDM) Project |

Source: JICA Study Team

Among nine projects, ***T-2 Lungtenzampa Bridge Renovation*** is a spot project. As the gateway to the city, the project is a candidate project for grant. ***T-6 Local Area Planning and Implementation for Core Thimphu*** addresses the need for urban infrastructure developments in central part of Thimphu including water supply, sewerage and roads. This project can be so designed to include ***T-3 Motithang Area Wastewater Treatment***, ***T-4 24 x 7 Water Supply Improvement***, ***T-5 Footpath Development and City Beautification***, and ***T-8 Begana Water Supply Project***. Given the nature of the project and the size of development funding requirements, the project should be a loan project. ***T-1 Structure Plan Revision*** should be designed to define the scope of the T-6 and provide the cost estimates. In 2015, there will be a decennial national census. There should be a coordination work between urban planners and census department to make best use of the results for future urban planning with regard to the census blocks and coverage. ***T-1Structure Plan Revision*** includes the precursor program of technical assistance in population statistics and future population forecasting for this purpose. Among urban infrastructure, water supply and sewerage systems have the most urgent needs for development. ***T-7 Water and Sewerage Master Plan*** focuses on city-wide planning for water supply and sewerage although it is more desirable to have it included as part of ***T-1 Structure Plan Revision. T-4 24 x 7 Water Supply Improvement*** aims at resolving the present intermittent water supply problems for public health and ***T-3 Motithang Area Wastewater Treatment*** aims at increasing the coverage of sewers to core areas to improve urban amenities.

If WB decides to finance ***T-8 Begana Water Supply Project***, the scope for ***T-6 Local Area Planning and Implementation for Core Thimphu*** needs to exclude the city wide water supply component.

In the area of urban transport, the reinforcement of public bus system on grant basis is crucial as part of ***T-9 Transport Demand Management (TDM) Project*** to maximize the impacts. At present, half of person trips of citizens of Thimphu rely on foot. Therefore, development of footpaths is critical in preserving the current modal split. City beautification elements will increase the economic impacts especially on tourism. ***T-5 Footpath Development and City Beautification*** should be formulated as a technical cooperation project to bring the Japanese experiences to Bhutan since the project scope is too small for loan and will not satisfy grant

qualifications. T-5 can be incorporated as part of ***T-1 Structure Plan Revision*** or **T-9 Transport Demand Management (TDM) Project**.

### (6) Phuentsholing Project Formulation

Table 3 shows the five proposed priority projects for Phuentsholing. The details of the projects including objectives, scope, environmental and social considerations are detailed in Appendix A-2.

**Table 3 Priority Projects for Phuentsholing**

| No | Project Title |
|---|---|
| P-1 | Om Chhu Flood/Landslide Control with Sabo Technologies |
| P-2 | Wastewater Treatment Expansion |
| P-3 | Water Supply System Rehabilitation |
| P-4 | Relocation Upgrading of Farmers Market to Michi No Eki |
| P-5 | Om Chhu Old Bridge Renovation |

Source: JICA Study Team

The most critical urban challenge in Phuentsholing is protection of human lives and urban facilities from natural disasters. For these objectives, ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies*** qualifies for grand aid. However, it is not possible to accurately define the scope or costs for the work. The planning work based on hydrological and geological data of the basin needs to precede the actual implementation. Sabo technologies are widely needed in other southern parts of Bhutan. Therefore, ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies*** is proposed as a technical assistance project. In order to solidify technology transfer, the project scope includes the implementation of 3-5 pilot projects for critical typical technologies locally adopted for Phuentsholing.

***P-3Water Supply System Rehabilitation*** addresses these urgent needs of preventing health risks to the residents by rehabilitation of distribution networks. The current wastewater treatment needs to be expanded as proposed in ***P-2 Wastewater Treatment Expansion***. One option is to merge with other projects such as those water supply and sewerage projects for Thimphu.

***P-4 Relocation Upgrading of Farmers Market to Michi No Eki*** is a technical assistance project to transfer technologies on community participatory development methodologies from Japan to Bhutan with a pilot project in Phuentsholing. MoWHS is now initiating a program to develop roadside farmers' market and has a keen interest in the Japanese experiences in Michi-no-Eki and One Village One Product Movement.

***P-5 Om Chhu Old Bridge Renovation*** qualifies as a grant project for its objective of transport safety.

# Chapter 1 Introduction

## 1.1 Survey Background and Objectives

Firmly based on its national development philosophy of Gross National Happiness (GNH), Bhutan pursues its development balancing between economic development and social integrity with culture and environment focusing on individual spiritual prosperity. With a pride of being environmental conscious country, Bhutan restricts development of forest resources and aims to have sustainable development socially and economically. On the other hand, rapid urbanization is taking place and it is forecasted to have more population concentration in capital region. Owing to its rugged topography, one severe constraint for urbanization is the limitation of available land for development. The sustainable development lags behind unfettered urbanization; there is a risk of increasingly rapid deterioration of urban environment.

Large cities such as Thimphu are already facing the issues of traffic congestions due to increase of vehicles, water pollution and odors due to lack of water supply and sewerage, and disposal of accumulated solid waste. Taking into account that Bhutan is environmental conscious country, and given the importance of tourism to the local economy, keeping amicable urban environment is vital for its long term sustainability. The development of proper urban infrastructure to accommodate the needs from urbanization is now desperately required.

Urbanization is taking place where unplanned due to unexpected population increase, and urban planning is required to revise. In addition, due to lack of water supply, sewerage, solid waste final disposal site, Bhutanese government request assistance to revise the urban planning as well as improvement of urban infrastructure.

Based on above background, the Survey has following objectives:

1) To grasp the development issues on urban infrastructure development and urban environmental improvement
2) To identify the bottlenecks towards development, and to clarify the project development procedures in line with environmental regulations etc, and
3) To understand the issues holistically by focusing on water/sanitation and urban transportation while covering other sectors by surveying urban planning and urban infrastructure development.

## 1.2 Survey Team and Activities

### 1.2.1 Team Composition

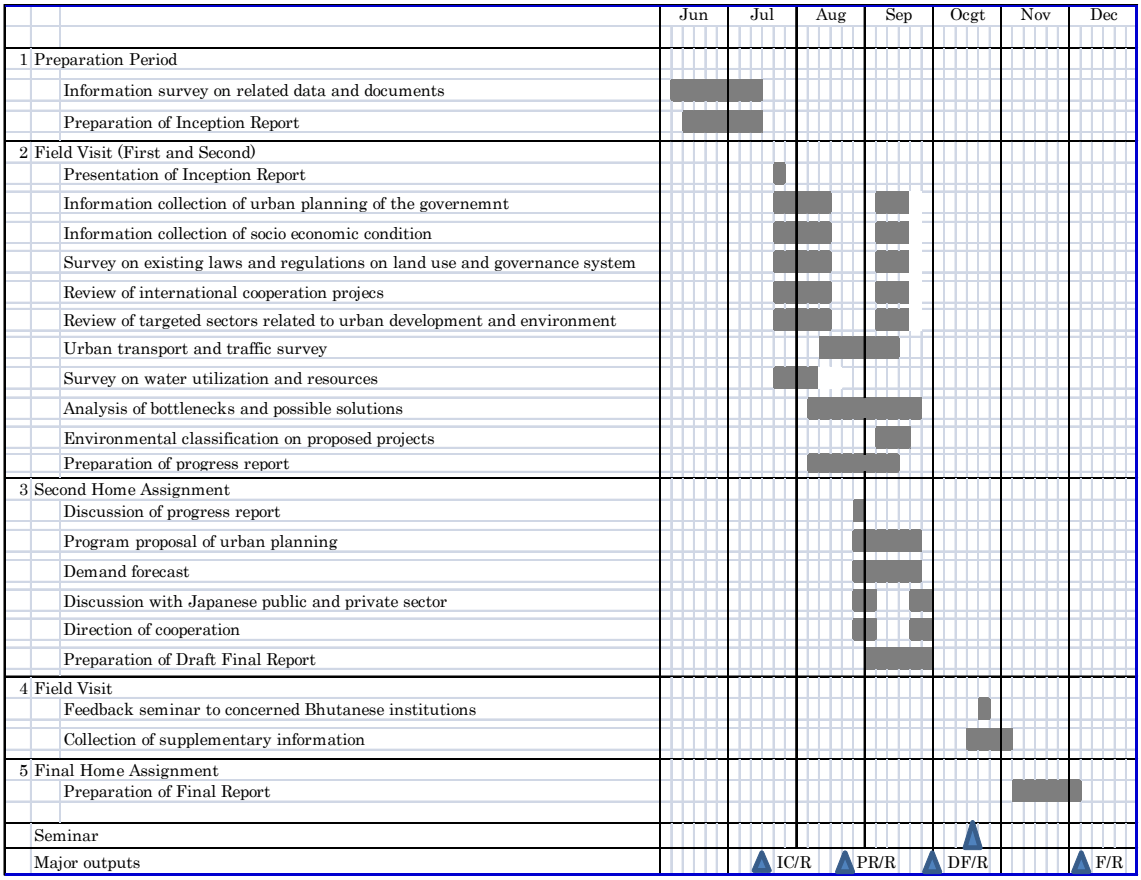
The survey team members with tasks assigned are shown below:

- Team Leader /Urban Development : Hiroshi NISHIMAKI, Exe・idea Ltd.
- Urban Planning : Natsuko KIKUTAKE, PADECO Ltd.
- Water Supply-Water Resource : Akira TAKECHI, TEC International Co. Ltd.
- Sewerage – Drainage : Haruki TAKAHASHI, TEC International Co. Ltd.
- Urban Transport Infrastructure : Morikata IKEGAMI, PADECO Ltd.
- Urban Transport Planning : Koichiro TAMURA, PADECO Ltd.
- Environment : Shinji NAMBO, Exe・idea Ltd.

### 1.2.2 Summary of Field Work Activities

#### (1) Overall Schedule

The overall schedule of field survey in Bhutan is shown in Figure 1-1. The survey started in June 2013 and completed in December 2013. The team started to survey first in Japan in June and visited to Bhutan three times from July 21 until Nov 5, 2013.




Source: JICA Survey Team

**Figure 1-1: Field Survey Schedule**

Counterparts were Ministry of Works and Human Settlement (MoWHS), Thimphu Municipality (Thromde), and Phuentsholing Municipality (Thromde). The survey consists of mainly information collection, with supplemental survey of water quality survey, traffic survey, and GIS analysis in order to complement existing data. Based on the analysis of collected information, bottleneck and needs analysis were further conducted and strategic solutions were deepened by the dialogues with counterparts. Official discussion for the inception were taken place in MoWHS, Thimphu Thromde, and Phuentsholing Thromde, while the final feedback seminar in Phuentsholing Thromde, and feedback together with overall wrap up seminar in MoWHS. During the survey several discussions were made with the specialists on the analysis and strategies and the result was summarized in this report.

# Chapter 2 Urban Development and Environment of Bhutan

## 2.1 Bhutan, Thimphu and Phuentsholing

### 2.1.1 Natural Environment[1]

#### (1) Land

Kingdom of Bhutan is situated in south Asia facing China at the north border, and with India at south, east and west. It is a landlocked country located between the latitudes 26°45'N to 28°10'N and longitudes 88°45'E to 92°10'E. It is a mountainous country with mountains and slopes covering most of the land as it situated at the southern slopes of eastern Himalaya Mountains. The Bhutan Himalayas is about 340km out of the 2,400 km long Himalayan range. Having the area of 38,394 sq.km (as of 2002), landscape ranges from alpine mountainous zone in the north with exceeding 7,000m to sub-tropical plains in the south with 160m of altitude. 20.5% of the land is above 4,200m above sea level, and part of them is covered by the perpetual snow, and ice forming the glaciers and glacial lakes exist[2].

The variation of the climate is extremely dependent on the altitude. Generally the climate is cold in the north, temperate in the in the inner Himalayan valleys of central regions and humid and subtropical in southern areas. The western area is particularly affected by monsoons with heavy rains. Annual precipitation varies regionally. In the north precipitation is only about 40 mm in a form of snow. In the temperate central regions average of 1,000 mm is more common, In the south where sub-tropical forest exists, highest record of 7,800mm is observed.

Generally dry spring starts in early March and lasts until mid-April, followed by summer with occasional showers until late June. Then the summer monsoon starts and lasts until late September with rains from southwest. This monsoon blocked by the Himalayas, brings heavy rains and high humidity, sometimes flash floods and landslides with heavy mists. Then autumn comes and lasts until November with bright and sunny days, followed by winter until March with frost throughout much of the country and snowfall above the elevation of 3,000m.

The vegetation varies according to the elevation and climate. A general tendency is that northern areas with cold climate are covered with coniferous trees and other alpines trees like magnolia, rhododendrons, birch, etc. The inner regions are covered with a variety of plants and trees including pine, chestnut, oak, apple, plume etc. while southern foothills are mostly covered by dense and thick deciduous trees.

Bhutan is covered by forests, 70.5% of the total land, followed by year-round snow and glaciers 7%, meadows and pastures 4%, and cultivated land with 3%[3]. In general there is a tendency of the north having less forest coverage and the south more due to climatic conditions.

#### (2) Geology

Bhutan is located in the east of the mountain range formed by the Himalayan orogeny. Due to active orogeny, Bhutan has a complex geological structure.

The land of Bhutan can be geologically classified into three structures. The first is the Tethyan (Tibetan) Himalaya Structure which can be seen partly in the north. The second is the Higher (Greater) Himalaya Structure which can be seen in major parts of the land, and the last one is the Lesser (Lower) Himalaya Structure which can be seen in the southern end area. According to Thimphu City State of Environment, the southern part which is composed mainly

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1 Major source: Statistical Yearbook 2011.

2 The data are from South Asian Floods, a regional cooperation organization for flood information exchange

3 Major source: Statistical Yearbook 2011

by Lesser Himalaya Structure is in a geologically weak zone. Geological maps are shown in Appendix B.

The geological formation of the Thimphu Dzongkhag region mainly belongs to Precambrian age (600 million years), and consists of highly metamorphosed gneisses, schist, and subordinate quartzite, calcium silicate rocks and marbles. Top soil is weathered Precambrian layer consisting of rocks and mud, therefore it is in a fragile condition. Due to less rain, landslide in Thimphu is not frequently happening. The valley of Thimphu consists of three layers; alluvial deposits, river terrace deposits and colluviums.

In case of Phuentsholing, the center of the city comes under Tertiary Himalayan formation and this area consists of Siwaliki Structure and Lesser Himalayan Structure. As the Indian Shield submerges under the Tibetan Shield near the southern border of Bhutan, seismic movement is active. The mountains behind the city of Phuentsholing rises sharply. The Highway No.1 connecting Thimphu and Phuentsholing drops off from 1,500m from the last mountain pass to 200m above the sea level of the city.

### (3) Hydrology

As Bhutan is a mountainous country located in the East Himalayan Mountains, the mountains are steep. Major rivers flow north to south, with steep longitudinal gradients and narrow V shape valleys, and occasional broader flat lands of cultivation. In the border with India the land turns flat with the elevation of around 200m with about 650km distance to the sea, consequently the river flow speed reduces and creates occasional floods[4].

Bhutan has four major river basins, from west they are: Am Mo Chhu, Wang Chhu, Puna-Tsang Chhu and Drangme Chhu. The basins have lateral valleys and major rivers have tributaries in the main and lateral valleys, with a variety of lengths with steep slopes and some waterfalls. Snow melt from highland alpine area becomes the origin of river source and the rivers run through the country and flow into the Brahmaputra River in the Indian plains. Bhutan has dry and rainy seasons, and the river flow has seasonal variations. The flow is relatively low during dry season due to limited rainfall, whereas the flow is high during rainy seasons with heavy sedimentations. According to Hydromet Services Division, Ministry of Economic Affairs, glacial lake outburst floods (GLOFs) are not likely to happen in the rivers of Wang Chhu and Am Mo Chhu which are main rivers passing Thimphu and Phuentsholing. There is no glacial lake in the upstream.

## 2.1.2 Society and Economy

According to the census of 2005, Bhutan has the population of 635 thousand (without floating population), and natural population growth rate of 1.3% comprising of 1.4% in urban areas and 1.2% in rural areas.

It has a mixture of mainly Tibetan origin Ngalops, Hindi origin Sharchops, and Nepali origin Lhotshampa, with Tibetan origin culture, and major language is Dzongkha and English.

### (1) Economy

As shown in Table 2-1, Bhutan has the GDP of Nu. 85,581 million equivalent to US$ 1,426 million as of 2011 converted with the exchange rate of US$1= 60. Per capita GDP as of 2011 is US$1,980[5]

[4] Major Source: South Asian Floods, a regional cooperation organization for flood information exchange

[5] Assuming that the population is 720,000 and US$ 1 = Nu.60

**Table 2-1 GDP by Sector (Unit: Nu. Million)**

| Sectors | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| Agriculture Livestock & forestry | 10,078 | 11,159 | 12,178 | 13,459 |
| Mining and quarrying | 1,252 | 1,392 | 1,617 | 1,942 |
| Manufacturing | 4,593 | 5,017 | 6,324 | 7,045 |
| Electricity and water | 11,521 | 11,816 | 12,764 | 11,912 |
| Construction | 6,251 | 7,470 | 10,309 | 13,917 |
| Wholesale & Retail Trade | 2,695 | 2,935 | 3,753 | 4,642 |
| Hotels & Restaurants | 569 | 538 | 608 | 949 |
| Transport, storage & Communication | 5,366 | 5,990 | 6,943 | 9,489 |
| Financing, insurance & real estate | 4,577 | 4,962 | 5,546 | 7,008 |
| Government | 7,544 | 9,668 | 12,139 | 14,864 |
| Others | 268 | 276 | 298 | 355 |
| Gross domestic product | 54,713 | 61,224 | 72,478 | 85,581 |

Source: Statistical Yearbook of Bhutan 2012 P196, National Statistics Bureau

The economy did not have stable economic growth. As shown in the following Table 2-2. The growth slowed down in 2008 and 2009, but it has grown in 2010 and 2011. This is owing to secondary and tertiary industries in 2010 and tertiary in 2011.

**Table 2-2 Annual GDP Growth Rate (%)**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Primary | 2.5 | 2.5 | 1.6 | 1.13 | 4.0 |
| Secondary | 41.6 | 5.5 | 4.1 | 12.7 | 3.2 |
| Tertiary | 5.9 | 4.8 | 12.2 | 15.4 | 15.7 |
| Whole GDP | 17.9 | 4.7 | 6.7 | 11.8 | 8.5 |

Notes: Estimated from Statistical Yearbook 2012, pp199 National Statistics Bureau
Source: Statistical Yearbook of Bhutan 2012, pp197, National Statistics Bureau

Trade statistics shows that Bhutan relies heavily on India with 84% of exports and 72% of imports. As for exports, the major export is electricity and 75% of power generated are exported to India. Other major export commodities are ferro-silicon, magnetic disc tapes/disk cards, copper wire, calcium, Portland cement, manganese, and iron bars/rods. Major import commodities are fuel, lubricants, machinery, vehicles, and fabrics.

**Table 2-3 Trade Balance (Nu. Million)**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Exports | 27,859 | 22,591 | 23,993 | 29,324 | 31,486 |
| Export to India | 22,724 | 21,480 | 22,434 | 26,001 | 26,378 |
| Imports | 21,745 | 23,495 | 25,650 | 39,084 | 48,698 |
| Import from India | 15,000 | 17,340 | 19,968 | 29.338 | 35,201 |
| Balance | 6,114 | -904 | -1657 | -9,760 | -17,212 |
| Balance w/India | 7,624 | 4,140 | 2,466 | -3,337 | -8.823 |

Source: Statistical Yearbook of Bhutan 2012 P157, National Statistics Bureau

**Table 2-4 Electricity Generation (Million Units)**

| | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/2011 |
|---|---|---|---|---|---|
| Power Generation | 4,520 | 6,542 | 6,961 | 6,998 | 7,067 |
| Exports | 3,644 | 5,429 | 5,609 | 5,353 | 5,284 |
| Imports | 11 | 7 | 17 | 20 | 20 |
| Loss | 121 | 151 | 165 | 167 | 94 |
| Domestic | 744 | 955 | 1,170 | 1,458 | 1,669 |

Source: Statistical Yearbook of Bhutan 2012 P140, National Statistics Bureau

The elasticity of export and import to GDP is shown in Table 2-5. The elasticity of import is much higher than that of export. This means that imports grows much faster than the exports in relation to GDP growth. In other words, with the economic growth Bhutan needs more foreign currency. Rupee, the main foreign currency to Bhutan, foreign reserve dwindled after rapid economic growth in 2011. The event was called Rupee Crunch.

**Table 2-5 Elasticity of Exports and Imports to GDP**

| | 2009 | 2010 | 2011 |
|---|---|---|---|
| Elasticity of Exports | 0.92 | 1.89 | 0.87 |
| Elasticity of Imports | 1.36 | 4.45 | 2.89 |

Source: JICA Survey Team

The trend of tourists is shown in the following Table 2-6. The nnumber of tourists decreased in 2009 after Lehman Shock in 2008, but drastically increased afterwards. The tourism revenue receipts has also same tendency as tourists. The tourists in 2011 was 37,479 and tourism revenue receipts were US$ 47.7 million. Compared with the major exports, tourism ranks in the fourth place after power generation, ferro-silicon, and magnetics. As most of the exports of commodities are destined to India, the receipts are in Indian Rupees except for tourism. Therefore the tourism plays an important role in obtaining US dollars and Euros.

**Table 2-6 Tourists and Revenue in Tourism**

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Visited People (persons) | 21,094 | 27,636 | 23,480 | 27,195 | 37,479 |
| Annual Growth (%) | | 31.01 | -15.04 | 15.82 | 37.82 |
| Tourism Revenue Receipts (US$ in Millions) | 29.85 | 38.83 | 31.88 | 35.98 | 47.68 |
| Annual Growth (%) | | 30.08 | -17.9 | 12.86 | 32.52 |

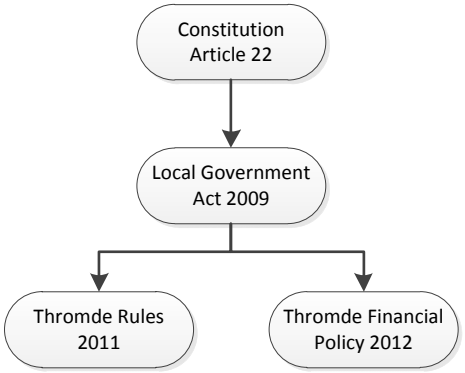
Source: JICA Survey Team based on Statistical Yearbook of Bhutan 2012, National Statistics Bureau

## 2.2 Institutions

### 2.2.1 Legal Framework of Local Government

The Constitution adopted in 2008 that marked the transition from a monarchy to a democratic monarchy also transformed local governance. The Constitution stipulates not only the basic founding principles of the nation and national legal framework but also basic framework of government institutions. The acts effective prior to the establishment of the Constitution that have ceased to be effective include *Municipality Act 1999, and Thromde Act 2007.* The new act, the *Local Government Act 2009* that defines the system of local governance

reflect the constitutional transformation. *Thromde Rules 2011* and *Thromde Financial Policy2012* further elaborates administrative procedures.




The Constitution defines the institutional framework of governments as well as the national legal framework. It basically further promotes decentralization of governance. The Article 22 of the Constitution sets the framework of local government, establishing three levels of governance, the central government, Dzongkhag, and Thromde/Gewog. It mandates the electoral selection of the head of Thromde/Gewogs. It prescribes the post of Dzongda, i.e., the head of Dzongkhag, as the appointment position by the King based on the recommendation by the prime minister, maintaining overall centralized control over local governance.

*Local Government Act 2009* combined laws that regulated urban local governments and ones that regulated rural local governments under an unified umbrella. Even though, the Constitution mandates the selection of chief of Thromdes by voting, the law classifies Thromdes into Class A and Class B, placing Class B Thromdes under the purview of Dzongda while maintaining the direct election for Class A Thromdes. This modification is based on the understanding that most of Class B Thromdes still lack in administrative capacities. At present, the cities classified as Class A Thromdes are Thimphu, Phuentsholing, Gelephu, and Samdrup Jongkhar, and the rest 16 cities belong to Class B Thromdes.

Thromde Rules 2011 defines the detailed functions, roles of the Thromde and administration rules. Thromde Financial Policy2012 defines the procedure for budgeting, accounting and auditing for the fiscal matters of the Thromde.

### 2.2.2 Institutional Setup

The country has several levels of government administration with 4 special cities as follows;

1) Central Government with 10 ministries,
2) Dzongkhag (District) administrations of 20 districts: each headed by Dzongda (governor or Dzongkhag administrator); Dzongkhag Tshogdu (Prefecture Assembly) is the decision making body of Dzongkhag,
3) Gewog (Village or Block) administrations of 205 Gewog's headed by Gewog headman called Gup.
4) Thromde (Dzongkhag capital cities):Thimphu, Phuentsholing, Gelephu, and Samdrup Jongkhar classified as Class A and others classified as Class B. The Thrompon (Mayor) of Class A is elected, and Class A cities have Thromde Tshogde as Council (Municipal Assembly) consisting of minimum of 7 to maximum 10 elected members, including Thrompon, and Executive Secretary.

In Dzongkhag Tshogdu, Thromde's representative is only one among other representative of Gewogs. Therefore, Thromde's representative is a minority for the topics which cover whole Dzongkhag. This implies that the Bhutanese policy making places more weight on rural agenda. On the other hand, in case that a discrepancy between policies of Thromde and Dzongkhag exists, the independency of Thromde is secured within their boundaries.

Four Class A cities have their own revenues mainly from water and sewerage charges, parking charges, and land transaction taxes. Other municipalities do not have their own revenues, therefore those municipalities are operated by grants or transfers from the central government.

### 2.2.3 Institutions Related to Urban Development

Table 2-7 shows the roles of major agencies related to urban environment improvement of the cities in Bhutan.

**Table 2-7 Roles of Major Agencies Related To Urban Environment**

| Institutions | Role |
|---|---|
| GNHC | Promotes development philosophy, produces Five Year Plan and provides budget allocation along with the Plan |
| Ministry of Finance | Plans and administers annual budgets |
| MoWHS | Copes with the issues in settlement (city, town, villages), including area development, and infrastructure development<br>Gives guidance to the Thromde on infrastructure development |
| Class A Thromdes including Thimphu and Phuentsholing | As autonomous body, having city council as its highest decision making body, determines the development of the city infrastructure.<br>Although autonomous, Thromde consults and seek assistance from MoWHS on their development when needed. |
| National Environmental Commission | Highest authority to adjudicate the environmental soundness of proposed projects by assessing the impact and provides Environmental Clearance when approved.<br>NEC has delegated its authority to ministries, municipalities (Dzongkhag, and Thromde) to judge on specific items.<br>However, the project proponent cannot judge environmental impact by themselves, and it has to be judged by a higher authority |
| Property Assessment and Valuation Agency | Evaluates and determines the value of land. All public acquisition must follow the value set by PAVA.<br>By law, the price has to be revised every three years, but the last revision was in 2009 |
| National Land Commission | Approves all land transactions. |
| District Land Commission (DLAC) | Manages land acquisition procedure. If land acquisition is necessary, the project proponent must submit the request to NLC for approval. If approved, District Land Acquisition Committee (DLAC) submits the notice to land owners at least three months prior to acquisition. The DLAC searches the substituting land and prepares for environmental clearance. The DLAC prepares the detailed report and submit it to NLC within one month in principle. Land shall be acquired only after the substitute land has been registered[6]. |
| Ministry of Agriculture (MoA) | Must approve its use when a project requires government forest land. |

[6] Based on ADB's Report ADB TA-BHU-7630 Bhutan Infrastructure Project Annex 3.2 Resettlement Planning Document

Several government agencies are involved in project implementation related to urban development. Depending on the types of projects, the involved agencies are shown in the following Table 2-8. Thromde proposes, plans and designs a Project, GNHC approves, Ministry of Finance approves annual budget, NEC or MoWHS provides environmental clearance, and the Thromde operates and manages the project. In case of bridges and river basin protection, as the Thromde does not have enough capacity to design, they collaborate with MoWHS. In such case that MoWHS plans and designs the project, the environmental clearance is provided by NEC in order to avoid conflict of interest.

**Table 2-8 Involved agencies with the type of projects in Urban Development**

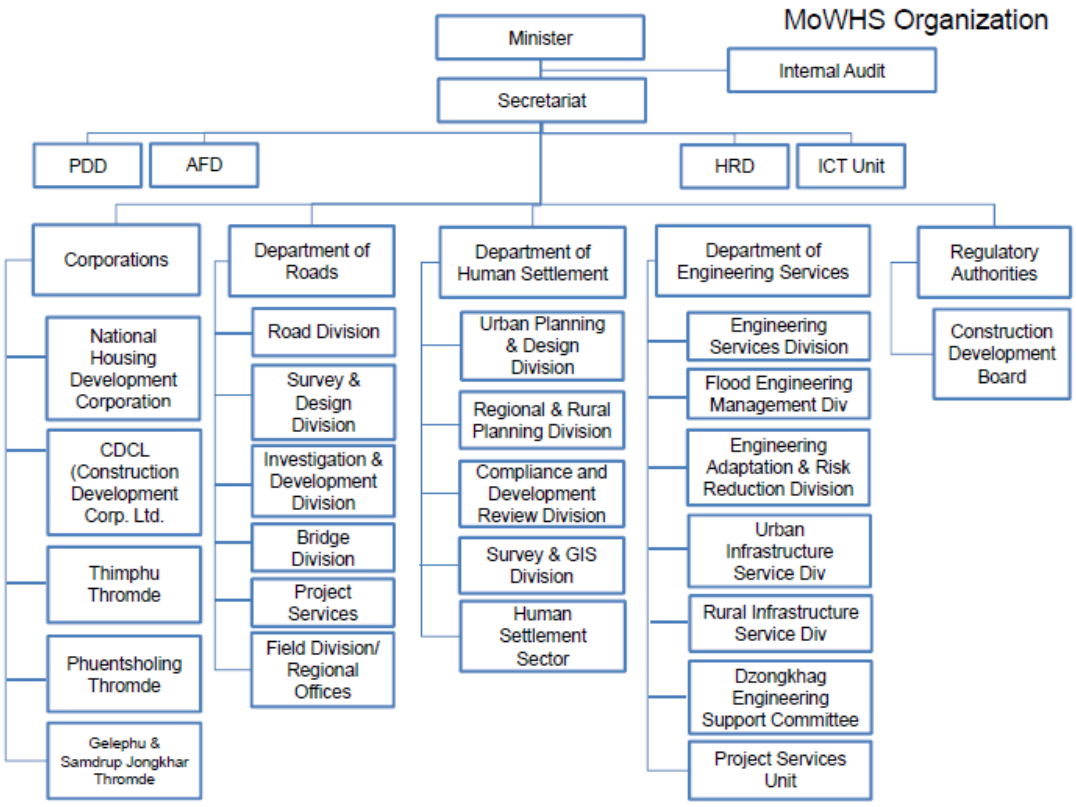
| | LAP | Water Sector | Road | Bridge | River basin protection |
|---|---|---|---|---|---|
| Project Proponent | Thromde | Thromde | Thromde | Thromde | Thromde |
| Design and Planning | Thromde | Thromde | Thromde | Thromde/ MoWHS | Thromde/ MoWHS |
| Approval of Project | GNHC | GNHC | GNHC | GNHC | GNHC |
| Annual budget approval | Min of Finance | Min of Finance | Min of Finance | Min of Finance | Min of Finance |
| Consent | MoWHS | MoWHS | MoWHS | MoWHS | MoWHS |
| Environmental Clearance | NEC | NEC | NEC | MoWHS/NEC | MoWHS/NEC |
| Forest Clearance if needed | MoA | MoA | MoA | MoA | MoA |
| Land Acquisition Authorization | NLC | NLC | NLC | NLC | NLC |
| Operation and Maintenance | Thromde | Thromde | Thromde | Thromde | Thromde |

Notes: Approval of project is necessary when the budget is not allocated in the 5th year plan
Consent of MoWHS is acquired depending on the scale and impact to the society
IEE is necessary for all projects for the environmental clearance.
Source: NEC

Major public institutions related to urban development are described below.

### (1) Ministry of Works and Human Settlements

The overall organizational structure of the Ministry of Works and Human Settlements (MoWHS) is summarized in Figure 2-1.




Source: Ministry of Works and Human Settlement

**Figure 2-1 Organizational Structure of the Ministry of Works and Human Settlement**

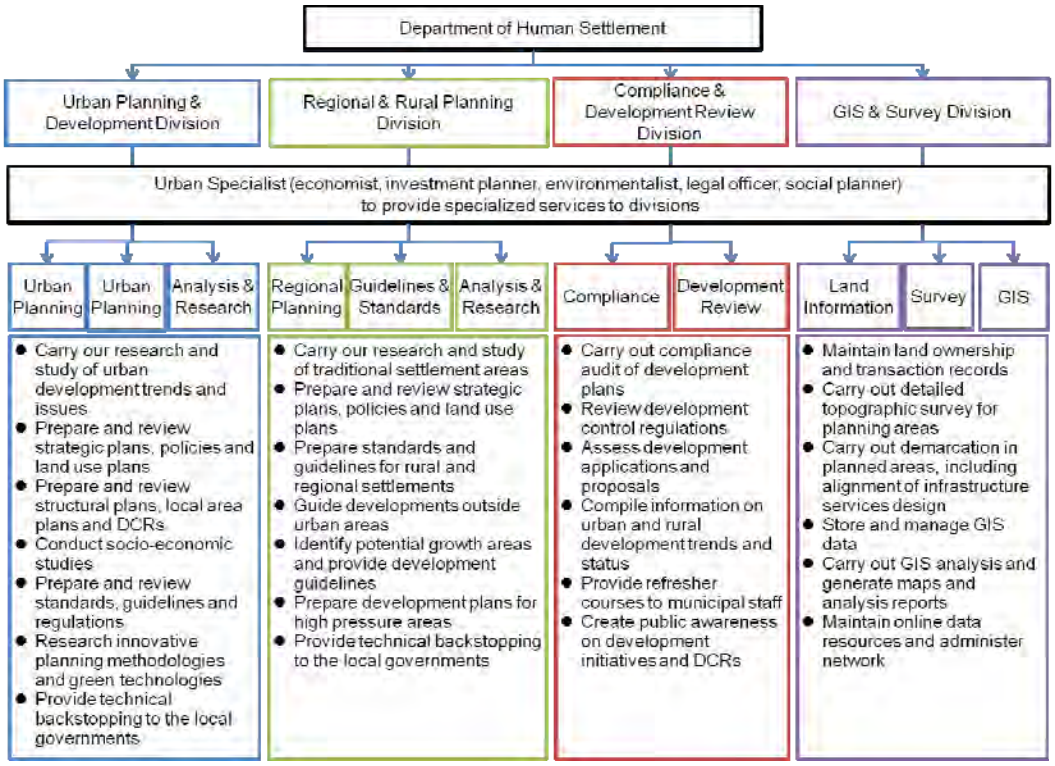
Ministry of Works and Human Settlement (MoWHS) has been created from the former Ministry of Construction in 2003 in order to be responsible for the provision of development plans and infrastructures for the whole country. The Department of Urban Development and Engineering Services has been formed in order to be responsible for urban development and engineering services for the country. In response to a growing demand from local governments in particular, this department has been split into Department of Human Settlement (DHS) and Department of Engineering Services (DES).

DHS makes policies, strategies, and basic/master plans of development on urban areas of municipalities of the nation. Specifically, the tasks of DHS are : 1) Planning of master/basic plans for settlement areas, 2) development of water supply and sanitation, and 3) development of basic construction guidelines.

DES administers and inspects the designs of infrastructure projects. Specifically, the tasks of DES are: 1) Design of urban development, 2) Confirmation and inspection of buildings and structures whether they are safely built, and whether they are keeping the laws and standards, 3)Design and supervision of government institution buildings, 4) Evaluation of buildings when acquisition is needed, 5) Design of structures after disaster, 6) Determination of unit cost of construction materials, 7) Design of pedestrians suspension bridges, 8) Management of the World Bank and ADB projects, 9) Provision of personnel to municipalities Dzongkhags.

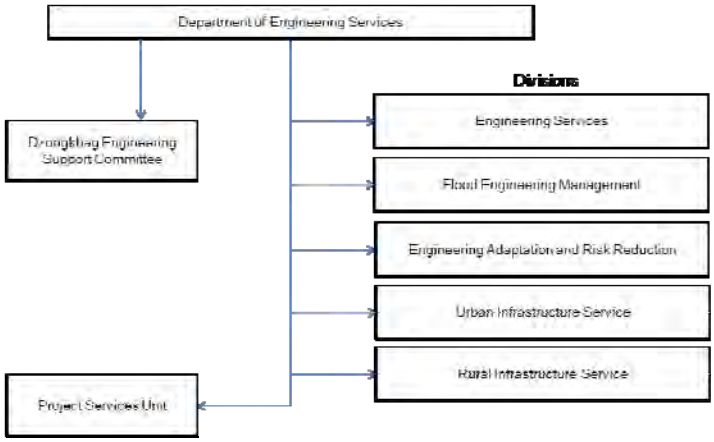
Thus, DHS develops basic policies while DES undertakes works in relation to urban development and structures. When Dzongkhags or Thromdes can implement by themselves, MoWHS gives priority to those initiatives and supports them.

The organizational structure of DHS and DES are summarized in Figure 2-2and Figure 2-3 respectively.




Source: Ministry of Works and Human Settlement

**Figure 2-2 Organizational Structure of Department of Human Settlement**




Source: Ministry of Works and Human Settlement

**Figure 2-3 Organizational Structure of Department of Engineering Services**

The number of staffs in the 3 major departments of Human Settlement, Engineering Services, Roads are shown in below.

**Table 2-9 Number of Staffs in Major Departments in MoWHS**

| Department Name | Roads | Human Settlement | Engineering Services |
|---|---|---|---|
| Number | 446 | 41 | 58 |

Notes: Department of Roads has staff in each municipality
Source Ministry of Works and Human Settlement

The Department of Roads has permanent staff members of 101 in the main office and 345 in its regional offices. These staff are almost all engineers and in addition, it has 3,500 unskilled labors. Department of Roads is responsible for development and maintenance of national highways. Small works are directly done by the region and large works by headquarter. Some works are contracted out depending on the necessity. Four Class A Cities (Thromdes) are responsible for development of roads within the city, but upon request from them, Department of Roads will assume the task. Bridge Division exists within the Department is responsible for the design and supervision of bridges. According to the JICA senior volunteer (Bridge expert), the most engineers have an engineering capacity of designing a bridge of 50m class since most of them have master levels in India or in Western countries. In addition the Department of Roads have experience in administering international donor financed projects such as ADB.

As for the road development between Samtse and Phuentsholing is not progressing well. They do not have much know-how on controlling soft soil, soil conservation technology for soft soil or soil under heavy rain. They have strong interest in obtaining Sabo technology from Japan.

Department of Engineering Services has permanent staff members 58 in the main office and 743 are seconded to Dzongkhags. Those in Dzongkhags are working under jurisdiction of Dzongkhag and paid by Dzongkhags. Thus they are not included in the staff roaster.

Within the DES, 7 water supply engineers and 3 sewerage engineers exist. They are also responsible for developing water supply and sanitation of towns of the country like Department of Roads. As many staffs are seconded to municipalities, small projects are done by municipalities, and large projects are done by the main office with hiring consultants whenever necessary. However since there are not much opportunity in Bhutan to see various kinds of technologies, it seems that the optimum choice of technology is dependent upon consultants. It may be good even only to visit and see the variety of technologies in Japan and other countries for the viewpoint of obtaining the knowledge, the technical assistance, overseas training is one of the priorities in this area.

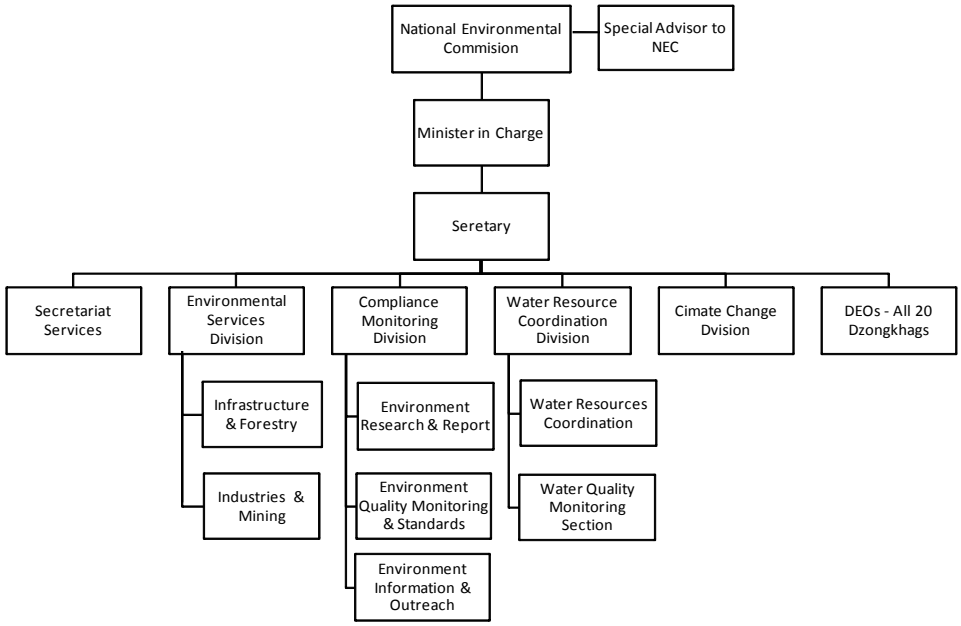
For disaster prevention and management, 11 staff members in total exist in the divisions of Flood Engineering Division, and Engineering Adaptation & Risk Reduction Division. As both of them are created in 2012, these are relatively new and require further development in organizational capability. The existing gauging stations in Bhutan for the purpose of measuring river discharge are for the sake of hydro power generation; and the stations are located only in large rivers. Hydrological data accumulation is the fundamental basis for the flood control planning. Therefore the organization has to develop the required gauging stations to accumulate hydrological data.

Staff in charge of urban planning are 9 in DHS. The main task is to formulate and manage projects of master plans of urban development. As a part of their task, Thimphu Structure Plan was prepared by consultants hired by MoWHS. It is MoWHS who has built the urban planning system of Structure Plan / Local Area Plan from working level. MoWHS is managing the M/P level urban planning of Bhutan, while Class A level cities are planned by themselves. MoWHS is searching their new roles under decentralization. The Japanese evaluation system of cities called Comprehensive Assessment System for Built Environment Efficiency (CASBEE), recommended , has a background that MoWHS proposed application of this system in order that they are to be always the leading pioneers in urban planning in the country.

### (2) Other Related Institutions

#### National Environmental Commission (NEC)

The overall organizational structure of the National Environmental Commission (NEC) is shown in the following Figure 2-4.




Source: NEC

**Figure 2-4 Organizational Structure of NEC**

NEC has four divisions of Environmental Services, Compliance and Monitoring, Water Resource Coordination, and Climate Change; and District Environment Offices (DEOs) in all Dzongkhags. The numbers of staff are shown in the following Table 2-10. With the Secretary, Assistant Secretary, 2 Special Advisors, and 20 Department Environmental Officers (DEOs), the number of staff of NEC is 74.

**Table 2-10 Number of Staff in NEC**

| Secretariat Services Division | Environmental Services Division | Compliance Monitoring Division | Water Resource Coordination | Climate Change Division | District Env. Officers in All 20 Dzongkhags |
|---|---|---|---|---|---|
| 23 | 7 | 10 | 4 | 6 | 20 |

Notes: In addition to above, 1 Secretary, 1 assistant, 2 special advisors to NEC are in the NEC
Source: NEC

#### Environmental Clearance

All the infrastructure projects must obtain environmental clearance in principle and Environmental Services is the division where they analyze the environmental clearance. However, due to increases in demand for environmental clearances, the role has delegated to ministries and municipalities.

The demarcation of the role among NEC, ministries and municipalities are defined in the Regulation for the Environmental Clearance of the Projects, 2002. In case of Thimphu and Phuentsholing, as they are Class A Thromde, all the activities within the municipal boundary will be examined by them in consultation with NEC. However in order to avoid conflicts of interest, if Thimphu or Phuentsholing are implementing agency, then a higher authority has to examine the project. The competent authorities and the work related to urban infrastructure and environment are shown in Table 2-11.

**Table 2-11 Project Types and Competent Authority**

| Project Type | Competent Authority |
|---|---|
| Construction of road within urban area | MoWHS |
| Bridges | MoWHS |
| Embankment | MoWHS |
| Check Dam | MoWHS |
| Dredging | MoWHS |
| Reclamation | NEC |
| Water Treatment Plant | NEC |
| Waste Water Treatment Plant | NEC |
| LAP | NEC |
| All projects approved within Municipal boundary of Thromde | Thromde |

Notes: The above are selected items and more items are listed in the ANNEX2 of the Regulation for the Environmental Clearance of the Projects. In order to avoid conflict of interest, a higher authority will assume the role of Environmental Clearance
Source: Interview with NEC and MoWHS

For instance, if Phuentsholing Thromde is the implementing agency, in order to avoid internal conflict of interests, MoWHS is the responsible authority for provision of Environmental Clearance. In case that MoWHS is the implementing agency, then NEC must be the responsible agent for Environmental Clearance.

It is the Environmental Services Division who evaluates and provides Environmental Clearance. However this Division consists of only 5 staff excluding Division Chief and sub chief. The number of application exceeds 300 annually. This numbers shows the difficult situation

## NE-1: Global Warming Mitigation Measures

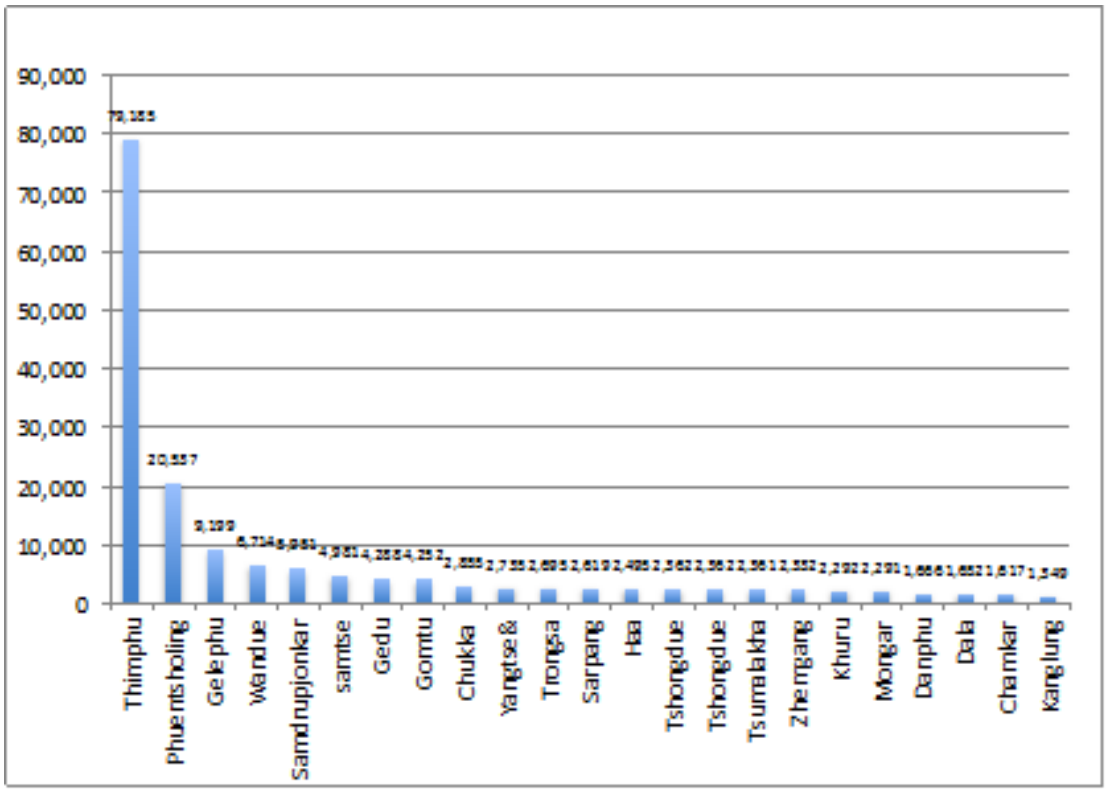
RGOB has ratified UN Framework Convention on Climate Change and accordingly has set up Climate Change Section and also an intra-governmental Multi-sectorial Technical Committee on Climate Change (MSTCCC) with concerned ministries. In 2006 it adopted National Adaptation Programme of Action (NAPA) to prevent disasters triggered by climate changes.

In 2013, MSTCCC is now in the process of adopting National Appropriate Mitigation Action (NAMA) as a more proactive stance to reduce global warming gasses. The proposed CASBEE introduction into the Structure Plan (2.4.6) and Transport Demand Management Project (5.2.4(4)) serve to satisfy the need for global warming mitigations.

## 2.3 Urbanization

### 2.3.1 Population

The population census was undertaken in 2005. The total population of Bhutan was 634,982 with annual growth rate of 1.28%. The next Figure 2-5 shows the top 23 cities in Bhutan headed by Thimphu with 79,185. The total urban population was 196,111. DUDES had estimated the total urban population at 137,864 in 2000. Thus the urban population growth rate during this five year period was 7.8% per year.



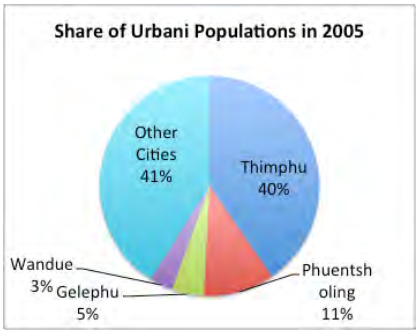

Source: Census 2005 listed in "Bhutan National Urbanization Strategy 2008"

**Figure 2-5 Population Sizes of Top 23 Cities in Bhutan**

### 2.3.2 Review of Population Projection

Figure 2-6 shows the share of urban populations by the cities in Bhutan in 2005.
Zipf's Law states that the ranking and percentage share of populations among top cities of any country is quite stable. A regression analysis of city sizes and ranking for Bhutan shows almost perfect log linear relationship. The result supports the viability of the Zipf's Law[7]. In other words, the ranking of the cities is likely to hold for the future as well unless there is a major structural change.

[7] Pop = 57644 + Exp(-1.369* City Rank) whereas Pop is the size of population of cities and City Rank is the cardinal ranking of the city.




Source: Bhutan National Urbanization Strategy 2008

**Figure 2-6 Share of Urban Populations by City in Bhutan 2005**

Bhutan National Urbanization Strategy 2008 gives an urban population estimates for the year 2020 based on the three scenarios of the national urban population reaching 50%,60%, and 70% by 2020. If it is assumed that the share of urban population are constant with the top cities, 50% urban population scenario implies Thimphu:155,141, Phuentsholing: 40,237; 60% urban population with Thimphu: 186,170, and Phuentsholing: 48,242, 70% urban population scenario with Thimphu: 217,198 and Phuentsholing:56,331. Most of the planners at MoWHS are skeptical of these forecasts. However, if the target year is delayed till 2030 to set the population of Thimphu at 200,000, the required growth rate from the year 2005 onward is 3.7% per year. Given the natural growth rate of 1.28%, it is quite reasonable to add 2.5% social migration growth. The Structure Plan of Thimphu uses an annual population growth of 5% starting the year 2000. In this survey's review, the annual percentage growth of 5% will be adopted for general review.

## 2.4 Urban Development Planning and Development System

Urban planning was formerly implemented by the Ministry of Works and Human Settlement (MoWHS), however, as the decentralization of power permeates under the administrative reform, authority has increasingly shifted to the Thromde while the MoWHS assuming supervisory roles. Until recently, the only city that had implemented a structure plan was Thimphu. This year (2013) Phuentsholing completed its draft Phuentsholing Structure Plan (2013-2028), which is soon to be approved.

The first and second largest cities in terms of population and economic activities are Thimphu and Phuentsholing which are located in west side of the country. Therefore *Bhutan National Urbanization Strategy* (BNUS) formulated in 2008 emphasizes the importance of strengthening cities in the eastern and southern region and strengthening linkages between cities in order to achieve balanced and equitable economic development.

### 2.4.1 General Urban Planning Framework

Urban development is the outcome of milliards of public and private activities. In a dense living environment, what one does affects others' well-being with or without intention. Urban planning becomes a necessary tool to suppress negative external impacts as well as to promote positive external impacts. Ordinarily urban planning documents have three functions of *guidance, regulation and design*. The first function of "guidance" is usually represented as visions, strategies and conceptual or schematic plans within the planning documents. It is a collective aspiration of what the future of a city should look like and feel like to live, work and visit the city. In a modern democratic society, a large portion of construction work within a city is undertaken by private entities including individual homeowners. The second function of "regulation" is aimed at inhibiting unwanted development work/activities while inducing acceptable ones in specific areas. They usually are represented as land use controls, and landscape and building rules. They are collective rules to suppress unwanted activities within a city. The government can exercise the third "design" function only to public spaces such as roads, water bodies, and open spaces. Even for public spatial construction, the issue of land acquisition is not free from interaction with the private entities. Land acquisition is the single most important element in realization as well as planning for the public space. Communities in

close proximity to undesirable planned public facilities such as landfills, wastewater treatment plants, or even highways may oppose and block the realization of the planned public facilities. Thus the design function is not a true blueprint of municipal space either.

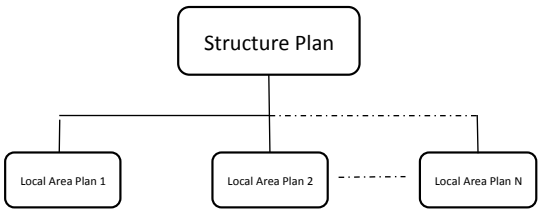



**Figure 2-7 Urban Planning System in Bhutan**

The urban planning system of Bhutan follows a similar framework adopted in Great Britain. Each Thromde has to have two layers of plans, i.e., Structural Plan that covers the entire city and Local Area Plans that cover each community of 50-200 ha as shown in Figure 2-7. In the case of Thimphu, there are 27 anticipated LAPs for the city.

According to the above definition of urban planning functions, the Structural Plan assumes functions of *guidance* and *regulation* and less of *design*.

### 2.4.2 Framework of the Structure Plan

The central component of urban planning in Bhutan is the Structure Plan, which is a general plan for the whole city including development objectives, population and residential development, plans for public space, and plans for urban infrastructure. In Thimphu City, which was the first city to apply this system, the structure plan was approved by the Cabinet in 2003. In the case of Phuentsholing, the draft plan is completed in July 2013 and is now under the review approval process.

The Structure Plan in Bhutan is comprised of a main report and two supplementary documents of Investment Plan and Development Control Regulations. The main plan is composed of three major elements of;

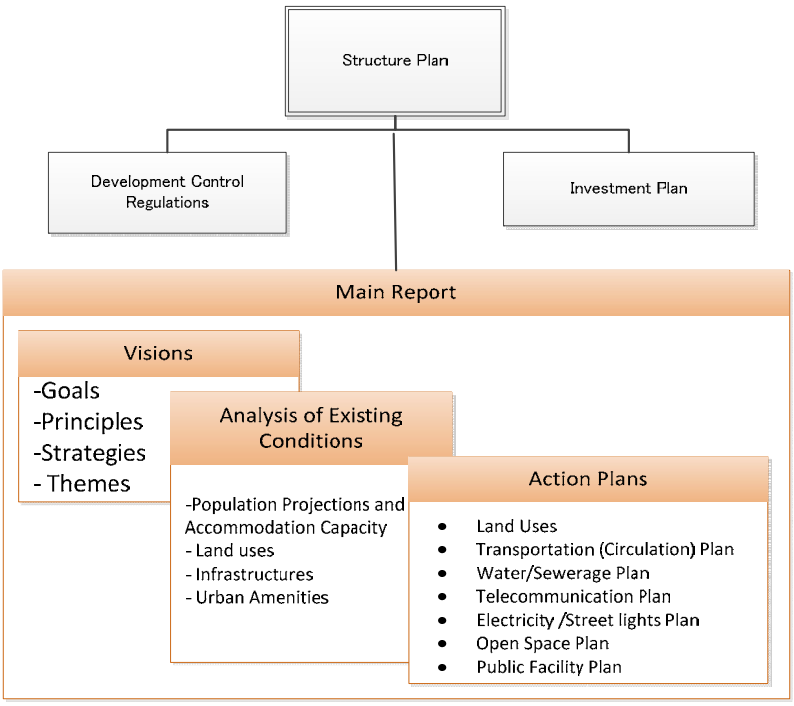
1) Vision (including goals, principles, strategies, themes, concepts etc.)
2) Review of Current Conditions (Analysis)
3) Action Plans

In light of the three functions defined in 2.4.1, the first section assumes the function of guidance. The second part is more of analytical part. The Action Plans are a mixture of guidance, regulation and design. Except for land use control part, however, the content is more of guidance than design. The Structure exercises its regulatory function with its land use control section within Action Plans and the supplementary document of Development Control Regulations. Design function of urban planning is delegated to LAP.

The plan takes a rational approach of first setting up goals, second, analyze the current conditions and third, proposing action plans for land uses, open space, urban amenities and major infrastructures. The visions and facility plans including open spaces are examined to details and standards are set out for these facilities, and the general spatial arrangement of land uses are detailed under the name of “precincts.” Therefore the plan sets out the images and atmospheres of the city for future development. The subcomponents of Analysis Part and Action Plans are illustrated in Figure 2-8.

There are two major drawbacks in the Structure Plan, one in Analysis part and the other in Action Plans. The analytical weakness is with population forecast. Despite the detailed plot-based population carrying capacity analysis for each district (in case of Thimphu, Urban Village) within the same document, a separate population forecast is carried out simply applying linear extrapolation to each area without regard to this carrying capacity analysis. The second planning weakness is on urban infrastructure planning of water, and sewerage and to some extent for transportation. There is no technical analysis for water sector, such as topography or hydrology, or candidate site examinations for treatment plant. There is no examination of appropriate technologies for wastewater treatment despite dozens of technical

options. Economic analysis is also missing to arrive at optimal choice of technologies in terms of life-cycle costs of construction and operation.




Source: JICA Survey Team

**Figure 2-8 General Framework of Structure Plan**

### 2.4.3 Framework of the Local Area Plan

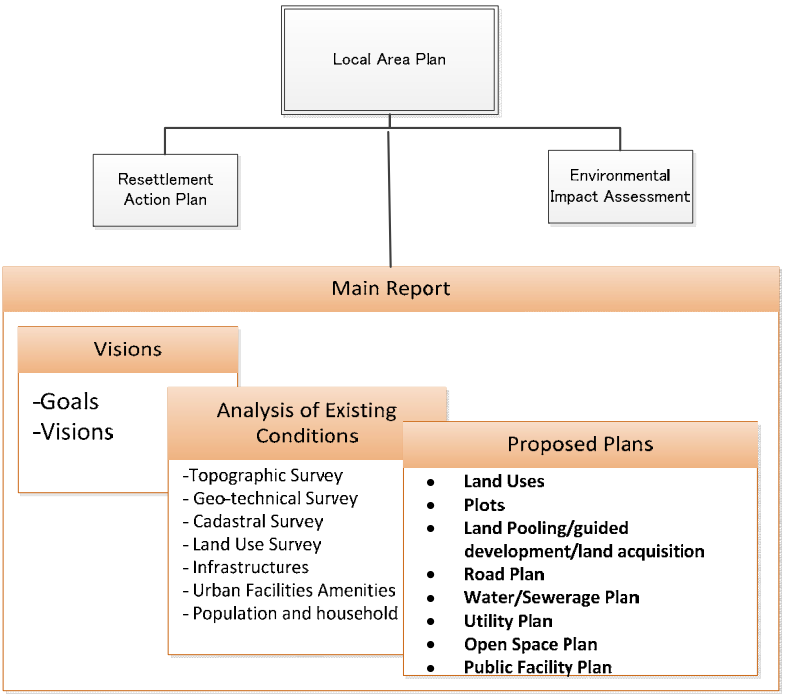
The role of Local Area Plan (LAP) is more of design for implementation. The LAP does define the exact boundaries of each plots and the access roads. Since the primary roles of this work is conversion of rural ownership patterns of land to urban setting, the adjustment of land to ensure vehicle accessibility to each plot becomes the primary goal. Thus, one of the prime tasks is development of access roads. For the original land ownership patterns, there are plots with access road and ones without. As explained more in detail in 2.4.5, among several land acquisition techniques, land pooling is the most common method employed in Bhutan. Land pooling makes it most practical to give more equitable access to roads for each plot within the planned area.

To make a community with full-fledged urban amenities and services, the plan prepares plans for utility networks, public spaces, and community hub facilities. In reality, these facilities are not implemented in the first phase due to shortage of funds. Sometimes, even the access road construction is not commenced at once. Nevertheless, the landowners within the area are satisfied because they will be able to start construction or transaction of their lands.

The LAP consists of the main report and two supplementary documents of resettlement action plan (RAP)and environmental impact assessment (EIA). The RAP contains the records of agreement of landowners to the proposed land pooling scheme. The EIA will include all the facilities including roads, water supply, sewerage, and other utility plans to receive once for all environmental clearance.

The general contents of the main report consists of 1)visions, 2)analysis of existing conditions and 3)proposed plans in a similar fashion to those of the Structure Plan. The important survey works are topographic survey to produce one meter level contour maps,

geo-technical survey to clarify geological requirements for construction works, and cadastral survey for plot boundary and land pooling plan. The general framework of the LAP is illustrated in Figure 2-9.




Source: JICA Survey Team

**Figure 2-9 General Framework of Local Area Plan**

### 2.4.4 Legal and Regulatory Framework Related to Urban Development

The Structure Plan's importance is more than a planning guidance with development objectives, concepts and strategies. It is a document with legal binding power. One of most important regulatory functions in urban planning is the control of land uses. The overall legal framework of Bhutan related to land use is illustrated in Figure 2-10. One of fundamental regulatory requirements in land use control is conservation of environmental and social importance.

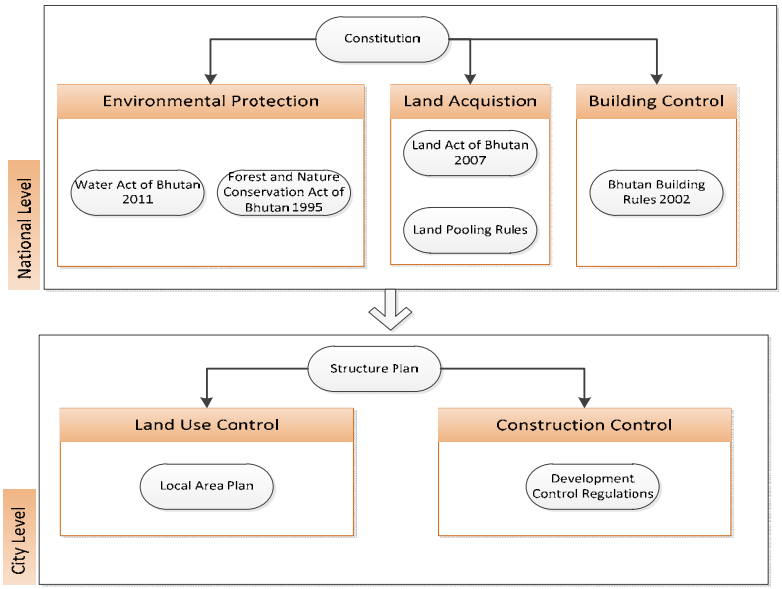
Bhutan has an overarching regulatory framework for environmental preservation applied to national territory beyond city limits: the *National Environmental Protection Act 2007*, *Forest and Nature Conservation Act 2006*, and *Water Act 2011*. Furthermore, the Constitution resides as the most superior foundation of environmental protection laws of Bhutan[8]. Within this national regulatory framework, the Structure Plan further elaborates the designation of land uses to more specific areas, such as urban areas, environmental conservation and social/religious conservation areas, agricultural areas, or natural hazard prone areas.

Land necessary for public uses are secured generally through contributions from landowners through the process of *Land Pooling*. In general, land owners and the government can engage in construction activities only when the boundaries are finalized and the LAP is formulated. The procedures and regulations on land contributions are stipulated in the *Land Act of Bhutan 2007*.

[8] National policies on environmental aspects are clearly written in the Constitution, for example, Article 6 stipulates that at least 60% of the national land area must be kept as forest.

While the law approves the legitimacy of Land Pooling, its operations is stipulated in the *Land Pooling Rules*.

Furthermore, private land owners must apply for a building permit and receive approval for the construction activities. The basis for such application and approvals are stipulated in the *Bhutan Building Rules 2002*, which is the national level building code. At the city level, in addition to the national level laws, further detailed regulations can be instituted. In the case of Thimphu, such detailed regulations were adopted as the *Development Control Regulations* along with the Structure Plan. Similarly, in Phuentsholing, *Development Control Regulations* are scheduled for adoption along with the Structure Plan.




Source: JICA Survey Team

**Figure 2-10 Laws and Regulations on Urban Planning in Bhutan**

### 2.4.5 Acquisition of Land

#### (1) Land Ownership

Prior to 2007, land ownership in Bhutan was managed by the Ministry of Agriculture. Today, the National Land Commission (NLC), which was established under the Land Act of 2007, autonomously manages land ownership. The NLC has the authority to issue the *lag thram* (ownership certificate), register the land, amend changes in the *thram*, to acquire land, allot substitute land and approve compensation.

#### (2) Cadastral Register

The cadastral data for each Class-A City is managed by the Development Control Division of each Thromde.

In Bhutan, the following three techniques can be applied to secure land for development of public facilities and utility.

**Land Pooling**

Similar to the Japanese Land Readjustment Scheme shown in Box 1, the Bhutanese Land Pooling strategy allows for the government to obtain a certain portion of land contributions

from landowners in order to secure public land required for the development of roads and other public facilities. Land Pooling is considered during the formulation of the Local Area Plan. Land pooling contributions usually range from 25% to 30%, with the maximum at 30% depending on the requirements of the urban infrastructure and geographical constraints.

Box 1: Land Readjustment Scheme (Land Pooling) in Japan

Land Readjustment Scheme in Japan enacted through *Law No. 119: The Land Readjustment Law* in 1955 is a "Project which involves the readjustment of land plots and new developments and/or modifications of public facility within the urban planning boundary, for the purpose of improvement of public facilities and the enhancement of residential uses." Its mechanism is as follows:

1. In order to maintain and improve roads, parks, waterways, and public facilities, readjust the land plots and enhance residential uses.
2. In areas with insufficient public facilities and urban infrastructure, depending on the entitlement, a certain amount of land is contributed by the landowner (reduction of site area for public land), which will be utilized for the extra land that is necessary for improvements in public facilities and urban infrastructure. Furthermore, a portion of such contributed land may be sold and utilized for project funds (reduction of site area for reservation land)
3. Other than funds obtained from the sale of land contributed by landowners (reduction of site area for reservation land), project funds are comprised from public sector budgets allocated for the maintenance of urban planning roads and public facilities (including land costs). Such monetary resources are utilized for the construction of public facilities and urban infrastructure, soil preparation for residential uses, and compensation for the relocation of residences.
4. For the landowners, the residential site area will decrease after the Land Readjustment Project, however, with the improvement of infrastructure and reorganized land plots, the owners will obtain residential sites with higher utility value.

Source: Urban Development and Improvement Division, City Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan

## Guided Land Development:

In areas where development has exceeded 25% of the total land area, Land Pooling cannot be applied by Law. In the case that Land Pooling is not possible, the method of Guided Land Development (GLD) may be applied, in which land between buildings will be utilized for roads and footpaths. No building demolition will take place as the compensation cost will be too high in practice.

## Land Acquisition

In the case that boundary issues of land ownership, which is a prerequisite for Land Pooling, are not resolved, and if the land shape is not orderly due to elevation and geological issues, both Land Pooling and Guided Land Development cannot be applied. In such a case, based on the regulations stipulated in the Land Act 2009, and in accordance to the appropriate authorization process, the government may acquire from landowners the land necessary for road and infrastructure development.

Land Values and compensation rates of land to be acquired by the Government are determined by the Property Assessment & Valuation Agency (PAVA) under the Department of National Properties of the Ministry of Finance. PAVA is mandated to revise these rates every three years[9]. The most recent revision of rates was conducted in 2009, and no revision has been available since. The "Land Compensation Rates - 2009 (Rural and Urban Land Compensation Rates Including Building/Structures Depreciation Guide When Acquired by the Government" prepared by PAVA indicates the Rural Land Taxes (by use, location and Dzongkhag) and Urban Land Taxes (by use and major Thromde), and its implementation process. One of the problems in Bhutan is the public land prices set forth by PAVA is not accepted by landowners due to clear gaps with market values. At present, there is hardly any chance to obtain land through legal restrictions.

### 2.4.6 Needs for Urban Planning and Development Schemes

From a global standard, the system of urban planning in Bhutan is well organized and it is functional. The core of the urban planning system in Bhutan is Structure Plan that is mandated for every Thromde. The hierarchy of Structural Plan, Local Area Plans and Development Control Regulations provides solid regulatory framework for the realization of urban spatial configurations in accordance to the visions set forth in the Structural Plan. A Structure Plan is authorized to designate land uses and also to adopt local building regulations for development control.

The Local Area Plan covers around one square kilometers and public land is secured through *Land Pooling,* and sets the design of land plots, road alignment and other public facilities. EIA is developed for the entire LAP to obtain clearances for the construction of all the facilities involved to ensure synchronized development of the area. As evidenced in Thimphu, the implementation of LAPs is slow.

There are four urban needs and challenges in urban planning and development as described below.

#### NU-1: Lack of Funds for Urban Infrastructure Development

In Japan the development of the infrastructure are financed by the selling partly the land acquired through land pooling, while in Bhutan the land pooling ratio is restricted up to 30% and development of infrastructure is financed by the government. The Local Area Plans implemented in Thimphu are all financed by external financing agencies. On the other hand, according to the latest Phuentsholing Structure Plan, the population increase will be mainly absorbed by land reclaimed, but the cost such work is not included.

#### NU-2: Lack of Urban Infrastructure Planning

The weakest point in the Structure Plan is the lack of linkage between overall population planning and long-term infrastructure planning such as water supply, sewerage and urban transportation. The most critical lapse is with water supply and sewerage planning. There is no comprehensive planning and this part still lies on detailed design by LAP. There is no area-wise demand and supply network examination and consequent city-wide long-term planning.

The planning of water supply or sewerage is left to each local area plan which only covers one $km^2$. These disjointed additions of water supply and sewerage schemes poses a risk of creating overall inefficiency of utility schemes. The linkage between population distribution scenario and traffic generation is not fully examined yet.

[9] Based on interview with DHS, MOWHS

## NU-3: Lack of Quantitative Monitoring of Plans

Monitoring is a critical part of planning cycle of Plan-Do-See. The third weakness in Structure Plan is lack of monitoring tools, especially quantitatively in accordance with the goals set forth. In other words, the Structure Plan in Bhutan lacks in "seeing" part. JICA now provides workshops on CASBEE in relation to future urban city program.

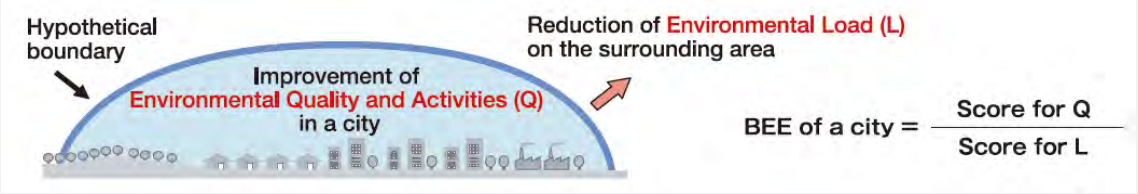
MoWHS has a mandate to follow through the implementation of Structure Plans and but it is not easy to monitor the progress of the Structure Plan and show in a snapshot. A staff from MoWHS who attended a JICA seminar on future city program had exposure to CASBEE concept. Now the ministry is contemplating the introduction of CASBEE into the monitoring of the urban planning and development. At the same time, NEC is now attempting to implement an anti-global warming program in Bhutan as part of environmental policy. MoWHS is supposed to take an initiative in the sector of urban development.

CASBEE is a certification program for environmental compliance with standard evaluation templates that can be applied easily to buildings and cities. CASBEE was developed by Ministry of Land, Infrastructure, Transport and Tourism of Japan to assist the planning and monitoring for environmental compliance of urban development and management by giving standard monitoring and evaluation tools. It allows the policy makers to determine the overall performance of a city by evaluating the overall activities in two dimensions of global warming gas emissions and social service delivery. It is deemed to have an universal applicability to any city in the world. MoWHS is now considering the introduction of CASBEE into the Structure Plan monitoring and look for the cooperation by JICA.

**Box 3: CASBEE for Cities**

CASBEE is an acronym for "Comprehensive Assessment System for Built Environment Efficiency," a system for assessing the environmental performance of built environments, developed under the initiative of the Ministry of Land, Infrastructure, Transport and Tourism (Japan) in 2001.

Within the CASBEE family, "CASBEE for Cities" is a system for comprehensive evaluation of the environmental performance of cities, which utilizes the triple bottom-line approach to environment, society, and economy in order to achieve a sustainable city. "CASBEE for Cities" sets forth a hypothetical boundary enclosing the target city in order to evaluate the Built Environment Efficiency (BEE) of the city. The BEE is calculated by the possible improvements in environmental quality and activities (referred to as "Quality – Q") within the enclosed boundary, over the reduction in negative environmental impact (referred to as "Load – L") on the area beyond the enclosed boundary.




As shown in the Figure and Formula above, if the environmental quality and activities (Q) are high, and the environmental load to the surrounding (L) is low, the City has a high environmental performance.

Source: Institute for Building Environment and Energy Conservation (IBEC)

## NU-4: Community Participation in Planning

There is a growing need for community participation from planning to implementation for certain projects such as footpath development in Thimphu as described in 3.3.6, or community development/local branding in Phuentsholing as described in 4.3.10. Based on the experiences of land pooling in involving local communities, more proactive participatory planning is needed in Bhutan. Japan has a long history of involving communities for local development through O*ne Village One Product Movement*, *Michi-no-Eki, Farmers Market*, and *Revitalization of Central Shopping Street*.

## 2.5 Environmental and Social Protection System

### 2.5.1 Environmental Regulations

Owing to its richly preserved natural resources, and Buddhist tradition of social and environmental harmony, Bhutan is a pro-environment country. Sustainable development is embedded into Bhutanese culture, tradition and religion. Environmental policy became clear at the Rio Summit in 1994 where the representatives announced "Conservation in Bhutan." The policy formation was followed by "National Environment Strategy" in 1998 and *Environmental Assessment Act* introduced in 2000, *Regulation for the Environmental Clearance of Projects and Regulation on Strategic Environmental Assessment* in 2002. The legal framework for environmental protection was further reinforced by *National Environment Protection Act of Bhutan* in 2007, and *Environmental Assessment Guidelines* in 2012. Among all the laws and regulations, *National Environmental Protection Act 2007* is the overall law on environmental protection. Major regulations are listed below.

#### (1) The National Environment Protection Act of 2007

This is the fundamental law on environment protection. It defines the basic principles of environmental protection with philosophy including Polluter-Pays-Principle, 3-R(Reduce/Reuse/Recycle) and the restrictions and limits of pollution discharge. In addition, it also specifies the establishment and functions of National Environmental Commission (NEC), stipulating that NEC is the highest decision making institution on governmental environmental control.

#### (2) Environmental Assessment Act 2000

The law defines the procedures of environmental assessment on policies, programs and projects. It stipulates that no development permit is provided without environmental permit. In other words, all development projects must obtain environmental clearance.

#### (3) Regulation for the Environmental Clearance of Projects 2002

This is a by-law defined by *Environmental Assessment Act 2000*. This regulation defines the procedures and responsibilities of agencies for environmental clearance. As can be seen in the Appendix of this law, some functions are delegated to ministries and municipalities from NEC.

#### (4) Environmental Assessment Guidelines 2012

These are guidelines which explain the procedures of environmental assessment. The guidelines of following sectors are published; general, roads and highways, forest activities, power transmission, mining and quarries, hydropower generation, etc.

### (5) Forest and Nature Conservation Rules of Bhutan 2006

When a project needs forest land, this law defines that forest clearance is necessary from the Ministry of Agriculture.

### (6) Water Act 2011

This act defines the provision of water supply. In addition it defines that NEC is the highest government institution for the coordination of water resources management.

## 2.5.2 Environmental Impact Assessment Procedure

### (1) General

In Bhutan, environmental impact assessment is defined by *Environmental Assessment Act 2000* (EA), and by the *Regulation for the Environmental Clearance of Projects 2002* (Regulation 2002). With the *Environmental Assessment Act 2000*, all the projects which could generate negative impacts requires the environmental clearance. The *Regulation 2002* defines the procedure and responsible institutions on environmental clearance. NEC is the ultimate organization responsible for the issuance and management of environmental clearance.

According to NEC, projects are not classified according to the magnitude of impacts. Excluding those projects defined in the *Appendix* of the *Regulation 2002*, all projects must have initial environmental examination (IEE) as environmental report prepared by consultants hired by the project implementing agency/proponent. The implementing agency /proponent prepares the scope for IEE. The environmental impact assessment is further required for the projects including hydropower, transmission, mining, special economic zones, large-scale school development, and all projects within the forest protected area, since NEC considers the impact is very significant.

Projects related to urban development and their necessity of EIA are shown in Table 2-12.

**Table 2-12 Urban Development Projects and Required Level of Environmental Report**

| Items | Necessary Environmental Report |
|---|---|
| Road Development | IEE if the road length is not long |
| Bridge | IEE |
| Market Development | IEE |
| Embankment | IEE |
| Check Dam | IEE |
| Dredging | IEE |
| Reclamation | IEE |
| Water Treatment Plant | IEE |
| Waste Water Treatment Plant | IEE |
| LAP | IEE + EIA depending on the scale of LAP |

Note: If the project is within the protected area, EIA is necessary
Source: Hearing from NEC and MoWHS

### (2) Special Features

Safe Guard Policy of the World Bank or JICA's Guideline are made in order not to have serious negative impacts. The environmental policy and the procedures of environmental impact assessment of Bhutan are made first with the technical assistance of ADB and then with that of the World Bank. Therefore, the policy and the procedure of the Bhutanese government are in line with the principles and thoughts of these multilateral organizations in general.

However, some differences exist. In Bhutanese environmental assessment procedure, for instance, there are no classification of projects into A,B,C according to the level of impacts. In addition, although protected ethnic minorities exist, no policy exists for special consideration and all people are equally treated in Bhutan. On the other hand, relocation and resettlement of people are very carefully handled until obtaining public consensus.

There have been some projects that had strong environmental impacts to fail to acquire the environmental license. For instance, a multi-purpose dam project for power generation and water supply planned at Begana formulated by Bhutan Power Corporation did not obtain environmental license and was rejected due to socially impact as there is a temple nearby and due to natural impact as it was planned within a national park. There are some other cases of mining or industrial projects that were also rejected.

### 2.5.3 Contents of Environmental Assessment

In order to obtain environmental clearance, environmental report must be prepared and submitted to the competent authority[10]. The information in that report should include can be summarized as follows[11];

- Potential adverse effects of the project on the environment including direct, indirect effects,
- How the project complies with relevant sectorial guidelines or code of best practices if any issued by the competent authorities,
- How the impacts of the project will be avoided, minimized or reduced, and
- The environmental benefits of the project, including how the project will benefit concerned people and use clean and sustainable technologies.

Most of the contents are common among sectors. The common contents and sector/item specific contents are shown below.

1) General Coverage

a) General Information
- Executive Summary
- Information about the project proponent and experience
- Justification of the project with technology
- Project financial statement, project benefits
- Schedule
- Name of Consultant preparing EIA report
- List of all approvals/No Objection Certificate required and its status

b) Essential Maps

c) Project Description
- Location, objectives, estimated cost
- Justification of appropriateness with land use under Development plan, if not consent from competent authority.

d) Resource Requirement
- Total site area, total structure build up area, total activity area,
- Technology to be used, Total raw materials to be used, daily consumption, methods of storage
- Hazardous chemicals toxic, inflammable substances to be used, and storage methods

[10] The competent authority on environmental clearance is shown in the Appendix of Regulation for the Environmental Clearance of Projects 2002.

[11] Regulation for the Environmental Clearance of Projects 2002.

- Energy sources, and total energy requirement
- Water requirement with sources
- Details of workforce to be employed and working hours

e) Alternative consideration

f) Baseline data

- Area acquired for the proposed project and the land use patterns
- Land ownership patterns of the acquired land
- Details of the topography
- Details of the water bodies (lakes, ponds, springs) with hydrology
- Boundaries of the nearest human settlement and its distance from the project site
- Presence of any other industries in the study area
- Flood plain boundary and flood risks of the area
- Presence of sensitive area (forests, national parks, religious area)
- Inventory of flora and fauna
- Data on ambient air quality, noise, water quality (receiving used water discharging water bodies)
- Estimation of ground water flow in the study area
- Details of existing socio-economic status of the study area

In addition to above, depending on the sector/item, major emphasis should be on specific information as shown in the following Table 2-13.

**Table 2-13 General Information Required By Sector/Project**

| | |
|---|---|
| Local Area Plan | - Population of the area,<br>- Land use of the area<br>- Depending on subcomponents, it should include information stated below |
| Road Development | - Preferred alignment, methods to be used<br>- Towns to be crossed<br>- Drainage along the road<br>- Topography and length of new alignment<br>- Geological information<br>- Accident data (if road expansion)<br>- Potential land slides |
| Bridge | - Preferred alignment, methods to be used<br>- Topography and length of new alignment<br>- Geological information<br>- Accident data (if road expansion) |
| Market Development | - Existing situation, constraints |
| Check Dam | - Catchment area characteristics up and down stream (name of river, km2, annual monthly flow, )<br>- Characteristics of dam (type, height, length )<br>- Geological information of the area<br>- Past records of land slides, Data related to the frequency of floods, maximum flood levels<br>- Possibility of Glacial Lake Outburst Flood (GLOF) |
| Embankment | - Catchment area characteristics up and down stream (name of river, km2, annual monthly flow)<br>- Characteristics of the structure<br>- River Characteristics (flow velocity, volume, inclination)<br>- Past records of land slides, Data related to the frequency of floods, maximum flood levels<br>- Possibility of Glacial Lake Outburst Flood (GLOF) |
| Dredging | - Same as Embankment plus |

| | |
|---|---|
| | - Characteristics of river ecosystem |
| Reclamation | - Same as Embankment plus<br>Characteristics of river ecosystem |
| Water Supply/ Treatment | - Forest area information and its ecosystem<br>- Catchment area characteristics up and down stream (name of river, km2, annual flow, monthly flow, peak flows and minimum flows)<br>- Past records of landslides, Data related to the frequency of floods, maximum flood levels |
| Waste Water Treatment Plant | - Surrounding area information<br>- Characteristics of the area to be built<br>- River Characteristics of up and down the site (flow velocity, volume, inclination) |

Source: Discussion with mainly NEC

2) Impacts

Impacts of the construction, as well as operation phase needs to include analyses as follows;

a) Land Environment: Changes in land use, land cover, drainage pattern, population, immigration, riverbank stability, impact due to submergence and diversion of the river course,
b) Biological Environment: Impact on flora and fauna, deforestation, pressure on existing natural resources,
c) Socio Economic Impacts: Impact due increase/ decrease of population, on local economy, human health, traffic increase,
d) Water Environment: Impact to river flow, quality of water, and
e) Air Environment and noise: Changes in ambient air quality with total emissions with the project.

In addition to above, depending on the sector/item, specific information may be required as shown in the following Table 2-14.

**Table 2-14 Impact Assessment Required by Sector/Project**

| | |
|---|---|
| LAP | - Impact of land use with change of population with economic activity<br>- Specific information required for its subcomponents as described below |
| Road Development | - Excavation method and disposal of excavated materials<br>- Geology including landslides, and erosion<br>- Socio economic impacts with the project<br>- Bio-diversity<br>- Land use pattern<br>- Noise, air quality due to change of traffic |
| Bridge | - Excavation method and how excavated materials to be disposed<br>- Geology including landslides, and erosion<br>- Socio economic impacts with the project<br>- Relation to the water body (embankment, river ecosystem)<br>- Land use pattern<br>- Noise, air quality due to change of traffic |
| Market Development | - Traffic increase, waste generation, safety |
| Check Dam | - Hydrological change, flow assessment<br>- Geology including land slides<br>- Dam/ structure break analysis<br>- Soil erosion |

| | |
|---|---|
| | - Socio economic impacts<br>- Floods reduction<br>- Bio diversity<br>- Land use pattern<br>- Noise, air quality |
| Embankment | - Same as check dam plus downstream impact |
| Dredging | - Same as check dam plus impact to river ecosystem |
| Reclamation | - Same as check dam plus impact to river ecosystem |
| Water Supply/ Treatment | - Impact to downstream of the intake river<br>- Solution of purification residuals (sludge)<br>- Use of chemicals<br>- Area coverage<br>- Noise level |
| Waste Water Treatment Plant | - Impact to discharging river ecosystem<br>- Solution of residuals (sludge)<br>- Use of chemicals<br>- Area coverage<br>- Surrounding Environment<br>- Odor |

Source: Discussion with mainly NEC

3) Impact predictions

If not described future predictions above, future impact at operation stage, and during its operation must be described.

4) Mitigation Measures and Environmental Management Plan (EMP)

Mitigation Measures and Environmental Management Plan must be included within the EIA. The followings points must be included;

a) Details of water pollution control, justification of technology selected,
b) Details of air pollution control, justification of technology selected,
c) Details of dust control in machineries,
d) Details of energy and water conservation measures,
e) Mitigation plan for biodiversity protection and conservation,
f) Mitigation plan for solid and hazardous wastes,
g) Mitigation plan for protection and conservation of water resources,
h) Mitigation plan for storm water collection and treatment system,
i) Flood management plan,
j) Plan for green belt development,
k) Road safety measures,
l) Organizational set-up for natural and social environmental management,
m) Plan of training and awareness programs on environmental and safety,
n) Preparation of resettlement and rehabilitation plan,
o) Public hearing, and
p) Compensation package,

### 2.5.4 Land Acquisition and Resettlement

Land acquisition is implemented based on the Land Act 2007. With this law, the government can acquire land if the purpose is for public use. Cash and/or alternative land is provided as compensation. The government institution called National Land Commission (NLC) is the organization which analyzes and approves the land acquisition. As for the evaluation of land, a government agency under Ministry of Finance called Property Asset and Valuation Agency (PAVA) makes evaluation. PAVA evaluated the land value of all country in 2009 and published

the data. If public sector needs to acquire land, they are required to use the price evaluated by PAVA.

The procedure of land acquisition is as below. First, the municipality or government who needs land, must submit a request for evaluation and approval to the National Land Commission. If the request is approved, the District Land Acquisition Committee (DLAC) which exists in each municipality will inform to the landowners at least 3 months in advance. DLAC evaluates the land values in view of agro-production and structural values, estimates the compensation, and reports the results to NLC. The government or municipality in charge is required to hold ample occasions for discussions and negotiations with the landowners to explain the necessity for land acquisition and evaluation result. After mutual agreement, the compensation is paid and/or provided substituted land and title is transferred, the government can acquire land.

*The Environmental Guidelines of Roads and Highways 2012* stipulates that the cash compensation should be based on market price. However the Land Act 2007, a superior law to the guidelines, defines that the PAVA is the organization which sets the land value, and PAVA published *Land Compensation Rates 2009*. Therefore the government cannot acquire land with higher price than those in Rate 2009 set by PAVA. PAVA is mandated to review the rates every 3 years, but the rates supposed to be published in 2012 have not been published yet. This is one of reasons that the PAVA rates have deviated from the market rate.

Actual cases in the past show that, when land acquisition is necessary the government or municipalities do not enforce the power to acquire in principle. The government spends time and pursues to persuade the owners in order to reach agreement. Usually several public consultations are held and municipalities make effort that affected people understand the necessity.

The land acquisition procedure is not an easy task. Fist people are so attached to land that they do not want to relinquish them. In addition, comparing land substitution and monetary compensation, people want the former but may not be satisfied, or NLC may not approve. As for the monetary compensation, the public rate for land is too low compared with the actual market value. It is rare that people accepts the monetary compensation. Long-term cost benefit calculation for land transaction also discourages the landowner for public land acquisition. When the planned public work is implemented, there will be windfall land value increases which the landowners to offer land for the project may not enjoy.

In case of Thimphu, the city refrains from land acquisition and relies more on Land Pooling. According to Thromde officials, Land Pooling is more equitable than land acquisition. Under Land Pooling people are more easily persuaded to accept the transaction as people benefit more evenly from the development.

In Phuentsholing, the flyover considered at the Om Chhu River required land acquisition. The municipality has to compensate by providing with alternative land and monetary compensation. In this case, the landowners to be negotiated is one single firm without any significant economic activity on the property. The municipality views that the land acquisition will not have much difficulty.

As for resettlement, *Environmental Assessment Guidelines 2012* stipulates that rehabilitation and resettlement is to be programmed, but there is no rule which defines the procedure. In the General Guideline of *Environmental Assessment Guidelines 2012*, the following principles are defined;

- Details of compensation including alternative land, cash compensation, employment, infrastructure facilities (housing, infrastructure, education, and health)
- Program Schedule of resettlement, responsible agency and its role, issues to be solved
- Plans for consideration of vulnerable people including women or landless people
- Details of compensation package when losing livelihood.

# Chapter 3 Urban Development in Thimphu

## 3.1 General

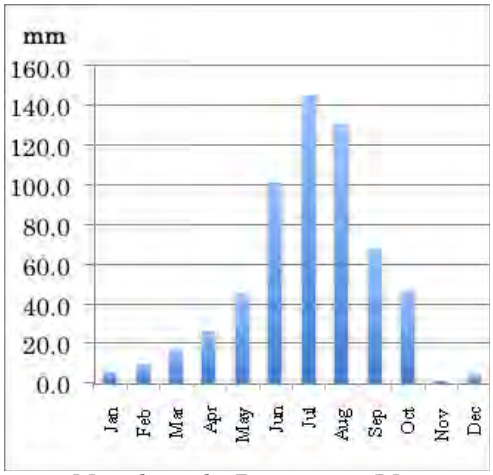
### 3.1.1 Geography and Topography

Thimphu City, the capital of Bhutan, is located in western Bhutan at 27° 30' N latitude and 89° 30' E. Its approximate altitude ranges from 2,240 to 2,648 meter above mean sea level with the surrounding hills rising over 3800 meter above mean sea level. It has an area of 26.13 $km^2$, which stretches along the river Wang Chhu linearly in north south direction. Thimphu was made up of four hamlets separated in valleys before the capital was transferred from Punakha in 1052. Since there is no urban agglomeration in the north of the city, the access to the city is limited to its southern gate of Babesa district of the city.

Thimphu has a typical V-shaped valley. 17% of the land has more than 30% in grade and 35% has more than 20% in grade.

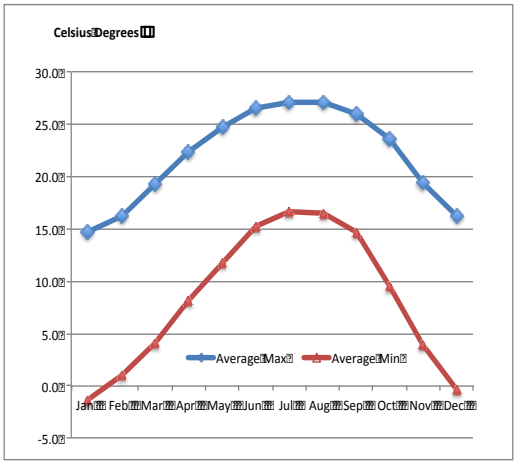
### 3.1.2 Climate

The annual precipitation of Thimphu is 4018mm (1996-2011: Simtokha Station) as shown in Figure 3-1. Figure 3-2 shows the monthly average precipitation during 1996-2011. Generally speaking, the monsoon period lasts between June through September. The heaviest precipitation takes place in July with an average of 140mm, followed by August with an average of 130mm. There is hardly any precipitation during the months of November through March. In terms of monthly average temperatures, the highest maximum temperature takes place in July and August with an average of 27.1 °C and the lowest minimum temperature takes place in January with an average of -1.3 °C. The climate is characterized as temperate throughout the year.




Source: Metrological Department/Ministry of Economic Affairs

**Figure 3-1 Monthly Average Precipitation of Thimphu（1996–2011）**




Source: Metrological Department/Ministry of Economic Affairs

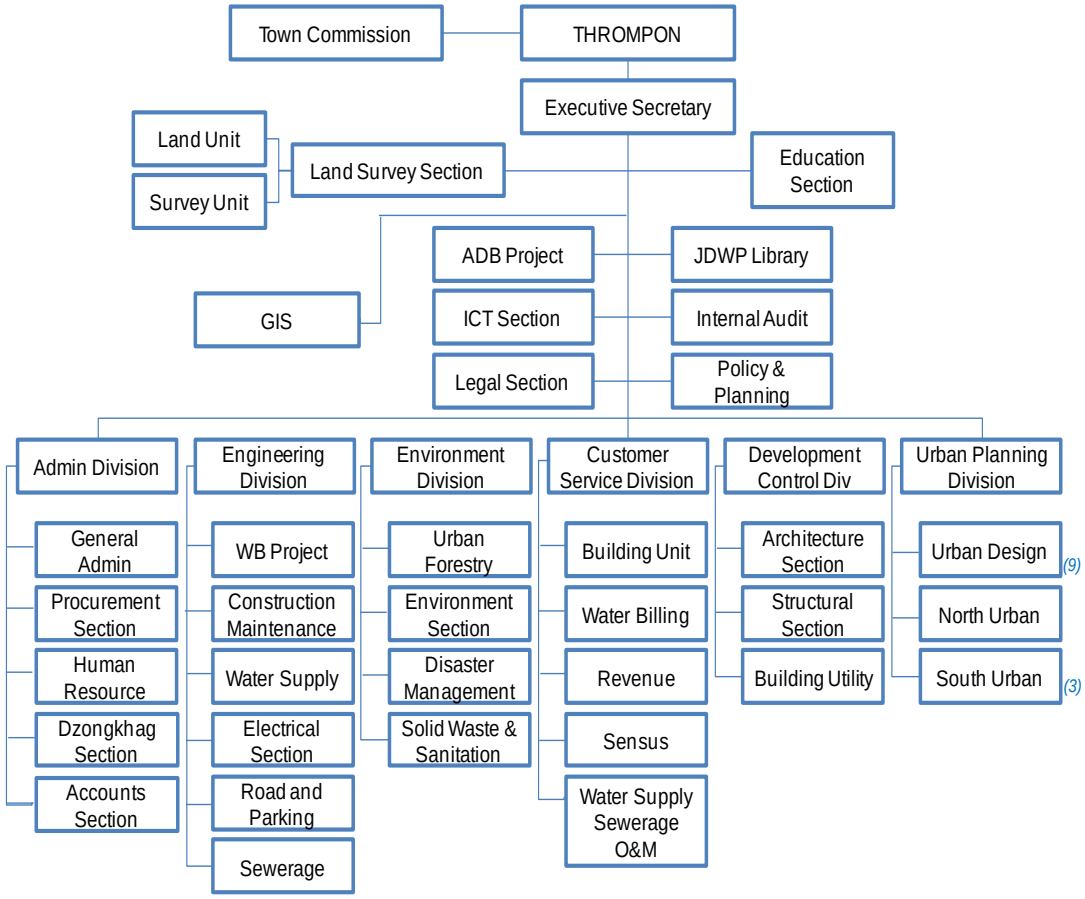
**Figure 3-2 Monthly Averages of Maximum/Minimum Temperatures of Thimphu（1996–2011）**

After 2003, there was not a single year in which the annual precipitation exceeded 600mm while the previous eight years saw five years exceeding 600mm level. There is some serious concern over the loss of water resources in Bhutan which the data from the last 16 years may be supporting.

## 3.2 Institution

### 3.2.1 Organization

The institutional structure of Thimphu Thromde is summarized in the following Figure 3-3.




Notes: This organization is to be implemented for the 11th 5year Plan
Source: Thimphu Thromde

**Figure 3-3 Organizational Structure of Thimphu Thromde**

Thimphu Thromde has 5 divisions of Administration, Engineering, Environment, Development Control, and Urban Planning. The numbers of the staff in each division are shown in Table 3-1. The total staff number of the Thromde is 249.

**Table 3-1 Number of Staff of Thimphu Thromde**

| Administration Division | Engineering Division | Environment Division | Customer Service Division | Develop. Control Division | Urban Planning Division | Others |
|---|---|---|---|---|---|---|
| 79 | 28 | 28 | 25 | 20 | 11 | 58 |

Notes: In addition to the above, 880 teachers exist.
Source: Thimphu Thromde

Staff members in charge of roads are 5 engineers and 135 unskilled workers. The responsibility is passed from MoWHS on July 2011. The current work is mainly daily maintenance with rented the machines from Construction Development Corporation Limited. In addition, road signs and markings are also under their task. As for new roads they never designed before and have yet to develop capability. They employ consultants whenever necessary. The new road constructed running in front of the Thromde office adopted the standard specification and the Road Department managed the procurement of contractors and supervised the work. The Thromde has sufficient competence in general administration capability. When the JICA Survey Team requested the cross section data of Lungtenzampa Bridge and found that no data was available, the Land Survey Section was ordered to measure and within one month the data was compiled for reporting. This event exemplifies the administrative capacity of the City in terms of survey ability as well as overall management.

Water Supply and Sanitation sector has 6 engineers in Engineering Division and 3 engineers in Customer Service Division, and 59 workers. They face a problem of lack of personnel since they have to maintain a large number of facilities including water purification treatment plants and waste water treatment plants. They have experience and knowledge on operation and maintenance on the existing facilities, but lack in knowledge on new technologies. It appears that they totally rely on consultants on the choice of technology for the new waste water treatment plant. Thus, capacity development on the planning and choice of technology is an important issue.

Urban planning consists of 9 staff members. Public consensus on the land pooling is very important for the implementation of LAP. Negotiation with people poses challenges to the staff with heavy workloads. Members of the staff resign one after another. The institutional setup for land pooling in Japan involve more community and local leaders for consensus building for a land pooling arrangement. It is also important that the staff be involved in more futuristic planning process for professional attainment.

Customer Service Division is responsible for fare and tax collection. The database introduced more than 10 years ago is not stable and encountered system failures from time to time, and some data have been corrupted. A system upgrade is urgently needed. On the other hand, GIS Department with only 3 staff members have enough capacity to plan and implement database building and integration of various sources. The only task is funding for their long-term vision. They are planning to integrate systems including cadastral, construction permit, and postal address databases. Integration of these databases with a population database should enable some population estimation for urban planning or infrastructure planning. This department has provided all the spatial data for our analysis in timely manner. The database of urban infrastructure is not yet fully functional, but they are planning in cooperation with other related departments. Since it requires lots of manpower to build a database, the next task is to develop a capability of utilization of GIS for various planning.

Environment Division has 11 engineers and 17 daily wage workers. As the division has four sections of Forest, Environment, Solid Waste, and Disaster Management, each section has less than 3 engineers overloaded with work. As for solid wastes, they have much work ahead since the concept of 3R is not thoroughly diffused. The city has only three pilot areas for waste segregation. They need increase collection capacity including vehicles, and improve the current landfill site, which is an unhygienic open type dumping. More public participation and sensitization of people are necessary to institute 3R. There are only two engineers in charge for disaster management with little experience.

ADB and the World Bank projects are under implementation, therefore they are experiencing management, monitoring, and reporting of international loan projects. ADB comments that they have sufficient competency in implementing the projects.

### 3.2.2 Public Finance

The budgets of Thimphu Thromde for the past 5 years are shown in the following Table 3-2. The total expenditure of Thimphu Thromde is the sum of Domestic Source Expenditure, ADB Project and the World Bank Project. The major sources of the revenue for the city are property tax, land tax, water and sewerage user fee, lease of land, property transfer tax, and public parking fees. According to Thimphu Thromde, all of its revenue is now expended on the recurrent cost, and some deficits are financed by the central government. Capital investments are financed by the central government and loans from ADB and the World Bank.

Furthermore, as the implementation status of the approved LAPs indicates, Thimphu Thromde does not have the budget to implement the LAPs after the formulation and approval. In general funds for LAP implementation are provided by donors. In the existing Land Pooling process, land contributed from landowners cannot be sold for the purpose of raising project funds. There should be some review in reference to Japanese Land Readjustment system which allows the sale of land contributed by landowners to raise part of project funds.

Public financial system for the city should be reassessed not only for urban infrastructure construction phase, but also for operation and management phase to optimize long-term financial soundness.

**Table 3-2 Budget of Past 5 years (unit: Nu. million)**

| Financial Year | Domestic Source Expenditure | | | ADB Project | | | World Bank Project | | | Own Revenue |
|---|---|---|---|---|---|---|---|---|---|---|
| | Recurrent | Capital | Total | Recurrent | Capital | Total | Recurrent | Capital | Total | |
| 2008-2009 | 72.9 | 45.26 | 118.1 | 0.8 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 45.1 |
| 2009-2010 | 84.6 | 73.7 | 158.3 | 0.9 | 12.8 | 13.7 | 0.0 | 0.0 | 0.0 | 60.0 |
| 2010-2011 | 108.5 | 161.3 | 269.8 | 0.4 | 159.2 | 159.6 | 0.4 | 2.9 | 3.3 | 70.0 |
| 2011-2012 | 154.0 | 152.6 | 306.6 | 0.5 | 233.4 | 233.9 | 0.3 | 8.0 | 8.4 | 120.0 |
| 2012-2013 | 159.7 | 197.9 | 357.6 | 0.5 | 382.3 | 382.8 | 0.0 | 153.2 | 153.2 | 130.0 |

Source: Thimphu Thromde

The 11th 5 Year Plan of Thimphu is shown in Table 3-3. It is the first time for four Class-A Thromdes to apply for budgets independently from the central government. Up to 10th Five Year Plan, the budgets of these four cities of Class were under MoWHS.

The total budget of Thimphu city is Nu.2,501 million[1]. Among these the highest amount is for urban infrastructure development (Nu.994 million), and most of these are for the existing ADB and World Bank's projects. Therefore, there is much less left for other purposes. The Bhutanese Five Year Plan normally includes contributions from international donors. It is important for external donors to have consensus building with Bhutanese government in order to have their projects included in the Five Year Plans.

In addition to the above, infrastructure development projects are included for urban transport (Nu.160 million) and roads (Nu.70 million). The budget is allocated with Nu.150 million for an investment for Bus Rapid Transit (BRT), which is based on recommendation of the feasibility study report prepared by IFC[2]. Other budgets include improvement of living standards including education promotion (Totaling Nu.501 million), street lighting (Nu.38 million), improvement of library (Nu.20 million), and greenery development (Nu. 5 million).

[1] GNHC states that Budget of Thimphu is Nu. 2,000million excluding the budget for education Nu. 501million.

[2] IFC、Bhutan Urban Transport System, September 2011

**Table 3-3 Budget of 11th 5 Year Plan for Thimphu Thromde (Nu. in million)**

| Sl.No | Activity | Amount |
|---|---|---|
| A | Construction and improvement of roads network | 70 |
| B | Construction and improvements of drains, walls, footpath and flood protections | 15 |
| C | Urban Transport and Vehicular parking | 160 |
| D | Construction and improvement of bridges | 23 |
| E | Development of parks and recreation facilities | 18 |
| F | Development of crematorium facilities and services | 18 |
| G | Development of Thromde infrastructures | 297 |
| H | Local Area Plans (LAPs) | 2 |
| I | Development of greenery and nurseries | 5 |
| J | Urban Infrastructure Development Project (ADB) | 994 |
| K | Sewerage and waste management (Include WB) | 321 |
| L | Strengthening of Jigme Dorji Wangchuk National Library (JDWNL) | 20 |
| M | Strengthening of Thimphu Thromde | 13 |
| N | Disaster management and risks reduction | 8 |
| O | Installation and maintenance of street lighting and CCTVs | 38 |
| P | Thromde water supply and sanitation | 0 |
| Q | Education infrastructure development | 495 |
| R | Support for disadvantage children and value education | 5 |
| S | Youth and literacy program | 1 |
| | Grand Total | 2,502 |
| | Total Education | 501 |
| | Total without education | 2,001 |

Source: GNHC

### 3.2.3 Institutional Needs

The institutional needs of Thimphu Thromde are described below.

#### TI-1: Development of Management Information System

As described in 3.5.7 (2), there is an urgent need to renew the database system for residents and customers judging from the fact that there has been a grave system malfunctioning to cause data corruption.

#### TI-2: Development of Planners for Water Supply and Sewerage Systems

As mentioned in (1) above, there is a need to develop capacity in water and sewerage engineering in planning for the adoption of optimal technologies. Judging from the range of various technologies deployed for the ongoing projects, there appears to be less consideration for the unification of selected technologies by leaving the examination to the project consultants.

**TI-3: Lack of Urban Planners**

Lack of urban planners due to a high turn-over rate is a major challenge in Thimphu. At present, the major work for urban planners in Thimphu is to coordinate land pooling which is time consuming discussion with landowners with less professional attainment. Given low salaries, lucrative job offers from outside as well as workload, it is difficult to retain experienced urban planners on the job. There may be two ways to solve this problem. One option is to reduce workloads in land pooling. It may be an option to let a cooperative or special purpose company to undertake the land pooling work to share the workload with the city. Another measure is to provide more professional incentives by giving scholarships for study abroad to those who have contributed to the work over a certain number of years.

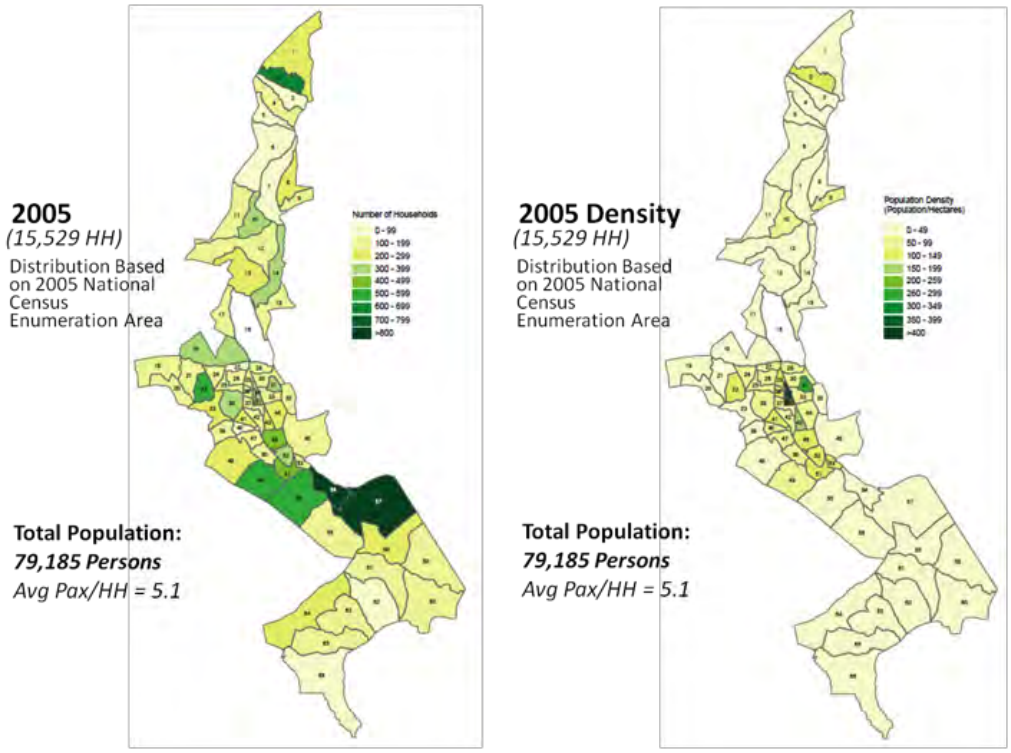
## 3.3 Urban Planning

### 3.3.1 Population of Thimphu

#### (1) National Census 2005

According to the population demographics survey conducted in 2000, the population of Thimphu was 43,479 persons in 2000. The National Population Census conducted in 2005 revealed that the population in Thimphu was 79,185 persons in 2005. These results suggest an extraordinary growth at an annual rate of 12.7% during this time.

The National Population Census is conducted every ten year, hence, population growth after 2005 can not accurately be measured. Current urban planning in Thimphu is based on the Structure Plan 2004 which was adopted in 2003. This plan was conducted prior to the National Population Census of 2005 and the population used in this plan is based on data from the 2000 survey.




Source: Data from Census Department tabulated by JICA Survey Team

**Figure 3-4 2005 Household and Household Density by Enumeration Area**

The number of households and density of households by enumeration area for Thimphu based on the 2005 National Census by the National Census Bureau (NSB) is shown in Figure 3-4. Based on the National Census, the total population for Thimphu in 2005 was 79,185 and the total number of households was 15,529, suggesting an average number of persons per household of 5.1.

### (2) Structure Plan Population Projection

One of the largest drawbacks in Structure Plan is lack of consistent population projections for infrastructure planning as described below.

Even though the painstaking efforts to evaluate the carrying capacity for population is examined as shown in Table 3-5, the results are not reflected in population projections. Table 3-4 shows the population projection of the Thimphu Structure Plan. The estimation is based on a simple 5% annual growth projection by zone; hence the central areas show a large estimate.

**Table 3-4 Future Population Projection**

| Ward/ Zone | Areas | Population (Year 2000) | Population* (Year 2027) |
|---|---|---|---|
| 1 | Dechencholing, Taba, Jongshina | 9,774 | 36,491 |
| 2 | Zilukha, Hejo, Langjophaka | 7,076 | 26,418 |
| 3 | Motithang, Changangkha | 8,801 | 32,858 |
| 4 | Thimphu Core | 5,428 | 20,265 |
| 5 | Changzamtog, Chang Bangdu, Yangchenphug | 6,615 | 24,697 |
| 6 | Simtokha, Babesa | 5,785 | 21,598 |
| | Thimphu | 43,479 | 162,327 |

Source: Thimphu Structure Plan (2002-2027)

On the other hand, the Thimphu Structure Plan calculates the additional population that can be absorbed through strategies such as densification and new development on public land and vacant land, and indicates the total population that can be accommodated by each Urban Village (Table 3-5). The results suggest that an additional 64,330 persons can be accommodated to the then existing 43,479 persons, resulting in a total population that can be accommodated at 107,809 persons. The population that can be accommodated is lower than the future population projection of 2027; however methods to fill this gap are not addressed in the Structure Plan.

**Table 3-5 Population that can be Accommodated by Urban Village**

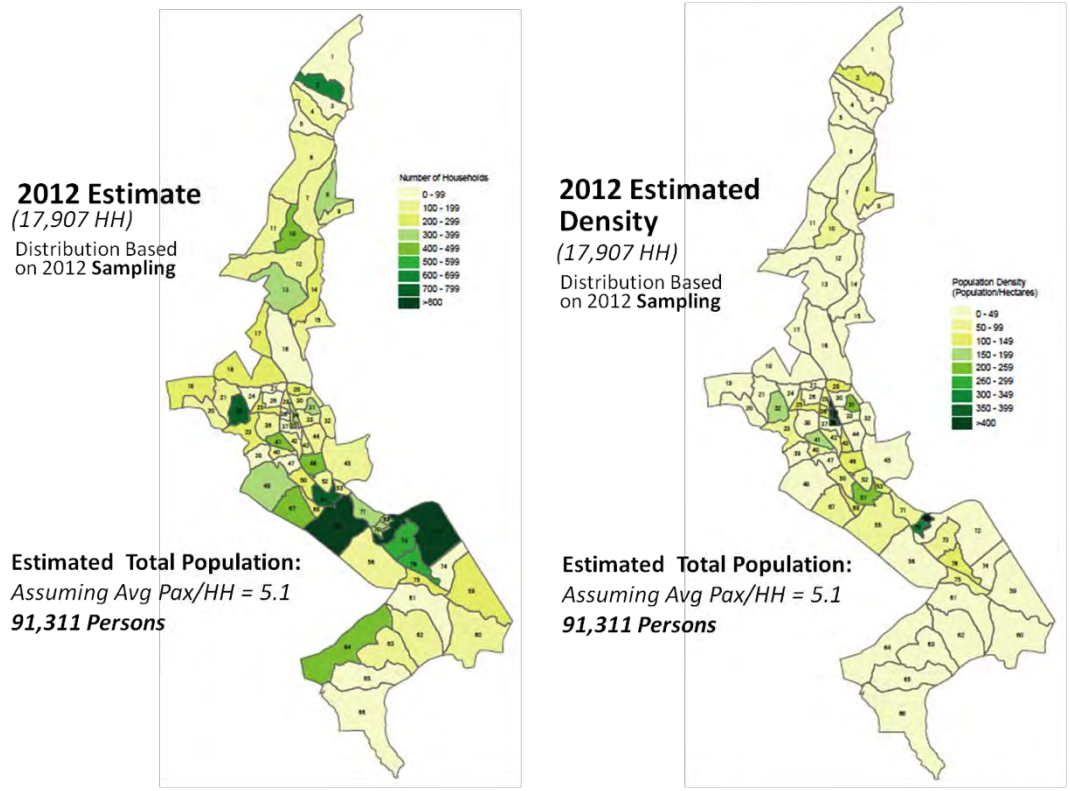
| Urban Village | Additional population that can be accommodated | | | | Total Additional Population that can be Accommodated | Existing Population | Total Population that can be Accommodated |
|---|---|---|---|---|---|---|---|
| | Government Lands | Existing Shrub Lands | Horizontal Densification in Residential Areas | Vertical Densification in Residential Areas | | | |
| Babesa | 8,968 | 4,054 | 114 | 93 | 13,229 | 1,781 | 15,010 |
| Simtokha | 4,829 | 5,616 | 365 | 260 | 11,070 | 2,433 | 13,503 |
| Lungtenphu | 63 | 567 | 189 | 103 | 922 | 1,571 | 2,493 |
| Chang Bangdu | 3,500 | 0 | 0 | 0 | 3,500 | 2,808 | 6,308 |
| Changzamtog | 2,010 | 0 | 0 | 695 | 2,705 | 2,808 | 5,513 |
| Changangkha | 0 | 65 | 14 | 91 | 170 | 1,925 | 2,095 |
| Yangchenphug | 4,972 | 0 | 540 | 0 | 5,512 | 999 | 6,511 |
| Core City | 3,608 | 0 | 166 | 1,898 | 5,672 | 5,428 | 11,100 |
| Lower Motithang | 610 | 0 | 93 | 380 | 1,083 | 3,367 | 4,450 |
| Upper Motithang | 865 | 0 | 259 | 101 | 1,225 | 3,509 | 4,734 |
| Zilukha | 451 | 0 | 197 | 0 | 648 | 1,414 | 2,062 |
| Hejo - Langjophaka | 1,127 | 0 | 176 | 125 | 1,428 | 4,062 | 5,490 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Taba - Jongshina | 100 | 1,956 | 29 | 157 | 2,242 | 5,730 | 7,972 |
| Dechencholing | 9,212 | 5,315 | 311 | 86 | 14,924 | 4,044 | 18,968 |
| Dzong Precinct | 0 | 0 | 0 | 0 | 0 | 1,600 | 1,600 |
| Royal Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Open Space Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Forest Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Endowment Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Institutional Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 40,315 | 17,573 | 2,453 | 3,989 | 64,330 | 43,479 | 107,809 |

Source: Thimphu Structure Plan (2002-2027)

### (3) Adjustment of Population Projection

Furthermore, in 2012, NBS conducted household sampling by enumeration area (it is important to note that the sampling method applied in 2012 differs from the method used in the 2005 National Census and that the implications of the comparison should be handled with caution). The estimated number of households and household density by enumeration area based on the sampling method is shown in Figure 3-5. The estimated total number of household in 2012 is 17,907. Assuming that the average number of persons per household is the same as in 2005 at 5.1 persons per household, the estimated total population for Thimphu in 2012 is 91,311 persons.




Source: Data from Census Department tabulated by JICA Survey Team

**Figure 3-5 2012 Estimated Household and Household Density by Enumeration Area based on Sampling Method**

JICA Survey Team applies adjustments to the Structure Plan population projection based on data from the 2005 National Population Census. The population of Thimphu in 2005 was 79,815 persons, and in these 5 years, the population had an increase of 80%. It is difficult to maintain

this growth, hence, a more moderate long term forecast parameters are applied to the 2005 population. Bhutan's natural population increase is at an annual rate of 1.28%, hence it can be said that the annual growth rate for the urban population at 5% on the high end and 3% on the low end is an acceptable assumption. With the assumption of annual growth rate at 3%, the population is 97,388 in 2012 and 151,727 in 2027. At an annual growth rate assumption at 5%, the population is 111,421 in 2012 and 231,637 in 2027. The figure 97,388 with annual growth of 3% is close to the projection of 91,311 which is based on statistical sampling.

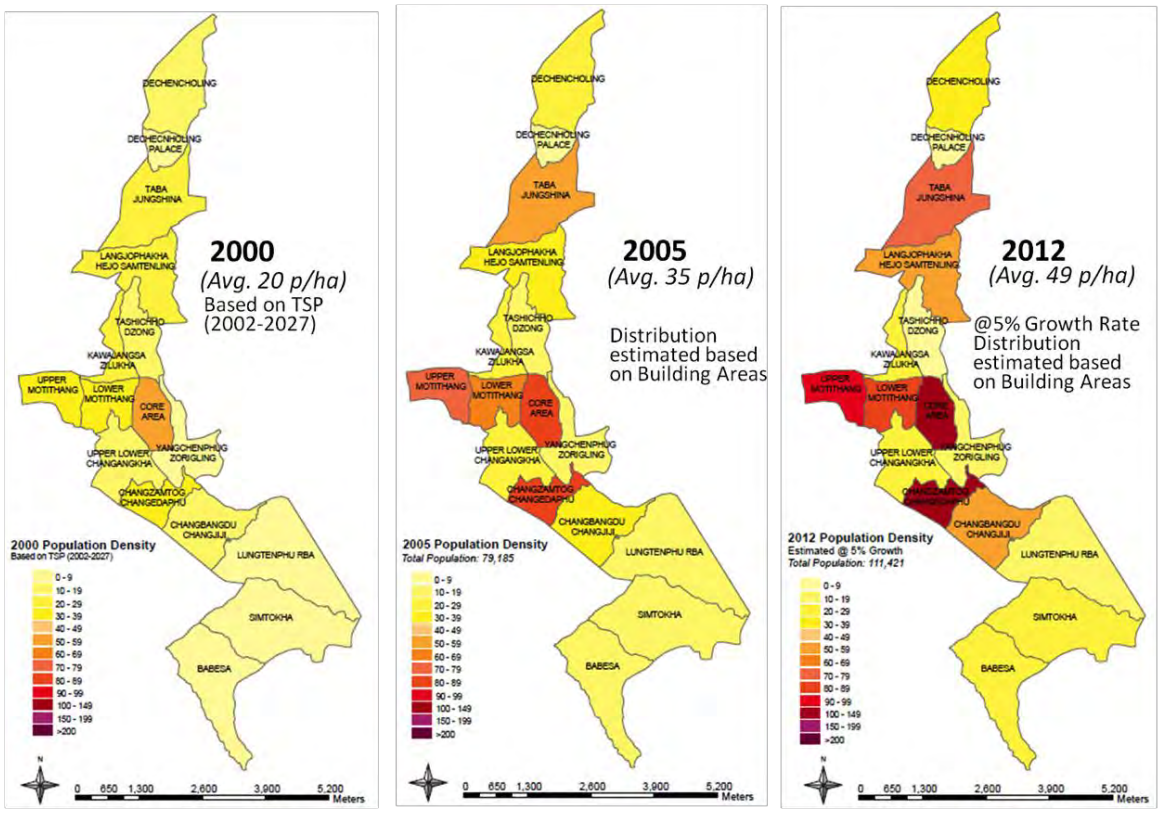
In the population forecast based on the national urban structure analyzed in Chapter 2, when assumed that 70% of the urbanized population is saturated, the population of Thimphu would be 217,198 persons. Furthermore, based on the GIS data analyzed in the section 3.3.2 (3), the growth rate of building area (from 2001 to 2012) has been utilized to forecast the population distribution by Urban Village from 2005 to 2027. The results of the population distribution by Urban Village are shown in Table 3-6.

**Table 3-6 Adjusted Population Estimates by Urban Village for Thimphu**

| Urban Village | 2000 | 2005 | 2012 | | 2027 | | Urbanization |
|---|---|---|---|---|---|---|---|
| | | | 3% growth | 5% growth | 3% growth | 5% growth | 70% |
| Babesa | 1,781 | 3,482 | 4,282 | 5,678 | 10,309 | 33,022 | 33,022 |
| Simtokha | 2,433 | 4,934 | 6,069 | 8,347 | 15,157 | 29,707 | 29,707 |
| Lungtenphu | 1,571 | 3,604 | 4,433 | 4,986 | 5,485 | 5,485 | 5,485 |
| Chang Bangdu | 2,808 | 5,710 | 7,023 | 9,686 | 13,878 | 13,878 | 13,878 |
| Changzamtog | 2,808 | 7,204 | 8,859 | 11,026 | 12,129 | 12,129 | 12,129 |
| Changangkha | 1,925 | 3,239 | 3,984 | 4,190 | 4,609 | 4,609 | 4,609 |
| Yangchenphug | 999 | 1,302 | 1,601 | 1,415 | 2,569 | 9,796 | 5,997 |
| Core City | 5,428 | 8,602 | 10,579 | 11,370 | 20,644 | 24,420 | 24,420 |
| Lower Motithang | 3,367 | 6,153 | 7,567 | 8,900 | 9,790 | 9,790 | 9,790 |
| Upper Motithang | 3,509 | 7,055 | 8,676 | 9,468 | 10,415 | 10,415 | 10,415 |
| Zilukha | 1,414 | 1,781 | 2,191 | 1,871 | 3,399 | 4,536 | 4,536 |
| Hejo - Langjophaka | 4,062 | 7,649 | 9,407 | 10,980 | 12,078 | 12,078 | 12,078 |
| Taba – Jongshina | 5,730 | 11,558 | 14,215 | 15,944 | 17,538 | 17,538 | 17,538 |
| Dechencholing | 4,044 | 5,781 | 7,110 | 6,893 | 12,516 | 41,730 | 32,059 |
| Dzong Precinct | 1,600 | 1,131 | 1,392 | 667 | 1,212 | 2,506 | 1,536 |
| Royal Precinct | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 43,479 | 79,185 | 97,388 | 111,421 | 151,727 | 231,637 | 217,198 |

Source: JICA Survey Team

The population density by area of the year 2000, 2005, and 2012 (based on 5% growth) are shown in the Figure 3-6.




Source: Data from Census Department tabulated by JICA Survey Team

**Figure 3-6 Population Density by Urban Village for 2000, 2005 and 2012**

The population projections by the study team, Thimphu Structure Plan, ADB TA 7630 Urban Infrastructure Project, and World Bank, Bhutan Urban Development Project are summarized in Table 3-7. The 2027 population forecast in the Thimphu Structure Plan is 162,327, which is approximately 10,000 more than the study team 2027 population projection at a 3% growth scenario. However, the World Bank projects a 2027 population of 71,246 persons for the Northern Thimphu local area plans covered by the donor. For the Southern Thimphu local areas plans covered by ADB, the donor projects a 2027 population of 159,392. The two combined suggests the total population of Thimphu in 2027 to be 230,630; the figure is close to the 5% growth scenario population projected by the study team.

These analyses suggest that the plans and implementation of local area plans within Thimphu are based on individual population projections, with its calculation method unclear. It is essential that there be a consensus on population projection among national level agencies including the NBS and MoWHS, Thimphu City, and implementing agencies including the donors involved.

## Table 3-7 Population Estimates by Each Study

| Urban Village | Area (Ha) | 2000 | 2005 | 2012 | 2027 | | TSP 2027 Forecast | ADB UIP TA 7630 | | | WB BUDP II | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5% growth | 3% growth | 5% growth | | 2005 | 2012 | 2027 | 2007 | 2012 | 2027 |
| Babesa (+Serbithang) | 238 | 1,781 | 3,482 | 5,678 | 10,309 | 33,022 | | 2,745 | 5,676 | 20,484 | | | |
| Simtokha | 330 | 2,433 | 4,934 | 8,347 | 15,157 | 29,707 | 21,598 | 3,197 | 5,428 | 19,403 | | | |
| Lungtenphu | 334 | 1,571 | 3,604 | 4,986 | 5,485 | 5,485 | | 2,122 | 5,316 | 19,351 | | | |
| Chang Bangdu (+Changjiji) | 175 | 2,808 | 5,710 | 9,686 | 13,878 | 13,878 | | 6,180 | 7,445 | 10,505 | | | |
| Changzamtog | 88 | 2,808 | 7,204 | 11,026 | 12,129 | 12,129 | 24,697 | | | | | | |
| Yangchenphug | 130 | 999 | 1,302 | 1,415 | 2,569 | 9,796 | | | | | | | |
| Core City | 97 | 5,428 | 8,602 | 11,370 | 20,644 | 24,420 | 20,265 | 52,074 | 61,900 | 89,649 | | | |
| Changangkha | 148 | 1,925 | 3,239 | 4,190 | 4,609 | 4,609 | | | | | | | |
| Lower Motithang | 102 | 3,367 | 6,153 | 8,900 | 9,790 | 9,790 | 32,858 | | | | | | |
| Upper Motithang | 98 | 3,509 | 7,055 | 9,468 | 10,415 | 10,415 | | | | | | | |
| Zilukha (+Kawangjangsa) | 69 | 1,414 | 1,781 | 1,871 | 3,399 | 4,536 | | | | | | | |
| Hejo - Samteling - Langjophaka | 204 | 4,062 | 7,649 | 10,980 | 12,078 | 12,078 | 26,418 | | | | 1,415 | 4,615 | 32,105 |
| Dzong Precinct | 84 | 1,600 | 1,131 | 667 | 1,212 | 2,506 | | | | | | | |
| Taba – Jongshina | 226 | 5,730 | 11,558 | 15,944 | 17,538 | 17,538 | 36,491 | | | | 4,950 | 9,839 | 32,377 |
| Dechencholing | 208 | 4,044 | 5,781 | 6,893 | 12,516 | 41,730 | | | | | 500 | 1,425 | 6,763 |
| Royal Precinct | 81 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Total | 2,613 | 43,479 | 79,185 | **111,421** | **151,727** | **231,637** | 162,327 | 66,318 | 85,765 | 159,392 | 6,865 | 15,881 | 71,246 |

Source: JICA Survey Team based on various studies

### 3.3.2 Current State of Urban Development

#### (1) Development within Thimphu City

Within Thimphu City boundaries, there has been urbanization resulting from rapid population increase, and new building development and sprawl can be seen spreading in the northern and southern end of the city. As shown in Figure 3-7, With the Babesa-Thimphu Expressway axis, there is significant residential development in Southern Thimphu and particularly in the 4 LAPs assisted by ADB.

Babesa-Thimphu Expressway
(Southern Thimphu)

Changbangdu and Lungtenphu
(Southern Thimphu)

Source: JICA Survey Team

**Figure 3-7 Residential Development in Southern Thimphu**

#### (2) Current Development Outside of the Municipal Boundary

Development in the following areas outside of the municipal boundary can be observed;

**Debisi:** Due to the rapid urbanization, MoWHS has intervened. With 75% of agreement signed, land pooling and infrastructure implementation is currently on-going.

**Kabesa:** The area is already very dense and developed as shown in Figure 3-8. The Dzongda has requested MoWHS for technical assistance, and currently land surveying is on-going to determine the feasibility of land pooling.

Development in Kabesa

Development in Debisi

Source: JICA Survey Team

**Figure 3-8 Residential Development Outside of Thimphu City Boundary**

While urbanization is not as rapid as Debisi and Kabesa, developments can be observed in the following areas:

- **Ribbon development between Thimphu and Paro:** land ownership pattern is being subdivided, and soon the two cities will probably be connected
- **Yusipang:** 9km from Thimphu towards Wangdi, close to Dochula
- **Hongtshu:** 4-5km from Yusipang towards Wangdi

### (3) Analysis of Urbanization through GIS Analysis

As shown in

Figure 3-10, the building layers from 2001 (shown in red) and 2012 (shown in blue) of the GIS database owned by Thimphu Thromde are compared to visualize the development of urbanization. The figure shows the growth in blue (2012) extending to the sloped areas. This growth is vividly illustrated in the Urban Villages of Motithang, Lungtenphu, and Samteling, and new development is extending outside of the city boundaries.

The increase and decrease of building ground floor area by Urban Village based on a geographical statistical analysis of GIS data is shown in Table 3-8.

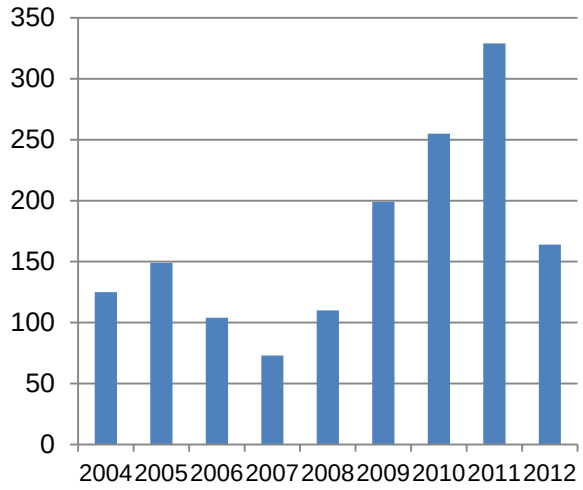
**Table 3-8 Change in Building Area in Thimphu (2001-2012)**

| Urban Village | 2001 Building Area (m2) | 2012 Building Area (m2) | Area Change (m2) | Percentage Change |
|---|---|---|---|---|
| BABESA | 32,739 | 68,751 | 36,012 | 110% |
| CHANGBANGDU CHANGJIJI | 50,580 | 110,484 | 59,904 | 118% |
| CHANGZAMTOG CHANG GEDAPHU | 32,449 | 89,411 | 56,962 | 176% |
| CORE AREA | 127,778 | 217,498 | 89,719 | 70% |
| DECHECNHOLING PALACE | 6,484 | 8,469 | 1,985 | 31% |
| DECHENCHOLING | 76,386 | 117,289 | 40,903 | 54% |
| KAWAJANGSA ZILUKHA | 44,366 | 60,026 | 15,661 | 35% |
| LANGJOPHAKHA HEJO SAMTENLING | 44,553 | 90,118 | 45,564 | 102% |
| LOWER MOTITHANG | 79,856 | 156,742 | 76,886 | 96% |
| UPPER MOTITHANG | 37,269 | 80,482 | 43,213 | 116% |
| LUNGTENPHU RBA | 59,885 | 147,577 | 87,692 | 146% |
| SIMTOKHA | 43,139 | 93,975 | 50,836 | 118% |
| TABA JONGSHINA | 42,995 | 93,155 | 50,160 | 117% |
| TASHICHHODZONG | 83,733 | 63,603 | (20,130) | -24% |
| UPPER LOWER CHANGANGKHA | 76,333 | 137,959 | 61,627 | 81% |
| YANGCHENPHUG ZORIGLING | 78,843 | 110,338 | 31,494 | 40% |
| Total | 917,386 | 1,645,875 | 728,489 | 79% |

Source: Thimphu Thromde. Analyzed by JICA Survey Team

The Urban Village with the largest rate of increase of building area is Changzamtog/Chang Gedaphu at 176%, followed by Chang Bangdu/Chang Jiji 118%, Simtokha 118%,

Taba/Jongshina 117%, Upper Motithang 116%, and Babesa 110%. There are significant increases from the central to southern area of the city, but not much increase can be seen in the northern area. As an absolute value of building area distribution, from the highest Core Area (+89,719m$^2$) and fifth highest Changzamtog/Chang Gedaphu (+56,962m$^2$), all are local in the central areas.



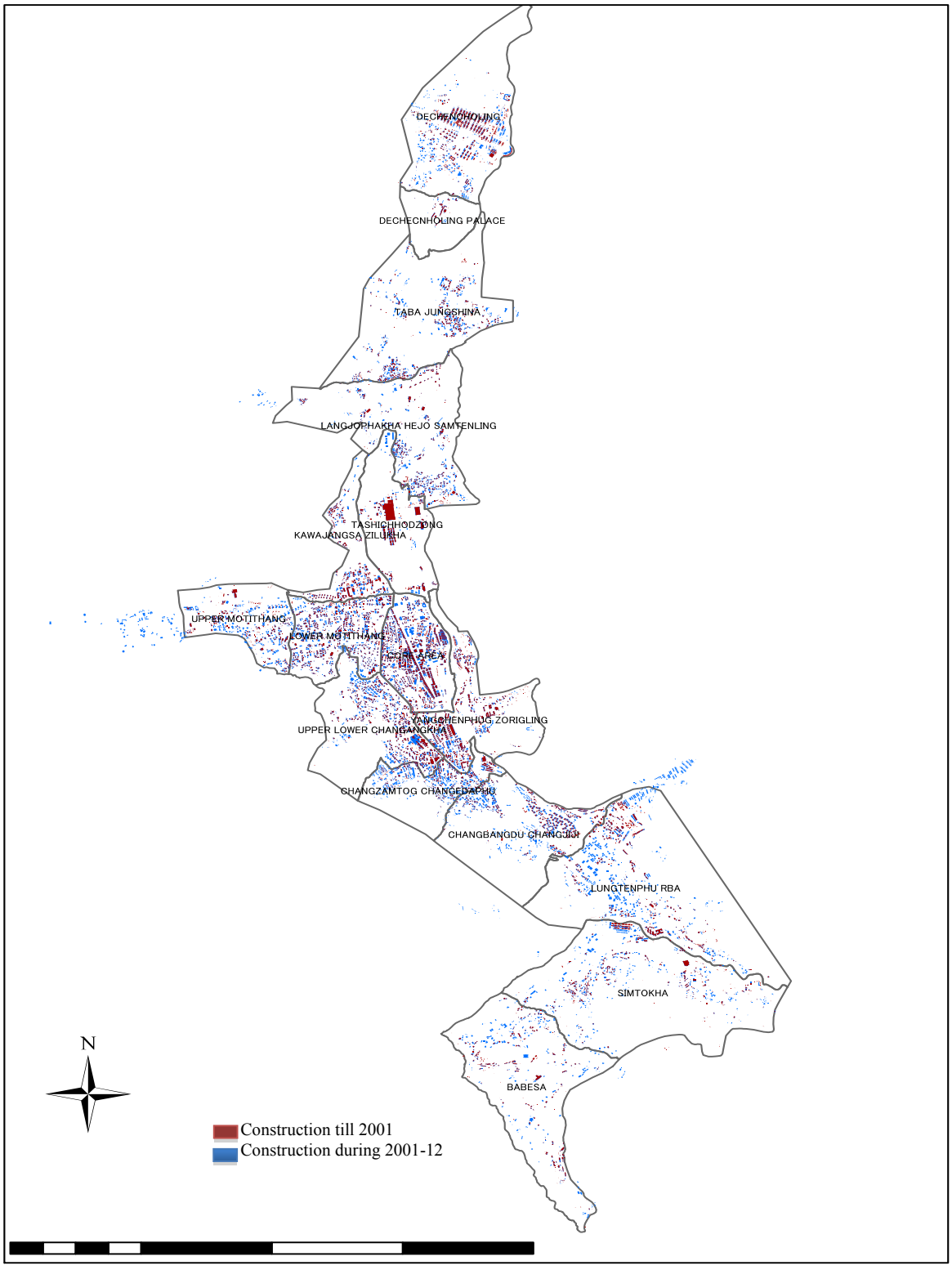

Source: World Bank, Bhutan Urban Development Project 2, Low Income Housing Analysis Draft Final Report

**Figure 3-9 Constructions Approved by Thimphu Thromde**

### (4) Construction Boom

Figure 3-9 shows the number of construction authorized by the Thimphu Thromde during the years 2004 – 2012. Until 2008, the number of approvals scored around 100, but started to sharply rise afterwards to reach its peak in 2011 to pass 300 which was halved in 2012. As explained in 2.1.2 (2), the economic structure of Bhutan necessitates imports to grow faster than the rate of economic growth while the export being less responsive. As a result, the economic growth widens the trade imbalance. In 2012, the economic growth led to Rupee Crunch whereas the foreign exchange reserve had dwindled.

One of the main driving forces behind identified was the construction boom since 2009. The construction materials required for multi-storied buildings such as cement are mainly imported from India. Thus the ROGB ordered a 15-month effective stoppage of housing construction loans. Furthermore, the Royal Monetary Authority (RMA) gave directives to financial institutions to maintain housing loans below 20% of their total loan disbursement, leading to a limited liquidity for construction loans.




Source: JICA Survey Team based on GIS data obtained from Thimphu Thromde

**Figure 3-10 Comparison of Urbanization in 2001 and 2012 based on GIS**

### (5) Factors Driving Development Outside of the Municipal Boundary

There are various factors driving the developments in rural land along the periphery of the municipal boundary of Thimphu as follows[3];

**Land Use Zoning:** Since the Structure Plan of the city does not apply, there are fewer restrictions on development.

**Development Process:** In rural areas, the Gup (elected village head) is authorized to provide permission for construction. In the case the Gup cannot approve, the matter will be taken up to the Dzongda. In the case both Gup and Dzongda cannot approve, the matter will be taken up to MoWHS. Construction permission is usually granted if the case of traditional housing construction using local material and labor, however may be difficult to obtain for concrete buildings.

**Subsidies:** In rural areas, timber for construction is subsidized, thereby encouraging construction.

**Land Act and Subdivision:** For wet land (patty fields), the Land Act allows of land subdivision but does not allow for building construction. However, there is a provision in the law allowing for wet land to be used for construction in the case that the subject land is the only land the owner possesses. Furthermore, the inheritance law allows for land to be subdivided for inheritance (i.e. the father may subdivide the land for the number of children). These provisions have resulted in loopholes for subdivision and fragmentation of land to smaller rural plots for sale and construction.

### (6) Urban Encroachment to Protected Areas

Source: Thimphu Structure Plan 2004

**Figure 3-11 E-4 Environmentally Protected Areas of Thimphu**

There are four environmental precincts from E1 to E4. Recently there is a strong development pressure exerted onto the E4 precincts which are designated as agro-use including agro-processing and warehousing with conditions of 20% building-to-land ratio and more than 1000m$^2$ in area. Green spaces in Figure 3-11 are the designated E4 areas. Given the lack of space and more limitation on rice paddy fields from cultural context, E4 is the only space freely available. Now with some relaxation of land use restrictions, some schools and even houses are being erected. E4 usually on higher grounds with more than 20% in grade pose several risks including loss of water retention capacities, increased risks of landslides, soil erosion caused by access roads leading up to isolated localities of development on E4 areas.

3 Based on interview with DHS, MOHWS

### 3.3.3 Thimphu Structure Plan and Thimphu City Development Strategy

#### (1) Development Objectives

Thimphu City is the capital of Bhutan, and its urban environment and the livelihood of its residents are symbolic of the national development philosophy of Gross National Happiness (GNH). These objectives are elaborated in the development vision of the Thimphu Structure Plan as follows:

> **Vision:**
> *Thimphu is the mirror of Bhutan. It must be the best of what the country can be. It is a reflection of the hopes, aspirations and dreams of the people. The capital should be a message of what the future can be. It is a media that transfers ideas!*
>
> Thimphu Structure Plan (2002-2027)

#### (2) Thimphu Structure Plan (TSP)

The overall guiding principle for urban planning and development of the Thimphu Municipal Area has been laid out by the Thimphu Structure Plan (2002-2027) completed in 2003. Under the national motto of Gross National Happiness (GNH), the Thimphu Structure Plan (TSP) is comprised of 22 main "Themes", 9 "Principles", and 10 "strategies" for development as summarized in Table 3-9.

**Table 3-9 Thimphu Structure Plan Themes, Principles, and Strategies**

| | | |
|---|---|---|
| Principles (9) of Intelligent Urbanism | 1. Balance with Nature<br>2. Balance with Tradition<br>3. Conviviality<br>4. Efficiency<br>5. Human Scale | 6. Opportunity Matrix<br>7. Regional Integration<br>8. Balanced Movement<br>9. Institutional Integrity |
| Strategies (10) | 1. Decentralization of Growth<br>2. Regionalization of Growth<br>3. Densification<br>4. Transport Oriented Growth (TOD)<br>5. Resource Utilization | 6. Urban Precincts<br>7. Public Assets<br>8. Defining the Urban Core<br>9. Facilitation Access to Shelter<br>10. "Let it Be!" |
| Themes (23) | 1. Nation Building & Civil Society<br>2. City of Our Dreams<br>3. Tashiccho Dzong<br>4. Conviviality & Human Scale<br>5. Public Policy and Urban Form<br>6. Bhutanese Dream<br>7. Parable of Archery<br>8. Urban Growth<br>9. Domain of Automobiles<br>10. Reclaiming the Public Domain<br>11. City Core<br>12. Gateway to the Capital<br>13. Urban Corridor | 14. Urban Villages<br>15. Open Space System and the Wang Chhu<br>16. Footpath System<br>17. Forest Boundary & City Landscape<br>18. Peripheral Zone Control<br>19. Knowledge City<br>20. Social Services<br>21. Utilities Network<br>22. Shelter Systems<br>23. National Capital Region |

Source: Thimphu Structure Plan (2002-2027)

The TSP is a long-term plan set for 25 years, formulated with the primary objective in cultural and environmental protection. Existing data on land, geological formation, landscape, land use and other were uniquely collected and analyzed, and plans have been formulated with its development vision. Upon identification of urban issues, action plans which include funding

and implementation plan, and proposals have been presented for each of the urban sectors (i.e. transport, water supply, drainage and sewerage, solid waste management, housing, and other).

A majority of the sections of the TSP are spent on the presentation of the conceptual vision. On the other hand, land uses called Precincts are designated in the Plan. Furthermore, detailed building codes only applicable to Thimphu City called the "Development Control Regulation" are formulated as a regulatory supplement. The Precinct designations and building code supplements are actually incorporated in the criteria for building permission, and thus is legally binding.

On the contrary, road design standards and other standards have also been established in the Plan, however, in reality, there are many roads that do not comply with these standards, and it is hard to say the system is functioning as hoped. An Urban Transport Circulation Plan and Water Supply and Sewerage Plan have been prepared, however they are not developed based on data on detailed geographic distribution. There is no technical analysis such as traffic simulations or hydraulic network modeling for water supply. There is no economic optimization in the design of the infrastructure networks. This signifies that the plan cannot be extended for detailed plans in a straight forward fashion, and is the biggest weakness of the Structure Plan.

### (3) Thimphu City Development Strategy (TCDS)

After the formulation and adoption of the TSP, the 2005 National Population Census conducted by the RGOB identified rapid urbanization and limited land for urban development as major development challenges. In order to review measures for such challenges, under the funding from the World Bank, the *Bhutan National Urbanization Strategy* (BNUS) was formulated in 2008. Furthermore, under the same project the Thimphu City Development Strategy (TCDS) was formulated with the following objectives.

- To conduct an early review of the TSP and Local Area Plans (LAP), as well as ensure consistency with the national level development strategy indicated in the BNUS. Furthermore, review Thimphu City's role in the BNUS.
- To review the TSP and LAPs from the perspective of urban management and by each sector.
- To utilize the urban development experiences of Thimphu City as an example for the BNUS.

However, it is recognized in its own report that the TCDS is a social consensus building process, which, under normal conditions, should have been conducted prior to the TSP. As described in Chapter 2, the Structure Plan has legal regulatory power as well as a vision statement. CDS has no such authority thus has no effective relevance to actual urban development including Local Area Plans.

### (4) Land Use

The existing land use areas (in Ha) are shown in the first three columns of Table 3-10. As evident, over 45% of the total land area is used for green uses (agriculture, forest, and orchard), 6% for defense, and 8% for institutional and public, leaving a limited amount of land for residential and commercial activities.

### (5) Precinct (Land Use) Plan

The Precinct Plan (land use likely after implementation) of TSP and LAPs is shown in Table 3-10. The Precinct Plan map is shown in Appendix C-1. The existing agricultural land is almost

completely been decreased in the plan and in order to accommodate urban roads, institutional and recreational spaces.

**Table 3-10 Area by Precinct after Implementation of TSP and LAPs based on TSP**

| Existing Uses, 2002 | | | Likely pattern after implementation of TSP and LAPs | | |
|---|---|---|---|---|---|
| Land Use | Area (in Ha) | Percentage of Total Area | Land Use / Precinct | Area (in Ha) | Percentage of Total Area |
| Agriculture | 410.24 | 15.7 | E-3 | 22.95 | 0.88 |
| Orchard | 290.3 | 11.1 | E-4 | 415.04 | 15.88 |
| Commercial | 37.64 | 1.4 | UV-1 | 86.29 | 3.3 |
| Defense | 174.55 | 6.6 | Endowment | 174.55 | 6.68 |
| Forest | 488.11 | 18.6 | E-2 | 399.13 | 15.27 |
| Industrial | 11.76 | 0.4 | UH | 9.786 | 0.37 |
| Recreational | 49.12 | 1.8 | G-1 & G-2 | 131.63 | 5.04 |
| Religious | 1.04 | 0 | H | 39.28 | 1.5 |
| Residential | 467.21 | 17.8 | UV-2 | 531.99 | 20.36 |
| Vacant | 187.61 | 7.1 | | | |
| Institutional | 221.84 | 8.4 | I (Institute) | 303.61 | 11.62 |
| Surfaced Road | 74.73 | 2.8 | Road | | |
| Unsurfaced Roads | 14.11 | 0.5 | | | |
| | | | Others | | |
| | | | NN (amenities) | 22.21 | 0.85 |
| | | | E-1 | 291.79 | 11.17 |
| Water | 60.62 | 2.32 | Water | 60.62 | 2.32 |
| Data unavailable | 124.12 | 4.75 | Data unavailable | 124.12 | 4.75 |
| Total | 2613 | 100 | Total | 2613 | 100 |

Source: Thimphu Structure Plan (2002-2027)

### (6) Main Urban Facility Development Plan in Structure Plan

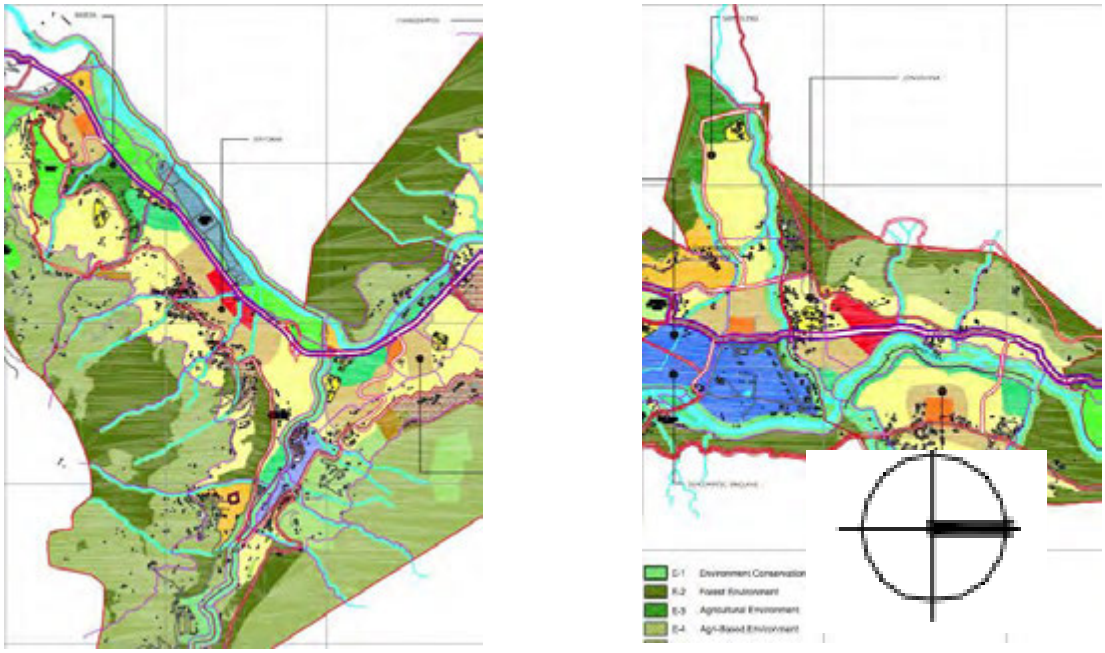
The Structure Plan of Thimphu proposes an Urban Corridor as the backbone of the city, connecting the central urban core and two urban sub-cores in the north and south. The local centers called "Neighborhood Nodes" are located to serve the areas defined by LAPs. The general locations of these facilities are shown in Figure 3-12.

Two sub-urban cores, the one in Simtokha and the other in Jongshina is shown in Figure 3-13. Even though ADB and WB are financing six LAP implementations in Thimphu south and north, the financing does not cover the development of community nodes or sub-cores. Given the vision and role of Thimphu's urban planning system of providing local self-sufficiency in a scale of LAP, the delayed development of urban cores and local community nodes will lead to one core urban structure.

*Graphic showing Urban Corridor linking Neighborhood Nodes, Urban Hubs and City Core*

Note: A big red circle is the core, two large green dots are sub-cores, and small dots are neighborhood nodes
Source: Thimphu Structure Plan 2004

**Figure 3-12 Urban Corridor, Urban Core, Sub-cores, and Neighborhood Nodes in Thimphu Structure Plan 2004**



Note: sub-cores are colored in red and one gird is 1 km in distance
Source: Thimphu Structure Plan 2004, Map 4.9

**Figure 3-13 Urban Sub-Core Plan for Simtokha(Left) and Jongshina(Right) in Structure Plan**

### (7) Investment Plan of Structure Plan

Table 3-11 shows the summary of the Investment Plan developed as a companion to the Thimphu Structure Plan. The total budget for the investments required is Nu. 4,202 million at the cost prices of 2002. Given the inflation during the past 10 years, the total budget is likely to have doubled during this period. The largest investment item is transportation system, almost 50% of the total investment, of which the road construction is the largest item. The LAP is allocated less than 10% of the total. However, the past experience shows one LAP costs around Nu. 250 million on the average, thus the final figure is likely to increase significantly.

**Table 3-11 Investment Plan within Thimphu Structure Plan**

| No. | Proposed Project Name | Estimated Amount Nu. (million) |
|---|---|---|
| 1 | Water Supply System and Network System | 932 |
| 2 | Sewerage System | 508 |
| 3 | Storm Water Drainage System | 56 |
| 4 | Solid Waste Collection and Disposal System | 0 |
| 5 | Electrical (Power) Distribution System | 83 |
| 6 | Street Lighting | 162 |
| 7 | Telecommunication System | 83 |
| 8 | Transportation System | 2,069 |
| 9 | Local Area Plan (Open Space System) | 308 |
| | Total | 4,202 |

Source: Thimphu Structure Plan 2004

## 3.3.4 Status of Local Area Plans

The sixteen urban villages designated in the Structure Plan have been divided into 27 local areas for Local Area Plans (LAPs) and land pooling. As part of the Phase 1 of the TSP implementation, during 2003 – 2006, 10 LAPS were formulated. Today, there are 12 approved LAPs, two on-going LAPs, and 13 remain unplanned. Of the 12 approved LAPs, only 6 are on-going or in the pipeline for implementation under donor assistance by the World Bank and Asian Development Bank (ADB). The approval and implementation status of the LAPs are shown in Table 3-12.

### (1) Donor Assistance on LAP Implementation

Of the 12 approved LAPs, six LAPs are under implementation by the Asian Development Bank (ADB) and the World Bank (WB) as follows:

- Babesa LAP: Implementation Completed by ADB
- Simtokha LAP: Implementation Completed by ADB
- Lungtenphu LAP: On-going by ADB
- Chang Bangdu LAP: On-going by ADB
- Langjophaka LAP: On-going by World Bank
- Dechencholing LAP: On-going by World Bank

The remaining six approved LAPs have no implementation plan as of now, as there is limited funding in the Thromde. As shown in Table 3-12 the land pooling contribution % ranges from 15%-29.5% and most of the agreements are over 65% with a few exceptions.

### (2) On-going LAP Formulation (Upper and Lower Changzamtog)

In 2010, Thimphu Thromde placed a public Expression of Interest (EOI) for the development of a LAP for the Upper and Lower Changzamtog. Planning was awarded to one of the three private sector companies after bidding. The LAP which commenced in 2011 covers 90 hectares and 365 land owners, and was initially scheduled for completion in eight-nine months, however, a nation-wide resurvey of land by the National Land Commission halted the project. The LAP process restarted this year and is due for completion in the end of August, 2013.

### (3) Areas with No LAP

In general, there is a construction moratorium for local areas with no approved LAP. However, due to pressures from citizens, currently areas with no LAP are subject to selective development. In the case that there is already a road and there are no disputes on land ownership, then development and construction may proceed[4].

**Table 3-12 Status and Details of Local Area Plans**

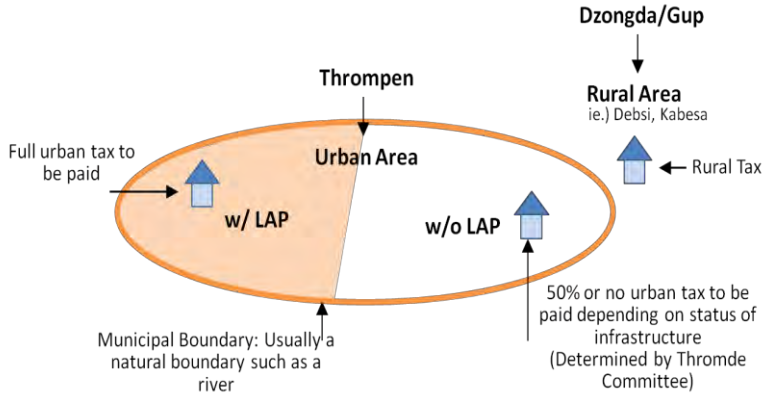
| # | Local Area | LAP Status | Area (Ha) | # of Plots | # of Land Owners | % Land Pooling Agreements Signed* | Land Pooling % Contribution* | Donor | Urban Village |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Serbithang LAP | Planned | 129.48 | 34 | 15 | NA | 15.0% | | Babesa |
| 2 | Babesa LAP | Planned | 104.49 | 351 | 258 | 79% | 27.5% | ADB | Babesa |
| 3 | Simtokha LAP | Planned | 50.59 | 481 | 230 | 80% | 29.0% | ADB | Simtokha |
| 4 | Lungtenphu LAP | Planned | 243.62 | 420 | 271 | 71% | 28.9% | ADB | Lungtenphu |
| 5 | Changbangdu LAP | Planned | 139.21 | 247 | 151 | 83% | 27.5% | ADB | Changbangdu |
| 6 | Core Area | Planned | 97.93 | 404 | 440 | NA | 0.0% | | Core |
| 7 | Langjophaka LAP | Planned | 44.11 | 121 | 122 | 85% | 25.0% | WB | Langjophaka |
| 8 | Hejo-Samteling LAP | Planned | 129.90 | 306 | 163 | 65% | 29.5% | | Langjophaka |
| 9 | Jongshina LAP | Planned | 118.57 | 306 | 303 | 65% | 29.5% | | Taba |
| 10 | Taba LAP | Planned | 105.62 | 354 | 352 | NA | 28.5% | | Taba |
| 11 | Dechencholing LAP | Planned | 37.63 | 220 | 152 | 98% | 25.0% | WB | Dechencholing |
| 12 | Changzamtog LAP | Planned | 10.93 | 126 | NA | NA | 25.0% | | |
| 13 | Lower Changzamtog | On-going | 18.62 | - | - | - | - | - | |
| 14 | Upper Changzamtog | On-going | 16.35 | - | - | - | - | - | |
| 15 | Chang Gedaphu | Unplanned | 75.43 | - | - | - | - | - | |
| 16 | Chang Jangsa (previous workshop area) | Unplanned | 32.37 | - | - | - | - | - | |
| 17 | Chang Khorlo (included JDWNRH & NPPF colony) | Unplanned | 32.21 | - | - | - | - | - | |
| 18 | Chang Bardo (above NPPF) | Unplanned | 32.21 | - | - | - | - | - | |
| 19 | Chang Gangay (swimming pool area & parts of Changangkha) | Unplanned | 23.76 | - | - | - | - | - | Changangkha |
| 20 | Chang Gumji (parts of Changangkha & Bangladesh Embassy) | Unplanned | 33.10 | - | - | - | - | - | Changangkha |

4 Based on interview with Mr. Meghraj Adhikari, DHS, MoWHS and interview on August 12, 2013 with Mr. Galey Norbu, Chief Urban Planner, Urban Planning Division, Thimphu Thromde

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 21 | Kawang Damisa (lower Motithang) | Unplanned | 58.92 | - | - | - | - | - | Lower Motithang |
| 22 | Kawang Dajo (Upper Motithang) | Unplanned | 99.55 | - | - | - | - | - | Upper Motithang |
| 23 | Kawang Jangsa | Unplanned | 35.46 | - | - | - | - | - | |
| 24 | Yangchenphu Area | Unplanned | 81.38 | - | - | - | - | - | Yangchenphu |
| 25 | Kawang Chenjo (area stretching from TCC office to NA building including golf course) | Unplanned | 41.12 | - | - | - | - | - | Kawan Chenjo |
| 26 | Zilukha | Unplanned | 32.42 | - | - | - | - | - | Zilukha |
| 27 | Lhadong (upper Langjophaka) | Unplanned | 32.42 | - | - | - | - | - | Urban Village |

Source: JICA Survey Team * Land Pooling Status of 2009

### 3.3.5 Land Ownership /Land Tax/Land Valuation




Source: JICA Survey Team

**Figure 3-14 Concept Diagram of Urban Land Tax**

#### (1) Urban Land Tax

Land categorized under Urban Land within the Municipal boundary is subject to Urban Land Tax, which is higher than Rural Land Tax. However, areas within the urban boundary which have no LAP, and subsequently none or limited urban infrastructure (roads, water supply, sanitation, electricity) are subject to 50% or no urban tax depending on the status of the infrastructure as shown in Figure 3-14. This is a mitigation measure to make the taxing commensurate with the provision of urban infrastructure and amenities. The Thromde committee will decide whether an area is subject to 50% or no urban taxation depending on the quality of the infrastructure present.

#### (2) Land Values

The land values for Thimphu are calculated by PAVA as explained in 2.5.4, and the revised rates of 2009 Thimphu Structure Plan precincts differ largely between Urban Core and other areas. The land values for Urban Core range between Nu. 12,661/$m^2$ - 14,523/$m^2$, while those for the other areas range between Nu.1,941/$m^2$–2,782/$m^2$. However, the rates are quite uniform within the two categories. From an international perspective, locational variance is more common. Therefore, it is likely that the rates are determined with some political considerations for social equity, which further widens the gap with the market rates.

### 3.3.6 Urban Landscape and Development

#### (1) Current Status

A major principle in the TSP is the preservation of culture and environment, and as shown in Figure 3-15, traditional architecture and greenification is promoted in Thimphu City. Based on such principles, currently there is one person staffed concurrently for City Beautification and Urban Forestry at Thimphu Thromde. The issue of securement of budget and manpower remains a challenge.

Roundabout in the Thimphu City Center

Clock Tower and Plaza in the Thimphu City Center

Traditional Pedestrian Bridge

Preserved Traditional Architecture

Source: JICA Survey Team

**Figure 3-15 Buildings in Thimphu**

The TPS emphasizes the importance of the traditional Bhutanese footpaths. As shown in Figure 3-16, much of the main roads have plenty of space set aside for pedestrians. However, as the footpaths are poorly maintained with many potholes and crumbling walls, there is a concern for pedestrian safety.

Sidewalk Along Norzin Lam

Footpath Connecting Major Roads

Source: JICA Survey Team

**Figure 3-16 Footpaths of Thimphu**

### (2) Structure Plan

Structure Plan of Thimphu categorized open spaces into five types: 1) Recreational Open Spaces, 2) Waterfronts, 3) River and Stream Side Green Belt, 4) Conservational Open Spaces and 5) Heritage Open Spaces. The plan also demarcated the city into seven zones of 1) Sir Ugyen Wangchuck Memorial Eco - Park Zone, 2) King Jigme Wangchuck Memorial Waterfront Zone, 3) King Jigme Dorji Wangchuck Memorial Waterfront Zone, 4) Tashichho Dzong Central Park or Jigme Dorji Wangchuck Memorial Central Park, 5) Royal Palace Green Belt Zone, 6) Motithang Green Zone, and 7) Changangkha Green Zone. The plan proposed a total of 54 projects. However, due to lack of development funds, the projects that have been implemented are limited to Changangkha Park, Centenary Park, and City Riverfront Greenbelt.

The drains that run through the central part of the city were originally small creeks. The Structure Plan envisages the redevelopment of these water bodies into green corridors. However, as described in 3.6.7, without solving the problems of wastewater treatment, the realization of green corridors faces a hurdle since the water contamination due to grey water disposal from the households.

## 3.3.7 On-going Projects

Following the completion of local areas plans, ADB and WB are implementing urban infrastructure projects as follows:

1） Project: Urban Infrastructure Project
Financing Agency: ADB Project Type: Loan
Loan Amount: US$19,870 thousand（Approved in November 2011）
Implementation Period: 15 February–14 February 2018
Implementation Agency: MOWHS, DUDES
Scope: Urban infrastructure development including water supply, sewerage and roads in Thimphu, Phuentsholing, Samdrup Jongkhar, Nganglam

2） Project: Bhutan Urban Development II
Financing Agency: World Bank Project Type: Loan
Loan Amount: US$12 million（Approved in 2010）
Implementation Period: 29 April 2010 – 31 December 2015
Implementation Agency: Thimphu Thromde

Scope: Municipal reform of Thimphu Thromde and its capacity building, urban infrastructure development of northern areas of Thimphu including water supply, sewerage and roads.

### 3.3.8 Challenges in Urban Planning

Based on the above section, major challenges in urban planning are summarized as follows.

**TU-1: Revision of Population Forecast**

As shown in 3.3.1 (2), the population forecast by the TSP for the year 2027 is set at 162 thousand while another section that estimates tabulates the total population accommodation capacity of the city at 107 thousand. Furthermore, there are totally divergent population allocations for district by these two methods. The tasks of allocating future population increases to different districts are left unresolved. As indicated in 3.3.3, the projects funded by the World Bank and ADB also adopt different population projections with differing assumptions. It is most desirable to reset the official population projection by utilizing the 2015 decennial national census results.

**TU-2: Urbanization of Peripheral Areas**

As described in 3.3.2 (2), now urbanization is creeping into Kabesa and Debisi showing an urban sprawl. There is no physical constraint to north south urban extension to Thimphu. However, liner development leads to less efficient investment.

**TU-3: Urbanization of Hills**

As shown in 3.3.2 (6), urban development is now progressing in an environmentally protected zone of E-4 precinct. Conflicts between urbanization pressure and environmental protection are manifesting itself as political pressures for encroachment.

**TU-4: Application of Urban Planning to Peripheral Areas**

The areas such as Kabesa and Debisi, indicated in TU-2, require an immediate LAP formulation, land use zoning and other development controls.

**TU-5: Delay in Urban Infrastructure Development of Central Areas**

As indicated in 3.3.4, Thimphu has yet to establish another 13 Local Area Plans out of the required 27. In addition, out of established 13 plans, only 4 LAPs in the south and 2 LAPs in the north have funding. The peripheral LAPs have been given more priority in order to convert rural land uses into urban plot and road design to realize more efficient urban structure for the future. As a result, the central areas have been left without proper upgrading of urban infrastructures.

**TU-6: Lack of Funds for Implementation of Local Area Plans**

Realization of urban plots and infrastructure create positive economic externalities in the form of increases in land values. Under a Japanese scheme equivalent to Bhutanese *land pooling,* the ratio of pooling is set at a higher rate of normally around 40% to generate some (not all) funds for infrastructure development. However, a cabinet order in Bhutan restricts the

ratio at 30% which is just sufficient for public space acquisition with no extra funds generated from land pooling itself. In reality, the development funds for LAP implementation depend on external funding and the availability limits the overall financing of LAPs.

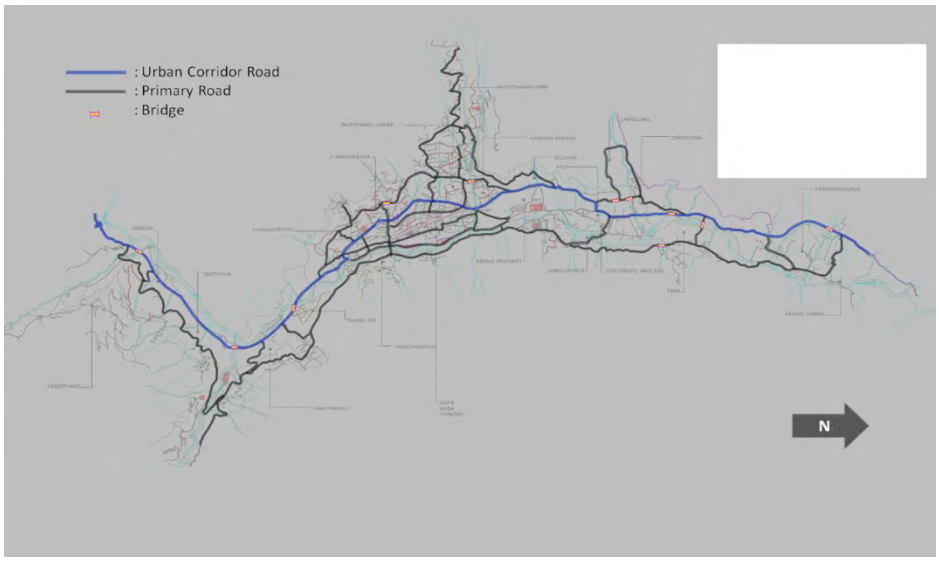
**TU-7: Delay in Development of Beautification and Open Spaces**

Urban development of Thimphu City aims at harmonizing with environment as well as tradition as manifested in the Structure Plan. The development of the city is a role model for the rest of the country. Development of urban infrastructures to enhance urban amenities is essential for the promotion of tourism: an important sector for Bhutan in job creation and foreign exchange earning. However, as indicated in 3.3.6, the implementation of plans for beautification and open spaces is much delayed.

## 3.4 Urban Transport

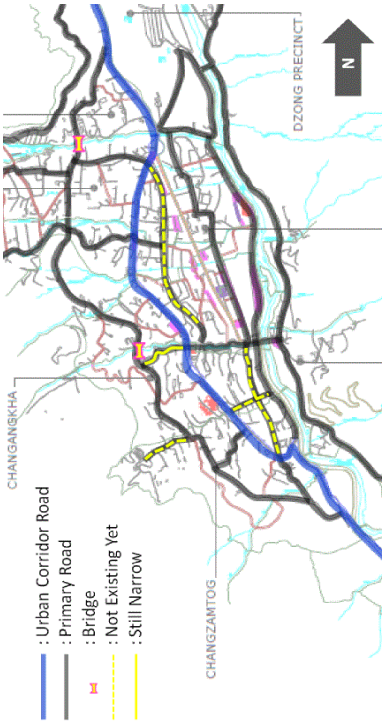
### 3.4.1 Road Network

In the Thimphu Structure Plan 2004 (TSP), the Thimphu road network plan was proposed and the major roads have been developed as shown in Figure 3-17. Four levels of road is specified in the plan: Urban Corridors (Width: 24m), Primary Roads (18m), Secondary Roads (10m) and Access Street (6m). However, as shown in Figure 3-18, some sections of primary road have not been developed yet. It is mainly because that there are already buildings along the planned roads in the central area and it is difficult to secure enough right of way in such areas. Major roads connecting east and west sides of the city are less developed compared with north-south roads because of steep terrain and the river. Instead of road extension and expansion, the city adopted one-way traffic control on major roads in the core area of the city as a remedy.



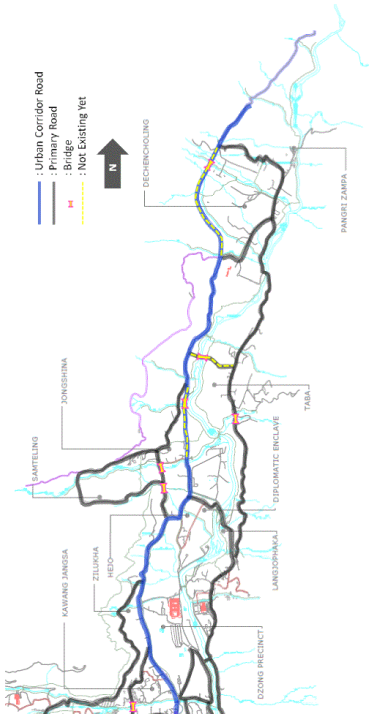

Source: JICA Survey Team

**Figure 3-17 Road Network Plan in Thimphu proposed in the Thimphu Structure Plan 2004 (TSP)**




Source: JICA Survey Team

**Figure 3-18 Current Status of Road Development in Central Part of Thimphu**




Source: JICA Survey Team

**Figure 3-19 Current Status of Road Development in Northern Part of Thimphu**

Planned roads in the north area have not been developed as shown in Figure 3-19. There are still some missing sections and bridges on the urban corridor in this less populated area (Figure 3-20). Roads in the southern parts are comparatively well developed and attract residential development (Figure 3-21). However, the Expressway in the south has divided the area into halves without sufficient crossings such as flyovers or underpasses. Development of sufficient and organized road network is one of key elements to avoid uncontrolled urban development in the suburban areas.

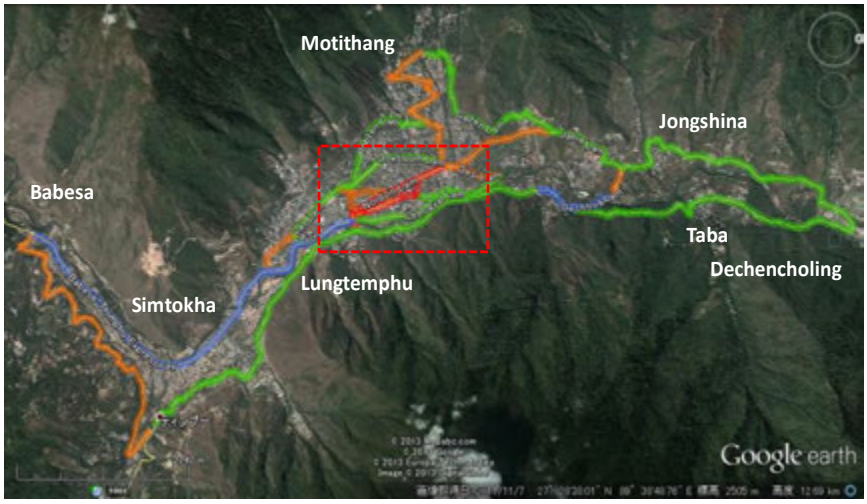
Source: JICA Study Team

**Figure 3-20 Undeveloped expressway in the north area**

Source: JICA Study Team

**Figure 3-21 Expressway and development of new plots in the south area**

Figure 3-22 illustrates travel speed in peak hours on the major roads, based on existing data and speed survey. This data takes into account stoppage time, thus represents the degrees of congestion. Conditions and causes of specific congested sections are analyzed in the following sub-section. Some sections in the outskirt are shown in orange, because those roads run over steep terrains and have winding alignments.




(a) All area


(b) Core area

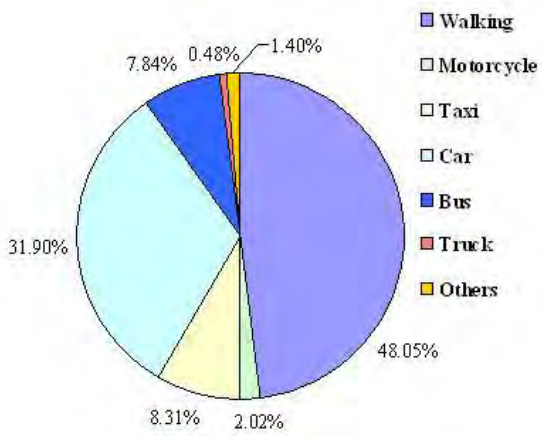
Legend: red = less than 20km/h, orange = less than 30km/h, green = less than 40km/h, blue = more than 40km/h
Source: JICA Study Team

**Figure 3-22 Peak hour travel speed[5] on the major roads**

[5] Travel speed counts stoppage time, and it can represent degree of congestion. "Running speed" is a different indicator which calculates only actual moving time of vehicle.

### 3.4.2 Modal Split

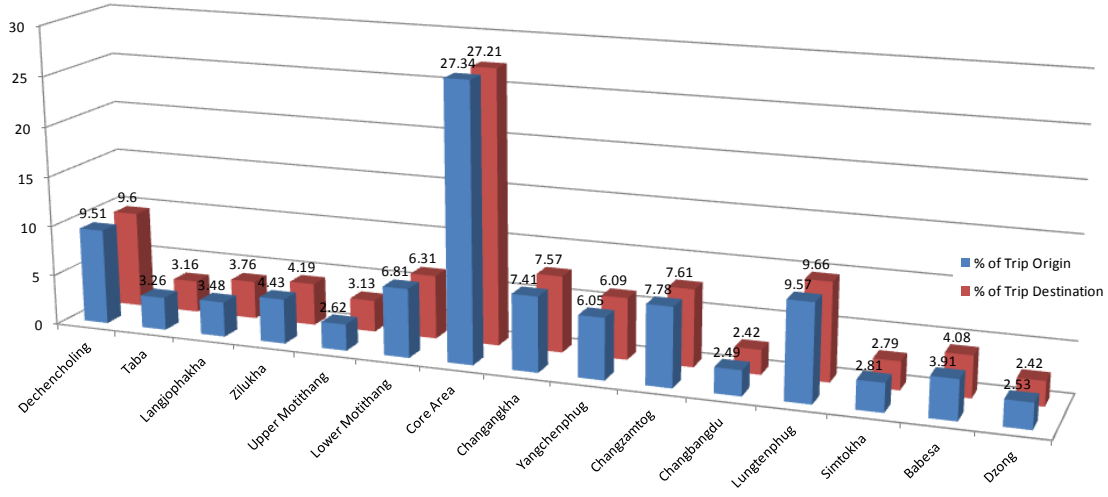
Under Thimphu Urban Transport Study in 2009, a person trip survey was conducted with 1,200 households to collect data to analyze traffic behaviors. According to the data, the percentage of walking accounts for almost half of the all trips made in the city as shown in Figure 3-23. This percentage is significantly high[6] and represents a unique urban structure of Thimphu where most functions are concentrated in walking distances in the compact urban core. However, this percentage is likely to decrease, as the percentage of motorized traffic grows faster in correspondence to increases in car ownership and urban sprawls to suburban areas. Focusing on motorized trips, car and taxi are majority (61% + 16%) and the share of bus remains at 15%. Trips by motorcycle and truck are few in the city.




Source: Thimphu Urban Transport Study (2009)

**Figure 3-23 Modal split in Thimphu**

According to the origin-destination (OD) data of trips in Thimphu Urban Transport Study, a quarter of OD are concentrated in the Core Area where most of offices and commercial facilities are located. There are considerable night-time population in Dechencholing and Lungtenphu, which have relatively high OD concentration outside of the Core Area (Figure 3-24).




Source: based on Thimphu Urban Transport Study (2009)

**Figure 3-24 Origin and Destination of Trips by Urban Village in Thimphu**

[6] For instance, percentage of walking trip in major cities in Japan is about 20%.

### 3.4.3 Vehicle Ownership

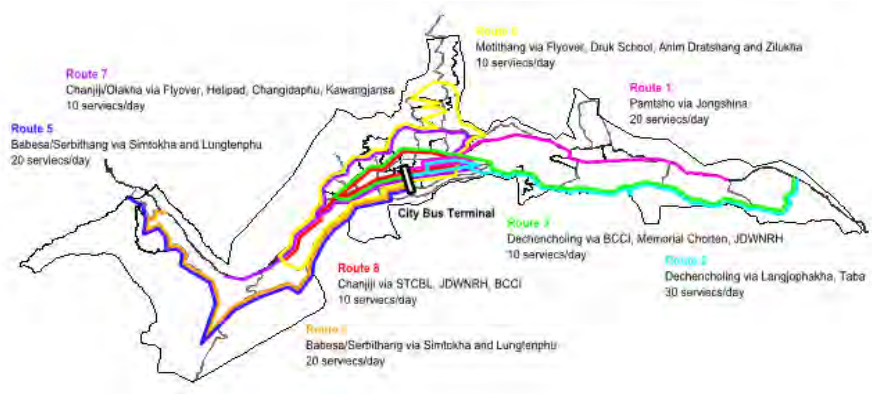
More than half of vehicles in Bhutan are registered in Thimphu and the number keeps growing. Vehicle registration in Thimphu increased 12.8% per year in the recent 5 years up to reach 33,546 registered vehicles in 2011, while annual growth rate of population was 12.7% between 2000 and 2005. Although it is commonly perceived that population growth has slowed to some extent since 2005, the number of vehicle grows faster than population because of growth in income and increase of longer distance commutes from suburbs. These trends are expected to last in the short run, hence demand to own private vehicles is expected to grow.

Cabinet of Bhutan has an intention to promote utilization of Electric Vehicles (EV) in Thimphu. Thimphu Thromde has already introduced a couple of EVs for public use. Low emission type bus fleet is preferred for increase of bus service capacity in future.

### 3.4.4 Present Mass Transit Service

"City Bus" operated by Bhutan Post Ltd. is a trunk service of public transport in Thimphu. There are 8 bus routes reaching the terminal in the Core Area from 6 AM in the morning to 8 PM in the evening as shown in Figure 3-25. Radial routes for north-south movements in the city have frequent services in response to higher demands compared with circular routes. According to Bhutan Post, demand between the core and suburb keeps growing in the recent years. Data in Thimphu Urban Transport Study tells that 27% of bus users are commuters and 30% are students. Buses run beyond the full capacity for passengers in morning and evening peak hours.

Three private operators also provide bus services on the routes between core and suburbs to capture growing passenger demands. Unlike Bhutan Post's service, these private buses stop anywhere, as there are no fixed bus stops for the service. Besides of intra-city services, RSTA (Road Safety and Transport Authority) owns an inter-city bus terminal space where a number of private operators are licensed to operate. The Thimphu Structure Plan proposes the relocation of both intra- and inter-city bus terminals, but the plan has not been realized due to uncompleted land acquisitions.

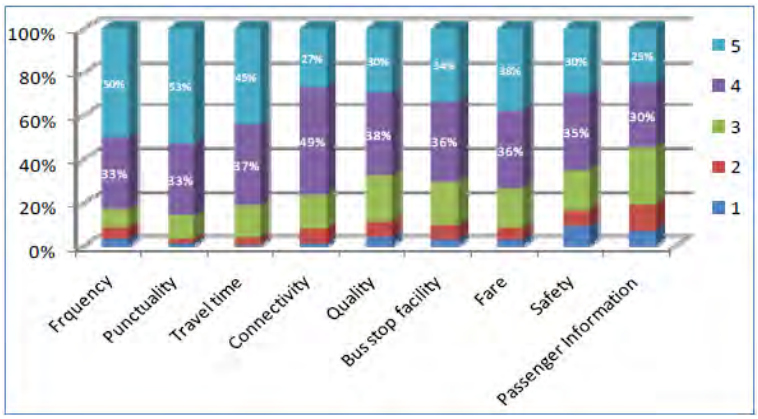



Source: JICA Survey Team

**Figure 3-25 City Bus Route in Thimphu**

IFC's study shows the result of opinion survey towards bus users (Figure 3-26), which demonstrates high satisfaction of users on most performances. Nevertheless, the results show

that bus services can be further improved if there are more provision of safety measures, bus routes and schedule information with shelter at every bus stop.




Note: 1 "very bad", 5 "very good"
Source: Bhutan Urban Transport System, System Selection and Eco-Friendly Report (2011)

**Figure 3-26 Perception towards City Bus Service**

IFC carried out a feasibility study on urban transport system in 2011 and recommended phased introduction of Buss Rapid Transport (BRT) system along with growth of passenger demand. According to the study, initial Pre-BRT stage will introduce 8 low emission fleets and operate frequent services on bus priority lanes by utilizing existing roads. In future, it proposes to extend the routes and to increase fleets in response to infrastructure development and demand growth. Planned trunk route runs 16.7km from Babesa in south to Dechencholing through Norzin Lam and Chang Lam in the Core. The study also proposes 3 feeder routes to supplement the trunk route. Although it is noted that full scale BRT with exclusive bus lane is not necessary until 2022, it will be a big challenge to secure space for bus lanes, especially in the Core Area. Availability of space and impacts to vehicle movements should be carefully examined, when excusive lanes are needed.

A Public Private Partnership (PPP) scheme is envisaged for the operation of the BRT. GNHC allocated Nu. 160 million, out of which Nu.150 million for buses, as a BRT scheme t under the 11th Five Years Plan. However, the actual funding source is not yet identified. Full-scale BRT would necessitate the acquisition of the right-of-way, thus will be accompanied with some difficulties. Therefore, the intermediate step in implementation would be the introduction of frequent looping or shuttle bus transit on main streets.

### 3.4.5 Mass Transit Operations

As written above, Bhutan Post Ltd. is the leading bus operator in the city. The company under MoIC receives subsidies from the governmental account to cover the operational deficit. The number of fleet has been increased to 32, and the procurement cost is also subsidized by Ministry of Finance. Because of this financial status, the service is run by minimum number of staff and budget. Bus fares are charged according to the number of passing bus stops.

### 3.4.6 Pedestrian Network

Thimphu Structure Plan proposes to make Norzin Lam a vehicle free pedestrian zone. Norzin Lam is presently a street of one lane and one directional traffic with on street parking space and pedestrian paths. Although some study repeatedly emphasizes the implementation of the plan, there are several issues to make it happen;

A) If automobiles are excluded from the most congested Norzin Lam, diverted traffics will shift to other streets in search of alternative routes. This impact should be carefully assessed from traffic management perspectives.
B) There are strong oppositions from commercial establishments and suppliers to the plan. It is necessary to make the plan accommodate the needs of the business community.
C) Development of multi-parking buildings can help automobile exclusion from the street. It is desirable to secure sufficient capacity and accessibility to the main street.
D) New public transport route is planned through Norzin Lam to serve access for pedestrian from the outskirt area. Development of footpaths is given an emphasis in the Structure Plan. Footpaths play a critical role to supplement east-west movements in the central Thimphu where vehicle routes are constrained by slope in the direction. Beautification and pavement improvement can increase attractiveness of footpaths and sidewalks for pedestrian.
E) Creating an exclusive pedestrian zone can be achieved by combination of some related measures as mentioned above, and examination is needed in a comprehensive manner. Consensus building is also important with automobile users and commercial sector. There is an initiative of pedestrian day throughout the country, and it was originally set on every Tuesday. However, it has changed to operation only in the environmental day and Tsechu festival days due to opposition from them.

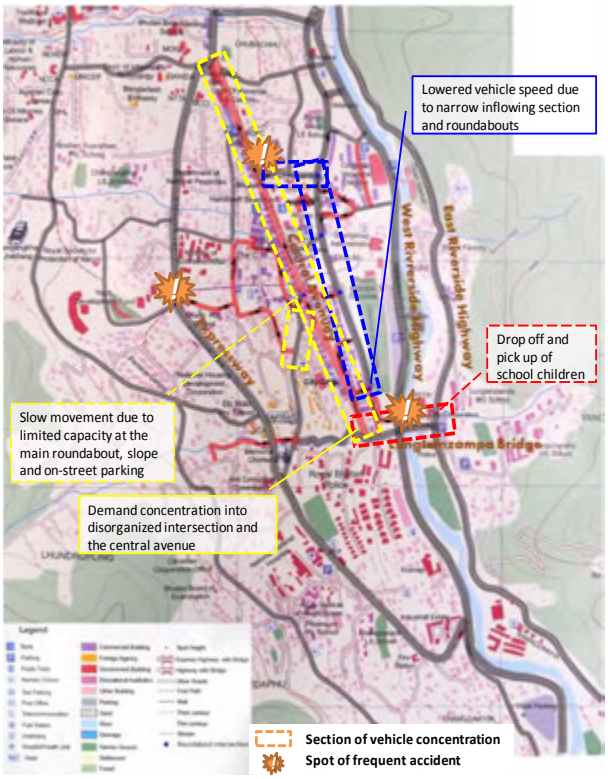
### 3.4.7 Traffic Management and Road Safety

Figure 3-27 summarizes spots of vehicle concentration and accidents in central Thimphu. Congestion is observed just on a couple of roads in peak hours and it is not yet in serious condition. However, the situation is likely to become worse, as increasing vehicle population cannot be accommodated by the existing road capacity which is constrained by on-street parking, slope and roundabout.

Among the problem sections, JICA Survey Team regards the area around Lungtenzampa Bridge as the most problematic bottleneck of urban transport in Thimphu. That is because this area is a junction of the busiest roads such as Norzin Lam, Chang Lam and Expressway but intersection is poorly designed and causes vehicle concentration not on the bridge but on the crossing of these major roads. This area is a forerunner of the future traffic problems in the city. More detailed analysis is given in the following sub-section.

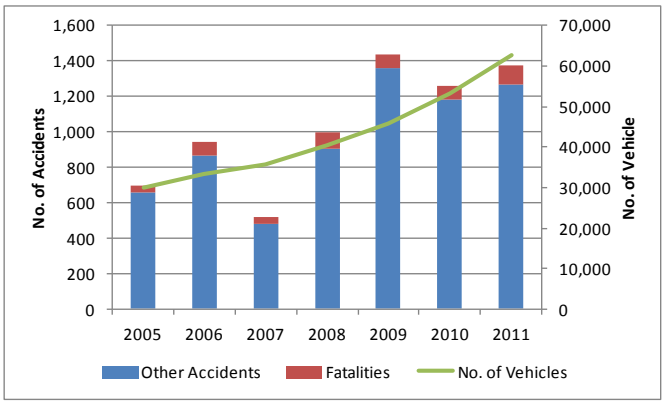
Figure 3-28 shows traffic accident data in national level from 2005 to 2001. According to this data, the number of traffic accident increases along with a growth in number of vehicles.

Although there is no location-wise data in Thimphu, dangerous points are generally perceived as shown in the above map.




Source: JICA Survey Team

**Figure 3-27 Vehicle concentration and accident spot in Thimphu**




Source: based on data from Road Safety and Transport Authority

**Figure 3-28 Traffic accident statistics in Bhutan**

Inside the Core Area, however, accidents tend to be not serious due to slow vehicle speeds. Most of fatal accidents occur in mountain roads outside of the city.

### 3.4.8 Parking Space

The Core Area of Thimphu was formed before motorization and the city did not prepare sufficient parking space to accommodate a large number of vehicles. Under this condition, the roadside space is used as on-street parking (Figure 3-29, Figure 3-30), and it results in reduction of road capacity. Thimphu Thromde manages 1,500 slots of on-street and off-street parking and outsources the collection of time based parking fees to private companies.

Parking lots in the Core Area are fully occupied during daytime, and there is scarcely room to allocate new on-street parking lots in the area. One solution is to utilize the limited area more efficiently. Based on the idea, IFC has proposed development of 5-storied multi-car parking building on a Public-Private Partnership (PPP) scheme on public land. Securing enough parking spaces is needed in both Core Area and surrounding areas, but it should be planned jointly with public transport and demand control of vehicle traffic. Experiences in other countries indicate that solely increasing parking space prompts more traffic, often aggravating the situation.

Regarding freight traffic, truck terminal is located along the Expressway, and trucks are not allowed to enter the Core Area during peak traffic hours (Figure 3-31).


Source: JICA Survey Team

**Figure 3-29 Major Parking Space in Central Thimphu**

Source: JICA Survey Team

**Figure 3-30 On-street Parking**

Source: JICA Survey Team

**Figure 3-31 Truck Terminal**

### 3.4.9 Traffic Survey

#### (1) Survey Outline

Study Team conducts traffic survey around Lungtenzampa Bridge which is the major bottleneck of traffic in Thimphu. The scope of the survey is summarized in Table 3-13.

**Table 3-13 Outline of traffic survey in Thimphu**

| | Survey Type | | |
|---|---|---|---|
| | **Traffic Count** | **Occupancy Survey** | **Pedestrian Count** |
| **Purpose** | To analyze inflow and outflow of the Bridge | To analyze pick-up and drop-off movement | To analyze pedestrians' movement |
| **No. of Location** | 7 (including on the Bridge)<br>x 2 directions | 1 (on the Bridge)<br>x 2 directions | 1 (on the Bridge)<br>x 2 directions |

| | | | |
|---|---|---|---|
| **Target** | Passenger vehicle, Taxi, Bus, Mini truck, Medium and heavy truck, Motorcycle, Others | Passenger vehicle, Taxi, Bus | Pedestrian |
| **Time** | 7:00 ~ 19:00 (12 hours) in 1 week day and 1 weekend day | | |

Source: JICA Survey Team

### (2) Survey Result

The results of traffic count survey are summarized below (Figure 3-32, Table 3-14, Figure 3-33)) and more detailed data is compiled in Appendix F. In the following data, morning peak hour is from 8:00 to 9:00 and evening peak hour is 16:00 to 17:00. The total numbers are simple summation in vehicle basis and not converted into *passenger car units* (PCU), as most of traffic is comprised of ordinary passenger vehicles and taxis.


Unit: vehicles (all types of vehicle counted in 07:00~19:00 of a weekday)
Source: JICA Survey Team

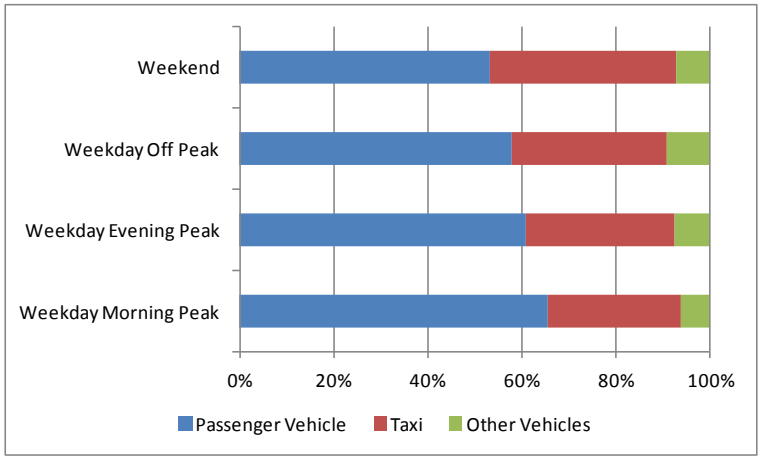
**Figure 3-32 Traffic movement around Lungtenzampa Bridge**

**Table 3-14 Traffic volume and peak hour ration at survey points**

| | Direction | Weekday | | | Weekend | | |
|---|---|---|---|---|---|---|---|
| | | 12 hours (veh.) | Morning peak | Evening peak | 12 hours (veh.) | Morning peak | Evening peak |
| | To Core | 4,836 | 13.6% | 10.1% | 3,267 | 7.0% | 10.3% |
| | From Core | 4,303 | 13.4% | 9.9% | 3,016 | 6.6% | 10.5% |
| | To Core | 16,272 | 12.5% | 10.0% | 13,774 | 5.9% | 8.0% |
| | From Core | 9,879 | 10.2% | 9.3% | 7,167 | 6.5% | 9.5% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | To Core | 8,490 | 15.3% | 8.3% | 7,335 | 6.0% | 11.3% |
| | From Core | 7,244 | 8.3% | 10.6% | 6,369 | 5.8% | 9.4% |
| | To Core | 3,755 | 10.1% | 10.5% | 2,659 | 5.5% | 11.1% |
| | From Core | 4,081 | 13.4% | 9.4% | 2,864 | 5.1% | 10.8% |
| | To Core | 1,929 | 14.4% | 8.6% | 1,576 | 5.7% | 10.0% |
| | From Core | 1,419 | 9.9% | 10.1% | 1,202 | 6.7% | 9.1% |
| | To Core | 1,493 | 9.7% | 9.6% | 665 | 8.7% | 9.2% |
| | From Core | 1,484 | 14.8% | 8.0% | 620 | 6.8% | 10.0% |
| | To Core | 2,516 | 14.5% | 8.6% | 3,428 | 5.7% | 11.7% |
| | From Core | 3,075 | 7.0% | 10.0% | 3,950 | 4.1% | 11.0% |

Source: JICA Survey Team




Source: JICA Survey Team

**Figure 3-33 Vehicle Type Composition (total of all locations and directions)**

The above survey results are summarized as follows:

A) The highest vehicle concentration is observed at the entering point of Norzin Lam, where vehicles flow into from Expressway, Chang Lam (turning), bridge and Dzongchen Lam Road to the hillside in the west.

B) Most of the traffics over the bridge are short-distance traffics and just turn around after the bridge, and there is much less traffic on the road in the east side compared with that on the bridge.

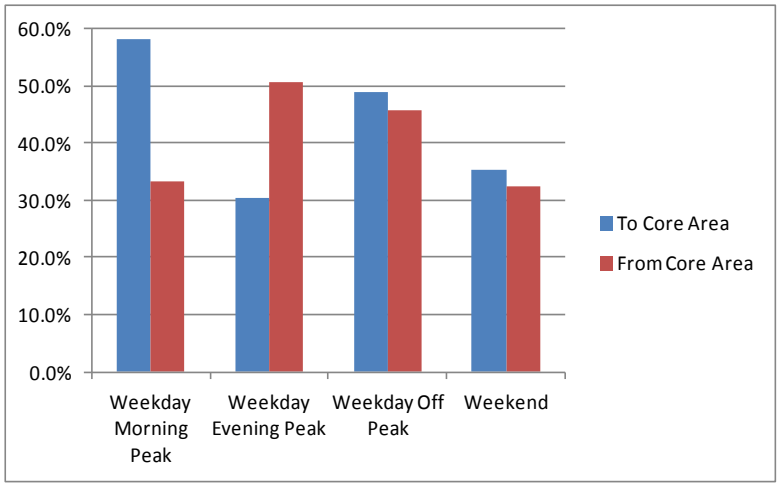
C) Traffic in the weekday concentrates on peak hours in morning and evening, and it accounts for a quarter of 12 hours traffic.

**Table 3-15 Number of Pedestrian over Lungtenzampa Bridge**

| | Weekday 12 hours | Weekday morning (7:30~8:30) | Weekday evening (16:00~17:00) | Weekend 12 hours |
|---|---|---|---|---|
| To Core | 4,261 | 189 | 2,080 | 2,129 |
| From Core | 3,981 | 1,591 | 258 | 2,240 |

Source: JICA Survey Team

Expressway has more traffic in direction to the Core Area in morning time, while in the opposite direction in evening, reflecting commuting movement between the Core and southern suburb.




Source: JICA Survey Team

**Figure 3-34 Single Passenger Car Ratio Over Lungtenzampa Bridge**

D) 90% of counted vehicles are passenger vehicles or taxis and the share of truck and motorcycle is quite limited (Figure 3-33). Particularly during peak hours on weekday, the percentage of passenger vehicle rises due to commuting demands including drop-offs and pick-ups of students.

E) Pedestrians over the bridge are concentrated during weekday mornings and evenings, and there are much fewer pedestrians on weekends. The number of pedestrians exceeds 2,000 at the busiest hour and most of them are school children (Table 3-15).

### 3.4.10 Bottleneck Analysis

The area around the Lungtenzampa Bridge is a gateway point to the Core Area from the southern and eastern areas. It is the most problematic bottleneck in the city. The present situation and the cause of the bottleneck are analyzed based on the results of traffic survey in the following sections.

#### (1) Lungtenzampa Bridge

The busiest time on the Lungtenzampa Bridge is around 8 AM in the morning and 16 PM in the afternoon. Congestions at these times are caused by drop-offs and pick-ups of school children at schools on the east side of the bridge. There are two schools side by side in the same locality. The total number of student exceeds 2,000. During the busiest 30 minutes before school opening time (8:15), more than 200 vehicles were observed to approach the schools, according to the traffic counts. Those vehicles came from the west side of the bridge and returned to the same way immediately over the bridge after dropping off children. Single passenger vehicle ratios in Figure 3-34 also implies this returning movement for drop off and pick up of children. This vehicle movement is a main cause of congestion of both directions on the bridge in the morning and evening.

Besides congestions, there is a concern about safety on the bridge. Risk of accidental contacts between pedestrian and vehicle is high. There are more than 2,000 pedestrians in peak hours, and the roadside paths are not wide enough for concentrated flow of pedestrians and guard rail is not equipped. Structure of the bridge is damaged after 20 years of construction by

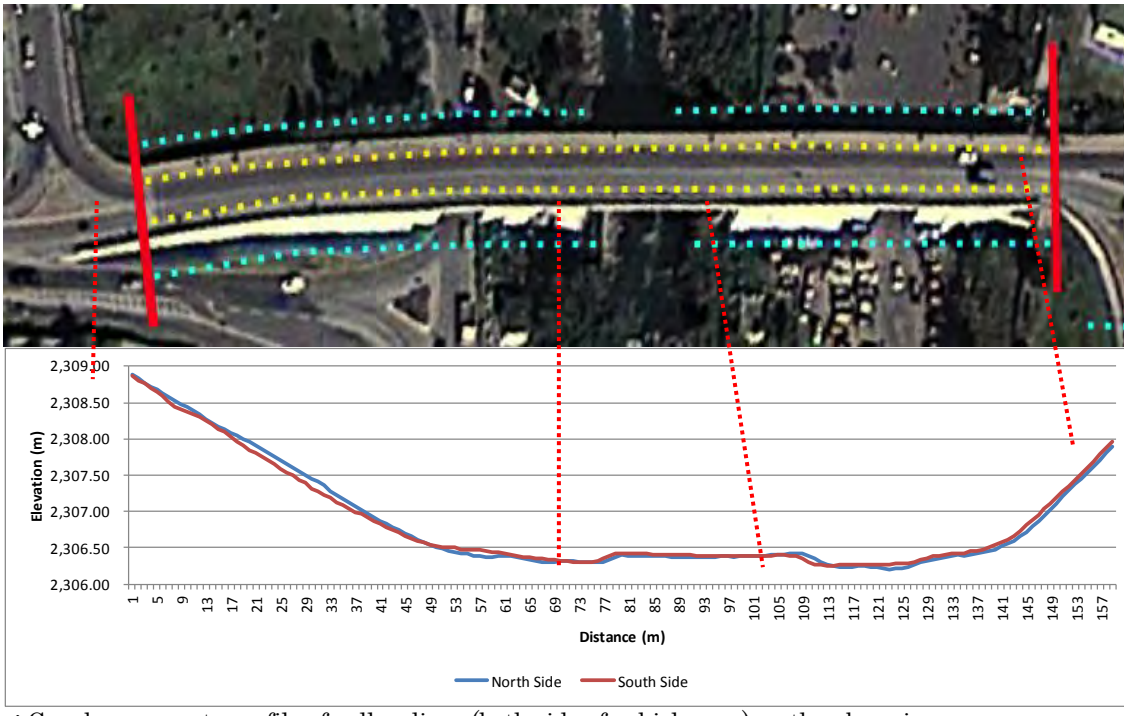
Source: JICA Survey Team

**Figure 3-35 Pedestrian on Lungtenzampa Bridge**

Source: JICA Survey Team

**Figure 3-36 Damages of Lungtenzampa Bridge**

India. The bridge has sunken and water stands in the sunken spots when it rains hard. There are some holes drilled afterwards to discharge rainwater on the bridge. According to the latest topographic survey data by Thimphu Thromde, irregular ups and downs are observed on the




Note: Graph represents profile of yellow lines (both side of vehicle way) on the above image
Source: JICA Survey Team based on survey data by Thimphu Thromde

**Figure 3-37 Vertical cross-section of Lungtenzampa Bridge**

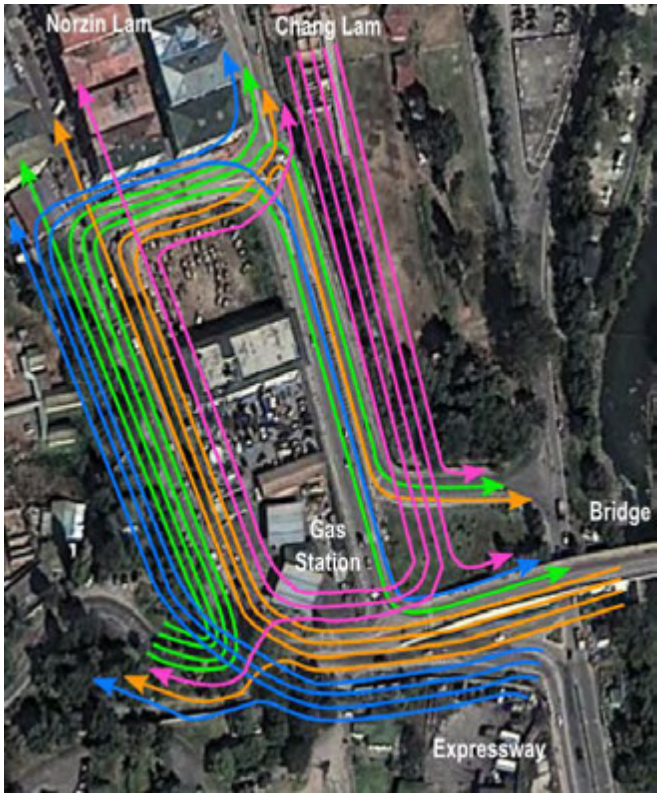
surface of the bridge. These irregular surface levels, especially around the main girder, imply

the deterioration of bridge structure, although there is not the original level data at construction time to make comparison. (Figure 3-35, Figure 3-36, Figure 3-37)

### (2) Traffic Flow at Entrance to Core Area

Complicated intersection arrangement on the west side of the bridge is another cause of congestion in this area. A large number of vehicles enter in this area especially from suburban areas through Expressway. (Figure 3-38) The intersection is not designed to handle such high traffic demand. Problems in traffic flow management are summarized below.

A) Excessive concentration occurs at the entering section to Norzin Lam, because vehicles have to detour one direction lanes to access Chang Lam and the bridge.
B) A gas station in the south end of Chang Lam causes waiting queues, and vehicles return to the Core Area after filling gas (Figure 3-40).
C) Four roads meet at the south-western section shown in Figure 3-39, and it causes complicated weaving of traffic that reduces travelling speeds. Prioritization and channelling of traffics are not properly designed.




Source: JICA Survey Team

**Figure 3-38 Vehicle Movement on West Side of Lungtenzampa Bridge**

Source: JICA Survey Team

**Figure 3-39 Inflow from Different Directions**

Source: JICA Survey Team

**Figure 3-40 Queue before Gas Station**

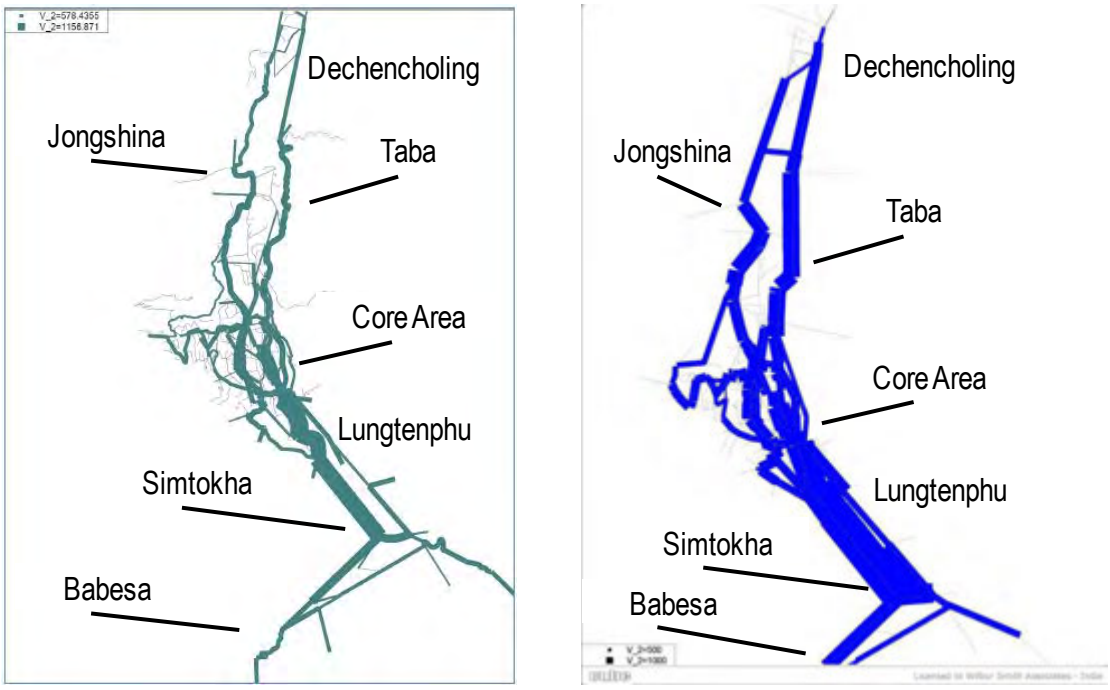
### 3.4.11 Projection of Traffic Generation

#### (1) Review of the Existing Studies

There are two existing demand analysis studies of Thimphu; Thimphu Urban Transport Study in 2009 by Department of Urban Development and Engineering Services (DUDES) under MoWHS; and Bhutan Urban Transport System: System Selection and Eco-Friendly Feasibility Report in 2011 by IFC. Both studies are based on actual traffic survey data and employ standard four steps modeling. The results of these studies are not always same due to difference in base data, unit factors, population scenario, and setting of the network. The results are summarized as follows.

According to DUDES study, traffic demand in trip basis grows 3% per year. Generation volume in 2015 increases by 20% and volume in 2020 increases by 35 % compared with that in 2009.

Figure 3-41 is the result of network assignment of traffic demand estimated in the IFC study. According to the result, demand grows especially on Expressway between the Core Area and Simtokha in the south and it will exceed the road capacity in ten years to 2022. Simtokha is a junction of two inter-city roads. Demand in the north area also grows on roads in both sides of the river.




(a) Base year (2012) (b) Forecast of "do-nothing" scenario (2022)

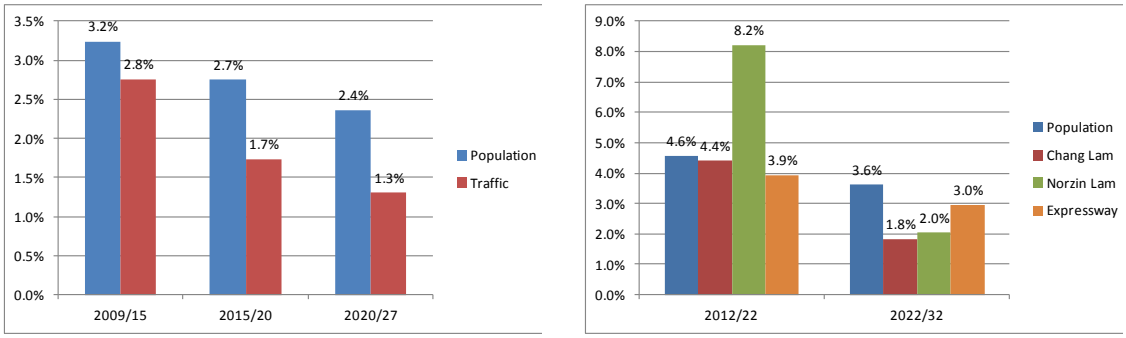
Source: Bhutan Urban Transport System, System Selection and Eco-Friendly Report (2011)

**Figure 3-41 Traffic demand assignment on the network**

#### (2) Analysis on Traffic Growth Rate

As mentioned above, there are some difficulties to make simple comparison between estimated demands in the two studies. To analyze possible patterns of demand growth, this study compares the growth rates of traffic demand and base population in these two studies. Figure 3-42 shows that IFC estimates a higher population growth but growth rates assumed in both

models are less than 5% and decrease in future. On the other hand, the growth rates of traffic are a bit slower than population growth. The elasticity of traffic growth against population growth ranges from 0.55 to 0.85 in the DUDES model. Exceptionally, IFC model estimates remarkably high traffic increase in Norzin Lam during the period from 2012 to 2022. It is considered that this model evaluates difference of link performance and represents vehicle concentration into the Core Area well.




(a) Growth rate in DUDES projection (b) Growth rate in IFC projection

Source: based on Thimphu Urban Transport Study (2009) and Bhutan Urban Transport System, System Selection and Eco-Friendly Report (2011)

**Figure 3-42 Comparison of growth in population and traffic**

Based on the above analysis and traffic count data, future traffic and volume to capacity ratio (V/C ratio)[7] are estimated on Lungtenzampa, Expressway, Norzin Lam and Chang Lam as shown in Figure 4-43 and Table 3-16.

**Table 3-16 Estimation of future traffic demand**

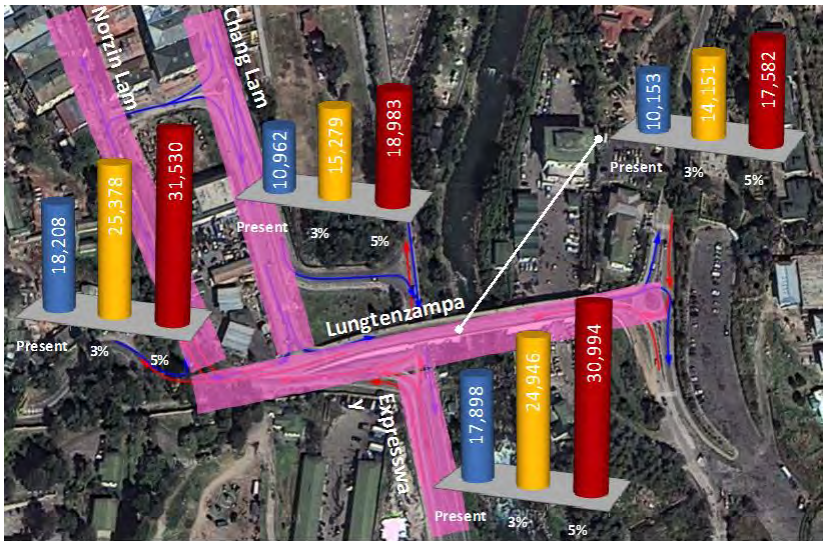
| | | Lungtenzampa | | Expressway | | Norzin Lam | | Chang Lam | |
|---|---|---|---|---|---|---|---|---|---|
| | | PCU** | V/C Ratio | PCU** | V/C Ratio | PCU* | V/C Ratio | PCU* | V/C Ratio |
| 2013 Present | | 10,153 | 0.91 | 17,898 | 0.60 | 18,208 | 1.52 | 10,962 | 0.74 |
| 2027 3% Growth | High | 14,743 | 1.33 | 25,989 | 0.87 | 26,439 | 2.20 | 15,918 | 1.08 |
| | Middle | 14,151 | 1.27 | 24,946 | 0.84 | 25,378 | 2.11 | 15,279 | 1.04 |
| | Low | 13,582 | 1.22 | 23,942 | 0.80 | 24,357 | 2.03 | 14,664 | 0.99 |
| 2027 5% Growth | High | 18,803 | 1.69 | 33,146 | 1.11 | 33,720 | 2.81 | 20,301 | 1.38 |
| | Middle | 17,582 | 1.58 | 30,994 | 1.04 | 31,530 | 2.63 | 18,983 | 1.29 |
| | Low | 16,435 | 1.48 | 28,971 | 0.97 | 29,473 | 2.45 | 17,744 | 1.20 |

Note: * PCU in 12 hours ** the values of Lungtenzampa and Expressway are total of two directions.
Source: JICA Survey Team

[7] When V/C is larger than 1, there is vehicle concentration exceeding design capacity of road.

The elasticity of traffic growth against population growth is assumed 0.7~0.9. Assumed road capacity is 1,500 PCU/hour on undivided two lanes section (Lungtenzampa, Norzin Lam and Chang Lam) and 3,600 PCU/hour on four lanes Expressway[8].

According to the result, current traffic on the Lungtenzampa Bridge is already at a level close to its capacity and it will go over the capacity in any scenario in 2027. The capacity of Expressway is comparatively large, but it is likely that traffic surpasses the capacity if population keeps growing by 5% every year. On Norzin Lam, traffic volume is found much higher than its capacity even in the current level. This analysis is based on roughly assumed elasticity and the result implies just one possibility. More precise estimation requires analysis of parameter based on the past trend and future population data by area. In this regard, it is desirable to include more accurate simulation of transport demand and population into the scope of Structure Plan revision.




Note: Unit is PCU in 12 hours (medium level estimation). The values of Lungtenzampa and Expressway are total of two directions.
Source: JICA Survey Team

**Figure 3-43 Estimation of traffic demand in 2027 by population scenario**

### 3.4.12 Ongoing Projects

#### (1) Progress of the Structure Plan

Thimphu Structure Plan is the basis of urban transport projects in the city. Although there are uncompleted projects after 10 years from the plan, necessity of the proposed projects is still high. In particular, promotion of public transport and pedestrianization in the central area are repeatedly mentioned in various planning documents such as Bhutan Transport 2040 (2011) by ADB. Table 3-17 summarizes outline and present status of urban transport projects proposed in the Structure Plan.

**Table 3-17 Status of proposed projects in the Structure Plan**

| | Project | Present Status |
|---|---|---|
| 1 | Upgrade and develop the existing road according to the assigned hierarchy | As noted in 3.1.1, some major sections in central and north area have not been developed yet due to limitation in land availability. |

[8] Values shown in Bhutan Urban Transport System, System Selection and Eco-Friendly Report (2011) are referred.

| | | |
|---|---|---|
| 2 | Construct new road | |
| 3 | Widen exiting bridge | Not adequately implemented. There is a need of rehabilitation of damaged Lungtenzampa Bridge. |
| 4 | Construct new bridge | Still missing especially in the north area; bridge to connect Jongshina and Taba; and new bridge near Dzong |
| 5 | Develop and improve road junction | Divider, one way regulation and road marking have been installed in some sections. There is discussion on introduction of signaling system, but it is not materialized. |
| 6 | Implement a Mass Transport System for the Thimphu City and the economic centers in the surrounding region | IFC conducted feasibility study for introduction of BRT system. Strategic development of urban hubs has not been implemented due to land constraint, though urban area expands to suburb. |
| 7 | Construct new Inter-City Bus Terminal | Relocation to junction point of highways is proposed, but land has not been acquired. The new location might be less convenient, as it moves out from the central area. |
| 8 | Develop a City-Bus Terminal | It is proposed to relocate to the site of present inter-city bus terminal, but the plan has not been realized because of land issue noted in the above column. It will benefit by easing traffic movement on road in the central area, but new location might be less convenient for users. |
| 9 | Develop new parking lots along Public transportation links | IFC proposes development of multi-storied parking building. Parking demand will continuously grow. |
| 10 | Construct Bus-stops with adequate street furniture | Undeveloped except for some stops. It will enhance attractiveness of public transport and encourage modal shift. |
| 11 | Construct and develop Taxi stands | Developed in the central area. Space should be allocated based on the number of taxi and balance among areas. |
| 12 | Construct and develop Bicycle tracks and pedestrian pathways | Bicycle tracks are set on some roads. Pedestrian pathways should be utilized more strategically for users' convenience to access the main street and public transport. |

Source: JICA Survey Team

### (2) Donor Projects

As already noted, IFC has proposed some projects based on the detailed study on urban transport in Thimphu as follows:

A) Construction of a five-storied car park building in the Core Area
B) Introduction of BRT system: initial stage is called as "Pre-BRT" stage where low-emission type fleets are operated on the existing roads.

Thimphu Thromde is in charge of the car park building as a potential PPP project, but budget and implementation structure for the projects have not been fixed yet. GNHC has allocated a budget for the BRT project in the coming 11th Five Year Plan (see 3.2.2) to start implementation.

## 3.4.13 Development Needs

Development issues in urban transport sector are summarized as follows.

### TT-1: Traffic Congestions at Entry Point to the Core Area

Current transport bottleneck is roads around Lungtenzampa Bridge where large volume of traffic concentrates into the complicated intersection. Improvement of traffic flow in this area is a significant challenge, as the situation is expected to be worse when traffic demand grows. More efficient layout of the area should be examined based on detailed traffic flow analysis.

### TT-2: Lack of Parking Space

As indicated in 3.4.8, the parking space in Thimphu during the daytime is saturated. Searching vacant lots at low driving speeds exacerbates traffics on main streets of the city. IFC has proposed the construction of a multi-storied parking under PPP. Experiences in other countries indicate providing more parking space often induce more traffics to the area, thus only provides a short term relief.

### TT-3: Future Traffic Increases

Traffics in Thimphu is increasing steadily in pace with the growth of automobile ownership. Street parking reduces the road capacity as well. It will not be long before the city sees the traffic paralysis with the continuation of the current trends. Overconcentration of traffic demand into the Core Area is an issue of Thimphu, and commuting vehicles flow into limited access roads in peak hours. This trend continues for some time along with population growth in peripheral areas. However, it is obvious that this demand structure is not sustainable, considering the limited road infrastructure.

### TT-4: Poor Pedestrian Environment

Although the number of vehicle is increasing, percentage of walking trip is still high in Thimphu and this strong point should be sustained into the future. It is reasonable to enhance vehicle free environment in the city where there is limitation of new development of roads and bridges in terms of topography. However, the conditions of footpaths in terms of amenities and connectivity are still in poor conditions in Thimphu. Various measures should be linked in a comprehensive manner in order to improve pedestrian friendly environment. Such measures include improvement of footpath in the compact Core Area, strengthening of public transport and allocation of parking facilities.

### TT-5: Undeveloped Major Road System

As indicated in Table 3-17 of 3.4.12, the most of the major roads planned by the Thimphu Structure Plan are not yet implemented. The only portion completed is the southern portion of the Urban Corridor.

### TT-6: Undeveloped Public Transit

As indicated in 3.4.2, buses share only 15% of the automobile based person trips in Thimphu. Widening of existing roads and construction of new roads are very limited in Thimphu due to space constraints. It is obvious that future traffic increase while retaining the current modal share would lead to transport paralysis of the central areas of the city

## 3.5 Water Supply

Water supply services in Thimphu consist of following two categories:

- Thromde Water Supply (TWS)
- Community Water Supply (CWS)

Thromde Water Supply is a water supply service provided by Thimphu Thromde. Water is produced at Motithang WTP, Jongshina WTP and bore wells, distributed to users through distribution networks. Thromde is responsible for the construction, operation and maintenance of the water supply facilities. Users pay water tariff to Thromde.

Meanwhile, Community Water Supply is an interim water supply scheme applied in the urban areas newly incorporated to Thimphu Thromde. Water is taken in the upstream of rivers, sent to storage tanks located near users and delivered to the users from the storage tanks. In this scheme no treatment and disinfection are conducted.

### 3.5.1 Water Sources

Major water source of the existing water supply systems is surface water from streams flowing into Wang Chhu and groundwater. Water supply system currently under construction and the planned ones also rely on the inflow steams to Wang Chhu.

The wells (Changbangdu wells) currently under operations, located on the right bank near the traditional bridge, are considered to be an interim water source. In other areas having difficulty in accessing to surface water, wells are used as a water source. Wells will be used as a water source in Debisi Development Plan as well.

Dependence on the groundwater is relatively low in Bhutan presently and historically where it is easy to obtain clear water from streams in valleys (however, dependence on the groundwater is higher in the southern flatland.). In Thimphu being developed along the Wang Chhu, major water sources have been stream water as well. The wells presently used are developed as an interim measure to the areas where the existing water supply system cannot reach. However, no hydrogeological survey has been conducted and water source potential of the groundwater has not been evaluated. The groundwater currently utilized is considered to be river-bed water which is directly affected by surface water.

Comparison of the design intake capacity of the two existing water treatment plants and water treatment plants to be constructed by ADB and World Bank projects and the maximum water intake potential of the water sources is shown in Table 3-18.

**Table 3-18 Design Water Intake and Maximum Water Intake Potential**

| WTP | Water Source | Design | Maximum | Remarks |
|---|---|---|---|---|
| Motithang | Upper Motithang | 6,500 | 8,018 | Existing |
| Jongshina | Samteling Chhu | 6,500 | 13,686 | Existing |
| Megypang | Lungten Chhu | 6,500 | 27,994 | Under |
| Dechencholing | Dechencholing | 1,400 | 4,631 | Planned |

1: These are design capacities of WTPs. Actual water intake may be 10 to 15 % more due to the operation loss such as back-washing.
2: Maximum intake was calculated by basin area and 10 year specific drought run-off ($0.4m^3/sec/100km^2$), which was derived from drought analysis in Appendix D.

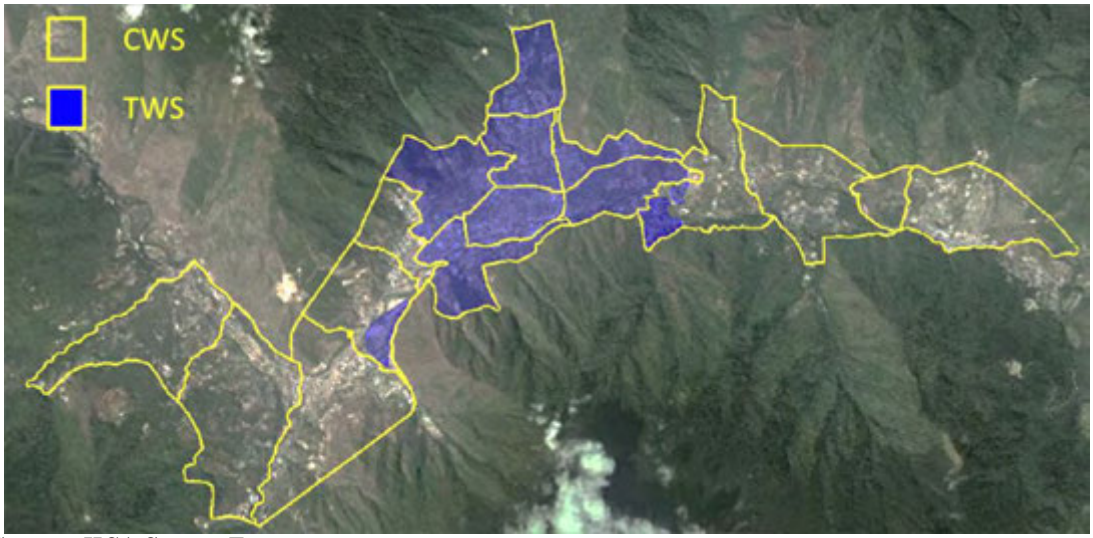
While the maximum water intake potentials of Jongshina WTP, Megypang WTP (ADB Project) and Dechencholing WTP (World Bank Package II) are considerably larger than the design intakes, the design intakes for the other WTPs are approaching the maximum potentials.

Branch streams of Wang Chhu near Thimphu are relatively small with a small catchment area; accordingly it has a low water source development potential and a large flow fluctuation, resulting in instability as water source.

Wang Chhu itself has an estimated water source capacity of approximately150,000 $m^3$000$m^3$/day (assuming catchment area of 480 $km^2$ and specific runoff of 0.4 $m^3$/sec/100 $km^2$) at the north part of Thimphu, which is equivalent to demand for a half to one million of the population.

### 3.5.2 Water Supply Conditions

In Thimphu all the urban villages covered by either of water supply services of TWS or CWS. Figure 3-44 shows the urban villages covered by TWS and CWS. Table 3-19 shows the population by urban villages. Among 15 urban villages in Thimphu Thromde, 9 urban villages (2 of them are partially) are covered by TWS, in population-wise 54,481 among 111,421 of a total population of Thimphu Thromde, counting 49 %.




Source: JICA Survey Team

**Figure 3-44 Areas Covered by TWS and CWS in Thimphu**

**Table 3-19 Population by Urban Village and Category of Water Supply**

| Urban Village | Name of Areas | Population of Area | Population of Urban Village[1] | Category | Population by Category | |
|---|---|---|---|---|---|---|
| | | | | | TWS | CWS |
| Taba-Jongshina | | | 15,944 | CWS | 54,481 | 56,940 |
| Dechencholing | | | 6,893 | CWS | | |
| Changzamtog | Changzamtog | 6,026 | 11,026 | CWS | | |
| | Changbangdu[2] | 5,000 | | TWS | | |
| Changangkha | | | 4,190 | TWS | | |
| Yangchenphug | | | 1,415 | TWS | | |
| Core City | | | 11,370 | TWS | | |
| Lower Motithang | | | 8,900 | TWS | | |
| Upper Motithang | | | 9,468 | TWS | | |
| Zilukha | | | 1,871 | TWS | | |
| Hejo- | Langjophapka[2] | 5,200 | 10,980 | TWS | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Langjophaka | Hejo[2] | 1,400 | | TWS | | |
| | Samteling | 4,380 | | CWS | | |
| Dzong Precinct | | | 667 | TWS | | |
| Babesa | | | 5,678 | CWS | | |
| Simtokha | | | 8,347 | CWS | | |
| Lungtenphu | | | 4,986 | CWS | | |
| Changbangdu | Changbangdu | 4,686 | 9,686 | CWS | | |
| | Changjiji[2] | 5,000 | | TWS | | |
| Total | | | 111,421 | | 48.9% | 51.1% |

1) Estimation by this study（based on 2005 census, applying annual growth of 5%）
2) Estimation by Thimphu Thromde based on number of connections.

### (1) Existing Conditions of TWS

TWS supplies treated water from Motithang and Jongshina WTPs and untreated groundwater from the wells through water reservoirs and distribution networks. Water production rate of WTPs and wells are shown in Table 3-20. The present production rate is 13,200 m3/day, including the wells. Although both design capacity of Motithang and Jongshina WTPs are 6,500 m3/day, presently Jongshina WTP is operated at the significantly lower rate due to the shortage of water transmission capacity. On the other hand, Motithang WTP is operated at the over-loaded rate to supplement the shortage of the Jongshina WTP production.

**Table 3-20 Average Daily Production Rate (2010-2011)**

Unit: $m^3$/day

| Month | Jongshina WTP | Motithang WTP | Sub-Total | Bore wells | Total |
|---|---|---|---|---|---|
| July | 4,498 | 8,348 | 12,845 | 400 | 13,245 |
| August | 4,622 | 8,412 | 13,034 | 400 | 13,434 |
| September | 4,565 | 8,389 | 12,954 | 400 | 13,354 |
| October | 4,567 | 8,423 | 12,989 | 500 | 13,489 |
| November | 4,670 | 8,399 | 13,068 | 500 | 13,568 |
| December | 4,282 | 8,429 | 12,711 | 500 | 13,211 |
| January | 4,433 | 8,386 | 12,818 | 500 | 13,318 |
| February | 4,125 | 8,811 | 12,936 | 500 | 13,436 |
| March | 4,669 | 8,238 | 12,907 | 500 | 13,407 |
| April | 4,601 | 8,071 | 12,672 | 500 | 13,172 |
| May | 4,810 | 7,828 | 12,638 | 500 | 13,138 |
| June | 4,641 | 8,184 | 12,825 | 500 | 13,342 |
| Average | 4,498 | 8,348 | 12,845 | 400 | 13,245 |

Source: Water Treatment Section, Engineering Division, Thimphu Thromde

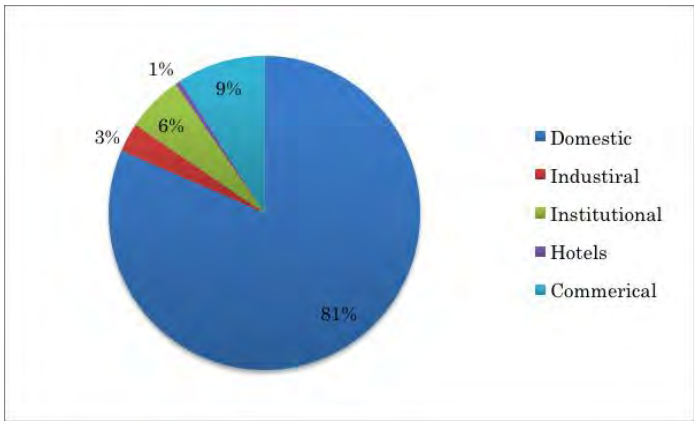
Annual water consumption rate is 3,425,526 $m^3$/year (9,385 $m^3$/day) on the average from 2011 to 2013 based on the Thromde's record of billed and collected amount shown in Table 3-21. Assuming the population about 54,000 (TWS population of 54,481 in Table 3-19), the per capita daily consumption rate in Thimphu is 173 l/capita/day. Figure 3-45 shows ratio of the customer group. Domestic customer is the largest group, accounting for 81% of the total consumption.

**Table 3-21 Water Consumption Rate and Billed and Collected Amount**

| Distribution Zone | 2011/2012 | | | 2012/2013 | | |
|---|---|---|---|---|---|---|
| | Consumption ($m^3$) | Billed Amount (Nu) | Collected (Nu) | Consumption ($m^3$) | Billed Amount (Nu) | Collected (Nu) |
| Plumbana | 90,391 | 413,768 | 406,722 | 4,538 | 26,801 | 27,259 |
| Motithang | 867,281 | 4,371,108 | 4,394,475 | 991,617 | 6,644,522 | 6,744,558 |
| Kawajangan | 434,792 | 2,329,754 | 2,348,363 | 443,304 | 3,054,276 | 3,091,179 |
| Changzamtog | 951,498 | 4,883,149 | 5,050,199 | 826,948 | 4,985,744 | 5,269,205 |
| Chuba Chhu | 277,185 | 1,374,238 | 1,382,676 | 292,435 | 1,873,835 | 1,908,029 |
| Agricultural/PWD Colony | 131,697 | 663,652 | 667,445 | 143,526 | 1,165,396 | 1,170,927 |
| Norzin Lam | 465,089 | 2,818,317 | 2,881,688 | 458,299 | 4,732,268 | 4,836,049 |
| Forest/BNP/P&T Colony | 242,433 | 1,221,505 | 1,224,729 | 230,019 | 1,454,068 | 1,465,065 |
| Total | 3,460,366 | 18,075,491 | 18,356,297 | 3,390,686 | 23,936,910 | 24,512,271 |

Source: Thimphu Thromde

The per capita daily consumption rate, 173 l/capita/day, is rather low for an urban water supply with house connection, but it is sufficient level since most of users consist of domestic users.




Source: JICA Survey Team

**Figure 3-45 Customer Group Ratio of Consumption**

Although the present demand and supply are almost balanced as mentioned above, water is intermittently supplied in most of the Thimphu areas according to the time schedule shown in Table 3-22. Water is supplied once to three times a day with two hour supply every time in the most areas. Buildings have their own water tanks as shown in Figure 3-46. Large consumption users, such as hotels, are buying water from water tankers.

**Table 3-22 Water Supply Time Schedule**

| Name of Area | Morning | Noon | Evening |
|---|---|---|---|
| Motithang( Zone One) | | | 24 hours |
| Kawang Jangsa( Zone Two) | 2hrs | 2hrs | 2hrs |
| Changzamtog/Chang Gedaphu(Zone Three) | 2hrs | | 2hrs |
| Chuba Chhu( Zone Four) | 2hrs | 2hrs | 2hrs |
| Agriculture/PWD Colony( Zone Five) | | | 24 hours |
| Norzin Lam(Zone Six) | 2hrs | | 2hrs |
| DNP/P&T Colony( Zone Seven) | 2hrs | | 2hrs |

Source: Thimphu Thromde

Source: JICA Survey Team

**Figure 3-46 Water Tank for Intermittent Water Supply（Yellow circle）**

In addition to the intermittent water supply, another significant problem of TWS is exposed piping. The exposed piping is observed everywhere in the town. The exposed piping is mostly for service connection pipes that send water from distribution pipes to each house (see Figure 3-47), but some distribution mains are also exposed, judging from pipe diameters and branched connection pipes (see Figure 3-48). Furthermore, as many pipes are placed in drainage channels, pipes running in dirty water are observed (see Figure 3-48).

Source: JICA Survey Team

**Figure 3-47 Exposed Piping**

Source: JICA Survey Team

**Figure 3-48 Exposed Pipe and Connections**

### (2) Present Conditions of CWS

There are 15 CWSs in Thimphu as shown in Figure 3-49, supplying to 6 urban villages, covering 43 % of the total population. It shows the location of intake of each CWS and the water tanks are located just upstream of the living places. Water is sent from the intake to the water tanks by gravity flow. There is no water supply network in CWS. Users connect the connection pipe, which sends water from the water tank to their house, at their own risk and cost (see Figure 3-50).


Source: JICA Survey Team

**Figure 3-49 Location of CWS**

Source: JICA Survey Team

**Figure 3-50 Water Tank and Connection Pipes of CWS**

Water of CWS is supplied without treatment as it does not have water treatment facilities. Usually water is clean as it is taken from the upper stream where there are few pollution sources. However, high turbidity water is supplied when it rains. Furthermore, it has a bacterial contamination risk as it does not have a disinfection facility.

### 3.5.3 Water Supply Facilities of TWS

Major facilities of TWS consist of 2 water treatment plants with intake facilities, 1 group of bore wells, 1 transmission pump station, 13 reservoirs, transmission pipes and distribution networks. Their locations are shown in Appendix C-2 and their outlines are shown in Table 3-23.

#### (1) Water Treatment Facilities (including wells)

The production capacities of the water treatment facilities are Motithang WTP; 6,500 $m^3$/day, Jongshina WTP; 6,500 $m^3$/day and wells 1,000 $m^3$/day, total of 14,000 $m^3$/day. As previously mentioned, Jongshina WTP is operated under the design capacity while Motithang WTP is operated over the design capacity of 8,000 $m^3$/day. In general such over loaded operation causes failure of proper turbidity removal and frequent clogging of filter beds. However, they are not so significant in Motithang WTP probably because of clear raw water. But it is inferable that they are suffering from high turbidity of the treated water during rain periods.

Water treatment process is comprised of coagulation with aluminium sulphate, sedimentation, and filtration. When raw water is clean (turbidity less than 5 NTU), aluminium sulphate is not dosed. A pumping station is located in Jongshina WTP which sends water to Swimming Pool Reservoir, Langjophaka Reservoir and Dzong Reservoir.

#### (2) Reservoirs

There are 11 reservoirs in TWS. Most of the reservoirs consist of a unit tank with capacity of 320$m^3$ or 230 $m^3$. A total capacity of the reservoirs is 4,480 $m^3$ and accounts 32% (equivalent to 7.5 hour consumption) of the daily water supply (refer to Table 3-20). Since fluctuations of water consumption rate in small water supply systems like TWS are high, it is recommended to have 50 to 100 % of a total capacity of reservoirs to absorb the fluctuations. Such shortage of the reservoir capacity may be one of the factors for the prevailing intermittent water supply.

#### (3) Transmission and Distribution Pipe

According to Thromde, a total length of transmission/distribution pipes is 170 km. Among them, 50% are ductile iron pipe with 100mm to 250 mm and remaining is galvanized iron pipe with diameter of 32mm to 150 mm.

The galvanized pipes were installed by DANIDA in 1990's and their degradation is suspected. DANIDA financed pipe replacement program to replace the galvanized pipe with ductile iron pipe in 2000 when Jongshina WTP was constructed. Thromde is following the program but it remains at the rate of 1 to 1.5 km per year due to shortage of fund.

**Table 3-23 Outlines of Major Water Supply facilities**

| Facility | Name | Description | |
|---|---|---|---|
| Supply Source | Motithang WTP | Construction | 1960's |
| | | Water source | 3 streams in the Motithang valley |
| | | Design Capacity | 6,500 $m^3$/day |
| | | Treatment process | Rapid filtration |
| | Jongshina WTP | Construction | 2005 |
| | | Water source | Discharge from hydro-power station |
| | | Design Capacity | 6,500 $m^3$/day |
| | | Treatment process | Rapid filtration |
| | Bore wells | Construction | 2012 |
| | | Numbers | 3 |
| | | Design Capacity | Total 1000 $m^3$ /day |
| | | Depth | 32 m |
| Transmission pumping station | Jongshina Pumping Station | Construction | 2005 |
| | | Number of pump | to Swimming pool 2+1 |
| | | | to Langjophaka and Dzong 1+1 |
| | | Capacity | to Swimming pool 90$m^3$/Hr x 43.2m |
| | | | to Langjophaka and Dzong l 90$m^3$/Hr x 65.5m |
| Reservoir | R1 | Number | 2 |
| | | Capacity | 640 |
| | | Elevation | 2,592 $m^3$ |
| | 3 Tanks | Number | 3 |
| | | Capacity | 960 |
| | | Elevation | 2,435 $m^3$ |
| | Hospital | Number | 2 |
| | | Capacity | 350 |
| | | Elevation | 2,392 $m^3$ |
| | RICB | Number | 1 |
| | | Capacity | 320 |
| | | Elevation | 2,400 $m^3$ |
| | Bhutan Hotel | Number | 1 |
| | | Capacity | 320 |
| | | Elevation | 2,355 $m^3$ |
| | Swimming pool | Number | 2 |
| | | Capacity | 460 |
| | | Elevation | 2,372 $m^3$ |
| | Kalu Bazar | Number | 1 |
| | | Capacity | 230 |
| | | Elevation | 2,480 $m^3$ |
| | YHS | Number | 1 |
| | | Capacity | 320 |
| | | Elevation | 2,403 $m^3$ |
| | Langjophaka | Number | 1 |
| | | Capacity | 230 |
| | | Elevation | 2,380 $m^3$ |
| | Dzong Tank | Number | 1 |

| | | | |
|---|---|---|---|
| | | Capacity | 250 |
| | | Elevation | 2,395 $m^3$ |
| | Jongshina | Number | 1 |
| | | Capacity | 400 |
| | | Elevation | 2,355 $m^3$ |

Source: Thimphu Thromde

**Table 3-24 Length of Pipes by Diameters**

| Pipe Diameter (mm) | Length (m) |
|---|---|
| 50 | 5,508 |
| 80 | 20,918 |
| 100 | 22,284 |
| 150 | 10,161 |
| 200 | 3,584 |
| 250 | 4,086 |
| Total | 66,542 |

Source: Thimphu Thromde

Pipe lengths by diameters are shown in Table 3-24. Since piping route and diameters and their length are based on the GIS data which is now under preparation by Thromde, the data are not consistent with the total lengths of pipes indicated by the Thromde. It is just reference data. According to the Appendix C-2, distribution of pipe is extremely sparse. Secondary and tertiary pipes may not be included in the GIS. On the other hand, from the pipe diameter, service connections may be counted as tertiary mains. There is a possibility that the distribution network is not sufficient. It can be a reason of long connection pipes.

### 3.5.4 Conventional Water Quality Test

Conventional water quality test was conducted at Motithang WTP, Jongshina WTP, Ola Rong Chhu CWS and Samteling CWS to evaluate the quality and safety of water supply.

According to the results shown in Table 3-25, as for the items related to the comfort issues (Fe, Mn, Hardness, color and turbidity), all the results of turbidity are less than 0.1 NTU and judged to be clean water, but color is high[9]. Other items are all low values and it is considered not to be polluted as it is taken in the upper stream.

On the other hand, the items related to safety, such as bacteria, E-coli and ammonia, bacteria and E-coli are detected from treated water of Motithang and Jongshina WTP. Bacterial contamination is suspected, but since bacteria free water could not be used in the conventional water quality test, consequently there is a possibility of equipment contamination; bacterial contamination cannot be concluded from this test. In general, bacterial contamination is derived from the contamination by fecal substance from animals, but in such case high ammonia concentrations are accompanied. The results do not show high ammonia concentrations, therefore, possibility of bacteria contamination by fecal substance would be low.

Heavy metals were not analyzed in this test, since there hardly exist human activities upstream and the possibility of such contamination is very low. Natural arsenic contamination occurs in groundwater in general, not from human activities. No arsenic contamination of surface water is known other than from mining and industrial wastewater.

[9] This is presumed to be originated from humic materials resulted by the decomposition of plant fibers under the highland wetland conditions. This is not considered hazardous while not pleasant visually.

**Table 3-25 Results of Conventional Water Quality Test**

| Facility | Sampling Point | pH | EC | Fe | Mn | $+NH_4$ | $-NO_2$ | $-NO_3$ | −TH | COL | TUR | Coliform | E. Col |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mS/cm | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | unit | unit | count/ml | count/ml |
| Jungshina WTP | 1-1 Arriving Well | 6.87 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 16.0 | < 0.1 | 6 | 3 |
| | 1-2 Sedimentation Outlet | 6.82 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 15.5 | < 0.1 | 21 | 3 |
| | 1-3 Filteration Outlet | 7.47 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 16.5 | < 0.1 | 18 | 4 |
| Motithang WTP | 2-1 Arriving Well | 6.90 | 0.06 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 7.0 | < 0.1 | 15 | 4 |
| | 2-2 Sedimentation Outlet | 7.62 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | 0.048 | < 1.0 | < 20 | 6.0 | < 0.1 | 12 | 1 |
| | 2-3 Filteration Outlet | 7.57 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 6.0 | < 0.1 | 24 | 1 |
| Community WS | 3-1 Olaronchuu (Tank outlet) | 7.04 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 38.0 | < 0.1 | 10+half over | 1 |
| | 3-2 Samteling (Source of Jungs | 6.78 | < 0.01 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | < 1.0 | < 20 | 15.0 | < 0.1 | 20 | 8 |

Source: JICA Survey Team

### 3.5.5 On-going Projects

As described in 3.3.7, there are two on-going urban infrastructure projects. The main objectives of the on-going and planned projects are to resolve local water shortages in the south by providing water supply system with a water treatment plant. A project to construct a water supply system is on-going by ADB funding in south part and two projects to construct a water supply system are on-going in the north part by World Bank funding.

ADB Project (Urban Infrastructure Development Project, Bhutan: ADB Loan No. 2258-BHU) considers the total water demand in 2027 of areas where LAP is completed within 4 urban villages of Lungtenphu, Simtokha, Babesa, and Changbangdu. Where no LAPs are formulated are out of scope, the plan covers entire area. The water treatment plant will be half size as planned, while water intake, conduction pipes and water transmission pipes will be full capacity to accommodate water demand in 2027 in entire 4 urban villages, and reservoirs and distribution network will be built where LAPs are completed. The budget for completing the necessary facilities for those areas where LAPs to be prepared later is not allocated yet.

The World Bank will finance construction of small water supply system only for the area where LAP is to be completed. Their project outlines are as follows and areas covered by those projects are shown in Figure 3-51. The Project C) World Bank Project (Second Bhutan Urban Development Project – Package III) will target the LAP implemented area of Langjophaka where TWS water is currently supplied (from Motithang WTP). The Project will install additional pumps in Jongshina pumping station to send Jongshina WTP water to Langjophaka. Due to lack of pumping capacity they are operating 2,000 $m^3$/day less than plan. With this project the transmission capacity will be increased and will be operated as scheduled. Therefore, TWS water supplied population is not increased by this project, but TWS production capacity increases.

A) Urban Infrastructure Development Project, Bhutan (ADB Loan No. 2258-BHU)

| | |
|---|---|
| Target areas | Areas with LAP in Lungtenphu, Simtokha, Babesa and Changbangdu Urban Villages |
| Population | 63,360 in 2027 |
| Facilities to be constructed | New intake and Water treatment plant at Megypang<br>Transmission of the water from the WTP to the project areas<br>Local reservoirs and break pressure tanks<br>Water distribution network in the project areas |
| Capacity of Facilities | All the facilities other than WTL and distribution networks are designed and to be constructed at the capacity of 13,000 m3/day. However, WTP is constructed at its 50% of capacity, 6,500 m3/day and distribution networks are constructed in the areas presently equipped with LAP. |

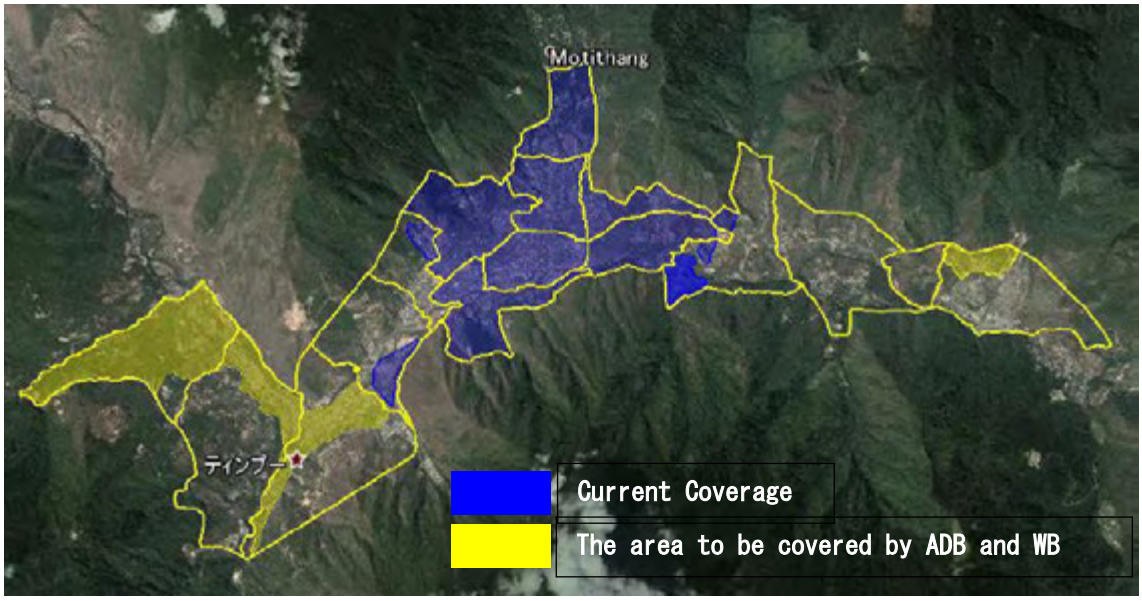
B) Second Bhutan Urban Development Project – Package II (Dechencholing)

| | |
|---|---|
| Target areas | Dechencholing |

| | |
|---|---|
| Population | 6,760 in 2027 |
| Facilities to be constructed | New intake and Water treatment plant at Dechencholing<br>Transmission of the water from the WTP to the project areas<br>Local reservoirs<br>Water distribution network in the project areas |
| Capacity of Facilities | 1,400 $m^3$/day |

C) Second Bhutan Urban Development Project – Package III (Langjophaka)

| | |
|---|---|
| Target areas | Langjophaka |
| Population | 10,500 in 2027 |
| Facilities to be constructed | Pumping station in Jongshina WTP<br>Transmission of the water from the pumping station to the project areas<br>Local reservoir<br>Water distribution network in the project areas |
| Capacity of Facilities | 2,891 $m^3$/day |




Source: Thimphu Thromde

**Figure 3-51 Current Coverage Area and World Bank and ADB Project Coverage**

### 3.5.6 Demand Supply Analysis

In the present water supply development, projects to resolve CWS are on-going and planned. Demand and water supply based on those projects is shown in Table 3-26. As shown in the table, in Central areas currently TWS supplies the supply surpasses the demand in 2012 and significant shortage in the supply is not being considered. However, in future after 15 years when present on-going and planned projects complete, the supply will become insufficient by15,000 $m^3$/day, 33% of the demand, in whole Thimphu.

**Table 3-26 Demand Supply Analysis**

| Name of Urban Village | Area | Population[1] | | Water Demand (Including loss)[2] ($m^3$/day) | | Water Production ($m^3$/day) | | Deficit in 2027 |
|---|---|---|---|---|---|---|---|---|
| | | 2012 | 2027 | 2012 | 2027 | 2012 | 2027 | |
| Taba-Jongshina | North | 22,837 | 59,268 | 4,567 | 11,854 | CWS | 4,291[4] | -7,563 |
| Dechencholing | | | | | | | | |
| Changzamtog | Core | 59,887 | 90279 | 11,977 | 18,056 | 13,245[3] | 13,245 | -4,811 |
| Changangkha | | | | | | | | |
| Yangchenphug | | | | | | | | |
| Core City | | | | | | | | |
| Lower Motithang | | | | | | | | |
| Upper Motithang | | | | | | | | |
| Zilukha | | | | | | | | |
| Hejo-Langjophapka | | | | | | | | |
| Dzong Precinct | | | | | | | | |
| Babesa | South | 28,697 | 82092 | 5,739 | 16,418 | CWS | 13,000[5] | -3,418 |
| Simtokha | | | | | | | | |
| Lungtenphu | | | | | | | | |
| Chang Bangdu | | | | | | | | |
| | Total | 97,088 | 231，637 | 22,284 | 46,328 | 13245 | 30,536 | -15,792 |

1: Population is calculated from 2005 Census population applying 5% of growth rate.
2: Water demand is calculated by assuming 140 l/capita/day and 30% loss.
3: Present actual production rate.
4: Production capacity after Second Bhutan Urban Development Project, Package II and Second Bhutan Urban Development Project, Package -III.
5: Production capacity after on-going ADB project (6,500$m^{3/}$day) and an additional project (6,500$m^{3/}$day)

Source: Thimphu Thromde

In the south part, as the water intake capacity of the river which is the water source of presently constructing WTP is sufficient, it will be possible to satisfy the future demand by constructing another WTP. Shortage in the north part will be supplemented by separate WTP which will be constructed as a part of LAP. However, to construct many small -scale water supply systems not only increases the unit construction cost and O&M cost, but also increases uncertainty in intake capacities which comes from water source.

As for the shortage in the central areas, augmentation of Jongshina WTP may be possible from its water source capacity, although augmentation of Motithang WTP may not be possible. In this case, augmentation of Jongshina WTP should be coordinated with the water supply development of the north part from viewpoint of the location.

In addition, Wang Chhu at the north of Thimphu (catchment; 480 $km^2$) has water source development potential of 166,233$m^3$/day (assuming 10 year specific draught runoff is 0.4 $m^3$/sec as shown in Appendix D)[10], which can supply water to 800,000 service population, assuming 200 l/capita/day of daily per capita demand. Therefore, it is better to make comprehensive water

[10] Benaga Small Power Hydropower Project (Feasibility Study Report, Executive Summary, Bhutan Power Corporation Limited, August 2009)

supply development plan which combines water supply development in the north part and the augmentation of the water supply for the central areas.

### 3.5.7 Institutional Setup

#### (1) Organization

Now two different divisions manage operations for water supply. Water Section of Engineering Division handles the planning and overall management of water supply. The Water Section of the Customer Division now handles the operation and maintenance work of the distribution network. The section has 3 engineers and about 60 daily waged workers, who do maintenance of the distribution mains, service connections, and meters, valve operations and invoicing and fare collection. The valve operations are needed as water supply hours are rotated for zone by zone.

Activities and human resources of the 2 sections are shown in Table 3-27.

**Table 3-27 Organization related to Water Supply**

| Section | Activities Responsible | Human Resources |
|---|---|---|
| Water Supply Section of Engineering Division | Operation and maintenance of:<br>- water intake<br>- water conduction pipe<br>- water treatment plants | - Staff of Motithang WTP: 1 engineer, 2 operators and 2 helpers. No shift, living in living quarters in WTP<br>- Staff of Jongshina WTP: 1 electrical technician, 1 civil technician, 1 operator and 1 helper, No shift, living in living quarters in WTP |
| Water Section of Customer Service | Operation and maintenance of ;<br>- transmission pipelines, reservoirs<br>- booster pumps<br>- distribution networks<br>- house connections<br>- customer care<br>- leakage detection and repair<br>- meter reading,<br>- invoicing and fare collection. | - 1 group with 1 plumber and 3 to 4 helpers, total 28 persons and 12 meter readers. |

Source: Thimphu Thromde

#### (2) Information System

Thimphu Thromde developed a billing system on FoxPro in 1990's. However, it was crushed in this year. The data of 2012/13 has illogical part suggesting that some data may be lost. Therefore, it is time to manage the records and financial affairs by updated system with high security, back upping and data analysis functions. Asset management by GIS is on-going by consolidating the cadastral data, utilities data, road network data, etc.

### 3.5.8 Financial Administration

Table 3-28 shows the water and sewerage tariff of Thimphu. 9% increase was implemented in this year for the first time in 2 years.

**Table 3-28 Water Supply and Sewerage Tariff of Thimphu**

| Water consumption ($m^3$) | 2011/12 (Existing) Nu./$m^3$ | | Approved new tariff (2013/14) Nu/$m^3$ | | Changes | |
|---|---|---|---|---|---|---|
| | Residential | Commercial | Residential | Commercial | Residential | Commercial |
| 0-20 | 2.65 | 2.65 | 2.90 | 2.90 | 9% | 9% |
| 21-40 | 3.20 | 5.30 | 3.50 | 5.80 | 9% | 9% |
| >41 | 4.00 | 10.60 | 4.35 | 11.60 | 9% | 9% |

Source: Thimphu Thromde

Table 3-29 shows the revenue and expenditure of water supply and sewerage service in Thimphu. The general financial performance is good. The last line of the table shows the surplus from operation and maintenance which indicates nearly half of the revenue, contributing significantly to the city's coffer.

The unaccounted-for-water (UFW) is less than 25% which is within an acceptable range on a global scale. Compared with the performances in the south Asia, it belongs to an excellent group.

The production cost of water ranges between 1.6～1.7 Nu./$m^3$, very low levels. The tariff levels of 3.1～3.5 Nu./$m^3$ are equally low. It is a rare case in water supply that both producers and consumers are both enjoying the benefits. According to the analysis of ADB[11], the current water charges are about 3% of the monthly income of low income class (Nu.2,462) which is acceptable level.

Wastewater operation is even more excellent. The operation and maintenance cost for sewerage ranges between 0.5～0.7Nu./$m^3$ while the average tariff ranges between 1.5～1.8 Nu./$m^3$. The surplus level is around 60%. The very reason for this high financial performance is the current lagoon system which uses little chemicals and electricity. However, a new system to be introduced by financing by ADB may change the financial performance.

According to simulation analysis of the Financial Analysis of ADB[12], when the Urban Infrastructure Project introduces the water supply sewerage system as Planned up to the Phase II, it will require increase of tariff to 1,253% until 2020 in order to recover all capital investment, and 624% increase in order to recover operation and maintenance cost. As a result, although the income of average low income class is increased annually by 6%, the share of water supply and sewerage spending will be 23% recovering all capital investment and 11% for operation and maintenance recovery[13]. ADB report recommends that the average spending could be within 5% of monthly income if the tariff increase could be lowered down to 245% increase by providing government subsidy for capital as well as operation and maintenance charges.

[11] ADB TA 7630 Urban Infrastructure Project Progress Report ANNEX 4.2
[12] Same as above
[13] It is written 24% in the mentioned report, but it seems error in printing, therefore the number is modified.

**Table 3-29 Financial Performance of Water Supply and Sewerage Operation in Thimphu**

| | | Unit | 2009/10 | 2010/11 |
|---|---|---|---|---|
| Water | Production | $m^3$ | 4,481,166 | 4,653,929 |
| | Consumption | $m^3$ | 3,447,659 | 3,545,632 |
| | Un-accounted For Water (UFW) | $m^3$ | 1,033,507 | 1,108,297 |
| | | % | 23% | 24% |
| | Revenue | Nu | 10,768,415 | 12521197 |
| | Expenditure | NU | 7,397,977 | 7,400,805 |
| | Surplus | Nu | 3,370,438 | 5,120,392 |
| | Unit Cost | Nu/ $m^3$ | 1.7 | 1.6 |
| | Average Tariff | Nu/ $m^3$ | 3.1 | 3.5 |
| | Average Revenue | Nu/ $m^3$ | 2.4 | 2.7 |
| Sewerage | Revenue | Nu | 5,057,180 | 6,246,403 |
| | Expenditure | NU | 1,601,667 | 2,363,013 |
| | Surplus | Nu | 3,455,513 | 3,883,390 |
| | Unit Cost | Nu/ $m^3$ | 0.5 | 0.7 |
| | Average Tariff | Nu/ $m^3$ | 1.5 | 1.8 |
| Total | Revenue | Nu | 15,825,595 | 18,767,600 |
| | Expenditure | Nu | 8,999,644 | 9,763,818 |
| | Surplus | Nu | 6,825,951 | 9,003,782 |
| | | % | 43% | 48% |

Source: Thimphu Thromde

The bill recovery of water and sewerage shows more than 100% for the last two years. The data proves a high level of public awareness for financial compliance. The service charge is collected with other taxes by the Customer Service Division of the Thromde.

### 3.5.9 Development Needs in Water Supply

As results of the analysis of the present conditions, the issues to be addressed are summarized below.

**TW-1: Lack of Long-term Supply Capacity**

As discussed in 3.5.6, Thimphu Thromde will face the considerable water supply shortage in near future. As for the south part (Babesa, Simtokha, Lungtenphu and Chang Bangdu), localized solution of finding a new water source will resolve the current water shortage. However, this method will not work in the north part (Taba-Jongshina and Dechencholing) since the present plan is limited to the LAP established areas with a separate small scale system with no expendabilities to surrounding areas. Reaming areas in the north part will need new water supply systems.

Furthermore, there is no plan to increase the water supply capacity to the central areas. There is a limit in further development of the present system because of aged facilities and water source capacity. It will be required to construct a new system and it would be reasonable to construct it in the north part from the land availability and topographic conditions. Therefore, a long-term production capacity expansion at least for Central areas and the north part is required.

**TW-2: Lack of Water Supply Master Plan**

The weakest point in the Structure Plan is the lack of long-term infrastructure planning especially for water supply, and sewerage. There is no technical evaluation for water source alternatives or optimization of distribution network. This work lies on detailed design by LAP. There is no area-wise demand and supply network examination and consequent city-wide long-term planning. The planning of water supply or sewerage is left to each local area plan which only covers one $km^2$. These disjointed additions of water supply and sewerage schemes poses a risk of creating overall inefficiency of utility schemes.

**TW-3: Long-term Water Supply Costs Increases**

As shown in 3.5.8, the current account shows that the financial situation of water supply and sewerage sector is in a good condition with a low tariff. However if the on-going project will be implemented as planned, the operation cost will increase drastically due to capital-intensive technology in the small-scale level. Therefore even donor points out that without government subsidy, it will be difficult to secure the affordability to pay including the low-income class.

**TW-4: Intermittent Water Supply**

Intermittent water supply is adopted in almost all the central areas. Intermittent water supply causes not only inconvenience in daily water use but also contamination risk with poor distribution system. As demand and supply capacity is balanced at present, the reason of intermittent water supply is suspected to come from poor distribution system, such as shortage of reservoir capacity. The distribution system can be improved independently from future production plan, by increasing the reservoir capacity, development of distribution network, replacing old and damaged pipes and resolving of the exposed pipes.

**TW-5: Improvements in CWS**

CWS should be resolved as expeditiously as practicable since it is an interim measure. However, the existing TWS has little reserve capacity and the only way is by the implementation of LAP but it takes long time. Moreover, water supply development by LAP is not a good policy as mentioned above but it should be handled in a long term development plan. Therefore, it is practical not to resolve CWS in short time and to rely on the present CWS for a certain period. The problems of CWS are high turbidity and bacterial contamination risk due to no treatment and disinfection. While removal of the turbidity needs an ordinary treatment plant, the improvement of the contamination risk can be achieved by disinfection at the water tanks.

## 3.6 Wastewater / Drainage

DANIDA introduced a modern sewerage system with wastewater treatment plant both in Thimphu and Phuentsholing Thromde in 1996. Those plants use lagoon system (Stabilization

Pond Process) which requires a large area of land. The service population is limited than the coverage offered by water supply. There have been no coherent efforts to develop a long-term master plan to meet the growing needs of urbanization and sustainable management of sewerage works in Thimphu and Phuentsholing Thromde.

Thimphu City was developed in a narrow basin along a river with steep slope behind. Sewerage in Bhutan is a separate sewer system because storm water is easily and directly drained to river along slope.

Drainage system is developed in urbanized area along with urbanization of town/city. Natural streams connected to a main river are utilized to drain storm water in urbanized area. In case there is no proper stream or capacity shortage artificial drainage system is constructed along slope connecting to river. Those drainage systems collect not only storm water but also overflow of septic tank and gray water from each house/building in un-sewered area through roadside ditch, etc.

### 3.6.1 Laws and Regulations on Sewerage

*RGOB Building Rules 2002* requires residence owner to connect house connection to the municipal sewer line or to install septic tank with soak pit where there is no municipal sewer system. *RGOB Water and Sanitation Rules 1995* also requires "Each property owner shall connect all of the toilet and sullage outlets to either the municipal sewer or a septic tank" and "All owners of properties located within 70m of a municipal sewer shall connect the outlets to the municipal sewer".

The property owner is obliged to pay sewerage tariff added on water tariff, even if the owner is not connected to municipal sewer. Therefore septage removal service is provided by Thromde for the houses/buildings in un-sewered area for free of charge once a year and thereafter for a fee.

"Standard for final effluent from Sewerage Treatment Plant (STP)" is set in the Environmental Standards published by National Environment Commission in November 2010, as follows;

- BOD: 30 mg/l
- TSS: 100mg/l
- Fecal Coliform: 1,000 MPN/100ml

### 3.6.2 Design Parameters of Sewerage System

The sewerage project for Thimphu was funded by DANIDA. The construction of phase 1 of the sewerage system commenced in December 1993 and completed in 1996. The sewerage system consists of house connections, sewer network, trunk sewers and a wastewater treatment plant at Babesa. A tank lorry and jet cleaner was also provided for maintenance of the sewerage system.

Babesa WWTP Design parameters for phase 1 (Up To Year 2005) are as follows;

- Population served: 12,500PE (population equivalent)
- Influent flow rate: 1,750$m^3$/d
- BOD Pollution load: 45g/cd
- Influent BOD: 325mg/l
- Design mean temperature of coldest period: 8℃

Above served population reaches only approximately 15% of total population of the year 2005 of Thimphu Thromde. The original Phase 2 Plan of the project was designed for a connected population of 25,000 persons.

The details of Babesa WWTP are as follows;

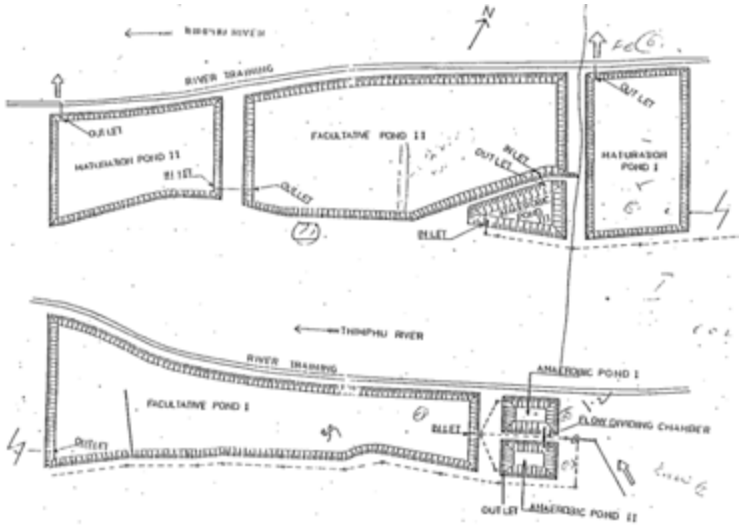
- Area and Location of WWTP: 4.9ha at Babesa, Thimphu
- Treatment Process: Stabilization Pond Process

- Size of each process is shown in
- Table 3-30

**Table 3-30 Babesa WWTP Size of each Process**

| | Area | Depth | Retention Time |
|---|---|---|---|
| Anaerobic Pond | 1,896m$^2$ (473m$^2$×2ponds+947m$^2$×1pond) | 3.0m | 3.25days |
| Facultative Pond | 3.42ha (1.72ha×2ponds) | 2.0m | 39days |
| Maturation Pond | 1.42ha (0.71ha×2ponds) | 1.5m | 12.2days |

Source: JICA Survey Team




Source: Thimphu Thromde

**Figure 3-52 Layout of Existing Babesa WWTP**

Layout of Babesa WWTP is shown in Figure 3-52. The wastewater treatment system is composed of two series of the anaerobic ponds, facultative ponds and maturation ponds.

### 3.6.3 Present Condition of Sewage Treatment

The photos of anaerobic pond, facultative pond and maturation pond of existing Babesa WWTP are shown in Figure 3-53.

Source: JICA Survey Team

**Figure 3-53 Anaerobic Pond (left), Facultative Pond (center) and Maturation Pond (right) of Babesa WWTP**

Current performance of existing WWTP is as follows;

- Influent flow rate: 1,400-1,560m$^3$/d (April to June 2013, 10-20% lower than design capacity 1,750m$^3$/d)
- Effluent quality: less than their own effluent standard (BOD<50mg/l, SS:60-120mg/l, and so on), due to no standard before 2011

- Present influent flow rate is 80% to 90% of design capacity, which comes from only approximately 10 to 15% of total population in Thimphu Thromde. An expansion project of existing WWTP is ongoing funded by ADB.

### 3.6.4 Present Condition of Sewer Network

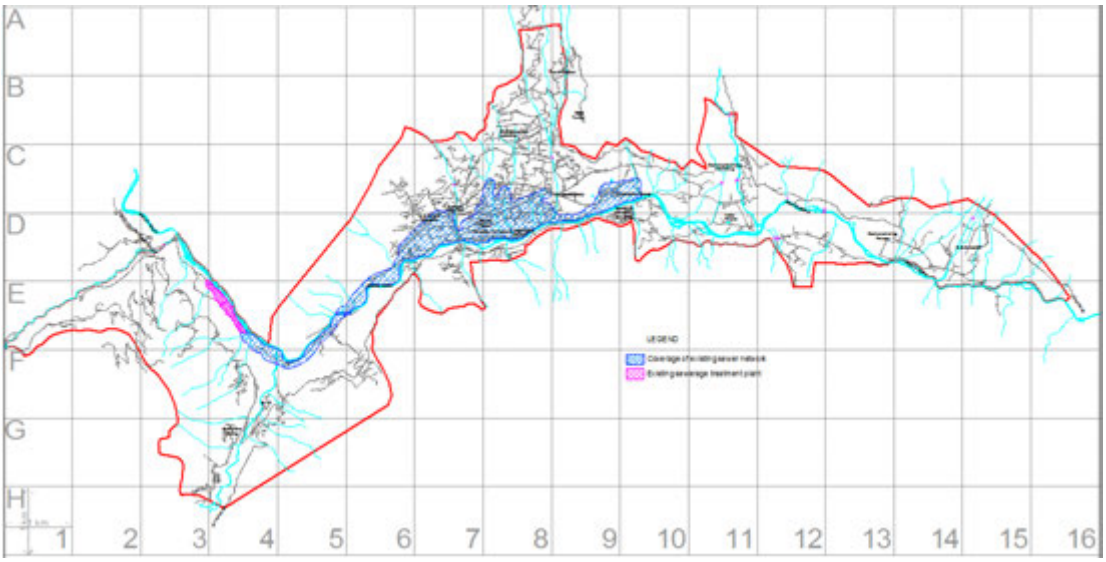
The sewer network of the phase I sewerage system covering from upper Trashichho Dzong to the existing WWTP constructed in1996 for Thimphu Thromde is as follows;

- Trunk & branch line (uPVC): 21km
- Sewer service pipe (HDPE): 35km

Location of existing WWTP and coverage of existing sewer network in 2004 are shown in Figure 3-54(Structure Plan 2004),

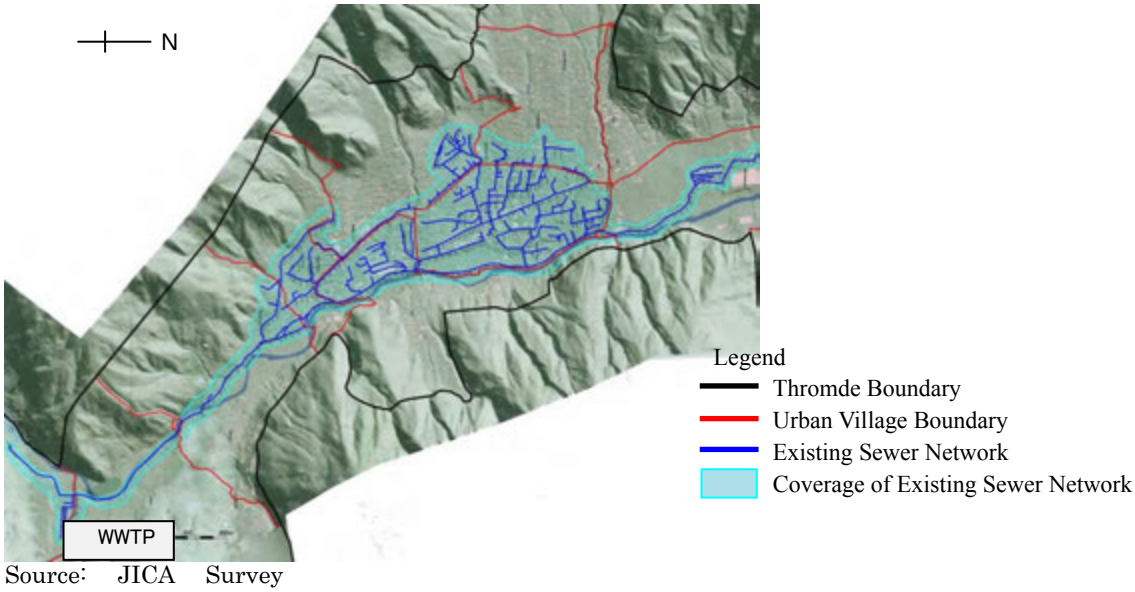
Since then Thimphu Thromde has constructed 9km sewer line and expanded the coverage area of sewer network to Changzamtog area, Changangkha area, and lower part of Lower Motithang of the city center. The latest sewer network (2012) is shown in Figure 3-55.

The other non-sewer areas use septic tanks for toilet water treatment and roadside drainage for kitchen and other wastewater disposal. Present non-sewer areas are southern four urban villages (Babesa-Serbithang, Simtokha, Lungtenphu and Chang Bangdu-Chang Jiji), four urban villages of city center (Changangkha, Lower Motithang, Upper Motithang and Kawang Jangsa-Zilukha) and northern three urban villages (Langjophaka-Hejo, Taba-Jongshina and Dechencholing).




Source: Thimphu Structure Plan 2004

**Figure 3-54 Sewer Network Coverage in Thimphu Structure Plan**




Source: JICA Survey Team

**Figure 3-55 Existing Sewer Network in Thimphu (2012)**

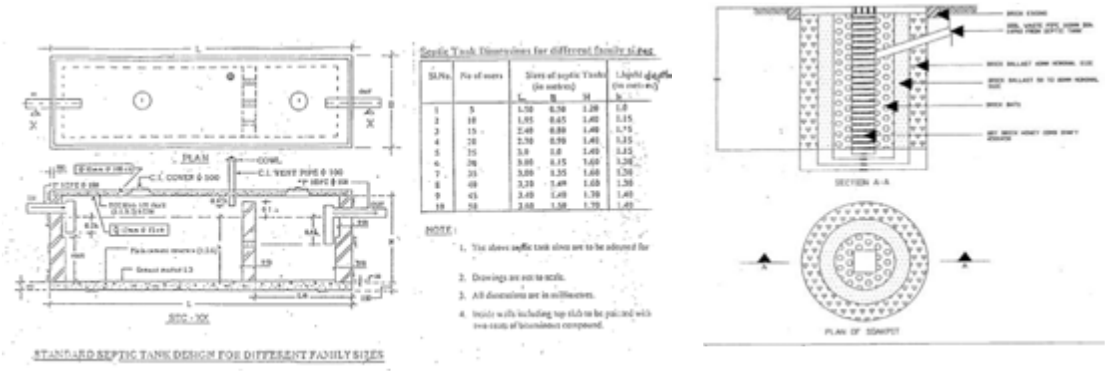
Figure 3-56 shows photos of sewer system in Thimphu, such as manhole under the road, manhole in the drain, manhole beside the road and sewer bridges crossing the river.

Source: JICA Survey Team

**Figure 3-56 Thimphu Sewer System: manhole on the road(top-left/center), manhole in the drain(top-right), manhole beside the road(bottom-left) and sewer bridges crossing river(bottom center/right)**

### 3.6.5 Present Condition of Septic Tank

Residence owners are required to install a septic tank with a soak pit where there is no municipal sewer system. Thromde presents a standard drawing of septic tank and soak pit with several sizes to the residence owner (refer to Figure 3-57). Thromde finally inspects it and certificate.



Source: Thimphu Thromde

**Figure 3-57 Standard Drawing of Septic Tank and Soak Pit**

Septic tank of individual house is cleaned by the Thromde's tank lorry. After collection septage is discharged into a sewer manhole nearby. A volume of collected septage is estimated at about 1,000m$^3$ per year. The residents who have connection to City Water Service but without sewer connection are allowed free septage collection once a year since sewerage fee is automatically levied together with water supply fee. Those of more than once or without water supply connection need to pay 1,000Nu per one trip for septage collection. Figure 3-58 shows septage cleaning operations and public relation leaflet.

Source: Thimphu City

**Figure 3-58 Cleaning of Septic Tank (left), Discharge to Manhole (center) and Public Relation Leaflet for Septage Cleaning**

Problems in the area using septic tank are as follows;

- Gray water from residence is free to discharge into drainage.
- Overflow from septic tank is discharged into drainage due to improper management.
- Sometimes no soak pit.

Those make trouble for residence downstream and pollute water environment downstream, such as stream, drainage channel in the city center and finally Wang Chhu. (Refer to Figure 3-59)

Source: JICA Survey Team

**Figure 3-59 Gray Water Discharge from Residence (left) to Drainage (center/right) in Motithang area**

### 3.6.6 Present Operation and Maintenance for Sewerage

Operation and maintenance work for sewerage, such as operation and maintenance of WWTP, cleaning of septic tank and sewer line, and complaint handling for wastewater spilling etc., are implemented by the following staff/equipment under one manager in Thimphu Thromde.

The operation and maintenance staff of WWTP consists of one chief who doubles as water quality analyst and 5 additional labors. Furthermore cleaning of septic tank and sewer line are implemented by the following three tank lorries and ten staff members including one chief;

A) One unit of $6m^3$ tank lorry with suction pump and jet cleaner is operated by one driver and two operators.
B) Two units of $3m^3$ tank lorry with suction pump are each operated by two driver and 4 operators.

For the maintenance of sewer lines type A) tank lorry is often used to utilize its jet cleaning capacity. Otherwise five-person maintenance crews clean the clogged sewers with manually operated drain cleaning rods.

### 3.6.7 Present Condition of Drainage System

There are main five drainage streams and drains at right bank of Wang Chhu in city central areas as shown in Figure 3-60. Those are Chuba Chhu (D1), Storm drain D2 with outlet near market, Storm drain D3 with outlet near Dzongkhag, Karisha stream (D4) and Storm stream (D5) in the Police Champ from the north. These drainages have a structure which water flows along the steep slope, and is drained at a stroke into Wang Chhu. Figure 3-62 shows the present condition. There is no significant problem on drainage system due to the steep slope, except drain clogging by garbage and other waste which causes storm water running on road and a partial flooding. However rain water overflows from drainages when it is a heavy rain in a short time, and the car traffic becomes difficult, but in most case rain water goes down in a short time and the traffic becomes normal again (Figure 3-61.)


Source: JICA Survey Team

**Figure 3-60 Main Drainages in Thimphu**

A problem is that these drainage systems are used for gray water discharge from residences in Motithang area and the neighborhood, and in some cases overflows from septic tanks are discharged into drainage (Figure 3-63). D1. D2 and D3 are passing through the urban center of Thimphu in an open channel mainly, and the waterway emits offensive odor at the periphery. These drainages were natural streams originally, and have become a target to be maintained as the pedestrian path along the stream that is amenity of the city in the Thimphu Structure Plan.

Source: JICA Survey Team

**Figure 3-61 Street Flooding after Heavy Rain（April 2013）**

In order to maintain those drainages as the pedestrian path easy access to the water, it becomes premise that the Motithang area and neighborhood will be covered by a sewer network completely, as described later. These pedestrian paths along the stream can maintain only by development of sewerage system with sewage treatment.

In addition, it is impossible to keep a function of the flood control such as storm water reservoir and recharge because rapid drainage is the first priority of design policy. Therefore the completion of sewerage system becomes the important issue at first for the purposes such as city beautification, and tourism promotion.

Source: JICA Survey Team

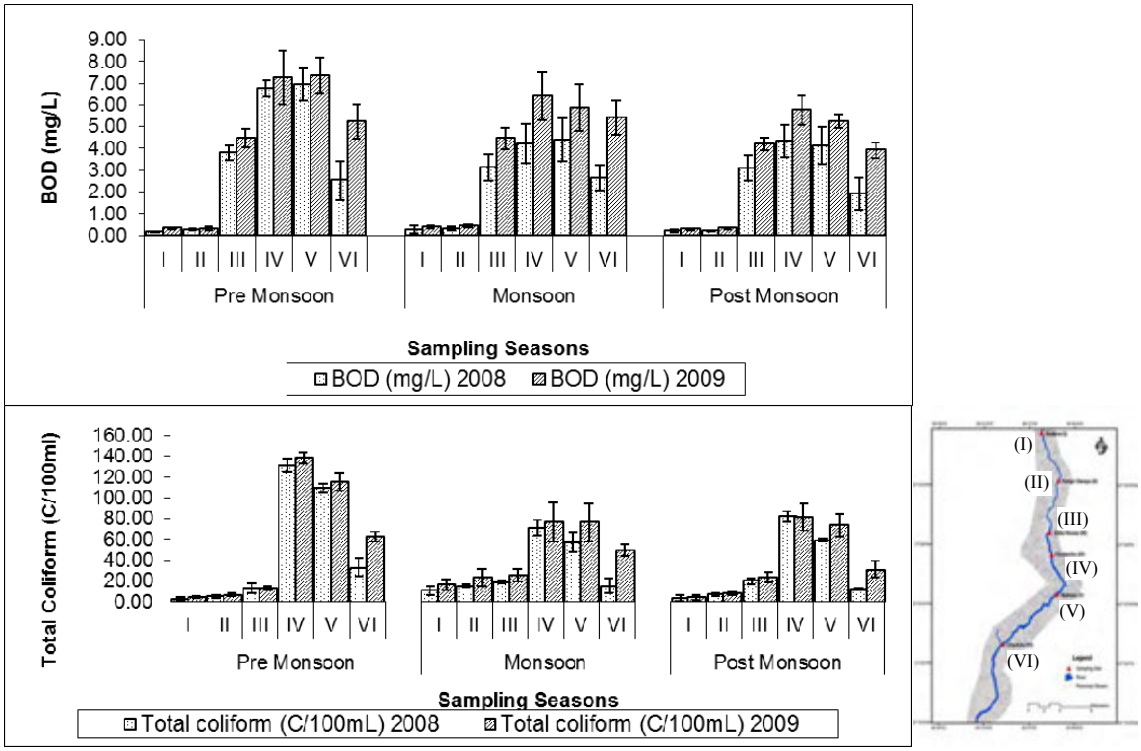
**Figure 3-62 Main drainage system, Chuba Chhu (D1), Storm drain D2, Storm drain D3 and Karisha stream (D4) from the left**

Source: JICA Survey Team

**Figure 3-63 Branch drainage systems with steep slope and clogging**

### 3.6.8 Present Condition of Public Water Bodies

Water qualities (BOD and Total Coliform in 2008/2009) of Wang Chhu are shown in Figure 3.75. These data clearly indicates that water quality deterioration of Wang Chhu start from India House (III) of beginning urban area and waters from Chuba Chhu (IV) of city center to lower reach are most polluted. Especially BOD at sampling points IV and V during pre-monsoon season indicates nearly 8 mg/l, which exceeds the WHO permissible limit of 6 mg/l for drinking water. Nitrate and Phosphate indicate similar trend.




Note 1): Sampling points are (I)Dodena, (II)Pangri Zampa, (III)India House, (IV)Chuba Chhu, (V)Babesa, and (VI) Charkilo, from upper reach.

Note 2): Sampling seasons are Pre Monsoon (Feb. to May), Monsoon (Jun. to Sep.) and Post Monsoon (Oct. to Jan.)

**Figure 3-64 Water Quality of Wang Chhu and Sampling Points**

Source: "URBAN GROWTH AND WATER QUALITY IN THIMPHU, BHUTAN" Journal of Urban and Environmental Engineering

JICA Survey Team conducted a water quality test by simple colorimetric method and other equipment. Sampling points are near mouth of Chuba Chhu joining Wang Chhu, Storm Drain D2 and Karisha Stream. The results shown in Table 3-31 clearly indicated those streams, especially Storm Drain D2 near market, are so much polluted in the same range of sewage due to sewage inflow. Figure 3-65 shows the polluted situation of the drain.

**Table 3-31 Results of simple water quality test**

| Sampling point | pH | EC | DO | $+NH_3$ | $-NO_2$ | $-NO_3$ | COL | TUR | Coliform Count | E. Col. |
|---|---|---|---|---|---|---|---|---|---|---|
| Chuba Chhu | 8.06 | 0.03 | 8.5 | 0.42 | 0.039 | 1.1 | 12.5 | 2.4 | 32 | 4 |
| Storm Drain D2 | 7.20 | 0.30 | 6.7 | >5.0 | 0.788 | 12.1 | 41.0 | 13.7 | Whole of test paper | Half of test paper |
| Karisha Stream | 8.23 | 0.13 | 7.6 | <0.2 | 0.085 | 6.3 | 17.5 | 3.2 | 12 | 0 |

Source: JICA Survey Team

Source: JICA Survey Team

**Figure 3-65 Polluted situation of Storm Drain D2 in the central areas**

### 3.6.9 Ongoing and Planned Projects

The main basis for urban infrastructure investment is the City Structure Plan and Local area Plan in Thimphu. As described in 3.3.7, there are two on-going urban infrastructure projects. The Urban Infrastructure Project UIP (2012-2018) is ongoing supported by ADB, following the Urban Infrastructure Development Plan UIDP (2007-2014). WB is financing the Bhutan Urban Development II in the northern areas of Thimphu.

**Table 3-32 Estimate of Future Population**

| Area | Design Population | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Project Areas** | 2005 | 2009 | 2010 | 2011 | 2012 | 2016 | 2027 | 2020 |
| Changbangdu | 3014 | 3309 | 3389 | 3489 | 3589 | 4039 | 5050 | 4380 |
| Lungtenphu | 2122 | 2388 | 3118 | 4077 | 5316 | 15480 | 19351 | 16789 |
| Simtokha | 3197 | 3598 | 3708 | 4488 | 5428 | 11646 | 19403 | 14022 |
| Babesa | 2350 | 2645 | 3266 | 4037 | 4989 | 11632 | 16625 | 13246 |
| Serbithang | 395 | 445 | 455 | 475 | 687 | 2989 | 3859 | 3280 |
| Changjiji | 3166 | 3597 | 3676 | 3766 | 3856 | 4225 | 5455 | 4636 |
| City Core | 52074 | 57480 | 58917 | 60390 | 61900 | 68326 | 89649 | 75419 |
| | | | | | | **Total** | **159393** | **131771** |
| | | | | | | | | |

Source: ADB TA 7630 – BHUTAN Urban Infrastructure Project Final Report October 2011

ADB is conducting to extend existing WWTP at Babesa to cover the growing needs of increasing population mainly in southern four LAPs (Chang Bangdu, Lungtenphu, Simtokha and Babesa) assisted by ADB. ADB estimates future population in southern areas and Central areas for this plan, as shown in Table 3-32.

Based on this estimate, the design parameters of Babesa WWTP are as follows;

A) Design population
- 131,800 people in 2020
- 159,400 people in 2027

B) Design wastewater inflow
- 14,000$m^3$/day as average daily flow in 2020
- 20,000$m^3$/ day as average daily flow in 2027

C) Design treatment area
- Above southern four area, Serbithang area, Changjiji area and Central areas area

D) Wastewater treatment process
- Aerobic biological treatment process, which will be procured under DBO contract
- (Despite that, three options are considered in TA report; i.e. Moving Bed Biofilm Reactor, Intermittent Decanted Extended Aeration Lagoon, and Biological Aerobic Filter.)

Source: JICA Survey Team

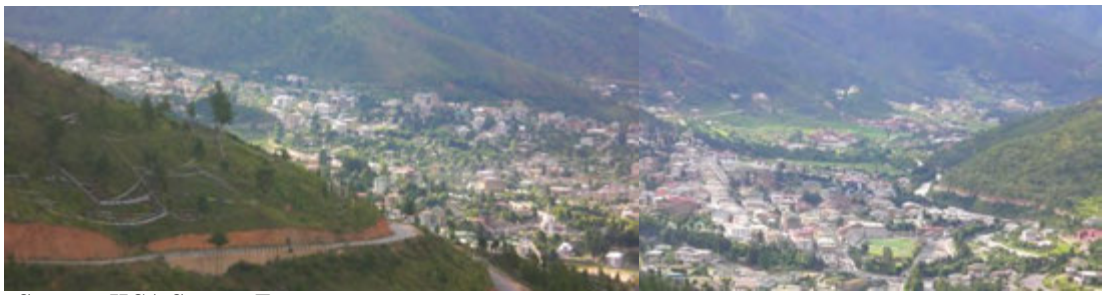
**Figure 3-66 Site of Dechencholing WWTP**

On the other hand WB assists LAPs in northern part of Thimphu. In Dechencholing LAP a small scale WWTP (750 m3/d) is under construction, which covers not only Dechencholing LAP but also Royal Body Guard Camp. In Langjophaka LAP also a small scale WWTP (approx. 800 m3/d) is studied. Figure 3-66 shows the construction site of Dechencholing WWTP.

### 3.6.10 Improvement of water environment in Motithang area and City Core area

Out of present un-sewered areas shown in 3.6.4, main parts of southern four urban villages and northern three urban villages will be covered by the above ongoing projects. In the remaining un-sewered areas of three urban villages of city center, the essential parts are Lower Motithang and Upper Motithang and its neighborhood.

The Motithang area is a high status residential area located uppermost part of city center area, as shown in Figure 3-67. The wastewater generated from Motithang area is disposed through side drains, which often spill into residences in the lower areas and causes heavy water pollution in City Core area and Wang Chhu. Figure 3-68 and Figure 3-59shows pollution inside of Motithang area and the drains.



Source: JICA Survey Team

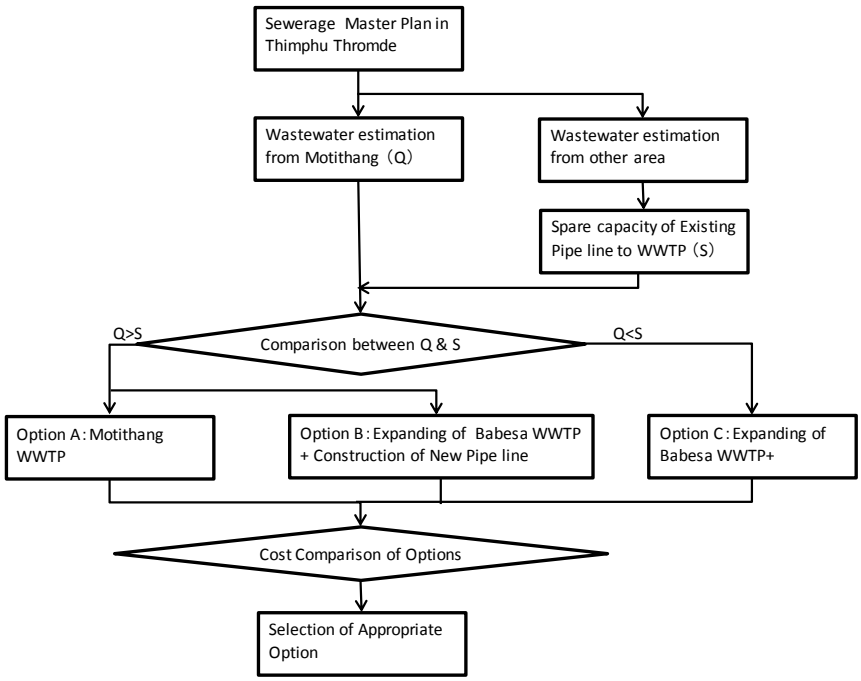
**Figure 3-67 Motithang area and City center area from the left**

Source: JICA Survey Team

**Figure 3-68 Motithang Area and Drainage**

To solve this situation the following tree options are needed to be investigated;
Case A): Construction of a local wastewater treatment plant or
Case B): Further expansion of Babesa WWTP with connecting pipes to the WWTP
Case C): Further expansion of Babesa WWTP

A methodology of the investigation is considered as Figure 3-69.




Source: JICA Survey Team

**Figure 3-69 A Proposed Flow for Motithang Study for Sewerage Treatment**

### 3.6.11 Development Needs in Sewerage/Drainage

#### TS-1: Water Pollution in Water Bodies in City

As indicated in 3.6.8, water bodies including drainage within the central part of Thimphu are increasingly getting polluted.

#### TS-2: Delay in Development of Green Corridor along Drainage

As indicated in 3.3.11 (2) and 3.6.7, lack of sewer connections in Motithang area is the biggest impediment to the development of green corridors along drainage in the central part of the city that have been planned by the Structure Plan.

#### TS-3: Lack of Wastewater Treatment Capacity

As indicated in 3.6.3 and 3.6.10, the current treatment capacity is less than 15% of the total population of the city. As a result, there are areas without sewer connections, even in prime locations such as Motithang.

#### TS-4: Increase in Long-term Wastewater Treatment Cost

As indicated in 3.5.8 and TW-3 in 3.5.9, the present low tariff while maintaining sound financial performances would not be sustainable after the introduction of the capital-intensive technologies currently under implementation. Increased operation costs will necessitate government subsidies.

#### TS-5: Lack of Sewerage Master Plan

Similarly to water supply planning, planning for sewerage systems is carried out on a local area plan level. Given the fact a local area plan has a boundary of one $km^2$ on the average, the area in consideration is too small to achieve overall economic efficiency. Before setting a sewerage plan of specified area, a city-wide comprehensive sewerage plan is required to avoid planning with a multitude of concepts. The sewerage master plan must incorporate city planning, water environment and sewerage management as well as meeting the growing needs of the increasing population and sustainable operation of sewerage service.

## 3.7 Environmental Situation in Thimphu City

### 3.7.1 Solid Waste Management

#### (1) General

Ministry of Works and Human Settlement made a survey of solid waste in 10 major cities with the assistance from DANIDA in 2007. The survey results show that 49% of the solid waste consists of organic wastes, 25.3% paper and cardboards, plastics 13.7%, glasses 3.6%, textiles 3%, etc.

In 2009 *Waste Management Act* has been introduced which defines waste management with segregation, recycling and composting. With this Act, individuals must separate at least bio-degradable and non-biodegradable, and municipality or authorized collectors have to collect

waste in a segregated manner. Minimum collection frequency is set at two times a week for residential areas and three times a week for commercial areas.

### (2) Thimphu City Current Situation[14]

Today the amount of solid waste generated is 60 to 65 tons per day. Only one final disposal site exists in Mermelakha. It has been operated since 1994 with the design capacity of 8 years, and it has already passed its lifetime. However, as no other alternative place exists, extension of use and improvement of waste management are being implemented with the assistance of Senior Volunteer and JICA Partnership Program (technical cooperation under partnership with NGOs).

The concept of 3-R (Reduce, Reuse, Recycle) has been already introduced and a pilot project for 3-R has been operated in 3 out of 16 districts with a Public - Private Partnership (PPP) initiative. As a result, 70% of the garbage generated is sent to the final disposal site. Garbage collection is done by the municipality and for center district every day and other areas twice a week. In this pilot project, garbage is classified into two; wet and dry. Wet garbage, organic waste, is transferred to a composting plant, where the wastes are converted to composts. A composting plant is constructed at Serbithang, with the official capacity of 25 to 30 tons per day with the cooperation from DANIDA. However, due to lack of collecting capability, the current output is only 1 ton per day.

Dry waste is transferred to the transfer station where recyclable wastes are separated and recovered. Used pet bottles, metals, papers carton boards, glasses, plastics are separated and recycled.15 A Bhutanese new firm named Green Way is the concessionaire who is assuming this dry waste separation of recyclable materials. PET bottles, metals, and glasses are exported to India.

The existing separation plant does not have enough capacity, and Green Way and the city proposed an additional plant. The proposed location was not approved and it will be built in a different place. With this new plant, the collection coverage area is expected to increase up to 50% of the city.

Medical wastes are treated at an autoclave oven within Thimphu JDRMWH hospital. The wastes are autoclaved for an hour at 120 degrees Celsius. After the autoclave, they are transferred to the dumping site, and no specific pit is developed.

### (3) Research for new disposal site

About 10 years ago Indian Consultants surveyed and recommended alternative sites, but none of these are resulted in inappropriate. Even Serbithang site, where composting plant exists, is not suitable as residential area and school exist close. Therefore, the only possibility to have new landfill site is to establish close to the existing Mermelakha site.

14 Basic information is obtained from Mr. Kashiwagi, Solid Waste Expert as Senior Volunteer of JICA to Thimphu City, July.

15 Although use of plastic bags, package wrappers has been banned since 1999, 12.7% of garbage is plastics with pet bottles, plastic bags, package wrappers, etc., since plastic bags, package wrappers are used in kiosk and shops. With the private initiative these are trying to recover.

### 3.7.2 Other Urban Environmental Situation

#### (1) Present

As for traffic related conditions, water supply and sewerage related situations, please see the specific clauses mentioned before. As for air condition, as explained in the Report to the Congress 2012, no serious air pollution is observed.

#### (2) Issues for Future

With the increase of traffic, production facilities, it may bring air pollution with increase of small particle matters. In case of Thimphu Thromde, as it is surrounded by steep mountains and rain is not much, it may have stagnant air pollution with small particulate matters in winter due to the inversed layer. As can be seen in Mexico City in Mexico, Santiago Chile, or La Paz in Bolivia, the stagnant dirty air damages health. Therefore it is necessary to take appropriate measures in the long term.

### 3.7.3 On-going Projects

**Solid Waste Management**

1) Japanese Senior Volunteer for Solid Waste Management
   Assisting Agency: JICA
   Project Type: Technical Cooperation through volunteers
   Period: 2 years from 2014
   Counterpart: Thimphu Thromde
2) JICA: Technology transfer operations regarding the environmental pollution control measure resulting from the wastes in Thimphu city (Technical cooperation under partnership with NGOs)

   Assisting Agency: JICA
   Project Type: Technical Cooperation
   Period: July 2013 - March 2016
   Counterpart: Thimphu Thromde

# Chapter 4 Urban Development in Phuentsholing

## 4.1 General

### 4.1.1 Geography/Topography

Phuentsholing is located at latitude 26 degrees 51' N and 89 degrees 23' E at the border to India in the southwest corner of Bhutan. The Highway No.1 that connects between Thimphu and Phuentsholing drops off from 1500m at the last mountain pass to the city at of 200 meter above mean sea level.

Am Mo Chhu runs in the west of the city prevents direct road access. At present there is an east-west highway project underway to connect the southern regions of Bhutan. It is expected that a highway will directly connect Samtse and Phuentsholing in a near future. Om Chhu River which is a tributary of Am Mo Chhu runs in the center of the city. This river has one of the sharpest gradients in the country which causes rapid flows, often flooding to the city. A record heavy precipitation in August 2000 caused a flood that passed the embankment to inundate the southern portion of the old city.


Source: JICA Study Team based on Google Earth

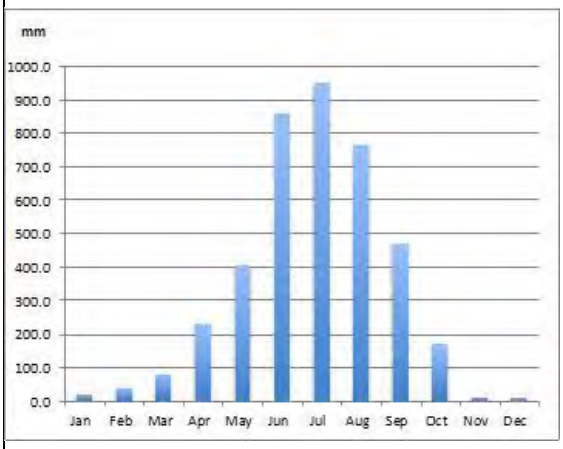
**Figure 4-1 Phuentsholing and Jaigaon**

The urban agglomeration continues beyond the border into India. The other side of the city is Jaigaon City with at a population of least 40,000. The mainstay of the city is trading with Bhutan. The scope and volume of goods and services offered in Jaigaon including fresh produce, meat, fishes, hardware and daily necessities overwhelm those offered in Phuentsholing. As a normal practice, the Bhutanese visitors and residents alike visit Jaigaon for shopping. It is reported that approximately 2000 low-income Bhutanese workers rent houses in Jaigaon and commute back to Phuentsholing. Some rich Indians prefer to live in Phuentsholing to enjoy more tranquil urban environment. Immigration inspection is kept at a minimum to allow active travels beyond the border. Jaigaon stretches over alluvial flat land without limitations for expansion.

Bordered by the big river in the west, the Indian border in the south and hills in the north and east, there is hardly room for expansion for the old city part of Phuentsholing. The old city had its urban area of 4.6 $km^2$, but it annexed all the areas to the east up to Pasakha to expand its area to 19.68$km^2$ in 2006. There is an industrial park in Pasakha with factories for bottling of beer and coca cola, electro-chemical industries including ferro-silicon, calcium carbide, plaster and cement, utilizing inexpensive electric power accessible in Bhutan.

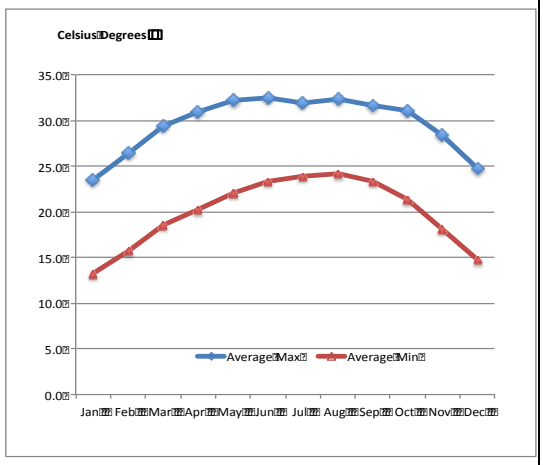
### 4.1.2 Climate

The annual precipitation of Phuentsholing is 4,018mm (1996-2011: Phuentsholing Station) as shown in Figure 4-2. Compared with relatively dry Thimphu, its precipitation is close to seven times and twice that of Japan (1,700mm). The monsoon brings wet wind through the Indian Continent to hit the first wall over 1000m behind Phuentsholing to pour out most of the moisture to the city. Figure 4-2 shows the monthly average precipitation during 1996-2011. Generally speaking, the monsoon period lasts between June through September. The heaviest precipitation takes place in June with an average of 950mm, followed by August with an




Source: Metrological Department/Ministry of Economic Affairs

**Figure 4-2 Monthly Average Precipitation of Phuentsholing（1996−2011）**




Source: Metrological Department/Ministry of Economic Affairs

**Figure 4-3 Monthly Average Maximum/Minimum Temperatures（1996−2011）**

average of 850mm. There is hardly any precipitation during the months of November through March. In terms of monthly average temperatures, the highest maximum temperature takes place in June with an average of 32.5 ℃ and the lowest minimum temperature takes place in January with an average of 13.3℃. The climate is that of tropics with relatively high temperatures throughout the year.（Figure 4-3）

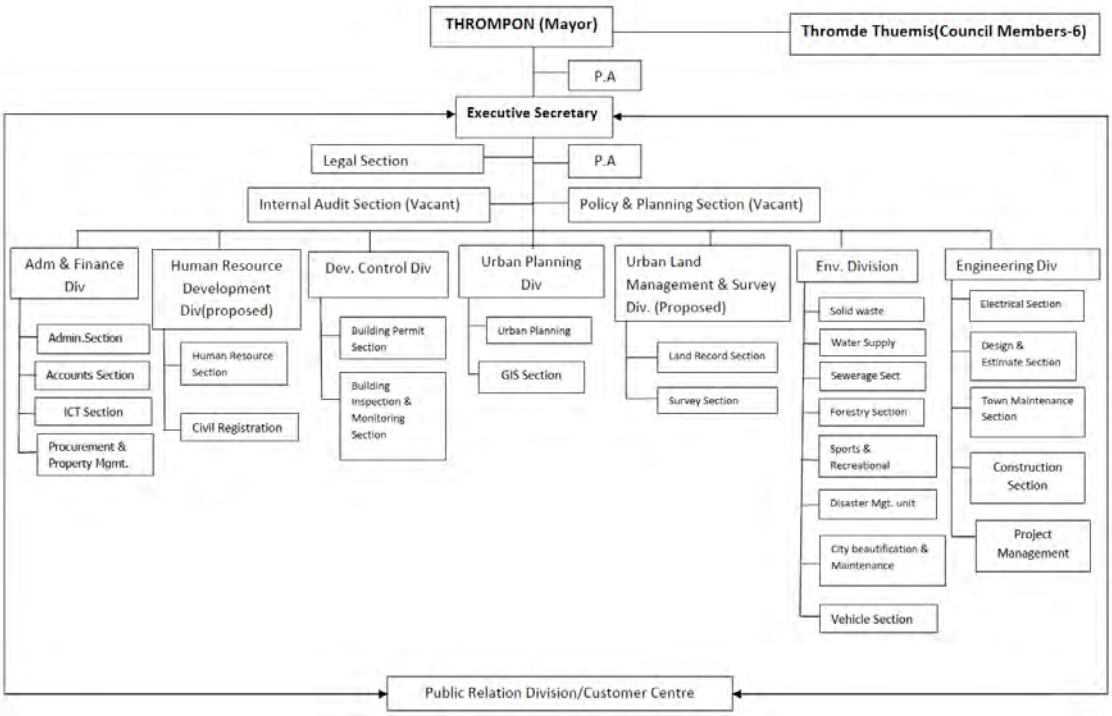
The fluctuations from year to year are quite large. The largest precipitation experienced between 1996-2011 was 6,699mm in 1998 while the smallest was 1,631mm in 2008. The difference is more than three times. There may be a long term declining trend in precipitation as is the case for Thimphu. After 2004, there were only two years in which the annual precipitation exceeded 4000mm while the previous eight years saw only one year missing this 4000mm level. There is some serious concern over the loss of water resources in Bhutan which the data from the last 16 years may be supporting.

A large river of Am Mo Chhu flows in the west of Phuentsholing while its tributary, Om Chhu cuts the core part of the city in east-west direct to join the Am Mo Chhu. The area of the Am Mo Chhu basin, originated in China, is approximately 3,600 $km^2$ while the Om Chhu has a basin of only 20 $km^2$. The river is less than 9 km and short but very steep grade; 13% on the average but more than 25% from 5km point upstream. The incident in August 2000 paralyzed the city several days, destroying sewer and water supply lines while causing casualties of more than 40 in Pasakha area.

## 4.2 Institution

### 4.2.1 Organization

The institutional structure of Phuentsholing Thromde is illustrated in Figure 4-4.




Source: Phuentsholing Thromde

**Figure 4-4 Organizational Structure of Phuentsholing Thromde**

Phuentsholing Thromde has 7 divisions totaling 87 people. The numbers of the staff in each department are shown in the following Table 4-1. With one Mayor, one Executive Secretary, one Legal Officer, the total staff number of the Thromde is around 90.

**Table 4-1 Number of Staff at Division Level at Phuentsholing Thromde**

| Adm. & Finance | HRD | Develop. Control | Urban Planning | Urban Land Mgt & Survey | Environment | Engineering |
|---|---|---|---|---|---|---|
| 23 | 1 | 11 | 7 | 4 | 22 | 19 |

Source: Phuentsholing Thromde

The staff members in charge of road are three engineers and 20 daily waged workers who are in charge of daily maintenance of roads and drainages. As they are sometimes also in charge of environmental issues, construction management capability is still on the way and consultants are hired when needed. In case of ADB projects, one proper staff and with consultants hired are formed as project implementation unit and they undertake the construction management. The construction of new national road to Samtse can be assumed by the City within the city boundary, but MoWHS is undertaking. This new road is not terminated; the bridge under construction has been paralyzed since the contractor has escaped, and various places of this new road along the river have been damaged by land slide and erosion. Lack of construction

management, lack of landslide prevention and slope management technology are observed. Thus so called Sabo technology is required and project management capability has to be improved.

As for Water supply and sanitation, 3 water supply engineers and 2 sanitation engineers exist in Environmental Division. In addition, about 60 daily workers also exist for this service. In order to cover various water purification plant and waste water treatment plant, staff members are not sufficient. Although the water infiltration plant constructed by the assistance of DANIDA was damaged by the flood of the year 2000, the 100% coverage was reconstructed by themselves. As can be seen in the deficiency on the sewerage network, it seems that they do not have enough capability on hydraulic design. In addition, as they are totally dependent on the consultants on the technology of sewage treatment, it seems that they do not have enough capability to figure out and select appropriate technology for them.

As for fare collection, a reliable and easy database system is introduced and they are well familiarized. Metering ratio is high, fare collection ratio is high, and the data management is also accurate, Thus accounting is precise based on the trust from residents.

Seven engineers are in charge of urban planning. LAP is completed with the initiative of themselves. The plan takes into account the topography and we understand their commitment on this plan. However, technologies on controlling landslides, floods are not sufficient.

The staffs in charge on the environment are 5 out of 22 in Environmental Division. Their main task is collection of solid wastes, but they are lack of garbage collection truck, and other equipment for separation, and they are not ready for population increase. Nevertheless, one engineer after coming back from JICA's three month training converted the open dumping site to the environmental friendly Fukuoka type land fill site. This means that they have a goodwill and sincere engineer with high level technology. For disaster prevention, 2 engineers of Environmental Division are double assigned. As they are recently assigned, they are not in capable of handling this theme.

### 4.2.2 Public Finance

The budget of Phuentsholing Thromde of the past 5 years is shown in Table 4-2. This revenue is acquired by property tax, land tax, water and sewerage user fee, lease of land, property transfer, public parking fees, etc. The expenditure spent for the past 5 years is shown in Table 4-3[1].

**Table 4-2 Revenue of Phuentsholing Thromde**

| Original Local Revenue | Nu. in Millions |
|---|---|
| 2008/2009 | 33,742 |
| 2009/2010 | 41,544 |
| 2010/2011 | 45,696 |
| 2011/2012 | 54,631 |
| 2012/2013 | 49,821 |
| Total | 225,434 |

Source: Phuentsholing Thromde

[1] According to Thromde, the revenue of the Table 4-3 and the own revenue of the Table 4-4 are not equal since they have expenditures which crosses fiscal years.

**Table 4-3 The expenditure of past 5 years (Nu. in Millions )**

| Investment | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 |
|---|---|---|---|---|---|
| Water Supply | | | 11.5 | 5.3 | 8 |
| Sewerage | | | 2. | 3.7 | 8.2 |
| Solid Waste | | | 0 | 0 | 1 |
| Roads, Bridges, Footpath | | | 41.6 | 31.5 | 36.3 |
| Consultancy, Survey Outsourcing | | | 16.9 | 11.7 | 69.4 |
| Total | 9 | 24 | 72.1 | 52.2 | 122.9 |

Source: Phuentsholing Thromde

According to Phuentsholing Thromde, the budget for the investment is subsidized by the central government, and operation and maintenance costs are financed by its own revenue. The breakdown of the investment is shown in Table 4-4. The revenue of the city is used for maintenance of water supply and sanitation, street lighting, and others including wages, office costs and electricity

**Table 4-4 Expenditure according to the source of funds (Nu. in Thousands)**

| (In Thousand Nu.) | Central Government | Own Revenue | ADB Project | Total |
|---|---|---|---|---|
| 2008/2009 | 8,979 | 32,214 | 5,658 | 46,851 |
| 2009/2010 | 23,953 | 29,508 | 36,694 | 90,155 |
| 2010/2011 | 72,008 | 37,136 | 11,934 | 121,078 |
| 2011/2012 | 52,234 | 50,483 | 4,315 | 107,032 |
| 2012/2013 | 122,872 | 56,054 | 43,751 | 222,677 |
| Total | 280,046 | 205,395 | 102,352 | 587,793 |

Source: Phuentsholing Thromde

The 11th 5 year plan is shown in the following Table 4-5. Up to the 10th the budget of Phuentsholing was under MoWHS, but from this 11th 5 year plan the budget is separately planned with other 4 Class-A cities.[2] The total budget of the Thromde is Nu.1,064 million[3]. The largest portion is the development of road network (Nu.481 million). In addition, several budget for infrastructure exists including development of bridges (Nu.110 million), Water supply and sewerage (Nu.33 million), Sewerage and waste management (Nu.31 million).

The budget includes not only own budget but also external finance. It also includes some amount which is pledged by external donor. For instance, in the budget of road and bridges, a large amount is included taking into account the construction of ring road to be financed by ADB. Thus excluding such amount the budget to be used freely is very limited. In addition to the budget for infrastructure, it has budget for improving the living standard including education

[2] GNHC views that the budget of Thimphu is Nu.2,000 million while other 3 class A cities are Nu.1,000 million each.

[3] GNHC views that the overall budget of Thromde is Nu.1,000 million excluding the budget for education Nu. 162 million.

promotion (Nu 162 million in total), Lighting (Nu15 million), Parks and recreational facilities (Nu.5 million).

**Table 4-5 Budget of 11th 5 year Plan for Phuentsholing Thromde (Millions in Nu.)**

| Sl No | Activity | |
|---|---|---|
| A | Local Area Plan | 7 |
| B | Development of Thromde infrastructures | 145 |
| C | Development and improvement of road networks | 481 |
| D | Sewerage and waste management | 31 |
| E | Construction and improvement of drainage system and footpath | 31 |
| F | Construction and improvement of Thromde water supply & sanitation | 33 |
| G | Construction of vehicle parking | 5 |
| H | Strengthening of Thromde Institutional Capacity | 14 |
| I | Construction and improvement of bridges | 110 |
| J | Disaster management and risk reduction | 21 |
| K | Development of parks and recreational facilities | 5 |
| L | Development of public transport system | 3 |
| M | Installation and maintenance of street lighting and CCTVs | 15 |
| N | Cultural and community development programs | 6 |
| O | Education Infrastructure Development | 160 |
| P | Support for disadvantage children and Value education | 1 |
| Q | Youth and literacy Program | 1 |
| | Total | 1,064 |
| | Total Education | 162 |
| | Total without education | 902 |

Source: GNHC

## 4.3 Urban Planning

### 4.3.1 Population in Phuentsholing

The population of Phuentsholing in 2000 was 12,625 persons. According to the 2005 National Population Census, the population increased to 20,537 persons in 2005. The estimated population for 212 is 23,915 persons[4]. This suggests that during the five years between 2000-2005, the Phuentsholing experienced an annual population growth rate of 10.2%, however, during 2005-2012; the growth rate remained at 2.2%.

The current draft Phuentsholing Structure Plan (PSP) uses two scenarios for its population forecast at an annual growth rate of 3% and 5%. As shown on Table 4-6, the population in 2037 is estimated at 50,066 for the 3% scenario and 80,975 for the 5% scenario.

[4] Source: http://world-gazetteer.com & http://www.countrywatch.com

**Table 4-6 Phuentsholing Future Population Forecast**

| Year | Population Projection with 3.0 % * Compound Annual Growth Rate | Population Projection with 5.0% ** Compound Annual Growth Rate |
|---|---|---|
| 2012 | 23,912 | 23,912 |
| 2017 | 27,721 | 30,518 |
| 2022 | 32,136 | 38,950 |
| 2027 | 37,254 | 49,711 |
| 2032 | 43,188 | 63,446 |
| 2037 | 50,066 | 80,975 |

Source: Phuentsholing Structure Plan (2013-2028)
* Phuentsholing Urban Development Plan (2002-2017), **Thimphu Structure Plan

### 4.3.2 Existing Population, Population Accommodation, and Future Population Forecast by Local Area

The 2003 existing population, based on the Phuentsholing Urban Development Plan (PUDP) approved in 2004, is shown in Table 4-7. The 2013 Phuentsholing Structure Plan applies the population from the 2005 National Population Census, 20,537 persons, as the existing population of Phuentsholing, and there is no breakdown by local area. Furthermore, in the draft PSP, there is no re-examination of the population by local area calculated in the 2004 PUDP. (Table 4-7)

**Table 4-7 Phuentsholing Existing Population by Local Area (2003)**

| Area | Population |
|---|---|
| EXISTING CITY CORPORATION AREA | 12,750 |
| HOUSELESS (SLUMS) | 600 |
| EXTENDED AREAS | 4,700 |
| PIPAL DARA | 200 |
| DAMDARA | 250 |
| KABREYTAR | 650 |
| RINCHENDING | 1,000 |
| PASAKHA | 2,600 |
| SPECIAL AREAS | 1,650 |
| RBA & RBP | 1,000 |
| IMTRAT, GREF & DANTAK, INDIA HOUSE | 600 |
| ROYAL HOUSES/ G. HOUSES | 50 |
| TOTAL POPULATION OF PUA | 19,700 |
| BHUTANESE STAYING IN JAIGAON | 1,500 |
| FLOATING POPULATION | 5,400 |
| DAILY WORKFORCE | 4,800 |
| LABOUR CAMPS & HUTMENTS | 600 |
| TOTAL POPULATION | 26,600 |

Source: Phuentsholing Urban Development Plan (2002-2017)

As shown in Table 4-8, the draft structure plan analyzes the capacity of population that can be accommodated in areas planned for new development. Based on the analysis, the total population that can be accommodated is 57,416 persons. However, a majority of this population is proposed to be dependent on the accommodation capacity of the Am Mo Chhu River Reclamation. Both Toorsa Tar and Am Mo Chhu refer to the planned reclamation area, and

approximately thirty thousand people are planned to be accommodated in this area. Furthermore, Toribari, which has been identified to have a high accommodation capacity, is a rural area in the east, located close to the Pasakha Industrial Estate. When comparing totals of the future population forecast and the population that can be accommodated in the region, it seems that the demand is balanced by supply. However, Am Mo Chhu, Toribari and Toorsa Tar are Greenfield development areas and implementation has not been committed. Hence, it is important to review how to accommodate the growing population in the scenario that the developments are not realized.

On the other hand, Phuentsholing borders with the Indian city of Jaigaon. Jaigaon has a city area which is three times the size of Phuentsholing, and functions to accommodate the population pressures of Phuentsholing. Based on the structure plan estimation, currently at least 2,000 Bhutanese reside in the India-side while working on the Bhutan-side. It is import to address the issue of population accommodation both Phuentsholing and Jaigaon in the context of the whole urban region[5].

**Table 4-8 Population that Can be Accommodated by Local Area**

| Neighborhood | Area for Development and Population accommodated | | | | | | |
|---|---|---|---|---|---|---|---|
| | Residential | | Terraced Housing | | Mixed Use | | Total Pop |
| | Area (Ha) | Pop | Area (Ha) | Pop | Area (Ha) | Pop | |
| Toorsa Tar | 41.2 | 11,175 | 0 | 0 | 5.16 | 467 | 11,642 |
| Am Mo Chhu | 53.72 | 14,572 | 5.34 | 543 | 52.97 | 4,790 | 19,904 |
| above Kabreytar | 0 | 0 | 1.05 | 107 | 0 | 0 | 107 |
| Kharaley, Khareyphu, Dokhiya | 4.33 | 1,175 | 3.51 | 357 | 0 | 0 | 1,531 |
| Rinchending | 0 | 0 | 15.53 | 1,579 | 0 | 0 | 1,579 |
| Ahlay | 7.33 | 1,989 | 5.7 | 579 | 0 | 0 | 2,569 |
| Toribari | 26.56 | 7,205 | 5.94 | 604 | 15.39 | 1,392 | 9,200 |
| Changmari and Gurung Dangra | 19.9 | 5,398 | 22.34 | 2,272 | 0 | 0 | 7,670 |
| Malbase | 6.4 | 1,736 | 1.37 | 139 | 0 | 631 | 2,506 |
| Pasakha | 1.94 | 526 | 1.79 | 182 | 0 | 0 | 707 |
| Total | 161.38 | 43,775 | 62.54 | 6,362 | 73.53 | 7,280 | 57,416 |
| Total Area (Hectares) | 297.45 | | | | | | |
| Total Pop Accommodated | 57,416 | | | | | | |

Source: Phuentsholing Structure Plan (2013-2028)

The PSP utilizes population from the 2005 National Population Census as the existing population. However, it has been 8 years since the census and a review of the urban population. A review of the current urban environment and future population forecast is required.

[5] Simply meaning, if housing on Phuentsholing side is inconvenient or not economical, there are possibilities of housing options across the border.

### 4.3.3 Current State of Urban Planning

#### Areas of Expected Housing Development

Due to the industrial and commercial activity in the vicinity and the employment pressures in Jaigaon, there is rapid growth in housing demand in which supply cannot keep up with. The PSP applies two population growth scenarios (3% and 5%), estimating approximately 37,000 in the case of 3% growth rate and 49,700 in the case of 5% growth rate in 2027. The plan is to accommodate the additional population initially within the three on-going Local Area Plans (LAP); furthermore, there are reviews of possible accommodation in large scale greenfield developments.

#### Am Mo Chhu Reclamation Project

In the PSP, the estimated population to be accommodated in the case that the Am Mo Chhu Reclamation and Township Project be implemented is approximately 19,000. The project site of the Am Mo Chhu Reclamation Project is shown in Figure 4-5. The Royal Government of Bhutan entrusted to DHI INFRA Ltd., a subsidiary of Druk Holdings Investments (DHI)[6]. DHI INFRA Ltd. has prepared the *Am Mo Chhu Land Reclamation and Development of New Phuentsholing City – Consultancy Package 1* in 2001. The status of the project is summarized below:

- Financial Source: Public Private Partnership (PPP)
- Area to be developed: 350.33Ha along the Am Mo Chhu
- A detailed hydrological study of the Reclamation has been contracted out to an Indian company and is currently on-going

Source: JICA Project Team

**Figure 4-5 Project Site for Am Mo Chhu Reclamation Project**

[6] Druk Holdings Investments (DHI) was established in 2007 through the Royal Charter issued by King Jigme Khesar Namgyel Wangchuck with the Ministry of Finance as its sole shareholder. DHI INFRA was formed in 2011 as a subsidiary of DHI with its primary mandate to "promote and develop the county's infrastructure to accelerate socio-economic development" and is currently undertaking major infrastructure works including the Education City near Thimphu, Am Mo Chhu Land Reclamation and Township Project, and Special Economic Zones (SEZ) in Gelephu, Samtse and Samdrup Jongkhar under the PPP model

**Toribari Development Project**

Source: JICA Project Team

**Figure 4-6 Project Site for Toribari Development Project**

In the PSP, the estimated population to be accommodated in the case the Toribari Development Project is implemented is approximately 9,200. As shown in Figure 4-6, the Toribari Development Project site has been selected for its relatively flat land necessary for development. However, as the site is a Greenfield development, the Environmental Impact Assessment (EIA) and the development approvals may be a challenge. Currently, there is only a land use designation for Toribari in the PSP, and LAPs and other studies necessary for the development have not been conducted.

**Toorsa Tar Development Project**

In the PSP, the estimated population to be accommodated in the case the Toorsa Tar Development Project is implemented is approximately 11,600. The development potential of these areas is high as it is located along the Samtse-Phuentsholing Highway which is currently under construction. However, the site is far from the Phuentsholing city core. Currently, there is only a land use designation for Toorsa Tar in the PSP, and LAPs and other studies necessary for the development have not been conducted.

### 4.3.4 Phuentsholing Structure Plan

#### (1) Development Objectives

Phuentsholing is the second largest city in terms of population and economic activity after Thimphu, and is considered the trade hub of Bhutan. The city is located along the border with India. As shown in Table 4-9, Phuentsholing is an important gateway for Bhutan, and accounts for 83% of total imports, and 73% of total exports.

**Table 4-9 Trade in the Phuentsholing Region (2010)**

| Phuentsholing share in total imports in 2010 | | | |
|---|---|---|---|
| | Imports from India | Imports from third countries | Total imports |
| Phuentsholing region | 23,725,263 | 8,776,684 | 32,501,947 |
| Overall for Bhutan | 29,329,106 | 9,746,092 | 39,075,198 |
| % share of Phuentsholing | 81% | 90% | 83% |
| Phuentsholing share in total exports in 2010 | | | |
| | Exports to India | Exports to third countries | Total Exports |

| | | | |
|---|---|---|---|
| Phuentsholing region | 11,530,236 | 2,190,989 | 13,721,225 |
| Overall for Bhutan | 15,589,427 | 3,323, 499 | 18,912,926 |
| % share of Phuentsholing | 74% | 66% | 73% |

Source: Phuentsholing Structure Plan (2013-2028)

Furthermore, Phuentsholing is located at the intersection of the Phuentsholing – Thimphu Highway, which connects the North to South of Western Bhutan, and the planned Southern East West Corridor which connects the southern border cities of Samtse – Phuentsholing – Sarpang – Gelephu – Samdrup Jongkhar, and further economic activities are anticipated in the future.

Phuentsholing's advantageous location in terms of economic activity is "strength" as a city. On the contrary, the limitation of land for development is considered "weakness." The development vision for Phuentsholing is to transform the city into the southern commercial, business, and tourism hub through efficient and optimal development of limited developable land, and is stated in the PSP as follows:

> **Vision:**
> *Strengthen Phuentsholing as a business and recreational hub with adequate support infrastructure within the south-western region of Bhutan; by applying the smart growth principle.*
>
> Source: Phuentsholing Structure Plan (2013-2028)

### (2) Urban Development Plan and Structure Plan

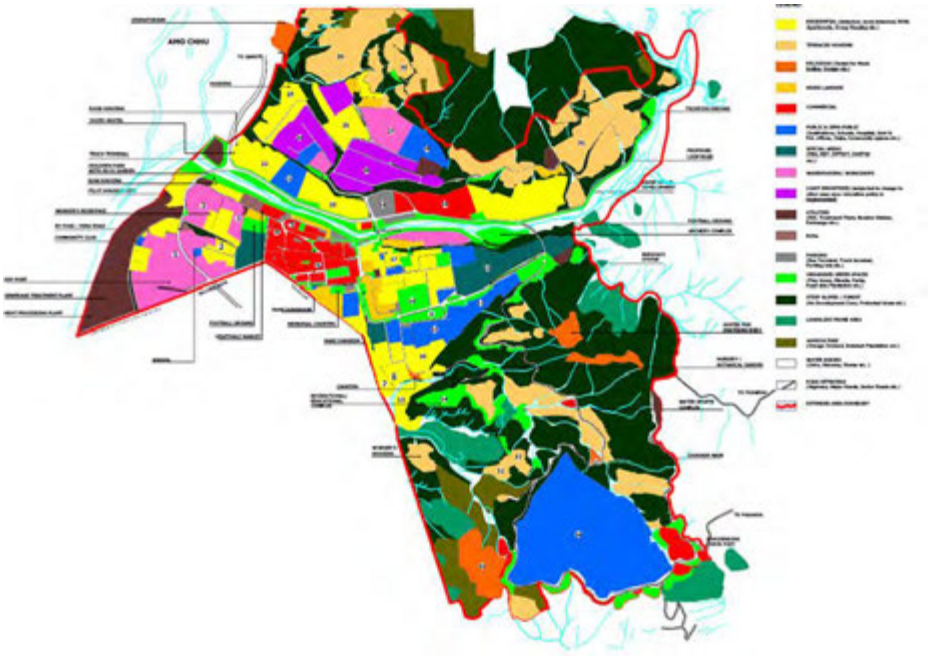
Urban Development in Phuentsholing has been guided by the following three Urban Development and Structure plans. Similar to Thimphu Structure Plan, PSP has the most important influence in terms of legal bindings and continuation of the implementation plan.

1. First Phuentsholing Urban Development Plan (1987-2001)
2. Second Phuentsholing Urban Development Plan (2002-2017)
3. Phuentsholing Structure Plan (2013-2028)

#### Phuentsholing Urban Development Plan (2002-2017)

The Second Phuentsholing Urban Development Plan (2002-2017) (PUDP), formulated in 2004 with assistance from the Danish International Development Agency (DANIDA) indicates the following four sectors as the pillars as the strategy for growth. As shown in Figure 4-7, the land use plan for the approximately 186 Ha of Phuentsholing City boundaries has been developed.

1. Trade and Commerce
2. Industrial Development
3. Warehousing
4. Construction

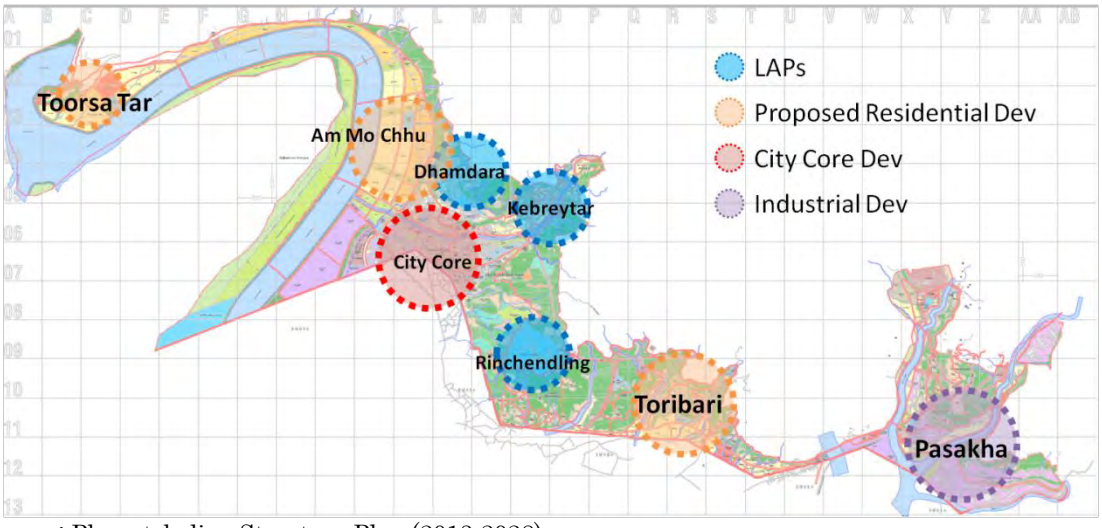


Source: Phuentsholing Urban Development Plan (2002-2017)

**Figure 4-7 Land Use Plan from Phuentsholing Urban Development Plan (2001-2017)**

## Phuentsholing Structure Plan (2013-2028)

The Phuentsholing Structure Plan (2013-2028) (PSP) was formulated in 2013 and the draft was submitted for approval in July and is currently under Government approval. The structure plans reviews the future growth and development demand due to rapid population increase and economic growth. As shown in Figure 4-8, the Phuentsholing Structure Plan covers approximately 1,680 Ha of land, including areas beyond the Phuentsholing city boundary (approximately 186 ha) such as rural areas and the Pasakha Industrial Estate.




Source: Phuentsholing Structure Plan (2013-2028)

**Figure 4-8 Areas Covered in the Phuentsholing Structure Plan (2013-2028)**

Furthermore, learning from the Thimphu Structure Plan and under the National Development Strategy of Gross National Happiness (GNH), the Phuentsholing Structure Plan is guided by 8 principles, 5 themes, and 8 planning components as shown in Table 4-10.

**Table 4-10 Principles, Themes, and Planning Components of the Phuentsholing Structure Plan**

| | | |
|---|---|---|
| Principles (8) of Smart Growth | 1. Community and Stakeholders' Involvement<br>2. Walkable Neighbourhood<br>3. Create Attractive Communities with Strong Sense of Place<br>4. Mix Land Uses<br>5. Make Development Fair and Cost Effective | 6. Preserve Open Space, Natural Beauty and Critical Environment Areas<br>7. Provide a Variety of Transport Options<br>8. Create a Range of Housing Opportunity |
| Themes of the Structure Plan (5) | 1. Creating an Economic Base<br>➢ Special Policies for Catalyzing Growth<br>➢ Economic Infrastructure and Industrial Estates<br>➢ Dry Port and Free Trade Zones<br>➢ New Phuentsholing-Samtse and Phuentsholing-Sarpang National Highways | 2. Gateway to the Kingdom<br>➢ Passenger Entrance<br>➢ Cargo Entrance<br>3. Sustainable Environment<br>4. Integrity among Tradition and Technology<br>5. Community, Conviviality and Human Scale<br>6. |
| Planning Components (8) | 1. The City Core<br>2. The Public Domain and Community Participation<br>3. Open Space System<br>4. Urban Corridor | 1. Foot Path System<br>2. Neighbourhoods<br>3. Forest Boundary and Natural Landscape<br>4. Peripheral Zone Control |

Source: Phuentsholing Structure Plan (2013-2028)

### (3) Investment Plan of Structure Plan

Table 4-11 shows the summary of the investment plans within Phuentsholing Draft Structure Plan. The total planned investment amount is Nu. 6,273 million which is approximately six times the budget allocated by the 11th Five Year Plan (Table 4-5.)

**Table 4-11 Investment Plan in Phuentsholing Structure Plan**

| SI. No. | Utilities and Infrastructure | Estimated Cost | |
|---|---|---|---|
| | | Nu in Million | USD ($) in million |
| 1 | Water Supply System and Network System | 844.9 | 15.36 |
| | A: Raw Water Transmission & Raw Water Reservoir | 105.6 | 1.92 |
| | B:Water Treatment Plant & Treated Water Reservoirs | 290.1 | 5.274 |
| | C:Break Pressure Tanks | 3.6 | 0.066 |
| | D:Distribution Networks | 375.9 | 6.835 |
| | E:Design & Supervision Cost | 69.8 | 1.269 |
| 2 | Sewerage System | 803.4 | 14.608 |
| | A: Sewage Treatment Plant including de-sludging and sludge drying beds | 508.2 | 9.24 |
| | B:Sewer Networks | 228.9 | 4.162 |
| | C:Design & Supervision Cost | 66.3 | 1.206 |
| 3 | Storm Water Drainage system, Flood Protection and River Training Work | 1,611.6 | 29.3 |
| | A:Protection & River Training Works | 1,344.3 | 24.443 |

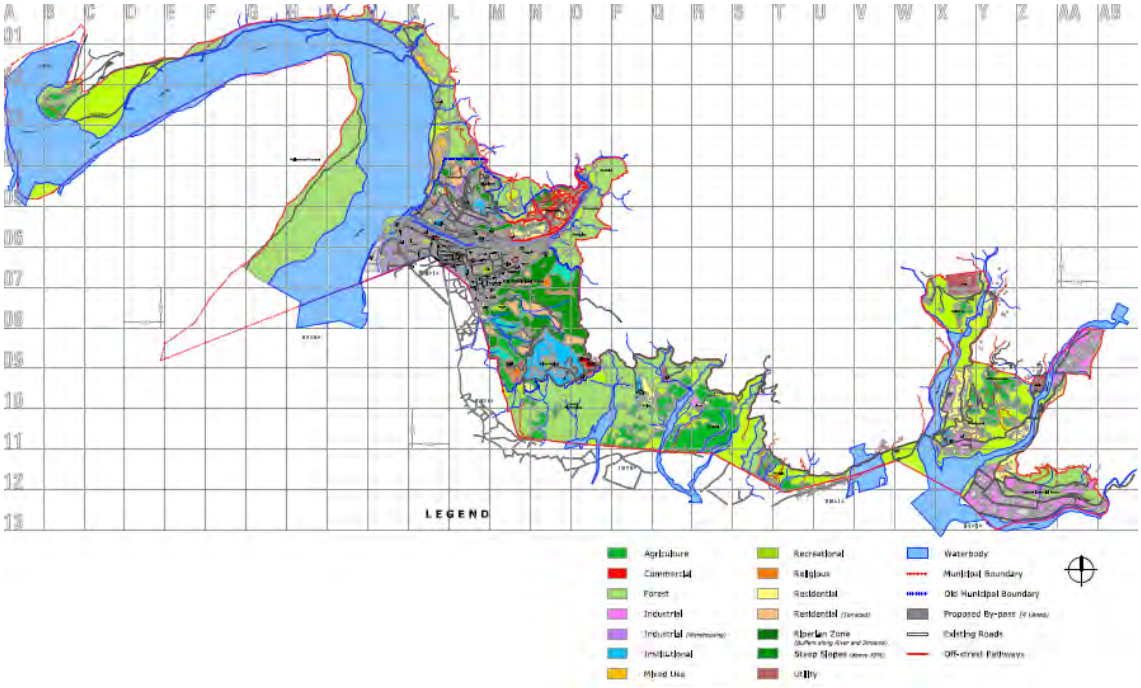
| | | | |
|---|---|---|---|
| | B:Storm Water Drainage | 134.2 | 2.44 |
| | C:Design & Supervision Cost | 133.1 | 2.419 |
| 4 | Solid Waste Collection and Disposal System | 43.7 | 0.79 |
| | A:Collection Structures | 40.1 | 0.728 |
| | B:Design & Supervision Cost | 3.6 | 0.065 |
| 5 | Electrical (Power) Distribution System | 494.3 | 8.987 |
| | A:Transformer | 0.1 | 0.001 |
| | B:Electrical Distribution Lines | 467.2 | 8.495 |
| | C:Design & Supervision Cost | 27.0 | 0.491 |
| 6 | Street Lighting | 57.0 | 1.04 |
| | A:Street Lighting System | 52.3 | 0.951 |
| | B:Design & Supervision Cost | 4.7 | 0.086 |
| 7 | Telecommunication System | 177.1 | 3.22 |
| | A:Telecommunication System | 162.5 | 2.955 |
| | B:Design & Supervision Cost | 14.6 | 0.266 |
| 8 | Transportation System | 2,351.0 | 42.75 |
| | A:Upgradation of Existing Roads | 565.5 | 10.283 |
| | B:Proposed New Roads | 779.6 | 14.174 |
| | C:Bridge & Culverts | 811.8 | 14.760 |
| | D:Design & Supervision Cost | 194.1 | 3.530 |
| 9 | Local Area Plan Implementation and Landscaping | 57.3 | 1.04 |
| | A:Preparation of Local Area Plan | 12.1 | 0.22 |
| | B:Landscape Design | 40.4 | 0.735 |
| | C:Design & Supervision Cost | 4.7 | 0.086 |
| | **Total** | 6,273.0 | 117.10 |

Source: Phuentsholing Structure Plan

### 4.3.5 Land Use

#### (1) Existing Land Use

The existing land use map and areas (Ha) by land use for the 1,680 Ha considered in the Phuentsholing Structure Plan are shown in Figure 4-9 and Table 4-12. As evident, 46% of the total land use is taken up by agriculture, forest, and open space while 37% is taken up by Water bodies (namely Am Mo Chhu and Om Chhu Rivers), indicating that only a limited area currently developed for urban conditions.




Source: Phuentsholing Structure Plan (2013-2028)

**Figure 4-9 Existing Land Use in the Phuentsholing Structure Plan**

**Table 4-12 Area by Land Use in the Phuentsholing Structure Plan**

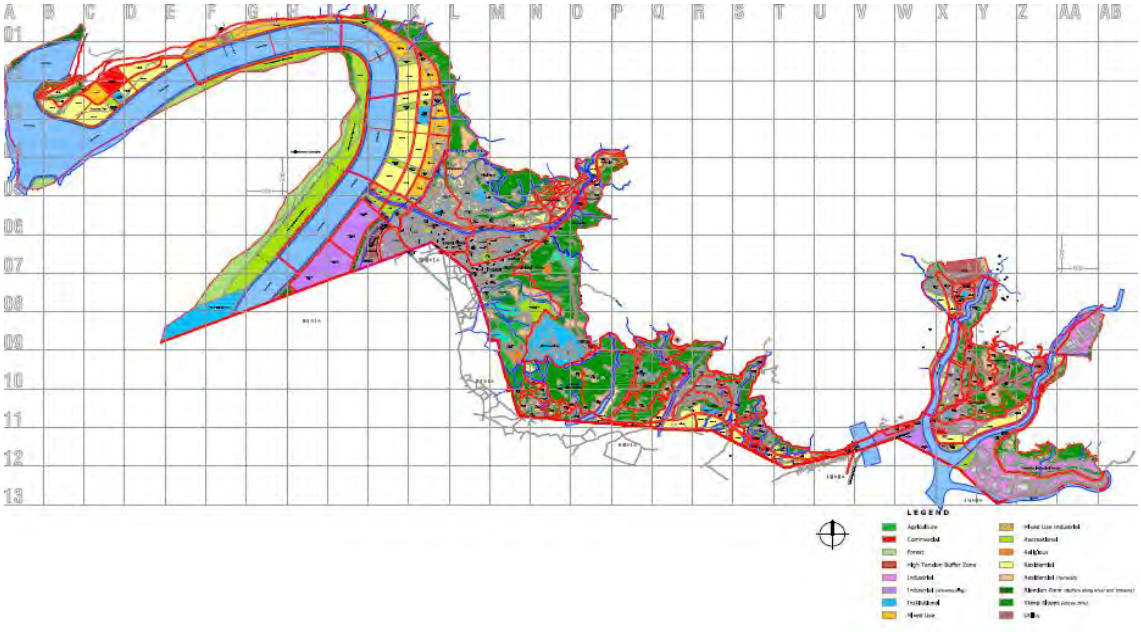
| Land Type | Area | | % |
|---|---|---|---|
| | Sq. Mt | Ha | |
| Not surveyed (mostly forested, open) | 772,475.97 | 77.25 | 4.60% |
| Agricultural | 1,025,139.06 | 102.51 | 6.10% |
| Commercial | 3,944.64 | 0.39 | 0.02% |
| Forest | 4,083,489.35 | 408.35 | 24.30% |
| Industrial | 840,368.71 | 84.04 | 5.00% |
| Institutional | 57,265.71 | 5.73 | 0.34% |
| Mixed | 162,451.28 | 16.25 | 0.97% |
| Open | 2,649,468.80 | 264.95 | 15.77% |
| Recreational | 10,972.68 | 1.1 | 0.07% |
| Religious | 14,458.72 | 1.45 | 0.09% |
| Residential | 493,768.81 | 49.38 | 2.94% |
| Utility | 141,603.66 | 14.16 | 0.84% |
| Water body | 6,279,913.28 | 627.99 | 37.37% |
| Roads | 269,779.34 | 26.98 | 1.61% |
| Total | 16,805,100.00 | 1,680.51 | 100.00% |

Source: Phuentsholing Structure Plan (2013-2028), Phuentsholing Thromde

## (2) Land Use Plan

The future land use plan and future areas (Ha) by land use for the 1,680 Ha considered in the Phuentsholing Structure Plan are shown in Figure 4-10 and Table 4-13.

A major aspect of the land use plan is that the current percent of residential land use of 2.9% is planned to increase to 13.3% through various residential developments. This issue is closely related to the population accommodation and the Greenfield developments further discussed in other sections of this chapter.



Source: Phuentsholing Structure Plan (2013-2028)

**Figure 4-10 Future Land Use Plan in the Phuentsholing Structure Plan**

**Table 4-13 Future Area by Land Use in the Phuentsholing Structure Plan**

| Land Use | Area | | % |
|---|---|---|---|
| | Sq. m | Ha. | |
| Residential (Terrace) | 625,446.90 | 62.54 | 3.72% |
| Residential | 1,613,758.77 | 161.38 | 9.60% |
| Mixed | 581,368.80 | 58.14 | 3.46% |
| Mixed Use Industrial | 223,710.72 | 22.37 | 1.33% |
| Commercial | 193,261.87 | 19.33 | 1.15% |
| Institutional | 361,879.23 | 36.19 | 2.15% |
| Steep Slopes | 3,566,699.80 | 356.67 | 21.22% |
| Forest | 499,695.60 | 49.97 | 2.97% |
| Agriculture | 0 | 0 | 0.00% |
| Riparian Zone | 1,029,333.93 | 102.93 | 6.13% |
| Recreational | 1,206,967.35 | 120.7 | 7.18% |
| International Buffer | 170,245.95 | 17.02 | 1.01% |
| HT Lines Buffer | 266,262.90 | 26.63 | 1.58% |
| Religious | 28,519.18 | 2.85 | 0.17% |
| Industry (non-polluting) | 822,295.10 | 82.23 | 4.89% |
| Industry (polluting) | | | |
| Warehousing | 560,309.66 | 56.03 | 3.33% |
| Water body (major) | 3,989,811.83 | 398.98 | 23.74% |
| Utility | 215,529.69 | 21.55 | 1.28% |
| Parking | 18,094.19 | 1.81 | 0.11% |
| Roads | 831,650.44 | 83.17 | 4.95% |
| Total | 16,804,841.90 | 1,680.48 | 100.00% |

Source: Phuentsholing Structure Plan (2013-2028)

### 4.3.6 Land Ownership/Land Tax/Land Value

#### (1) Urban Land Tax

Land and categorized under Urban Land within the Phuentsholing City boundary (approximately 186 Ha) is subject to Urban Land Tax, which is higher than Rural Land Tax. Currently, the remaining 1,494 Ha (1, 680 Ha minus 186 Ha) reviewed in the PSP is in general considered Rural Land with Rural Tax rates applied, however, based on the status of development, Urban Tax may be applied.

#### (2) Land Values

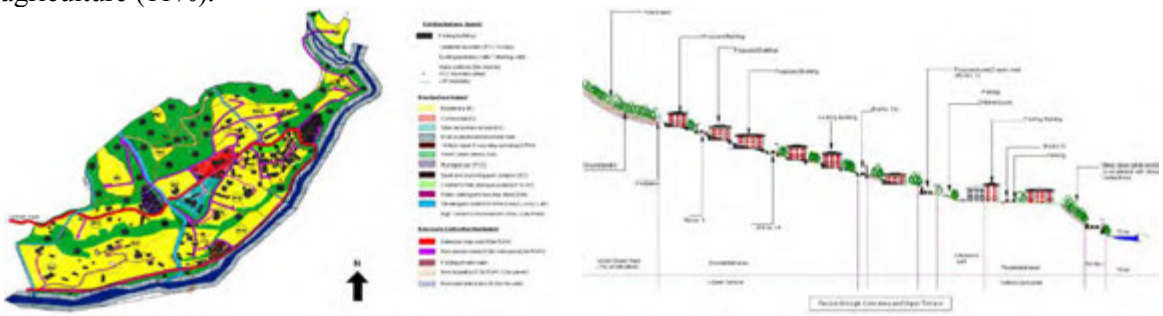
Land values set by PAVA in 2009 shows that it has a value of 3,508Nu./$m^2$ for all residential areas while 9,778Nu./$m^2$ to 9,829Nu./$m^2$ for the commercial area, meaning that no much differentiation. As in the case of Thimphu it seems that there is little reflection of actual land transaction values but rather there is much reflection of political consideration

### 4.3.7 Status of Local Area Plans

Currently, there are three Local Area Plans (LAP) for the areas of Kabreytar, Rinchending, and Dhamdara which are completed, on-going or in the approval process. Phuentsholing City plans to focus on housing development in these areas in order to accommodate the population growth in the near future. The land use plan for the three LAPs are shown in Figure 4-11 and Figure 4-12.

**Kabreytar Local Area Plan**

The LAP for Kabreytar was completed in 2002 by Department of Urban Development & Engineering Services (DUDES) in 2002 and is under implementation. The land use is primarily residential (37%), government land (including slope area at 29%), vacant lots (18%) and agriculture (11%).



Kabreytar Land Use Plan

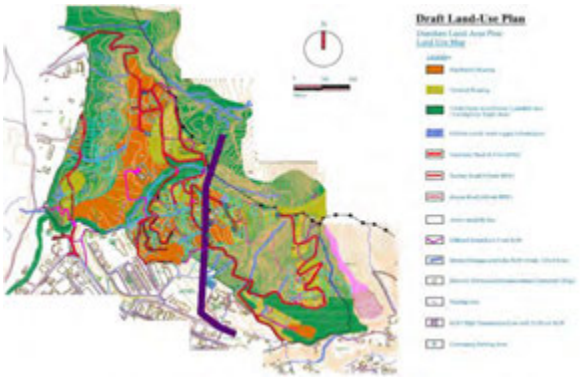
Section of Middle and Upper Terraces

Source: Kabreytar Local Area Plan

**Figure 4-11 Kabreytar LAP Land Use Plan and Section**

**Dhamdara and Rinchending Local Area Plan**

The existing land use of Dhamdara is predominantly residential (terraced) use, which Rinchending is predominantly institutional use. While the predominant land use is to remain as is in the future plans, the LAPs would provide the necessary urban infrastructure to the neighborhood.




On-going Dhamdara Draft Land Use Plan

On-going Rinchending LAP

Source: Dhamdara Local Area Plan and Rinchending Local Area Plan

**Figure 4-12 Dhamdara and Rinchending LAP Draft Land Use Plan**

### 4.3.8 Progress of Local Area Plans

#### Kabreytar Local Area Plan

Kabreytar, which has a land area of 45 Ha, is located in the north of Om Chhu River. The land is terraced into three layers, upper, middle, and lower, and flat land for development it limited. Development is progressing especially in the middle terrace along the Kabreytar Road and urban infrastructure is partially being upgraded. Resolved land ownership boundaries are a pre-requisite for Land Pooling. In the case of Kabreytar, there remain unresolved land ownership boundary issues and therefore the Land Pooling technique cannot be applied to Kabreytar. Furthermore, Guided Land Development cannot be implemented throughout the whole site due to unresolved boundary issues and the sloped geological constrains.

Due to the above mentioned reasons, the Kabreytar LAP applies the methodologies of Guided Land Development and land acquisition based on to the Land Act 2007, depending on the characteristics of the site. In areas with orderly shaped plots and relatively flat land, Guided Land Development is implemented. In other areas, based on the provisions of the Land Act 2007, the Government will acquire the land necessary for roads and urban infrastructure under the appropriate approval process. Land owners will receive a cash compensation for their land and assets calculated by PAVA, and if possible, will be provided a substitute plot within the city boundary.

#### Rinchending Local Area Plan

The percentage of land pooling contributed by landowners in the Rinchending LAP is 15%. However, in areas where significant development has already occurred and there is no land to contribute, then a financial contribution may be applied. In case of landowners who own land plots where the whole area of the plot is located in a high hazard zone, Land Pooling is not applied. In the case of a plot where the majority of the site area is in located in a high hazard zone, if over 10 decimals[7] is within a non-hazard zone, Land Pooling is applied.

[7] 1 Decimal = 1/100 acre (40.46 m²)

**Dhamdara Local Area Plan**

The Dhamdara Local Area is currently in the process of formulation, and Land Pooling is currently under review.

### 4.3.9 Urban Landscape and Development

As shown in Figure 4-13, Phuentsholing is surrounded by mountains and the Am Mo Chhu River with flows to India, and similar to the Thimphu Structure Plan, the Phuentsholing Structure Plan the emphasizes Phuentsholing's goal to become an environmentally sustainable city .

Where Am Mo Chhu River and Om Chhu River Meet

Waste Water Treatment Plant and Natural Landscape along the Am Mo Chhu River

Source: JICA Project Team

**Figure 4-13 Natural Environment of Phuentsholing**

Having the characteristic as a commercial city along the border, there is an international gate and weighbridge located in the center of the city. Currently, long haul trucks pass through the city, and pedestrian safety is a concern. As a response, Phuentsholing City is planning to improve the pedestrian environment in the city center through the construction of the ADB assisted ring road and second gate in order to divert long haul truck traffic to the outside of the city center. As shown in Figure 4-14, through the utilization of existing Footpaths, pedestrian bridges, and bus terminals, the development of a Walkable City is considered.

Pedestrian Walkway on Om Chhu River Embankment

Pedestrian Bridge over Om Chhu River

Gate to India in the City Center

RSTA Bus Terminal

Source: JICA Project Team

**Figure 4-14 Potentials for Pedestrian Environment in Phuentsholing**

Similar to Thimphu City, Phuentsholing City emphasizes the importance of walkability and balance with the environment in Urban Planning. However, it does not seem that Phuentsholing emphasizes tradition and culture as much as Thimphu.

As shown in Figure 4-15, buildings in Phuentsholing meet the Bhutanese architecture codes structurally, however, until Thimphu, not much ornamentation is applied to buildings in Phuentsholing.


Buildings in the City Center

Buildings in the City Center

Source: JICA Project Team

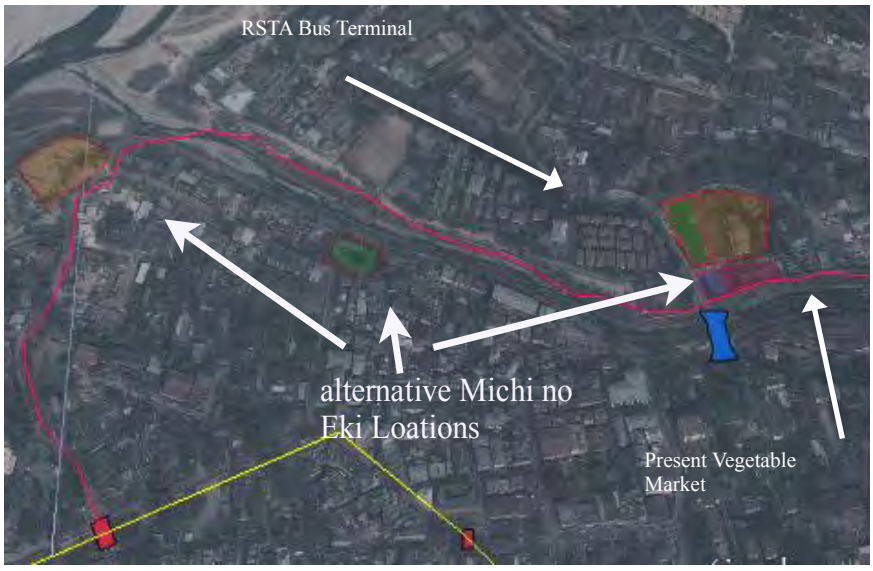
**Figure 4-15 Buildings of Phuentsholing**

### 4.3.10 Relocation of Farmers' Market

There is a small farmers' market near the Om Chhu Bridge. The market was transferred to this location after the river flooded in the city core to destroy the original market at what is now a truck parking during the incident of 2000 August Flood. However, this market has to be relocated again for the construction of the ring road.

Phuentsholing urban agglomeration extends beyond the political boundary to the adjoining Indian city of Jaigaon, which is three times larger in area and five to eight times larger in population. There is virtually no restriction on human traffic on the border control. Thus it is common for Bhutanese people to cross the border casually for shopping. An acute shortage of housing supply and supportive infrastructure has led to cross -country rental accommodations by low-income group of residents. Phuentsholing loses much of economic activities to India, but at the same time, Phuentsholing would not be attractive destination for Bhutanese from other cities without commercial opportunities provided by Jaigaon. In other words, there are both competitive and collaborative relationships between the two cities. From an industrial policy viewpoint, the development of higher value-added economic activities such as hotels, shopping and recreation is an imperative for economic survival of Phuentsholing.

The discussion between Phuentsholing Thromde and JICA Survey Team has led to a proposal of Michi-no-Eki. Instead of pushing around this small institution rooted in local community, it is better to upgrade it for more strategic regional development approach. One recommendation is to adopt "Michi-no-Eki" concept widely practiced in Japan which is to offer market, resting place and restaurant to give travellers full exposure to local products and culture. It is now functioning as local branding strategy in Japan.



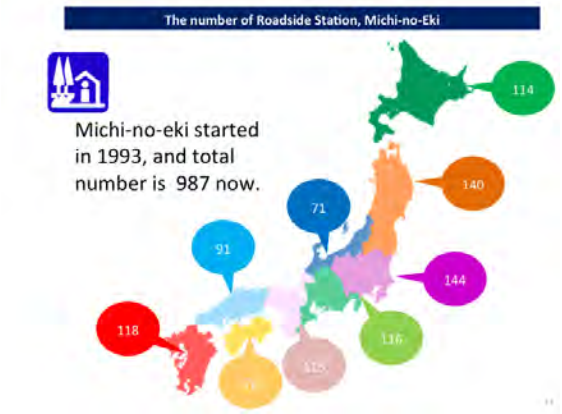

Source: JICA Study Team

**Figure 4-16 Alternative sites of Michi no Eki**

The ring road will divert unwanted heavy vehicles from the city core to the periphery area. At the same time, the question rises whether there is a strategy to capture the benefits of providing conduit for long distance traffic. In a near future Phuentsholing will become a junction point for the traffics to and fro Samtse in addition to India. The highway will intersect to the roundabout that the ring road and the existing Om Chhu Bridge meet.

There are several candidate locations for the relocation as shown in Figure 4-16. The best location is in a vacant land within the RSTA bus terminal next to the current location. First, the location will be right next to a long distance bus terminal with many passengers. It faces both the ring road and Phuentsholing – Samtse Highway. Instead of simply transferring a farmer's market, a strategic choice to upgrade the market into a Michi-no-Eki, a Japanese style roadside station with higher amenities, café or restaurants, handicrafts shops as well as farmers' market will make it possible to capture the full economic opportunities of new routes.

The Michi-no-Eki could boost the competitiveness of local commerce and promote Bhutanese or Phuentsholing brands to tourists and drivers. Michi-no-Eki will contribute to enhance Phuentsholing as development as an international gateway.




**BOX 3: What is Michi-no-Eki?**

Michi-no-Eki, translated as "roadside stations", provides resting, shopping and local information to travellers. It has become a development tool for rural development in Japan. Starting as a quasi-service area for ordinary trunk roads in 1993 with 24 hour parking and public toilet place, Michi-no-Eki rapidly grew to a network of approximately 1000 locations by 2011. As the number grew, new types of Michi-no-Eki emerged to add new functions and roles to the established models. Each Michi-no-Eki defines its own functions and services to best utilize locally available resources and create local brands to boost local productions and linkages with travelling customers. Given its high standard of maintenance and fresh produces with competitive pricing as well as unique local products, there are even some tourists whose objective of the trip is to make a round of visiting different Michi-no-Eki. Unlike service stations on highways, the Michi-no-Eki is open to the participation of local farmers, food processors and handcraft persons while maintaining price and marketing competition among the participants. Competitive collaboration creates a sense of local brand that benefit the entire locality.

Japan has a history of community participation movement so called "One Village One Product Movement," in the development of local products and local branding. The relocation of the farmers' market offers an opportunity to incorporate more inclusive economic development for the community.

MoWHS is now working on the development of roadside markets starting with the next Five Year Plan. The introduction of Michi-no-Eki was a timely proposal to match the local initiatives. The ministry is intent on exploring the lessons from the Japanese experiences.

### 4.3.11 Development Needs in Urban Planning

Based on the above section, major challenges in urban planning are summarized as follows:

#### PU-1: Structure Plan Population Forecast Revision

The PSP applies a 3% and 5% compound annual growth rate on the existing population based on the 2005 National Population Census to estimate the future population. 8 years has passed since the 2005 National Population Census, therefore, a review of population forecast based on updated population trends and urban environment conditions is necessary. Since the draft Structure Plan is just completed, the complete overhaul is not practical. However, it might be possible to reconvene the same team to revise the forecast with fewer resources.

**PU-2: Overdependence on Reclamation Project for Population Absorption**

The Structure Plan envisages that almost all population to be accommodated in the greenfield development sites of Am Mo Chhu, Toribari, and Toorsa Tar, hence the actual accommodation of future population remains as a major challenge. In the case that these Greenfield developments are not realized, and urban conditions remains as current, there is a need to establish alternate strategy for population absorption such as densification including conversion of government lands and densification of low density lands. As described in 4.3.7 and 4.3.8, urban development is progressing rapidly in the three LAP areas, the provision of adequate urban infrastructures are much needed.

**PU-3: Relocation of Farmers' Market**

As indicated in 4.3.12, the current farmers' market is going to be relocated due to the construction of the planned Ring Road. The relocation should be viewed as an opportunity to upgrade the market to Michi-no-Eki for the development of unique local products and brands.

**PU-4: Development of Southern Hub for Commerce and Tourism**

The development vision stated in the Phuentsholing Structure Plan is to "Develop Phuentsholing into a commercial, business and tourism hub of the south"; however, in terms of urban environment, there is still room for improvement. It is important to incorporate tradition and culture uniquely Bhutanese, utilize the advantages of the natural environment, and build on the economic activities unique to the border town in order to establish a growth strategy for the southern hub. Strategies include City Beautification involving upgrading of footpath networks and urban forestry, development of commercial facilities such as "Michi-no-Eki" (roadside markets uniquely developed in Japan), and development of a symbolic gateway facility such as Land Mark or city hall. As discussed in 4.7.1, the introduction of Sabo technologies is proposed. The check dams can be converted to serve as recreational facilities as practiced in Japan.

Upgrading of footpaths and urban forestry is important to increase the *walkability* of the city.

## 4.4 Urban Transport

### 4.4.1 Road Network

Phuentsholing locates on Highway No. 1 which connects India and inland Bhutan. This highway runs through the territory of Bhutan but is managed by an Indian road agency called DANTAK. On the highway, there is an immigration check point of Bhutan before the junction of branch road to industrial area in east of the city, Pasakha. Document checks and entrance control are managed at this checkpoint as substitute of the border gate where vehicles can pass through almost free of inspection. Indian drivers are admitted to head for the way to Pasakha but not for direction to Thimphu and other Bhutan hinterland.

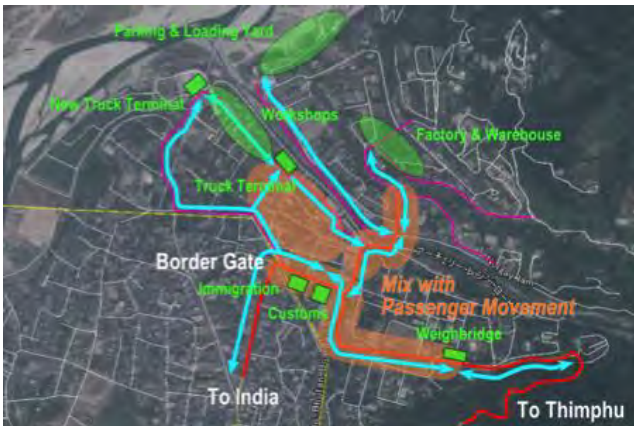
New access roads to Pasakha and Samtse are planned as primary road standard (18m wide) as shown in Figure 4-17. Pasakha access road will be assisted by ADB and part of new Samtse highway is under construction by RGOB. These new trunk roads are expected to improve access across the city. As the main focus of this section is urban transport, the following sections are mainly concentrated on transport issues in the core area which is the only substantial urban space in the city.


Source: JICA Study Team based on the Draft Structure Plan

**Figure 4-17 Existing and planned road network in Phuentsholing**

Figure 4-18 illustrates major transport facilities in the central Phuentsholing. The existing city core faces the Indian border and the main road. Business and commercial functions are concentrated in this area, where people and vehicles move in and out the national border very actively and easily for economic activities. The urban area is divided by Om Chhu River, and the north and south sides are connected by only one bridge for vehicles and another foot bridge for pedestrians.

A large number of trucks pass through this border town. Both heavy freight trucks and passenger vehicles are concentrated on the two lanes major road connecting the border gate and highway to Thimphu through the central area.




Source: JICA Study Team

**Figure 4-18 Major Transport Facilities and Truck Movements in Phuentsholing**

This causes congestion and invites a variety of related problems such as loss of time for travel, increase in accident risks, pollution of the air, increased emission of CO2 and deterioration of road pavement. Specific conditions on the road are summarized as follows;

- International trucks have to pass immigration and customs for trade, but the facilities for the process are located in separated places in the city. For example, trucks have to go and back between the customs office and weighbridge, and the movement results in generation of excessive traffic of trucks on the road.
- Weighbridge can process only 1 vehicle at a time and requires approximately 3 minutes for measurement and document check per truck. Nearly 20 trucks always wait for the process on the road at a peak time. As the road section before the weighbridge is of just two lanes wide, there is a high risk that a vehicle encounters oncoming vehicle from the opposite direction when it overtakes the queue. Because of overtaking movement, the shoulder of the road is damaged.

- There is no climbing lane for slow trucks on the mountainous Highway No. 1 from the weighbridge to Thimphu. This causes accidents of overtaking vehicles and disturbance of traffic due to slow trucks.
- Long distance trucks access truck terminals, warehouses or loading space in the city for taking break or loading/unloading of cargo. There are two truck terminals owned by Thromde and unpaved parking spaces on the north coast of Om Chhu. Trucks run through the core area and residential area to access these facilities.

(i) Congestion on the main road

(ii) Congestion around the customs office

(iii) New truck terminal

(iv) Truck parking on the north of Om Chhu

(v) Weighbridge


(vi) Queue for weighbridge on the main road

Source: JICA Study Team

**Figure 4-19 Present Status of Transport in Phuentsholing**

As there is only one vehicle bridge on the Om Chhu River, the majority of vehicles travelling between north and south of the city are concentrated on it. The bridge has to bear heavy freight trucks and buses accessing inter-city bus terminal beside the bridge. This bridge is getting damaged rapidly due to unexpected growth of heavy traffic, though it was constructed on 2003. Citizens have expressed a concern about safety of the bridge to the office of Thromde. Road pavements in north side of the bridge are more likely to be damaged because of steep terrain and heavy rain in Phuentsholing.

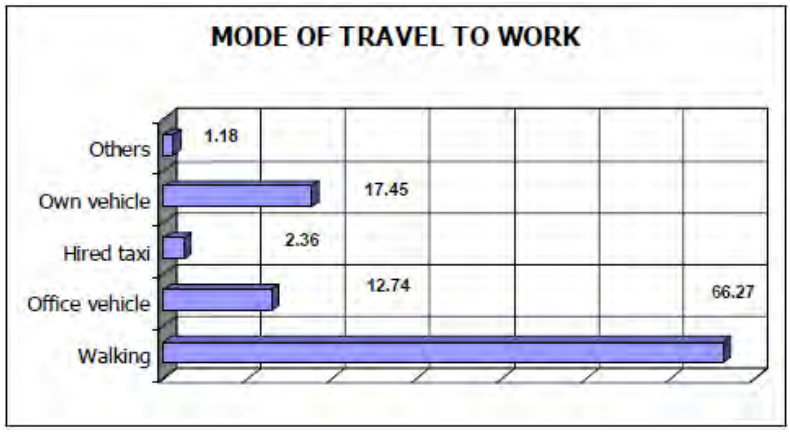
(i) Surface deterioration of the bridge

(ii) Pavement deterioration at intersection

Source: JICA Study Team

**Figure 4-20 Deterioration around the first Om Chhu Bridge**

### 4.4.2 Modal Split




Source: Urban Development Plan (2002-2017)

**Figure 4-21 Commuting mode in the central Phuentsholing**

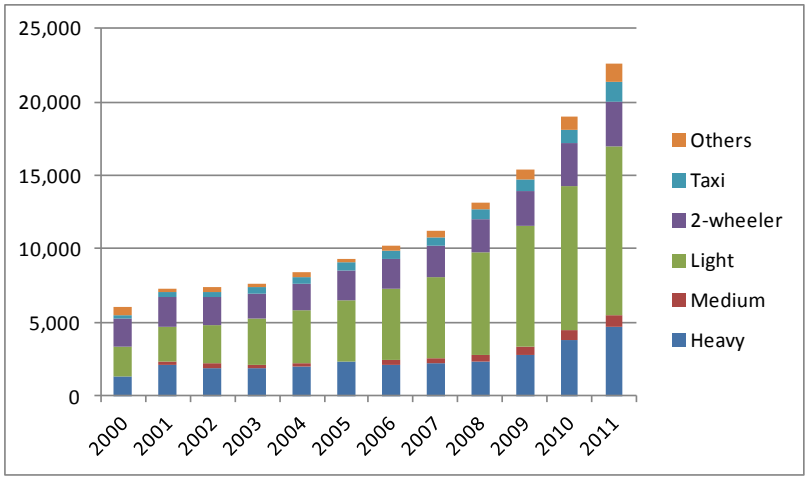
There is no public transport service inside the compact urban area of Phuentsholing, and a certain portion of trips is made on foot. According to the data of household survey in 2003, two thirds of commuting trips are on foot as shown in Figure 4-21. Although this percentage should have decreased in the last 10 years due to rapid motorization, importance of walking is still high in the city due to compact urban structure besides the fact that vehicle ride is not always convenient to pass through narrow and complex road network in the core area.

Popularity of motorcycle is another characteristic of transport mode in the compact urban area of Phuentsholing. According to the result of traffic survey in this study, 13 % of counted vehicles are motorcycle in Phuentsholing, while there is scarcely motorcycle traffic in Thimphu. Some of these motorcycles come from the Indian side.

### 4.4.3 Vehicle Ownership

Trend of vehicle registration in Phuentsholing is shown in the Figure 4-22 below. The total number of vehicle has risen three times at an exponential rate in the last 10 years to reach 22,577 in 2011. Increase of passenger vehicle is significant in the late 2000s and this trend of motorization is supposed to continue for some time.

### 4.4.4 Present Mass Transit Service




Note: Light = less than 3 ton, Medium = 3-5 ton, Heavy = more than 5 ton
Source: Structure Plan for Phuentsholing (2013)

**Figure 4-22 Vehicle registration in Phuentsholing**

There is no public transport service inside the compact urban area of Phuentsholing. Citizens without private vehicle use taxi when they travel outside walking distance. In the Draft Structure Plan, bus routes are proposed along the major roads to secure transport to new development area in the future, though it is noted there is no urgent need. (Figure 4-23)

Middle and long distance buses are currently operated in the city. Bhutan Post, which is the operator of Thimphu City Bus, provides middle distance service between the center and Pasakha with two fleets. There are other private operators and commuter service by factories/ plants on the same route. These buses use space at entering point of the city center on the main road as terminal.

Phuentsholing is a hub of long distance bus in Bhutan. There are services not only to cities in Bhutan but to Kolkata and Siliguri in West Bengal State of India. RSTA (Road Safety and Transport Authority) owns large inter-city bus terminal on the north side of Om Chhu River and a number of private operators' station there. (Figure 4-24)

Source: JICA Study Team

**Figure 4-23 Taxi terminal**

Source: JICA Study Team

**Figure 4-24 Inter-city bus terminal**

As described above, there is not intra-city bus service but Bhutan Post and private operators provide middle and long distance bus services.

### 4.4.5 Pedestrian Network

Walking plays an important role in mobility inside Phuentsholing, as discussed earlier. It can be said that walking is a convenient mode rather than automobiles in the compact core of the city where road network is narrow and complex. There is demand of pedestrian between the existing core and facilities in the north of Om Chhu River such as residence, bus terminal, vegetable market and school. A footbridge over Om Chhu responds to part of this demand. Pedestrians enjoy walking on footpath on embankment along Om Chhu.

Existing urban structure and assets should be utilized to create more pedestrian friendly environment, which will be a key to control increase of vehicle population. One example of issues on the present pedestrian network is a safety measure from flooding water in raining time. Drainage work and stepped sidewalk can improve this.

### 4.4.6 Traffic Management and Road Safety

Road safety measures are insufficient in Phuentsholing. Demand of heavy freight truck is high in the city, but there is no road crossing controlled by signaling system. Entrance of trucks into narrow roads in the core is restricted by time. Risk of accident is higher in deteriorated sections and 2 lanes slope sections.

### 4.4.7 Parking Space

Demand of freight traffic is high in Phuentsholing and Thromde develops and operates terminals for trucks (see Figure 4-19). Conventional terminal near the city core is now undersized against present demand; so larger paved terminal has been newly developed in the west side of the city but not fully utilized.

Indian trucks have to trans-load cargo to inland Bhutan in Phuentsholing, as those trucks are not allowed to enter the way to Thimphu. Also, there are loading and unloading works of cargo shipped from or consigned to Phuentsholing. These haulage works are done in truck terminals and informal parking space. Also, many small-scale warehouses and wholesalers load and unload cargo at various places on roads. Cargo handling area should be located in appropriate place to reorganize function and environment in the city core.

Parking space for passenger vehicle also should be secured in order to respond to increasing vehicle population. It will be efficient to build multi-storied parking or use underground floor of buildings in order to utilize limited land resource.

### 4.4.8 Traffic Survey

#### (1) Survey Outline

The survey to understand present traffic situation in Phuentsholing is outlined in Table 4-14.

**Table 4-14 Outline of traffic survey in Phuentsholing**

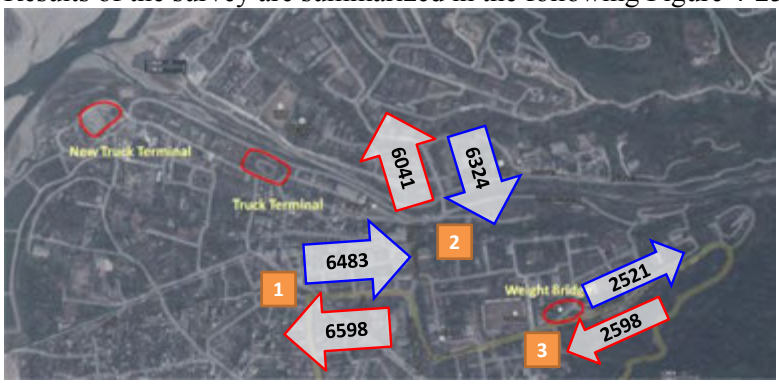
| | Survey Type | |
|---|---|---|
| | **Traffic Count** | **Interview** |
| **Purpose** | To analyze traffic demand through the city | To analyze travel route and movement in the city |

| | | |
|---|---|---|
| **No. of Location** | 3 x 2 directions | 1 (on weighbridge) |
| **Target** | Passenger vehicle, Taxi, Bus, Mini truck, Medium and heavy truck, Motorcycle, Others | 10% of truck drivers |
| **Time** | 7:00 ~ 19:00 (12 hours) in 1 week day and 1 weekend day | |

Source: JICA Study Team

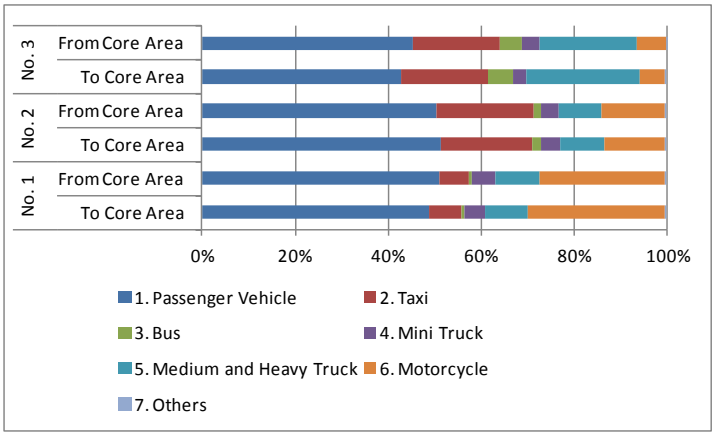
### (2) Survey Result

Results of the survey are summarized in the following Figure 4-25, Figure 4-26 and Table 4-15.




Unit: PCU
Source: JICA Study Team

**Figure 4-25 Traffic movement in Phuentsholing (weekday 12 hours)**




Source: JICA Study Team

**Figure 4-26 Vehicle composition at survey locations (number of vehicle basis)**

Findings from the survey are as follows (See Appendix F for detailed results):

- There is heavy traffic on the border and the Om Chhu Bridge, where lots of passenger vehicles and motorcycles pass in addition to trucks.
- Time variance of truck movement is relatively small than passenger vehicle and motorcycle. It means that there is constant influence of truck to congestion on the roads, as a truck occupies more than double the space occupied by a passenger vehicle.
- The number of trucks around the weighbridge is about 60% of that on the border. This gap implies that a certain portion of truck travels between India and the central Phuentsholing and does not access to inland Bhutan.
- Nearly half of trucks go to Pasakha and others to the way to Thimphu, according to the result of interview at the weighbridge.
- There are some answers saying “stop at Phuentsholing” on inward (i.e. upward to Thimphu) direction. This means movement returning to the city after inspection at the weighbridge. These trucks come to this point all the way from the city center just for inspection.

**Table 4-15 Result of route interview survey (weekday)**

| Trip Direction | | No. |
|---|---|---|
| Valid answer | | 31 |
| Inward | | 27 |
| | To Pasakha | 8 |
| | To Thimphu and Inland Bhutan | 10 |
| | Stop at Phuentsholing | 9 |
| Outward | | 3 |
| N/A | | 1 |

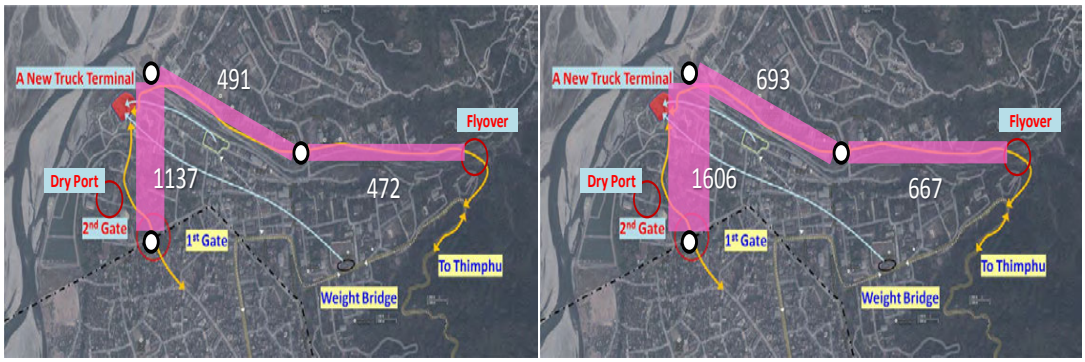
Note: Inward stands for upward direction to inland Bhutan.
Outward stands for the opposite (downward) direction.
Source: JICA Study Team

### 4.4.9 Bottleneck Analysis

The bottleneck of urban transport in Phuentsholing is the main road connecting to the border gate, and there are several problems including congestion, accidents, deterioration of the urban environment and pavement because of heavy traffic of freight trucks on the road. Phuentsholing is a small city and does not have sufficient road network for vehicle transport. This bottleneck road is the most important trunk road of the city, and there is high vehicle concentration not only of trucks but private vehicles. Also, various facilities are located along the road and vehicles frequently move in and out the facilities. Congestion is caused by these conditions on the bottleneck for long periods in daytime. The fundamental problem is that there is no alternative route to separate freight traffic and passenger traffic. It is a serious issue to secure a route to bypass trucks from the city core of Phuentsholing.

### 4.4.10 Projection of Traffic Generation

ADB examines feasibility for development of a bypass route for trucks and analyzes future traffic demand as shown in Figure 4-27[8].




(a) 2013 (hypothetical situation when bypass has existed) (b) 2027Unit: vehicle/day (trucks in two directions
Source: based on Regional Transport Development in South Asia, Bhutan Sub-regional Project (Phuentsholing): Draft Final Report (2013)

**Figure 4-27 Demand forecast of truck on the proposed bypass route**

According to traffic count survey in this study, 1,269 trucks passed the border gate and head for the way to Thimphu, and 541 trucks run on the connecting road between the city core and Highway No.1. These numbers are slightly higher than the above projection result. Growth rate in this projection is approximately 2.5% for the annual average between 2013 and 2027. The

[8] This forecast takes into account construction of Pasakha access road.

projected result might need to be revised upward, as actual observation of traffic is larger than the estimate and trade of freight is expected to grow in faster pace than 2.5% in short term.

### 4.4.11 Ongoing Projects

#### (1) Structure Plan

Phuentsholing Thromde has drafted the Structure Plan, and it is under process of finalization. Projects studied by ADB are also positioned in the future road network of this Structure Plan (see Table 4-16).

**Table 4-16 Outline of Proposed Projects in Draft Phuentsholing Structure Plan**

| | Project | Outline |
|---|---|---|
| 1 | Construction of new transit hub | Strengthening of function of terminal as transit hub |
| 2 | Construction and development of the taxi stands at various places | Development for access to major facilities and new development area |
| 3 | Upgrade and development of the existing roads according to the assigned hierarchy | Improvement of connectivity to major activity centers and achievement of compact and pedestrian friendly environment |
| 4 | Construction of new roads | |
| 5 | Construction of bus stops with adequate street furniture | Identification and development of bus stops |
| 6 | Constructing and developing both on-street and off-street pedestrian pathways | Promotion of pedestrian movement in the town and creation of pedestrian friendly environment |
| 7 | Constructing new pedestrian bridges | Facilitation of easier connections between separated areas, encouragement of walking and cycling |
| 8 | Constructing a new truck parking | Facilitation of proper parking area and smooth traffic flow |
| 9 | Upgrade of existing bridges and culverts and construction of new bridge | Preparation for future population and highway connection |

Source: Draft Structure Plan of Phuentsholing 2013-2027

#### (2) Donor Projects

ADB proposes the following projects under SASEC Road Connectivity Project as below.

Project: SASEC Road Connectivity Project
Donor: ADB
Project Type: Loan
Loan Amount: US$50,350 thousand（not yet approved）
Implementation Period: From 2014 but detail not yet determined.
Executing Agency: MOWHS, DUDES, Phuentsholing Thromde
Scope: Contribution to construction of East – West Highway in the southern Bhutan.

Table 4-17 summarizes the estimated investment and return on investment for each project.

**Table 4-17 Estimated investment and return of the proposed projects**

| Project | | Investment (USD) | EIRR |
|---|---|---|---|
| Ring Road | (Option 1) | 5,900,150 | 17.5% |
| | (Option 2) | 6,412,502 | 16.1% |
| Mini Dry Port | | 2,794,012 | 23.7% |
| Pasakha Access Road | | 7,411,428 | 18.8% |

Note: Option 2 is a plan with flyover as shown in the figure above, and option 1 is a plan with bridge in west side of the flyover.
Source: Regional Transport Development in South Asia, Bhutan Sub-regional Project (Phuentsholing): Draft Final Report (2013)

## Ring Road

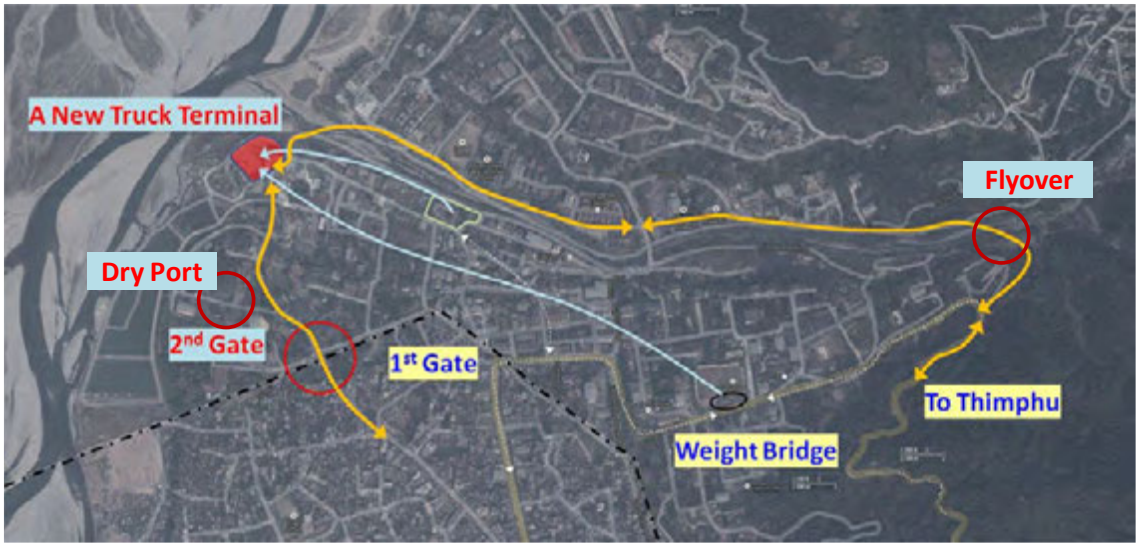
- This project includes the new border gate, bypass road and bridges to separate freight vehicles from the city core. This aims at significant reduction of truck congestion in the city (Figure 4-28).
- Two bridges (flyover) are included on the proposed route.
- Routing of this uncertain section has not been decided, but there would be possibility of relocation.

## Mini Dry Port

- This facility will be developed in 2.2ha land nearby the new border gate. Functions include customs clearance, loading, unloading and transshipment.
- This project aims at facilitation of freight traffic by gathering necessary processes for international transport into a single place.

## Pasakha Access Road

- This project facilitates access between Pasakha industrial area and India by constructing road and bridge.
- New border gate will be opened with a customs control office nearby.
- This project aims at separation of freight traffic to Pasakha which runs through the central area of Phuentsholing at present.




Source: JICA Study Team

**Figure 4-28 Proposed Route of the Ring Road**


Source: JICA Study Team

**Figure 4-29 Proposed option of the flyover section**

After detailed examination by ADB, the loan agreement is planned for signing on the second quarter of 2014 and start construction from the beginning of 2015. The dry port project is regarded as the most prioritized project. Early implementation of bridge work is desirable, as it will require a longer construction period than other road sections. A proposed option of the flyover section is illustrated on Figure 4-29.

### 4.4.12 Development Needs

Development issues in urban transport sector are summarized as follows;

**PT-1: Bypassing of Cargo Traffic**

The biggest issue to be addressed in Phuentsholing is control of inflow of freight trucks into the central area. Early implementation of ADB's ring road project can alleviate congestion in the

city. Implementation of this section should be pursued to fully achieve the expected impact of the project.

**PT-2: Improvements of Damaged Road and Bridges**

Pavement and structure of transport infrastructure are easily deteriorated in Phuentsholing where there are heavy vehicle traffic and heavy rainfall over steep terrains. The bridge over Om Chhu River is one of the most damaged road facilities. Safety in transport has to be ensured for north-south connection and traffic on new highway to Samtse in future.

**PT-3: Economic Linkages to Road and Terminal Facilities**

Transport environment in Phuentsholing will improve drastically after the completion of big projects such as the ring road. The areas along the new trunk road and terminal facilities should be utilized strategically to generate positive impact on economy and society of the city in future. For instance, introduction of "Michi-no-Eki" concept can create new business opportunities and benefit for farmers around the city.

**PT-4: Reinforcement of Pedestrian Environment**

Although the number of vehicle is increasing, percentage of walking trip is still high in Phuentsholing and this strong point should be sustained into the future. It is reasonable to enhance vehicle free environment in the city where there is limitation of new development of roads and bridges in terms of topography.

## 4.5 Water Supply

In Phuentsholing, all the city area is covered by water supply operated by Thromde and some adjacent areas also covered by the water supply by Thromde. Thromde Water Supply is a water supply service provided by Phuentsholing Thromde. Water is produced at North WTP, South WTP, Kharbani WTP and bore wells, distributed to users through distribution network. Water supply facilities were enormously damaged by August 2000 Flood. While the water supply has been almost satisfactorily restored, it still remains only capable of intermittent supply in the most areas.

For the expanded Thromde areas, The Draft Structure Plan proposes 10 decentralized water supply systems considering land use and topographic conditions and water use patterns of the supplied areas.

### 4.5.1 Water Source

North WTP and South WTP were originally designed to source water from river-bed of Am Mo Chhu and surface water of Om Chhu. Water intake facilities for those water sources were destroyed by the 2000 flood and since then water is taken from small branch rivers of Om Chhu and bore wells.

Dependence on the groundwater is high. The groundwater counts 70 % of the total water production. Since Phuentsholing is situated on an alluvial fan of Am Mo Chhu and Om Chhu, it has a rich groundwater potential. However, considering that more than 200,000 populations living in Indian side, all relying on the groundwater, that there is no hydrogeological data of Phuentsholing groundwater and that the groundwater analysis cannot be conducted without

hydrogeological information in the Indian side, dependence on the ground water should be decreased in the future. It would be natural to increase dependence to Am Mo Chhu and Om Chhu to decrease the dependence to the groundwater.

The catchment area of Am Mo Chhu at Dorokha Bridge is 3,040 $km^2$ and it has 10 year draught runoff of 2,000,000 $m^3$/day, assuming 10 year specific draught runoff ratio of 0.73$m^3$/sec/100$km^2$. Tributaries of the Om Chhu are all small with a catchment area of a few $km^2$. There is no gauging statin in Om Chhu. Om Chhu has catchment area of 21 $km^2$ at Phuentsholing with estimated 10 year draught runoff of 13,000$m^3$/day. As such Phuentsholing has enough surface water potential (See Appendix D: Draught Analysis). All the tributaries Om Chhu have only a few $km^2$ of catchment area, thus the estimated runoff is between 1,000$m^3$ to 2,000$m^3$ per day. Given the combined water production capacity of the city of 4000 $m^3$ per day with three intakes from three different tributaries, the estimated 10 year draught runoff is 3,000$m^3$ to 6,000$m^3$ per day; therefore the intakes are close to technical limitations.

### 4.5.2 Present Water Supply Conditions

Major facilities consist of 3 water treatment plants with intake facilities, 2 bore well fields, 1 well, 1 transmission pump station, 10 reservoirs, 1 booster pumping station, approx. 12.0 km of raw water transmission lines and approximately 27 km of distribution pipelines with more than 870 connections. Most of the existing water supply network was constructed in 1990s. The diameters of pipes range from 50mm to 200 mm. 90% of pipes are made of galvanized pipe and the remaining are ductile pipes.

The designed production capacity of WTPs and wells in total is 13,692 $m^3$/day and the ratio of surface water contribution to groundwater sourcing is 3:7. The actual production rate is reported to be 8,000$m^3$/day[9]. The population of the city in 2012 is estimated at 23,915 based on 2005 Census and per capita water consumption is calculated at 292 l/capita/day, which seems too big for the size of the city and life style. Daily inflow of the people from the Indian side and leakage may affect this large per capita consumption.

Despite ample water supply capacity, intermittent water supply is practiced in many areas with 4 to 7 hours per day.

### 4.5.3 Water Supply Facilities

Water supply facilities consist of WTP, wells, transmission pipe, reservoirs and distribution network. Their location is shown in Figure 4-30.

#### (1) WTP and Wells

The production capacities are shown in Table 4-18 and Table 4-19

North and South WTPs adopt slow sand filtration and rapid sand filtration is attached as a pre-treatment to remove high turbidity. However, as it does not have a coagulation process, rapid sand filtration may not be functioning properly.

In slow sand filtration, sand scraping works to remove biofilm developed on the sand surface is being conducted every one to two weeks, which is considered to be proper. However, their filtration rate of more than 10 $m^3/m^2$/day is rather high compared to common rates of 3 to 5 $m^3/m^2$/day. This may cause instability of the water quality of the filtered water.

[9] Phuentsholing Structure Plan (2013 - 2028) and Interview with Thromde

**Table 4-18 Production Capacity of WTPs**

| WTP | Treatment Process | Design Production Capacity ($m^3$/day) | Actual Production Rate ($m^3$/day) |
|---|---|---|---|
| North WTP | Slow sand filtration and disinfection (with pre-treatment by rapid sand filtration during high turbidity) | 2,000 | 1,632 |
| South WTP | | 2,000 | 519 |
| Kharbandi | Rapid sand filtration | 250 | 313 |
| Total | | 4,250 | 2,462 |

Source: Phuentsholing Thromde

**Table 4-19 Production Capacity of Wells**

| Wells | Design Production Capacity ($m^3$/day) | Actual Production Rate ($m^3$/day) |
|---|---|---|
| CHPC | 9 Wells: 45$m^3$/hour/well<br>6 wells: 24 hour operation<br>3 wells: 12 hour operation<br>Total: 8,100 $m^3$/day | 4,187 |
| R&C | 2 wells: 28$m^3$/hour/well, 24 hour operation<br>Total: 1,344 $m^3$/day | 1,428 |
| Pemailing (CST) | 1 Pump: 45$m^3$/hour/well, 24 hour operation<br>Total: 540$m^3$/day | |
| Total | 9,444 $m^3$/day | 5,615 |

Source: Phuentsholing Thromde

**Table 4-20 Reservoir Capacity**

| Name of Reservoir | Capacity ($m^3$) |
|---|---|
| North WTP | 300 |
| | 320 |
| MSD | 200 |
| Booster PS (Except Fire Reservoir) | 530 |
| | 300 |
| South WTP | 660 |
| | 340 |
| Kharbandi WTP | 170 |
| Pemaling | 30 |
| Peepaldara | 230 |
| Total | 3,080 |

Source: Phuentsholing Thromde

### (2) Reservoirs

There are 10 reservoirs in the transmission/distribution system and 3 reservoirs to reduce pressure in the conduction system. As shown in Table 4-20, a total capacity of the reservoirs in the transmission/distribution system is 3,080 $m^3$, which is less than 22% of the total design production capacity and 38% of the actual total production.

Since fluctuation of water consumption rate in small water supply systems like Phuentsholing is higher, it is recommended to have 50 to 100 % of total capacity of reservoirs to absorb the fluctuation. Such

shortage of the reservoir capacity may be one of the factors of the intermittent water supply.

### (3) Transmission/distribution Pipe

**Table 4-21 Length of Pipe by Diameter**

| Diameter (mm) | Length (m) |
|---|---|
| 50 | 4,305 |
| 75 | 7,986 |
| 100 | 3,642 |
| 150 | 3,922 |
| 200 | 449 |
| Total | 2 ,304 |

Source: Phuentsholing Thromde

The lengths of transmission/distribution pipe, which is shown spatially in Figure 4-30, by diameter is shown in Table 4-21. This figure is based on the drawing provided by Thromde. Distribution area of Khrabandi WTP shows only trunk line. According to Thromde, a total length of transmission/distribution pipe is 27 km. Thus there is some inconsistency with the drawing information. Most of transmission/distribution pipe was installed in 1990's and mostly galvanized pipe.

### (4) Water Consumption and Unaccounted-For-Water

Table 4-22 shows average daily water consumption volumes from July 2012 to June 2013 by districts and user groups. A total daily consumption is 4,564 $m^3$ and consumption by domestic use has biggest portion, accounting for 40% of the total, followed by the commercial use of 32%, institutional use of 18% and industrial use of 10%. Comparing to cities in other countries, water use other than domestic use is larger. This may indicate that Phuentsholing is an international city where commercial activities are very high.

**Table 4-22 Daily Water Consumption by District and Customer Type in Phuentsholing**

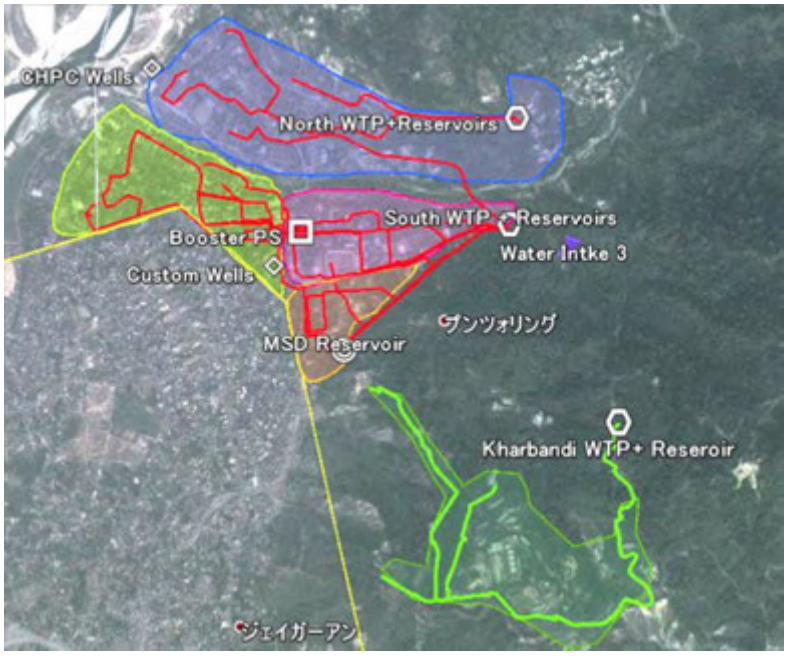
| Zone Name | Domestic | | Institution | | Commercial | | Industrial | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No of Customers | Consumption ($m^3$/day) | No of Customers | Consumption ($m^3$/day) | No of Customers | Consumption ($m^3$/day) | No of Customers | Consumption ($m^3$/day) | No of Customers | Consumption ($m^3$/day) |
| Namgayling | 24 | 54 | 1 | 2 | 19 | 111 | 3 | 8 | 47 | 175 |
| Pemaiing I | 68 | 354 | 2 | 16 | 39 | 406 | 2 | 2 | 111 | 778 |
| Pemaling 11 | 270 | 219 | 25 | 269 | 15 | 77 | 3 | 9 | 313 | 574 |
| Tashiling I | 55 | 91 | 13 | 242 | 64 | 510 | 2 | 15 | 134 | 858 |
| Tashiling 11 | 192 | 974 | 2 | 25 | 37 | 276 | 8 | 48 | 239 | 1323 |
| Zorigling | 40 | 137 | 17 | 288 | 22 | 72 | 25 | 359 | 104 | 856 |
| Total | 649 | 1,829 | 60 | 842 | 196 | 1,452 | 43 | 441 | 948 | 4564 |

Note: The daily consumption was derived from billing data between July 2012 to June 2013.
Source: Phuentsholing Thromde Billing Cell

If the production level is 7000-$m^3$-7500 $m^3$ per day, the unaccounted-for-water would be 35%-40%, which is above a global average. The leakage level needs to be investigated through proper water auditing to ascertain the problem. Given the fact that 90% of the distribution network is comprised of galvanized iron pipes of over 13 years in age, the pipes are likely to be corroded and leaking in many places. The common practice of service connection by breaking the distribution main pipe with a chisel and attaching a ferrule would have given much rapture

in service connections as well. It is no surprise to see a high percentage of leakage. Hydraulic network diagnosis and water auditing should be conducted to detect the areas of leakages. If funding is available, the replacement of galvanized iron pipes with pipes made of more durable materials such as ductile iron or HDPE, or MDPE are strongly suggested.

Since the raw water source is taken from the upstream of clean streams and is treated with sand filtration and sterilized, and the water sourced from wells is also sterilized, the quality of produced water should be acceptable and safe. However, the areas with intermittent water supply are exposed to water contamination risks at its distribution network. Negative pressures created within the pipes during the down times often invite foul water intrusion into the distribution networks.




Source: Phuentsholing Thromde

**Figure 4-30 Water Supply Facilities and Distribution Areas**

### 4.5.4 Conventional Water Quality Test

Conventional water quality test was conducted to evaluate the comfort issues and safety.

According to the results shown in Table 4-23, as for the items related to the comfort issues (Fe, Mn, Hardness, color and turbidity), all the results of turbidity are less than 0.1 NTU and Color is less than 5 degree. Other items show all low values and it is considered not polluted as it is taken in the upper stream. On the other hand, as for items related to safety, such as bacteria, E-coli and ammonia, bacteria and E-coli are detected from treated water of three WTPs. Bacterial contamination is suspected, but since bacteria free water could not be used in the conventional water quality test, consequently there is a possibility of equipment contamination, bacterial contamination cannot be concluded from this test. In general, bacterial contamination is derived from the contamination by fecal substance from animals, but in such case high ammonia concentrations are accompanied. The results do not show high ammonia concentrations, therefore, possibility of bacterial contamination by fecal substance would be low.

Heavy metals were not analyzed in this test since there hardly exist human activities; possibility of such contamination is very low. In Phuentsholing about 50% of supplied water is

taken from wells. Arsenic in the groundwater is a major concern in neighboring India and Bangladesh. However, according to the precautionary tests by UNICEF in 2001[10], arsenic is not a major risk in the southern belt.

**Table 4-23 Results of Conventional Water Quality Test**

| Facility | Sampling Point | pH | EC | Fe | Mn | $+NH_4$ | $-NO_2$ | $-NO_3$ | −TH | COL | TUR | Coliform | E. Col |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mS/cm | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | unit | unit | count/ml | count/ml |
| South WTP | 1-1 Arriving Well 1 | 8.40 | 0.43 | < 0.20 | < 0.60 | 0.94 | < 0.02 | 1.6 | 103 | 1.0 | 3.4 | 16 | 7 |
| | 1-1 Arriving Well 2 | 8.48 | 0.24 | < 0.20 | < 0.60 | 0.47 | < 0.02 | 1.5 | 79 | 0.5 | 1.0 | 8 | 0 |
| | 1-3 Rapid Filter Outlet | 8.40 | 0.24 | < 0.20 | < 0.60 | 0.39 | < 0.02 | 1.4 | 79 | 0.0 | 1.6 | 6 | 1 |
| | 1-4 Slow Filter Outlet | 8.29 | 0.24 | 0.26 | < 0.60 | < 0.20 | < 0.02 | 2.3 | 70 | 3.5 | 0.5 | 2 | 0 |
| Kharabandi WTP | 1-1 Arriving Well | 7.96 | 0.38 | < 0.20 | < 0.60 | 0.23 | < 0.02 | 3.1 | > 100 | 2.5 | 0.0 | > 40 | 5 |
| | 2-2 Slow Filter Outlet | 7.92 | 0.37 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | 3.6 | > 100 | 2.0 | 0.6 | > 40 | 0 |
| North WTP | 1-1 Arriving Well 1 | 8.22 | 0.30 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | 1.1 | > 100 | 2.0 | 0.0 | 27 | 6 |
| | 1-1 Arriving Well 2 | 8.22 | 0.24 | < 0.20 | < 0.60 | 0.36 | < 0.02 | 1.9 | > 100 | 2.5 | 0.4 | 7 | 2 |
| | 3-3 Rapid Filter Outlet | 8.23 | 0.24 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | 1.5 | 87 | 3.0 | 1.3 | 7 | 2 |
| | 4-4 Slow Filter Outlet | 8.23 | 0.24 | < 0.20 | < 0.60 | < 0.20 | < 0.02 | 1.3 | > 100 | 0.0 | 0.3 | 0 | 0 |

Source: JICA Study Team

### 4.5.5 Ongoing and Planned Projects

Structure Plan proposes 10 separated water supply systems for 11 neighbourhoods in the planned areas, including upgrading of the present system by restoring the water intake from Am Mo Chu to reduce the dependency to the groundwater, as a long term strategy. As for the 10 water supply system, the plan identifies major required facilities for each system but has not dealt with their facility planning and designing.

After finalizing the Structure Plan, Phuentsholing Thromde will seek for the implementation measures, including financing sources.

### 4.5.6 Water and Sewerage Management

Table 4-24 shows a list of employees for water supply and sewerage services in Phuentsholing, totaling 84. There is 14 regular staff all together and the rest are daily wage workers. The largest numbers are engaged in the maintenance of water distribution and sewer networks.

**Table 4-24 Personnel for Water Supply and Sewerage (Unit: Persons)**

| | | Water | Sewerage | Total |
|---|---|---|---|---|
| Operation and Maintenance Section | Regular | 6 | 6 | 12 |
| | Field Operators | 26 | 21 | 47 |
| | Office | 19 | | 19 |
| Billing Section | Regular Worker | 2 | | 2 |
| | Meter Readers | 4 | | 4 |
| Total | | 57 | 27 | 84 |

Source: Phuentsholing Thromde

[10] Report of Arsenic Detection Tests, Phase 1 & 2, PHES/UNICEF, April 2001.

### 4.5.7 Financial Conditions of Water Supply and Sewerage Operations

Table 4-25 shows the tariff table of water supply and sewerage service in Phuentsholing.

**Table 4-25 Water and Sewerage Tariff in Phuentsholing**

| Water consumption ($m^3$) | Tariff Nu./$m^3$ | | | |
|---|---|---|---|---|
| | Domestic | Industry | Institutional | Commercial |
| 0-20 | 2.30 | 2.50 | 2.50 | 2.50 |
| 21-40 | 2.50 | 3.50 | 3.50 | 3.50 |
| 41-999999.00 | 3.00 | 4.50 | 4.50 | 4.50 |

Source: Phuentsholing Thromde

Table 4-26 shows the revenues collected by the Phuentsholing Thromde for water supply and sewerage services during the period of July 2012 through June 2013 according to districts and services. The charges include water supply, sewerage treatment, meter rent, arrear collection and surcharge. The annual revenue amounts to approximately Nu.11 million.

**Table 4-26 Water and Sewerage Revenue July 2012 – June 2013**

Unit: Nu.

| Zone Name | Consumption ($m^3$) | Water | Sewer | Meter Rent | Arrear | Surcharge | Total |
|---|---|---|---|---|---|---|---|
| Doars | 600 | 1,983 | 1,012 | 60 | 1,862 | 35 | 4,952 |
| Tashi'Iing I | 516,375 | 1,417,816 | 708,971 | 10,240 | 90,685 | 1,814 | 2,229,526 |
| Pemaling I | 656,309 | 1,637,520 | 818,803 | 16,920 | 25,228 | 505 | 2,498,976 |
| Zorigling | 361,948 | 1,037,831 | 518,927 | 5,365 | 46,426 | 926 | 1,609,476 |
| Namgayling | 194,970 | 568,376 | 284,314 | 5,955 | 29,316 | 587 | 888,547 |
| Tashiling II | 469,708 | 1,398,738 | 698,088 | 8,830 | 35,596 | 712 | 2,141,964 |
| Perraling II | 224,743 | 652,067 | 326,099 | 4,630 | 16,620 | 333 | 999,749 |
| NPPFB | 86,431 | 207,126 | 103,684 | 17,645 | 9,517 | 192 | 338,164 |
| Pemaling | 35,912 | 90,608 | 45,488 | 3,600 | 4,757 | 96 | 144,549 |
| Dhamdara | 21,836 | 61,192 | 30,627 | 1,585 | 3,896 | 78 | 97,378 |
| TOTAL: | 2,568,832 | 7,073,257 | 3,535,992 | 74,830 | 283,902 | 5,277 | 10,973,259 |

Source: Phuentsholing Thromde

Table 4-27 shows the estimated expenditures for the operation and maintenance of water supply and sewerage services in Phuentsholing. Although Phuentsholing supplies less water than Thimphu, the operation costs are higher. The main reasons behind higher operation costs is the requirement of water lifting for water supply and sewage pumping which add significant costs to the operations.

**Table 4-27 Operation Expenditures for Water Supply and Sewerage Service in Phuentsholing (Unit: Nu.)**

| Operation Cost | Water | Sewerage | Total |
|---|---|---|---|
| Wage | 294,000 | 126,000 | 420,000 |
| Salary | 128,000 | 96,000 | 224,000 |
| Electricity | 400,000 | 25,000 | 425,000 |
| Material | 125,000 | 66,667 | 191,667 |
| Monthly | 947,000 | 313,667 | 1,260,667 |
| Annual | 11,364,000 | 3,764,000 | 15,128,000 |

Source: Phuentsholing Thromde

### 4.5.8 Development Needs

From the observation of the current status of the water supply and study on the on-going projects, following issues are identified:

#### PW-1: Risk of Potable Water Contamination

Intermittent water supply would induce negative pipe pressure during the stoppage time of water supply, letting outside water into the pipe from a damaged area. This is a critical issue from a viewpoint of responsibility of water supply operation to supply safe water. From demand/supply balance, which is almost balanced, a major cause of the discontinuous water supply is considered not due to shortage of water production capacity, but due to distribution capacity, such as capacity of reservoirs and size of transmission/distribution pipes. The current reservoir capacity is 20% of daily production. It will be possible to restore 24 x 7 water supply by increasing the reservoir capacity and repairing damaged pipes.

#### PW-2: Lack of Water Resource Development Plan

The Structure Plan proposes separate water supply systems from the present water supply system and the ones independent each other. Considering the disjointed newly incorporated areas, it may be reasonable to separate each district (LAP) to avoid longer water transmission and transmission accidents by landslide, flooding as well as natural conditions.

The Structural Plan also presents the policy of the water supply development for the present water supply area by restoring the water intake from Am Mo Chhu and reducing dependence on the groundwater. The population increase would mainly occur in the expanded areas, though yet to be tested, even though there would be some extent of an increase in the present water supply area and augmentation of the existing system is required. Moreover, renewal of the existing system will become crucial in near future. As discussed above, since Am Mo Chhu has an enough water source development capacity, augmentation of the water supply capacity for the existing area relying on Am Mo Chhu is reasonable. It is required to establish a concrete plan for the restoration of water intake from Am Mo Chhu.

## 4.6 Wastewater / Drainage

### 4.6.1 Design Parameters of Sewerage System

The sewerage project for Phuentsholing was funded by DANIDA. The construction of the sewerage system commenced in December 1993 and completed in 1996. The sewerage system consists of house connections, sewer networks, trunk sewers and a wastewater treatment plant. A tank lorry and jet cleaner were also provided for maintenance.

Phuentsholing WWTP Design parameters for Year 2005 are as follows;

- Population served: 13,950PE (population equivalent)
- Influent flow rate: 2,157m3/d
- BOD Pollution load: 45g/cd
- Influent BOD5: 291mg/l
- Design mean temperature of coldest period: 19℃

Above served population is approximately 80% of total population in Phuentsholing Thromde. It is estimated that the proportion of population coverage is the same as the situation of 2005. The details of Phuentsholing WWTP are as follows;

- Area and Location of WWTP: 7.0ha at mouth of Om Chhu to Am Mo Chhu
- Treatment Process: Stabilization Pond Process
- Size of each process: as Table 4-28

**Table 4-28 Phuentsholing WWTP Size of each Process**

| | Area | Depth | Retention Time |
|---|---|---|---|
| Anaerobic Pond | 1,066$m^2$ (533$m^2$×2ponds) | 3.0m | 1.5days |
| Facultative Pond | 0.89ha×1pond +0.99ha×1pond | 1.5m | 12days/14days |
| Maturation Pond | 1.06ha×1pond | 1.1m | 5.4days |

Source: JICA Survey Team

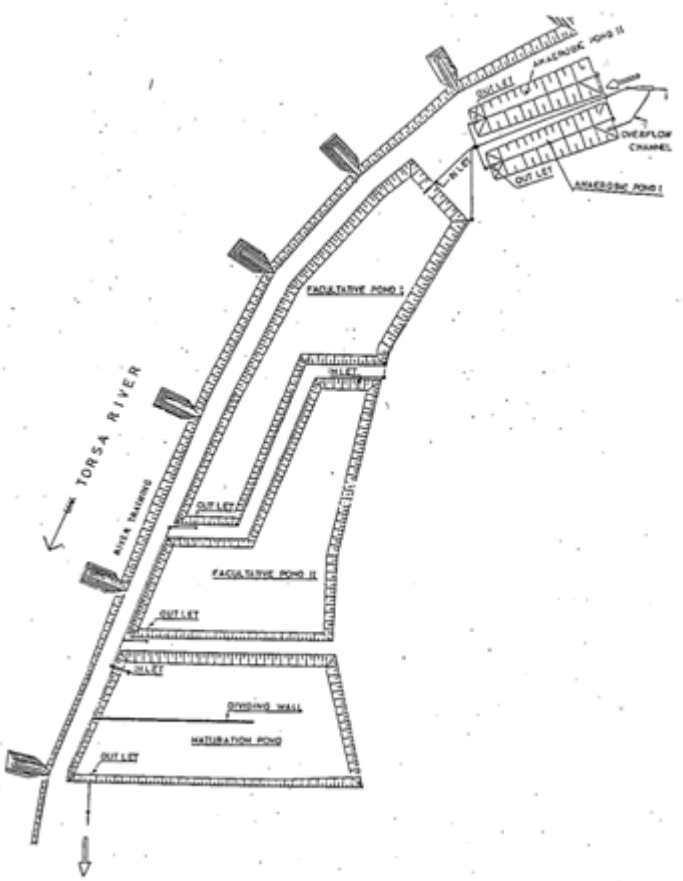
Layout of Phuentsholing WWTP is shown in left of Figure 4-31. The anaerobic pond, facultative pond and maturation pond of Stabilization Pond Process are aligned in a series.

### 4.6.2 Present Condition of Sewage Treatment

The photos of anaerobic pond, facultative pond and maturation pond of existing Phuentsholing WWTP are shown in right of Figure 4-31. The current performance of the existing WWTP is as follows;

- Influent flow rate: 1,000-1,200m3/d (April to June 2013, almost half of the design capacity 2,157m3/d)
- Effluent quality: less than their own effluent standard (BOD<50mg/l, SS: 60-120mg/l, and so on), due to no standard before 2011

The present influent flow rate is almost half of the design capacity for the reasons described in 4.6.3.




Source: JICA Survey Team

Source: JICA Survey Team

**Figure 4-31 Layout of Existing Phuentsholing WWTP (left) and Anaerobic Pond (right-top), Facultative Pond (right-center) and Maturation Pond (right-bottom) of the WWTP**

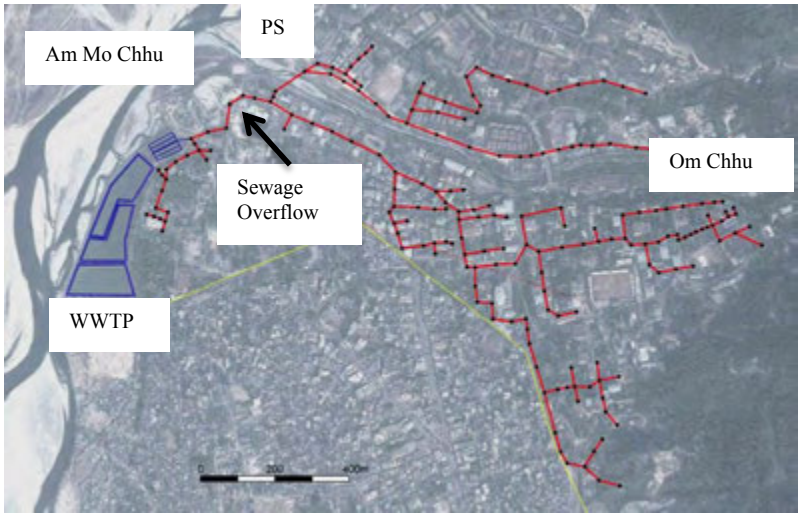
### 4.6.3 Present Condition of Sewer Network

The sewer network covering old municipal area of both side of Om Chhu was constructed in 1996 for Phuentsholing Thromde is as follows;

- Trunk line (uPVC): 10km
- Sewer service pipe (HDPE): 25km

Location of existing WWTP and existing sewer network are shown in Figure 4-32. In recent years sewer lines are extended in housing zones near WWTP and at lower reach of the right bank.

Un-sewered areas rely on septic tanks for toilet water treatment and roadside drainage for kitchen and other wastewater disposal.




Source: JICA Survey Team

**Figure 4-32 Existing Sewer Network of Phuentsholing**

The current inflow volume is almost half of design capacity. This reduction is caused by overflows from L01 manhole into drainage channel nearby due to obstruction or unevenness of the last main sewer to the WWTP (Refer to Figure 4-33). To solve this situation Phuentsholing Thromde plans to construct bypass sewer extended from L01 manhole to L04 manhole which will complete in the beginning of 2014.

Source: JICA Survey Team

**Figure 4-33 High Water Level in the Manhole (left) and Overflow of Sewage (right)**

### 4.6.4 Present Condition of Septic Tank and Operation and Maintenance

Present condition of septic tank in Phuentsholing is same as Thimphu, such as standard drawing, inspection/certificate, cleaning tariff, public relations, etc.

The current office located at WWTP covers not only operation and maintenance work for WWTP but also septic tank and sewer cleaning. Then the office staff consists of one manager, one assistant, one laboratory, one plant operator, 3 drivers, 13 labors (5 for WWTP, one for manhole, and 7 for septage /sewer cleaning), and 3 guards.

Three tank lorries (one unit of $10m^3$ and two units of $3m^3$ shown in Figure 4-34) are used for septage collection and sewer cleaning by Phuentsholing Thromde. After collection, septage is discharged into a sewer manhole nearby or conveyed to WWTP. A volume of collected septage is estimated at about 300 - 400 $m^3$ per year. A problem in septage collection is to approach residences located at steep slope.

Source: JICA Survey Team

**Figure 4-34 Tank Lorries of 3m$^3$ (left) and 10m$^3$ (right)**

### 4.6.5 Present Condition of Drainage System

There was a devastating flood along Om Chhu in the year 2000 that caused severe damage to the life and properties of residents in the lower market area. After that huge investments have been made by RGOB for river protection works and ADB fund for a number of drainage constructions.

The road surface runoff as storm water drainage pattern created by its topographical conditions forms the primary storm drainage network. The secondary storm water network runs underneath the street footpath. There is no significant problem on drainage system except drain clogging by garbage and other waste. (Refer to Figure 4-35)

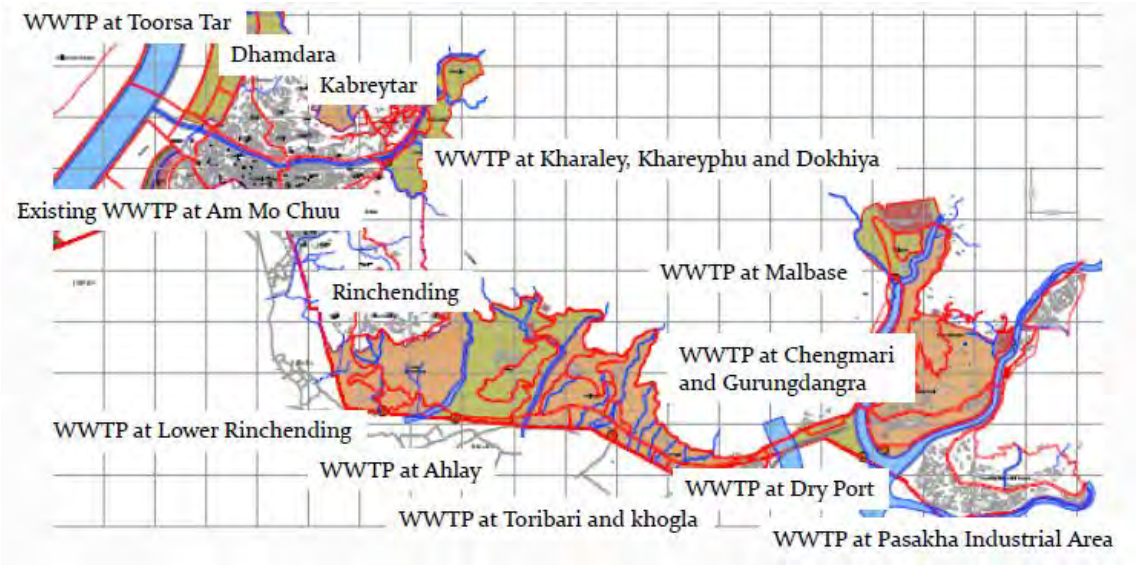
Source: JICA Survey Team

**Figure 4-35 Drainage of Road Surface Runoff (left) and Outlet of Drain with Screen to River (right)**

### 4.6.6 Ongoing and Planned Projects

According to the Draft of Structure Plan 10 WWTP projects are proposed, an expansion of existing WWTP at Am Mo Chhu and 9 new WWTPs (WWTP at Toorsa Tar, WWTP at Kharaley, Khareyphu and Dokhiya, WWTP at Lower Rinchending, WWTP at Ahlay, WWTP at Toribari and Khogla, WWTP at Chengmari and Gurungdangra, WWTP at Malbase, WWTP at Dry Port and WWTP at Pasakha Industrial Area.) (Refer to Figure 4-36)

The expansion of existing WWTP at Am Mo Chhu will cover areas such as Dhamdara, Kabreytar, and Rinchending where Phuentsholing Thromde is implementing Local Area Plan.



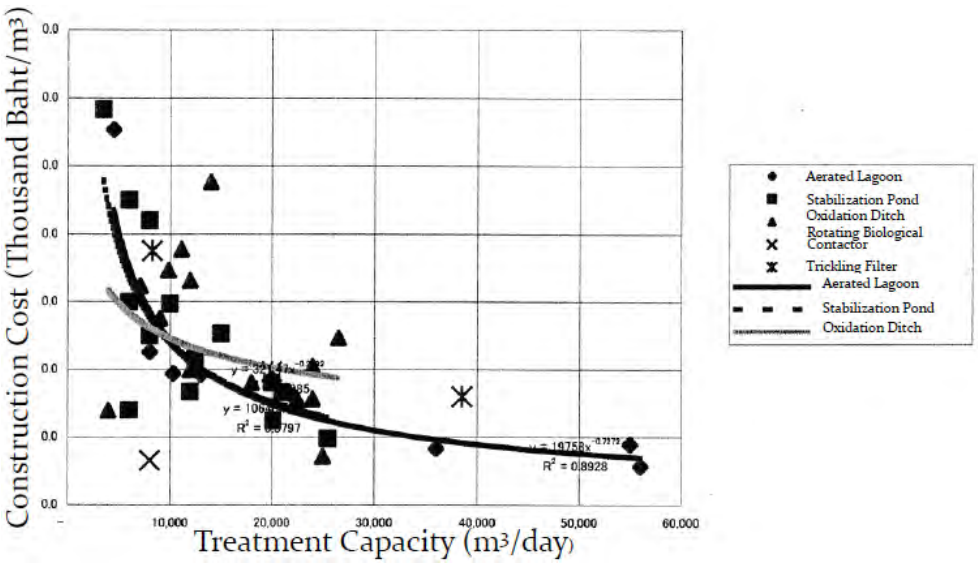

Source: Phuentsholing Structure Plan (Draft)

**Figure 4-36 WWTP Projects of Phuentsholing Structure Plan (Draft)**

The expansion of existing WWTP at Am Mo Chhu will cover areas such as Dhamdara, Kabreytar, and Rinchending where Phuentsholing Thromde is implementing Local Area Plan.

### 4.6.7 Selection of Optimal Technologies

As a general principle, there is a strong inverse relationship between the scale of treatment and unit investment cost. Figure 4-37 shows comparative study carried out for actual cases in Thailand.




Source: PWRI, 2001, Report No. 3778, Public Works Research Institute

**Figure 4-37 Unit Construction Cost per Capacity for Treatment Process in Thailand**

From this viewpoint, cost-effective analysis will be recommended in selecting the following treatment areas out of the above 10 WWTP projects;

- Local Area Plan areas, Dhamdara, Kabreytar and Rinchending, may be covered by extended existing WWTP.
- It is also possible to consider combining areas, such as Lower Rinchending/Ahlay and Chengmari/Gurungdangra/Malbase.

On the other hand, large site space availability allows flexibility on selection of wastewater treatment process. Low cost treatment processes, such as Stabilization Pond, Aerated Lagoon, Constructed Wetland, and Oxidation Ditch and so on, usually require a larger space. A low cost and reliable treatment process should be selected by comparison of treatment processes. (Refer to Appendix E: Introduction of Treatment Processes)

### 4.6.8 Expansion of Wastewater Treatment Plant

The existing WWTP is located at mouth of Om Chhu to Am Mo Chhu and the site is wide and directly connected to dry riverbed, as shown in Figure 4-38. This means it is possible to expand the capacity of existing WWTP to receive wastewater from other treatment area. The conversion of existing WWTP site to more commercial use should be also considered for the growing needs of increasing population and developing industries under the Phuentsholing Structure Plan.

Source: JICA Survey Team

**Figure 4-38 River bed of Am Mo Chhu at the mouth of Om Chhu**

There are two options to the utilization of the riverbed area (Figure 4-39).


Source: JICA Survey Team

**Figure 4-39 Two Options for Utilization of Current WWTP Site**

Option 1: Remove the current WWTP to a new riverbed area further out to treat the entire city effluents and convert the current site for more economical uses,
Option 2: Upgrade the space efficiency of the existing WWTP with a different technology and receive effluents from additional areas while converting extra space for more economical uses.

### 4.6.9 Development Needs in Sewerage/Drainage in Phuentsholing

Development needs in Sewerage/Drainage Sector in Phuentsholing are listed below.

**PS-1: Lack of Long-term Wastewater Treatment Capacity**

As indicated in 4.6.1, the present treatment capacity is no more than 60% of the present population of Phuentsholing.

**PS-2: Lack of Long-term Master Plan**

The Structure Plan does not give reasoning for the choice of 10 WWTP Projects, one for each district. A city-wide comprehensive sewerage plan is required to undertake cost-benefit analysis in determining wastewater treatment zoning and to arrive at a unified technical approach in view of operation phase after construction. The sewerage master plan must encompass city planning, water environment and sewerage management as well as meeting the growing needs of the increasing population and maintain sustainable management of sewerage works.

**PS-3: Selection of Optimal Wastewater Treatment Technologies**

As recommended in 4.6.7, although there is no technical evaluation for the selection of technologies or appropriate zoning for sewer collection, the land plot size available for the treatment plant site will make it possible to select appropriate technology more economically.

**PS-4: Utilization of Flood Plain**

As shown in 4.6.8, Am Mo Chhu River has an immense riverbed. With less land restrictions it is possible to select more economical technology.

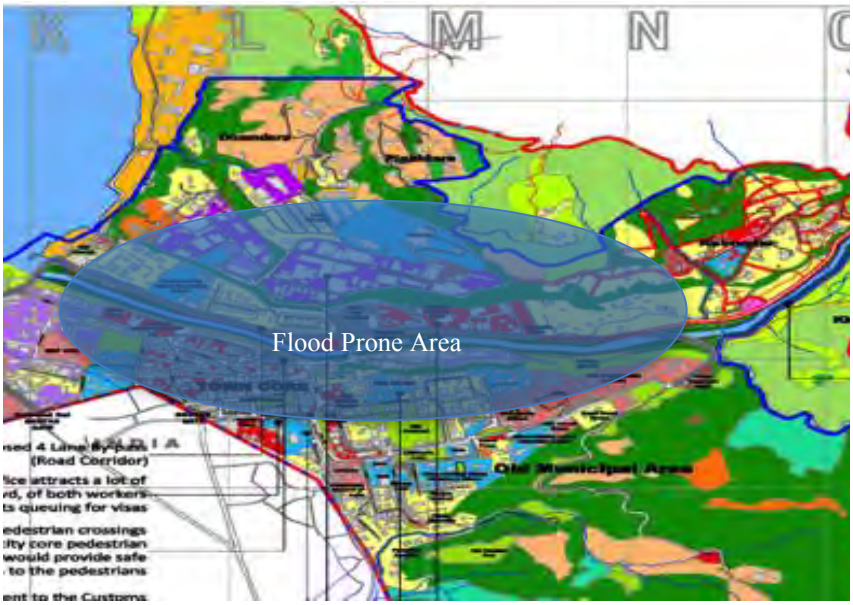
## 4.7 Environmental Situation in Thimphu City

### 4.7.1 Land Slide and Floods

#### (1) Phuentsholing City Current Situation

Phuentsholing is located where natural disaster frequently exists. Disaster prevention is therefore the most important issue for this city. Landslides and floods are caused by heavy rain, weak soil, and earthquakes. When the southwest monsoon hits the towering Himalayan Mountains in the north, it brings heavy rains of more than 4,000mm per year. In addition, as the Himalayan orogeny is active as the Indian Shield submerges under the Tibetan Shield resulting in frequent earthquakes. Combined with the weak soil, the land is not stable at all.

There was a heavy rain of more than 1,000mm during August 1 to 3, in 2000. This heavy rain caused the food of Am Mo Chhu and Om Chhu to destroy four water intake facilities built by DANIDA. 24 hour supply system has not been recovered until now. The Om Chhu, which passes in the middle of the city, flooded, and the city was paralyzed for several days; the market was washed away; the sewerage system was damaged; and the casualty was more than 40 people in Pasakha area. No more serious floods have happened but could happen in any year. Landslides in upstream of Om Chhu, the riverbed scouring, and destruction of embankment are taking place regularly.




Source: JICA Survey Team based on Phuentsholing Structure Plan

**Figure 4-40 Inundation Area caused by Floods of Om Chhu**

Actual situation is shown below. The road to Pasakha is damaged by a huge landslide where the road is missing. In addition, the new road to Samtse which is under construction is damaged by landslides and vehicles are impossible to pass through.

Figure 4-41 and Figure 4-42 shows the landslides in upstream Om Chhu.

Source: JICA Study Team

**Figure 4-41 Road to Pasakha**

Source: JICA Study Team

**Figure 4-42 National Highway to Samtse**

The landslide occurred in upstream Om Chhu is shown in Figure 4-43.

Source: JICA Study Team

**Figure 4-43 Landslide at upstream of Om Chhu**

In Phuentsholing as the land is scarce, the pressure of urbanization naturally leads people to live in the areas where are risky and difficult to develop.

Source: JICA Survey Team

Kabreytar is the current development frontier; the area is hilly and is exposed to danger of floods and landslides (Figure 4-44).

UNDP will implement a project against landslide in 4 areas of Phuentsholing, and against river erosion in some areas around Pasakha Industrial Estate.

**Figure 4-44 Houses along Om Chhu in Kabreytar Area**

### (2) Development Needs in Disaster Management

#### PE-1: Cyclic Floods

Most serious issue is the floods in Om Chhu which passes through the core part of the city. The river has only 20 km$^2$ in its catchment, the steep gradient generates strong stream power to erode upstream and to move huge rocks downstream. Floods occur due to heavy rains every 10 to 15 years. Flood prevention thus is the key factor for urban safety. Without safety, economic activity will not be sustainable, investors and residents will hesitate to invest in Phuentsholing. For the flood control it is not enough to have embankment protection. It is important to control sedimentation and scouring by stabilizing the riverbed.

#### PE-2: Frequent Land Slides

Landslides frequently happen around Phuentsholing. The most frequently observed areas are along the national highway No1 or along the national highway to Samtse which is under construction, or upstream of Om Chhu as well. Kabreytar where the Local Area Plan is completed also have several locations with past landslides, rocky dried river, and loss of foundation by scouring.

#### PE-3: Urban Encroachment into Hazard Prone Areas

There is not much plain area available in Phuentsholing; thereby the land development has been done in some areas of higher grounds of Kabreytar. In addition it has been planned in the Structure Plan to develop the riverbed area of Am Mo Chhu[11]. Phuentsholing where land is scarce urban encroachment is occurring into dangerous higher places despite the warnings of the city.

[11] As for the plan, DANIDA has made a survey and the result shows that they judge that the reclamation land can be protected from floods. The implementing agency DHI is also making another survey to make sure the safety of the reclamation land. However, as this development of the riverbed is subject to the flood control function of multipurpose dam planned to be built upstream of the river, it has various hurdles in several steps to be solved for realization.

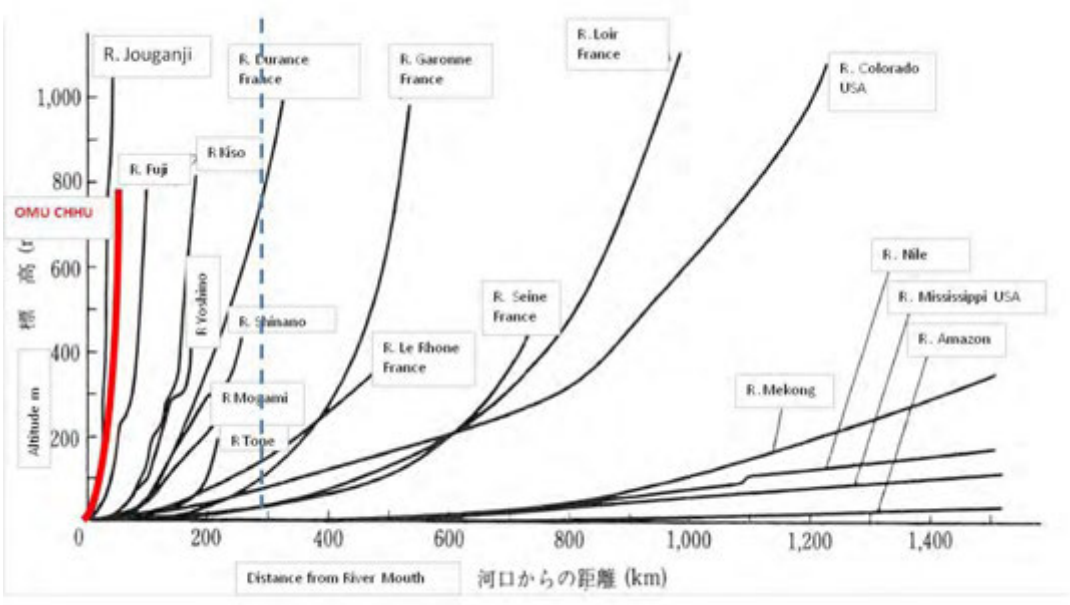
## PE-4: Lack of Flood / Landslide Control Technologies

The flood control and landslide prevention technology are not yet established in Phuentsholing or even in MoWHS. One of the reasons of this is the uniqueness of the land condition. Figure 4-45 shows the comparison of Om Chhu and some major rivers of the world. Om Chhu is very steep among rivers of the world. It has similar steepness to the Jogangi River of Japan which was one of the rivers with the most frequent floods.

Bhutan has developed its engineering technology by importing Indian technologies since Bhutan is closer to them in terms of culture, geography, and politics. Indian consultants have been often hired for public works. However, for such river as shown in southern Bhutan, Japanese so called "Sabo" technology is more appropriate (See Appendix G "River Basin Disaster Management with SABO Technologies"). Having this Sabo technology will help to solve the issue in the long term. The engineer in charge in MoWHS understands well the superiority of Japanese technology and has applied to JICA's technical assistance in the past.

## PE-5: Lack of Hydrological Data

Phuentsholing Thromde has been protecting the embankment by symptomatic treatment without data on the river condition. Since there is no gauging station to measure water flow, velocity, volume, river level, there is no accumulation of river data. It has to start from grasping the river condition.




Source: JICA survey team based on Kasen Kogaku, by Hiroshi Takahashi, University of Tokyo Press (in Japanese Language)

**Figure 4-45 Comparison of Om Chhu and World Rivers**

### 4.7.2 Solid Waste Management

#### (1) Phuentsholing City Current Situation

Total amount generated is 15 to 20 tons per day. Only one final disposal site exists in Toribari, 7 km east from the center. It was developed in 2002 by assistance from Demark, and started use in 2004. However, it was just open dumping site. It should be emphasized that in 2005, with the initiative of the engineer who went to Japan for 3 months training (JICA training), the Municipality converted the site to Fukuoka type.

The city collects garbage twice a day in the core area, and once in the core surrounding dense area. Once every 2 days are done in further less dense area, and once every three days in the rest of areas.

PPP is not introduced and separation is not done yet. However, collection of recyclable items like metals, plastics, bottles are done by informal sector. People in fact separate these items and sell to those who are collecting. It is estimated that 20% of the garbage are segregated and recycled in this form. The remaining garbage is transferred to the final disposal site.

The disposal site today is operated cleanly with Fukuoka type. The total land area is 4.8 acres, and current landfill site is using 1.6 acres. This existing landfill site has still more years to be able to fill. Top soil to be used for landfill is excavated within the same area, which at the same time the excavated area could be next landfill site. According to the city environmental division, no new EIA is required for development of new landfill site within the area since Environmental Permit is already obtained for the whole area. In addition as the solid waste management activity is to improve the environmental condition of the city, disposal of garbage to be done is pro-environment. Furthermore, the way of disposing is environmentally conscious, and is not damaging the environment. Thus it has to submit modification of Environmental License but no objection is expected.

In case of medical waste, no autoclave exists in Phuentsholing city. Therefore, the wastes from Phuentsholing General Hospital are transported to Thimphu, JDWMRH in order to be treated at the autoclaved oven. The treated wastes are transferred to the dumping site, and no specific pit is developed. Other medical wastes generated from health posts, are open burned.

#### (2) Issues

For the solid waste sector, no immediate issues are observed. However the land fill site will be filled in the end, it is necessary to take appropriate measures in the long run. In order to reduce the amount to be transferred to the land fill site; construction of transfer station is necessary for segregation and recycling of wastes. At least the municipality plans to separate the biodegradable and non-biodegradable wastes, and composting plant is necessary for transform biodegradable wastes. Construction of Segregation plant is budgeted in 11$^{th}$ Five Year plan. In addition, concept of 3R (reduce reuse recycle) should be promoted and diffused more.

### 4.7.3 Other Urban Environmental Situation, Existing Situation and Issues

#### (1) Transport, Water Supply and Sewerage

As for the issues of transport, water supply and sewerage, please see the pertinent sections.

.

#### (2) Air Environment

Air pollution is observed from industrial estate and automobiles. The still mill in the Pasakha industrial estate is generating heavy air pollution which can be seen from distance. In addition,

Phuentsholing is the gateway city to India and most of imports and exports are passing through this city. Heavy trucks transporting the goods out and into Bhutan exhaust air pollution.

With more economic activities increased, more air pollution might be observed. Therefore it is necessary to take appropriate measures in the long term.

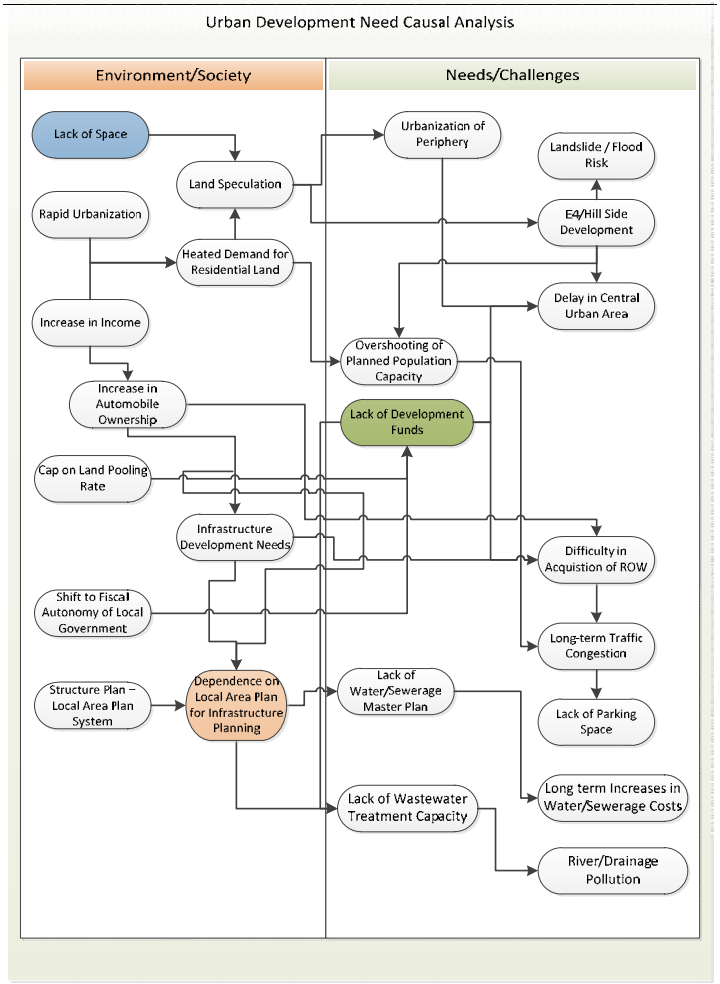
### 4.7.4 On-going Projects

Project Name: Addressing the Risks of Climate-induced Disasters through Enhanced National and Local Capacity for Effective Actions
Assisting Agency: UNDP,
Financial Source: Global Environmental Facility
Project Type: Technical Assistance and Grant
Project Cost: Overall US$ 11.5 million, For Phuentsholing US$ 4.4 million
Period: 4 years from March 2014
Counterpart: Phuentsholing Thromde, NEC
Scope: The projects are outcome of the National Adaptation Programme of Action–II implemented by UNDP. Following two projects are for Phuentsholing;

1) Land Slide Prevention at 4 areas of north Phuentsholing: The drop off in front of Traffic Check Point Area, Around 1km from the Traffic Check Point Area towards Pasakha, Near College of Science and Technology and Military Medial Storage area, Near Rinchending Rhakang. Budget is US$ 4 million
2) Flood Prevention Survey for Pasakha Industrial Estate, a survey for obtaining data of Barsa River and development a plan for flood prevention. Budget is US$ 400,000

# Chapter 5 Development Strategies and Recommendations

## 5.1 Constraints to Urban Development in Bhutan




Source: JICA Survey Team

**Figure 5-1 Urban Development Needs Causal Analysis**

The fundamental cause of problems associated with urbanization is rapid social migration into large cities. However, no social system historically succeeded in halting urbanization. The only solution is a coping strategy to conserve urban environment and traditional culture while maintaining economic and social vitality brought by urbanization.

One of the largest constraints to urbanization in Thimphu and Phuentsholing is lack of land owing to topography of the country. Increases in land prices further fuel speculation for land that discourages availability of land on the market. Now a large percentage of ordinary people are investing in real estate developments. The phenomenon is typical to bubbles in Thimphu and Phuentsholing.

As a result of development demands against less available land in central parts of cities, urbanization is now finding its way into agricultural lands in peripheries and hillside. The areas exposed to urbanization pressures are environmental conservation areas designated as E-4 in the case of Thimphu and floodplains and uplands prone to landslides. The annual precipitation level in Phuentsholing is over 4000 mm on the average, geological weakness and seismic activeness of the area provides fertile ground for high disaster probabilities.

Urbanization in distant areas normally increases the travelling distances of the newly urbanized population as they commute to the center. As the expansion of public transport lags behind urbanization of peripheries in Thimphu, dependency on automobiles will increase as peripheral urbanization progresses. Growing traffics now manifest themselves as traffic jams in certain bottlenecks of the city. Urban expansion also manifests itself as problems associated with localized water shortage and water pollution by sewage disposal. The development of

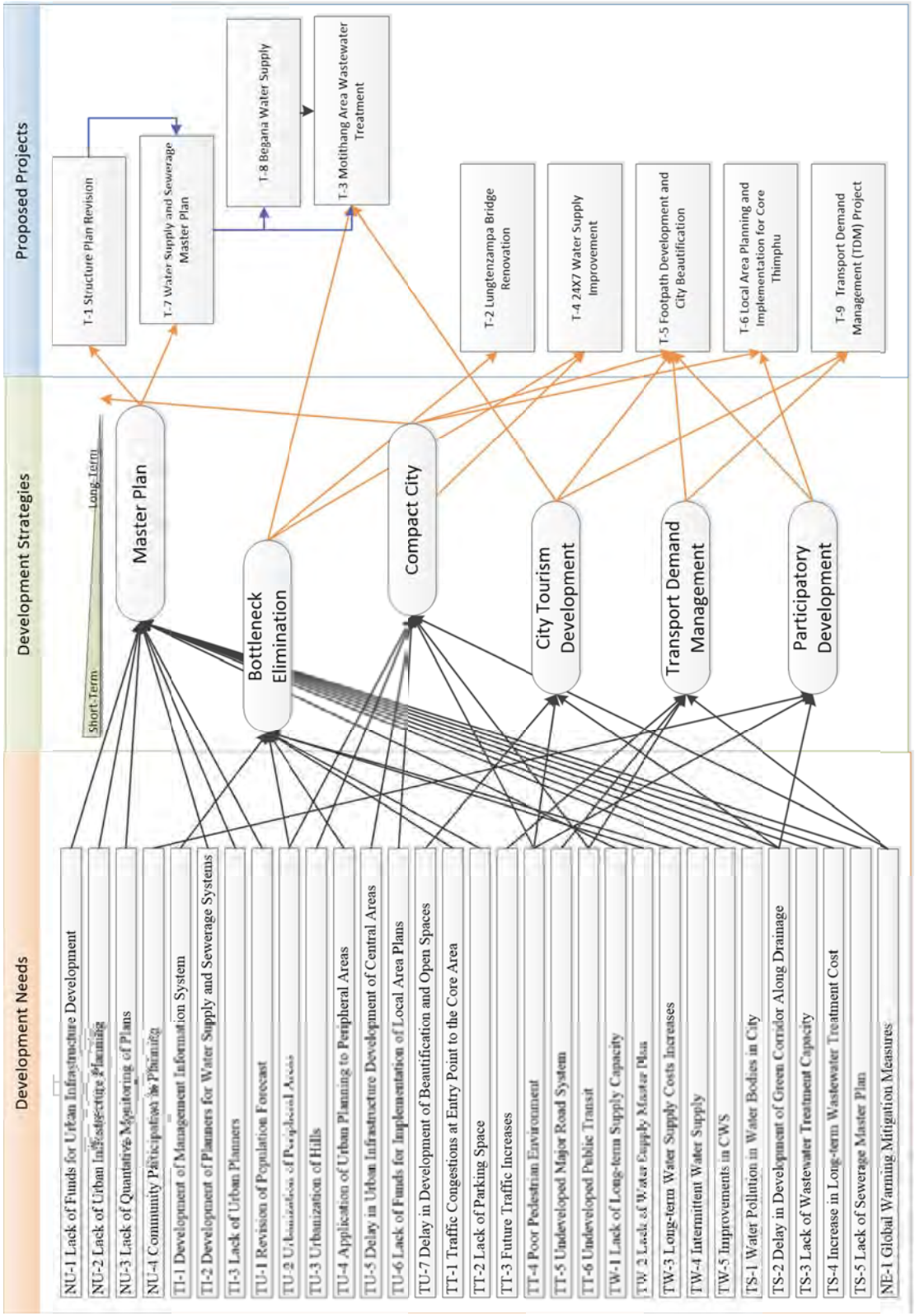
urban infrastructure becomes more urgent to cope with these problems and the funds required for such development becomes larger and larger.

The most critical bottleneck in urban development in Bhutan is lack of finance. The first step in development is the acquisition of public space for the development of urban infrastructure such as roads. However, the public land prices set forth by the law is so far from the prevailing land prices in the cities that a negotiation may not even start. Fortunately, in Bhutan, there is a well-established methodology for land acquisition called, *land pooling*, which allows the pooling of public space required for urban infrastructure development. Thus the methodology enables the government to acquire the land while retaining the development benefits accruing to land for the landowners. The rate of land pooling is capped at the maximum of 30%; therefore the *land pooling* scheme in Bhutan cannot finance the construction of infrastructure. Since the RGOB is always short of development finance, the construction of urban infrastructure in Bhutan is now largely dependent on external donor financing.

The third major constraint is the nature of the Structure Plan itself in Bhutan. As discussed in detail in Chapter 2, the technical planning for urban infrastructure is left to *Local Area Planning,* which has no more than one square kilometer jurisdiction, leading to piecemeal planning process of infrastructure network planning of water, sewerage and road, escalating the costs of operations.

## 5.2 Thimphu Development Strategies

Chapter 2 outlined the development needs at the national level and Chapter 3 described the development needs appropriate for Thimphu sector by sector. JICA Study Team proposes general strategies to cope with the select needs in relation to the proposed projects. Figure 5-2 shows the overall relationship between the needs, strategies and proposed projects. A strategy is defined as a policy target to be achieved through various projects, incentives and regulations. The proposed strategies range from short term to long-term development strategies. The short term strategy *is the Bottleneck Strategy. Transport Demand Management Strategy, Participatory Community Development Strategy* will be effective in mid-term. *Master Plan Strategy, Compact City Strategy, and City Tourism Development Strategy* are effective in the long term. Capacity development is very important but integral element to technical assistant projects.




Source: JICA Study Team

**Figure 5-2 Thimphu Development Strategy**

### (1) Bottleneck Strategy

The *Bottleneck Strategy* is a collection of projects that provide immediate relieves to deficiencies caused by rapid urbanization in Thimphu. One of urgent issues in urban planning is *TU-2 Urbanization of Peripheral Areas*, expansion of urban areas to outside of Thimphu. At present, the urbanization is progressing in north-south axis in Thimphu. If urbanization is left unchecked while retaining the land plot configurations, it is highly likely to see an inefficient and malfunctioning urban agglomeration to appear, particularly in terms of automobile access. Thus land use control and plot adjustment from rural to urban conversion is an immediate urgency for the city structure of Thimphu. The corresponding project proposed is the scope to review the current structure plan boundary and the plan by including the peripheral areas as part of the proposed ***T-1 Structure Plan Revision***. WB and ADB are currently financing the peripheral areas which were least urbanized within Thimphu. These locations may have been chosen for the same reason as the rationale for this T-1 project.

In the field of urban transport, *TT-1 Traffic Congestions in Entry to Core Area* is the most notable problem faced in Thimphu. Specifically the junction between Lungtenzampa Bridge and Norzin Lam exhibits the most congestion. The reconstruction cost is beyond the means of the RGOB thus is a candidate project for grant. The proposed ***T-2 Lungtenzampa Bridge Reconstruction*** project aims at realignment of the major crossing roads to the bridge as well as the construction of a new bridge in order to eliminate the traffic congestions.

In the field of water supply, it is important to address the issue of *TW-2 Intermittent Water Supply*. Negative pressures created within empty pipes of water distribution network during down time allow intrusion of groundwater and foul water from the surrounding environment, therefore increasing the risk of potable water contamination. It is the worst situation to be avoided in view of public health for water supply. As described in Chapter 3, there is a chance of several damages to distribution pipes as well. The target of the remedy is to restore 24 X 7 water supply as embodied in ***T-4 24 x 7 Water Supply*** project. The target can be achieved by repairing the problems to be identified within the distribution network. The remedy can be implemented independently from projects related to water supply and is likely to lead less UFW. Thus the remedy would lead to long-term improvements in finance and service levels. In that sense, the remedy to this issue is the first step to a long-term goal of the water sector. *TW-3 Improvements of CWS* is needed since the CWS collects water from a source in the upstream of a stream in valleys and send it to reservoir tanks without providing disinfection or distribution network (water tariff is free of charge). The public would welcome the improvements of service in terms of delivery and sanitation even for a fee.

Among the areas without sewerage connection, the Motithang area poses a biggest problem such as *TS-1Water Pollution in Water Bodies in City* as shown in 3.6.8, and causing *TS-2 Delay in Development of Green Corridor along Drainage* as shown in 3.6.7. The only solution for these bottlenecks is to resolve *TS-3Lack of Wastewater Treatment Capacity*. The corresponding proposed project is ***T-3 Motithang Area Wastewater Treatment***.

### (2) Master Plan Strategy

The institutional setup for urban development in Bhutan is well developed with Structure Plan and Local Area Plan with land use zoning and building codes. The biggest weakness of the system is the lack of city-wide master plan for urban infrastructures, water supply and sewerage system in particular, as indicated by *NU-2Lack of Urban Infrastructure Planning, TW-2 Lack of Water Supply Master Plan, and TS-5 Lack of Sewerage Master Plan*. Without technical and financial optimization over the city, such detailed planning is left as mandate for Local Area Plans. As a result, there are issues such as *TW-3 Long-term Water Supply Costs Increases,*

*TS-1Water Pollution in Water Bodies in City, TS-2Delay in Development of Green Corridor along Drainage, TS-3Lack of Wastewater Treatment Capacity,* and *TS-4Increase in Long-term Wastewater Treatment Cost*. The best solution is to undertake an overall study to optimize the systems over the city in the long run. In order to solve *TW-1Lack of Long-term Supply Capacity*, there is a need for reliable population forecast by districts. The current population of Thimphu may have already surpassed the planned absorption of population set forth by the Structure Plan adopted 10 years ago（*TU-1Revision of Population Forecast*）.

The core project proposal of this *Master Plan Strategy* is ***T-1 Structure Plan Revision*** which is basically a technical assistance project covering the scopes of 1) assistance to the national population census of 2015, 2) the incorporation of urban plan monitoring system of CASBEE developed in Japan, and 3) undertaking of Local Area Plans in central areas and city-wide infrastructure plans. ***T-7 Water and Sewerage Master Plan*** addresses the most critically missing element within the Structure Plan of water and sewerage master plans. ***T-8 Begana Water Supply Project*** would provide the ultimate solution for *TW-1 Lack of Long-term Supply Capacity*.

Capacity development components should be included to create synergy by utilizing more local resources and providing training opportunities to address the issues and needs identified as *TI-2 Development of Planners for Water Supply and Sewerage Systems, TI-3 Lack of Urban Planners,* and *NU-3 Lack of Quantitative Monitoring of Plans.*

### (3) Compact City Strategy

The current approach to urban development in Thimphu is no more than bottleneck strategy which addresses symptoms without more fundamental solutions. The short term solution is necessitated by *NU-1 Lack of Funds for Urban Infrastructure Development* and *TU-6 Lack of Funds for Implementation of Local Area Plans.* The situation of fund shortage is the same for the central government. There are many areas that require urban infrastructure development such as Jongshina (this area already has a Local Area Plan); there are many unutilized plots including open space, underutilized military lots etc.（*TU-5 Delay in Urban Infrastructure Development of Central Areas.*）Densification of these plots will certainly increase population accommodation capacity. Even government lands require time from ownership transfer for new uses, therefore a long term planning is required.

*Compact City Strategy* will limit uncontrolled expansion of city boundaries to suppress the costs of providing urban services and urban infrastructures. For residents there is an economic disadvantage of longer commutes if central residences are not available. *Compact City Strategy* enhances not only efficiency of public administration but also of residents, thereby increasing the city-wide productivity and enabling higher disposable incomes. The core project for the *Compact City Strategy* is ***T-6 Local Area Planning and Implementation for Core Thimphu*** which undertakes planning and implementation of Local Area Plans in central areas of Thimphu.

### (4) Transport Demand Management Strategy

Urban transport is increasing becoming heavy in Thimphu as indicated as（*TT-1 Traffic Congestions at Entry Point to the Core Area, TT-2Lack of Parking Space*）; however, due to lack of land availability, the issues such as *TT-5Undeveloped Major Road System, TT-2Lack of Parking Space* cannot be easily resolved in Bhutan. No action may see paralysis of central parts of the city by *TT-3 Future Traffic Increases.* On the other had, due to *TT-6Undeveloped Public Transit*, according to a person trip survey, buses has only the modal share of 15% of all the automobile modes.

*Transport Demand Management Strategy* is to introduce a modern transport policy widely adopted in advanced economies after failing to accommodate motorization and its associated

problems. Construction and widening of roads, endless expansion of parking space created more incentives for dependence on automobiles, encouraging commutes from farther areas. After decades of infrastructure expansion and ever increasing traffics, the policy turned to the control of transport demand. Leapfrog to an advanced policy will conform to the national development philosophy as well as practical limitations on space in Bhutan.

*Transport Demand Management Strategy* is to implement combined measures to suppress automobile transports including reinforcement of public transit, infrastructure development for pedestrians and bicycles, penalization for parking and automobile use in central areas, and traffic calming. There are already two comprehensive studies regarding urban transport in Thimphu 1) Thimphu Transport Master Plan (2009) by MoWHS, and 2) Bhutan Urban Transport System: System Selection and Eco-Friendly Feasibility Report (2011) which makes most of transport policies including promotion of public transit. The next 11$^{th}$ Five Year Plan for Thimphu includes a budget for the introduction of BRT. Therefore it is high time for the implementation of *TDM Strategy*

The national policy of Bhutan includes "harmonization with environment." As indicated in *NE-1 Global Warming Mitigation Measures* in Chapter 2, the RGOB is now working on the mitigation measures for global warming. The largest contributor to Greenhouse Gas Emission is transport sector in Bhutan with its share of 44%. Therefore this *Transport Demand Management Strategy* should constitute to the new policy orientation. *Transport Demand Management Strategy* is closely associated the *Compact City Strategy* as the control of spatial expansion should control exponential growth in energy consumption in transport sector by reducing average commuting distance and enhancing overall productivity of the city.

***T-9 Transport Demand Management (TDM) Project*** is a project proposal to combine the provision of public bus systems together with a technical assistance project to promote modal shift to bus trips. Addition of a technical assistance component will enable to make an interactive implementation of TDM measures by monitoring the impacts on modal shifts to arrive at an optimal policy mix.

### (5) City Tourism Development Strategy

One of emerging urban issues in Bhutan is creation of jobs in cities. Although the cities, particularly Thimphu, attract a large young population despite the fact that the unemployment rates for the young are rising. College graduates are finding increasingly difficult to secure jobs. As shown in 2.1.2 (2), the tourism industry is one of the main foreign exchange earning sectors in Bhutan with rapid growth. The labor market indicate that service industry offers employment only second after the public administration in Bhutan. Traditional tourism in Bhutan is focused on nature such as trekking. City-based tourism is an important element to further develop the sector. The development of urban amenity is becoming more significant to promote tourism.

As described in 3.3.6, *TU-7 Delay in Development of Beautification and Open Spaces* has become an urgent issue in Thimphu, together with *TT-4 Poor Pedestrian Environment*. Thimphu has many vertical pathways with some commercial activities. These footpaths with backdrops of hills provide pleasant walking experiences in Thimphu as well as tourism and commercial opportunities. Therefore, improving urban amenities through *City Tourism Development Strategy* in these corridors will have double impacts.

### (6) Participatory Community Development

In the past, professional urban planners from the public sector have led planning work in Bhutan. In the future, urban issues such as the redevelopment of footpaths which are mainly private spaces will constitute part of urban amenity enhancement for tourism promotion. These works will require the participation of communities and private sector (*NU-4 Community Participation in Planning*.) Even if the public sector redevelops pedestrian walks, the urban amenity is not maintained without proper maintenance. In addition, landscaping and architecture

on adjoining private properties need to match the public space to create true urban amenities. Thimphu has many traditional architectures, and private footpaths that run between buildings that offer potential tourism attractions. The participation of communities is essential to fully capture the potentials in Thimphu.

Some experiments have been carried out on Norzin Lam for automobile exclusion which is seriously studied. Thimphu Thromde envisages that the development of multi-parking buildings could enable the automobile exclusion from the main street of Norzin Lam. However, still a large number of shop owners and product suppliers are opposed to the idea of pedestrianization of the Norzin Lam. In view of TDM, automobile exclusion from the main street is one method of increasing the cost of using automobiles in the center. At the same time, it will increase the economic costs of material supplies and also consumer's transport of goods. Therefore, the project will not be sustainable without full participation of the communities along the street, and will be a cornerstone for participatory planning in Thimphu.

***T-5 Footpath Development and City Beautification*** is a technical assistance project proposal that provide trainings and exposure trips to communities in Japan with successful participatory community development, consultancy to pedestrian space development planning, and pilot project implementation. Many communities, local governments, and commercial associations in Japan have rich experiences in participatory development, thus offer a chance of grass root level technical cooperation.

## 5.3 Phuentsholing Development Strategy

Chapter 2 outlined the development needs at the national level and Chapter 4 described the development needs appropriate for Phuentsholing sector by sector. JICA Study Team proposes general strategies to cope with the select needs in relation to the proposed projects. Figure 5-3 shows the overall relationship between the needs, strategies and proposed projects in Phuentsholing.

The proposed strategies correspond to immediate urban development needs to long-term development goals. *Disaster Prevention Strategy* addresses the most urgent and critical needs in Phuentsholing. As is the case for Thimphu, *Bottleneck Strategy* addresses the immediate needs. *International Competitiveness Enhancement Strategy* and *Participatory Community Development Strategy* on a mid-term and *Master Plan Strategy* is a long term strategy.

### (1) Disaster Prevention Strategy

The major threat to the city of Phuenthsoling is human life risks by floods of Om Chhu (*PE-1Cyclic Floods*) and the landslides (*PE-2Frequent Landslides*) at urban encroachment into floodplain and hillsides (*PE-3Urban Encroachment into Hazard Prone Areas*). On the other hand, the technologies for mitigations are yet to be developed (PE-4 Lack of Flood/Landslide Control Technologies). As described in 4.7.1, the most suitable technologies for Bhutan is so-called Sabo technologies developed in Japan for flood and landslide control. In Phuentsholing it is necessary to manage the entire basin in view of sedimentation control from forest preservation to debris stoppage, from river profile modification to embankment. Japan has long experienced the disasters of floods and landslides and has accumulated mitigation technologies.In Japan, there is a collection of such river basin management technologies named "Sabo." *Sabo* is a collection of mitigation/prevention technologies to tame landslides, floods and rock/debris flow with measures including forest protection, erosion control, river flow control, riverbed stabilization, and embankment. Since topography and hydrology of Phuentsholing are more akin to those of Japan, *Sabo* technologies will have direct applications to prevent the flooding and landslides in Phuentsholing.

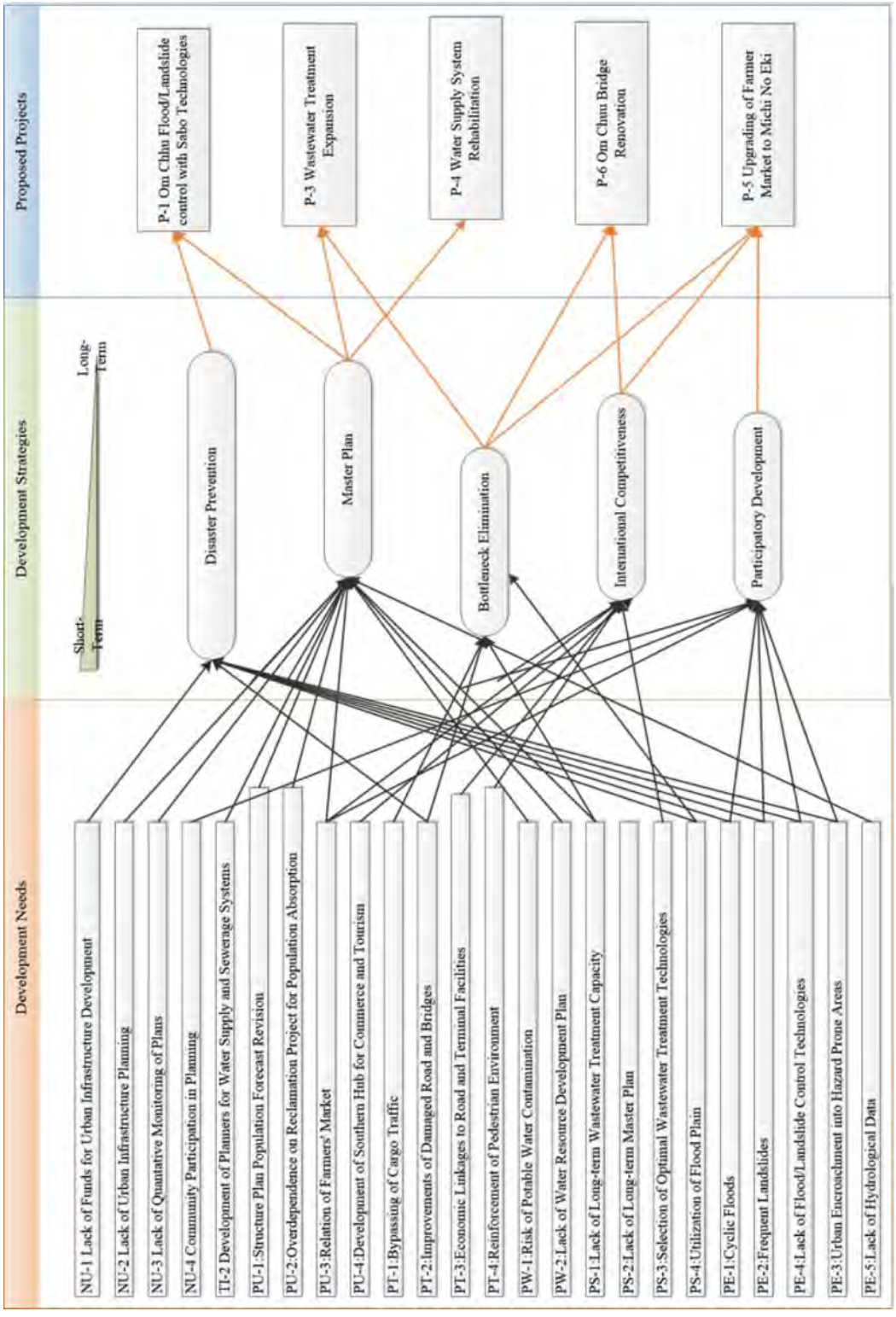
The core project proposed to fulfill this Strategy is ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies***. Sabo implementation will be a comprehensive basin management system to protect human lives and urban infrastructure. Sabo technologies include more than check dams commonly known. Sabo encompasses technologies riverbed stabilization, water course stabilization, and slope stabilization. The optimal mix of technologies suited to local conditions needs to be prescribed as master plan. In addition to flood and landslide control, the goals of Sabo include the protection of ecosystem, and the provision of riverfront amenities and recreational facilities for the public. Sabo technologies should be localized to reduce the investment and maintenance costs of Sabo by utilizing locally available materials such as wood and rocks.

### (2) Bottleneck Strategy

*Bottleneck Strategy* in Phuentsholing also addresses the issues that require immediate attention. An urgent action is needed for *PU-3 Relocation of Farmers' Market* due to relocation necessitated by the construction of the planned ring road.

The most critical transport problem in Phuentsholing is the passage of long distance trucks through the center of the city as described in 4.3.1 (*PT-1 Bypassing of Cargo Traffic.*) The Ring Road and mini-dry port projects planned by ADB are expected to solve this urgent problem. There is an old bridge that will join to this ring road over the Om Chhu between northern and southern parts of the old city. The old bridge would require the replacement in a few years (*PT-2 Improvements of Damaged Road and Bridges.*) The corresponding project proposed is ***P-5 Om Chhu Bridge Renovation.*** The bridge is originally constructed to connect the northern and southern parts of the city. The old city of Phuentsholing is mainly located in the south. The most active urban development is now taking place in the north such as Dhamdara and Kabreytar areas. In addition, there is a national road construction project underway to connect Phuentsholing to Samtse Dzongkhag. These developments will increase the traffic dramatically over the bridge. Phuentsholing Thromde realizes that increased traffic will place more burdens on this aged bridge and the original structural design may not withstand the increased traffic loads in the future (*PT-2 Improvements of Damaged Road and Bridges*), thus proposes to replace this bridge with a new stronger bridge.

As is the case in Thimphu, Phuentsholing Thromde can only supply water on an intermittent basis even though there is sufficient water resource and production capacity. Intermittent water supply poses *PW-1 Risk of Potable Water Contamination*. Therefore, the restoration of continuous water distribution is an important measure in protection of public health. ***P-3 Water Supply System Rehabilitation*** aims at the restoration of 24 x 7 continuous water supply by improving the distribution networks.




Source: JICA Study Team

**Figure 5-3 Phuentsholing Development Strategy**

### (3) Master Plan Strategy

As is the case in Thimphu, Phuentsholing adopts Structure Plan – Local Area Plan System for urban infrastructure planning which creates a void in city wide master plan of urban infrastructure (*PW-2 Lack of Water Resource Development Plan, PS-2 Lack of Long-term Master Plan.*) Phuentsholing is endowed with a large unutilized space in the flood plain of Am Mo Chhu. The only facility built in this flood plain is the existing wastewater treatment plant. As indicated in 4.3.3, there is a mega project under plan to reclaim a large tract of land for residential development on this flood plain. However, there is always a flood risk. The investment induces minimum risk for loss of lives is the expansion of wastewater treatment plant (*PS-3 Selection of Optimal Wastewater Treatment Technologies, PS-4 Utilization of Flood Plain*.)

Since Phuentsholing has just completed the draft Structure Plan in 2013, it is too soon to revise the plan. Given the size of the city, it is not economical to undertake a water and sewerage master plan for Phuentsholing alone with external funding. One option is to link with the next physical investment project study. Therefore, ***P-2 Wastewater Treatment Expansion*** or P-***3 Water Supply System Rehabilitation*** should include the city wide master plan element to serve both *Bottleneck Strategy* and *Master Plan Strategy*.

***P-2 Wastewater Treatment Expansion*** first investigates an option of combining three separate wastewater treatment zones proposed in the Structure Plan into one to achieve economy of scale and evaluate the most technically and economically suitable technologies with different size of plot availability.

### (4) International Competitiveness Enhancement Strategy

Phuentsholing is the gateway to India from Bhutan. The border exists but there is virtually no restriction on border crossing for the residents on either side. Given the superiority in size and variety of commercial establishments in Jaigaon, a survival tactics for Phuentsholing is to develop higher value-added products and services including hotels, shops and recreational facilities (*PU-4 Development of Southern Hub for Commerce and Tourism*.) The Ring Road under planning will divert most of the heavy trucks from passing through the core part of the city. With the project, the amenity of the city will improve but there is a risk of losing commercial opportunities as well. Another new corridor is the highway connection to Samtse which is now under construction. Once completed, Phuentsholing will become a gateway to Samtse as well. Phuentsholing Thromde must concentrate on inducing investments to capture economic opportunities arising from new traffic flows (*PT-3 Economic Linkages to Road and Terminal Facilities*.) A project proposal to address these needs is ***P-4 Relocation Upgrading of Farmers Market to Michi No Eki,*** which aims at maximizing the economic opportunities from passing traffics on new roads. The construction of the Ring Road will necessities the relocation of a farmers' market located in front of a bus terminal. Instead of preserving the current functions, the relocation is viewed as a new opportunity to increase industrial development potentials to develop local brands for the promotion of local goods and services.

### (5) Participatory Community Development Strategy

As described in (4) above, Phuenthsoling needs to increase its competitiveness as a commercial hub. The core project to realize this strategy is ***P-4 Relocation Upgrading of Farmers Market to Michi No Eki.*** According to experiences in Japan, successful Michi-no-Ekis are initiated with community participation for the identification of local resources and potentials leading to the development of unique local products and branding. P-4 with *Participatory Community Development Strategy* aims at the development of local capacity

of internal voluntary development departing from traditional government led development efforts.

## 5.4 Project Formulation

The proposed candidate projects listed below have been formulated by the JIC Survey Team through discussion with local experts and field observations. Any of the projects is not yet officially endorsed either by Bhutanese governments or JICA. The list of projects rather aims at aiding the future discussions between two governments in formulation of specific aid projects instead.

In addition to the understanding of local needs and development strategies, the activities of other donors need to be incorporated for project formulation because the lack of development finance is the fundamental bottleneck for Bhutan. At present, WB is undertaking *Bhutan Urban Development II* (loan approval 2010, US $12 million.) Under this program, RGOB is implementing two LAPs for Dechencholing and Langjophaka. WB is planning to take up another Urban Village for implementation; the candidate area is Taba. The decision and details will be decided by the mission planned in December, 2013. ADB is undertaking *Urban Infrastructure Project* (Loan Approval, Nov. 2011, US$19,870 thousand) to develop urban infrastructures such as water and sewerage, roads for four cities of Thimphu, Phuentsholing, Samdrup Jongkhar, and Nganglam. In Thimphu, the Program started to construct water supply and sewerage systems for four southern LAPs. As for Phuentsholing, ADB is now preparing the road project loan under SASEC Project. SASEC Road Connectivity Project (Approval forthcoming, US$ 50 million) aims at financing the development of east-west highway on the southern belt of Bhutan. As a part of this project, ADB plans to finance the Ring Road in Phuentsholing.

### 5.4.1 Project Formulation for Urban Planning

As discussed in Chapter 2 for urban planning, Bhutan has developed a solid urban planning and implementation scheme but at the same time, there are several aspects to be improved as follows;

- Quantitative monitoring methods, and
- Pan-city infrastructure planning for water supply, sewerage and urban transportation.

Given the fact that Bhutan aims at environmentally sound country, and NEC is now initiating a program to reduce global warming gas emissions. Department of Human Settlement of MoWHS, in charge of planning and monitoring, is now keenly interested in CASBEE as environmental monitoring method for urban development and is seeking JICA assistance.

The Structure Plan lacks in technical and financial evaluation of alternatives. There should be tight coordination between area-wise population forecasts and infrastructure to arrive at an optimal network of water supply, sewerage and urban transport. There should be also technical evaluation of water and sewerage options to minimize future operation costs and overall transport policies to realize desirable transport modal compositions.

On a national scale, the current Structure Plan should incorporate a quantitative monitoring system using CASBEE and also inclusion of urban infrastructure planning in depth. The Structure Plan of Thimphu has become outdated in population targets and corresponding city area or land uses, therefore there should be updated. Therefore the revision of Structure Plan is included as part of Thimphu Projects as shown in T-1 in Appendix A-1.

### 5.4.2 Project Formulation for Thimphu

Table 5-1 shows the nine proposed priority projects for Thimphu. The details of the projects including objectives, scope, environmental and social considerations are detailed in Appendix A-1.

**Table 5-1 Priority Projects for Thimphu**

| No | Project Title |
|---|---|
| T-1 | Structure Plan Revision |
| T-2 | Lungtenzampa Bridge Renovation |
| T-3 | Motithang Area Wastewater Treatment |
| T-4 | 24 x 7 Water Supply Improvement |
| T-5 | Footpath Development and City Beautification |
| T-6 | Local Area Planning and Implementation for Core Thimphu |
| T-7 | Water and Sewerage Master Plan |
| T-8 | Begana Water Supply Project |
| T-9 | Transport Demand Management (TDM) Project |

Source: JICA Study Team

Among nine projects, ***T-2 Lungtenzampa Bridge Renovation*** is a spot project. As the gateway to the city, the project is a candidate project for grant. Other projects are interrelated, thus there are possibilities of combination and other modifications.

Due to funding shortage, the current urban infrastructure developments are focused on the southern and northern parts of the city in Thimphu, therefore the more central areas are left without development, thereby depriving the compactness of the city. Therefore funding for the development of the central areas is essential. ***T-6 Local Area Planning and Implementation for Core Thimphu*** addresses the need for such developments including water supply, sewerage and road developments. This project can be so designed to include ***T-3 Motithang Area Wastewater Treatment***, ***T-4 24 x 7 Water Supply Improvement***, ***T-5 Footpath Development and City Beautification***, and ***T-8 Begana Water Supply Project***. Given the nature of the project and the size of development funding requirements, the project should be a loan project. ***T-1 Structure Plan Revision*** should be designed to define the scope of the T-6 and provide the cost estimates.

Structure Plan for Thimphu was adopted in 2003. With the passing of 10 years since its adoption in 2003, the validity of population forecast is in question. With most likelihood, the current population has surpassed the planned population of the plan. There is a high demand for the revision of official population target for future infrastructure plans especially for each district. In 2015, there will be a decennial national census. There should be a coordination work between urban planners and census department to make best use of the results for future urban planning with regard to the census blocks and coverage. ***T-1Structure Plan Revision*** includes

the precursor program of technical assistance in population statistics and future population forecasting for this purpose.

Among urban infrastructure, water supply and sewerage systems have the most urgent needs for development. ***T-7 Water and Sewerage Master Plan*** focuses on city-wide planning for water supply and sewerage although it is more desirable to have it included as part of ***T-1 Structure Plan Revision.***

***T-4 24 x 7 Water Supply Improvement*** aims at resolving the present intermittent water supply problems for public health and ***T-3 Motithang Area Wastewater Treatment*** aims at increasing the coverage of sewers to these core areas to improve urban amenities. Standalone implementation of these projects is options for its urgency. However, the size of funding may be too small for a loan project. In any case it is necessary to undertake a feasibility study for these two projects to ascertain the project scopes and corresponding investment costs.

***T-3 Motithang Area Wastewater Treatment*** has options of establishing a small local system or connecting the main sewer to Babesa Treatment Plant for which economic evaluations need to be carried out.

WB is now planning to take up TABA area as the third LAP. RGOB requested WB to look at the city wide water demand situation instead of LAP. Now WB is looking at the possibility of bringing water from the upstream Wang Chhu at Begana. If WB decides to finance this project, the scope need for ***T-6 Local Area Planning and Implementation for Core Thimphu*** needs to exclude the city wide water supply component. If WB decides not to include Begana Water Supply, ***T-8 Begana Water Supply Project*** becomes one of the core subprojects for T-6.

In the area of urban transport, given lack of parking space in the city core, it is necessary to implement measures for transport demand management in Thimphu. Among all, the reinforcement of public bus system on grant basis is crucial as part of ***T-9 Transport Demand Management (TDM) Project*** to maximize the impacts. At present, half of person trips of citizens of Thimphu rely on foot. Therefore, development of footpaths is critical in preserving the current modal split. City beautification elements will increase the economic impacts especially on tourism. If this project is to be executed alone, ***T-5 Footpath Development and City Beautification*** should be formulated as a technical cooperation project to bring the Japanese experiences to Bhutan since the project scope is too small for loan and will not satisfy grant qualifications. T-5 can be incorporated as part of ***T-1 Structure Plan Revision*** to bring out the synergy effects of technical assistance. Another option is to combine with **T-5** with **T-9 Transport Demand Management (TDM) Project** in order to induce maximum impacts on modal shifts from automobile to foot or public transit.

**Technical Precautions for Scoping**

The limitations that the Study has found are the lack of hydrological and geological data in Thimphu. The hydrological data from Lungtenphu Station are available for the period since 1991. There is no hydrological data on any of tributaries of Wang Chhu. The meteorological data is available from 1996.

The collected geological data are more less surface based data or on a large scale. No boring core sample is found yet. It is known that the intake site of ***T-8 Begana Water Supply Project*** is located within a national park. Therefore, the mitigation measure to minimize the environmental impacts is needed.

### 5.4.3 Project Formulation for Phuentsholing

Table 5-2 shows the five proposed priority projects for Phuentsholing. The details of the projects including objectives, scope, environmental and social considerations are detailed in Appendix A-2.

**Table 5-2 Priority Projects for Phuentsholing**

| No | Project Title |
|---|---|
| P-1 | Om Chhu Flood/Landslide Control with Sabo Technologies |
| P-2 | Wastewater Treatment Expansion |
| P-3 | Water Supply System Rehabilitation |
| P-4 | Relocation Upgrading of Farmers Market to Michi No Eki |
| P-5 | Om Chhu Old Bridge Renovation |

Source: JICA Study Team

The most critical urban challenge in Phuentsholing is protection of human lives and urban facilities from natural disasters. For these objectives, ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies*** qualifies for grand aid. However, it is not possible to accurately define the scope or costs for the work. The planning work based on hydrological and geological data of the basin needs to precede the actual implementation. Sabo technologies are widely needed in other southern parts of Bhutan. Therefore, ***P-1 Om Chhu Flood/Landslide Control with Sabo Technologies*** is proposed as a technical assistance project. As any physical planning requires solid data, Sabo requires good hydrological and geological data of the area. However, there is no measurement station on this small river of Om Chhu. Therefore the first step is to establish a hydrological measurement system on Om Chhu to collect a minimum data for planning. Master plan and basic design need to be established prior to feasibility study. Based on these plans, the river basin management of Om Chhu needs to be implemented. In order to solidify technology transfer, the project scope includes the implementation of 3-5 pilot projects for critical typical technologies locally adopted for Phuentsholing.

Floods of Year 2000 devastated the water supply and sewerage facilities in Phuentsholing. Since then 24 hour continuous water supply has ceased to pose public health risks to the residents. The distribution network is deemed to have some damages and leaks; the production facilities are functionally deficient. ***P-3Water Supply System Rehabilitation*** addresses these urgent needs. The current wastewater treatment capacity is not sufficient to cover the entire population let alone future population increments. Therefore it is necessary to expand the treatment capacity and extend the sewer networks as proposed in ***P-2 Wastewater Treatment Expansion***. Naturally it is desirable to have a long term planning for water supply and sewerage systems for the entire city by incorporating urban planning, topography and hydrology. In the long run, there is a need for planning for the newly incorporated areas. The two projects of P-3 and P-2 are basically loan projects but the size of funding may be too small as a single project even for both combined. One option is to merge with other projects such as those water supply and sewerage projects for Thimphu.

***P-4 Relocation Upgrading of Farmers Market to Michi No Eki*** is a technical assistance project to transfer technologies on community participatory development methodologies from Japan to Bhutan with a pilot project in Phuentsholing. MoWHS is now initiating a program to develop roadside farmers' market and has a keen interest in the Japanese experiences in

Michi-no-Eki and One Village One Product Movement. Starting with training and exposure trips in Japan, the project scope covers the identification of locally unique resources, crafts and products, the development of local products and local brands consulting work, and the development and management of a Michi-no-Eki pilot project.

***P-5 Om Chhu Old Bridge Renovation*** qualifies as a grant project for its objective of transport safety. If P-4 project site is located in the vacant land of RSTA bus terminal, the P-5 will directly joins to the location of P-5, further reinforcing the impacts on trade promotion.

**Technical Precautions for Scoping**

The limitations that the Study has found in Phuentsholing are also the lack of hydrological and geological data. The hydrological data from Dorokha on Am Mo Chhu are available for the period since 2003 and those from Doyagang Station also on Am Mo Chhu are available from 2004. The meteorological data is available from 1996.

The collected geological data are more less surface based data or on a large scale. No boring core sample is found yet.