



SMART PARKING in Bharatpur Metropolitan City

2019

WeGO Smart Sustainable City Feasibility Study Program
Supplementary Report



SRPOST
Smart innovation, stronger communities

EXECUTIVE SUMMARY

Project type:	WeGO Smart Sustainable City Feasibility Study Program 2019
Project title:	Feasibility Study on Smart Parking in Bharatpur Metropolitan City
Project start date:	September 17, 2019
Project end date:	January 17, 2020
Target government:	Bharatpur Metropolitan City, Federal Democratic Republic of Nepal
Target government project manager:	Ms. Menaka Pandit Information Officer
Contracting party:	World Smart Sustainable Cities Organization (WeGO)
Contracting party project manager:	Ms. Alexandra Sidorova WeGO Secretariat Program Officer
Implementation party:	SRPOST Co., LTD
Implementation party project manager:	Mr. Nangyu Kim Head of Strategy&Business Development Division

1. The 2019 WeGO Smart Sustainable City Feasibility Study focuses on analysing public parking environment in Bharatpur Metropolitan City, Federal Democratic Republic of Nepal and assessing the feasibility of its transition to smart parking.
2. The main parties involved in this project are World Smart Sustainable Cities Organization (WeGO), Bharatpur Metropolitan Government (BMG) and SRPOST Co., LTD (SRPOST).
3. Bharatpur Metropolitan City is not a heavily congested city. However, as Bharatpur is one of the fast-growing cities of Nepal, it will possibly face serious traffic issues in the future as traffic load continues to increase on a daily basis. BMG is working on compiling a comprehensive Master Plan that will envision Smart City development in Bharatpur. Currently (as of Nov 2019), 50% of the Master Plan is completed and the final version is expected to be delivered in 2020.
4. The Study concluded that lack of awareness about Smart Parking concept is the biggest challenge in transition to Smart Parking for Bharatpur. However, the BMG officials

recognize that Smart Parking systems implementation should be broken down to smaller phases to educate its citizens and to ensure seamless introduction of such new and innovative technologies. This will provide enough time for transition to Smart Parking without making any irreversible mistakes.

5. There are six main off-street parking facilities managed by BMG: Bharatpur Airport Parking, Bharatpur Central Bus Terminal Parking, Lions Chowk Parking, Ganesh Hall East Parking, Ganesh Hall West Parking and Kamalnagar Truck Parking. All parking facilities display the following common features: basic infrastructure in some places (Bharatpur Airport and Central Bus Terminal), no infrastructure in some places; no parking lot standards and no parking lines (some only at Bharatpur Airport); parking areas are not busy and parking process itself is not chaotic. Private vehicle owners avoid using these parking lots for short-term parking due to either difficult location of parking or unwillingness to park so far from the destination.
6. The Mahendra Highway in Bharatpur is the busiest road in the city with much parking occurring on the sides of the road. The parking is unsupervised and there is no concept of on-street parking. The study concluded that transition to Smart Parking on-street is currently not a viable task, as there are plans for the highway infrastructure expansion from 4 to 6 lanes, 3 each direction. However, the precise timeline for expanding Bharatpur's territory is yet to be determined. However, a development of master plan for on-street parking management is needed along with the highway infrastructure expansion.
7. The study concluded to recommend Bharatpur Airport as the pilot project site. Even though the airport is operated by the Civil Aviation Authority of Nepal and falls under the jurisdiction of the Nepalese government, Bharatpur Metropolitan Government can negotiate with the Nepalese government for it to be selected as the beneficiary for Smart Parking pilot project implementation. The study proposes a full-featured Smart Parking for Bharatpur Airport that will allow vehicle drivers to be charged based on time parked in the rather than a flat-rate. The proposed system will improve customer experience by facilitating more efficient, faster and easier parking process in Bharatpur Airport.
8. The study concluded that BMG has a successfully functioning government structure that would benefit from a small-scale departmental reorganization. BMG should focus on establishing a Department (Directorate) of Transportation to centralize efficient maintenance and development of Bharatpur's transportation system and infrastructure as

well as smooth transition to and efficient management of all future Smart Parking ecosystem aspects.

9. The study recommends to either look for internal funding within the Government of Nepal or focus on external sources of financing the project. Bharatpur Metropolitan Government is encouraged to look into foreign investment opportunities, i.e. participate in various international (e.g., WeGO Smart City Feasibility Study) and intragovernmental ODA programs (e.g., ODA programs at Korea International Cooperation Agency), cooperate with national investment promotion agencies for FDI programs (e.g., Investment Board of Nepal), partner with international companies (including Korean SMEs), and cooperate with multilateral development banks for loans and other fund mechanisms (e.g., Asian Development Fund whose top recipient has been Nepal). International funding is a possible option; however, procurement of such funding depends on the list of priority project subjects set by these organizations.

Keywords: *smart parking, smart city, feasibility study, WeGO, WeGO Smart Sustainable City Feasibility Study, WeGO FS 2019, SRPOST, Bharatpur, Nepal*

TABLE OF CONTENT

LIST OF ABBREVIATIONS	vii
LIST OF TABLES.....	ix
LIST OF PICTURES.....	x
1. INTRODUCTION	1
1.1. Project background.....	1
1.2. Project organization structure.....	2
1.3. Project objectives and expected outcomes	3
1.4. Project outputs.....	4
1.5. Project implementation schedule	4
1.6. Project methodology	5
2. PROJECT BENEFICIARY PROFILE	6
2.1. General overview	6
2.1.1. Federal Republic of Nepal	6
2.1.2. Bharatpur Metropolitan City	9
2.1.3. Bharatpur Metropolitan Government.....	9
2.2. ICT development analysis.....	12
2.3. Smart City analysis.....	14
3. AS-IS ANALYSIS	16
3.1. Transportation management stakeholders	16
3.2. Parking management stakeholders	16
3.3. Vehicle types, registration and license plate types	16
3.3.1. Vehicle types.....	16
3.3.2. Vehicle registration	17
3.3.3. License plate types.....	19
3.4. Driving license application process.....	21
3.5. Bharatpur parking overview	23
3.5.1. Bharatpur Airport Parking	26

3.5.2.	Bharatpur Central Bus Terminal Parking.....	28
3.5.3.	Lions Chowk Parking.....	31
3.5.4.	Ganesh Hall East Parking	33
3.5.5.	Ganesh Hall West Parking	35
3.5.6.	Kamalnagar Truck Parking	37
3.5.7.	Bharatpur on-street parking	39
4.	TO-BE MODEL.....	41
4.1.	Pilot project recommendations.....	41
4.2.	Estimated cost	45
5.	SMART PARKING DEVELOPMENT ROADMAP	48
5.1.	Roadmap overview.....	48
5.2.	Departmental reorganization	49
5.3.	Regulatory reforms.....	52
5.4.	Strengthening of technical capacity	54
5.5.	Raising public awareness	55
5.6.	Stakeholder engagement	56
	CONCLUSION	57
	REFERENCES.....	58

LIST OF ABBREVIATIONS

Abbreviation	Explanation
ADB	The Asian Development Bank
ADSL	Asymmetric digital subscriber line
AI	Artificial intelligence
ANPR	Automatic number plate recognition
app	Application
BHR	Bharatpur Airport
BMG	Bharatpur Metropolitan Government
CCTV	Closed-circuit television
DOTM	the office of Department of Transport Management
DPR	Detailed Project Report
Dy	Deputy
EF	Event frequency
ENG	English
est.	Estimated
etc.	et cetera
FDI	Foreign direct investment
FS	Feasibility Study
GDP	Gross Domestic Product
GPS	Global Positioning System
h	Hours
i.e.	In example
ICT	Information & Communication Technology
ID	Identity document
ISP	Internet Service Provide
KCCA	Kampala Capital City Authority
KMC	Kathmandu Metropolitan City
KVDA	Kathmandu Valley Development Authority
km	Kilometer
L	Letter

LCD	Liquid crystal display
LEV	Low-emission vehicles
LPR	License recognition plate
LTE	Long Term Evolution
m	meter
MIC	Ministry of Information and Communications
mm	Millimeter
N	Number
N/A	Not applicable
NDCL	Nepal Doorsanchar Company Limited
NPR	Nepalese rupee
NTA	Nepal Telecommunications Authority
ODA	Official development assistance
PD	Parking event duration
PID	Project Initiation Document
PPP	Purchasing power parity
RFID	Radio Frequency Identification
SMEs	Small and medium-sized enterprises
STPL	Smart Telecom Private Limited
SO	Sensor occupation
sq.	Squared
SWOT	Strengths, Weaknesses, Opportunities, Threats
TDF	Town Development Fund
TOPIS	Seoul Transport Operation and Information Service
UEIP	Urban Environmental Improvement Project
USD	United States dollar
VD	Vacancy duration
WeGO	World Smart Sustainable Cities Organization
WiMAX	Worldwide Interoperability for Microwave Access
WLL	Wireless Local Loop

LIST OF TABLES

Table 1. 2019 WeGO FS project organization structure	2
Table 2. 2019 WeGO FS project participants.....	2
Table 3. WeGO project objectives and expected outcomes	3
Table 4. 2019 WeGO FS project implementation schedule	4
Table 5. Nepal profile (Central Intelligence Agency data)	7
Table 6. Provincial map of Nepal	10
Table 7. ICT Development Index (IDI), 2016-2017	12
Table 8. General information on major Bharatpur parking lots.....	24
Table 9. Parking fees for major Bharatpur parking lots.....	25
Table 10. Full-featured Smart Parking scenario	43
Table 11. Smart Parking hardware overview	44
Table 12. Total estimated implementation cost.....	45
Table 13. Estimated labor cost (USD)	46
Table 14. Estimated travel cost (USD)	46
Table 15. Estimated hardware cost (USD).....	46
Table 16. Estimated software cost (USD).....	47

LIST OF PICTURES

Picture 1. Map of Nepal.....	6
Picture 2. Location of Bharatpur.....	9
Picture 3. New Nepalese license plates.....	19
Picture 4. Previous Nepalese license plates	20
Picture 5. Bharatpur City government vehicle (white plate with red numbers& letters)	20
Picture 6. Bharatpur public vehicle (black license plate with white numbers & letters).....	20
Picture 7. Electronic driving license registration page	21
Picture 8. Driving license payment slip	22
Picture 9. Location of all parking facilities on the map of Bharatpur.....	23
Picture 10. All airports of Nepal	26
Picture 11. Bharatpur Airport map.....	27
Picture 12. Bharatpur Airport Parking area.....	27
Picture 13. Motorbike parking area at Bharatpur Airport Parking.....	27
Picture 14. Airport Parking as viewed from parking entrance (parking area for cars)	27
Picture 15. Car parking area at Bharatpur Airport Parking.....	27
Picture 16. Entrance to the Bharatpur Airport Parking (payment area on the right)	27
Picture 17. Parking payment area at Bharatpur Airport.....	27
Picture 18. Parking ticket at Bharatpur Airport	27
Picture 19. Bharatpur Central Bus Terminal location	28
Picture 20. Bharatpur Central Bus Terminal structure	29
Picture 21. Short-term waiting area (view from entrance)	30
Picture 22. Short-term waiting area (view from the back).....	30
Picture 23. Long-term waiting area for buses	30
Picture 24. Buses parked in the long-term waiting area	30
Picture 25. Unsupervised bus parking area.....	30
Picture 26. Unsupervised bus parking area.....	30
Picture 27. Nepalese bus (front).....	30
Picture 28. Nepalese buses (back)	30
Picture 29. Location of Lions Chowk Parking.....	31
Picture 30. Lions Chowk Parking area	31

Picture 31. Lions Chowk Parking (view from entrance)	32
Picture 32. Lions Chowk Parking (view from the back towards the entrance)	32
Picture 33. Cars parked at Lions Chowk Parking	32
Picture 34. Lions Chowk Parking (picture taken at the center of parking lot)	32
Picture 35. Lions Chowk Parking is almost completely empty	32
Picture 36. Elevation at the center of Lions Chowk Parking	32
Picture 37. Pole at the center of elevation.....	32
Picture 38. Entrance from the street to the Lions Chowk Parking area.....	32
Picture 39. Location of Ganesh Hall East Parking	33
Picture 40. Ganesh Hall East Parking (right) and West Parking (left top corner)	33
Picture 41. Ganesh Hall East Parking (view from above)	33
Picture 42. Panorama view of Ganesh Hall East Parking.....	33
Picture 43. Vans parked at Ganesh Hall East Parking.....	34
Picture 44. Ganesh Hall East Parking is surrounded by buildings on all 4 sides	34
Picture 45. Utility pole in the center of Ganesh Hall East Parking.....	34
Picture 46. Bus stop at Ganesh Hall East Parking	34
Picture 47. Narrow and difficult entrance to Ganesh Hall East Parking.....	34
Picture 48. Parking navigation sign on the way to Ganesh Hall East Parking	34
Picture 49. Location of Ganesh Hall West Parking	35
Picture 50. Ganesh Hall West Parking (left) and East Parking (right).....	35
Picture 51. Ganesh Hall West Parking (view from above)	35
Picture 52. Panorama view of Ganesh Hall West Parking	35
Picture 53. The road leading to Ganesh Hall West Parking.....	36
Picture 54. Parking navigation sign next to Ganesh Hall West Parking	36
Picture 55. Ganesh Hall West Parking	36
Picture 56. End of street next to Ganesh Hall West Parking (on the right)	36
Picture 57. Location of Kamalnagar Truck Parking	37
Picture 58. Kamalnagar Truck Parking structure	37
Picture 59. Panorama view of Kamalnagar Truck Parking.....	38
Picture 60. Entrance to the Kamalnagar Truck Parking area from the main road	38
Picture 61. Kamalnagar Truck Parking area as seen from the entry point.....	38
Picture 62. Kamalnagar Truck Parking as seen from the back	38
Picture 63. The unused area behind the Kamalnagar Truck Parking.....	38

Picture 64. Nepal Mahendra Highway	39
Picture 65. Mahendra Highway in Bharatpur	39
Picture 66. Bharatpur Airport parking as seen from above.....	41
Picture 67. Bharatpur Airport parking scheme	42
Picture 68. Examples of Control Center system for parking managers	45

1. INTRODUCTION

1.1. Project background

WeGO – established by 50 founding members in 2010 – is an international association for cities, local and regional governments, smart tech solution providers, national and regional organizations that are concerned with and committed to the transformation of cities into smart sustainable communities. WeGO is run by the Secretariat based in Seoul and is supported by regional offices in East Asia (Chengdu, China), Eurasia (Ulyanovsk Region, Russia), the Mediterranean (Beyoğlu, Turkey) and Latin America (Mexico City, Mexico). WeGO has more than 150 members around the world and serves as their international platform to improve quality of life, innovate delivery of public services and strengthen regional competitiveness.

WeGO carries out a broad range of activities worldwide that include facilitating knowledge sharing, capacity building, action-oriented cooperation and cross-stakeholder partnerships toward urban sustainability. WeGO also provides free consultation services to WeGO members through its annual Feasibility Study (FS) project on smart city and e-government issues. This technical assistance project is designed to help cities around the world address most pressing challenges in various smart city areas and advance in their transformation into smarter and more sustainable cities. Within the FS program, WeGO annually selects 1 – 2 WeGO member cities on a competitive basis.

2019 WeGO FS theme is “Generating Actionable Data for Smarter Cities” and it prioritizes areas of mobility and public safety. A total of 14 submissions were received, representing innovative initiatives across Asia, Africa, Europe and South America. WeGO has selected Kampala Capital City Authority (KCCA) of the Republic of Uganda as the beneficiary local government for the Smart Sustainable City Feasibility Study 2019. Bharatpur Metropolitan Government of the Federal Democratic Republic of Nepal was selected as a second beneficiary for a smaller-scale analysis due to the city’s overlapping project proposal and prospect for replicability. The projects in both cities focus on analysing the feasibility of introducing smart parking technologies into everyday life.

1.2. Project organization structure

The main parties involved in the 2019 WeGO FS project are World Smart Sustainable Cities Organization (WeGO), Bharatpur Metropolitan Government (BMG) and SRPOST Co., LTD (SRPOST). The project participants are outlined in the table below.

Table 1. 2019 WeGO FS project organization structure




SRPOST FS Team PM: Mr. Nangyu Kim	WeGO FS Team PM: Ms. Alexandra Sidorova	BMG FS Team PM: Ms. Menaka Pandit
		

Table 2. 2019 WeGO FS project participants

Org	Full name	Position	E-mail
BMG	Ms. Menaka Pandit	Information Officer	menakapandit@gmail.com
	Mr. Pradyumna Prasad Upadhyay	Under Secretary (Chief Administrative Officer)	pradyumna7@gmail.com
	Mr. Kul Bahadur G.C.	Under Secretary (General Administration Division)	curiouskb@yahoo.com
	Mr. Anuj Ghimise	Revenue Officer	anujdeepghimise@gmail.com
	Mr. Ashim Regmi	Officer (7 th level)	ashim.regmi@nepal.gov.np
WeGO	Ms. Alexandra Sidorova	Senior Program Officer	alexandra@we-gov.org
	Ms. Eunbyul Cho	Program Manager	eunbyul@we-gov.org
SRPOST	Mr. Nangyu Kim	Project Manager	robin@srpost.co.kr
	Ms. Anastassia Brehhunova	Principal consultant	ana@srpost.co.kr
	Ms. Jiwon Nam	Principal consultant	lima@srpost.co.kr
	Ms. Hyejoo Kim	Research & Study Manager	hayley@srpost.co.kr
	Mr. Yongdon Cho	Principal consultant (Winner Tech)	tosung@hanmail.net

1.3. Project objectives and expected outcomes

Project objectives and expected outcomes are as follows:

Table 3. WeGO project objectives and expected outcomes

No	Objectives	Expected outcomes
1	To foster BMG's commitment to addressing public parking issues in an inclusive, smart and sustainable manner	Increased commitment of BMG toward addressing public parking issues
3	To facilitate a positive impact of the FS project on the Bharatpur society and the quality of life of its citizens	Improved public parking experience and safer a safer parking environment
5	To examine all major public on-street and off-street public parking facilities in Bharatpur and create a parking lot introductory guide	Comprehensive on-site inspection of all major on-street and off-street public parking facilities in Bharatpur
6	To assess the overall parking environment in the city and identify challenges facing parking management in the area	Increased understanding of overall parking environment in Bharatpur
7	To understand what government parking policies and strategies are integral to transitioning to smart parking, if and how they need to be modified in order to cope with future parking demand	Enhanced understanding of transportation policies of the Federal Democratic Republic of Nepal
9	To understand whether it is feasible to develop and implement a Smart Parking System that includes a smart parking mobile app for citizens and a management system for BMG officials to monitor and manage the public parking spaces	Enhanced understanding of economic and technical feasibility of implementing a comprehensive Smart Parking System in Bharatpur
11	To estimate the implementation costs and assess whether the future project can be funded from BMG budget or needs to attract external investment	Increased understanding of Smart Parking implementation costs
12	To recommend new strategies to solve parking challenges in Bharatpur	Comprehensive analysis of all parking-related rules and regulations, outlining of possible strategies to solve parking challenges in Bharatpur
13	To promote intragovernmental cooperation between the Republic of Korea and Federal Democratic Republic of Nepal, BMG and SMG; Korean and Nepali private enterprises	Strengthened international cooperation between Korean and Nepali governments, organizations and private enterprises

1.4. Project outputs

The main output of the 2019 WeGO Supplementary FS is the Supplementary Report “Feasibility Study on Smart Parking in Bharatpur Metropolitan City”. The FS for Bharatpur Metropolitan Government does not envision a Smart Parking pilot project development and implementation.

1.5. Project implementation schedule

The project spanned over the period of four months between September 17, 2019 and January 17, 2020. All the tasks required for the implementation of the FS project are outlined according to the project implementation phase in the figure below.

Table 4. 2019 WeGO FS project implementation schedule

No	Phase	Task	Project schedule									
			Sep		Oct		Nov		Dec		Jan	
1	Project initiation	Project planning										
		PID composition										
		Project launch										
2	Environment analysis	Macroeconomic analysis										
		Transportation analysis										
		Vehicle type analysis										
		Vehicle license plate analysis										
3	On-site inspection	Official visit										
4	Project finalization	Final report ENG										

1.6. Project methodology

The study utilized the following three analysis methods to collect and examine data: As-Is status analysis, SWOT analysis and To-Be model analysis.

1) *As-Is status analysis*

As-Is analysis focused on understanding the current state of parking affairs in Bharatpur by identifying the overall position of parking management in Nepal's transportation ecosystem, identifying parking management stakeholders, differentiating between public and private parking, analyzing the most prominent public on-street and off-street parking facilities in Bharatpur, parking fees as well as conducting research on Nepali vehicle number plates.

2) *SWOT analysis*

SWOT analysis is a strategic planning technique that was used to help the FS team to identify main internal (strengths and weaknesses) and external (opportunities and threats) factors that define the current parking environment in Bharatpur based on the beneficiary government's environment and As-Is analysis.

3) *To-Be model development*

In order to identify the right direction for the To-Be model proposal, the FS team considered what do we really want this model to achieve for BMG and Bharatpur, what we don't want it to achieve and what assets the city possesses currently that will contribute to the model development process. The proposed To-Be model is expected to ideally meet the needs of Bharatpur vehicle drivers, municipal authorities and local residents.

2. PROJECT BENEFICIARY PROFILE

2.1. General overview

2.1.1. Federal Republic of Nepal

Nepal, the landlocked multi-ethnic, multilingual, multi-religious country, is situated north of India in the Himalayas, in the region where, about 40 to 50 million years ago, the Indian subcontinent has crashed into Asia. Because of that accident, Nepal has some of the world's highest mountains. The altitude of the Himalayan Region (the highland) ranges between 4877 m - 8848 m. It includes 8 of the highest 14 summits in the world, which exceed altitude of 8000 meters including Mount Everest. The mountain region accounts for about 64 percent of total land area, which is formed by the Mahabharat range that soars up to 4877 m and the lower Churia range. The lowland Terai, the flat river plain of the Ganges with a belt of marshy grasslands, savannas, and forests, occupies about 17 percent of the total land area of the country.



Picture 1. Map of Nepal

Table 5. Nepal profile (Central Intelligence Agency data)

Fact	Details
Name	Federal Democratic Republic of Nepal (Short name: Nepal)
Government	Federal Parliamentary Republic
Legal system	Mixed legal system of English common law and Hindu customary law; note - new criminal and civil codes came into effect on 17 August 2018
Capital	Kathmandu
Area	Total: 147,181 sq. km Land: 143,351 sq. km Water: 3,830 sq. km
Land boundaries	Total: 3,159 km Border countries (2): China 1389 km, India 1770 km
Coastline	Landlocked; strategic location between China and India; contains eight of world's 10 highest peaks, including Mount Everest and Kanchenjunga - the world's tallest and third tallest mountains - on the borders with China and India respectively
Population	30,327,877 (July 2020 est.)
Population growth rate	1.1% (2017), 0.98% (2020 est.)
Urbanization	Urban population: 20.6% of total population (2020) Rate of urbanization: 3.15% annual rate of change (2015-20 est.)
Nationality	Nepali (singular and plural)
Ethnic groups	Chhettri 16.6%, Brahman-Hill 12.2%, Magar 7.1%, Tharu 6.6%, Tamang 5.8%, Newar 5%, Kami 4.8%, Muslim 4.4%, Yadav 4%, Rai 2.3%, Gurung 2%, Damai/Dholii 1.8%, Thakuri 1.6%, Limbu 1.5%, Sarki 1.4%, Teli 1.4%, Chamar/Harijan/Ram 1.3%, Koiri/Kushwaha 1.2%, other 19% (2011 est.)
Languages	Nepali (official) 44.6%, Maithali 11.7%, Bhojpuri 6%, Tharu 5.8%, Tamang 5.1%, Newar 3.2%, Bajjika 3%, Magar 3%, Doteli 3%, Urdu 2.6%, Avadhi 1.9%, Limbu 1.3%, Gurung 1.2%, Baitadeli 1%, other 6.4%, unspecified 0.2% (2011 est.)
Religions	Hindu 81.3%, Buddhist 9%, Muslim 4.4%, Kirant 3.1%, Christian 1.4%, other 0.5%, unspecified 0.2% (2011 est.)

Currency	Nepalese rupee Rs (Nepali: ₹) (NPR)
GDP (PPP)	\$84 billion (2018 est.) \$79.19 billion (2017 est.) \$73.39 billion (2016 est.) \$72.96 billion (2015 est.)
GDP per capita (PPP)	\$2,842 (2018 est.) \$2,700 (2017 est.) \$2,500 (2016 est.) \$2,500 (2015 est.)
Temperature	Nepal has five climatic zones, broadly corresponding to the altitudes. The tropical and subtropical zones lie below 1,200 meters, the temperate zone 1,200 to 2,400 meters, the cold zone 2,400 to 3,600 meters, the subarctic zone 3,600 to 4,400 meters, and the Arctic zone above 4,400 meters. Nepal experiences five seasons: summer, monsoon, autumn, winter and spring. The Himalayas block cold winds from Central Asia in the winter and form the northern limits of the monsoon wind patterns
Precipitation	The average annual rainfall is 1,600 mm, but it varies by eco-climatic zones, such as 3,345 mm in Pokhara and below 300 mm in Mustang.
Land use	Agricultural land: 28.8% (2011 est.) Arable land: 15.1% (2011 est.) / permanent crops: 1.2% (2011 est.) / permanent pasture: 12.5% (2011 est.) Forest: 25.4% (2011 est.) Other: 45.8% (2011 est.)
Irrigated land	13,320 sq. km (2012)
Renewable water resources	237 km ³ /year (225 km ³ /year for surface sources and 12 km ³ /year for groundwater sources)
Natural resources	Quartz, water, timber, hydropower, scenic beauty, small deposits of lignite, copper, cobalt, iron ore
Current environmental issues	Deforestation (overuse of wood for fuel and lack of alternatives); forest degradation; soil erosion; contaminated water (with human and animal wastes, agricultural runoff, and industrial effluents); unmanaged solid-waste; wildlife conservation; vehicular emissions

2.1.2. Bharatpur Metropolitan City

Bharatpur is a city in the central-southern part of Nepal. Located in Chitwan District, Bharatpur is the district headquarter of the Chitwan District, as well as a separate Metropolitan authority, and is the fifth largest city of Nepal with the population of 199,867 (census 2011). Bharatpur is one of the fast-growing cities of Nepal. It lies on the left bank of Narayani River and serves as a commercial centre of Chitwan district and central region of Nepal. It is located at the centre of Mahendra Highway and Kathmandu - Birganj (North-South) road corridor.



Picture 2. Location of Bharatpur

2.1.3. Bharatpur Metropolitan Government

It is important to understand the administrative structure of Nepal and organizational structure of Bharatpur Metropolitan Government (BMG) in order to understand transportation and physical infrastructure (roads and parking) management. There are four levels of administrative divisions of Nepal (organized by priority):

1. The Government of Nepal;

2. 7 provinces;
3. 77 districts;
4. 6 metropolitan cities + 11 sub-metropolitan cities + 276 municipalities + 460 rural municipalities.

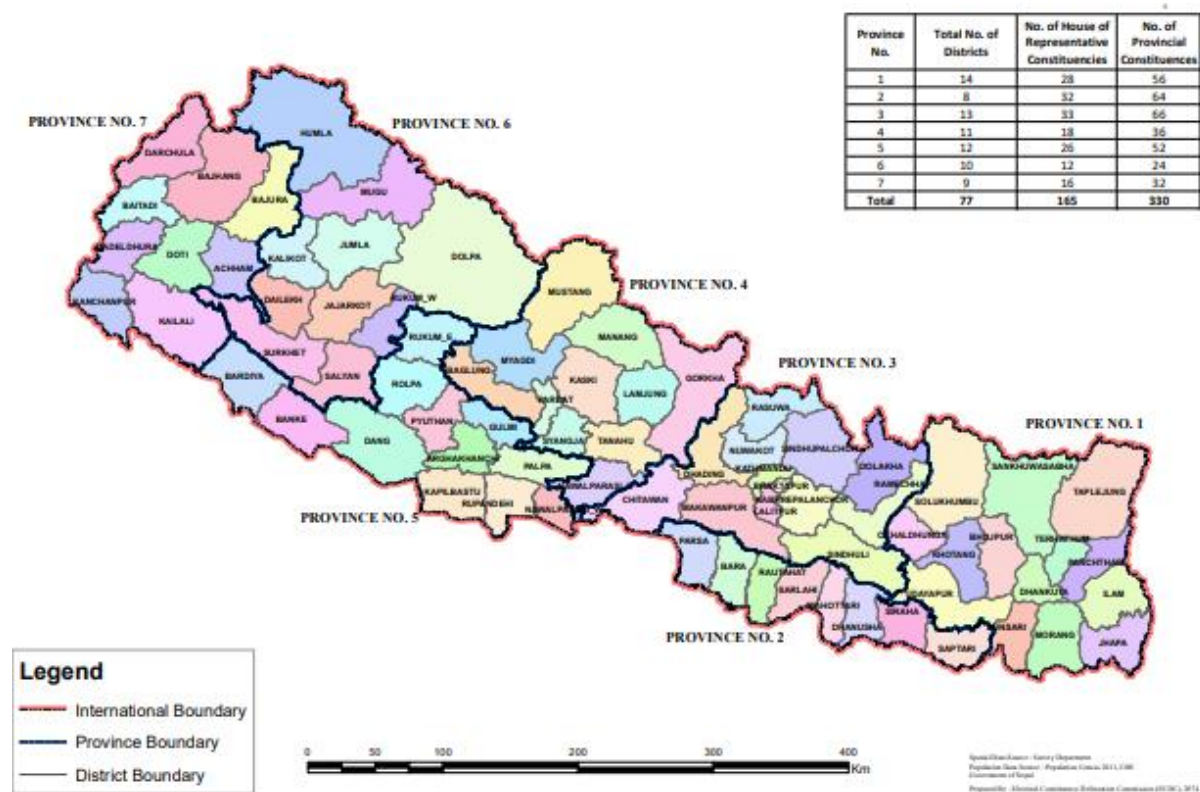


Table 6. Provincial map of Nepal

Bharatpur Metropolitan City is one of the six metropolitan cities. It is located in Chitwan District, Province No. 3. Organizational structure of BMG is as follows (organized by priority):

1. City Assembly;
2. Municipal Executive Meeting;
3. Mayor (Deputy Mayor);
4. Chief Administrative Officer (Gazzated First Class Officer);
5. 10 Department Heads (Gazzated Second Class Officer);
6. 26 Section Heads (Gazzated Third Class Officer).

The city assembly is the main body of the BMG. It is comprised from 5 members from each ward (overall 145 members from 29 wards) plus Mayor, Deputy Mayor Chief Administrative

Officer performing the member secretary duties – a total of 148 members. The City Assembly is held twice a year – in June and December.

The Municipal Executive Meeting is comprised from 40 members – Mayor, Deputy Mayor, 29 ward chairmen, 8 members elected from city assembly and 1 Chief Administrative Officer. The Meeting is held every month within the first week of the start of Nepal Month. The Bharatpur Metropolitan City Mayor is elected directly from Bharatpur citizens. The current mayor is Mrs. Renu Dahal (as of Nov 2019). The current Deputy Mayor position Mrs. Parvati shah Thakuri.

The bureaucratic setup is headed by Chief Administrative Officer (Gazzated First Class Officer). He leads a group of ten Gazzated Second Class Officers who in turn head ten BMG departments. These departments are as follows:

1. Department of General Administration;
2. Department of Revenue Management;
3. Department of City Infrastructure Development;
4. Department of Health and Social Department;
5. Department of Planning and Information;
6. Department of Financial Administration;
7. Department of Education Administration;
8. Department of Economic Growth;
9. Department of Environment and Disaster Management;
10. Department of Governance Management.

These departments themselves are headed by Under-Secretary (Gazzated 2nd Class Officer). There are around 26-30 sections in the departments, each is headed by the Section Officer.

The official website of BMG is <http://bharatpurmun.gov.np/en>.

2.2. ICT development analysis

The Ministry of Information and Communications (MIC) is responsible for ICT sector policy in Nepal. The Nepal Telecommunications Authority (NTA), established in 1998, is responsible for sector regulation. The relevant legislation is the Telecommunications Act, 1997. The Ten-Year Master Development Plan (2011 – 2020 A.D.) for telecommunications outlines programs for achieving key objectives including making basic telecommunication services available within "shouting distance"; providing on-demand telecommunications services in urban areas and for manufacturing and commercial enterprises; ensuring that urban consumers have the opportunity to use services from different service providers, which shall be gradually extended to rural subscribers; and enhancing network capability to support efficient utilization of ICT for improving the quality of life of the Nepalese. The National Broadband Policy of 2015 outlines the government's vision for affordable, secure, reliable and ubiquitous high-speed Internet. It sets several targets for 2018, including a broadband penetration rate of 30 per cent at a minimum of 512 kbps and a download speed of at least 10 Mbps on demand in urban areas.

There has been relatively little change in the ICT Development Index (IDI) rankings for most world economies between 2016 and 2017. Overall ICT indices for Nepal remain relatively low due to the poor information infrastructure and low levels of Internet penetration in the country. Furthermore, Nepal displayed a negative growth during the 2016-2017 period, dropping one place in the global rankings.

Table 7. ICT Development Index (IDI), 2016-2017¹

	2017	2016
IDI Value	2.88	2.60
IDI Rank, Global	140	139
IDI Rank, Regional	28	-

Each year Nepal Ministry of Communication and Information Technology publishes a comprehensive report on the readiness and development strategies of information and communication technologies (ICT) in Nepal. The latest report was published in 2019 under the name of “2019 DIGITAL NEPAL FRAMEWORK: Unlocking Nepal's Growth Potential”.²

¹ Source: International Telecommunication Union (ITU) <http://www.itu.int/>

² The information contained in this report can be accessed via the Data Tab of the Nepal in Data Portal by selecting the section Infrastructure, Communication & Technology. This publication is in English and is published in pdf format.

According to the 2019 “DIGITAL NEPAL FRAMEWORK: Unlocking Nepal's Growth Potential” report, over the last years Nepal has enjoyed incredible success in digital adoption compared to its neighbours, with mobile penetration exceeding 100% and Internet penetration reaching 63%. There was an addition of 2.25 million new Internet users in 2017 alone, translating into approximately 250 new Internet users every hour. The growing popularity of social media is a crucial driver for Internet adoption in Nepal, after Bhutan in South Asia. As of January 2018, Nepal had nearly 9.3 million Facebook users. Entertainment and video sharing are other popular use cases with more than 6.4 million registered users on YouTube. Bharatpur Metropolitan Government officials have also confirmed that Bharatpur citizens predominantly use smartphones in their daily lives and mobile network coverage provides for a good and stable 3G connection.

There are three main mobile operators in Nepal. They include the incumbent, state-owned Nepal Doorsanchar Company Limited (NDCL); NCELL, a subsidiary of the Malaysian AXIATA mobile group; and Smart Telecom Private Limited (STPL), a local company. In addition, United Telecom has recently got an approval to run mobile service. Despite the difficulty of expanding coverage in the mountainous country, 91% of all households had a mobile phone. Mobile Internet is increasingly popular since the deployment of 3G in 2010. NDCL launched LTE in early 2017 and the other two operators are waiting for regulatory approval to launch LTE.

NDCL dominates the fixed telephone market. Four other companies also provide fixed telephone services using VSAT or Wireless Local Loop (WLL) technologies. Fixed telephone penetration is low owing to its limited coverage and the popularity of mobile. There are a number of ISPs. Fixed broadband (ADSL, cable modem, fiber/LAN) accounted for 64 per cent of subscriptions in 2016, with fixed wireless (CDMA EVDO, WiMAX and VSAT) making up the remainder. Construction of Nepal's national fiber-optic backbone commenced in 2002. The network is largely constructed alongside highways and also uses optical fiber from the Nepal Electric Authority. Links to more remote areas are achieved using microwave and satellite systems. As a landlocked nation, Nepal is reliant on neighboring India for access to submarine cables. There are several cross-border fiber-optic links. The Nepal Internet Exchange was established in 2002 and has over thirty participants.

Overall, despite being a landlocked country with a challenging geography, Nepal has achieved a respectable level of access to mobile technologies, which has been driven by a competitive market and by the Government's efforts to improve connectivity and strengthen the ICT sector.

2.3. Smart City analysis

The Government of Nepal introduced the concept of 'Smart City' for the first time in 2012, only 22 years after other mega-cities in the world embraced it. Currently, the Government is gearing up transform Kathmandu into its first environmentally friendly, and socially and economically smart city. Kathmandu Metropolitan City (KMC) has announced ambitious plans to develop Kathmandu as a smart city with all amenities and services of international standard. Besides other things, the Smart City transition program includes management of parking facilities, introduction of e-toilets, hi-tech fire engines, installation of technology-based billboards, mobile app to handle complaints and grievances of service-seekers, etc.³

The Kathmandu Valley Development Authority (KVDA) plans to transform the existing urban space into four smart cities and is working extensively to this end. The smart cities land areas are being named after the directions used in ancient building construction popularly called Vastu Shastra-Agneya, Ishaan, Nairitya and Uttar. The blueprint for developing the Kathmandu-based smart cities is completed and the authority is waiting on the Detailed Project Report (DPR). Kathmandu is not the only Nepali city that will be transformed into smart cities, a similar DPR for building a smart city in Bhaktapur was prepared last year. Besides, the DPR for the two other cities has also been completed in the first month of the current financial year. According to KVDA Commissioner Bhaikaji Tiwari, once the DPR for the Kathmandu smart cities is also submitted, then a Project Management Committee will be formed to start groundwork.⁴

The Ministry of Urban Development of the Government of Nepal pointed out the following issues standing in the way of Smart City implementation in Nepal:

1. Centralized decision on making smart cities;

³ "Journey Towards Smart City", *The Rising Nepal*. February 4, 2020.
<http://therisingnepal.org.np/news/19609>

⁴ "Nepal Urbanization: Kathmandu Valley to Have Four Smart Cities!", *Nepali Sansar*, August 26, 2019.
<https://www.nepalisansar.com/tourism/nepal-urbanization-kathmandu-valley-to-have-four-smart-cities/>

2. No public opinion collected;
3. Not a citizen-centric approach overall;
4. No study on level and conditions of infrastructure and population density;
5. Lack of knowledge and large-scale investment for initiation of smart city projects;
6. Need for the implementation of a pilot project as a test before venturing into establishment of multiple smart cities.⁵

In case of Bharatpur, Bharatpur Metropolitan Government does not yet have clear Smart City development goals outlined. However, the involved teams are working hard on compiling a comprehensive Master Plan that will envision Smart City development in Bharatpur. Currently (as of Nov 2019), 50% of the Master Plan is completed and the final version is expected to be delivered in 2020. Bharatpur Metropolitan City considers the lack of awareness about Smart Parking concept its biggest challenge in transition to Smart Parking. However, the city officials recognize that Smart Parking systems implementation should be broken down to smaller phases to ensure seamless introduction of such new and innovative technologies.

⁵ Government of Nepal, Ministry of Urban Development, Department of Urban Development and Building Construction. 2017. *Smart City In Nepal: Concept And Indicators*.
https://www.academia.edu/33684114/SMART_CITY_IN_NEPAL_CONCEPT_AND_INDICATORS

3. AS-IS ANALYSIS

3.1. Transportation management stakeholders

There is neither a separate department of transportation nor traffic control center in Bharatpur Metropolitan City Government as of yet. However, the officials are very open to the idea of expanding their services and creating an additional department that would handle the city transportation and parking affairs. At present, transportation-related affairs are handled by the Department of Revenue Management, Department of City Infrastructure Development, and Department of Planning and Information.

Bharatpur city transport is officially under the jurisdiction of Bharatpur Police. There is a separate Department of Traffic within the Police office (known as the Traffic Police) that manages the traffic in the city. There are around 100 CCTV cameras installed in Bharatpur that fall under the jurisdiction of the police. The cameras monitor the city environment 24/7.

3.2. Parking management stakeholders

There is no parking management division at present in Bharatpur Metropolitan Government. All transportation related affairs are also handled by the Department of Revenue Management, Department of City Infrastructure Development, and Department of Planning and Information.

Bharatpur Metropolitan City is excited about Smart Parking development prospects and is open to tendering and outsourcing parking management roles and responsibilities in Bharatpur to an expert company.

3.3. Vehicle types, registration and license plate types

3.3.1. Vehicle types

For the purpose of vehicle registration Vehicle & Transport Management Act, 2049 (1992) and Vehicle & Transport Management Rule, 2054 (1997) of Nepal, classifies vehicles on the basis of size and capacity into the following 5 main categories:

1. *Heavy and medium-sized vehicle*: This includes bus, truck, dozer, dumper, loader, crane, Fire engine, tanker, roller, pick-up, van, mini bus, mini truck, minivan etc. having the capacity to carry more than 14 people (for passenger vehicle) or more than 4 tons (for cargo vehicle).
2. *Light vehicle*: This includes car, jeep, van, pick-up, micro bus etc. having the capacity to carry less than 24 people or less than 4 tons.
3. *Two-wheeler*: This includes vehicle having two wheels like motor cycle, scooter etc.
4. *Tractor and power-trailer*
5. *Three-wheeler*: This includes vehicle having three wheels like tempo, auto-rickshaw etc.

The above-mentioned categories are further divided into 6 sub-categories on the basis of ownership and service-type as follows:

1. *Private vehicle*: Vehicles which are for entirely personal purpose uses red license plates with white letters.
2. *Public vehicle*: Vehicles which are for public transport purpose uses black license plates with white letters.
3. *Government vehicle*: Vehicles owned by government agencies and constitutional bodies such as ministries, departments, directorates, along with the police, military, etc., falls under this category which uses white plates with red letters.
4. *National Corporation vehicle (Nepal Telecom, Dairy Development Corporation, Nepal Electricity Authority etc.)*: Vehicles which are registered under the name of public corporations that are fully or partially owned by the government fall under this category. These vehicles use yellow plates with blue letters.
5. *Tourist vehicle*: Vehicles which are registered for tourist transport uses green license plates with white letters.

3.3.2. Vehicle registration

Vehicle registration process in Nepal is outlined in the Motor Vehicles and Transport Management Rules, 2054 (1997) as follows:

1. An application must be made to the Office with which the applicant intends to register the motor vehicle. All necessary documentation should be attached to the application form (online application is also possible, but credible confirmation is necessary).

2. The Office shall exam the submitted documentation, register the motor vehicle in the motor vehicle register and issue the registration certificate to the applicant.
3. The Office shall issue a number plate

The following documents are required when applying for vehicle registration:

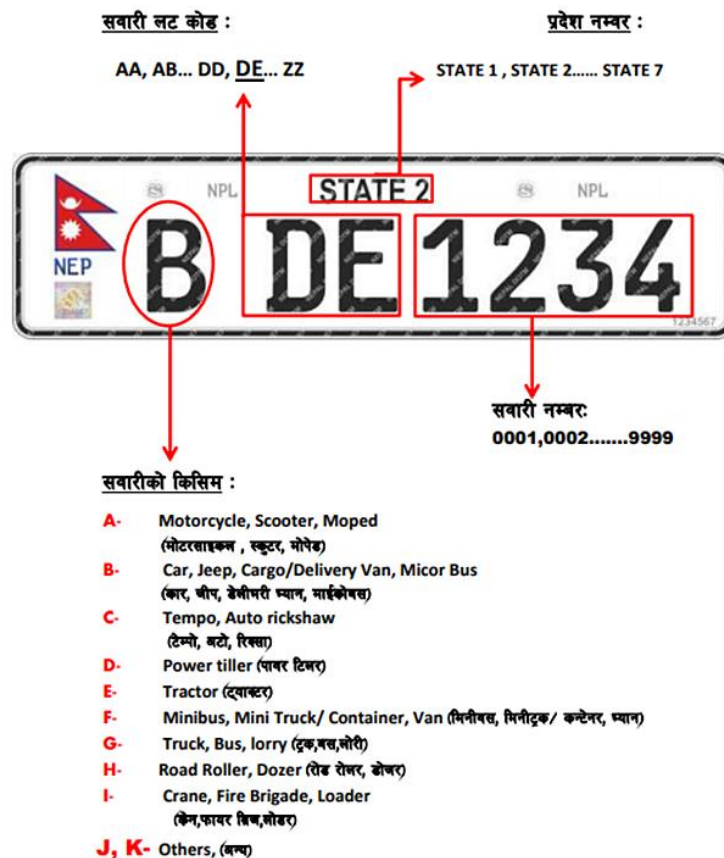
1. Vehicle registration form;
2. Vehicle purchase evidence;
3. A certified copy of the certificate of citizenship of Nepal;
4. Three recent passport photos;
5. In the case when the owner of motor vehicle is not the applying person - the letter of authorization;
6. In the case when the vehicle is imported from abroad and is registered abroad - copy of the registration certificate;
7. In the case of a governmental motor vehicle - a letter from the governmental office in whose name the motor vehicle is going to be registered;
8. In the case of a diplomatic vehicle - a recommendation letter from the Ministry of Foreign Affairs, the Government of Nepal;
9. In case the vehicle is to be registered in the name of any person - a copy of his/her passport or citizenship + three passport size photos;
10. In case the vehicle is registered by a foreign citizen who carries out business and transactions within the Federal Democratic Republic of Nepal - a recommendation letter of the concerned diplomatic mission;
11. In case the vehicle is to be registered in the name of a minor – his/her guardian shall make apply in his/her stead + three passport size photos (both guardian and minor) + certified copy of citizenship.

3.3.3. License plate types

In Nepal, all road vehicles with or without a motor (except bicycles) are subject to registration number. License plates are commonly known as number plates in Nepal. The license plate number is issued by the state-level Transport Management Office, a government agency under the Department of Transport Management at the Ministry of Physical Infrastructure and Transport (homepage: <https://dotm.gov.np/en>). The license plates must be placed in the front as well as back of the vehicle. The international vehicle registration code for Nepal is NEP.

A new format was introduced on 21 August 2017. During the first introduction phase, the modern license plates were installed in government-owned vehicles. Since then, the plates have been installed in more than 4,600 vehicles plying on the roads of Kathmandu valley. This format consists from L LL NNNN where:

1. L is the category of vehicle,
2. LL is a "counter" comprising two letters, which increments after the sequence number reaches 9999.
3. NNNN is a sequence number from 0001 to 9999.



Picture 3. New Nepalese license plates

These new plates come with a RFID microchip that enables the government to maintain uniformity in issuance of number plates and prevent duplication. Similarly, the new number plates also help authorities to maintain digital records of vehicles plying on the roads, collect revenue on time and control auto theft.

All vehicles in Bharatpur still use the previous license plate system. The previous Nepalese license plate format consisted from four parts composed of letters (L) and numbers (N) in the LL NN LL NNNN format:

1. The first part stands for the zonal code (zone where the vehicle is registered).
2. The second part is the set number which is prefixed when the four-digit number runs out from the last part.
3. The third part indicate the type of vehicle (i.e. private, public, government, national corporation, tourist etc.) as well as the class of vehicle (i.e. two-wheeler, light vehicle, heavy and medium-sized vehicle etc).
4. The four digits in the bottom part are the vehicle ID numbers.



Picture 4. Previous Nepalese license plates



Picture 5. Bharatpur City government vehicle (white plate with red numbers& letters)



Picture 6. Bharatpur public vehicle (black license plate with white numbers & letters)

3.4. Driving license application process

Driving license application process can be summarized as follows:

1. First, citizen has to fill in the online form on the Department of Transport Management website. After submitting the form, citizen is redirected to a verification page along with time (there are cases when the portal server is down due to heavy traffic and you have to wait until the server is up).

The screenshot shows the 'Driving License' application page of the Government of Nepal's Department of Transport Management. The page header includes the national emblem and the text 'NEPAL ELECTRONIC DRIVING LICENSE AND VEHICLE REGISTRATION SYSTEM'. The form is divided into several sections:

- Personal Information:** Includes fields for Blood Group, Citizenship No., Passport No., Identity Mark, Witness First Name, Witness Last Name, and Trainer Name.
- Citizenship Details:** Includes dropdowns for Citizenship (set to Nepal), Citizenship Issue District, and Passport Issued Country, along with fields for Witness Middle Name, Witness Relationship, and Trainer License No.
- Address Details:** A section titled 'PERMANENT ADDRESS' with fields for Zone, Village, Tole, Mobile No., and Contact No. It also includes fields for District, Ward No., Block No., Office Contact No., and Email.

Picture 7. Electronic driving license registration page

2. Then, citizen needs to print out the confirmation page and take it along with his/her national identity card (citizenship) to the office of Department of Transport Management. The date of visit is specified on the confirmation page. The Department officials will record the details of citizen's citizenship as well as gather all biometric details. After that, the citizen is advised to take an eye examination and blood group verification test. (Eyes and blood test service is available near DOTM office).
3. Then, the citizen is asked to pay 500 NPR (4.34 USD) for the written examination. The exam typically takes place the next day at 7:00 am. In cases when citizen already possesses any driving license and is simply applying for an additional driving category, he is exempted from taking the written examination.

4. Once the citizen passes the written examination, he can attend the vehicle driving trials. The officials provide all information on the trial date and time. Motorbike trials cost 50 NPR (0.43 USD) and car trials cost 500 NPR (4.43 USD).
5. After 10 days of passing the driving trials, the citizen is required to visit the office of Department of Transport Management to pay the driving license cost 1,500 NPR (13 USD). In case of application for an additional driving license, the cost to be paid is 500 NPR (4.34 USD). Once payment is accepted and processed, the citizen receives a payment slip along with his/her license number (the slip is a temporary license). Then, the office officials inform the citizen of the license collection time.

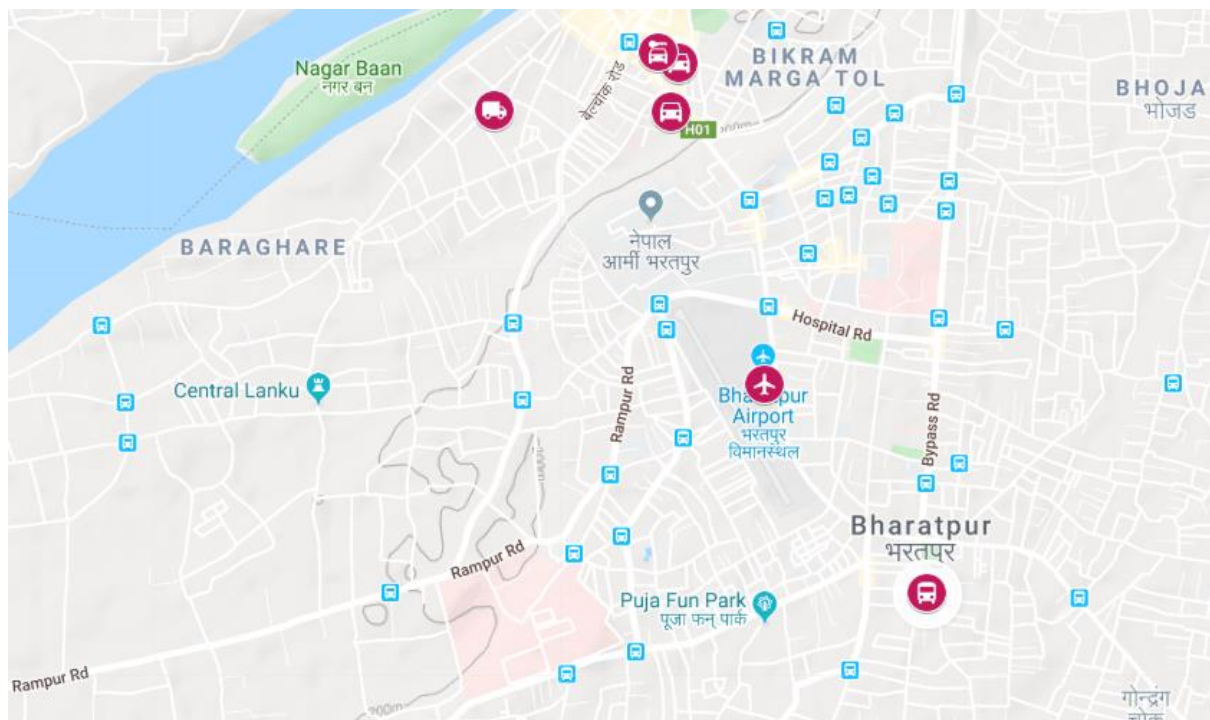
Picture 8. Driving license payment slip

6. Citizen visits the office and collects his/her driving license.

3.5. Bharatpur parking overview

The following six Bharatpur Metropolitan City parking facilities were inspected during the official visitation:

1. Bharatpur Airport Parking
2. Bharatpur Central Bus Terminal Parking
3. Lions Chowk Parking
4. Ganesh Hall East Parking
5. Ganesh Hall West Parking
6. Kamalnagar Truck Parking



Picture 9. Location of all parking facilities on the map of Bharatpur

All parking facilities display the following common features:

1. Basic infrastructure in some places (Bharatpur Airport and Central Bus Terminal), no infrastructure in some places;
2. No parking lot standards and no parking lines (some only at Bharatpur Airport);
3. Parking areas are not busy and parking process itself is not chaotic;
4. Private vehicle owners avoid using parking lots for short-term parking due to either difficult location of parking or unwillingness to park so far from the destination;

The following table gives data on ownership, ground type, infrastructure and parking structure for major Bharatpur parking lots.

No	Parking lot	Ownership	Surface type	Infrastructure level	Parking lines	Parking space size (approx. value)	Parking capacity (approx. value)	Perimeter (approx. value)	Area (approx. value)
1.	Bharatpur Airport Parking	Nepal government	All asphalt (relatively good state)	Basic infrastructure	Some for cars, none for bikes	2.40m * 4.80m	90-100 cars + 100 motorbikes	240 m	2,838 m ²
2.	Bharatpur Central Bus Terminal Parking	Bharatpur Metropolitan City	Partially asphalt (relatively bad state), partially bare ground	Basic infrastructure	None	N/A	75 buses + 20 cars + 40-50 motorbikes	810 m	31,980 m ²
3.	Lions Chowk Parking	Bharatpur Metropolitan City	Old asphalt in bad state, some concrete blocks	No infrastructure	None	N/A	32-35 cars + 50-60 motorbikes	175 m	1,817 m ²
4.	Ganesh Hall East Parking	Bharatpur Metropolitan City	Bare ground	No infrastructure	None	N/A	15 buses + 30 cars	195 m	1,784 m ²
5.	Ganesh Hall West Parking	Bharatpur Metropolitan City	Bare ground	Very basic infrastructure	None	N/A	20 cars	82 m	393 m ²
6.	Kamalnagar Truck Parking	Bharatpur Metropolitan City	Bare ground	No infrastructure	None	N/A	22 trucks	180 m	2,006 m ²

Table 8. General information on major Bharatpur parking lots

The following table gives data on parking rates in major Bharatpur parking lots. Parking rates are displayed in Nepalese Rupees (NPR). The approximate USD value is given in brackets and is calculated according to the following exchange rate: 1 NPR = 0.00872823 USD.

No	Parking lot	Vehicle type	2h parking rate	4h parking rate	1-day parking rate	1-day 1-night parking rate
1.	Bharatpur Airport Parking (operates between 8am – 5pm and collects approximately 2,400 NPR in 1 day which is 20.80 USD)	Motorcycle or two-wheeler	3 NPR (0.03 USD)	N/A	N/A	N/A
		Car/van or four/wheeler	10 – 20 NPR (depending on size) (0.08 – 0.17 USD)	N/A	N/A	N/A
2.	Bharatpur Central Bus Terminal Parking	Motorcycle or two-wheeler	N/A	N/A	N/A	N/A
		Car/van or four/wheeler	N/A	N/A	N/A	N/A
3.	Lions Chowk Parking	Motorcycle or two-wheeler	20.00 NPR (0.17 USD)	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	N/A
		Car/van or four/wheeler	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	100.00 NPR (0.87 USD)	200.00 NPR (1.75 USD)
4.	Ganesh Hall East Parking	Motorcycle or two-wheeler	20.00 NPR (0.17 USD)	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	N/A
		Car/van or four/wheeler	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	100.00 NPR (0.87 USD)	200.00 NPR (1.75 USD)
5.	Ganesh Hall West Parking	Motorcycle or two-wheeler	0.00 NPR	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	N/A
		Car/van or four/wheeler	30.00 NPR (0.26 USD)	50.00 NPR (0.44 USD)	100.00 NPR (0.87 USD)	200.00 NPR (1.75 USD)
6.	Kamalnagar Truck Parking	Truck, transport vehicle	25.00 NPR (0.22 USD)	50.00 NPR (0.44 USD)	75.00 NPR (0.65 USD)	100.00 NPR (0.87 USD)

Table 9. Parking fees for major Bharatpur parking lots

3.5.1. Bharatpur Airport Parking

Bharatpur Airport (airport code BHR) is an airport serving Bharatpur Metropolitan City, a city in the Chitwan District in Province No. 3 in Nepal. The airport is one of two airports in Bharatpur Metropolitan City, the other one being Meghauli Airport. The airport is located 1.6 km southwest of Bharatpur's city center. It is operated by the Civil Aviation Authority of Nepal and is served by all major domestic airlines of Nepal.



Picture 10. All airports of Nepal

This airport was built as part of the resettlement and malaria control program in the Chitwan Valley, with the assistance of the Government of the United States of America. The airport was built in 1958 and the first passenger flight landed at the airport on 5 March 1965. From 1981 to 1985, the airport was shut down due to political instabilities in Southern Nepal.

The airport is considered as the country's 4th busiest airport, as it is the main tourist gateway to Chitwan National Park. It consists of one departure, one operation terminal and one arrival terminal shed, with some shops available around the airport (no shops in the airport itself, only one small coffee stand). Despite its relatively small size, the airport sees a large amount of traffic on a daily basis. It is considered to be growing fast in terms of aircraft and passenger traffic: the trend for five years shows a steady growth of aircraft and passenger movements.

The airport can efficiently handle 3 ATR 42, 2 Jetstream J-41 and one beech 1900 or any other STOL aircraft. The airport resides at an elevation of 183 m above mean sea level. It has one runway, which measures 1,158 by 30 metres.



Picture 11. Bharatpur Airport map



Picture 12. Bharatpur Airport Parking area



Picture 13. Motorbike parking area at Bharatpur Airport Parking



Picture 14. Airport Parking as viewed from parking entrance (parking area for cars)



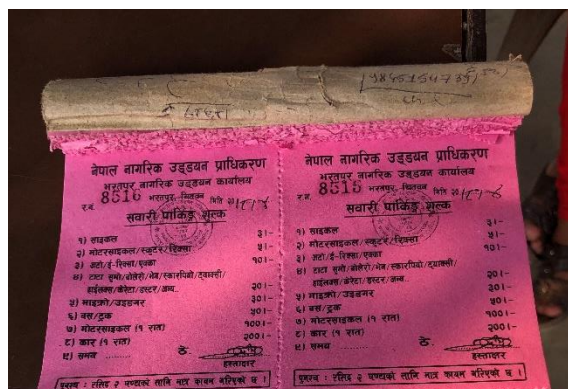
Picture 15. Car parking area at Bharatpur Airport Parking



Picture 16. Entrance to the Bharatpur Airport Parking (payment area on the right)



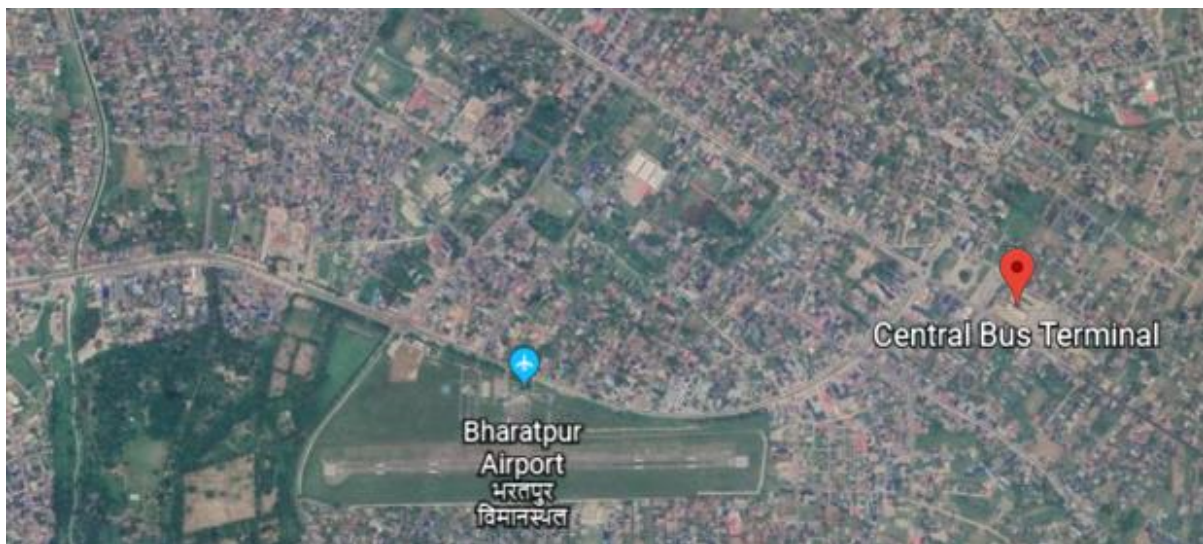
Picture 17. Parking payment area at Bharatpur Airport



Picture 18. Parking ticket at Bharatpur Airport

3.5.2. Bharatpur Central Bus Terminal Parking

Bharatpur Central Bus Terminal is located in Ward No.9 of Bharatpur Municipality. The Bus Terminal construction concept was “To build the Bus Terminal as Landmark in Bharatpur City to serve as a social platform to the Users”. The official name at the time of constructions was “Long-term Bus Parking”. The Bus Terminal covers approximately 34,000 m². The construction cost is reported to be within 110,000,000 – 1,000,000,000 NPR (957,264 – 8,702,147 USD). Construction was funded by the ADB, Urban Environmental Improvement Project (UEIP) and Town Development Fund (TDF). The Central Bus Terminal is an important transportation point, located mid of east-west highway and is often called the Central Bus Terminal of Nepal.



Picture 19. Bharatpur Central Bus Terminal location

Central Bus Terminal has Arrival and Departure berths for 18 buses and 10 microbuses. The terminal building in the middle is a 2-storied building, which consists of a framed structure with a clock in front as well as light weight space frame made of tubular steel in the roof. Door and window structures are aluminum.

The Terminal ground floor consists of entrance lobby, reception/display board, waiting hall, ticket counter, first aid, clinic, kiosks, locker room, control room, security office, area for drinking water. A small restaurant is located on the second floor.

The parking area is a concrete block with sand cushion, asphalt in the short-term waiting area. The rainwater drainage system is also reportedly in place.

The following challenges were reported during the construction of the Central Bus Terminal:

1. Lack of financial resources for construction;
2. Trip maker/passenger's mode of behavior;
3. Intervention in parking alongside highway and other arterial roads.⁶



Picture 20. Bharatpur Central Bus Terminal structure

Bharatpur Central Bus Terminal is divided into four large areas as follows (as marked on the map above):

1. Short-term waiting area where buses wait for passenger boarding. The area belongs to and is controlled by the Bharatpur Metropolitan City;
2. Long-term parking area for buses. The area belongs to and is controlled by the Bharatpur Metropolitan City;
3. Closed area, probably area for broken down buses or buses in maintenance. The area belongs to and is controlled by the Bharatpur Metropolitan City;
4. Short-term parking area for buses waiting overnight for their trip next morning. This area is officially under jurisdiction of Bharatpur Metropolitan City; however, no one is managing this area at present. When measuring the Central Bus Terminal area, this short-term parking area was excluded. The area perimeter is 480 meters and covers 14,120 m².

Implementation of Smart Parking in Bharatpur Central Terminal is not advised during the pilot project implementation stage due to the size of the terminal. However, in long-run, the Terminal is considered a promising spot for Smart Parking system implementation.

⁶ The following information is based on the presentation of Narayan Prasad Sapkota - Mayor/Executive Officer of Bharatpur Municipality at 2013 CITYNET Seoul Congress November 3-6, 2013.
<https://citynet-ap.org/wp-content/uploads/2013/11/Bharatpur-City-Best-Practice-Briefing.pdf>



Picture 21. Short-term waiting area (view from entrance)



Picture 22. Short-term waiting area (view from the back)



Picture 23. Long-term waiting area for buses



Picture 24. Buses parked in the long-term waiting area



Picture 25. Unsupervised bus parking area



Picture 26. Unsupervised bus parking area



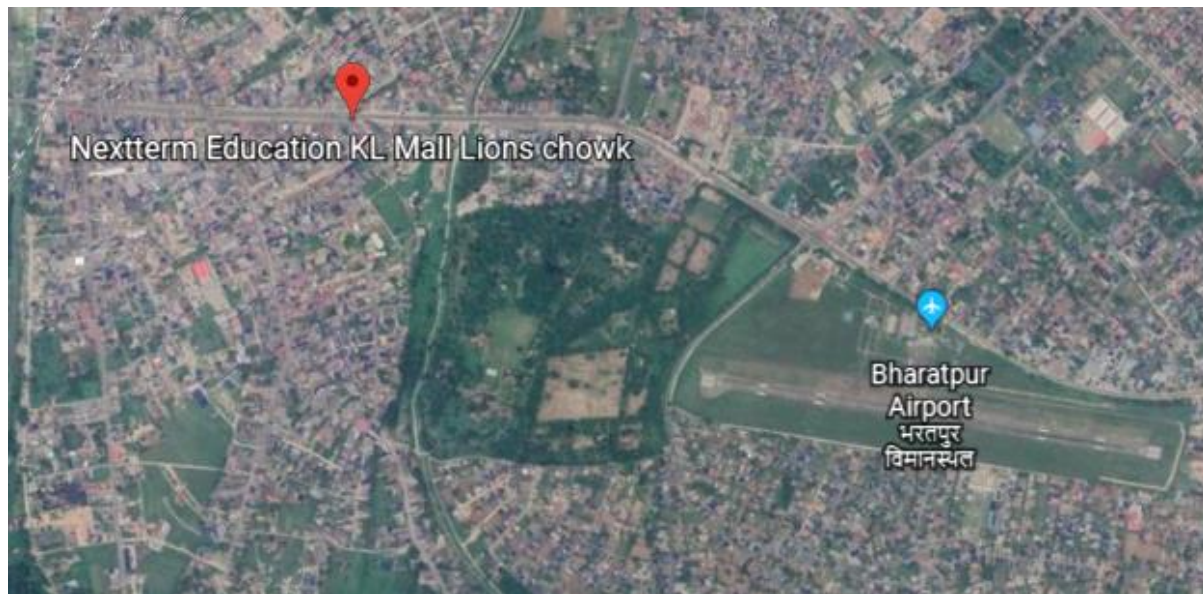
Picture 27. Nepalese bus (front)



Picture 28. Nepalese buses (back)

3.5.3. Lions Chowk Parking

Lions Chowk Parking area is the main parking area designated for the Lions Chowk fruits and vegetables market. The parking area, however, remains largely unused since customers prefer to park right in front of the shop they plan to visit. Thus, the parking lot is practically abandoned and not well-managed. The surface of the parking is decaying asphalt and ground. Cars are parked along the buildings surrounding the parking lot. The center of the parking lot is an elevated ground, which probably was an elevation for a previously demolished building.



Picture 29. Location of Lions Chowk Parking



Picture 30. Lions Chowk Parking area



Picture 31. Lions Chowk Parking (view from entrance)



Picture 32. Lions Chowk Parking (view from the back towards the entrance)



Picture 33. Cars parked at Lions Chowk Parking



Picture 34. Lions Chowk Parking (picture taken at the center of parking lot)



Picture 35. Lions Chowk Parking is almost completely empty



Picture 36. Elevation at the center of Lions Chowk Parking



Picture 37. Pole at the center of elevation



Picture 38. Entrance from the street to the Lions Chowk Parking area

3.5.4. Ganesh Hall East Parking

Ganesh Hall West Parking is a secluded parking lot located far from the main street. The parking lot accommodates all types of vehicles as well as serves as a bus stop. The area is wide enough, however, not often used by local car drivers due to the unfavourable location.



Picture 39. Location of Ganesh Hall East Parking



Picture 40. Ganesh Hall East Parking (right) and West Parking (left top corner)



Picture 41. Ganesh Hall East Parking (view from above)



Picture 42. Panorama view of Ganesh Hall East Parking



Picture 43. Vans parked at Ganesh Hall East Parking



Picture 44. Ganesh Hall East Parking is surrounded by buildings on all 4 sides



Picture 45. Utility pole in the center of Ganesh Hall East Parking



Picture 46. Bus stop at Ganesh Hall East Parking



Picture 47. Narrow and difficult entrance to Ganesh Hall East Parking



Picture 48. Parking navigation sign on the way to Ganesh Hall East Parking

3.5.5. Ganesh Hall West Parking

Ganesh Hall West Parking is located within walking distance from Ganesh Hall East Parking. Contrary to East Parking, the West Parking accommodates vehicles with parking tickets during a certain season or specified time period. The area is very small and accommodates up to 20 cars.



Picture 49. Location of Ganesh Hall West Parking



Picture 50. Ganesh Hall West Parking (left) and East Parking (right)



Picture 51. Ganesh Hall West Parking (view from above)



Picture 52. Panorama view of Ganesh Hall West Parking



Picture 53. The road leading to Ganesh Hall West Parking



Picture 54. Parking navigation sign next to Ganesh Hall West Parking



Picture 55. Ganesh Hall West Parking



Picture 56. End of street next to Ganesh Hall West Parking (on the right)

3.5.6. Kamalnagar Truck Parking

Kamalnagar Truck Parking falls under the jurisdiction of Bharatpur Metropolitan City and accommodates truck and other large vehicle parking. The area is relatively small and not well-managed. The traffic in the area is not busy.



Picture 57. Location of Kamalnagar Truck Parking

Kamalnagar Truck Parking area is divided into two smaller areas:

1. Actual parking area (as displayed in red below);
2. The unused empty area (wild area with vegetation) behind the actual parking area, which, if needed, can be used to expand the parking lot.



Picture 58. Kamalnagar Truck Parking structure



Picture 59. Panorama view of Kamalnagar Truck Parking



Picture 60. Entrance to the Kamalnagar Truck Parking area from the main road



Picture 61. Kamalnagar Truck Parking area as seen from the entry point



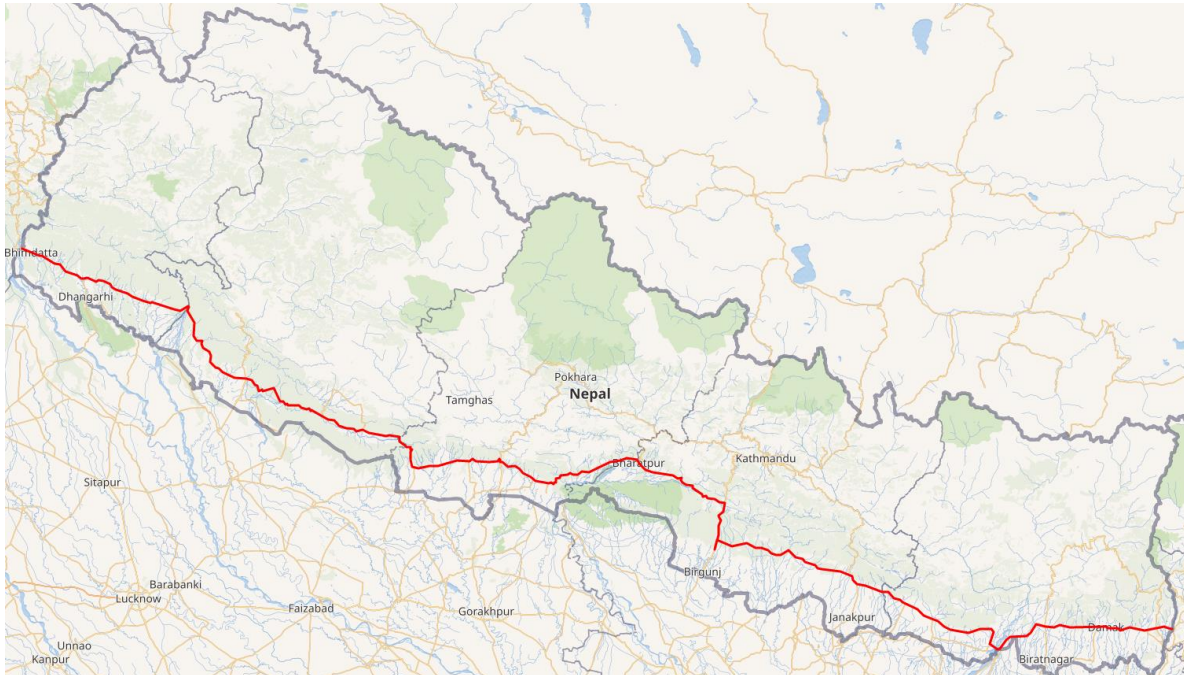
Picture 62. Kamalnagar Truck Parking as seen from the back



Picture 63. The unused area behind the Kamalnagar Truck Parking

3.5.7. Bharatpur on-street parking

The central street of Bharatpur that runs across the city is the Mahendra Highway (which is usually called the East-West Highway). The highway runs across Nepal from east to west and is the longest highway in Nepal. The whole highway is under the jurisdiction of the Nepalese Ministry for Physical Infrastructure and Transport (even the parts of highway running through cities).



Picture 64. Nepal Mahendra Highway



Picture 65. Mahendra Highway in Bharatpur

Currently (as of Nov 2019), the Mahendra Highway in Bharatpur has 4 lanes, 2 each direction (all major highways in Nepal have just two lanes). According to the Bharatpur Metropolitan City officials, there are plans for the highway infrastructure expansion from 4 to 6 lanes, 3 each direction. However, the precise timeline for expanding Bharatpur's territory is yet to be determined. According to news (as of March 2019), the China Construction Seventh Engineering Division, which bagged the contract of expanding a part of Nepal's East-West Highway, has started work on the project.⁷

The Mahendra Highway in Bharatpur is the busiest road in the city with much parking occurring on the sides of the road. The parking is unsupervised and there is no concept of on-street parking. The Bharatpur Metropolitan City officials agree that proper planning for on-street parking management is needed along with the highway infrastructure expansion.

⁷ “Chinese company starts expansion work of Nepal's longest highway”, *Xinhua*. March 23, 2019. http://www.xinhuanet.com/english/2019-03/23/c_137918192.htm

4. TO-BE MODEL

4.1. Pilot project recommendations

As many other smart city initiatives, Smart Parking ecosystem development requires an approach that gives sufficient flexibility and enables deeper engagement of key stakeholders for impactful change and solid investments at any stage of the project. For those who are just beginning the Smart Parking journey, it is necessary to secure proof of concept to minimize the risk of irreversible mistakes. Building upon a pilot smart parking project will contribute to building a sustainable Smart Parking infrastructure in Bharatpur in the long run. Bharatpur Metropolitan Government officials agreed with the FS team consultants that starting small will provide opportunities for easier implementation of the project on a larger scale and allow better citizen engagement in the adoption of Smart Parking services.



Picture 66. Bharatpur Airport parking as seen from above

The FS study concluded to recommend Bharatpur Airport as the pilot project site. Even though the airport is operated by the Civil Aviation Authority of Nepal and falls under the jurisdiction of the Nepalese government, Bharatpur Metropolitan Government can negotiate with the Nepalese government for it to be selected as the beneficiary for Smart Parking pilot project implementation. The airport parking site is thus recommended for the implementation of Smart Parking project due to the following reasons:

1. Bharatpur Airport is an off-road parking (on-road parking premises usually cover a very large area and are not suitable for small-scale project implementation);
2. Bharatpur Airport has necessary basic infrastructure - an asphalt parking lot, which is in good condition (additional asphalt road construction works are not considered necessary);
3. Bharatpur Airport parking has a clear perimeter and clearly defined area – important when installing intelligent CCTV cameras to monitor the environment;
4. Bharatpur Airport parking is not extremely busy;
5. Proximity to Bharatpur Metropolitan City Government (proximity translates into easier project implementation as well as operation, monitoring, and maintenance of the system by municipality officials);
6. As Bharatpur Airport is steadily growing, the demand for more efficient Smart Parking management is increasing in order to provide efficient parking facilities to both Nepali citizens and foreign tourists.







It is recommended to mark (paint) parking lot lines and traffic direction lines in order for drivers to move and park efficiently in the parking lot (this shall contribute to order and less traffic); check all electricity and network cables; if needed, install additional or replace old ones; and prepare a room for parking lot control center at the airport building to prepare the site for pilot project implementation.



Picture 67. Bharatpur Airport parking scheme

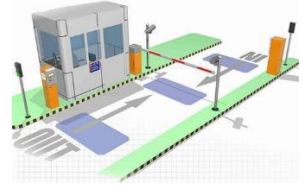



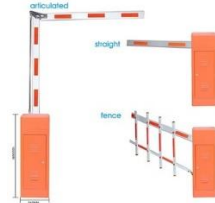


The FS proposes a full-featured Smart Parking for Bharatpur Airport that will allow the vehicle drivers to be charged based on time parked in the rather than a flat-rate. The proposed system will improve customer experience by facilitating more efficient, faster and easier parking process in Bharatpur Airport. The full-featured Smart Parking scenario includes the following six stages.

Table 10. Full-featured Smart Parking scenario

No	Parking stage	Illustration
1	Vehicle arrives at the parking entry gate. Vehicle driver checks parking availability on the entrance display.	
2	2.1. The camera/LPR unit scans the vehicle number plate and registers the number in the system. OR Driver presses the button on the ticket dispenser and collects a parking ticket (in rare case the plate is not recognized). 2.2. Open signal is sent to the barrier gate as soon as the driver collects his ticket OR the number plate is registered in the system. Barrier gate opens and vehicle proceeds to the parking lot.	
3	The driver consults the guiding displays that show real-time information about location of vacant parking spaces. The driver chooses a specific parking lane and proceeds to the chosen parking space.	
4	Driver pays for the parking at the kiosk by either scanning the parking ticket OR inputting his vehicle number plate number.	
5	Vehicle proceeds to the parking exit point, where the camera/LPR unit scans the number plate, recognizes payment and opens barrier gate OR the vehicle driver scans the paid parking ticket, the system recognizes payment and opens the barrier gate.	
6	Vehicle leaves the parking lot.	

The system envisions the installation of the following Smart Parking hardware. The proposed hardware is weather resistant, easy to deploy and will provide for full parking automation at Bharatpur Airport.

Table 11. Smart Parking hardware overview

Hardware	Functions	Image
Loop detectors	Installed at the parking entrance roadway. When the vehicle approaches the parking gate and steps over a loop detector (magnetic loop detector is the most popular vehicle sensor), it senses the car and its presence is signalled to the LPR unit.	
LPR unit (license plate recognition) unit	Installed at the parking entrance, captures full log of the vehicle's license plate, date of entry and photo of the vehicle. Upon vehicle exit, system can calculate and display parking fees.	
Parking payment machine	Walk-up parking machines that allow parking payment for Pay & Display, Pay by License, or Pay by Space. Drivers can pay either in cash or by debit/credit card.	
Entrance display	Display is well positioned at the entrance of the parking garage and displays available parking space count at the parking lot (or, alternatively, it displays that all parking lots are taken).	
Barrier gate	Barrier gates are installed to block vehicular access through a controlled point. They can be articulated, straight or fence, depending on the preference.	
Ticket dispenser	Installed before the barrier gates. Press the button to take the parking ticket, wait for barrier gate to open and proceed. Can be customised: intercom, security camera, card reader + PIN pad, etc. Installed in case the LPR unit cannot recognize the vehicle number.	
Computers, servers, etc.	Parking control room computers, entrance fee calculator computer, etc.	

The system envisions an Integrated Control Center on the airport premises that will provide efficient monitoring and management of facilities 24/7/365, including such services as prompt response to emergency actions and customer complaints in real-time. The Control Center managers will also be responsible for all parking related data management.



Picture 68. Examples of Control Center system for parking managers

The Control Center system will fully automate parking management, record vehicle's entrances and exits history, keep logs on vehicle parking by specified date and time, control parking payments. The Control Center system can also be accessed by Bharatpur Metropolitan Government officials for performance monitoring. The mobile application for vehicle drivers is not envisioned by the pilot project.

4.2. Estimated cost

The following table provides an estimation of the envisioned two-year Smart Parking pilot project (one-time costs only) for Bharatpur Airport. The system shall be fully installed and operational within the first year. The second year is envisioned for system maintenance and includes system performance monitoring and performance enhancement. The estimated cost of system maintenance is calculated at 12% of the system implementation cost.

Table 12. Total estimated implementation cost

Category	Amount (USD)	Remarks
System implementation	673,147	Year 1
System maintenance cost	242,333	Year 2
Total Amount	915,479	

The following tables represent the cost breakdown by categories. The first two tables represent the calculation of estimated labor costs and the travel expenses that will be incurred by the project team when travelling to Bharatpur from Korea for pilot project implementation.

Table 13. Estimated labor cost (USD)

Category		Product / Description	M/M	Unit Price	Total
Project Management	Expert Technician	Project Manager	9	13,793	124,138
Parking Management Sys.	Expert Technician	Project Leader / Architecture Design & Dev.	9	13,793	124,138
	Advanced Technician	Engineer / Construction	9	11,207	100,862
	Intermediate Technician	Engineer / Construction	6	9,483	56,897
	Intermediate Technician	Engineer / Construction	6	9,483	56,897
	Assistant	Engineer / Construction	6	4,310	25,862
	Assistant	Engineer / Construction	6	4,310	25,862
Interface (Payment...)	Advanced Technician	Engineer / System Link	4	11,207	44,828
Translation	Intermediate Technician	Interpretation / Translation	4	9,483	37,931
Labor Cost Total-					597,414

Table 14. Estimated travel cost (USD)

Category	Product / Description	QTY.	Unit Price	Total
Direct expenses	Travel expenses	20	2,586	51,724
	Meeting expenses	4	86	345
	Printing expenses	1	862	862
Travel Cost Total				52,931

The following table represents the cost breakdown of all necessary Smart Parking hardware.

Table 15. Estimated hardware cost (USD)

Category		Product / Description	QTY.	Unit Price	Total
Development & Construction System	PC	2.0Ghz(8Core)/RAM 8GB/HDD 1TB	1	4,310	4,310
	Monitor	24Inch	1	431	431
		Barrier	1	586	586

Entrance System	Entry Barrier System	Vehicle detector with ground inducting loops	3	86	259
		Loop coil	3	60	181
	Entry System	License plate recognition camera	1	1,207	1,207
		Ticket box	1	362	362
		Automatic card dispenser	1	267	267
		ID Reader	1	103	103
		Control board	1	466	466
		Power supply	1	95	95
		LED display	1	328	328
Exit System	Exit Barrier System	Barrier	1	586	586
		Vehicle detector with ground inducting loops	3	86	259
		Loop coil	3	60	181
	Exit System	License plate recognition camera	1	1,207	1,207
		Ticket box	1	362	362
		Smart parking control board	1	466	466
		Automatic card collector	1	267	267
		LED Display system	1	328	328
		IC/ID Reader	1	103	103
Power supply		1	95	95	
Control Center	Management System	Recognition module	1	2,000	2,000
		Switch exchanger 8 ports	3	103	310
		Self-payment machine	1	6,405	6,405
		CCTV camera	4	172	690
		DVR (HDD 2TB)	1	345	345
Hardware Cost Total					22,198

The following table represents the estimated cost of Smart Parking software for Control Center management.

Table 16. Estimated software cost (USD)

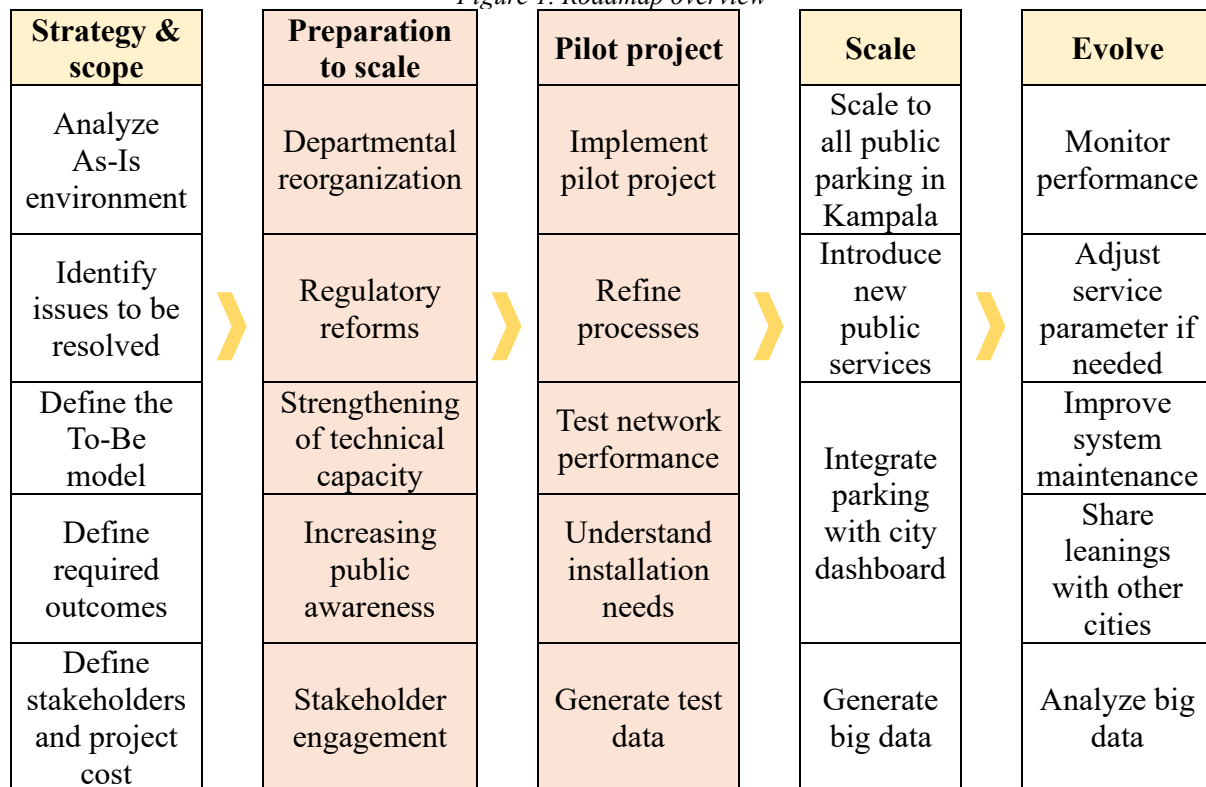
Category		Product / Description	QTY.	Unit Price	Total
Development & Construction System	Management Software	System management software	1	603	603
Software Cost Total					603

5. SMART PARKING DEVELOPMENT ROADMAP

5.1. Roadmap overview

Starting with a small-scale off-street project is usually the best approach for Smart Parking beginners as it reduces the risk of irreversible mistakes. Building upon a pilot project by growing it step-by-step will ensure a sustainable Smart Parking infrastructure in the future. The core stages of growth from a small Smart Parking project to a comprehensive system implementation – the Smart Parking development roadmap – are explained in the following figure.

Figure 1. Roadmap overview



This FS is the first step in the right direction for BMG as it provides Bharatpur public parking environment analysis, identifies issues that need to be resolved with help of the municipality, proposes a To-Be model and necessary steps for pilot project implementation and scale-up preparation. The next step for BMG will be the pilot project implementation and preparation to scale. The pilot project implementation was discussed in the previous chapter; this chapter will focus on the recommendations for scale-up preparation.

5.2. Departmental reorganization

Bharatpur is one of the fastest growing cities in Nepal and is quickly becoming one of Nepal's key urban centres. Due to growing tourist population, Bharatpur is attracting more and more people to live and work, which in turn facilitates more rapid economic development.

Bharatpur Metropolitan Government officials are working on compiling a comprehensive Master Plan that will envision and define Smart Bharatpur City concept, development and implementation strategies as well as expected outcomes. Currently, 50% of the Master Plan is completed and the final version is expected to be delivered in 2020. Moreover, Bharatpur Metropolitan Government applied for WeGO Smart Sustainable City Feasibility Study 2019 in order to modernize parking experience for its citizens and introduce Smart Parking technologies into citizens' daily lives. Bharatpur government's application stood out for its aim and earnest desire to build a smart parking ecosystem to simplify off-street and on-street parking experience and ensure efficient mobility within the city premises. Bharatpur Metropolitan City is excited about Smart Parking development prospects and is open to tendering and outsourcing parking management roles and responsibilities in Bharatpur to an expert company.

Currently, there is no parking management division and no Department of Transportation in Bharatpur Metropolitan Government. All transportation related affairs are handled by the Department of Revenue Management, Department of City Infrastructure Development and Department of Planning and Information. Moreover, Bharatpur traffic is officially under the jurisdiction of Bharatpur Police. There is a separate Department of Traffic within the Police office (known as the Traffic Police) that manages city traffic.

The FS team concluded that Bharatpur Metropolitan Government has a successfully functioning government structure that would benefit from a small-scale departmental reorganization. Bharatpur Metropolitan Government should focus on establishing a Department of Transportation to centralize efficient maintenance and development of Bharatpur's transportation system and infrastructure as well as smooth transition to and efficient management of all future Smart Parking ecosystem aspects. The new Department of Transportation should take responsibility over the following aspects:

1. City public transportation system management;
2. City transportation infrastructure management (*parking facilities included*);

3. Development and enforcement of transportation laws, rules, regulations and policies;
4. Vehicle registration and driver licensing;
5. Strengthening of technical capacity;
6. Provision of public access to all information related to city transportation;
7. Stakeholder engagement.

The new Department of Transportation would also benefit from establishing a Traffic Control Center within the department. The Traffic Control system should ideally employ not only traffic control managers but also team up with Bharatpur Police and Medical Emergency services, who would be responsible for law enforcing and emergency situations. In the long-term, the Traffic Control Center should monitor road traffic, public transport operation and public parking facilities in real-time 24/7/365, provide prompt response to emergency situations, solve traffic-related difficulties as well as forecast traffic using big data analysis.

The FS team located in Seoul recognizes Seoul's strategies as good references for outlining the vision of the future in Bharatpur. Some best cases are given in the following sub-chapters as references. Seoul Metropolitan Government's initiative of "Seoul's Policy Sharing Initiative" aims to provide capacity building programs, policy consulting, and knowledge sharing, which Bharatpur Metropolitan Government officials are encouraged to participate in in close cooperation with the WeGO network.

A newly established Department of Transportation is recommended to focus on managing such transportation infrastructure as roads, traffic lights, bridges, railways, railway terminals, airports, bus terminals, bus stops, public parking, etc.

Upon inspection the FS team concluded that some Bharatpur parking lots (all of them are off-street) do not have sufficient infrastructure in place for Smart Parking implementation and additional construction works are considered necessary. When developing the basic parking infrastructure in Bharatpur, the following aspects are advised to be taken into consideration:

1. *Parking lot design:* Optimize the parking area space and define a clear perimeter. The FS team recommends using rectangular areas and making the long sides of parking areas parallel. Design the parking so that parking spaces are located along the lot's perimeter. It is also recommended to pay special attention to the flow of vehicles in and out of the parking lot (some of Bharatpur public parking lots are hidden between buildings and are not easily accessible).

2. *Parking ground construction preparations:* Some parking lots in Bharatpur have some vegetation and rocks – these should be removed prior to construction.
3. *Parking ground base construction:* The FS team recommends an asphalt concrete base as it will greatly reduce the potential for problems related to water strength and stability. It is also recommended to focus on drainage provision as Bharatpur has a long monsoon season starting around mid-June and peaking in July and August. Drainage should be carefully designed and installed early in the construction process.
4. *Parking angle and parking space dimensions:* The FS team recommends a 90° angle, as it provides the most parking spaces for a given area. The parking space dimensions shall vary according to vehicle type.
5. *Parking lot markings:* Markings are a crucial element of a good Smart Parking lot. The parking area should be clearly marked to designate parking spaces. Traffic flow markings should also be marked for directing the vehicle movement. The markings will last longer on asphalt concrete base.

As the transition to Smart Parking will progress in Bharatpur, it is recommended for all public off-street parking lots in Bharatpur to transition to automated parking for effective management of limited space. This transition will require more hardware linked digitally to the city control centers.

Thus, it is recommended to not only consider improving the physical infrastructure, but also make effort towards improving Bharatpur digital infrastructure, as well. It is recommended to establish CCTV monitoring infrastructure in the public parking lots in Bharatpur. At present, there are around 100 CCTV cameras installed in Bharatpur to monitor the city environment, however, none of them monitors the parking areas. Moreover, the cameras are under the jurisdiction of the Bharatpur police.

It is recommended to install additional CCTV at public parking lots and connect them to the future Traffic Control Center within Bharatpur Department of Transportation. The CCTVs installed in parking lots will enable local officials to receive real-time and regular information on accidents and crimes, vehicle speeds, and adherence to parking rules (e.g., skipping traffic signals, incorrect lane driving), which will in turn provide a safe parking experience in the city.

The FS team also proposes Seoul CCTV Integrated Control Center – a control center monitoring Seoul city public spaces – as the best case study for Bharatpur Government. Among

other functions, Seoul CCTV Integrated Control Center plays a crucial role in enforcing parking rules and regulations. The center monitors illegal parking activities by recognizing the illegal parking event, detecting and recognizing the vehicle number plate and then taking a snapshot to redirect to the authorities, who later issue a parking fine to the vehicle owner. Seoul Metropolitan Government operates the Integrated Control Center in close cooperation with the district offices and the police and fire departments.

Moreover, it is important to plan the transition towards digital payments for parking as it is one of the most crucial aspects of Smart Parking. According to the 2019 “DIGITAL NEPAL FRAMEWORK: Unlocking Nepal's Growth Potential” report, over the last years Nepal has enjoyed incredible success in digital adoption compared to its neighbours, with mobile penetration exceeding 100% and Internet penetration reaching 63%. There was an addition of 2.25 million new Internet users in 2017 alone, translating into approximately 250 new Internet users every hour. The growing popularity of social media is a crucial driver for Internet adoption in Nepal, after Bhutan in South Asia. As of January 2018, Nepal had nearly 9.3 million Facebook users. Entertainment and video sharing are other popular use cases with more than 6.4 million registered users on YouTube.

Bharatpur Metropolitan Government officials have also confirmed that Bharatpur citizens predominantly use smartphones in their daily lives and mobile network coverage provides for a good and stable 3G connection. It is recommended to take leadership in driving 5G adoption in Bharatpur to facilitate faster adoption of smart city initiatives in the society in the future (disasters, public safety, traffic, parking, etc).

Good internet connection is vital as Smart Parking solutions provide parking availability status to vehicle owners through an app. Typical solutions require users to update their requirements at any given time on the app for the system to reflect the current occupancy status of the parking spaces in real time. The system can also update users about the prevalent parking rates at the designated spot and allow them to reserve a parking slot using mobile payment.

5.3. Regulatory reforms

1) Parking payment rules and regulations

Bharatpur Metropolitan Government should outline clear transportation laws as well as clear parking rules and regulations and apply them to all public transportation infrastructure. When developing a Smart Parking ecosystem in Bharatpur, it is recommended to consider establishing a more comprehensive parking fare system.

Currently, the local parking fare system differentiates only vehicle types (motorcycle or two-wheeler, car/van or four-wheeler, truck/transport vehicle) and parking duration (2 hours, 4 hours, 1 day, 1 night&1day). The proposed new parking fare system should be divided into three categories as follows:

1. Parking type: very short time (up to 30 minutes), short-term (1h-2h), medium-term (2h-4h), long-term (8h+), subscription (parking pass);
2. Vehicle type: motorcycle, car, large vehicle, public transport, etc.;
3. Discount eligibility: no eligibility (regular fees), drivers with disabilities, women, economy cars, low-emission vehicles (LEV), shopping receipts/event receipts from adjacent shops/places, etc.

2) *Parking infrastructure regulations*

The new parking fare system should also clearly outline parking regulations for all public parking spaces, since specific regulations can increase/decrease parking of certain vehicle groups, i.e.:

1. Specify all vehicle types that are allowed to park (i.e., no trucks are allowed);
2. Specify minimum and maximum parking duration (i.e. minimum 1h parking to avoid short-term vehicles such as deliveries);
3. Specify parking opening hours (i.e. no parking before 9 am and after 9 pm as all adjacent shops/places work between 9 am - 8 pm);
4. Specify employee parking spaces;
5. Specify special restrictions (i.e. parking is closed first Sunday each month for maintenance and cleaning);
6. Specify clear rules regarding removal of inoperable or abandoned vehicles, vehicles without a parking pass/parking ticket, etc.;
7. Specify parking fine payment procedure.

In addition to that, Bharatpur authorities are also recommended to learn more about Seoul's transportation policies, energy policies, water supply policies, urban planning policies and

urban safety policies, as they all are directly or indirectly connected to Smart Parking planning. For example, as Bharatpur is attracting more and more tourists, it sees a boost in consumption. A thorough separate waste disposal system should be created to reduce waste generated by vehicle drivers. The FS team proposes to look into Seoul Metropolitan Government's efficient waste management policies that focus on recycling, prevention and reduction of waste. As Smart Parking is a parking strategy that combines technology and human innovation in an effort to use as few resources as possible – less fuel, time and space – it is also necessary to develop policies for environmental protection (promote green transport).

3) *Vehicle registration and driver licensing*

Currently, there are no guidelines clearly explaining vehicle registration, driver licensing or vehicle number plate types available at Bharatpur Metropolitan Government. The FS team concluded that a comprehensive research on vehicle number plates in use in Bharatpur is necessary for the future Number Plate Recognition system implementation (NPR). The FS team carried out a preliminary study on Nepalese number plate types, vehicle registration and driver licensing on a national level; confirmation from Bharatpur Metropolitan Government officials is necessary to understand whether the collected information applies to Bharatpur.

It is also necessary to understand when vehicles in Bharatpur are expected to fully adopt the new security embossed number plates, which are readable by automatic number plate recognition (ANPR) camera systems. The new format was introduced on 21 August 2017. During the first introduction phase, the modern license plates were installed in government-owned vehicles. Since then, the plates have been installed in more than 4,600 vehicles plying on the roads of Kathmandu valley, however, they were not yet introduced in Bharatpur.

5.4. Strengthening of technical capacity

Bharatpur is expanding rapidly and as the city population increases, the pressure on the city's infrastructure increases. In order to create a successful Smart Parking infrastructure in the future, it is necessary to strengthen the city's technical capacity along with securing budget for such activities.

Bharatpur Metropolitan Government is recommended to focus on local capacity building necessary for implementing an efficient Smart Parking ecosystem. Possible ways include

training of municipality officials by sending them overseas to learn about best Smart Parking examples or inviting experts to Bharatpur for knowledge transfer to a larger number of officials.

On a broader scale, the Government of Nepal should consider fostering talent that would carry out research in subjects related to Smart Parking. For example, as vehicle number plate recognition is one of the most crucial elements of Smart Parking, it is important to support work on developing an effective automatic number plate recognition for Nepali transportation vehicles. Some research on Nepali number plate recognition, which is capable of automatically labelling a given number plate to its identity, already exists and it is necessary to further encourage work on such machine learning-related topics.⁸ This research, however, focuses on recognition of old format number plates. The new format number plates are easily readable by various automatic number plate recognition (ANPR) camera systems.

On the local level, local governments in Nepal are encouraged to establish partnerships with Nepali universities and research institutes to conduct relevant research (Kathmandu University, Tribhuvan University, Pokhara University, and others).

5.5. Raising public awareness

It is important that all transportation-related policies, laws, rules and regulations, real-time information be clearly indicated to Bharatpur citizens. In case of Smart Parking, by providing timely information, Bharatpur Metropolitan Government will improve vehicle owner experience and service quality by providing comprehensive information on all public parking lots, related parking rules and regulations.

It is also recommended to create a separate page for the future Department of Transport on the official website of Bharatpur Metropolitan Government where citizens could check all relevant information.

Particularly, the municipality should focus on introducing the Smart Parking system to the public beforehand to familiarize them with the concept. Furthermore, it is recommended to create an official mobile app for the Department of Transport in Bharatpur that will not only provide information on public parking, but also lay down details of various public transport

⁸ Pant, Ashok Kumar et al. Automatic Nepali Number Plate Recognition with Support Vector Machines. 2016.

modes including taxi and buses in the city. Ideally, the future app will provide information on the various routes, connecting key locations, availability/frequency/transport schedule, time estimates, and fare details.

5.6. Stakeholder engagement

Smart Parking ecosystem development requires not only talent, but also significant funding and investment, which the local government cannot provide alone. Following their previous efforts, Bharatpur Metropolitan Government should continue promoting entrepreneurship, encouraging private sector participation, and attracting foreign investment. Possible actions that Bharatpur Metropolitan Government can undertake are promoting digital payments for parking for revenue collection and promoting local public-private partnerships (tendering and encouraging participation by providing incentives and relaxing entry).

Bharatpur Metropolitan Government is also encouraged to look into foreign investment opportunities, i.e. participate in various international (e.g., WeGO Smart City Feasibility Study) and intragovernmental ODA programs (e.g., ODA programs at Korea International Cooperation Agency), cooperate with national investment promotion agencies for FDI programs (e.g., Investment Board of Nepal), partner with international companies (including Korean SMEs), and cooperate with multilateral development banks for loans and other fund mechanisms (e.g., Asian Development Fund whose top recipient has been Nepal).

CONCLUSION

As metropolitan areas around the world grow, they begin facing growing traffic congestion that typically results in uncertainty in or insufficient supply of parking availability. As cities stand to face the challenge, they often face such problems as uncertain parking payment regulations, problems with observing traffic laws, corruption in revenue collection and poor infrastructure. Bharatpur in Nepal is one of such cities, working hard to improve the traffic situation in the city and improve the on- and off-street public parking facilities for its citizens.

Despite the challenges of its mountainous terrain, the landlocked Nepal has achieved a relatively high level of mobile access driven by the Government's efforts to improve connectivity and strengthen the ICT sector. This fact is of utmost importance to developing a successful Smart Parking infrastructure in Nepal the future. There is, finally, a lot of potential in Nepal for attracting investments and securing stakeholder commitments.

Close monitoring of Smart Parking pilot project's performance will be necessary to understand the feasibility of scaling such project to multiple sites in Bharatpur. Promotion of the new Smart Parking services among citizens is also crucial for its successful operation. Moreover, obtaining detailed feedback on the operations of parking facilities will also prove to be crucial to understand whether such parking shall successfully run in the long term. Smart Parking management in Bharatpur should be transparent, ensure accountability, and improve governance structures.

REFERENCES

1. “Chinese company starts expansion work of Nepal's longest highway”, *Xinhua*. March 23, 2019. http://www.xinhuanet.com/english/2019-03/23/c_137918192.htm
2. “Nepal Urbanization: Kathmandu Valley to Have Four Smart Cities!”, *Nepali Sansar*. August 26, 2019. <https://www.nepalisansar.com/tourism/nepal-urbanization-kathmandu-valley-to-have-four-smart-cities/>
3. Government of Nepal Ministry of Communication and Information Technology. 2019. 2019 DIGITAL NEPAL FRAMEWORK: Unlocking Nepal’s Growth Potential. <https://nepalindata.com/resource/2019-digital-nepal-framework-unlocking-nepals-growth-potential/>
4. Government of Nepal, Ministry of Urban Development, Department of Urban Development and Building Construction. 2017. Smart City In Nepal: Concept And Indicators. https://www.academia.edu/33684114/SMART_CITY_IN_NEPAL_CONCEPT_AND_INDICATORS
5. Narayan Prasad Sapkota. 2013. CITYNET Seoul Congress Presentation. <https://citynet-ap.org/wp-content/uploads/2013/11/Bharatpur-City-Best-Practice-Briefing.pdf>
6. Pant, Ashok Kumar et al. *Automatic Nepali Number Plate Recognition with Support Vector Machines*. 2016.
7. International Telecommunication Union (ITU) <http://www.itu.int/>
8. “Journey Towards Smart City”, *The Rising Nepal*. February 4, 2020. <http://therisingnepal.org.np/news/19609>