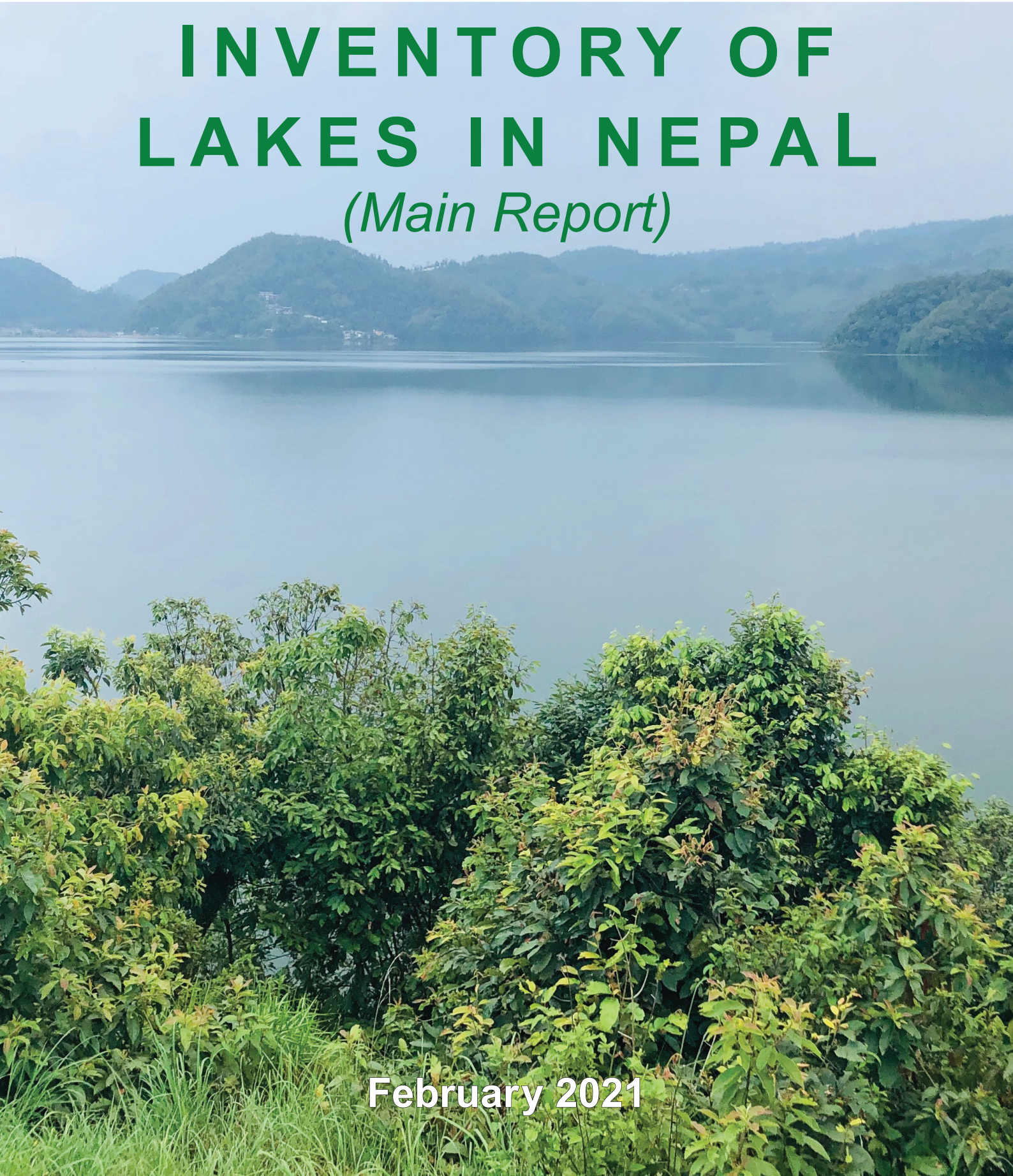
INVENTORY OF LAKES IN NEPAL

(Main Report)



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(Main Report)

February 2021

Goverment of Nepal

Ministry of Forests and Enviroment

Government of Nepal
Ministry of Forest & Environment
Singhadurbar, Kathmandu

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Date:-

FOREWORD

Lakes offer diverse values and opportunities for biodiversity conservation, ecosystem regulation, culture, and livelihoods in Nepal. Therefore, sustainable development and conservation of lakes are essential for securing the livelihood especially of lake-dependent communities. Understanding the importance and values of lakes, the Government of Nepal (GoN) established the 'National Lake Conservation Development Committee' (NLCDC) in 2007 as an Apex body to look after overall issues related to lakes in Nepal.

The National Lake Conservation Development Committee realized the information gap on lakes as a key barrier for managing lakes and their environment. To fill the information gap, NLCDC initiated the preparation of an inventory of the lakes of Nepal in different phases, each phase focusing on selected districts. Need was felt to develop a consolidated national inventory of lakes with information disaggregation across new political boundaries in the changing federal context.

This report has synthesized the information based on different available studies/inventories, and adding information on new political boundaries. The lakes included in this inventory were assessed by appropriately customizing the Wetland Inventory and Assessment and Monitoring Tool (WIAM) developed by the GoN. A total of 626 lakes included in this report are spread over all seven Provinces in Nepal, with the highest number of lakes (222) in the Bagmati Province and the lowest (7) in the Karnali.

I would like to congratulate NLCDC and associated experts for bringing out such a highly comprehensive and timely report on the inventory of lakes in Nepal. I would like to appreciate various government and non-governmet institutions, academia, local communities and stakeholders for their valuable inputs and support in preparation of this report. I would also like to thank the Policy and Institutions Facility of Oxford Policy Management for their technical support in the final editing and publication of this report.

I sincerely believe this report would serve as a very useful baseline for designing and implementing policies and programs. This report provides strong policy shreds of evidence aimed at the conservation of lakes and wetlands in Nepal that would ultimately contribute to enhancing climate resilient-livelihoods for wetland-dependent communities.

Bishwa Nath Oli, PhD
Secretary

Secretary:- 4211567 Fax:- 4211868

Government of Nepal
Ministry of Forests and Environment
National Lake Conservation Development Committee
2007

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ACKNOWLEDGMENTS

National Lake Conservation Development Committee (NLCDC) realizing the needs to develop a baseline inventory of lakes to guide overall policy and programs for their sustainable development, conservation, and management has made efforts in developing inventories of the Himalayan lakes since 2012 and as a result, published several reports in different phases in collaboration with Conservation Development Foundation (CODEFUND) Nepal. Finally, this report is prepared primarily based on the review and taking reference of those reports and the report of lake inventory of additional 13 districts prepared by the Department of Forests. The lake inventories across various regions of the country were developed using the Government of Nepal Wetland Inventory, Assessment, and Monitoring (WIAM) tool.

During this process of developing the overall framework for inventory and information collection during different phases, many institutions like Central Department of Environmental Science (Tribhuvan University); Central Department of Botany (Tribhuvan University); Geology Department (Trichandra Campus/Tribhuvan University); Ministry of Environment, Science and Technology; Ministry of Forests and Soil Conservation; Water and Energy Commission Secretariat; Department of Forests and Soil Conservation, Nepal Academy for Science and Technology; UNDP/Small Grant Program; IUCN Nepal; WWF Nepal; National Trust for Nature Conservation; Bird Conservancy Nepal, and The Mountain Institute (Nepal) were involved in the consultative processes. The NLCDC highly acknowledges their substantial inputs to bring the report into the current shape. Furthermore, cooperation and valuable inputs were received from local communities during the process of developing inventory at various phases. Similarly, NLCDC is highly indebted to Prof. Dr. Vishnu Prasad Pandey and his team for their sincere efforts to bring the report in this shape by collating all available information. NLCDC expresses sincere appreciation to the Policy and Institution Facility of Oxford Policy Management for technical support in the final editing and publication of this report.

This report has some constraints and the information presented about Lake Inventory is limited to within 3,000 masl only. As a result, only 626 lakes are listed and many glacial and other lakes at higher altitudes are missing in this publication. Nevertheless, this is the first publication of this kind in Nepal, which will be useful for managing lakes by the government and non-government bodies; community groups; academia; lake managers, and other relevant stakeholders.

Finally, NLCDC is highly obliged to the Ministry of Forests and Environment for continued support, guidance, and advice, which inspired us for this task directly or indirectly.

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EXECUTIVE SUMMARY

The Government of Nepal (GoN) created the National Lake Conservation Development Committee (NLCDC) in 2007 as the apex body for the conservation and development of lakes across the country. The NLCDC also gives related policy advice on program planning and implementation to the GoN. The NLCDC saw the need for more information to better manage lakes and their environment and initiated an inventory of lakes in Nepal to that purpose. This publication provides comprehensive information on lakes focusing on their religious and cultural importance, ecological and hydrological features, socio-economy of lake basins, ecosystems goods and services, restoration and management practices, touristic value, and current condition. The inventory includes lakes within an elevation of 3,000 meters above mean sea level (masl).

This report is primarily based on a review of available inventories prepared mostly by the NLCDC over the years. Lake inventories were developed by customizing the Wetland Inventory and the Assessment and Monitoring Tool (WIAM) developed by the GoN for assessment purposes. All the documented lakes – a total of 626 – are characterized by general features (e.g., location, wetland type, conservation status, area, etc.), ecological features, socio-economy of the lake basins, ecosystem goods and services that the lakes provide; restoration/management attempts; tourism potential and condition (good or degrading).

Lakes in Province-1: The inventory records 80 lakes within 3,000 masl in Province-1, with a distribution across the Terai, Hill, and Mountain regions respectively of 43%, 44%, and 13%. Districts (figure in parenthesis indicates the number of lakes in the district) with the most lakes in decreasing order are Jhapa (20), Morang (11), Panchthar (9), Ilam (7), Khotang (7), Sunsari (5), Bhojpur (4), Terhathum (4), Udaypur (4), Taplejung (3), Dhankuta (2), Sankhuwasabha (2), Solukhumbu (2), and Okhaldhunga (0). Out of 137 Palikas in Province-1, Shivasataxi Municipality in Jhapa district has the biggest number of lakes (8) compared to other Palikas.

Lakes in Province-2: There are 81 lakes recorded in Province-2, all in the Terai region. Districts with the most lakes in decreasing order are Dhanusha (23), Siraha (13), Sarlahi (10), Mahottari (9), Rautahat (8), Saptari (8), Bara (7), and Parsa (3). Out of 136 Palikas in the province, Janakpurdham Sub-Metropolitan City in Dhanusha district has the biggest number of lakes (21) compared to other Palikas.

Lakes in Bagmati Province: The province has 222 lakes distributed across the Terai (4%), Hill (95%), and Mountain (1%) regions. Districts with the most lakes in decreasing order are Lalitpur (97), Kathmandu (58), Bhaktapur (52), Chitwan (6), Dolakaha (3), Sindhuli (2), Makwanpur (1), Nuwakot (1), Ramechhap (1) and Sindhupalchowk (1). Out of 119 Palikas in the province, Lalitpur Sub Metropolitan City in Lalitpur district has the biggest number of lakes (50) compared with other Palikas.

Lakes in Gandaki Province: Gandaki Province has 42 lakes within an elevation of 3,000 masl, distributed across the Terai (5%), Hill (71%), and Mountain (24%) regions. Districts with the most lakes in decreasing order are Kaski (17), Lamjung (8), Baglung (4), Gorkha (3), Parbat(3), Myagdi (2), Mustang (2), Nawalpar (2), and Tanahun (1) . Out of 86 Palikas in the province, Pokhara Lekhnath Municipality of Kaski district has the biggest number of lakes (10) compared to other Palikas.

Lakes in Lumbini Province: This province has 97 lakes, located in the Terai (92%); Hill (6%), and Mountain regions (2%). Districts with the most lakes in decreasing order are Rupandehi (28), Kapilvastu (24), Parasi (21), Dang (8), Banke (4), Bardiya (3), Arghakhanchi (2), Palpa (2), Pyuthan (2), Rukum (2) and Rolpa (2). Lumbini Sanskritik Municipality of Rupandehi district has the biggest number of lakes (7) compared to other Palikas.

Lakes in Karnali Province: Karnali Province holds 7 lakes, which are distributed across the Terai (14%), Hill (57%), and Mountain (29%) regions. Districts with the most lakes in decreasing order are Dailekh (3), Jumla (1), Mugu (1), Salyan (1), and Surkhet (1). No palika has more than one lake.

Lakes in Sudurpaschim Province: This province has 87 lakes, which are distributed across the Terai (84%), Hill (5%), and Mountain (11%) regions. Districts with the most lakes in decreasing order are Kailali (47), Kanchanpur (26), Acchham (7), Bajura (2), Doti (2), Baitadi (1), Bajhang (1), and Dadeldhura (1). Godawari Municipality in Kailai district has the biggest number of lakes (35).

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ACRONYMS AND ABBREVIATIONS

MCM	Million Cubic Meters
ILEC	International Lake Environment Committee
NLCDC	National Lake Conservation Development Committee
DOF	Department of Forests
WECS	Water and Energy Commission Secretariat
CBS	Central Bureau of Statistics
IUCN	International Union for Conservation of Nature
DHM	Department of Hydrology and Meteorology
EUS	Epizootic Ulcerative Syndrome
GLOF	Glacial Lake Outburst Flood
ILBM	Integrated Lake Basin Management
GIS	Geographic Information System
DDC	District Development Committee
VDC	Village Development Committee
WWF	World Wildlife Fund
ET	Expert Team
SCE	Steering Committee of Experts
UNDP	United Nations Development Programme
GPS	Global Positioning System
ICIMOD	International Centre for Integrated Mountain Development
LN	Local Name
LU	Local Use
EN	English Name
NA	Not Available
MBT	Main Boundary Thrust
MCT	Main Central Thrust
MFT	Main Frontal Thrust
JICA	Japan International Cooperation Agency
WIAM	Wetlands Inventory, Assessment and Monitoring Tool
MOFSC	Ministry Of Forest And Soil Conservation
MOHP	Ministry of Health and Population
GON	Government of Nepal

EDR	Eastern Development Region
CDR	Central Development Region
WDR	Western Development Region
MWDR	Mid-Western Development Region
FWDR	Far-Western Development Region
NY	New York
Ha	Hectares
mg	Milligrams
Km	Kilometres
L	Litres
PH	Potential of Hydrogen
Fig.	Figure
Temp	Temperature
PRA	Participatory Rapid Appraisal

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1. INTRODUCTION

1.1 Lake as an ecosystem

The word 'lake' does not have a widely agreed global definition. Understanding of what is a lake varies across countries depending on their language (Box 1). In general, a lake is understood as a body of relatively still liquid of considerable size, localized in a basin, that is surrounded by land apart from a river or other outlet that serves to feed or drain the lake. Water is always a dominant character in the lake that may or may not have inlets and outlets. Lakes lie on land and are not part of the ocean, and therefore are distinct from lagoons, and are larger and deeper than ponds. Lakes can be contrasted with rivers or streams, which are usually flowing. However, most lakes are fed and drained by the rivers and streams. Lakes have three fundamental characteristics in common *i.e.,* integrating nature, long retention time, and complex response dynamics. Individually, these characteristics are not unique to lakes - for example, groundwater also has a long retention time, and estuaries can have complex dynamics. However, the combination of these characteristics is unique to lakes (ILEC, 2005).

Box 1 Lake: Etymology, Meaning and Usage

The word 'Lake' comes from Middle English 'Lake' (lake, pond, waterway), from Old English 'Lacu' (pond, pool, stream), from Proto-Germanic 'Lakō' (pond, ditch, slow moving stream), from the Proto-Indo-Europeanroot 'Le' (to leak, drain). Cognates include Dutch Laak' (lake, pond, ditch), Middle Low German 'Lāke' water pooled in a riverbed, puddle), German 'Lache' (pool, puddle), and Icelandic 'lækur' (slow flowing stream). Also related are the English words *leak* and *leach*.

There is a considerable variability on defining the difference between lakes and ponds, and no current internationally accepted definition of either term across scientific disciplines or political boundaries exists (Moss et al, 1996). For example, limnologists have defined lakes as water bodies, which are simply a larger version of a pond, which can have wave action on the shoreline or where wind-induced turbulence plays a major role in mixing the water column. None of these definitions completely excludes ponds and all are difficult to measure. For this reason, there has been increasing use of size-based definitions to separate ponds and lakes. One definition of *lake* is a body of water of two hectares or more in area (Moss et al., 1996; Williams et al., 2004); however, others have defined lakes as waterbodies of five hectares and above, or eight hectares and above. Charles Elton, one of the founders of ecology, regarded lakes as waterbodies of 40 hectares or more (Elton and Miller, 1954).

In common usage, many lakes bear names ending with the word *pond*, and a lesser number of names ending with *lake* are in quasi-technical fact, ponds. For example, in Newfoundland, almost every lake is called a pond, whereas in Wisconsin, almost every pond is called a lake (Thomas, 2009). (***Source:*** *Wikipedia.com)*

Natural lakes are generally found in mountainous areas, rift zones, and areas with ongoing glaciations. Other lakes are found in endorheic basins or along with the courses of mature rivers. All lakes are temporary over geologic timescales, as they will slowly fill in with sediments or spill out of the basin containing them. Many lakes are artificial and are constructed for human uses like industry or agriculture, for hydropower or domestic water supply, or aesthetic or recreational purposes.

Elton and Miller (1954) consider a lake as an ecosystem with a sum of structure and function of biotic (living community) and abiotic (non-living or physical environment) regimes exchanging materials between them in the form of matter and energy. A schematic of a freshwater lake is depicted in *Figure 1-1*. The major components comprising the ***structure*** of a freshwater lake are biotic components (i.e., inorganic substances, organic substance, and climatic regime) and biotic components (Odum 1971). There are different zones in a lake. For example, a temperate lake consists of two zones such as open water zone and benthic zone.

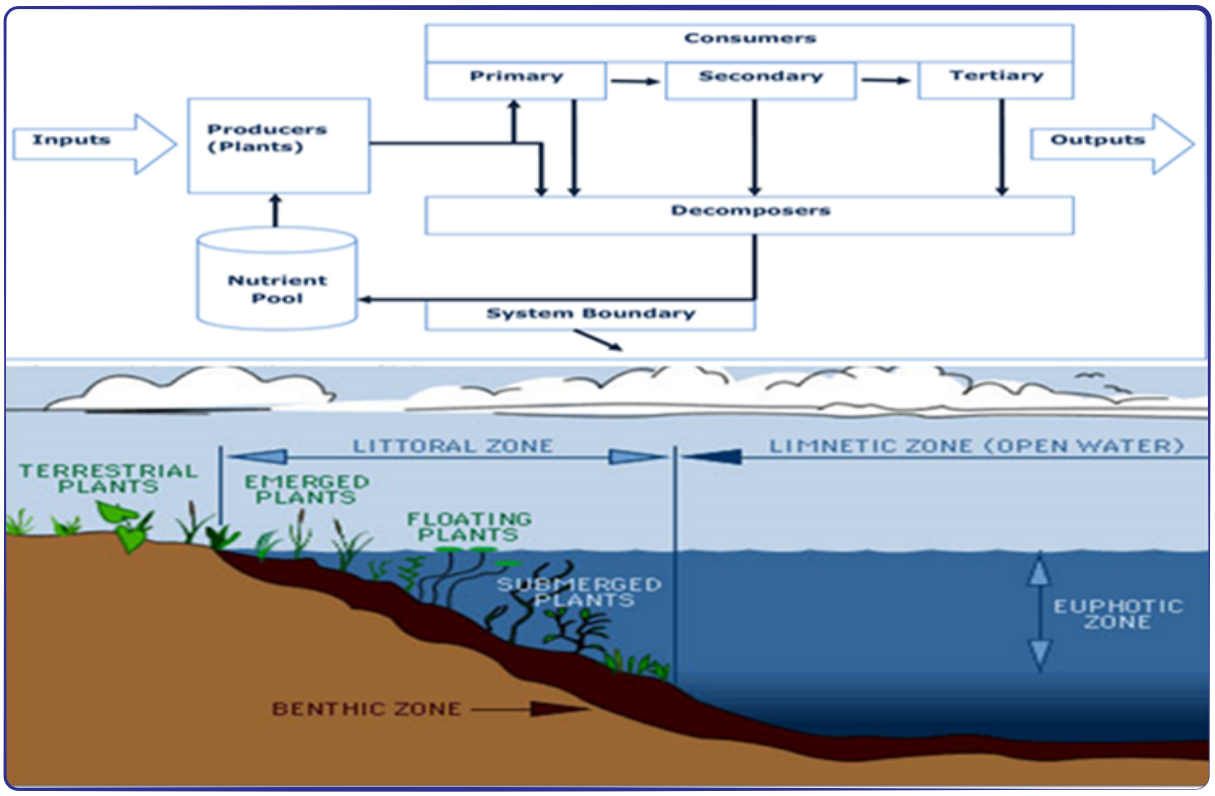

Figure 1-1 **|** *Schematic diagram of the lake ecosystem*

(*Source: Modified from Lake Champlain Ecosystem Assessment, 2016*)

As an ecosystem, lakes offer various services to humans. Various consumptive and non-consumptive values of lakes/wetlands are summarized in *Table 1.1* and various values are detailed below:

- **The resource values of lakes (provisional):** Lakes and their basins provide many uses of different values to humans. They supply water for drinking, agriculture, industry, livestock uses, and energy generation; they buffer downstream areas against both flood and drought; they provide sinks for sediments and contaminants to protect downstream areas (although this can cause problems in the lake itself); they provide a path for transportation, and they offer habitat for important food species. Lakes have both consumptive and non-consumptive values (*Table 1.1*). For countries like Nepal, the importance of lake is immense. They are often considered as the center of livelihoods for local communities, particularly the fishermen.
- **Lakes as biological gene bank:** Lakes being the interfaces of terrestrial and aquatic ecosystems are a productive ecosystem in the biosphere with diverse *floral* and *faunal* communities. Their extensive ecological food-chain with high primary productivity often

supports rich biodiversity and endemism. They do preserve the genes of different species for numerous future uses; therefore, lakes are variously called biological gene banks, biological supermarkets, wonderful lands of biological resources; etc.

Table 1.1 | *Use values of lakes/wetlands*

Direct Use Value	Indirect Use Value	Non-Use Value
Fishing; food; medicine; minerals; nutrients; agriculture and wetland products	Nutrient and sediment retentions	Biodiversity; habitats and unique ecosystem values
Education (teaching, learning, and research)	Watershed management and flood control	Religious and cultural values
Recreation and tourism	Storm and erosion	Research and education values
Wildlife harvesting	Water purification	Spiritual values
Water and timber supply	Regulation of microclimate	Bequest values
Energy (peat, hydro-power, fuelwood)	Shoreline stabilization and biomass export	Genetic values

- **The religious-cultural value of lakes:** The value of lakes is ingrained in the major religion of Nepal. The ancient Hindu holy scripture-*Nepal Mahtmmya, Pashupati Puran, Agni Puran, Bhabishya Puran, Bhagwat Puran, Bishnu Puran, Skanda Puran, Barah Puran, Balmiki Ramayana, Mahavharat, Veda, Himavatkhanda, etc.* mentions the shrine-like properties of lakes and rivers. The earth was a water body in the initial stage of creation, which later formed a basis for the creation of the biosphere, sky, flora, and fauna (Amatya, 2006 -quoting *Brihad-Aranyaka Upanishada*[1]). The importance of lakes and wetlands has been well recognized after the eighth Conference of Parties of the Ramsar Convention (2002) with its global theme *"Wetlands: Water, Life, and Culture"*.
- **Lakes as ecological regulators:** One of the most important values of lakes is being ecological regulators. Lakes retain water, recharge underground aquifers, purify or process polluted water, and improve water quality by removing or retaining nutrients. Lakes perform water-filtering roles when streams slow down to enter the water bodies, causing absorbed sediments which may include chemicals to drop; removing chemicals from the water through aerobic and anaerobic processes, such as denitrification and chemical precipitations. Lakes also contribute to the maintenance of high primary productivity with commensurate mineral uptake by vegetation and benthic deposition when vegetation dies, and high acceleration of decomposition processes due to greater abundance of diverse decomposers (Hussain,1994).

1.2 Lake typology

Lake typologies are generally defined based on productivity, morphology and nutrients, salinity, circulation pattern, and basin characters. There are also special lakes such as **Dystrophic** or **brown water lakes** (with high concentrations of dissolved humic acid that comes from the basin environment) and **warm lakes** (with surface temperatures in summer about 25°C and a homogenous temperature after winter turnover of well above 12°C).

1.2.1 Based on productivity

There are two types of lakes based on productivity, namely, oligotrophic and eutrophy.

[1] Different holy scripts of the Hindu communities.

- **Oligotrophic lakes** are deep and their hypolimnion is larger than their epilimnion. They have low primary productivity. A deep lake with a high concentration of nutrients can be temporarily oligotrophic if limiting nutrients, especially if the phosphate in the surface water is depleted and if the exchange with the hypolimnetic nutrient-rich water is prevented by the thermocline. Such lakes are temporarily "morphometric oligotrophic".
- **Eutrophic lakes** are often more shallow. The internal loading of phosphorus from the sediment supplies the euphotic trophogenic zone continuously with the limiting factor phosphate. They have greater primary productivity, plankton populations are denser and "blooms" are very common. The general trend of increasing productivity with decreasing depth is apparent.

1.2.2 Based on morphology and nutrients

Table 1.2 shows a simple scheme that illustrates the essentials of lake typology with a special focus on lake morphometry and nutrient loading; which presumes a relationship between the number of nutrients entering a water body and the response in the production to that nutrient input. Fertile eutrophic lakes are typical where the soil is rich in nutrients. In nutrient-poor regions, lakes are less productive (after Odum, 1971).

Shallow lakes are particularly sensitive to climatic variation. For example, Lake Nakuru has little buffering capacity to withstand both intra-seasonal and inter-seasonal climate variability because of its shallow depth, high evaporation rates, and seasonal inflowing rivers. The Lake Nakuru basin is a closed basin so only evaporation accounts for water loss from the lake (ILEC, 2005).

Table 1.2 **|** *A single scheme of lake typology*

Depth of Lake	Low Concentration of Nutrients	High Concentration of Nutrients
Shallow lakes	Morphometric eutrophy	Eutrophic
Deep lakes	Oligotrophic	Morphometric oligotrophy

(*Source: Odum, 1971*)

1.2.3 Based on salinity

Saline waters are defined as those with total ionic concentrations greater than 3 g/l (William, 1998). When water evaporates, most of the ions remain behind. When evaporation is the dominant way for water to leave a lake, there is a gradual increase in the lake's salinity. The saline lake is marked by a climate that balances precipitation and evaporation and thereby regulates salinity. In arid areas where closed basins hold concentrated waters, salinity is governed by inputs of dissolved ions from the basins and the magnitude of evaporation. Other factors that influence salinity are temperature and wind. Saline lakes can be classified based on dominating anions into carbonate, chloride, or sulfate waters. The range of salinity is extremely high, up to 200,000 mg/l in the Great Salt Lake of Utah, USA (ILEC, 2005).

The salinity of a lake is of utmost importance to the biota, and consequently to human users. The Aral Sea was once a moderately saline water body, but due to the upstream diversions of rivers, the lake's water balance has become dominated by evaporation and its salinity has dramatically increased, leading to the complete loss of the fishery.

1.2.4 Based on circulation pattern

Five typologies of lakes based on circulation pattern are:

- **Dimictic lake** has two seasonal periods of circulation or overturns: in spring after ice break and in fall when the temperature of epilimnion drops and the homothermic water body of the entire lake is mixed. This circulation pattern is characteristic of temperate lakes.
- **The warm monomictic lake** has water circulation freely in winter when, with sinking temperatures, the surface water is sinking. Lakes of temperate latitudes, Mediterranean and subtropical climates belong to this type of mixing. The temperature does not drop below 4^0C in this type of lake.
- **The oligotrophic lake** is the thermally stable tropical lake with a very slow or rare mixing.
- **Polymictic lake** is characterized by irregular continuous mixing periods depending on the lake morphometry and climatic conditions. It consists of equatorial and high altitude lakes without severe temperature and density gradients. The patterns of mixing are complex. Diurnal patterns of water temperature and density may be more significant than seasonal patterns (Tundisi, 1984).
- **The meromictic lake** does not undergo complete circulation; the surface water does not mix with lower water layers. The deeper part of the water, underlying the upper part is termed monimolimnion, underlying the mixolimnion (Wetzel, 1983). The reasons for meromixis are different. In ectogenic meromixis water of different salinity is intruded by some external event into a lake. As a result, a superficial layer of less dense water is overlying the monimolimnion of denser water of high salinity. Endogenic meromixis results from submerged saline springs delivering dense water into the deep parts of the lake. Accumulation of salts can also be due to biological activities when abnormal meteorological or morphometric conditions prevent the full circulation of a dimictic lake. This type of meromixis is termed temporary meromixis.

1.2.5 Based on basin character

Lakes are intimately connected to their drainage basins and are influenced by activities happening in their airshed beyond their surface water basins. Lake basins can be categorized by their water balance, that is, how water gets into and out of the lake. Scientists distinguish between open and closed lake basins or those that have rivers draining the lake and those that do not. A study of 28 global lakes by ILEC (2005) reported seven types of basins as depicted in *Figure 1-2*.

- **The surface drainage basin** is an open basin with surface water outlet(s). Water leaves the lake by one or more rivers, allowing ions (components of salinity) to be flushed. Thus, the water remains fresh. Water also leaves this type of lake via evaporation and groundwater, but those components are relatively minor compared with river outflows. Examples are Lakes Baikal, Biwa, and so on.
- **The subsurface drainage basin** is an open basin with a significant subsurface inlet/outlet(s). Many lakes have no surface river discharge, yet remain fresh due to substantial flow of water (and salt) via groundwater. Lake Naivasha (Kenya) is an excellent illustration of a lake dominated by groundwater flow.
- **The transitional drainage basin** is a basin with some surface or subsurface outflow but

with significant evaporation. This type of lake occurs mainly in low latitude and arid/semi-arid areas where solar radiation - and hence evaporation - is strong. Small changes in climate or human use can switch a transition basin lake between open and closed states. Greater relative dependence on direct precipitation and evaporation makes these lakes more sensitive to atmospheric inputs than other open basins of equal area, for example, Lake Malawi/Nyasa Basin, Cocibolca, and Victoria.

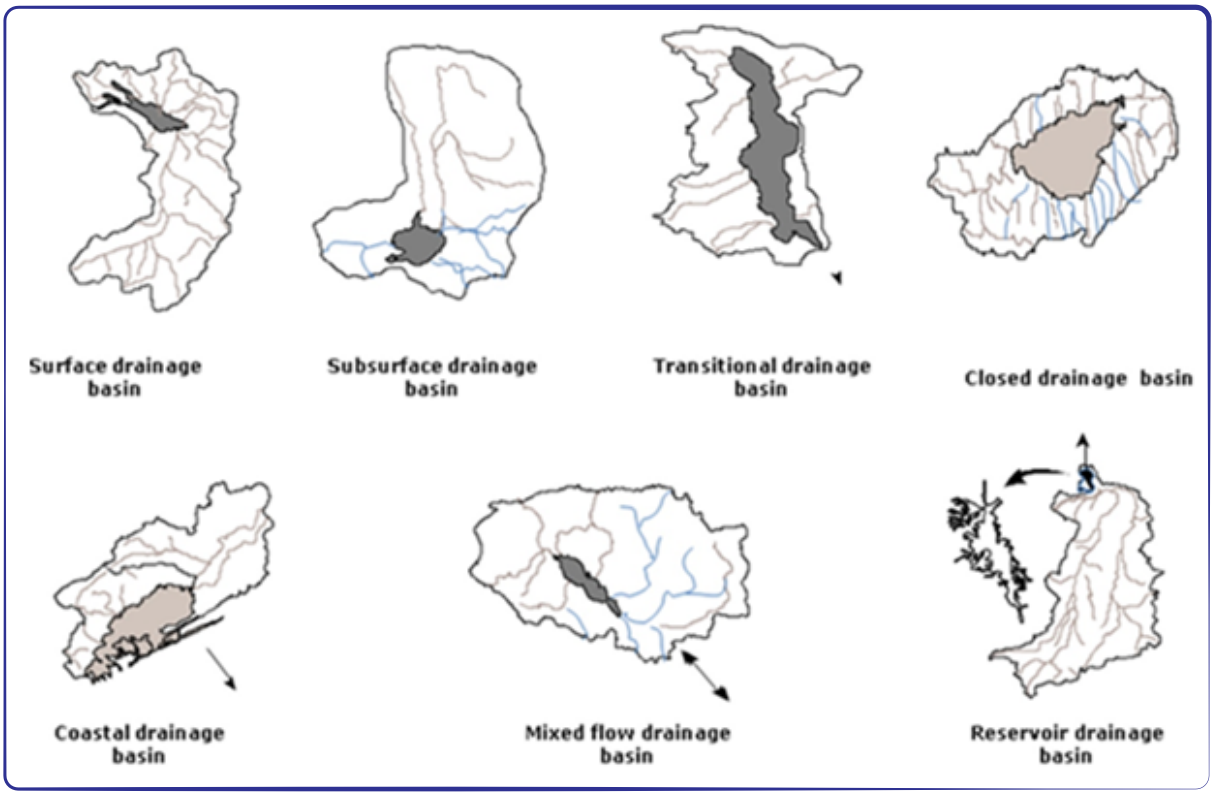

Figure 1-2 | *Types of lake basins*

(Source: ILEC, 2005)

- **The closed drainage basin** is a terminal basin with neither significant surface nor subsurface outflow. Water leaves the lake only through evaporation, which generally leads to higher salinity. Thus, most lakes in closed basins are either saline (total ionic concentration >3 g/L) or are becoming so. Examples include the Aral Sea, Issyk-kul, and Nakuru.
- **The coastal drainage basin** is a drainage basin with flows to and from the ocean. Freshwater typically enters the lake through rivers draining to it. The lake periodically/seasonally drains into the ocean; sometimes the ocean drains into the lake. This can lead to a complex and seasonally dependent salinity gradient that is important for the biota. Examples include Chilika Lagoon (India).
- **The mixed flow drainage basin** is a drainage basin with inflowing rivers that reverse direction depending on the season. In contrast to a coastal lake, the flows come from a freshwater river. This reversal of flow leads to large fluctuations in lake water level and area. These lakes commonly occur in internal deltas. Tonle Sap is a prime example of this type. For this type of basin, the size of the lake's drainage basin is seasonal, since the connecting river inflow is seasonal.
- **The reservoir basin** is a drainage basin with a dammed river. In many areas where

geology and climate do not favor the formation of natural lakes, reservoirs are constructed, although the reasons for construction are quite diverse. Reservoirs tend to have large basin-to-lake area ratios and often have a highly dendritic shape; both characteristics are illustrated in the Tucurui Reservoir and its extensive basin. The transition from river to lake environments within the reservoir proper is gradual and progresses with proximity to the dam. Examples include the Kulekhani Reservoir (Nepal).

1.3 Global distribution and extent of lakes

The variation in geology and climate primarily determines the distribution of lakes. The amount of freshwater including the glaciers of the Arctic and Antarctic regions accounts for only 2.4 percent of the total water available globally; 97.6 percent belonging to the vast amount of water in the ocean that covers 71 percent of the surface of the earth. Lakes contain only about 0.01 percent of the water available on Earth. It is estimated that there are approximately 5.31 million lakes in the world with a size larger than 1 hectare (*Table 1.3*). They cover around 2.51 billion hectares in total.

Table 1.3 | *Origin, number, and extent of the world's lakes (> 1 ha size)*

Origin	Number	Total Area (Hectares, ha)
Glacial	3,875,000	1,247,000
Tectonic	249,000	893,000
Coastal	41,000	60,000
Riverine	531,000	281,000
Volcanic	1,000	3,000
Constructed	45,000	NA
Other/Unknown	567,000	88,000
Total	**5,309,000**	**2,509,000**

(*Source: Adapted from Meybeck (1995) in ILEC (2005)*)

Lakes are most abundant in Canada, the Nordic countries, and the Russian Federation, where there are numerous depressions and a surplus of rainfall over evaporation. However, they are found on all continents. Antarctica is home to many saline surface lakes and even has some lakes buried under a kilometer of ice (for example, Lake Vostok). Arid and semi-arid areas have lakes, many of which are naturally saline due to high evaporation rates (ILEC, 2005) such as the trans-boundary Dead Sea in between Israel and Jordan.

The global water cycle has been profoundly affected by the construction of artificial lakes by damming rivers; these reservoirs contain over 14 percent of global annual runoff. While construction of larger reservoirs is a modern phenomenon, older, smaller reservoirs such as the Bhoj wetlands (Bhopal, India) have been around for over a thousand years (ILEC, 2005). Reservoirs and impoundments are often built in regions that lack a substantial numbers of lakes and are used primarily to address problems of water shortages (drought, for example in Udayapur, India) or excess (floods). In 2000, the World Commission on Dams estimated the existence of over 45,000 large dams (15 m high or between 5-15 m high with a reservoir volume over 3 million m^3). Most were constructed in the latter half of the 20th century.

1.4 Objectives and structure of the report

Lakes are providing vital resources for biodiversity conservation, ecosystem regulation, culture and livelihoods in Nepal. Recognizing the diverse value of lakes, the Government of Nepal (GoN) established a separate entity 'the National Lake Conservation Development Committee (NLCDC)' under the Ministry of Culture, Tourism, and Civil Aviation in 2007. After federal restructuring, it is now placed under the Ministry of Forests and Environment. In 2012, the NLCDC initiated an inventory of the Himalayan lakes of Nepal. In the first phase, an inventory of 11 districts of Eastern Nepal was completed. The second phase started in 2013 with an inventory of lakes in 26 additional districts in Central Nepal. The NLCDC carried out an inventory of 62 districts till 2014 at different phases. However, since the formation of a new federal structure of Nepal in 2015, there is a gap to address and coordinate lakes and wetland conservation status in the inventories across national, provincial and local governments.

The objective of this report is to consolidate available studies/inventories and synthesize them in the form of a National Lake Inventory Report according to the new federal structure of Nepal, more specifically, province-wise. The following are the reports/inventories reviewed and synthesized to develop this report:

- Inventory of lakes in Province-1, Nepal, published in 2018 (NLCDC, 2018)
- Inventory of Himalayan lakes of Central Nepal including Bhojpur, available from the NLCDC (NLCDC, 2013)
- Inventory of Himalayan lakes of Western Nepal (climate change focus) (Gorkha, Kaski, Lamjung, Nawalparasi, Palpa, Parbat, Rupandehi, Syangja, and Tanahu districts), 2014, available from the NLCDC (NLCDC, 2014)
- Inventory of Himalayan lakes of Western and Mid-Western Nepal (climate change focus) (Kapilvastu, Arghakanchi, Baglung, Magdi, Manang, Mustang, Pyuthan, Dang, Rolpa, Rukum, Banke, Bardiya, Salyan, Surkhet, Dailekh, Kalikot, Jumla, and Mugu), 2015, available from the NLCDC (NLCDC, 2015)
- Wetlands of Western Nepal 2017, a brief profile of selected lakes, published by the Department of Forests (DoF, 2017)
- Stone spouts and lakes of Kathmandu Valley, published by Kathmandu Valley Water Supply Management Board (KVWSMB/GoN, 2019).

This report is structured into 10 chapters. These chapters provide an understanding of lakes as an ecosystem, typology of lakes, and a broader global overview of the availability and extent of lakes. The second chapter sheds light on the importance of lakes in the Nepalese context. The third chapter outlines the methodological approach adopted. The fourth to tenth chapters provide details on the availability and distribution of lakes in each province with disaggregation into districts. Finally, details of each lake are provided as annexes.

2. LAKES IN NEPALESE CONTEXT

2.1 Importance of lakes in Nepal

Lakes in Nepal are an integral part of socio-ecological landscape. Nepal's National Wetlands Policy 2003 (amended in 2013) is the only policy document related to lakes and wetlands. It is silent on defining lakes but defines wetlands as *"naturally or artificially created areas, such as swamp; marsh; riverine floodplains; lake; water storage areas and agricultural lands containing water from underground water resources or atmospheric precipitations that may be permanent or temporary; static or flowing, and freshwater or saline"*. This definition recognizes all lakes as wetlands but all wetlands are not necessarily lakes. The National Lake Conservation Development Committee/Government of Nepal defines 'lake' in a very loose but colloquial form as *"All kinds of Tal; Taliya; Daha; Kunda and Pokhari"* (Formation Order of NLCDC 2006).

All the lakes of Nepal are Himalayan lakes irrespective of size, form, and altitude because each drop of water that each lake receives is from the Himalaya (Pokharel and Nakamura, 2010). Being the *"Water Towers of Asia"* in the Hindu-Kush-Himalaya, the country is also the primary source of water for a large part of Asia's population in the form of glaciers, rivers, rainfall lakes, and groundwater. Of these, rivers are the largest source of water. There are about 6,000 rivers/rivulates. Four of them (Mahakali, Karnali, Gandaki/Narayani, and Koshi) are large and fed by snow (WECS, 2011). About 78 percent of the average water flow in the country is drained by those large basins.

There are 3,252 glaciers with an area of 5,323 km^2 and an estimated ice reserve of 481 km^3 that sustain water availability in the region (WECS, 2011). The glacier contribution to the total lotic flow of the basins in which they are situated varies widely across the basins. Lakes at elevations over 3,500 masl are glacial lakes in Nepal, and they are 2,323 such lakes with a coverage of 75 km^2 (Mool et al., 2001). Lakes are believed to cover three percent of total land cover in Nepal (Sharma, 1997).

Nepal has 103 ethnic groups (CBS, 2001). Major traditional ethnic groups with their livelihoods from lakes through fishing are Bote, Majhi, Chepang, Darai, Satar, Tharu, Kewat and Kumale (*Table 2.1*). The IUCN's report lists 20 ethnic groups that are traditionally dependent on wetlands resources including Sunaha/Sundhuwas, Gongi, Mukhia, Kushar, Kachhare and Pode (IUCN, 1998).

Table 2.1 | *Ethnic group dependent on wetlands in Nepal*

Ethnic Groups	Places	Population	Percentage of Total Population (%)
Tharu	All over the Terai	1,533,879	6.75
Mushar	East to Narayani; concentrated in Nawalparasi	172,434	0.76
Dusadh/Paswan/Pasi	Parsa	158,525	0.70
Kewat	Nawalparasi	136,953	0.60
Mallah	Concentrated near Gandak Barrage	115,986	0.51
Kumal	Chitwan	99,389	0.44
Majhi	Inner Terai	71,614	0.32
Danuwar	Jhapa, Sindhuli, Siraha, Morang	53,229	0.23
Dhangar/Jhagar	Moran, Sunsari, Sarlahi	41,764	0.18

Bantar/Sardar	Sunsari and Saptari	35,839	0.16
Darai	Nawalparasi and Chitwan	14,859	0.07
Bote	Nawalparasi and Chitwan	7,969	0.04
Barhamu/Baramu	Gorkha	7,383	0.03
Total		**2,449,823**	**10.79**

(Source: CBS, 2001)

About three percent of communities are believed to be making a living from the lakes. The ethnic groups dependent on wetlands in Nepal are a small fraction of the population and are scattered over the physiographic regions. Many of them have their language, culture and way of life. They live along river basins and wetlands sites. Scholars have included them in different sociological/ethnic categories but they hold their own identity and position in relation to lakes. People dependent on wetlands resources tend to own very little. One will find only a few earthen pots and a hand-woven basket made of bamboo, wild grasses, and cattail inside a house. They retain their traditional ways. They worship *Ban Devi* (goddess of forests) and *Kulkulayan* (the family deity).

2.2 Origin (genesis) of the Himalayan lakes

The origin of Nepal's lakes follows the evolution process of the Himalaya. It is believed to have started about 55 million years ago when the northward moving Indian plate collided with the southern edge of Asia (Tibet) closing the intervening Tethys Sea that was lying between them (Searle et al., 1987). During this process, the Indian plate's leading northern edge was folded, sliced, and uplifted to form the Himalayan mountain belt which comprises different tectonic zones of about 800 Km long.

The Nepalese Himalayan mountain belt is generally divided into five major contrasting tectonic zones having east-west extension (Gansser, 1964) separated by the major faults responsible for controlling the basic framework of the Himalaya. These master faults are the Main Central Thrust (MCT), Main Boundary Thrust (MBT), and Main Frontal Thrust (MFT) from north to south, respectively. The thrusts (low angle reverse fault) get younger from the north to south: the MCT being the oldest and the MFT the youngest. During the movement along with the MCT, a 25-30 Km thick pile of overlying rocks moved southward for over 200 Km (Parrish and Hodges, 1996) overriding a different set of rocks in the south. MBT and MFT also moved similarly at different times. At present, significant movement occurs only along with MFT that today forms the most active structure of the Himalaya (Harrisonet al., 1998). Each of the tectonic zones is characterized by its distinct lithology, tectonics, structure, and geological history. From south to north, these zones are the Terai, Siwalik (Churia), Lesser Himalaya, Higher Himalaya, and Tethys Himalaya. As the geological setting of the country varies considerably in the north-south direction, geological processes responsible for originating lakes in Nepal also differ accordingly.

i) Lakes in the Terai

The Terai depicts three distinct geomorphological units (south to north, southern Terai, middle Terai and Bhaber). The grain size of the sediments in the Terai decreases from north to south having coarser sediments like gravel, cobbles, and boulders in the Bhabar zone and finer sediments such as silt and clay in the southern Terai. In the Middle Terai, the sediments are intermediate consisting of gravel and sand intermixed with silts and clays.

The Bhabar zone forms the major recharge area for the groundwater in the Terai. Following the surface elevation, the groundwater also flows from north to south. As soon as the groundwater arrives at the Middle Terai, the rate of groundwater flow decreases owing to the comparatively finer sediment size (lower permeability comparing to the situation of Bhabar zone). It causes the groundwater to flow further south with a rise in water table across the Middle Terai. Once the groundwater enters the Southern Terai, the rate of groundwater flow further decreases because of the lower permeability of the sediments (fine sand, silt, and clay). Consequently, the water table rises further up and in some low-lying areas, it just emerges on the earth's surface resulting in natural wetlands (marshy land, swampy, or waterlogged) in the southern part of the Middle Terai (Bhattarai and Rao, 1989). This process forms many lakes found in the Terai.

The Terai plane also experiences a considerable amount of tectonic stress induced by the ongoing collision between the Indian and Tibetan plates. It is believed that the Terai plane itself is also gradually uplifting to adjust the stress condition caused by the collision. Since the uplifting process slowly alters the elevation of the area, new lakes may emerge or the existing ones may disappear. Attempting to maintain equilibrium under the newly induced stress condition, rivers start eroding more at some locations and initiate depositing in other places. Consequently, rivers flowing across the Terai plain and Dun valleys have meandered and shifted their channel. While doing so, they have left behind oxbow lakes (abandoned river channels) which, in many instances, are preserved as lakes (*Figure 2-1*).

ii) Lakes in the Himalayan regions

As mentioned above, the Himalayan region consists of different mountain ranges originated at different times with different geological settings. The mountains are made of sedimentary, igneous, and metamorphic rocks that are intensively faulted, jointed, and folded. In the Higher Himalayan area, glaciers made features are also common. Generally, it seems that the origin of wetlands can be linked to rock types, geological structures and glacier made features.

The limestone, a type of sedimentary rock, is slightly soluble in water, particularly when it contains carbonic acid. As the water flows through the cracks formed in limestone, channels are slowly widened until they cave and caverns are created. Later, these also cave and caverns are collapsed forming larger depressions called sinkholes. As there are many limestone terrains in the Himalayan region, there remains a possibility that the sinkholes could have preserved as wetlands.

The fault is a geological structure also contributing to lake formation. Once the faulting process initiates, the earth surface, which includes rock and soil, lying on one side of the fault gradually uprises and it can block river channels or can force a river to change its channel after continuously acting for thousands of years. For example, the paleo Kathmandu Lake was developed after blocking the Bagmati River by upliftment of the Chandragiri Mountain by a fault. Similar conditions must have existed to give rise to lakes or to make them vanish in other parts of the Himalayan region including in the Dun valleys, where a thrust fault, known as Central Churia Thrust, passes longitudinally.

Landslides in the mountain slopes sometimes block rivers or streams creating an artificial dam across the river. The dam may be breached in a few hours in case of big rivers. However it may create lakes permanently in case of small rivers particularly if the river discharge is very low.

The glaciers as moving mass of ice are common in the Higher Himalayan region of Nepal and are an effective means of erosion. They can transport the sediments up to their terminus. The glacier deposited sediment is called till: a very poorly sorted accumulation of detritus ranging in size from rock flour to boulders. The till deposits commonly form ridges or mounds known as moraines. Sometimes a big ice mass is trapped beneath the moraine and when the buried ice mass is melted the overlying ground is collapsed. This process results in a kettle lake (*Figure 2-2*). Besides, if a glacier retreats the moraine deposits may be left behind, both at the terminus of the glaciers and along the sides. The terminal moraines act as a natural dam that may block the outwash flow or the snowmelt water coming from the higher elevation. This process also results in the glacier lakes in the Higher Himalayan region. Besides, the outwash flow or the snowmelt water generally flows along the sides (foot slope) of moraines.

Figure 2-1 | *Wetland (oxbow lake) in Dun valley, Udayapur district*

Figure 2-2 | *A small kettle lake situated on the way to Gokyo in Solukhumbu district*

2.3 Status of lakes in Nepal

Nepal's lakes are estimated to hold three percent of available inland water in Nepal (Sharma, 1997). In 1986, the Water and Energy Commission Secretariat (WECS) prepared the very first inventory of glacial lakes in Nepal. The report documented 194 of them. Later, the Government enumerated 634 lakes including glacial lakes in Nepal (DHM, 1998 a, b, c). An inventory of Nepal's Terai Wetlands counted a total of 163 wetlands comprising 78 lakes and ponds, 13 marshes, 5 swamps, 53 flood plains, 6 reservoirs and 8 canals. They cover an area of 724,257 ha. Forty-six wetlands out of them had area above 8 ha (IUCN- Nepal).

The largest lake of Nepal is the Rara (1,036 ha) lake in Mugu district which is at an altitude of 2,990 masl, and the 2nd largest is the Shey Phoksundo lake (452 ha) of Dolpa district. The

highest freshwater lake is the Tilicho (354 ha.) at an altitude of 4,917 masl. Tilicho is the highest freshwater lake of this size at the highest altitude of the world.

There is little information on the status of lakes in Nepal's mid-hills. A district profile produced in the early 1970s[2] () enlisted 83 freshwater lakes in the mid-hills and High Mountains. Pokhara valley has a sub-tropical lake in Pokhara valley with a total coverage of 3.68 square miles that includes Phewa, Rupa, Begnas, Dipang, Khaste, Maidi, Gunde; Kamal Pokhari and Neureni lakes. Most of these lakes are tectonic in origin and shallow in nature (Gurung, 2001).

In 2009, the NLCDC completed a map-based inventory of lakes in Nepal that listed 5,358 lakes. Out of 75 districts in the country, 74 contain lakes of some form/type. The altitude-wise variation of the lakes is shown in Table 2-2. It shows that 2,712 lakes (51%) are located below 500 m and 2,111 lakes (39%) above 4,000 m. Only 419 lakes (<8%) are spotted in the mid-hills in a range between 500 m-2,999 m, and 116 lakes (2%) are found in a range of 3,000-3,999 m (*Table 2.2*, *Table 2.3*)

Table 2.2 | *Altitudinal distribution of lakes in Nepal*

Altitude (m)	Lakes	
	Number	%
Below 499	2,712	51
500 – 2,999	419	8
3,000 – 3,999	116	2
Above 4,000	2,111	39
Total	**5,358**	**100**

(*Source: Bhuju et al., 2010*)

Table 2.3 | *Lakes distribution by districts, ecological zones, and phytogeographical regions of Nepal*

Ecological Zones	Phyto-geographical Regions: Western (< 83°00'E)		Central (83°00'-86°30'E)		Eastern (> 86°00'E)	
	Districts	Lakes (nos.)	Districts	Lakes (nos.)	Districts	Lakes (nos.)
Highlands	Jumla	99	Dolakha	42	Taplejung	380
	Kalikot	1	Sindhupalchok	75	Sankhuwasabha	159
	Mugu	125	Rasuwa	38	Solukhumbu	339
	Humla	381	Manang	66		
	Bajura	57	Mustang	78		
	Bajhang	25	Dolpa	210		
	Darchula	19				
	7	***707***	***6***	***509***	***3***	***878***
Mid-Hills	Pyuthan	19	Sindhuli	9	Pachthar	17
	Rolpa	16	Ramechhap	25	Ilam	30
	Rukum	70	Kavrepalanchok	1	Dhankuta	4
	Salyan	5	Lalitpur	3	Terhathum	4
	Surkhet	22	Bhaktapur	2	Bhojpur	7
	Dailekh	7	Kathmandu	1	Okhaldunga	0
	Jajarkot	16	Nuwakot	3	Khotang	10
	Achham	13	Dhading	5	Udayapur	14
	Doti	19	Makwanpur	2		
	Dadeldhura	2	Gorkha	36		
	Baitadi	1	Lamjung	23		

[2] Title: Mechi to Mahakali, Parts 1 to 5, 1974

			Tanahau	2		
			Syangya	4		
			Kaski	29		
			Myagdi	33		
			Parbat	5		
			Baglung	60		
			Gulmi	11		
			Palpa	12		
			Arghakhachi	3		
	11	**190**	**20**	**269**	**8**	**86**
Terai-Siwaliks	Kapilbastu	351	Dhanusa	230	Jhapa	136
	Dang	38	Mahottari	186	Morang	184
	Banke	243	Sarlahi	74	Sunsari	69
	Baridiya	82	Rautahat	85	Saptari	46
	Kailali	114	Bara	93	Siraha	140
	Kanchanpur	85	Parsa	71		
			Chitwan	40		
			Nawalparasi	163		
			Rupendehi	289		
	6	**913**	**9**	**1231**	**5**	**575**
Total	**24**	**1,810**	**35**	**2,009**	**16**	**1,539**

(*Source: Department of Survey, 2007/Topographical Sheets, 1992 & 2001 / Field Verification*)

2.4 Lakes as the Ramsar sites

Table 2.4 shows Nepal's contribution under the Ramsar Convention with a designation of nine wetlands until 2015 that hold 34,455 ha of the country's land. Of these internationally important sites, eight are classified under lakes and reservoirs whereas the Koshitappu Wildlife Reserve is the floodplain and non-lake Ramsar site. Most of these sites are spotted inside the protected areas, with four each in high altitude and Terai regions. Mai Pohkari is the only Ramsar site in the mid-hills of Nepal.

Table 2.4 | *Brief overview of Ramsar sites of Nepal (as of 2015)*

SN	Name	Districts	Area (ha)	Elevation (m)	Designation Date	Zone
1	Kshi Tappu Wildlife Reserve	Sunsari	17,500	90	17.12.1988	Terai
2	Beesh Hazari Tal	Chitwan	3,200	286	13.08.2003	Terai
3	Godaghodi lake area	Kailali	2,563	205	13.08.2003	Terai
4	Jagadishpur reservoir	Kapilbastu	225	197	13.08.2003	Terai
5	Gokyo lake complex	Solukhumbu	7,770	975	23.09.2007	High Mountain
6	Gosaikunda complex	Rasuwa	1,030	4,380	23.09.2007	High Mountain
7	Rara lake	Mugu	1,583	2,990	23.09.2007	High Mountain
8	Shey-Phoksundo lake	Dolpa	494	3,612	23.09.2007	High Mountain
9	Mai Pokhari	Ilam	90	2,100	27.11.2008	Mid-Hills
	Total Area		**34,455**			

(*Source: modified from Wetlands International/Ramsar, 2017*)

2.5 Issues of the Himalayan lakes

The problems in lakes can arise from both the direct exploitation of lake resources as well as from human activities taking place within and outside of the lake basins. The nature and extent of threats vary according to the geographical location of the lakes and the magnitude of anthropogenic pressure. Major threats are:

Lake drainage and reclamation: Draining lake water for dry-season crop irrigation is widespread in Nepal. Either people use high-powered pumps or dig outlet ditches to drain out water or construct canals for irrigation. Many lakes in the Terai do not have water-feeding inlets, so draining out of water ultimately led to the subsidence of lakes. Conversion of sites for aquaculture, road construction, solid-waste disposal, discharge of sediments, commercial and industrial development, dam construction, eutrophication, etc. accelerate the soil reclamation process. For example, the area of Phewa lake decreased from 10 Km^2 (1956/57) to 5.5 Km^2 (1976) and 4.4 Km^2 (1998), an over 50 percent reduction within five decades (JICA/SILT, 2002). Once the surface area gets dry, either it is subjected to vegetation succession or people further reclaim the land for other purposes.

For example, conversion of the Chimdi lake in Sunsari district has displaced some 200 fishing and potter communities (Gachhadar et al., 2004). Similarly, formerly productive agriculture and marshy fields around the Begnas Lake are now subjected rapid conversion into dense suburb and semi-commercial areas. The past high density of eel fish is now rarely observed.

Deforestation and habitat fragmentation: The mid-hills and the Terai support a growing human population that puts pressure on forest resources including timber, fuelwood, fodder, litter and other products. The nature and condition of lakes greatly depend on the fate of forests in their basin. Deforestation in the basins leads to landslides and soil erosion that greatly correlates to the physics of the lakes as well as the loss of habitats of birds, fishes, amphibians and aquatic flora.

Hydro-power development: Hydropower developments have several positive socio-economic impacts including the emergence of new lakes. A thorough study of the impact of hydropower development on lakes ecology has not been done yet. Anecdotal evidence from river basins may apply to lakes showing the ecological impacts of hydropower dams, notably the reduction of aquatic flora, fishes, and ungulates. Nepal has 15 ungulate species dependent on wetlands. The Koshi Tappu, the only site with a viable population of Asian Wild Buffalo, has lost over half of its endemic ungulate species.

Agriculture run-off: Pesticides, herbicides, and chemical fertilizers are heavily used around lake basins to enhance the production of crops in Nepal. During the rainy season, the high run-off of fertilizers and pesticides in lakes from the crop fields is common. Agriculture-run-off affected 69 percent of 163 wetlands of Nepal's Terai. Animal by-products cause a high concentration of toxic products causing death, sub-lethal effects and reduce reproductive capabilities. They are also responsible for the widespread occurrence of the Epizootic Ulcerative Syndrome (EUS), a disease caused by the fungus *Aphanomyces invadans* in fishes causing their mortality in the Koshi Tappu (1983) and Ghodaghodi Lake (1998); lake conversion from mesotrophic to eutrophic; natural succession aggravated by an overgrowth of aquatic macrophytes like water hyacinth and trapa in many lakes of the Terai and mid-hills (IUCN, 2004).

Sewage disposal: Lakes in urban and sub-urban areas are used for the disposal of untreated domestic sewerage, effluents, and septic tanks. As a result, many lakes in Kathmandu are extremely polluted. Toilets directly opened onto the holy lakes of Janakpur (the Ganga Sagar

and Dhanusha Sagar). Phewa Lake is reported to have $8x10^6$ coliform per 100 ml (Khatiwada, 2005).

Sedimentation: Landslide, sheet erosion, soil erosion, and water from agriculture fields in the basins are sources of sedimentation into lakes in mountain areas. As a result, lake areas are gradually filled with sediments, and the dry surface area appears, for example in the head of the Phewa and Rupa lakes.

Overharvest of fishes: Over-fishing effects often multiplied by destructive fishing practices have caused a reduction in the fish population of many species. The trend of fish poisoning with thiodine and phoret is widespread in the Terai. Other mal-practices include electro-fishing, using small-mesh nets, excess draining out of the water, and use of explosives. Such practices have caused the death of the aquatic fauna as well as affected the ecological food chain (IUCN, 2004). For example, over-fishing in the Rupa and Begnas Lakes has reduced the population of Sahar fish (*Tor spp.*) thereby reducing the fish-eating birds' population as well. (Source: Personal communication with Mr. Lekhnath Dhakal, President of the Rupa Lake Restoration and Fishery Cooperative, 2013).

Overgrazing: Overgrazing due to free-grazing yaks, sheep, and goats around lakes in Damodarkunda, Gokyo, Gosainkunda and other lakes in high altitude areas have changed the composition of pastureland (Karki et al., 2005; Karki et al., 2007; Shrestha, 2005). Over 12,600 cattle were recorded grazing along the shoreline forests of the Ghodaghodi Lake (IUCN, 2004). Impacts of overgrazing and movement of livestock along the shoreline result in soil erosion, high inputs of nitrogenous nutrients into the wetlands, accelerating eutrophication, and over-growth of aquatic macrophytes (IUCN, 2004). Overgrazing also correlates with livestock health due to poor nutrients, inadequate food supply, and high population pressure; making livestock exposed to diseases like the liver fluke associated with marshland snails. Such diseases when transmitted as epidemics to wild ungulates cause the extinction of species[3] (IUCN, 2004).

Alien species: Alien fish and invertebrate species have been introduced to many lakes, sometimes with severe consequences for native species. These introductions can be either accidental or deliberate. For example, the introduction of alien species in Taudaha Lake of Kirtipur (Nepal) can alter the physical habitat, compete for food resources, and predate on native species. In extreme cases, they can be cause for a loss of aquatic biodiversity. However, some introductions of exotic species may have provided commercial and nutritional benefits to local populations (ILEC, 2005); for example, in the Rupa Lake area (Nepal).

Weed infestations: Excess growth of aquatic plants can cause problems in lakes by altering the habitats of native fauna, interfering with water transport, harboring nuisance species such as flies and mosquito. It can even cause blocking water intakes, impeding water flows, and increase evapotranspiration from the lake surface. Often these plants are exogenous to the lake and their dominance is promoted by increased nutrients levels (ILEC,2005); for example, *Echinocornia sp.* in most of Nepal's lakes in the Terai.

Climate Change: The rate of receding of glaciers in the Himalaya could have potentially serious consequences in terms of water shortage and livelihoods[4]. Nepal is not a direct contributor to global warming, though warming rates increase progressively with elevations (Liu and Chen, 2000; Shrestha et al., 1999). High warming causes rapid deglaciation that alters hydrological

[3] Population of the Asian Wild Water Buffalo in the RCNP in the early 1960s may have become extinct due to the diseases transmitted by domestic Cattle and buffaloes brought in by immigrants settling around the park areas (IUCN 2004).

[4] The International Commission for Snow and Ice

regime in river basins such as an increase in floods and drought frequency and magnitude; formation of glacial lakes and increased vulnerability to a glacial lake outburst flood (GLOF). Nepal already observed about 25 GLOF events (Shrestha, 2007). There are an additional 26 glacial lakes that have potential threats of GLOF including the Tsho Rolpa (the largest glacial lakes of Nepal grew from 0.23 Km^2 in 1957 to 1.76 Km^2 in 2006).

2.6 Lake conservation initiatives

From 1972 to1978, Nepal prioritised forest management to address environmental issues in its first National Forestry Plan (1976) and Community Forestry Plan (1978). This period was important in Nepal because it became a party to the Ramsar Convention in 1972 and established its first Ramsar site, the Koshi Tappu Wildlife Reserve at the confluence of Sunsari, Saptari, and Udaypur districts (Pokharel and Adhikari, 2009).

Lake conservation formally started in 1976 with the establishment of the Koshi Tappu Wild Life Reserve under the Ramsar heritage. Consequently, the National Wetlands Policy (2003, amended in 2012) came into effect with the ambition to conserve lake and wetlands resources sustainably. To translate the policy into action, the National Lake Conservation Development Committee (NLCDC) was formed in 2007 under the Ministry of Culture, Tourism and Civil Aviation. This is the only government institution aiming to coordinate national and international bodies, formulate and implement policies and programs and build national and international partnerships conserving lakes for tourism, biodiversity, and livelihoods in Nepal (Pokharel and Adhikari, 2009).

NLCDC is contributing as the global partner for Integrated Lake Basin Management (ILBM); a comprehensive management prescription that advocates in addressing Lake issues by strengthening lake governance. NLCDC has been working with Japan based International Lake Environment Committee Foundation (ILEC) since 2007.

3. APPROACH AND METHODOLOGY

The approach adopted in developing this report consists of the following steps:

- Review of following reports related to inventory of lakes in Nepal
    - Inventory of lakes in Province-1, Nepal, published in 2018
    - Inventory of Himalayan lakes of Central Nepal including Bhojpur, available from the NLCDC
    - Inventory of Himalayan lakes of Western Nepal (climate change focus) (Gorkha, Kaski, Lamjung, Nawalparasi, Palpa, Parbat, Rupandehi, Syangja, and Tanahu districts), 2014, available from the NLCDC
    - Inventory of Himalayan lakes of Western Nepal (climate change focus) (Kapilvastu, Arghakanchi, Baglung, Magdi, Manang, Mustang, Pyuthan, Dang, Rolpa, Rukum, Banke, Bardiya, Salyan, Surkhet, Dailekh, Kalikot, Jumla, and Mugu), 2015, available from the NLCDC
    - Wetlands of Western Nepal 2017, a brief profile of selected lakes, published by the Department of Forests (DoF, 2017).
- Extract information of each lake and digitize it in a form of a comprehensive Excel database.
- Prepare a GIS database based on the Excel database. It consists of geographical location (latitude/ longitude), administrative location (Ward, Palika, rural municipality, municipality or metropolitan city), district and province, and other technical details available in the reports above.
- Prepare GIS maps with the location of lakes in each physiographic region, province, and district.
- Synthesize information in the form of appropriate tables, figures, and GIS maps. Then, prepare a national lake inventory report with analysis and elaboration in terms of distribution across different physiographical regions, provinces, districts, size of lakes, development potentials of lakes, etc. The level of analysis is guided by the level of information available.

The reviewed reports related to inventory of various regions, primarily those commissioned by the NLCDC, follow a field-based scientific inventory of lakes based on primary and secondary information. The Wetlands Inventory, Assessment, and Monitoring Tool (WIAM) developed by the Government of Nepal was re-envisioned and modified to develop a tool better fitted for the inventory of the Himalayan lakes. A scientific committee was formed to steer the process with representatives of the environmental institution, academia, individual experts, and relevant ministries and departments of the Government of Nepal. The committee reviewed the operational framework including the lake inventory team and endorsed its application.

Before field coordinators and enumerators were mobilized, they were oriented through a training program and did some preliminary field-testing. The enumerators collected primary data from the field, and other relevant secondary information from District Forest Office, district development committee (DDC), Palikas then village development committee (VDC), community

forest users' groups, local organizations, and individuals. Field assistants were hired to assist enumerators in the districts. The field information was assessed and entered in the Lake Information Datasheet and analysed. The following sub-sections elaborate on the approach and methodology adopted in the Lake Inventory Development process.

3.1 Approach

The following approaches have been adopted during the inventory and assessment of lakes:

Lake basin approach: Conserving lakes does not apply only to the core water body but also its basin, and even beyond. Therefore, while delineating the lake area, the study team has incorporated the information of the entire basin. It is an integral part of the inventory in compliance with the water management approach in alignment with global communities, the World Lake Vision (ILEC-UNEP, 2003) and the Fourth Ramsar Strategic Plan 2016-2024 (Ramsar Convention Secretariat, 2016).

Ecosystem approach: The inventory process adopts the approach of 'Use ecosystems, but don't lose them'. This approach governs the principles of ecosystem functions and integrity, recognizes ecosystem boundaries and trans-boundary issues, maintains biodiversity, recognizes the inevitability of change, recognizes people as a part of the ecosystem, recognizes the need for knowledge-based adaptive management, recognizes the need for multi-stakeholder collaboration, and making ecosystem-based management a mainstream development approach.

Lake basin governance approach: This approach is very concrete, and determines who gets what water, when, and how in a transparent, responsive, accountable, and participatory manner. Governance manifests itself in daily interactions between local public officials, citizens, communities, and organizations. How water is governed is critical for the management of biodiversity and secured livelihoods (ILEC, 2005). Unless local level lake governance is not in place, the task of managing the lake becomes critical. Thus, local government bodies are consulted during the inventory process as a prerequisite for exploring lake data.

Consultative and participatory: The expert team adopted a general, participatory and interactive approach. The process involved: mobilizing of the designated working team, regular contact and consultation with the District Forest Offices (DFOs) and District Soil Conservation Offices (DSCOs), information sharing throughout the study period with the NLCDC and regular briefing/reporting. The study adopted communication/interaction among concerned line agencies, collection and utilization of the secondary data available with different environmental entities and line agencies, and review of all relevant documents.

In central level meetings and consultations, the experts' team consulted with relevant stakeholders to get their inputs. In general, the consultation process was managed at 3 levels:

- Consultation with the NLCDC for consensus on procedures,
- DDC, VDC and community consultation for exploring local concerns, and
- Review for national inputs and suggestions from steering committee members.

Mobilization of human resource and capacity building: The expert team organized two separate workshops in Biratnagar and Kathmandu to enhance the technical capacity of field coordinators and graduate students on natural resource management (*Figure 3-1*). During the training, the Lake Inventory tool was field-tested separately in Biratnagar and Kathmandu to

assess its relevance. The "Lake Inventory Tool" used in the inventory process and classification of lake types is provided in Annex-1 and Annex-2, respectively.

The trained enumerators visited the districts with the checklist of lakes that the expert team provided. They consulted relevant offices in each district. Based on inputs and suggestions from these district agencies, the enumerators verified and prepared the profile of individual lakes. For field verification, photographs of each lake and evidence of meeting with communities were strictly documented.

3.2 Methodology

The overall methodological framework adopted for the inventory of each region and the steps followed is shown in *Figure 3-1* and detailed here:

Step 1 – Formation of the expert team (ET): A multidisciplinary team of experts led by a team leader was formed to administer the process of lake inventory development. The team prepared a framework for the scientific and field-based inventory of the Himalayan lakes thoroughly discussed amongst the team.

Step 2 - Formation of the steering committee of experts (SCE): A 'Lake Expert Group' was formed to steer the process of inventory development. It included representatives from the Government, development agencies and non-government institutions, academia, and individual experts involved in lake and wetlands conservation. The group consisted of experts from the Central Department of Environmental Science, the Central Department of Botany, IUCN Nepal, WWF Nepal, the National Trust for Nature Conservation, the Ministry of Environment, Science and Technology, the Ministry of Forests and Soil Conservation, the Water and Energy Commission Secretariat, the NLCDC, the Nepal Academy for Science and Technology, UNDP/Small Grant Program, the National Engineering College, the Bird Conservancy Nepal, the Geology Department/Trichandra Campus and the Mountain Institute. This group had the crucial role of reviewing the processes and progress of the inventory, devising the framework of inventory and inventory tool, and finalizing the progress reports through a series of consultative processes.

Step 3 – Literature review and direct and indirect consultation (national and international): The Expert Team (ET) and enumerators conducted a desk review of relevant literature (published and unpublished) such as a review of relevant policies, analysis of topo sheet, reference maps, and map-based lake inventory, review of district and village profiles, and analysis of relevant information from national and international reports. The team also reviewed the Assessment Tool prescribed by the Ramsar Secretariat and Wetlands Inventory Assessment and Monitoring (WIAM) by MoFSC/GON.

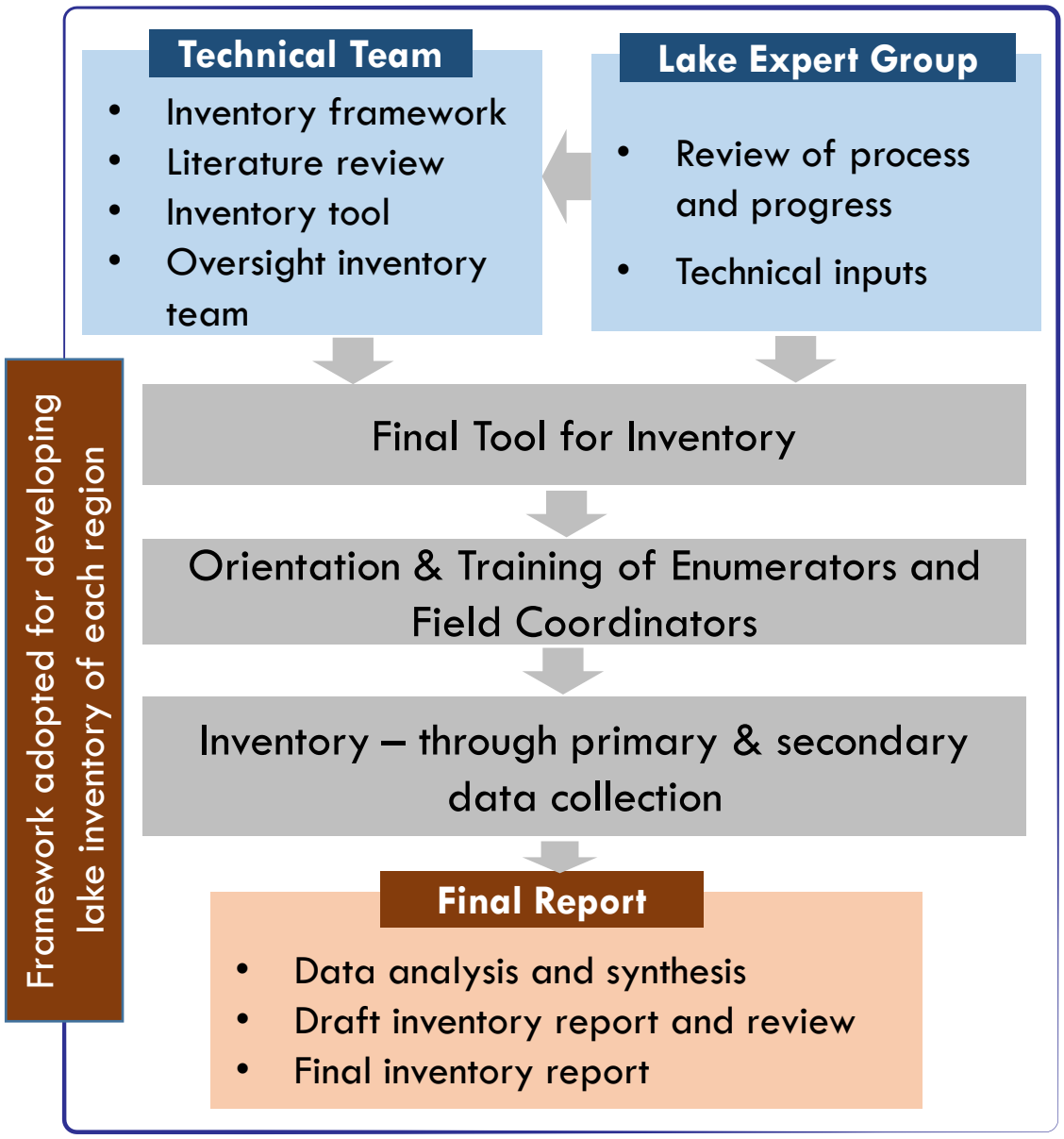

Figure 3-1 | *Methodological framework for inventory of Himalayan lakes in Nepal*

Required demographic data on the various caste/ethnic groups, including demographic information on vulnerable groups, was collected from DDC/VDC.

Consultations were held with national and international organizations engaged in lake conservation.

Step 4 –Development of inventory tools: Based on step 3 outputs, the ET in consultation with experts of the SCE reviewed different tools such as the lake brief guidelines (by ILEC/Japan), WIAM (by MoFSC/GoN), Global Wetlands Assessment Guidelines (by Ramsar) and other relevant documents. The team developed a draft tool applicable to the Nepalese context. The SCE including the NLCDC reviewed, discussed and approved this draft tool. The tool was adopted after pre-testing and incorporation of feedback from the field. (Annex 1).

Steps 5 and 6 – Field survey and assessment, and data collection and geo-referencing: As in the Methodological Framework, enumerators, mostly environmental studies and forestry

graduate students, were selected for the field assessment of lakes. They were provided with training on Lake Inventory and Assessment tool (*Figure 3-2*).

Figure 3-2 **|** *Enumerators and coordinators engaged in training and field testing of the Lake Inventory Tool in 2012 and 2013*

The expert team and enumerators jointly conducted a field survey in the target districts. They used an inventory tool and other techniques such as the Participatory Rapid Appraisal (PRA) and compiled firsthand data in questionnaires. Other data collection tools were key informant interviews, personal interviews, group discussions, indirect observations (for wildlife), direct measurements of temperature and water volume, etc.

Enumerators consulted different tiers of stakeholders such as DDCs, DFOs, VDCs, CFUGs, local communities in the field. The aim was to assess their opinions on the roles and responsibility of actors and agencies, issues with regards to policy and legal measures and other bottlenecks on lake management. The geo-referencing of individual lakes wetlands was carried out to demarcate and map lake basin areas with a geographic positioning system (GPS) and mobile applications.

Step 7 Data analysis, synthesis, and triangulation: The expert team analyzed the data in a specific format, following simple statistical procedures. Lake ranking was done based on indicators prescribed by WIAM[5]. Socio-ecological information was collected in the field and secondary sources of information were triangulated from multiple sources, which include consultations with experts, local institutions, and key informants. Google Earth and Google Free Map Tool was used to analyze the wetlands. Selected sites were revisited to validate existing information. Features of the wetlands covered in the inventory are shown in *Table 3.1* below.

Table 3.1 **|** *Tentative features of wetlands covered in the inventory*

• A geographical location with coordinates and attitudes	• Livestock in the basin
• Conservation status	• Wetlands dependent communities
• Administrative description	• Traditional production system
• Management/administrative authority and ownership	• Cultural feature
• Wetlands type (national and scientific categories)	• Genesis of wetlands
• Hydrological character (Area, Inlet & outlets)	• Resources use
• Ecological feature (water volume; Ambient temperature; Average length/width etc)	• Structural intervention

[5] WIAM indicators include Biodiversity; Uniqueness; Human use of resources; Vulnerability (Settlement, Livestock grazing, Infrastructure), Structural/non-structural practices, Conservation priority etc.

• Floral diversity	• Non-structural intervention
• Faunal diversity	• Monitoring
• Endemism	• Potential
• Access route and distance	• Overall status
• Socio-economic information	

Steps 8 and 10 – Draft/Final report preparation: Based on steps 1 to 7, the draft report was prepared. It was then reviewed by experts and finalized by the NLCDC.

In addition, a synthesis table with key features of each of the lakes listed in this report was prepared, (please see Annex-3 for the synthesis table).

3.3 Limitations

This inventory does not cover the distribution of lakes above 3,000 masl, excluding important lakes like SavaPokhari Lake in Sankhusava, and Panch Pokhari and Gokyo Lakes in Solukhumbu districts. Lake inventory in the High Mountains and Himalaya regions is challenging and thus could not be carried out due to limited time, technology, and financial resources.

4. LAKES IN PROVINCE-1

4.1 Biophysical and socio-economic context

4.1.1 General features

Nepal is a federal democratic nation as per the newly promulgated constitution in September 2015. It is divided into seven provinces. Province-1 lies in the easternmost part of the country and covers 14 districts (*Figure 4-1*) and several municipalities. Province-1 has 137 Palikas, of which, only one is a Metropolitan City, two are Sub-Metropolitan Cities, 46 are Municipalities, and the rest are Rural Municipalities. The province stretches from the Terai in the south to the Himalayas in the north. Province-1 is home to 4.5 million people (17.1% of the country's population) (CBS, 2012) and covers an area of 25,905 km^2 (17.6% of the country's land area).

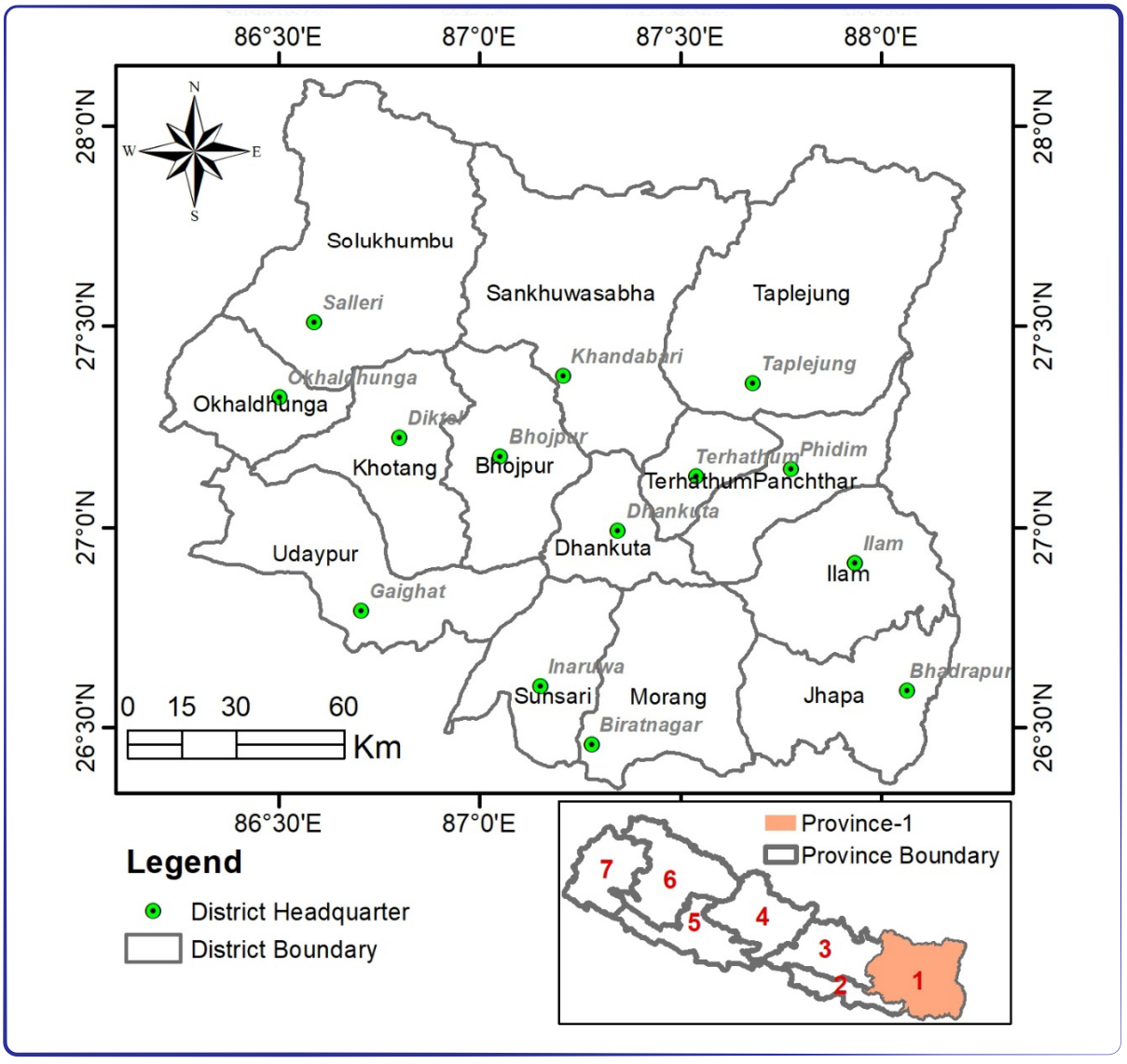

Figure 4-1 | *Location and districts covered in Province-1*

The Himalayan region in the north of the province is the section of the Eastern Himalaya, which consists of popular mountains such as Kanchanjunga, Mahalangur Kumbhakarna, Umvek, Lumbasumba, and Janak. The highest mountain of the world, Mount Everest (8,848 m) and the

third highest mountain, Kanchanjunga (8,598 meters) lie in this province. Besides, the Khumbu, Yalung, and Barun glaciers are notable landmarks. The Nagma Glacier Lake at the Tamor watershed is well known for its natural vegetation and biodiversity. The Terai region of the province extends from the Mechi River in the east at the international boundary with India to the Kamala River in the west. The Kechana Kalan is the lowest point of Nepal i.e., 60 m in the south of the Jhapa district. The Inner Terai such as Ghaighat (Udayapur) is situated to the west of the Koshi River in between the Mahabharat and Churia belts. They hold flat plains with winding rivers that shift course from time to time, running northwest or southeast along the axis of the Churia ranges until they find a break and flow into the Terai and Gangetic plain.

The eastern region of the country is characterized by the development of extensive thrust sheets (allochthonous) of high-grade metamorphic rocks (gneiss and schist) which has moved southwards. Below this, a large exposure of low-grade metamorphic rocks (autochthonous) is observable formed from erosion. The amount of exposure of the Tibetan Tehys Zone is almost negligible in the area but present on top of Mount Everest (Dahal, 2006).

Province-1 contains both subtropical evergreen forests and tundra vegetation. This province has huge potentials for agriculture, hydroelectricity, and tourism. It contains the Kanchanjungha Conservation Area, the Koshitappu Wildlife Reserve, the Makalu Barun National Park, and the Sagarmatha National Park.

4.1.2 Climate

Province-1 is characterized by different climatic conditions depending on locations and places. For example, humid subtropical climate in the Terai, hot summer meridian climate in mid-hills, the subtropical highland oceanic climate in the mountains, and tundra climate in the north high mountains (Climate Data, 2017). The province receives sufficient rain from the monsoon winds originating from the Bay of Bengal. It receives approximately 2,500 mm of rain annually. *Table 4.1* shows city-specific climate data of some locations in the province.

Table 4.1 | *Meteorological parameters at meteorological stations in selected cities of Province-1*

Major Cities	Annual Avg. Rainfall (mm)	Annual Avg. Temp (°C)	Major Cities	Annual Avg. Rainfall (mm)	Annual Avg. Temp (°C)
Bhadrapur	2,363	24.7	Gaighat	1572	24.3
Bhojpur	1,602	17.6	Ilam	1966	18.8
Biratnagar	1,898	24.4	Inaruwa	1922	24.4
Birtamod	2,449	24.6	Itahari	2007	24.4
Chandragadhi	2,382	24.7	Khandbari	1609	21.1
Damak	2,618	24.5	Namche Bazaar	1110	6.1
Dhankuta	1,002	20.6	Okhaldhunga	1985	15.4
Dharan	1,799	23.2	Phidim	1545	20.1
Diktel	1,717	16.9	Salleri	2148	11.9

(*Source: Climate Data, 2017*)

4.1.3 Hydrology/Drainage

The hydrology/drainage pattern of the province (*Figure 4-2*) falls under three grading based on river discharges and their sources. The Saptakoshi also called Kaushiki (Koshi) is the main and first-grade river that originates from a glacier on ice-capped mountains above the snow line. Saptakoshi has seven river tributaries flowing across different districts such as Tamur (Taplejung,

Terhathum, and Dhankuta), Sunkoshi (Okhaldhunga; Udayapur), Dudhkoshi (Solukhumbu), Arun (Sankhuwasava, Bhojpur, Dhankuta), Likhu (Okhaldhunga), Tamakoshi and Indrawati. Kabeli (Taplejung) is the major tributary of Tamur. An average discharge of Tamur at Majhitar (catchment area = 4,050 km^2) is 245 m^3/s and Kankai at Mainachuli (catchment area = 1,148 km^2) is 63.2 m^3/s. Koshi is the largest river basin in eastern Nepal (catchment area = 27,863 km^2) with a discharge of 1,409 m^3/s.

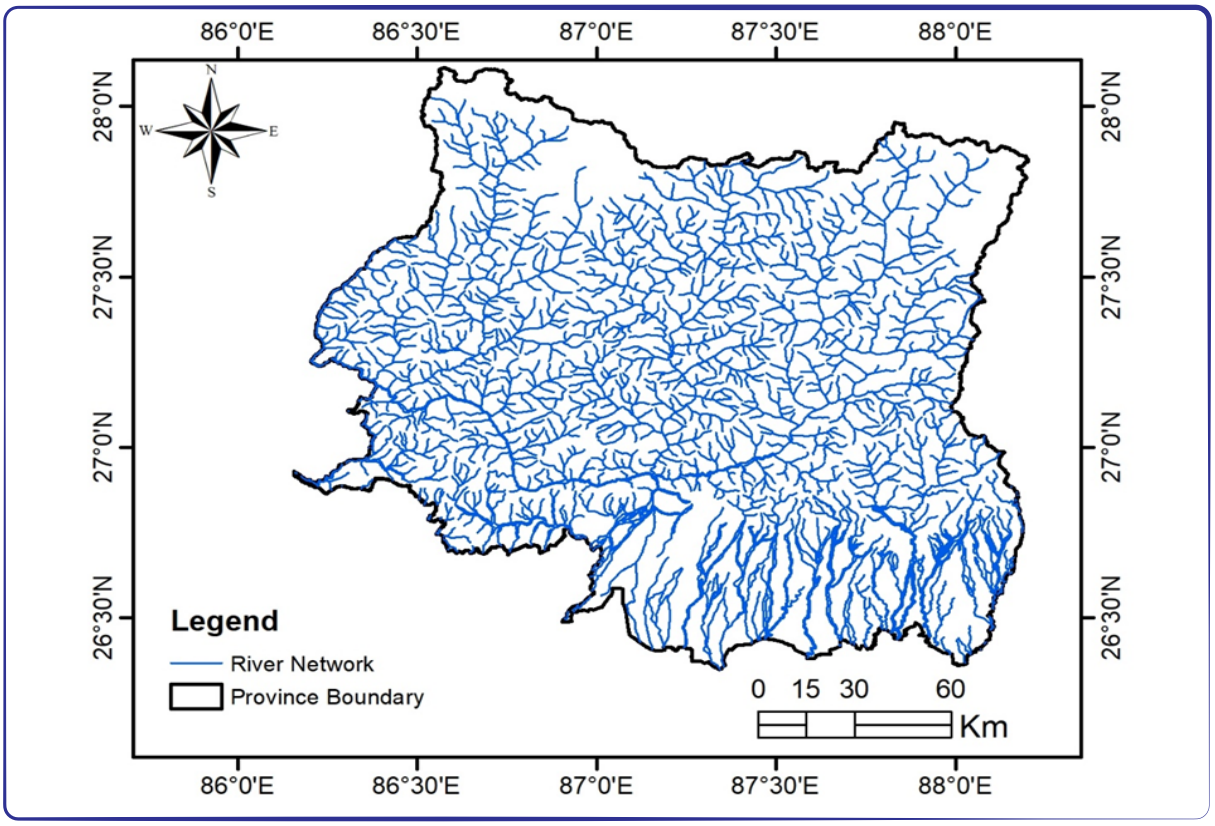

Figure 4-2 | *Spatial distribution of drainage network in Province-1*

Second-grade rivers are the Mechi River (Jhapa), Kankai River (Ilam; Jhapa), Kamala River (Udyaur, Siraha), Rawa, Sawa, and Sapsukhola (Khotang), Sava, Irkhuwa, and Chirkuwa (Sankhuwasava). Kankai, also called Mai River, is the major river flowing in the middle of the Jhapa district. Mai at Rajdwali (catchment area = 377 km^2) has a discharge of 5 m^3/s. Several other flashy rivers, including Biring (Jhapa) and Ratuwa rivers (Ilam, Jhapa), join Kankai in the Nepal-India border. Mechi is the border river between Nepal and West Bengal (India). Tawa and Trijuga is the 2nd-grade river in Udayapur. These streams do not dry up in the low flow period as they meet spring and shallow underground water tables.

In the outer Terai in Jhapa, Morang, and Sunsari, third-grade rivers originate from Siwaliks hills and the Terai plain. They often contain either little water in the winter or no surface flow in the dry period. The major streams are Gachhiya and Kesaliya (Morang), and Budhi and Sunsari Khola (Sunsari).

The province is known to have many lakes, marshy fields, and man-made ponds. High mountains are enriched with glacial lakes such as Imja Lake (Solukhumbu). The middle mountains have scattered few shallow lakes such as MaiPokhari (Ilam) and Rajarani (Dhankuta). The outer Terai is full of ponds. The Chimdi also called Birju Tal is the largest one in the Sunsari district.

4.1.4 Land use/cover

The province has eight different types of land use/cover (*Figure 4-3*). District-wise land use/cover pattern is shown in *Table 4.2*. Agriculture area (or crop field) is the major land use/cover type (40.1%) followed by forests (33.6%), and shrubland (12.1%) (*Table 4.2*). Water bodies cover only 0.6% of the total land in the province. In the recent past, land use/cover in the province has undergone tremendous change, for example, an increase in crop fields and urban formation but a decrease in forests, snow land, and glaciers (Paudel et al., 2016). The largest proportion of forest is in Sankhuwasava and Taplejung, whereas forests cover a lesser area in Sunsari and Terhathum districts. Water bodies chiefly dominated by river systems can be found in Sunsari, Morang and Udayapur districts due to tributaries of the Saptakoshi River.

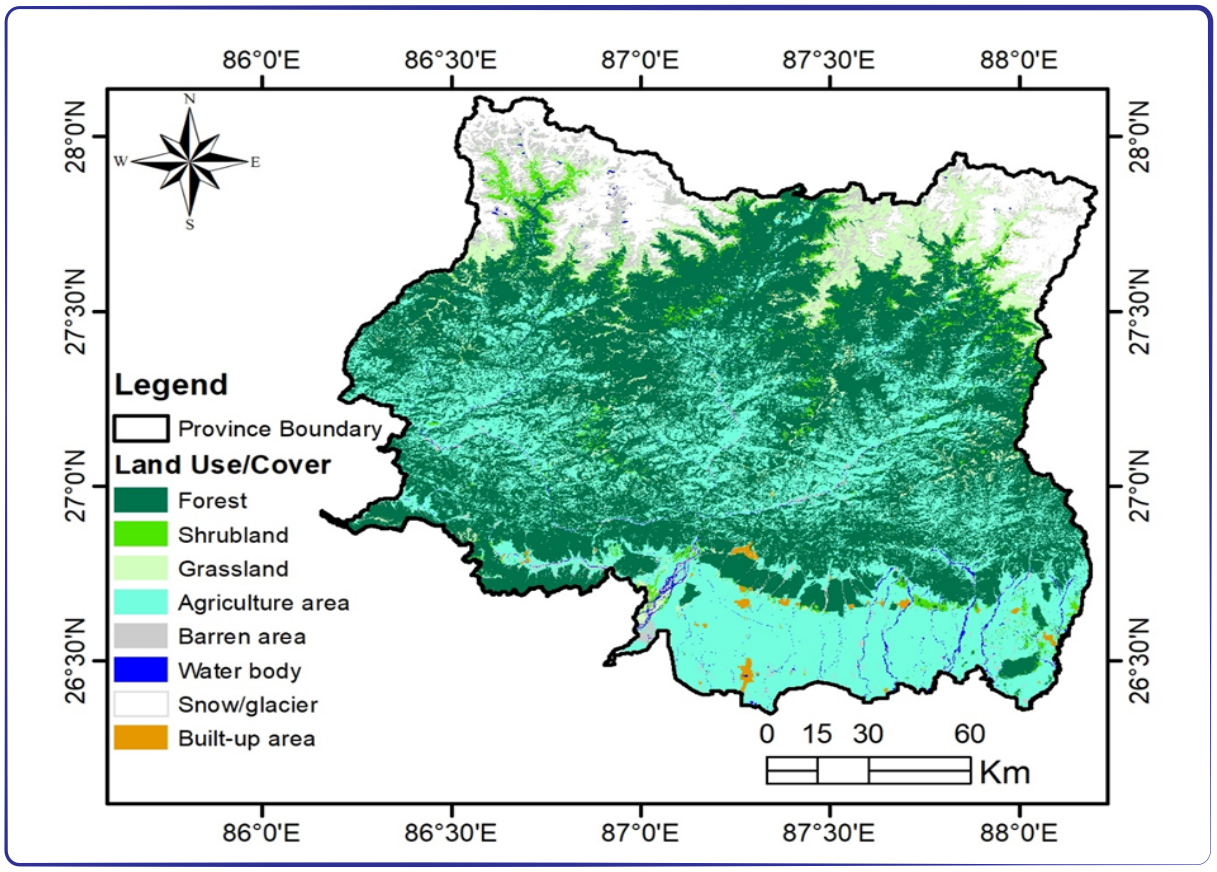

Figure 4-3 **|** *Land use/cover distribution in Province-1*

(Source: Prepared with data from ICIMOD, 2010)

Table 4.2 **|** *Land use/cover (ha) in Province-1*

District	Land use/cover area (ha)								
	Forests	Shrub	Cropfield	Water	Barren	Snow	Others	Total	%
Taplejung	112,256	56,362	70,946	405	37,757	60,115	27,496	365,337	14.1
Panchthar	53,182	14,369	54,078	181	326	29	-	122,165	4.7
Ilam	72,214	31,649	64,595	236	2,873	-	-	171,567	6.6
Jhapa	13,239	1,863	141,795	778	6,517	-	-	164,192	6.3
Morang	43,814	6,040	126,955	1,374	4,996	-	-	183,179	7.1
Sunsari	21,304	1,508	91,799	6,262	6,861	-	-	127,734	4.9
Dhankuta	26,324	14,598	47,350	549	982	-	-	89,803	3.5

Terhathum	20,033	12,489	34,917	129	494	-		68,062	2.6
Sankhuwasabha	159,872	48,476	71,335	975	23,723	40,825	-	345,206	13.3
Bhojpur	61,448	22,207	66,525	552	1,284	-	-	152,016	5.9
Solukhumbu	86,002	49,628	67,424	571	59,670	50,037	19,509	332,841	12.8
Okhaldhunga	32,363	15,592	58,858	352	729	-	-	107,894	4.2
Khotang	61,039	22,571	74,328	931	2,020	-	-	160,889	6.2
Udayapur	109,404	15,766	70,005	1,150	6,587	-	-	202,912	7.8
Total	872,494	313,118	1,040,910	14,445	154,819	151,006	47,005	2,593,797	
%	33.6	12.1	40.1	0.6	6.0	5.8	1.8	100.0	

(*Source: CBS, 2008*)

4.1.5 Population and ethnicity

The human population in the province is about 4.5 million (*Table 4.3*), of which the female population consists of 52.2%. The Mountain region is inhabited by the following communities: Sherpas, Lama, Rai, Bhutias, etc. The hilly region is inhabited by Tamang, Magar, Gurung, Newar, Brahmin, Chettri, etc. In the Terai can be found: Tharu, Marwaris, Muslims; Danuwar, Yadav, Kushawah, Satar, Dhimal, Rajbansi, etc. Sunsari is the most densely populated district (607 persons/km^2) followed by Morang and Jhapa. Solukhumbu has the lowest population density with 32 persons/km^2.

Table 4.3 **|** *District-wise population distribution in Province-1*

Districts	Area (Km^2)	Population			Major ethnicity
		Male	Female	Total	
Bhojpur	1,507	86,053	96,406	182,459	Rai, Magar, Gurung, Tamang
Dhankuta	891	76,515	86,897	163,412	Limbu, Magar, Aathapahrias
Ilam	1,703	141,126	149,128	290,254	Limbu,Yakha,Sunuwar,Brahmins, Ra
Jhapa	1,606	385,096	427,554	812,650	Limbu, Rajbanshi, Dhimal
Khotang	1,591	97,092	109,220	206,312	Rai, Bhramin, Chhetrri, Gurung
Morang	1,855	466,712	498,658	965,370	Tharu, Limbu, Rajbanshi
Okhaldhunga	1,074	68,687	79,297	147,984	Tharu,Chhettri, Brahmin, Tamang
Panchthar	1,241	90,186	101,631	191,817	Limbu, Kiratis, Chhetri, Tamang
Sankhuwasava	3,480	75,225	83,517	158,742	Kumal, Yakkha, Kulung, Rai
Solukhumbu	3,312	51,200	54,686	105,886	Sherpa, Rai, Chhettri
Sunsari	1,257	371,229	392,258	763,487	Tharu, Bhramin, Chhetri
Taplejung	3,646	60,552	66,909	127,461	Limbu,Sherpa,Gurung,Rai
Terhathum	679	47,151	54,426	101,577	Limbu, Rai, Magar, Gurung
Udayapur	2,063	149,712	167,820	317,532	Tharu, Magar, Tamang
Total	25,904	2,166,536	2,368,407	4,534,943	

(*Source: CBS, 2012*)

4.1.6 Economic activities

Biratnagar is the largest industrial sub-metropolitan city in the Morang district of the province. Major Bazars (Market places) in Province-1 districts is shown in *Table 4.4* below.

Table 4.4 | *Major bazars in Province-1 districts*

District	Headquarters	Major Bazars (Market places)
Ilam	Ilam	Ilam, Phikkal, Pashupatinagar, Kolbung,Gajurmukhi
Jhapa	Chadragadhi	Birtamod, Bhadrapur, Damak, Gairiganja, Sanischare
Panchthar	Phidim	Phidim, Ravi, Embung, Panchami, Ranitar, Yasok, Chiligdin, Oyam, Phalicha
Taplejung	Fungling	Fungling, Suketar, Olagchung gola, Siwan, Dovan
Bhojpur	Taksar	Taksar, Dingla, Ghoretar, Chandi, Baying, Sadananda
Dhankuta	Dhankuta	Dhankuta, Hile, Pakharibas
Morang	Biratnagar	Biratnagar, Rangeli, Rani, Urlabari, Letang, Pathari
Sankhuwasava	Khandbari	Khandbari, Tumlingtar, Chainpur, GufaPokhari, Chauki
Sunsari	Inaruwa	Inaruwa, Itahari, Duhabi, Dharan, Jhumka, Chimdi
Terhathum	Myaglung	Myanglung, Basantapur, Lahsune, Srijung, Sakranti
Khotang	Diktel	Diktel, Lamidanda, Halesi, Ainselukharka, Tingla
Okhaldhunga	Okhaldhunga	Okhaldhunga, Rumjatar, Thoksila, Katunje, Baksha
Solukhumbu	Salleri	Phaplu, Salleri, Nele, Lukla, Namche, Sotang
Udayapur	Gaighat	Gaighat, Katari, Udayapur, Beltar, Triveni, Rupatar

4.2 Lakes distribution across physiography

Table 4.5 shows a summary of 80 lakes at elevation below 3,000 masl and *Figure 4-4* depicts their spatial distribution in Province-1 with mix-values for biodiversity, livelihoods, and religion and culture. The districts from highest to lowest number of lakes are Jhapa (20), Morang (11), Panchthar (9), Ilam (7), Khotang (7), Sunsari (5), Bhojpur (4), Tehrathum (4), Udayapur (4), Taplejung (3), Dhankuta (2), Sankhuwasava (2), and Solukhumbu (2). The number lakes reported in Okhaldhunga district are below 3000 masl of altitude.

Table 4.5 | *Physiographic distribution of lakes in Province-1 at altitudes less than 3,000 masl*

S.N	District	Lakes (nos.)	Physiographic Regions			
			Terai (< 700m)	Siwalik (700- 1,500)	Mahabharat (1,500 – 2,700 m)	Hill (>2,700 m)
D-1	Bhojpur	4		1	2	1
D-2	Dhankuta	2			2	
D-3	Ilam	7		2	5	
D-4	Jhapa	20	20			
D-5	Khotang	7		1	6	
D-6	Morang	11	11			
D-7	Okhaldhunga	0				
D-8	Panchthar	9			2	7
D-9	Sankhuwasabha	2				2
D-10	Solukhumbu	2			2	
D-11	Sunsari	5	5			
D-12	Taplejung	3			2	1
D-13	Terhathum	4		1	3	
D-14	Udyapur	4	1		3	
	Total	**80**	**37**	**5**	**27**	**11**

A total of 21 lakes are found in a good condition, the remaining are degrading. The core area of these lakes varies from less than 1 hectare to 103 hectares. Only 3 lakes are larger than 8 hectares: Kechanakal (Jhapa), Rajarani (Dhankuta), and Barju Tal (Sunsari). However, they are important, irrespective of size, for biodiversity and livelihoods especially at high altitude. Chimdi (Barju) lake of Sunsari district is the largest lake (area = 37.1 ha) in Province – 1.

Similarly, lake density is higher in the Terai region whereas it is lesser in the Siwalik region. There are 37 lakes in the Terai, followed by five in Siwalik, 27 in Mahabharat, and 11 Hill region. Lake density gradually decrease in the mountains when altitudinal gradients increase.

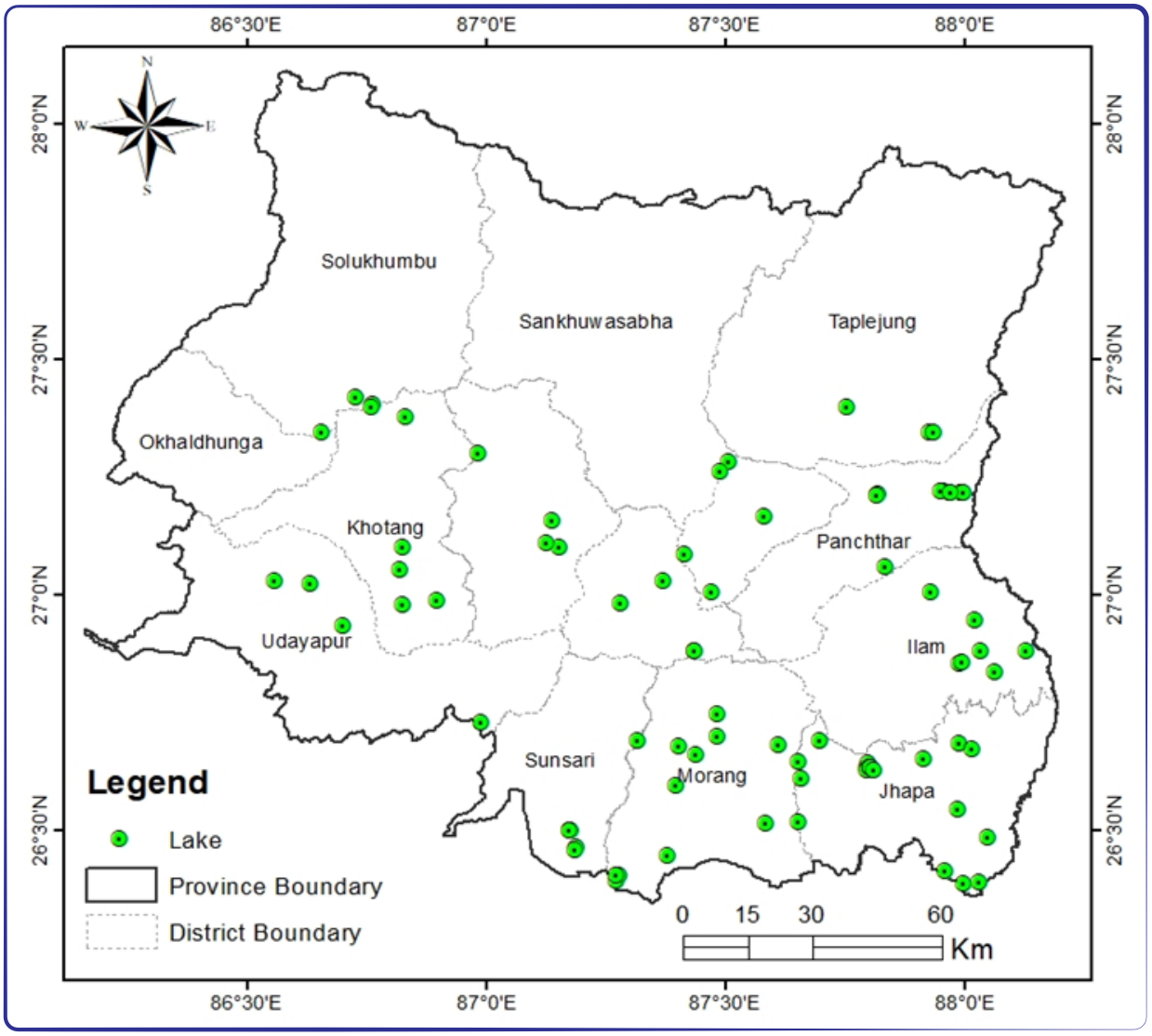

Figure 4-4| *Spatial distribution of lakes in Province-1*

When compared with the map-based inventory, Taplejung district should have the biggest number of lakes, however the field base inventory only found 3 lakes. It may be due to the distribution of lakes of glacial nature found at above 3,000 m not covered in this report. Many lakes below 3,000 m are exploited and converted to other forms of land use.

Most of the lakes in the Terai are used for irrigation and fishery. Some lakes are utilised for tourism such as the Betani lake of Morang and Jamunkhadi and Salbari (Budho Holi) of Jhapa

districts. The Arjundhara lake in the Jhapa district has a religious value. Most of the high altitude lakes are treated as religious symbols.

The Mai Pokhari Lake in Ilam district is the most visited place for domestic tourism and religious purposes. It is the only Ramsar Lake in eastern Nepal at below 3000 m. The Gokyo lake complex of Solukhumbu district, which is also a Ramsar Lake, is not covered by this inventory because of its location above 3,000 m inside the Sagarmatha National Park of Solukhumbu district.

The Mai Pokhari is known to harbor endemic bryophytes *i.e., sphagnum nepalense,* and a primitive amphibian Himalayan warty newt (*tylototricton verrucosus*). Himalayan newts are also reported in the Rajarani lake of Dhankuta district. Further, Salbari lake of Sanischare, Jhapa is home to an endemic plant called *Cycas pectinata*.

Rajarani of Morang district is regarded as the home of orchids with 45 species. It is also the location of a small ethnic group called the Dhimal in eastern Nepal; hence also known as Dhimal Pokhari.

All these lakes have a total core area of about 1.37 km^2 in Province- 1, which is 0.005% of the total surface area of the province. The core water body of the lakes covers a small proportion of the land area, however, lake basins cover nearly 47 km^2. It indicates the value of lakes for biodiversity and livelihoods living in and around the basins.

4.3 Lakes distribution across districts

Province-1 of Nepal consists of 14 districts namely Bhojpur, Dhankuta, Ilam, Jhapa, Khotang, Morang, Okhaldhunga, Panchthar, Sankhuwasabha, Solukhumbu, Sunsari, Taplejung, Terhathum and Udayapur. No lakes below 3,000 masl are reported in inventories in the Okhaldhunga district. The lake distribution in other districts is discussed below.

Bhojpur district: There are four lakes in Bhojpur District (*Table 4.6*). Haans Pokhari is the largest one (1.6 ha) and Manedanda Pokhari and Nira Pokhari are the smallest ones (0.1 ha). All the lakes in Bhojpur are in degrading condition. Please refer to Annex-4 for details on the features of each lake and *Figure 4-5* for spatial distribution.

Table 4.6 | *Lakes in 14 districts within Province-1*

District	Name of Lake	Type of Lake	Area (Ha)		Conditions
			Core	Basin	
Bhojpur	Chyangre Pokhari	Freshwater, Lacustrine, Permanent	0.5	6.3	Degrading
	Haans Pokhari	Freshwater, Lacustrine, Permanent	1.6	6.0	Degrading
	Manedanda Pokhari	Freshwater, Lacustrine, Permanent	0.1	2.6	Degrading
	Nira Pokhari	Freshwater, Lacustrine, Seasonal	0.1	16.7	Degrading
		Total	**2.3**	**31.6**	
Dhankuta	Marga Pokhari	Freshwater, Palustrine, Emergent	0.6	3.2	Degrading
	Rajarani	Freshwater, Lacustrine, Permanent	5.8	275.4	Degrading
		Total	**6.4**	**278.6**	
Ilam	Antu Pokhari	Fresh Water, Palustrine, Emergent	1.10	13.6	Degrading
	Ashok Pokhari	Fresh Water, Palustrine, Emergent	0.20	6.3	Degrading

	Gore Pokhari (Seti Devi)	Fresh Water, Palustrine, Emergent	0.04	9.8	Good
	Jor Pokhari	Freshwater, Lacustrine, Permanent	0.40	6.7	Degrading
	Mai Pokhari	Fresh Water, Lacustrine, Permanent	2.20	7.5	Degrading
	Suke Pokhari	Fresh Water, Palustrine, Emergent	0.30	5.0	Degraded
	Uttare Pokhari	Freshwater, Palustrine, Emergent	0.40	6.6	Degrading
		Total	**4.64**	**55.5**	
Jhapa	Arjundhara	Freshwater, Lacustrine, Permanent	0.1	9.0	Degrading
	Arna Khadi	Freshwater, Palustrine, Emergent	1.0	22.8	Degrading
	Banyani Bandh	Freshwater, Lacustrine, Permanent	0.6	44.9	Degrading
	Dadagaun Bandh	Freshwater, Lacustrine, Permanent	0.6	15.4	Good
	Deunia Khadi	Freshwater, Riverine, Perennial	1.5	58.4	Degrading
	Devi Paini	Fresh water, Palustrine, Emergent	0.5	243.0	Degraded
	Dhamala Bandh	Freshwater, Lacustrine, Permanent	0.2	*	Degrading
	Dhanusha Pokhari	Freshwater, Palustrine, Emergent	0.9	67.1	Degrading
	Dudamari Bandh I	Freshwater, Lacustrine, Permanent	0.7	137.7	Degrading
	Dudamari Bandh II	Freshwater, Lacustrine, Permanent	0.8	28.6	Degrading
	Indreni Tal	Freshwater, Palustrine, Emergent	0.6	36.4	Degrading
	Jamunkhadi	Freshwater, Palustrine, Emergent	4.5	215.4	Good
	Katahare Bandh	Freshwater, Lacustrine, Permanent	0.2	*	Degrading
	Kechana Rani Pokhari	Freshwater, Palustrine, Emergent	10.9	730.2	Good
	Lahure Bandh	Freshwater, Lacustrine, Permanent	0.2	18.1	Good
	Lajeko Bandh	Freshwater, Palustrine, Emergent	0.9	100.8	Good
	Mahadevthan Bandh	Freshwater, Riverine, Perennial	1.0	25.8	Degrading
	Pagari Bandh	Freshwater, Lacustrine, Permanent	0.1	37.8	Degrading
	Pathriya Khadi	Freshwater, Riverine, Perennial	0.9	46.6	Degrading
	Salbari (Budho Holi, Bhimsen Pokhari)	Freshwater, Riverine, Perennial	1.7	158.2	Good
		Total	**27.9**	**1,996.2**	
Khotang	Bahane Pokhari	Freshwater, Lacustrine, Permanent	0.6	5.8	Good
	Baraha Pokhari	Freshwater, Lacustrine, Permanent	3.3	85.3	Degrading
	Chhitta Pokhari	Freshwater, Lacustrine, Permanent	0.1	41.3	Degrading
	Homma Pokhari	Freshwater, Lacustrine, Permanent	0.1	5.6	Degrading
	Indreni Pokhari	Freshwater, Lacustrine, Seasonal	0.1	3.8	Degrading
	Kaali Pokhari	Freshwater, Lacustrine, Seasonal	0.1	3.2	Degrading
	Laamche Pokhari	Freshwater, Lacustrine, Seasonal	0.1	1.8	Degrading
		Total	**4.4**	**146.8**	
Morang	Betini Simsar	Freshwater, Riverine, Perennial	2.8	109.8	Good
	Betna	Freshwater, Lacustrine, Seasonal	7.2	380.9	Good
	Bagjhoda	Freshwater, Lacustrine, Permanent	1.9	69.6	Degrading
	Dhanpalgadi	Freshwater, Palustrine, Forest	0.2	59.2	Degraded
	Hasina Simsar Pokhari	Freshwater, Riverine, Perennial	1.2	69.3	Good
	Rajarani Pokhari	Freshwater, Lacustrine, Permanent	8.4	62.1	Good
	Raja Birat Ko Pokhari	Freshwater, Lacustrine, Seasonal	1.1	57.6	Degraded
	Raja Dhanpalthan Pokhari	Freshwater, Lacustrine, Seasonal	0.7	22.8	Degrading
	Rani Pokhari	Freshwater, Lacustrine, Seasonal	0.7	75.3	Degrading
	Rani Mantha Pokhari	Freshwater, Lacustrine, Seasonal	0.3	**	Degrading
	Sunbarsi Pokhari	Freshwater, Palustrine, Forest	1.9	56.8	Good

	Total		**26.4**	**963.4**	
Panchthar	Dabala Pokhari	Freshwater, Palustrine, Emergent, Forest	0.20	6.8	Degrading
	Gunte Pokhari	Freshwater, Palustrine, Emergent	0.10	4.3	Degrading
	Harkote Pokhari	Freshwater, Palustrine, Emergent, Forest	0.03	4.8	Degrading
	Hile Pokhari	Freshwater, Palustrine, Emergent, Forest	0.10	4.6	Good
	Jor Pokhari-I (Vale Pokhari)	Freshwater, Lacustrine, Permanent	0.02	2.8	Degrading
	Jor Pokhari-II (Pothi Pokhari)	Freshwater, Lacustrine, Permanent	0.10	2.8	Degrading
	Lam Pokhari	Freshwater, Palustrine, Emergent, Forest	0.30	14.6	Good
	Suke Pokhari-I	Freshwater, Palustrine, Emergent, Forest	0.70	5.3	Degrading
	Suke Pokhari-II	Freshwater, Palustrine, Emergent	0.20	2.1	Degrading
	Total		**1.75**	**48.1**	
Sankhuwasabha	Gupha Pokhari	Freshwater, Palustrine, Emergent	0.4	41.2	Good
	Lam Pokhari	Freshwater, Palustrine, Emergent	0.1	9.7	Good
	Total		**0.5**	**50.9**	
Solukhumbu	Phurke Pokhari	Freshwater, Lacustrine, Seasonal	0.2	12.1	Degrading
	Suke Pokhari	Freshwater, Lacustrine, Permanent	0.2	18.6	Degrading
	Total		**0.4**	**30.7**	
Sundari	Barju Tal	Freshwater, Lacustrine, Seasonal	37.1	499.2	Degraded
	Daita Pokhari	Freshwater, Lacustrine, Seasonal	1.2	14.8	Good
	Magar Daha	Freshwater, Lacustrine, Seasonal	3.0	91.1	Degrading
	Savdov Pokhari	Freshwater, Lacustrine, Seasonal	4.9	75.4	Degrading
	Tal Talaiya	Freshwater, Lacustrine, Seasonal	3.2	242.3	Degrading
	Total		**49.4**	**922.8**	
Taplejunj	Kali Pokhari-I	Fresh Water, Palustrine, Emergent	0.01	2.7	Degrading
	Kali Pokhari-II	Fresh Water, Palustrine, Emergent, Forest	0.40	6.8	Degrading
	Suke Pokhari	Fresh Water, Palustrine, Emergent, Forest	0.04	5.1	Degrading
	Total		**0.45**	**14.6**	
Tehrathum	Chichiling Pokhari	Fresh water, Palustrine, Emergent	0.2	2.0	Degrading
	Marga Pokhari	Freshwater, Palustrine, Emergent, Forest	0.2	4.1	Good
	Mudke Aahal	Freshwater, Palustrine, Emergent	0.1	5.2	Degrading
	Panchkanya Chhather Pokhari	Freshwater, Palustrine, Emergent	0.2	13.1	Degrading
	Total		**0.7**	**24.4**	
Udaypur	Belha Gavi	Freshwater, Lacustrine, Permanent	1.6	28.2	Degrading
	Dahar Pokhari	Freshwater, Lacustrine, Permanent	0.1	8.5	Degrading
	Rautamai Pokhari	Freshwater, Lacustrine, Seasonal	0.5	9.1	Degrading
	Taple Pokhari	Freshwater, Lacustrine, Permanent	0.6	9.7	Good
	Total		**2.8**	**55.5**	

Dhankuta district: Dhankuta district has only two lakes. Both of them are in degrading conditions (*Table 4.6*). The Rajarani Lake is the largest one (5.8 ha) and Marga Pokhari the smallest one

Illam district: There are seven lakes in the Ilam district (*Table 4.6*). Mai Pokhari is the largest lake with an area of 2.2 ha, while Gore Pokhari (Seti Devi) is the smallest lake (0.04 ha). Almost all the lakes in the district are in degrading conditions except Gore Pokhari. Mai Pokhari is the only Ramsar heritage found to have a 2.2 ha area. Details on the features of each lake are provided in Annex-6 and spatial distribution in *Figure 4-7*.

Jhapa district: Jhapa hosts the highest number of lakes in Province-1. Out of 20 lakes in Jhapa, Kechana Rani Pokhari is the largest one (10.9 ha), and Pagari Bandh and Arjundhara are the smallest ones (0.1 ha). Six lakes are in good condition where others are degrading (*Table 4.6*). Please refer to Annex-7 for details on the features of each lake and *Figure 4-8* for spatial distribution.

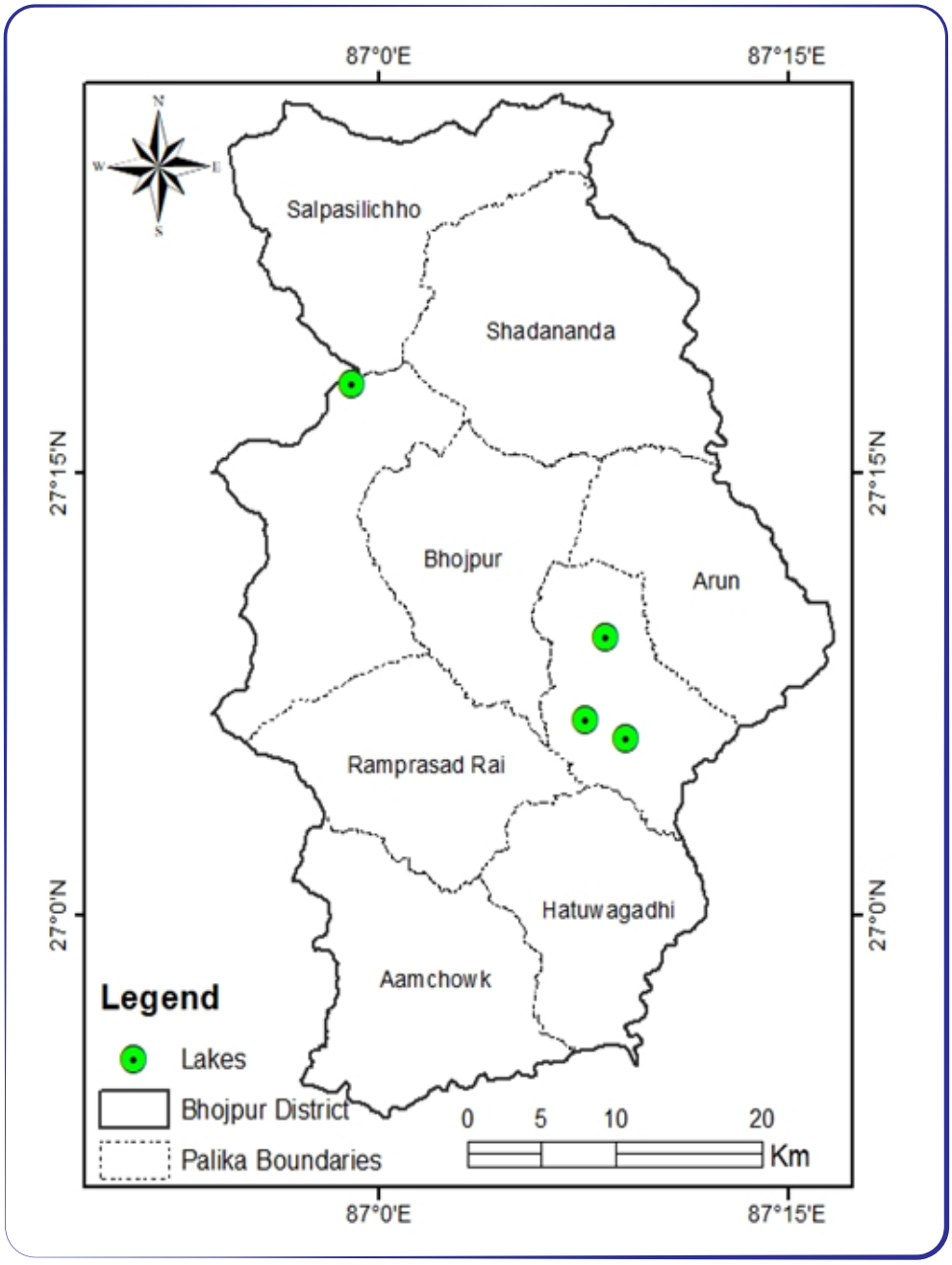

Figure 4-5| *Spatial distribution of lakes in Bhojpur district*

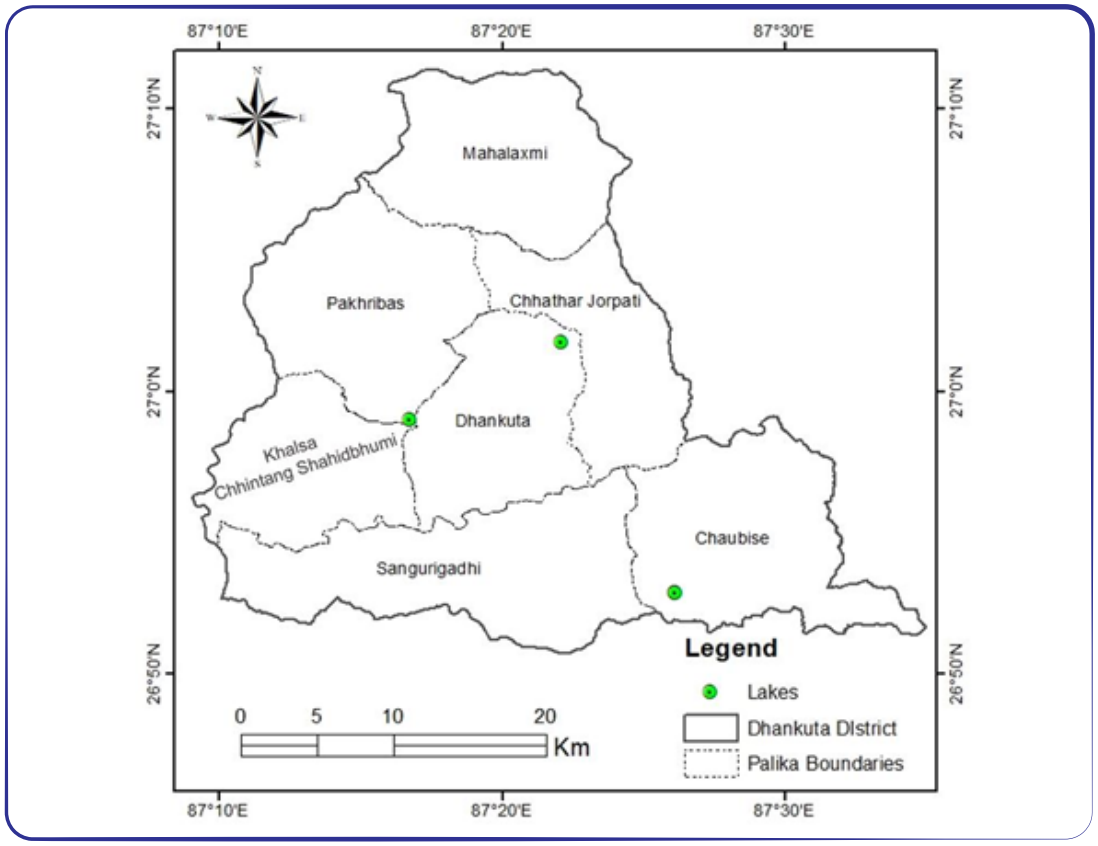

Figure 4-6 | Spatial distribution of lakes in Dhankuta district

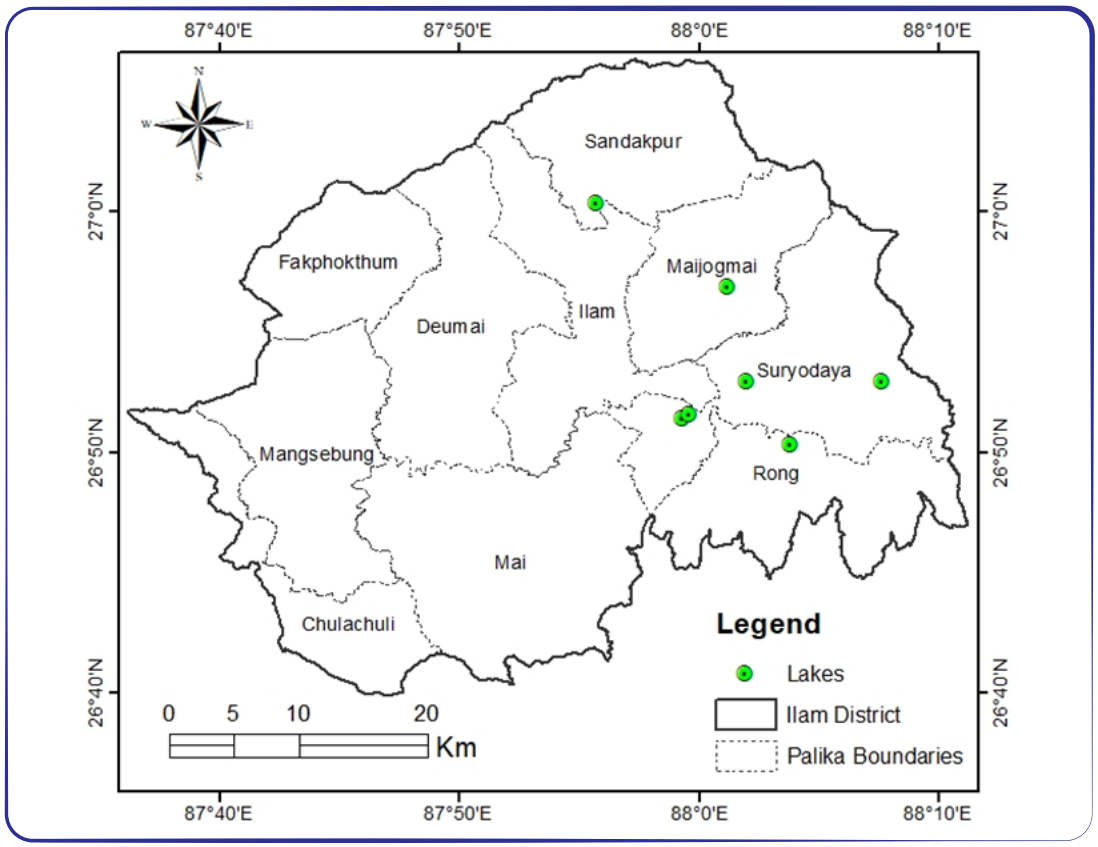

Figure 4-7 | Spatial distribution of lakes in Ilam district

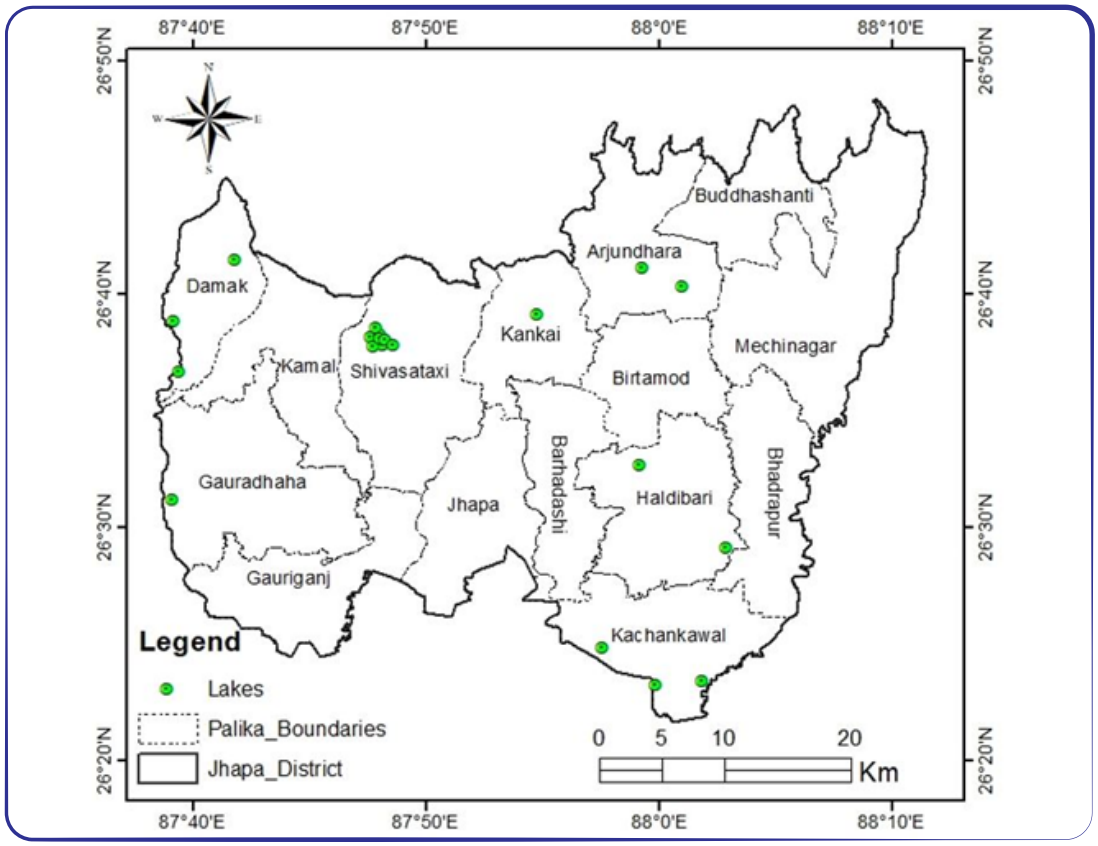

Figure 4-8 | *Spatial distribution of lakes in Jhapa district*

Khotang district: There are seven lakes in Khotang district. The largest one (i.e., Baraha Pokhari) has the largest area of 3.3 ha and the smallest ones (i.e., Chitta, Homma, Kali, Indreni, and Lamche Pokhari) have an area of 0.1 ha (*Table 4.6*). All lakes are degrading except Bahane Pokhari. Please refer to Annex-8 for details of each lake and *Figure 4-9* for spatial distribution.

Morang district: There are 11 lakes in Morang district. Their spatial distribution is shown in *Figure 4-10*. Betna is the largest one with an area of 7.2 ha and Dhanpalgadi the smallest one (0.2 ha) (*Table 4.6*). Rajarani Lake also known as Dhimal Pokhari is believed to be the birth place of the indigenous Dhimal communities. Details on the features of each lake are provided in Annex-9.

Panchthar district: There are nine lakes in Panchthar. They are distributed across the district as shown in *Figure 4-11*. Suke Pokhari –I is the largest one (0.7 ha), whereas Jor Pokhari I and Harkate Pohari are the smallest ones. Most of the lakes are degrading (*Table 4.6*). Hile Pokhari and Lam Pokhari are in good condition. Details of each lake are provided in Annex-10.

Sankhuwasabha district: There are two lakes in Shankhuwasabha (*Figure 4-12*), with Gupha Pokhari the largest one (0.4 ha) and Lam Pokhari the smallest (0.1 ha) (*Table 4.6*). Both lakes are important for biodiversity conservation. Details on the features of each lake are available in Annex-11.

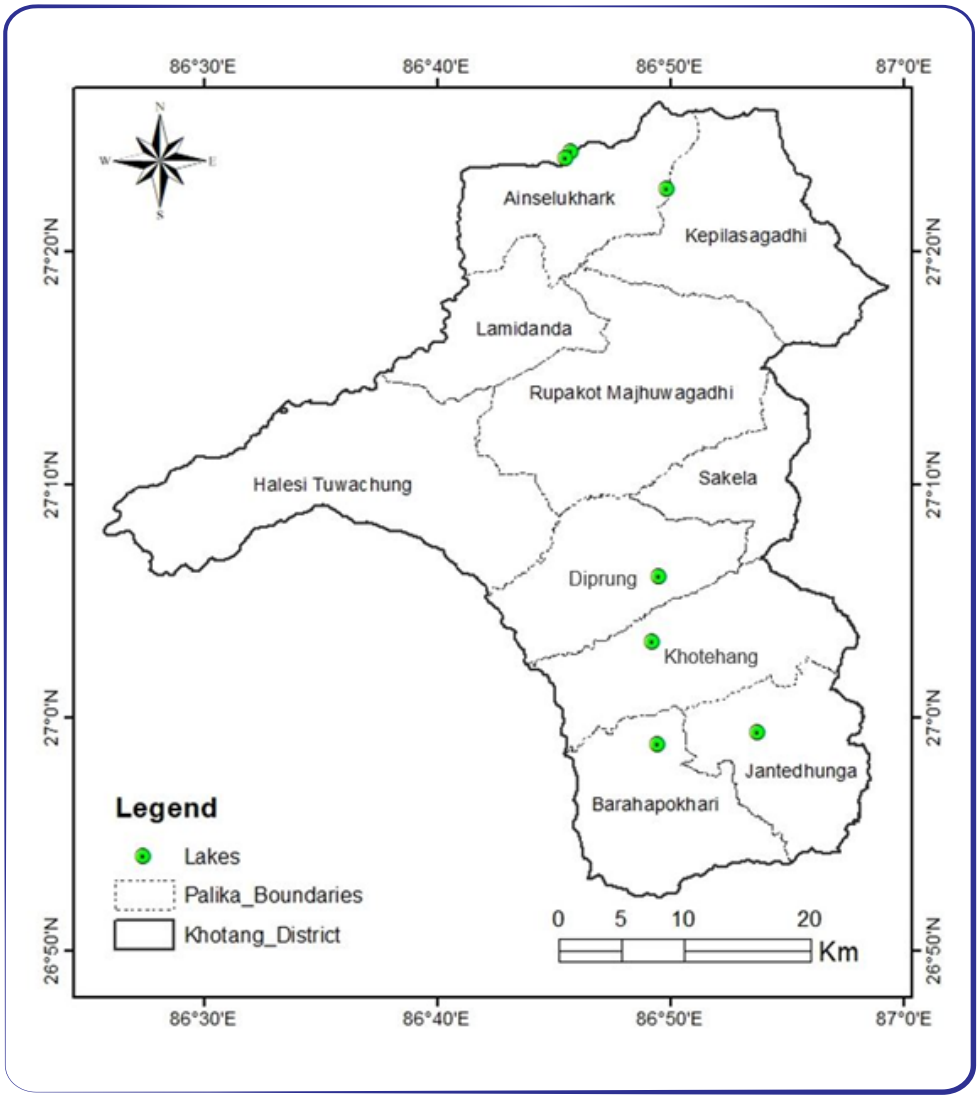

Figure 4-9 | *Spatial distribution of lakes in Khotang district*

Solukhumbu district: There are two lakes in Solukhumbu district (*Figure 4-13*) Both of them are smaller and degrading (*Table 4.6*). Please refer to Annex-12 for the detailed features of each lake.

Sunsari district: There are five lakes in Sunsari district. Barju Taal is the largest one (37.1 ha) and Daita Pokhari the smallest (1.2 ha) (*Table 4.6*). The smallest lake has great potential for tourism and livelihoods. Please refer to *Figure 4-14* for spatial distribution of the lakes and Annex-13 for details on the feature of each lake.

Taplejung district: There are three lakes located in Taplejung. Their spatial distribution is shown in *Figure 4-15*. Kali Pokhari-II is the largest lake (0.4 ha) and Kali Pokhari II the smallest one (0.01 ha) (*Table 4.6*). All three lakes are in degrading condition. For detailed features, please refer to Annex-14.

Tehrathum district: There are four lakes in the Terhathum district (*Table 4.6*) with spatial distribution shown in *Figure 4-16*. All lakes are small. Two of them are in degrading condition. Details on each feature of each lake are provided in Annex-15.

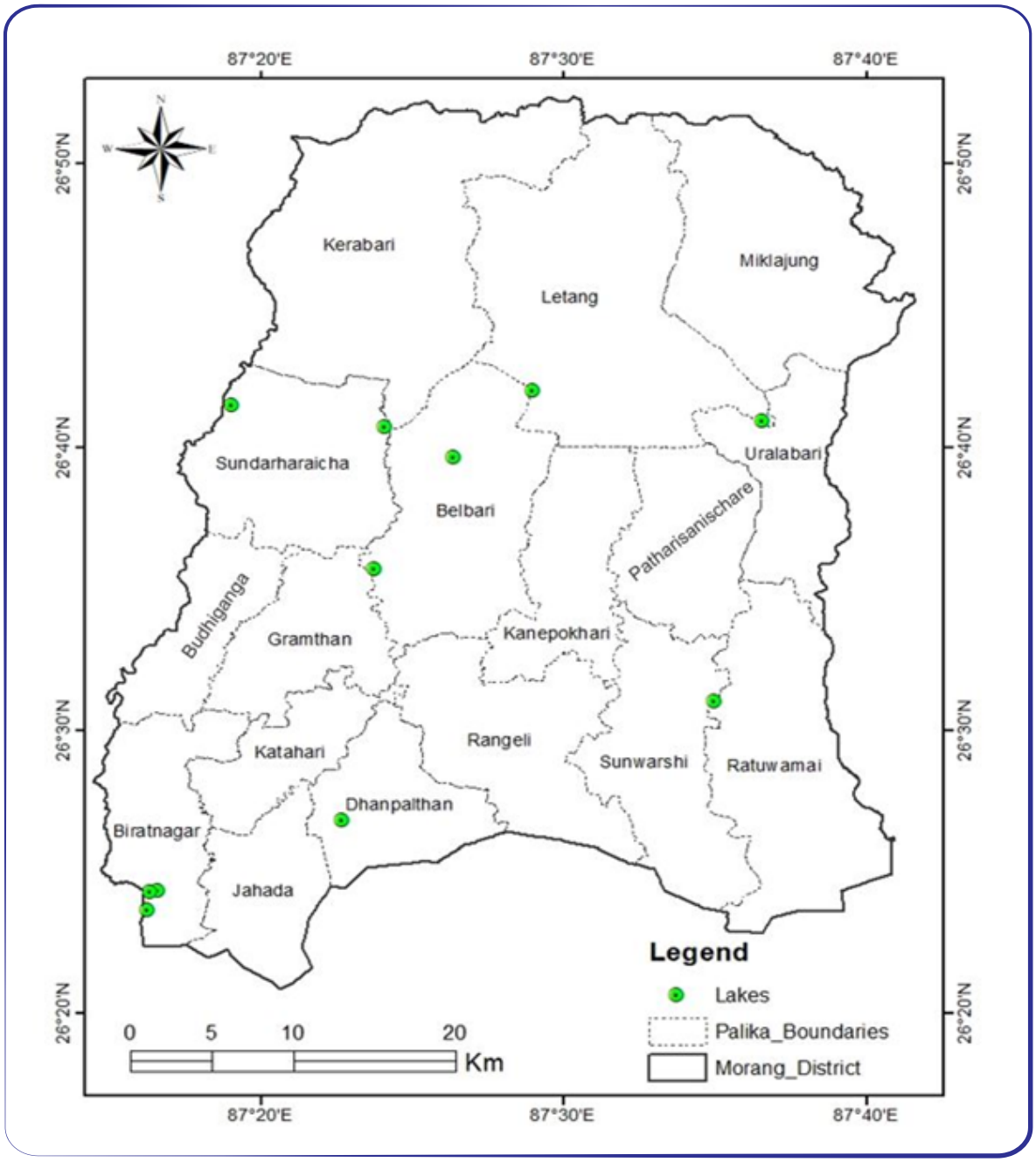

Figure 4-10| *Spatial distribution of lakes in Morang district*

Udayapur district: This district has four lakes. Belha GaviPokhari is the largest (1.6 ha) (*Table 4.6*). Their spatial distribution is shown in *Figure 4-17* and detailed features in Annex-16. Three out of four lakes are in degrading condition.

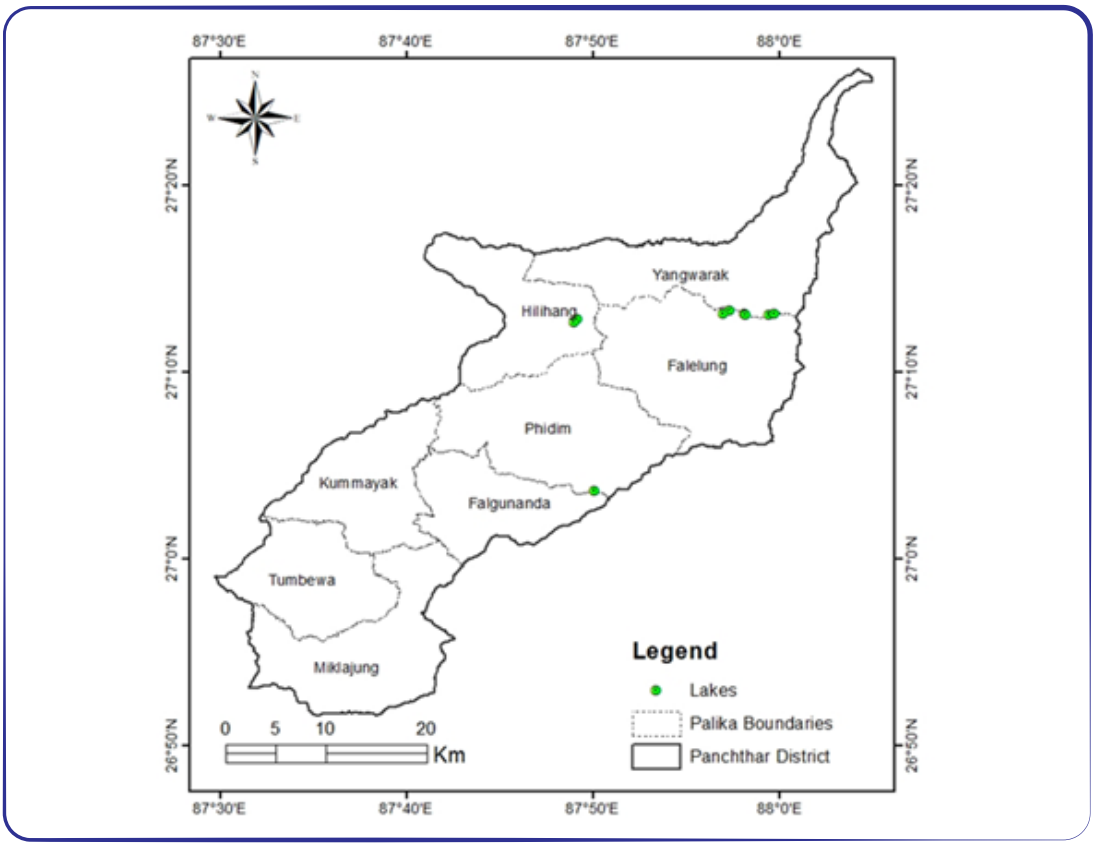

Figure 4-11 | *Spatial distribution of lakes in Panchthar district*

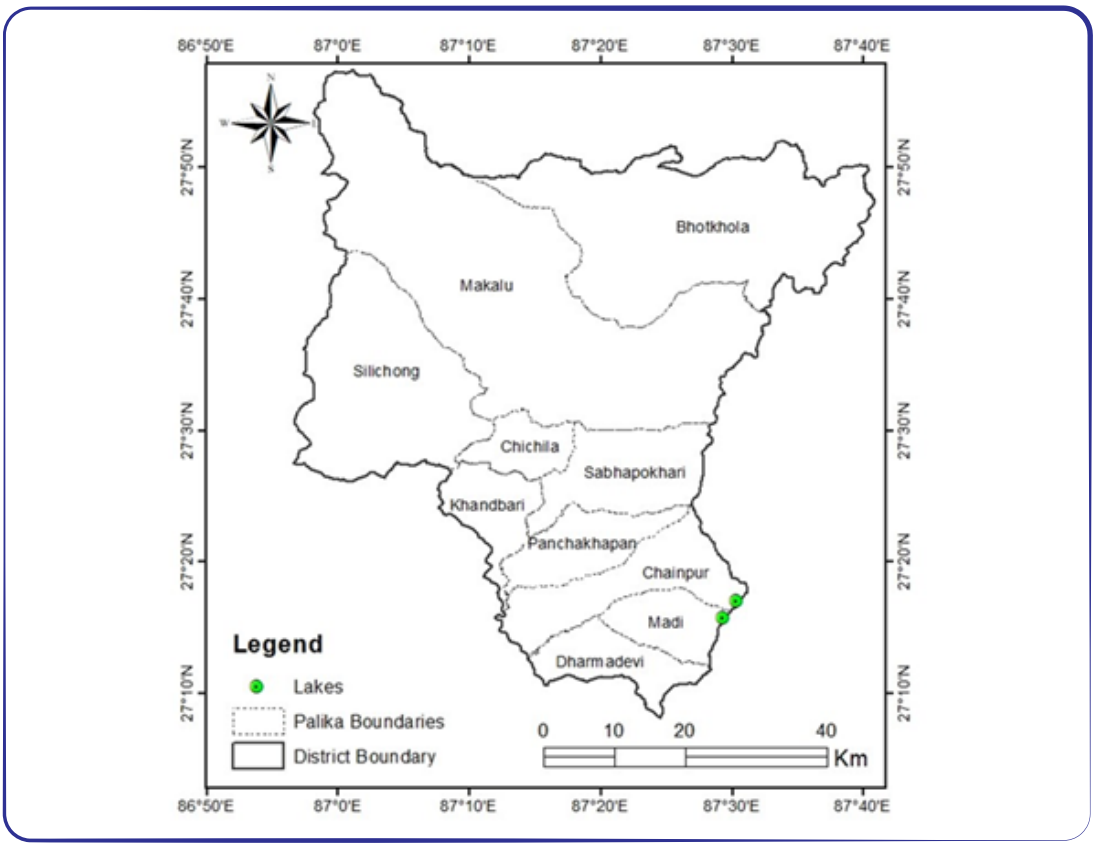

Figure 4-12 | *Spatial distribution of lakes in Sankhuwasabha district*

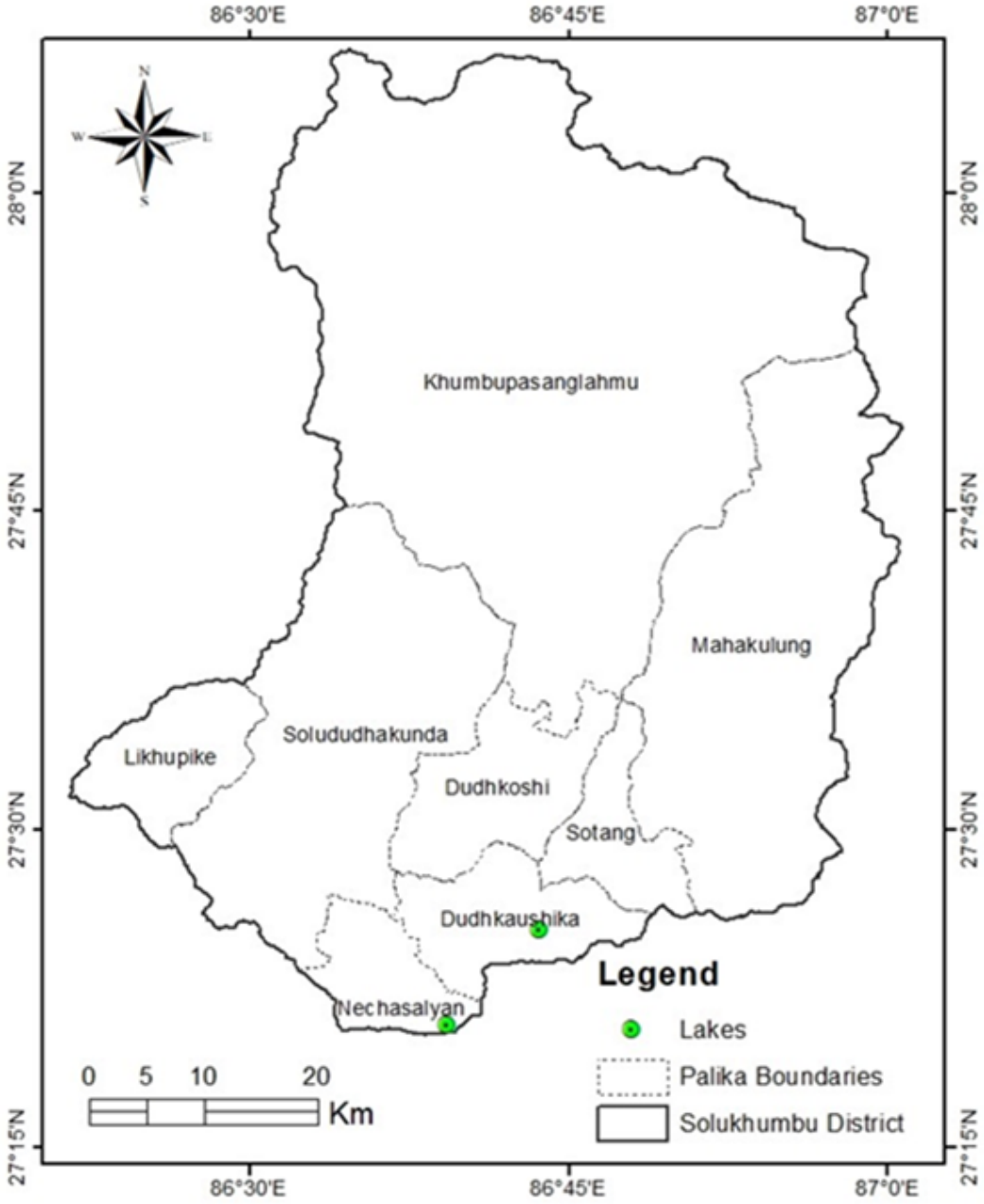

Figure 4-13 | *Spatial distribution of lakes in Solukhumbu district*

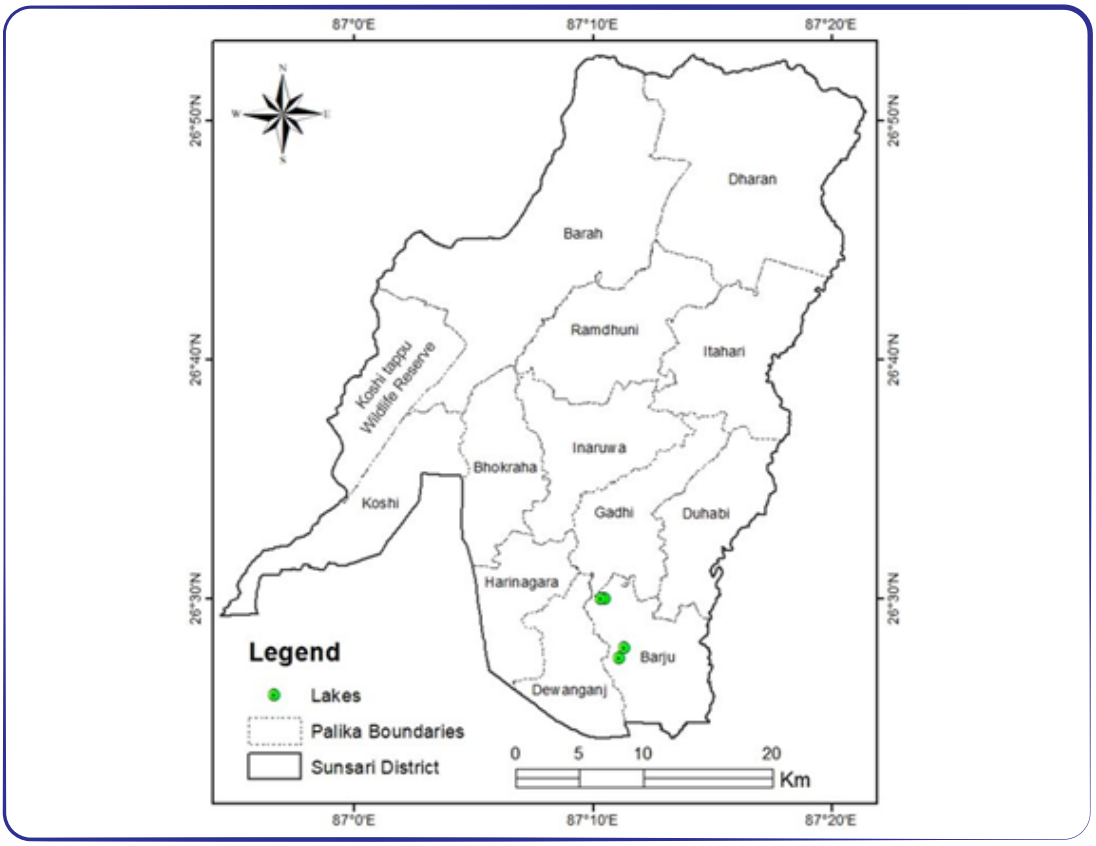

Figure 4-14| *Spatial distribution of lakes in Sunsari district*

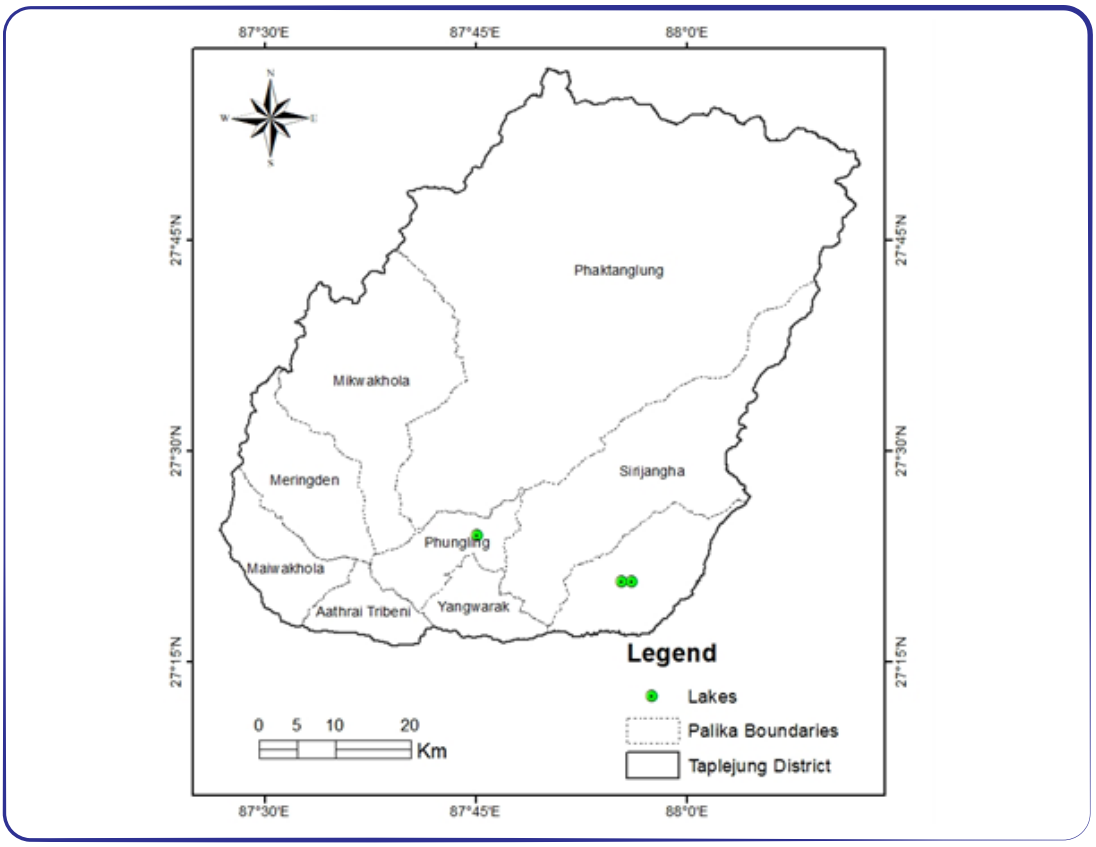

Figure 4-15| *Spatial distribution of lakes in Taplejung district*

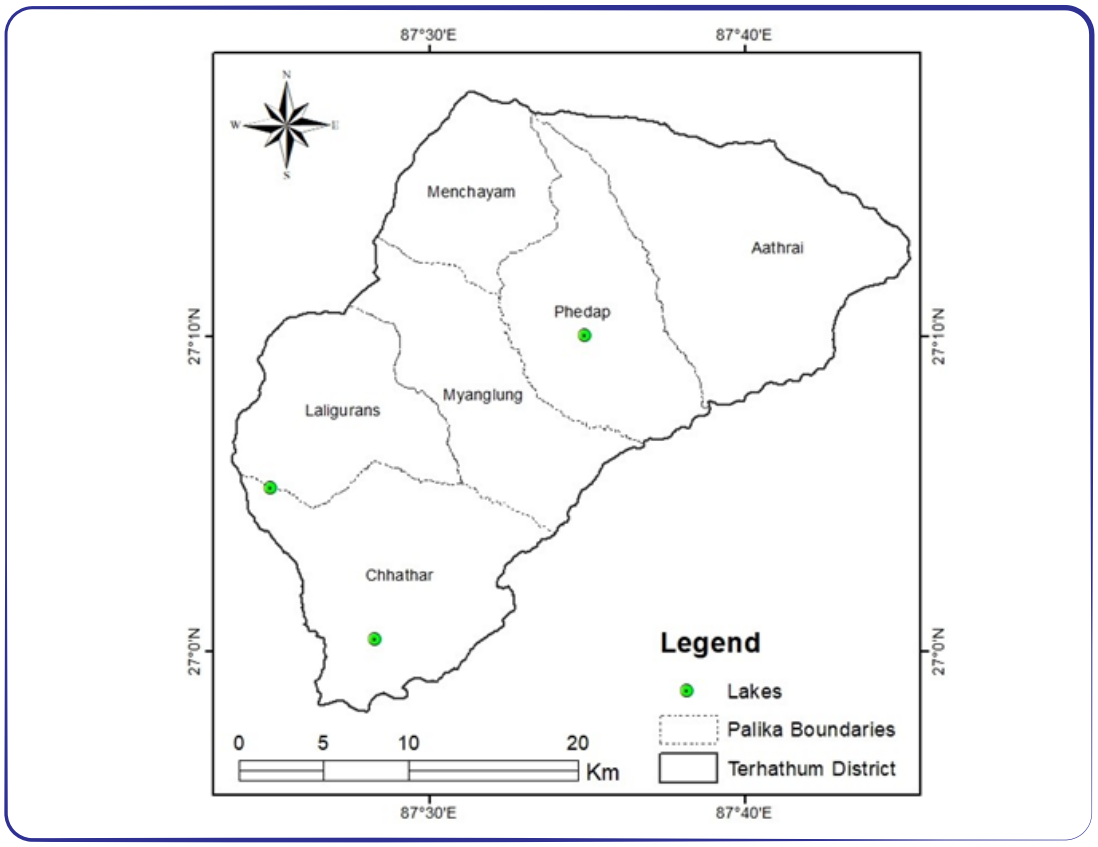

Figure 4-16| *Spatial distribution of lakes Terhathum in district*

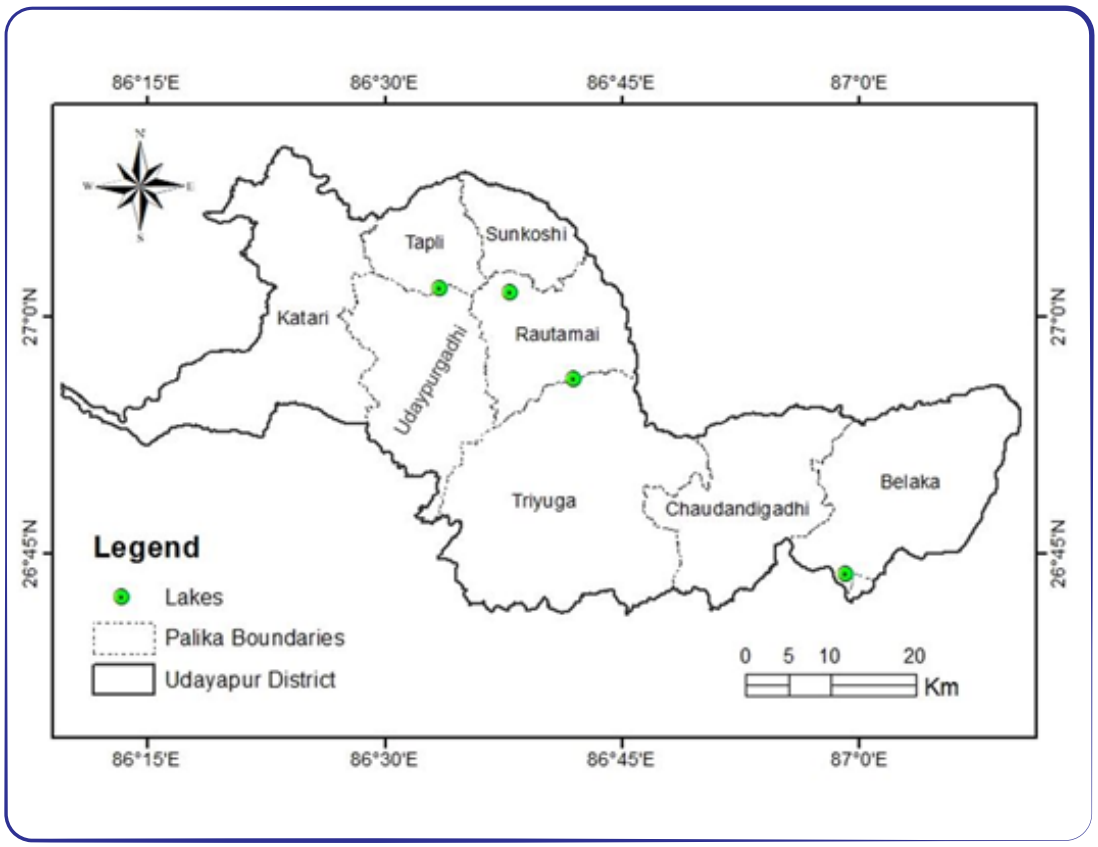

Figure 4-17| *Spatial distribution of lakes in Udayapur district*

5. LAKES IN PROVINCE-2

5.1 Biophysical and socio-economic context

5.1.1 General features

Province-2 is in the southeastern region of Nepal (*Figure 5-1*). It is Nepal's second-most populous province, however, the smallest in terms of area. It borders Province-1 to the east, Bagmati province to the north, and India to the south. It has an area of 9,661 km^2, which is about 6.5% of the country's total area.

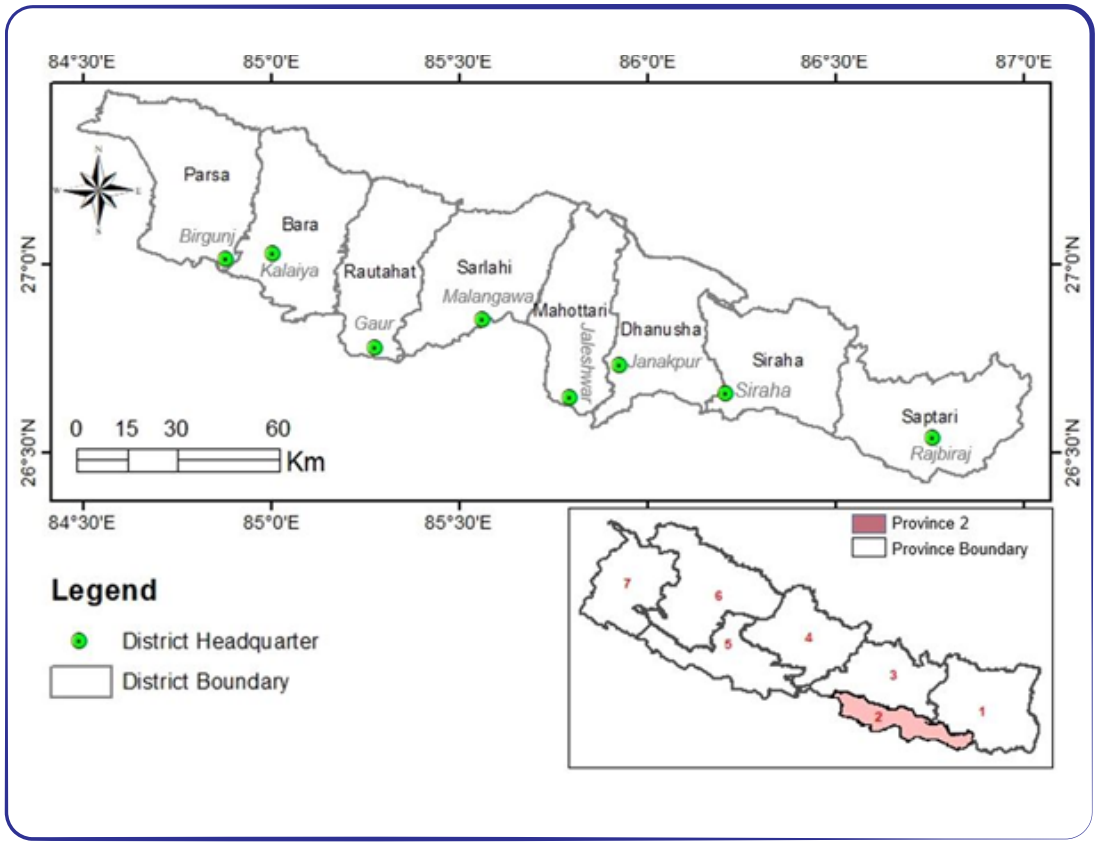

Figure 5-1 | *Location and districts covered in Province-2*

The province is located on the flat plains of the Terai. Chure (Churiya) or the Shiwalik Hills are the natural northern border of the province whereas its borders with India in the south. Province-2 covers eight districts namely, Parsa, Bara, Rautahat, Sarlahi, Mahottari, Dhanusha, Siraha, and Saptari (*Figure 5-1*). Province-2 has 136 Palikas, of which, only 1 (i.e. Birgunj) is the Metropolitan City, 3 are Sub-Metropolitan Cities, 73 are Municipalities, and the rest are Rural Municipalities).

5.1.2 Climate

Climate in Province 2 is classified as warm and temperate. Summers are much rainier than winters. The region receives sufficient rain (average annual rainfall = 2,500 mm, approximately) from the monsoon winds originating from the Bay of Bengal. However, rainfall, as well as temperature, varies depending on location as shown in *Table 5.1*.

Table 5.1 | *Rainfall and temperature in selected cities of Province-2*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp (°. C)
Karmaiya	1834	25.16
Rajbiraj	1777	23.1
Simara Airport	1552	22.1
Gaur	1516	23.9
Manusmara	1508	24.99
Lahan	1418	24.79
Janakpur Airport	1361	24.3
Jalesore	1266	21.66
Parwanipur	1262	24.53

(Source: DHM, 2001)

5.1.3 Hydrology/Drainage

Major river networks in Province-2 are shown in *Figure 5-2*. Major rivers are Ratu, Kamala, Lakhandei, and Lalbakaiya. Gagan, Balan, Ratu, and Lalbakaiya. They originate from the Churia Hills in Province-2. A significant part of Bagmati and Kamala basins lies in this province too. Out of the 3,422 sq. km area of the Bagmati basin, 589 sq. km area lies in the province. Moreover, 909 sq. km out of 2,381 sq. km catchment area of Kamala basin lies there as well. In the east, the province is bordered by the Koshi River (separating Sunsari of Province-1 and Saptari of Province-2) whereas Amuwa Khola borders the west separating the province from the Bagmati Province.

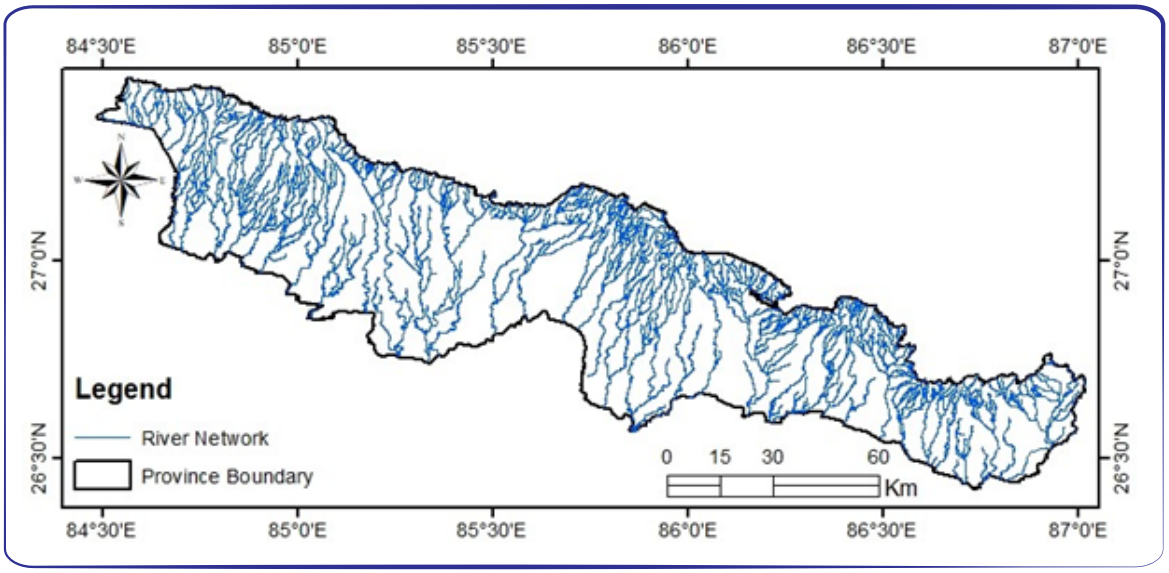

Figure 5-2 | *Spatial distribution of drainage network in Province-2*

The Province has many lakes, marshy fields and man-made ponds. The Nawagacchi pond of Parsa district is the largest pond with a core area of 35 ha.

5.1.4 Land use/cover

Province-2 has eight different types of land use/cover (*Figure 5-3*). District-wise land use/cover pattern is shown in *Table 5.3*. Agriculture area (or crop field) is the major land use/cover type (63.4%) followed by forests (26.9%), and barren land (5.3%) (*Table 5.2)*

Water bodies cover only 0.9% of the total land. The proportion of forest distribution is almost uniform in all districts except Parsa holding a massive 36.23% of forest within. Water bodies chiefly dominated by river systemscan be found in Saptari due to tributaries of Saptakoshi river.

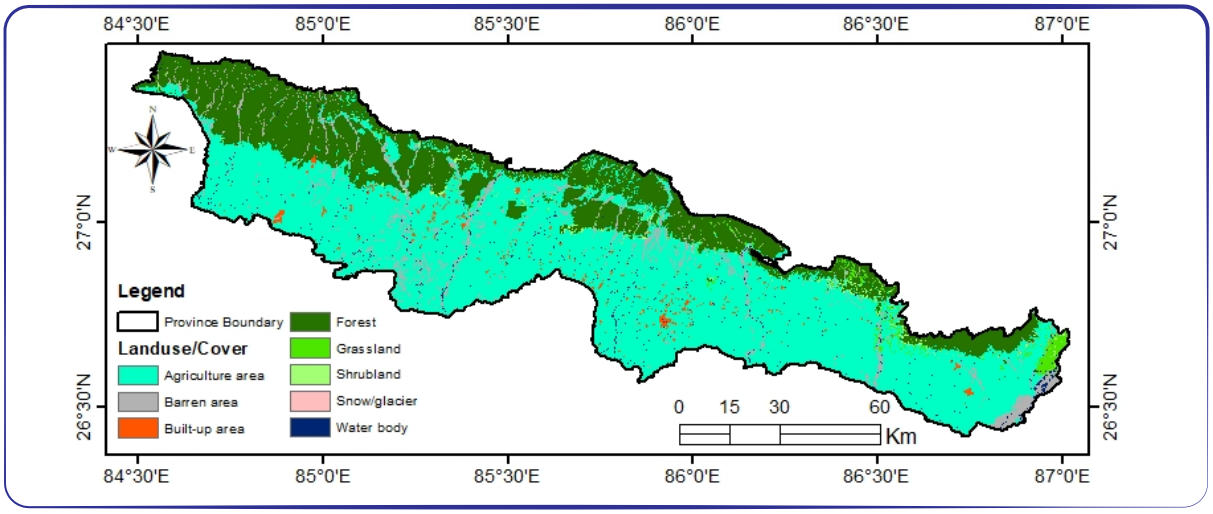

Figure 5-3 *| Land use/cover distribution in Province-2*

(Source: Prepared with data from ICIMOD, 2010)

Table 5.2 **|** *Land use/cover (ha) in Province-2*

District	Landuse/Cover Area (ha)								
	Forests	Shrub	Grassland	Crop field	Barren	Water	Builtup	Total	%
Bara	46074	449	449	71323	6765	851	1259	127170	13.3
Dhanusha	27261	400	1103	80684	5382	1067	2698	118595	12.4
Mahottari	21626	841	448	69914	4723	1316	1331	100199	10.5
Parsa	74368	135	550	57174	6649	783	842	140501	14.7
Rautahat	26929	821	517	63431	9564	1191	1379	103832	10.8
Saptari	19239	1792	8120	86478	9771	2037	710	128146	13.4
Sarlahi	26407	1136	713	90269	5064	881	1420	125889	13.1
Siraha	15896	1913	2859	88706	3214	704	613	113905	11.9
Total	257798	7486	14759	607978	51132	8830	10252	958236	
%	26.9	0.8	1.5	63.4	5.3	0.9	1.1	100	

5.1.5 Population and ethnicity

The human population is about 5.4 million (*Table 5.3.*), of which, the female population consists of 49.7%. This province is inhabited by Musalmans, Yadavs and Kurmis. Dhanusha is the most densely populated district (640 persons/km^2) followed by Mahottari and Sarlahi. Parsa is the lowest densely populated district with 444 persons/km^2.

Table 5.3 **|** *District-wise population distribution in Province-2*

Districts	Area (Km^2)	Population			Major Ethnicity
		Male	Female	Total	
Bara	1,190	351,244	336,464	687,708	Musalman,Yadav, Tharu,Kanu

Dhanusha	1,180	378,538	376,239	754,777	Yadav, Musalman, Kewat
Mahottari	1,002	311,016	316,564	627,580	Yadav, Musalman, Dhanuk
Parsa	1,353	312,358	288,659	601,017	Musalman, Kurmi, Yadav
Rautahat	1,126	351,079	335,643	686,722	Musalman, Kurmi, Yadav, Teli
Saptari	1,363	313,846	325,438	639,284	Yadav, Musalman, Kewat
Sarlahi	1,259	389,756	379,973	769,729	Yadav, Koiri, Musalman, Teli
Siraha	1,188	310,101	327,227	637,328	Yadav, Musalman, Musahar
Total	9,661	2,717,938	2,686,207	5,404,145	

(Source: CBS, 2011)

5.2 Lakes distribution across physiography

Table 5.4 shows the distribution of 81 lakes in Province-2 across districts and physiographic regions. *Figure 5-4* depicts their spatial distribution with mix-values for biodiversity, livelihoods, and religion and culture. The district-wise distribution of lakes is reported as seven in Bara, 23 in Dhanusa, nine in Mahottari, three in Parsa, eight each in Rautahat and Saptari, 10 in Sarlahi, and 13 in Siraha.

Dhanusha District has the biggest number of lakes (23) followed by Siraha (13) and Sarlahi (10). Many lakes dotted in the map-based inventory in the Terai have already disappeared.

A total of nine lakes are in a good condition, the remaining 72 are degrading. Core areas of these lakes vary from less than 0.53 hectares to 35 hectares. Nawagachhi Dam of Parsa District is the largest lake (area = 35 ha) in Province-2.

Table 5.4 | *Physiographic distribution of lakes in Province-2 at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Bara	7	7			
D-2	Dhanusha	23	23			
D-3	Mahottari	9	9			
D-4	Parsa	3	3			
D-5	Rautahat	8	8			
D-6	Saptari	8	8			
D-7	Sarlahi	10	10			
D-8	Siraha	13	13			
	Total	**81**	**81**			

Lakes are relatively well distributed across all districts. All 81 lakes fall in the Terai region and are used for irrigation and fishery. The Hatmare Pokhari and MathPokhari of Sarlahi District have a religious value. Most of high-altitude lakes are used for religious purposes. Lakes in Province-2 have a total core area of about 316 ha, which is 0.033% of the total surface area of the Province.

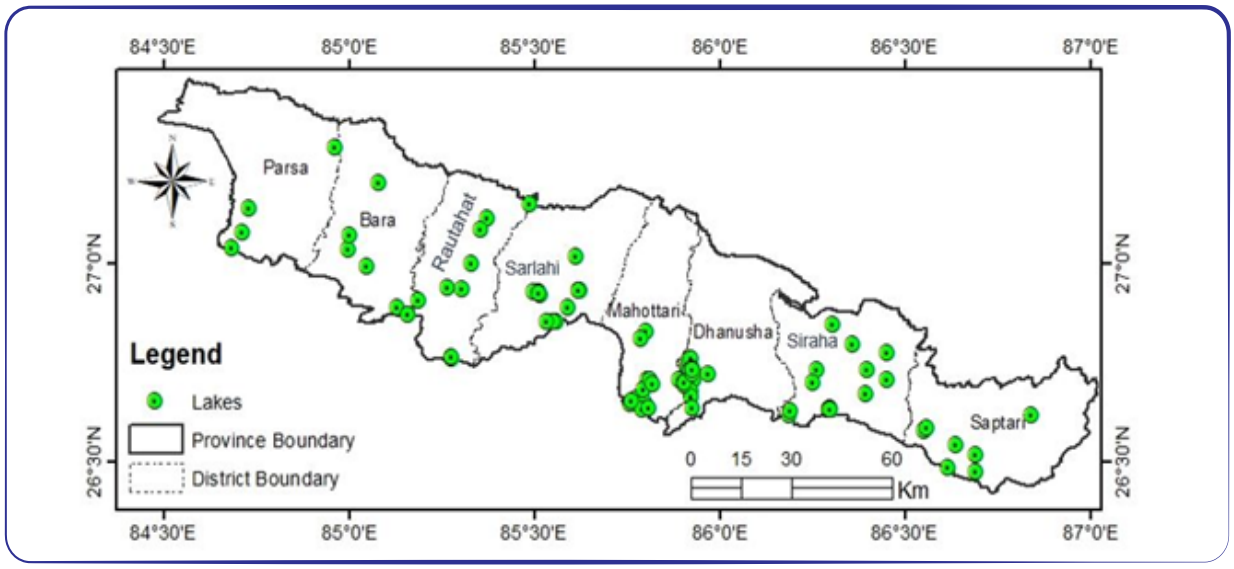

Figure 5-4 | *Lake distribution within Province 2*

5.3 Lakes distribution across districts

There are eight (8) districts in Province-2 (Bara, Dhanusha, Mahottari, Parsa, Rautahat, Saptari, Sarlahi, and Siraha). The name and details of each lake in are shown in *Table 5.5* and are summarized in the following sub-sections.

Bara District: There are seven lakes/Pokharis in Bara district. With a 33.5 ha core area, Halkhoria Lake is the largest, and Kamini Daha (1.6 ha.) the smallest. All lakes are in degrading condition. Please refer to Annex-17 for details on features of each lake and *Figure 5-5* for their spatial distribution.

Table 5.5 | *Lakes within eight districts in Province-2*

District	Name of Lake	Type of Lake	Area		Conditions
			Core	Basin	
Bara	Gadiganga Taal	Freshwater, Lacustrine	1.67		Degrading
	Halkhoria Lake	Freshwater, Lacustrine	33.5		Degrading
	Ishara Pokhari	Freshwater, Lacustrine	2		Degrading
	Jharkhuria Lake	Freshwater, Lacustrine	5		Degrading
	Kamini Daha	Freshwater, Lacustrine	1.5		Degrading
	Ramjanaki Pokhari	Freshwater, Lacustrine	1.6		Degrading
	Sohiri Lake	Freshwater, Lacustrine	2.5		Degrading
	Total		**47.8**		
Dhanusha	Aagni Kund	Freshwater, Lacustrine	2.5	15 - 20	Degrading
	Angraj Sar	Freshwater, Lacustrine	3	10-15	Degrading
	Beeshahara Sagar	Freshwater, Lacustrine	4		Good
	Bihar Kunda	Freshwater, Lacustrine	2.5	15 - 20	Degrading
	Bindhichowk Pokhari	Freshwater, Lacustrine	4	10-12	Degrading
	Biral Sagar	Freshwater, Lacustrine	1.5	2	Degrading
	Chapkai Pokhari	Freshwater, Lacustrine	2	10-12	Degrading

	Devpura Lake	Freshwater, Lacustrine	2.8	4-5	Degrading
	Dhanu Sagar	Freshwater, Lacustrine	2	15 - 20	Degrading
	Ganga Sagar	Freshwater, Lacustrine	2	10-12	Degrading
	Gautam Sarobar	Freshwater, Lacustrine	4		Degrading
	Ithi Pokhari	Freshwater, Lacustrine	2		Degrading
	Kapalmochani Sagar	Freshwater, Lacustrine	2.5	3	Good
	Kuti Pokhari	Freshwater, Lacustrine	2		Degrading
	Laski Pokhari (Shiva Sagar)	Freshwater, Lacustrine	3		Degrading
	Maharaj Sagar	Freshwater, Lacustrine	6	10-12	Degrading
	Manipal Taal	Freshwater, Lacustrine	2	10-12	Degrading
	Murali Sagar	Freshwater, Lacustrine	4	7-8	Degrading
	Parseni Sagar	Freshwater, Lacustrine	2		Degrading
	Rukmini Sagar	Freshwater, Lacustrine	1.7	3	Good
	Singrahi Lake	Freshwater, Lacustrine	10	400-500	Degrading
	Subbaji Pokhari	Freshwater, Lacustrine	5		Good
	Tarahi Pokhari (Laksman Sar)	Freshwater, Lacustrine	2.5		Degrading
	Total		**73**		
Mahottari	Bramhasthan Pokhari	Freshwater, Lacustrine	1.5		Degrading
	Dami Madai Pokhari	Freshwater, Lacustrine	2		Degrading
	Gotman Sagar	Freshwater, Lacustrine	2	10-15	Degrading
	Mahadev Pokhari	Freshwater, Lacustrine	4	10-12	Degrading
	Naini Pokhari	Freshwater, Lacustrine	2		Degrading
	Purni Pokhari	Freshwater, Lacustrine	4	10-15	Degrading
	Rani Pokhari	Freshwater, Lacustrine	3	3	Degrading
	Satuniya Pokhari	Freshwater, Lacustrine	31	123	Degrading
	Sukhdev Pokhari	Freshwater, Lacustrine	3	10-12	Degrading
	Telia Pokhari	Freshwater, Lacustrine	1		Degrading
	Thari Pokhari	Freshwater, Lacustrine	2	3	Degrading
	Tharuhai Pokhari	Freshwater, Lacustrine	1.5	3	Degrading
	Total		**12**		
Parsa	Gamharia Pokhari	Freshwater, Lacustrine	1.5		Degrading
	Nawagachhi Dam	Man-made,storage for irrigation	35		Good
	Rabidash Pokhari	Freshwater, Lacustrine	2		Good
	Total		**38.5**		
Rautahat	Bauddhi Pokhari	Freshwater, Lacustrine	2.01		Degrading
	Chandi Pokhari	Freshwater, Lacustrine	1.2		Good
	Dhamaura Pokhari	Man-made (storage area)	1		Degrading
	Gaur Pokhari	Freshwater, Lacustrine	4.02		Degrading
	Mahadev Pokhari	Freshwater, Lacustrine	1		Degrading
	Mahakar Pokhari	Freshwater, Lacustrine	2.68		Good
	Mardhar Pokhari	Freshwater, Lacustrine	9.6		Degrading
	Nagarpalika Pokhari	Freshwater, Lacustrine	4.5		Degraded
	Nunthar Pokhari	Freshwater, Lacustrine	1		Degrading
	Total		**27**		

Saptari	Bagmohi Nadi	Freshwater, Lacustrine	6	145	Degrading
	Jhola Daha (Gopit Ganga)	Freshwater, Lacustrine	2.1	92	Degrading
	Lohajara Thakur Daha	Fresh ater, Lacustrine	3.77	78	Degrading
	Purnai Pokhari	Freshwater, Lacustrine	0.99	74	Degrading
	Sakuwayi Pokhari	Freshwater, Lacustrine	2.55	82	Degrading
	Singaya Dhar	Freshwater, Lacustrine	4	84	Degrading
	Singrahi Pokhari	Freshwater, Lacustrine	1.08	110	Degrading
	Thani Pokhari	Freshwater, Lacustrine	4.2	90	Degrading
	Total		**24.7**	**755**	
Sarlahi	Betini Daha	Freshwater, Lacustrine	4		Degraded
	Chandragunj Pokhari	Freshwater, Lacustrine	0.95		Degrading
	Hatmare Pokhari	Man-made	5		Degrading
	Kerwa Pokhari	Man-made	4		Degrading
	Lekhandehi Taal	Freshwater, Lacustrine	2		Degrading
	Math Pokhari	Freshwater, Lacustrine	3		Degrading
	Nadhi Taal	Freshwater, Lacustrine	1.54		Degrading
	Nagarpalika Pokhari	Man-made	2		Degraded
	Nassi Pokhari	Man-made	0.6		Degraded
	Panpiya Taal	Freshwater, Lacustrine	0.53		Degrading
	Purano Pokhari (Musailiko Pokhari)	Lacustrine, permanent	3		Degrading
	Total		**26.6**		
Siraha	Adda Pokhari	Freshwater, Lacustrine	1.35	2	Degrading
	Baban Tol Pokhari	Freshwater, Riverine	1.5	2	Degrading
	Beli Pokhari	Freshwater, Riverine	1.5	2	Degrading
	Bishnupur Pokhari	Freshwater, Lacustrine	1	1.5	Degrading
	Dewal Subba Pokhari	Freshwater, Lacustrine	1.6	2	Degrading
	Kamal Daha	Freshwater, Lacustrine	4.5	12.12	Degrading
	Mahadev Pokhari	Freshwater, Lacustrine	0.6773	1.49	Degrading
	Manik Daha	Freshwater, Lacustrine	6	8	Degrading
	Narahiya Pokhari	Freshwater, Lacustrine	12	13	Good
	Naya Bandh	Freshwater, Lacustrine	1.3	2	Degrading
	Patari Pokhari	Freshwater, Lacustrine	1.35	4	Degrading
	Purni Pokhari	Freshwater, Lacustrine	2	3	Degrading
	Rajdevi Pokhari	Freshwater, Lacustrine	1.5	2	Degrading
	Total		**36.2**	**55.1**	

Dhanusha district: Dhanusha has the highest number of lakes among the other 26 Terai districts. 23 lakes were found in Dhanusha. Singrahi Lake with size (core area =10 ha) is the largest lake, while Biral Sagar is the smallest (1.5 ha core area). Beeshahara Sagar, KapalmochaniSagar, Rukmini Sagar, and Subbaji Pokhari are in good condition. Please refer to Annex-18 for details on the features of each lake and *Figure 5-6* for their spatial distribution.

Mahottari district: There are altogether 12 Ponds (Pokharis) in Mahottari district. Satuniya Pokhari is the largest Pokhari (31 ha core area) in the district. All the Pokharis are in degrading condition. Please refer to Annex-19 for details on the features of each lake and *Figure 5-7* for spatial distribution.

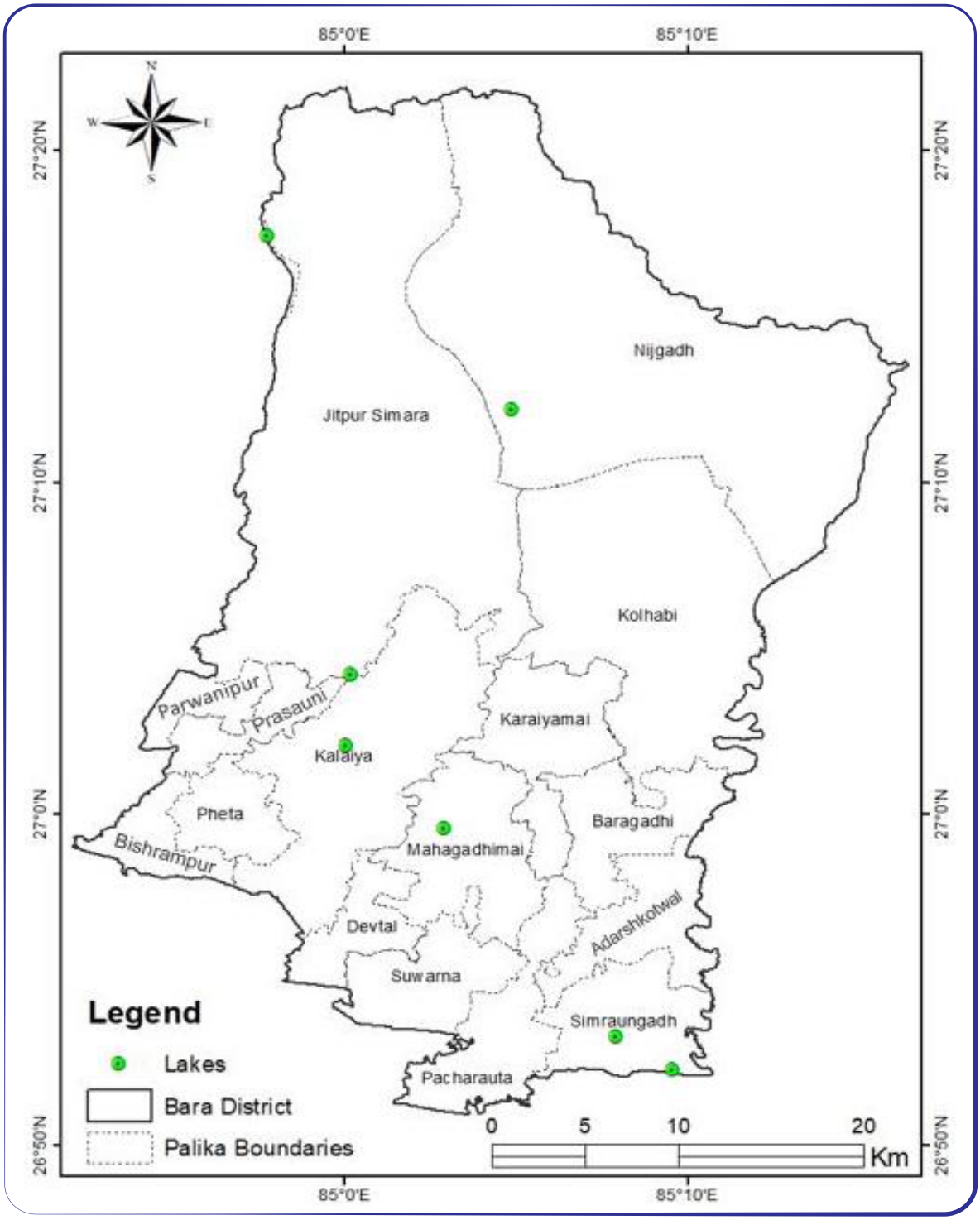

Figure 5-5 | *Spatial distribution of lakes in Bara district*

Parsa district: There are three lakes in Parsa district. Nawagachhi Dam is the largest lake (35 ha core area). Nawagacchi Dam and Rabidash Pokhari are in good condition. Please refer to Annex-20 for details on the features of each lake and *Figure 5-8* for spatial distribution.

Rautahat district: There are nine lakes in Rautahat district. Mardhar Pokhari has the largest area (9.6 ha). All Pokharis except Chandi Pokhari and Mahakar Pokhari are in degrading condition. Please refer to Annex-21 for details on the features of each lake and *Figure 5-10* for spatial distribution.

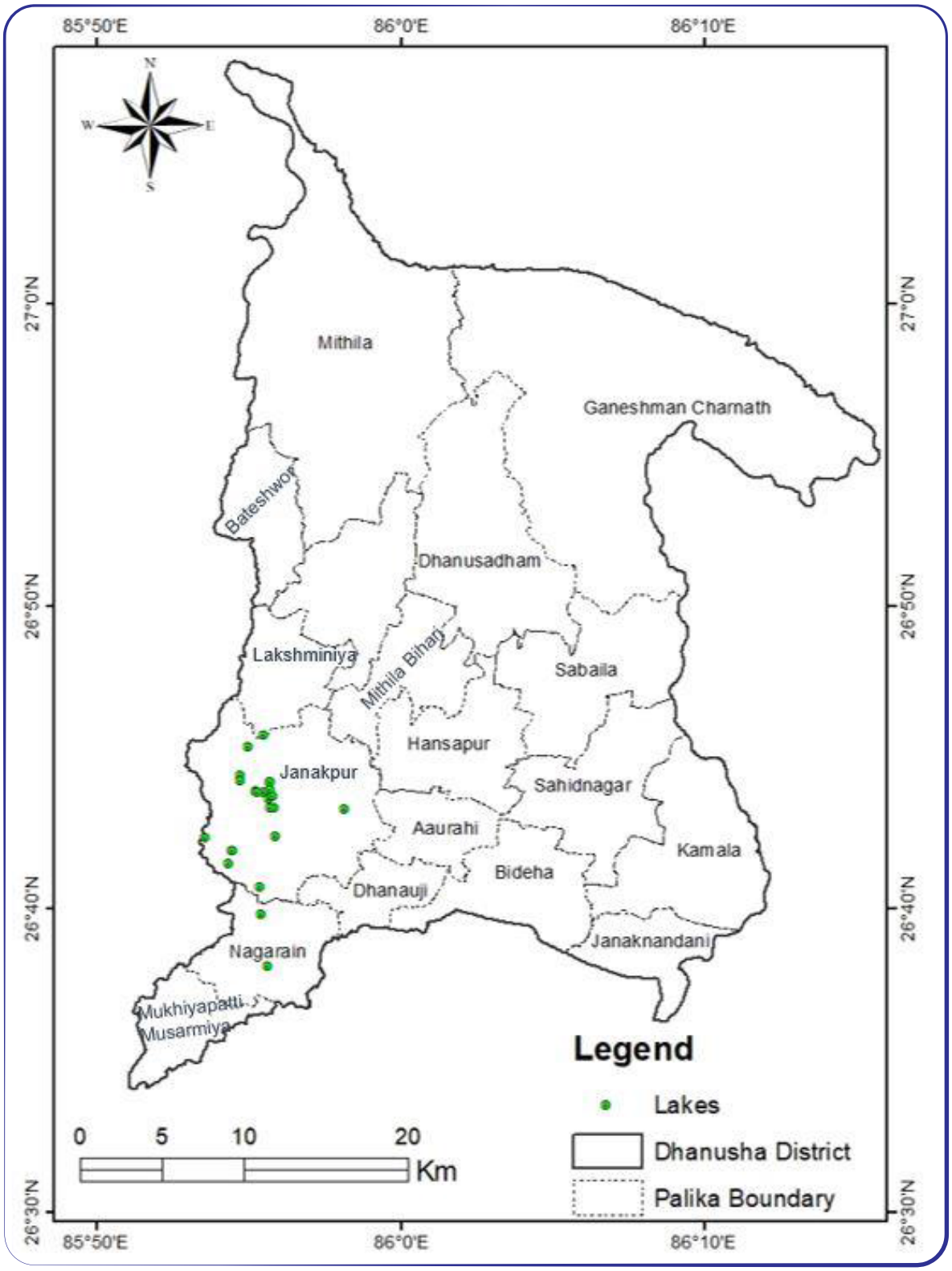

Figure 5-6| *Spatialdistribution of lakes in Dhanusha district*

Saptari district: Eight lakes can be found in Saptari district. Loharaja Thakur Daha with a 3.77 ha, is the largest lake. All lakes are in degrading condition. Please refer to Annex-22 for details on the features of each lake and *Figure 5-9* for spatial distribution.

Sarlahi district: There are 11 lakes in Sarlahi district. With 5 ha, Hatmare Pokhari is the largest Pokhari and with a 0.53 ha, Panpiya Taal is the smallest. Four lakes are man-made while the rest are fresh water and lacustrine. Betini Daha is degraded while the others are in degrading condition. Please refer to Annex-23 for details on the features of each lake and *Figure 5-11* for spatial distribution.

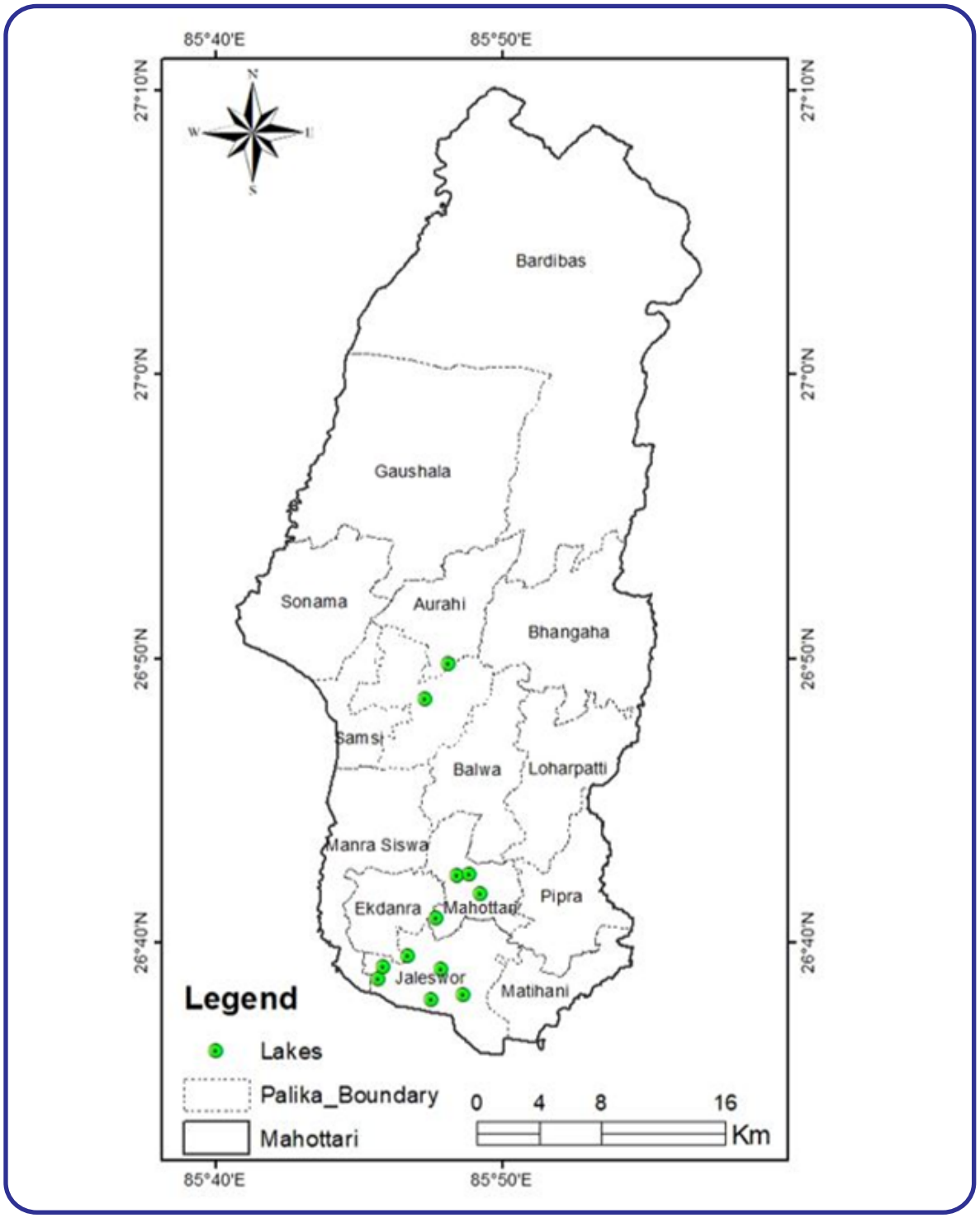

Figure 5-7 | *Spatial distribution of lakes in Mahottari district*

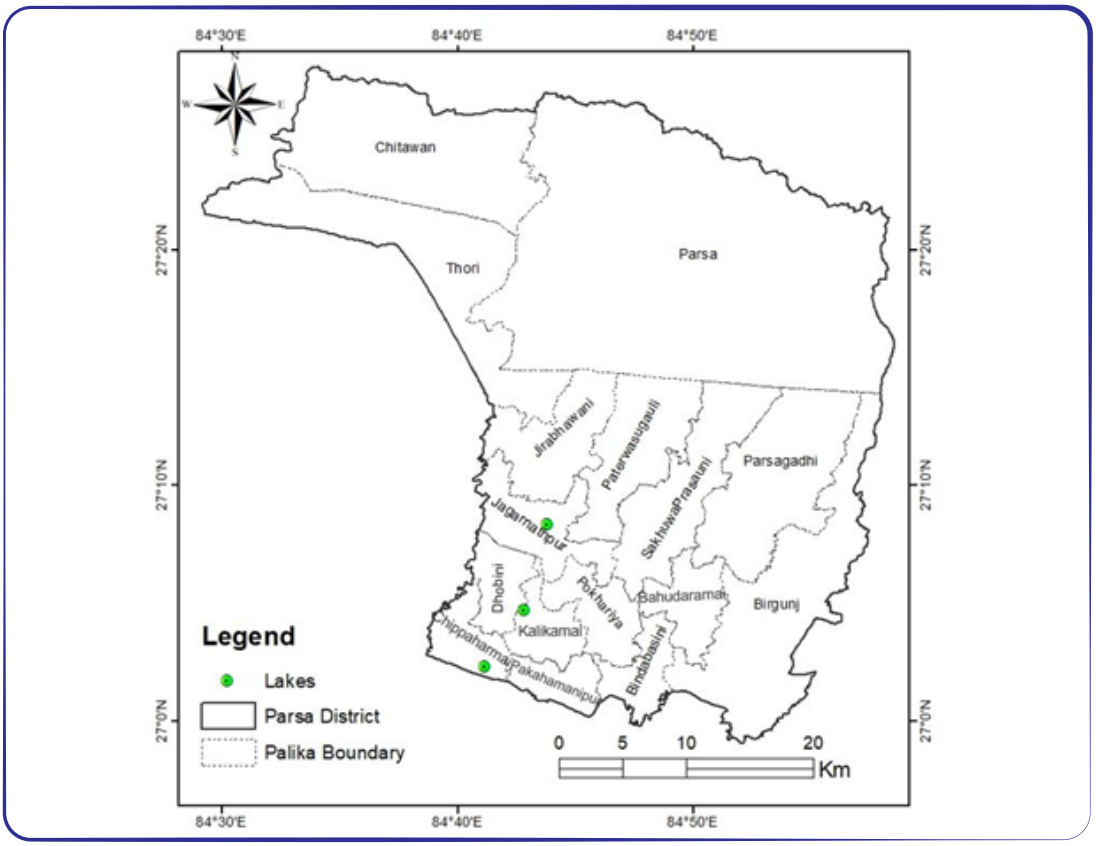

Figure 5-8 | *Spatial distribution of lakes in Parsa district*

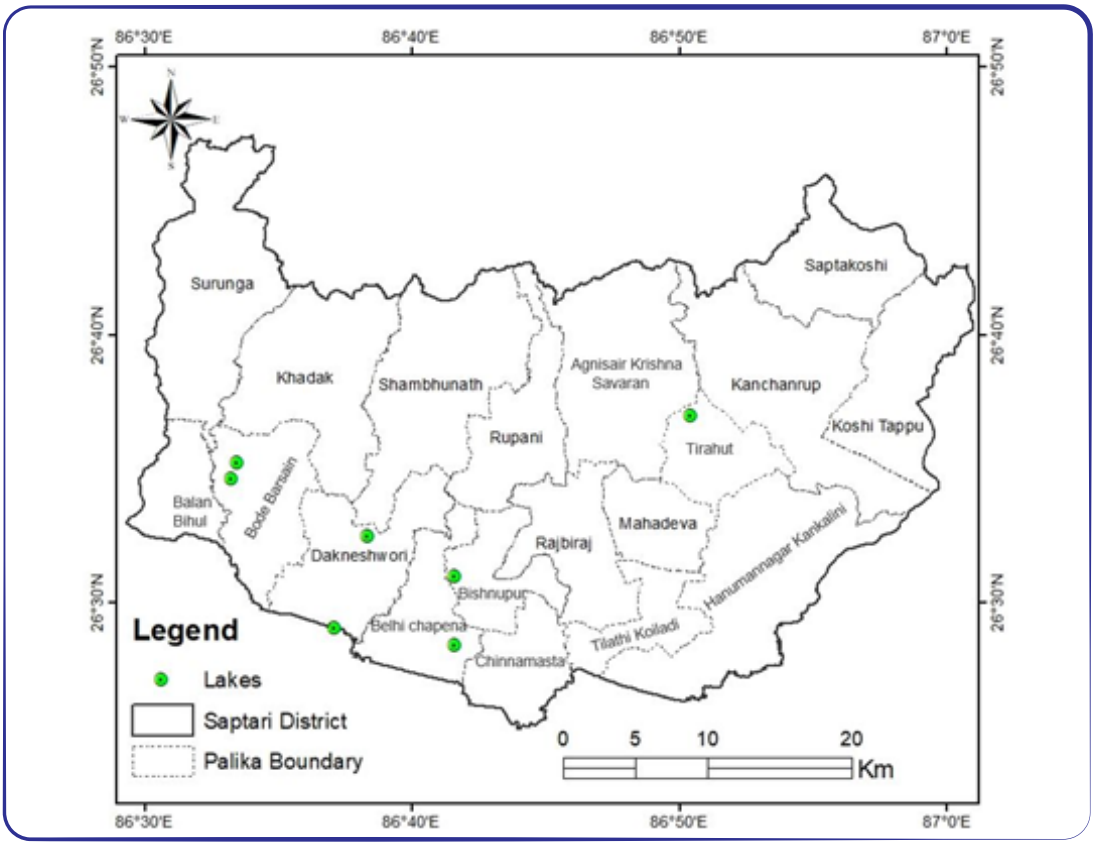

Figure 5-9 | *Spatial distribution of lakes in Saptari district*

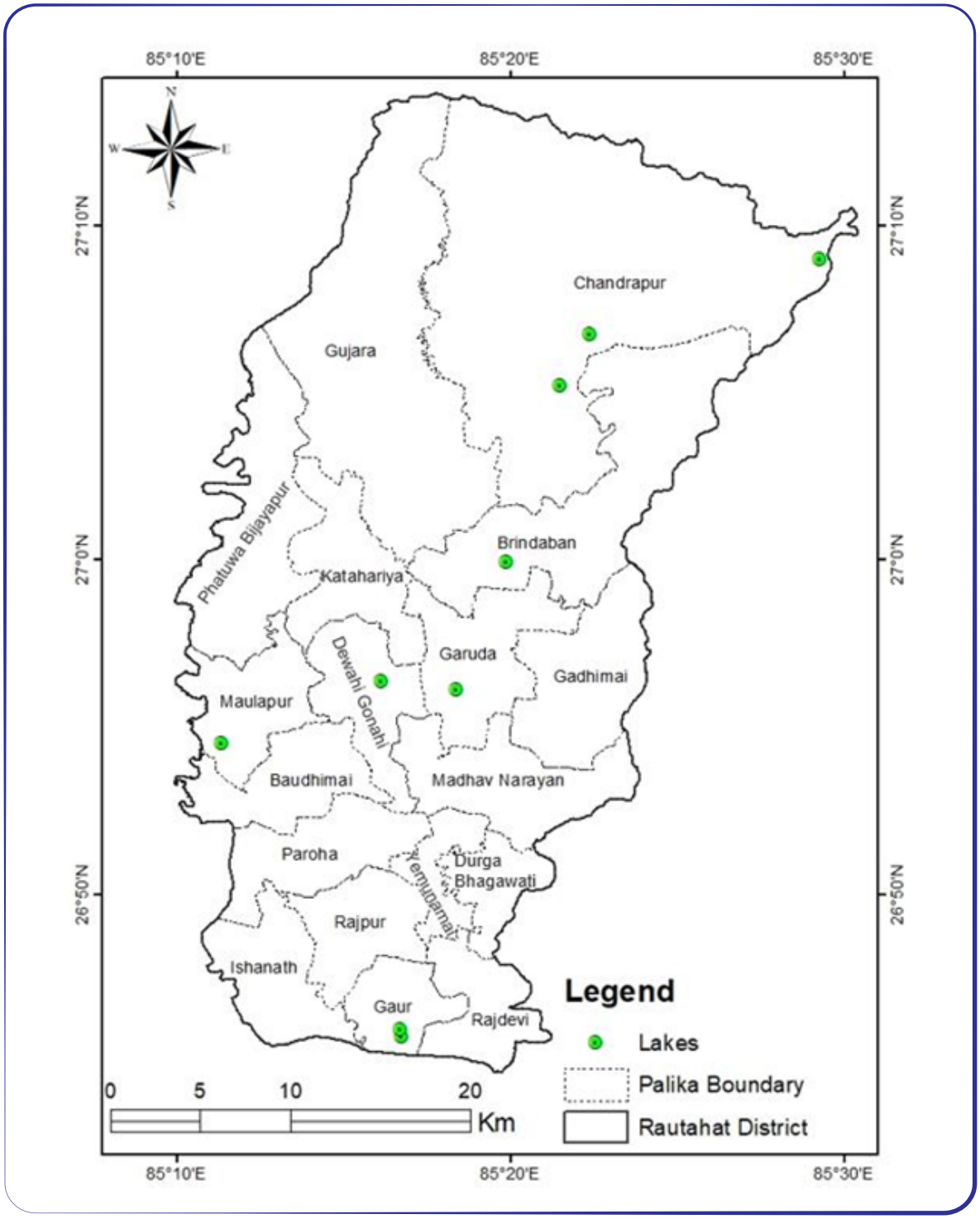

Figure 5-10| *Spatial distribution of lakes in Rautahat district*

Siraha district: Thirteen lakes were found in Siraha district. Narahiya Pokhari is the largest lake (12 ha core area) and Bishnupur Pokhari the smallest with 1 ha. Only one lake is in good condition. Please refer to Annex-24 for details on the features of each lake and *Figure 5-12* for spatial distribution.

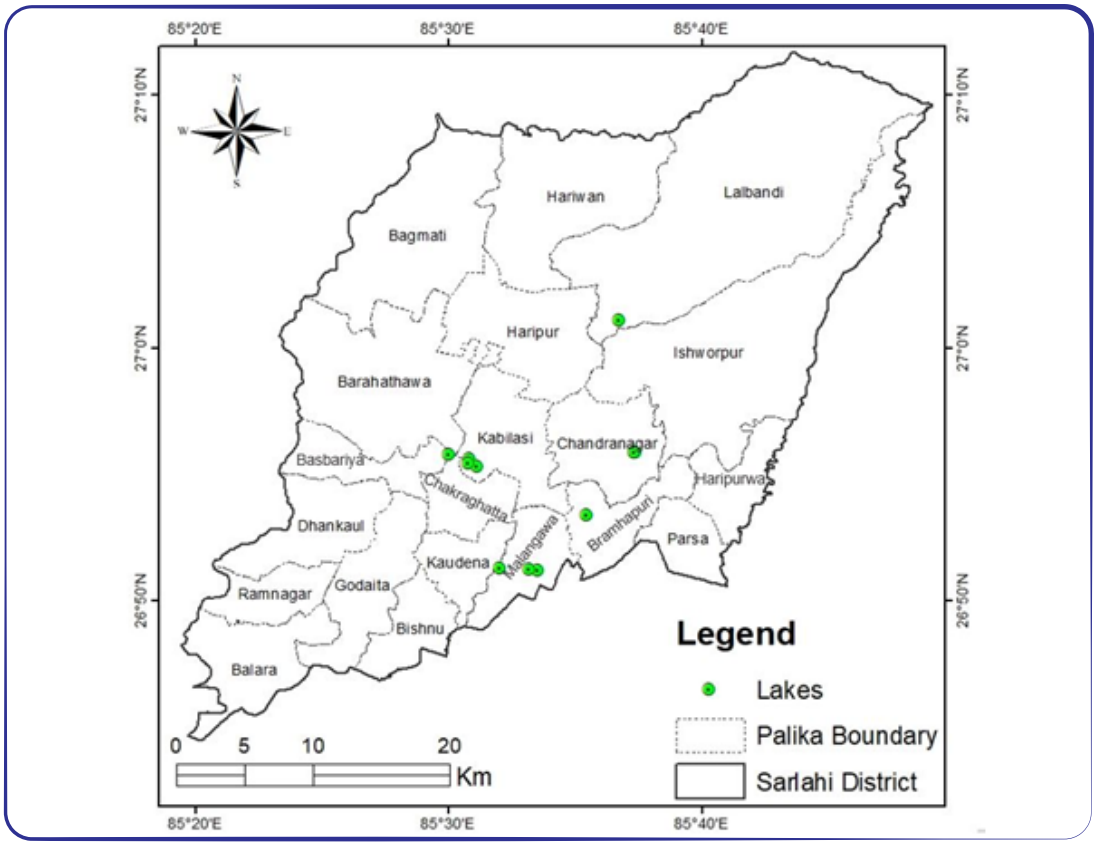

Figure 5-11| *Spatial distribution of lakes in Sarlahi district*

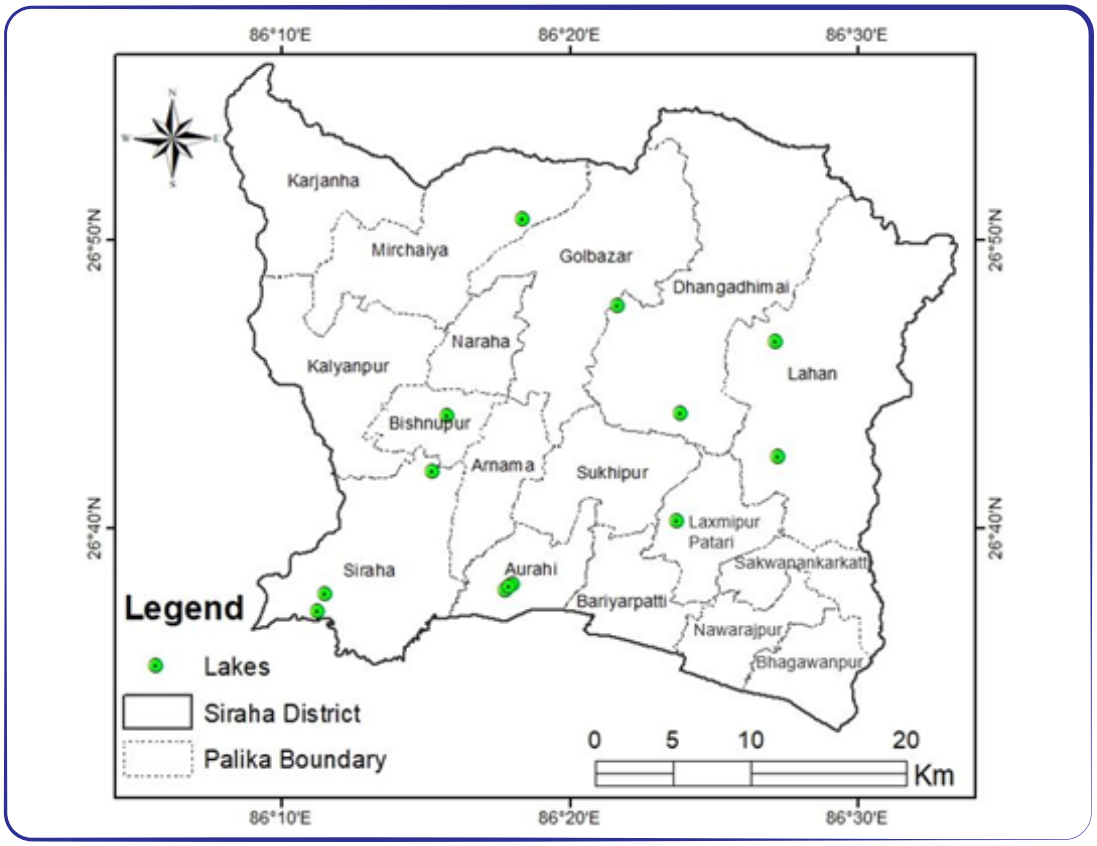

Figure 5-12| *Spatial distribution of lakes in Siraha district*

6. LAKES IN BAGMATI PROVINCE

6.1 Biophysical and socio-economic context

6.1.1 General features

The Bagmati Province lies in the central part of the country and include 13 districts (*Figure 6-1*) and many municipalities. It stretches from Province-2 in the south to the Himalayas in the north. It is the home for some 4.6 million people (20.87% of the country's population) (CBS, 2012) and covers an area of 20,300 km^2 (13.8% of the country's land area). It has 119 Palikas, out of which three are Metropolitan Cities, 1 is a Sub-Metropolitan City, 41 are Municipalities and the rest are Rural Municipalities.

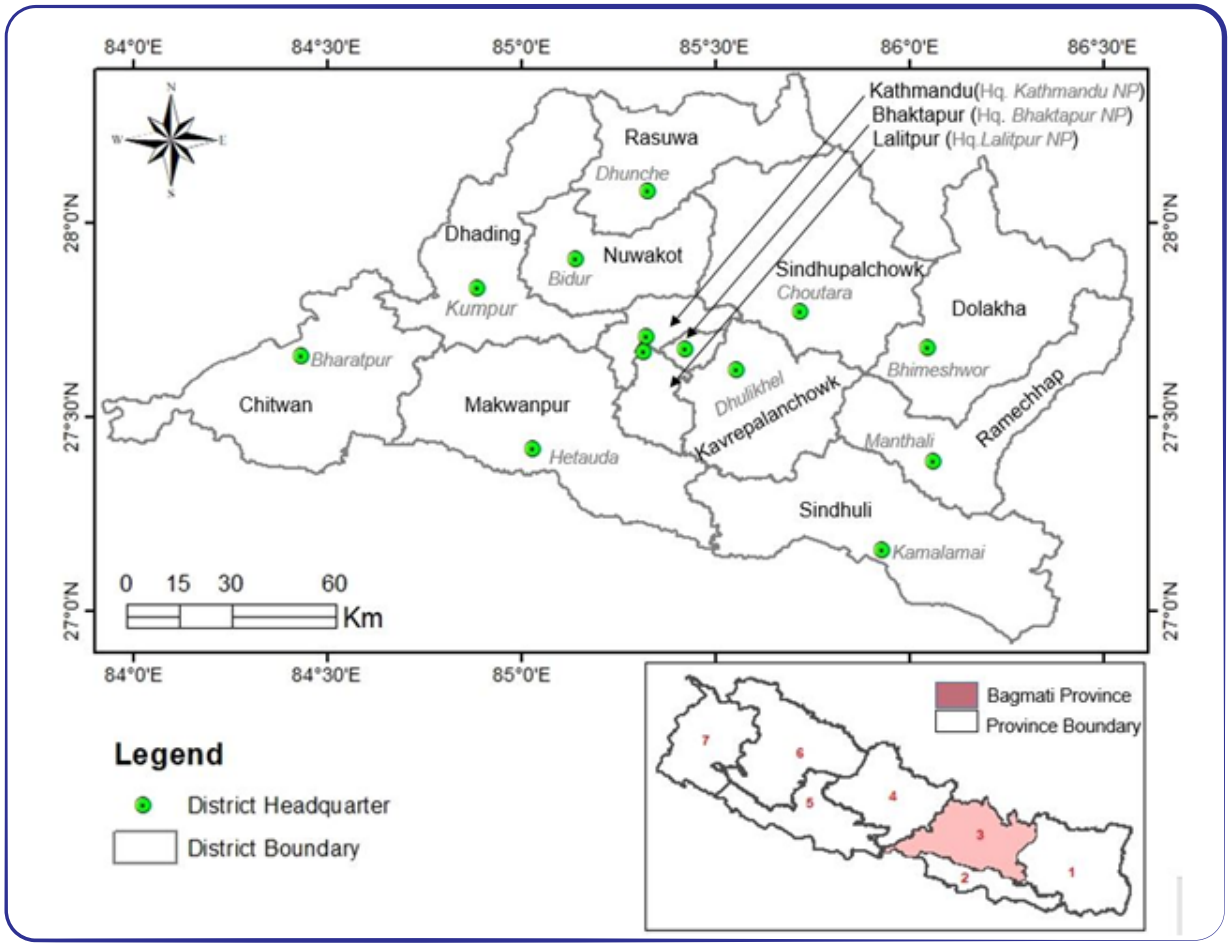

Figure 6-1 | *Location and districts covered in Bagmati Province*

This province has an altitude to support deciduous, coniferous, alpine forests and woodlands. Temperature varies with altitude. Rainfall takes place mainly during summer. The province borders the Tibet autonomous region of China to the north, Province-1 to the east, Gandaki Province to the west, and both Province-2 and the Indian state of Bihar to the south. It possesses a rich cultural diversity with resident communities and casts including Newar, Tamang, Madhesis, Sherpa, Tharu, etc. The province consists of mountains such as Gaurishankar, Jugal, Langtang, and Ganesh. Sankhusava. The Chitwan national park, rich in flora and fauna, can be found there.

6.1.2 Climate

The Bagmati Province is characterized by different climatic conditions. For example, there is a humid subtropical climate in the Terai, a hot summer meridian climate in the mid-hills, a subtropical highland oceanic climate in the mountains, and a tundra climate in the north in the high mountains (Climate Data, 2017). The province receives approximately 1,800 mm of rain annually. *Table 6.1* shows city-specific climate data of some locations in the province.

Table 6.1 | *Meteorological parameters at meteorological stations in selected cities of Bagmati Province*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp (°. C)	Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp (°. C)
Pansayakhola	3239	15.1	Dhunche	1792	12.5
Kakani	2824	15.2	Rampur	1784	22.8
Sinduli Gadhi	2598	21.8	Nuwakot	1765	18.8
Nagarkot	2353	13.8	Kathmandu Airport	1600	16.0
Jiri	2235	13.7	Dhulikhel	1570	16.5
Hetauda N.F.I.	2124	21.9	Dhunibesi	1541	19.2
Buddhannilkantha	2103	16.1	PaniPokhari	1473	19.2
Godavari	1982	15.7	Panchkhal	1177	17.9
Daman	1804	12.4	Khumaltar	1126	15.8

6.1.3 Hydrology/Drainage

The hydrology/drainage pattern of the Bagmati Province is shown in *Figure 6-2* and is characterized by the varying nature of rivers. The major basins are the Gandaki Basin, Bagmati Basin, Koshi Basin, and Kamala Basin. Out of the 31,897 Km^2 area of Gandaki Basin, 8270Km^2 area falls in the province. Similarly, 7849Km^2 area out of 26217 Km^2 of the Koshi Basin falls in the province. The Bagmati basin and Kamala Basin have an area of 2832Km^2 and 973Km^2 area respectively. The major rivers are the Bagmati, Trishuli, Melamchi, Sunkoshi, and Bhotekoshi rivers.

6.1.4 Land use/cover

The province has eight types of land use/cover (*Figure 6-3*). District-wise land use/cover pattern is shown in *Table 6.2*. Forest is the major land use/cover type (55.2%) followed by agriculture (27%), and grassland (8.1%) (*Table 6.2*). Water bodies cover only 0.4% of the total land. In the recent past, land use/cover has undergone tremendous change, such as a noted increase in crop fields and urban formation but a decrease in forests, snow land, and glaciers (Paudel et al., 2016). The largest proportion of forest is in Sindhuli and Makawanpur. Forest covered areas are smaller in Rasuwa and Kathmandu districts. Water bodies dominated by river systems are found in Chitwan and Makawanpur districts.

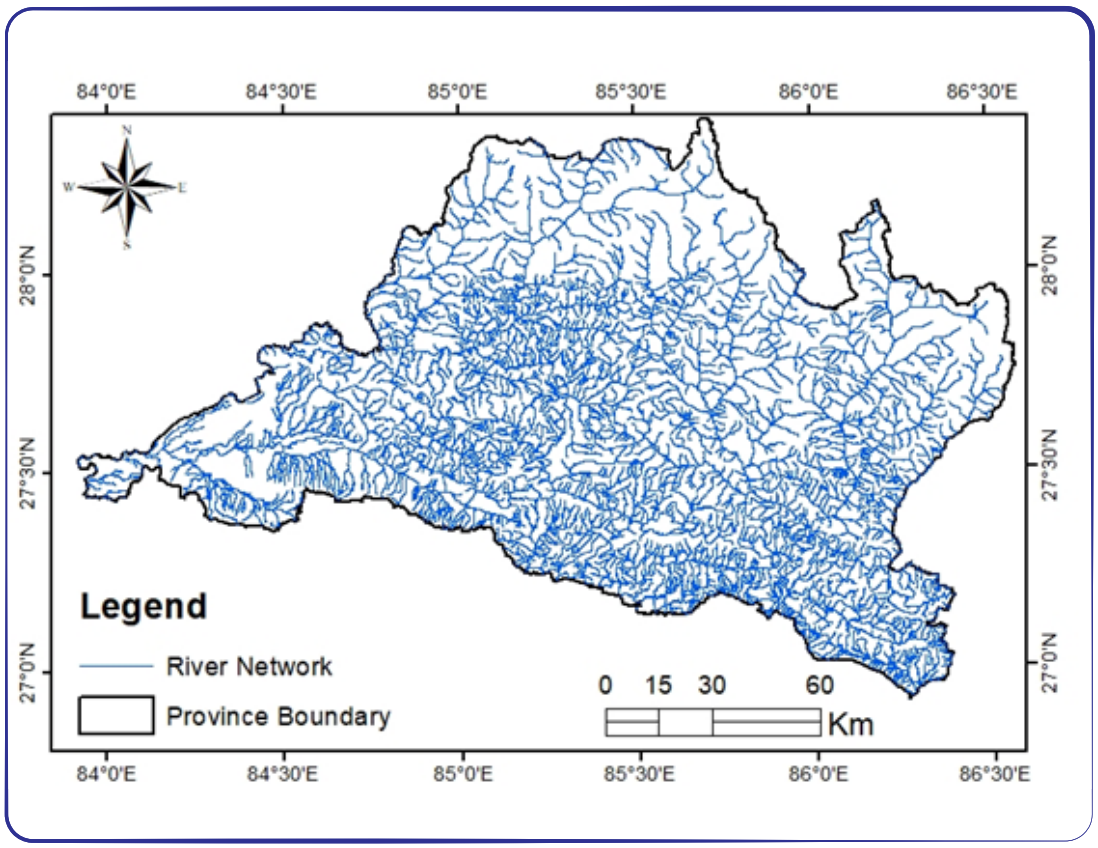

Figure 6.2 | Spatial distribution of drainage network in Bagmati Province

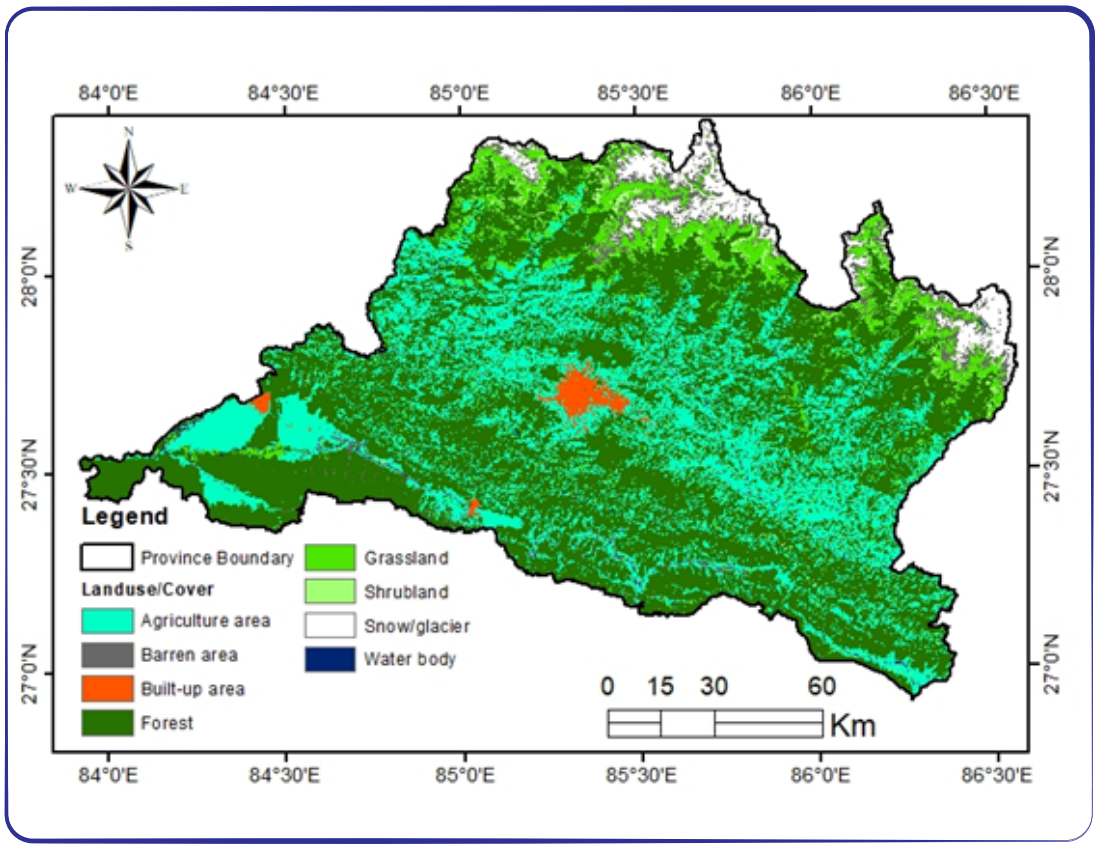

Figure 6.3 | Land use/cover distribution in Bagmati Province
(Source: Prepared with data from ICIMOD, 2010)

Table 6.2 | *Land use/cover (ha) in Bagmati Province*

District	Landuse/Cover Area (ha)									
	Forests	Shrub	Grassland	Cropfield	Barren	Water	Builtup	Snow/glacier	Total	%
Bhaktapur	3520		273	4287	30	-	386	-	8497	0.4
Chitwan	142313	295	5341	66633	4384	2386	2369	-	223721	11.0
Dhading	97188	2977	19297	63177	3254	734	-	4018	190644	9.4
Dolakha	99484	5792	35177	35927	14693	322	-	22921	214316	10.6
Kathmandu	15764	0	443	15169	60	10	9929	-	41375	2.0
Kavrepalanchowk	76357	107	3033	58138	900	481	507	-	139523	6.9
Lalitpur	23532	59	1114	11824	108	33	3072	-	39743	2.0
Makawanpur	172473	344	4362	58620	6512	1131	1013	0.2	244455	12.1
Nuwakot	59069	161	6694	51521	1460	418	-	18	119342	5.9
Ramechhap	71171	1498	13313	59822	4945	293	16	5473	156531	7.7
Rasuwa	48031	6739	33489	8835	21013	139	-	31235	149481	7.4
Sindhuli	176120	995	4915	60959	4162	1454	-	-	248605	12.3
Sindhupalchowk	133403	4798	35659	52333	9512	367	-	12529	248602	12.3
Total	1118425	23765	163111	547245	71033	7769	17293	76194	2024835	
%	55.2	1.2	8.1	27.0	3.5	0.4	0.9	3.8	100	

6.1.5 Population and ethnicity

The human population is of about 5.5 million (*Table* 6.3), of which, the female population consists of 50.3%. The province is inhabited by Newars, Tamangs, Brahmins and Chhetris. Kathmandu is the most densely populated district (4415 persons/km^2) followed by Bhaktapur and Lalitpur. Rasuwa has the lowest population density with only 28 persons/km^2.

Table 6.3 | *District-wise population distribution in Bagmati Province*

Districts	Area (Km^2)	Population			Major Ethnicity
		Male	Female	Total	
Bhaktapur	119	154884	149767	304651	Newar, Chhetri, Brahmin
Chitwan	2218	279087	300897	579984	Brahmin, Chhetri, Tharu
Dhading	1926	157834	178233	336067	Tamang, Brahmin, Chhetri
Dolakha	2191	87003	99554	186557	Chhetri, Tamang, Brahmin
Kathmandu	395	913001	831239	1744240	Brahmin, Newar, Chhetri,Tamang
Kavrepalanchowk	1396	182936	199001	381937	Tamang, Brahmin, Chhetri
Lalitpur	385	238082	230050	468132	Newar, Chhetri, Brahmin, Tamang
Makawanpur	2426	206684	213793	420477	Tamang, Brahmin, Chhetri
Nuwakot	1121	132787	144684	277471	Tamang, Brahmin, Chhetri
Ramechhap	1546	93386	109260	202646	Chhetri, Tamang, Newar, Magar
Rasuwa	1544	21475	21825	43300	Tamang, Brahmin
Sindhuli	2491	142123	154069	296192	Tamang, Magar
Sindhupalchowk	2542	138351	149447	287798	Tamang, Chhetri, Newar
Total	20300	2747633	2781819	5529452	

6.2 Lakes distribution across physiography

Table 6.4 shows the finding of 222 lakes in Bagmati Province and *Figure 6-4* depicts their spatial distribution with mix-values for biodiversity, livelihoods, and religion and culture. The district-wise distribution of lakes is reported as 52 in Bhaktapur, six in Chitwan, three in Dolakha, 58 in Kathmandu, 97 in Lalitpur, one each in Makawanpur, Nuwakot, and Ramechhap, two in Sindhuli, and one in Sindhupalchowk. Lalitpur district has the biggest number of lakes (97) followed by Kathmandu (58) and Bhaktapur (52).

Table 6.4 | *Physiographic distribution of lakes in Bagmati Province at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Bhaktapur	52		52		
D-2	Chitwan	6	6			
D-3	Dolakha	3			3	
D-4	Kathmandu	58		58		
D-5	Lalitpur	97		93	4	
D-6	Makawanpur	1		1		
D-7	Nuwakot	1			1	
D-8	Ramechhap	1			1	
D-9	Sindhuli	2	2			
D-10	Sindhupalchowk	1			1	
	Total	**222**	**8**	**204**	**10**	

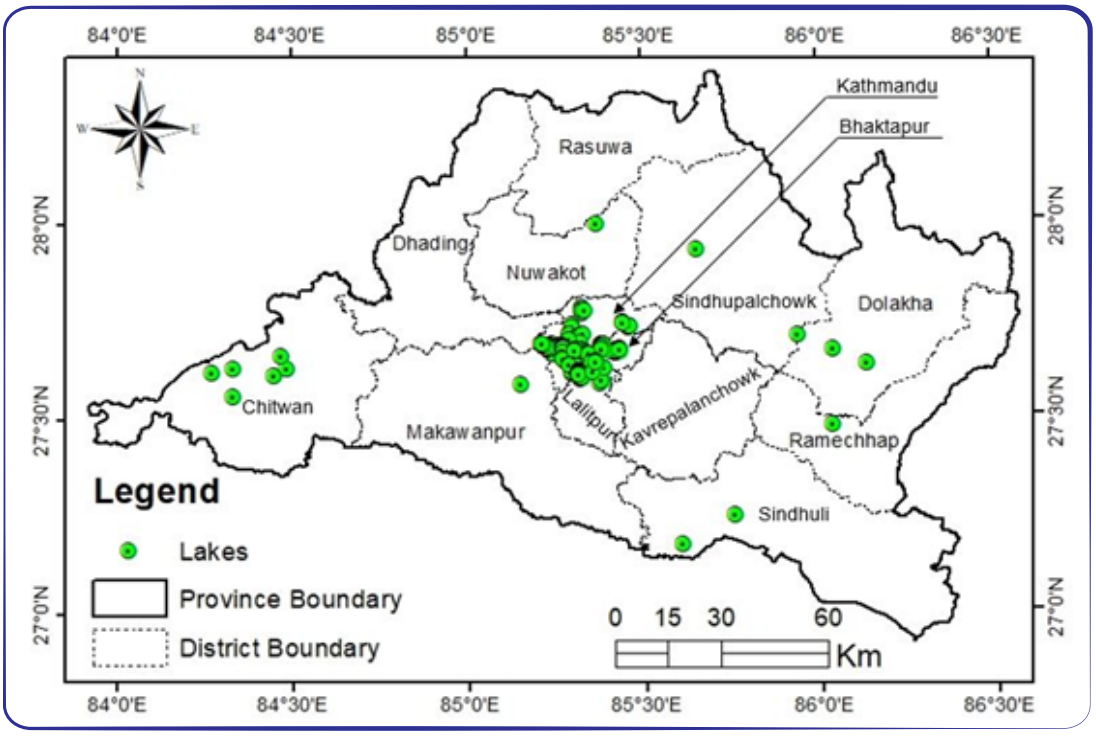

Figure 6-4 | *Spatial distribution of lakes in Bagmati Province*

The core area of these lakes varies from less than 0.1 hectares to 220 hectares. The largest one is the Kulekhani Reservoir (Indrasarobar) of Makwanpur district with a core area of 220 ha. The lakes range in altitude from 162 m to 2600 m, with Shiva Pokhari of Dolakha district lying high at an altitude of 2600 m. The average depth of lakes varies from 1m to 9 m whereas the basin area varies from 6.5 ha up to 15,600 ha.

Similarly, lake density is higher in the Siwalik region compared to the Terai. There are 204 lakes in Siwaliks, followed by 10 in Mahabharat, and 8 lakes in the Terai region. Lakes densities gradually decrease in the mountains when altitudinal gradients increase.

Many lakes have religious as well as tourism values. KamalPokhari of Bhaktapur, Balaju Baishdhara, and RaniPokhari of Kathmandu, Kulekhani of Makwanpur are tourist destinations. The NagPokhari lake of Kathmandu has a great religious importance.

6.3 Lakes distribution across districts

There are altogether 13 districts in Bagmati Province, namely, Bhaktapur, Chitwan, Dhading, Dolakha, Kathmandu, Kavrepalanchowk, Lalitpur, Makwanpur, Nuwakot, Ramechhap, Rasuwa, Sindhuli, and Sindhupalchowk. The district-wise lake distribution is shown in *Table 6.5*. Except for Dhading district, in which no lakes are reported in inventories, all other districts have lakes.

Bhaktapur district: There are altogether 51 lakes in Bhaktapur district. Please refer to *Figure 6-5* for their spatial distribution.

Table 6.5 | *Distribution of lakes in 13 districts of Bagmati Province*

District	Name of Lake	Type of Lake	Area		Conditions
			Core	Basin	
Bhaktapur	Jenla Pukhu				
	Salan Pukhu				
	Lamaga Pukhu				
	Bekha Pukhu				
	Kwathandau Pukhu				
	Yatu Bahare Pukhu				
	Gwanga Pukhu				
	Bhola Pukhu				
	Naag Pukhu				
	Ancha Pukhu				
	Khancha Pukhu				
	Nhad Pukhu				
	Chorcha Pukhu				
	Yalanchhe Byasi Pukhu				
	Byasi Pukhu				
	Iyakhu Phukhu				
	Kumari Pukhu				
	Khyo Pukhu				
	Mangalachhe Pukhu				
	Bhanda Pukhu				
	Degamana Pukhu				
	Mangaltirtha Pukhu				
	Runche Pukhu				

	Indrayani Pukhu				
	Kaldaha Pukhu				
	Machaphong Pukhu				
	Tekhachon Pukhu				
	Na Pukhu				
	Ta Pukhu				
	Bhajuya Pukhu				
	Rani Pukhu				
	Nag Pokhari				
	Garud Kunda				
	Wamune Pokhari				
	Barha Pokhari				
	Kamal Pokhari				
	Khasi Pokhari				
	Pukusi				
	Nhucchen Pokhari				
	Lachi				
	Bishnumati				
	Khapala Pokhari				
	Bishnu Kunda				
	Vulankhel				
	Wakha Pu (Shiva Pokhari)				
	Balkumari (Kolakhu Pukhu)				
	KumaLachi				
	Dui Pokhari (Southern Side)				
	Dui Pokhari (Northern Side)				
	Swanga Pukhu				
	Kyaku Pukhu				
	Total				
Chitwan	Anjana Taal	Fresh water, Riverine	1		Degrading
	Beeshazari Taal	Fresh water, Riverine	100	262	Degrading
	Ghaila Taal	Fresh water, Lacustrine	1		Degrading
	Khageri Dam	Man-made, water storage area	1.5	262	Degrading
	Rani Pokhari	Fresh water, Lacustrine	2.5		Degrading
	Rhino Taal	Fresh water, Riverine	3		Degrading
	Total		**109**		
Dolakha	Shiva Pokhari	Fresh water, water storage area	2	15	Good
	Simpani Pokhari	Fresh water, Lacustrine	0.5	15	Degrading
	Thuli Pokhari	Fresh water, Lacustrine	0.5	10	Degrading
	Total		**3**	**40**	

Kathmandu	Hiti Pokhari
	Balaju Baishdhara
	Pokhari
	Machha Pokhari
	Bhikhel Pokhari
	Museu Marga
	Pokhari
	Rani Pokhari
	Pokhari
	Kamal Pokhari
	Naag Pokhari
	Gahana Pokhari
	Pokhari
	Ikha Pokhari
	Buddhasthan Pokhari
	Buddha Pokhari
	Lachhi Pokhari
	Sano Pukhu
	Matsyanarayan Kunda
	Matsyanarayan Kunda II
	Kamal Pokhari
	Pau Pokhari
	Thakhel chaur Pokhari
	Matatirtha Kunda
	Mahadev Kunda
	Sano Pukhu
	Santoshi Mata Pokhari
	Tribhuban Pokhari I
	Tribhuban Pokhari II
	Laxmi Chha
	Tribhuban Park III
	Silafal Pukhu
	Mavi Pukhu
	Lava Pukhu
	Bhin Phuku
	Devdhoka Pokhari
	Thala Pukhu
	Dev Pukhu
	Devidhoka Pukhu
	Taudaha
	Aakha Pokhari I
	Pale Pukhu
	Pale Pukhu
	Dathal tole Pukhu
	Kamal Pokhari
	Kwara Pukhu

	Kalas Pokhari
	Mahadev Pokhari
	Phukhulachi
	Kamal Pokhari
	Sanagaon Phuku
	Sanagaon Phuku II
	Ganeshman Pokhari
	Mahadev Pokhari
	Narayan Pokhari
	Sapan Tirtha
	Sapan Kunda 1
	Chandeshwori Kunda
	Total
Lalitpur	Paleswan Pukhu
	La (Sitanga) Pukhu
	Tyagal Pukhu
	Guita Pukhu
	Balkumari North
	Balkumari West
	Bhailagaa: Pukhu
	Luksi Pukhu
	Prayag Pokhari
	Kumbheshwor Pukhu
	Chyasal Pukhu B
	Khapinchhe Pukhu
	Kutisaugal Pukhu
	Capah Pukhu
	Bhandarkhal Pukhu
	Purnachandi Pukhu
	Pimbaha Pukhu
	Ta Pukhu
	Saptapatal Pukhu
	Eulakhyo Pukhu
	Lagankhel Pukhu 1
	Lagankhel Pukhu 2
	Lagankhel Pukhu 3
	Nhu Pukhu
	Jywalakhel Pukhu
	Buddha Pokhari
	Ganga Pokhari (Dhokapini)
	Jamuna Pokhari (Bhunn)
	De Pokhari
	Na Pokhari
	Po Pokhari
	Khaincha Pokhari

Dhokasi
De Pokhari
Kha Pukhu (Pokhari)
Palo Pokhari
KutuPukhu
Ghaa Pukhu
Khaicha Pokhari
Pukushi Pokhari
Lankha Pokhari
Nagdaha
Dya Pukhu
Khaicha Pokhari 2
Phonga Pokhari
Krishna Dey Pukhu
Deykheba Pokhari
Dhalko Pokhari
Mahadev Mandir Pokhari
Tarpa Pukhu
Iku Phuku
Jhyali Phuku
Mava Phuku
Pronga Phuku
Hymane
Songu Phuku
Phunga Phuku
Buddha Pokhari
Thecho Pokhari
Khalcha Phuku
Jyoti Bihar Phuku
Jhiru Bari Pokhari
Pyangaon Phuku I
Pyangaon Phuku II
Pauli Pokhari
Godawari Kunda
Bande Gaun Pukhu I
Bande Gaun Pukhu II
Kamal Pokhari
Pailan Pokhari
Naudhara Kunda
Panch Dhara Pokhari I
Panch Dhara Pokhari II
Phunga Pokhari
Pukhu Near Police Sector
Lanka Pukhu
Kumar sahu Pukhu
Barkha Pukhu

	Jhochhe Pukhu				
	Tallo Iachhi Pukhu				
	Bhairabeswor Pokhari				
	Pingle Pukhu				
	SatyaPokhari				
	Santi Pukhu				
	Nehu Pukhu				
	Kamal Pokhari				
	Priyia Pukhu				
	Boje Pokhari				
	MachhaPokhari I				
	MachhaPokhari II				
	Inbal Pukhu				
	Bagaicha Pokhari				
	Bagaicha Pokhari II				
	Mahadev Pokhari				
	Khasi Pokhari				
	Sano Pokhari				
	Thaiba Pukhu				
	Total				
Makwanpur	Kulekhani Reservoir	Fresh water, Lacustrine	220	15600	Managed
	Total		**220**	**15600**	
Nuwakot	Sajar Kunda	Fresh water, Lacustrine	0.6		Degrading
	Total		**0.6**		
Ramechhap	Pokhari Dada	Fresh water, Lacustrine	0.1		Degrading
	Total		**0.1**		
Sindhuli	Kund	Fresh water, Lacustrine	2	10 - 12	Degrading
	Pancha Kanya	Fresh water, Lacustrine	1.5	5-8	Degrading
	Total		**3.5**		
Sindhupalchowk	Raithaneshwori Pokhari	Fresh water, Lacustrine	1.2	35	Degrading
	Total		**1.2**	**35**	

Chitwan district: There were six lakes in Chitwan district excluding the taals and ponds inside the Chitwan National Park. Beeshazari Taal is the largest, while Anjana and Ghaila Taals are small at 1 ha each. All the lakes are degrading. Please refer to Annex-25 for details on the features of each lake and *Figure 6-6* for spatial distribution.

Dolakha district: There were three Pokharis in Dolakha district. Shiva Pokhari has the largest core area size (2 ha.) and the only Pokhari in good condition. Please refer to Annex-26 for details on the features of each lake and *Figure 6-7* for understanding the spatial distribution.

Kathmandu district: There are altogether 58 lakes in Kathmandu district. Please refer to *Figure 6-8* for understanding the spatial distribution.

Lalitpur district: A total of 97 lakes are found in Lalitpur district. Please refer to *Figure 6-9* for understanding the spatial distribution.

Makwanpur district: Kulekhani Reservoir of Indra Sarobar is the only lake found in Makwanpur district. It has a 220 ha area with 15,600 ha of basin area. The reservoir is managed to generate hydro-electricity. Please refer to Annex-27 for details on the features of each lake and *Figure 6-10* for understanding the spatial distribution.

Nuwakot district: Sajar Kunda (0.6 ha. core area) is the only lake of the district. The Kunda is in degrading condition. Please refer to Annex-28 for details on the features the lake and *Figure 6-11* for spatial distribution.

Ramechhap district: The only Taal found in Ramechaap district is Pokhari Dada with a 0.1 ha core area. Please refer to Annex-29 for the details on the features of the lake and *Figure 6-12* for spatial distribution.

Sindhuli district: Only two lakes were found in Sindhuli district. Both lakes are degrading. Please refer to Annex-30 for details on the features of each lake and *Figure 6-13* for understanding the spatial distribution.

Sindhupalchowk district: The only lake found in Sidhupalchowk district was Raithaneshwori Pokhari. Its core area is 1.2 ha and its basin area is 35 ha. Its condition is degrading. Please refer to Annex-31 for details on features of the lake and *Figure 6-14* for understanding the spatial distribution.

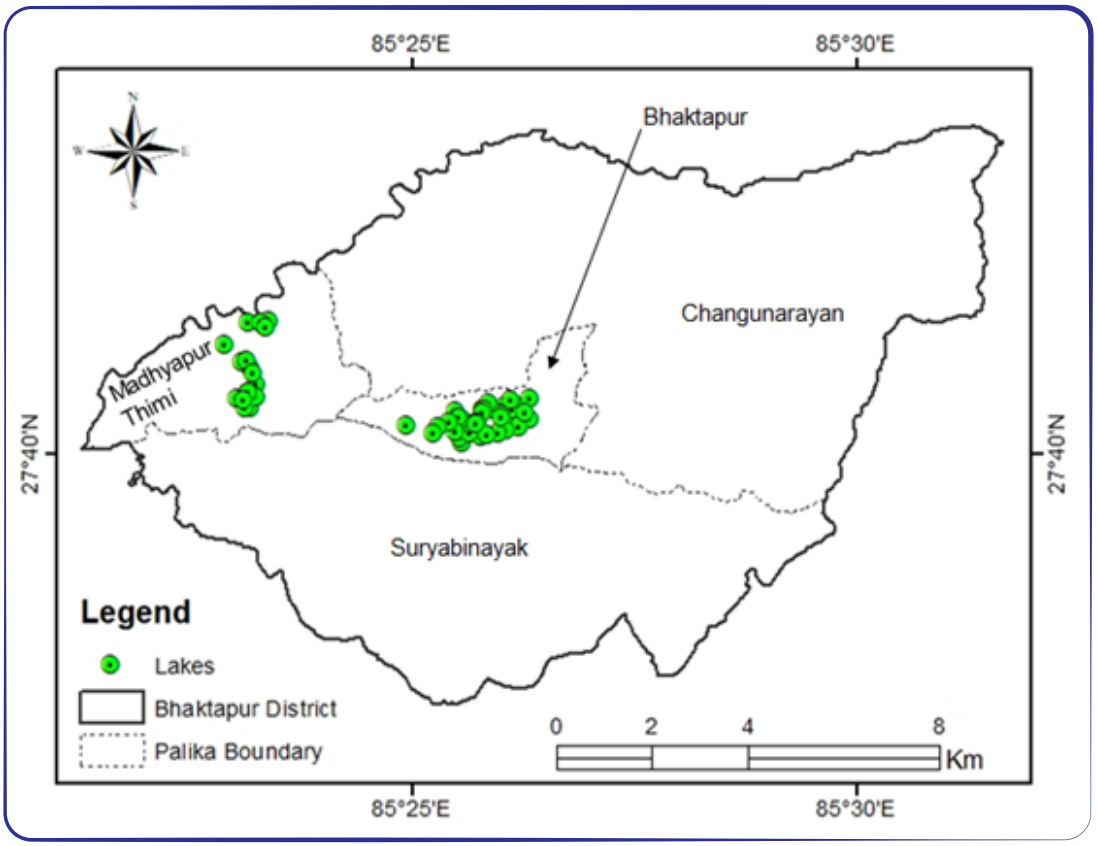

Figure 6-5 | *Spatial distribution of lakes in Bhaktapur district*

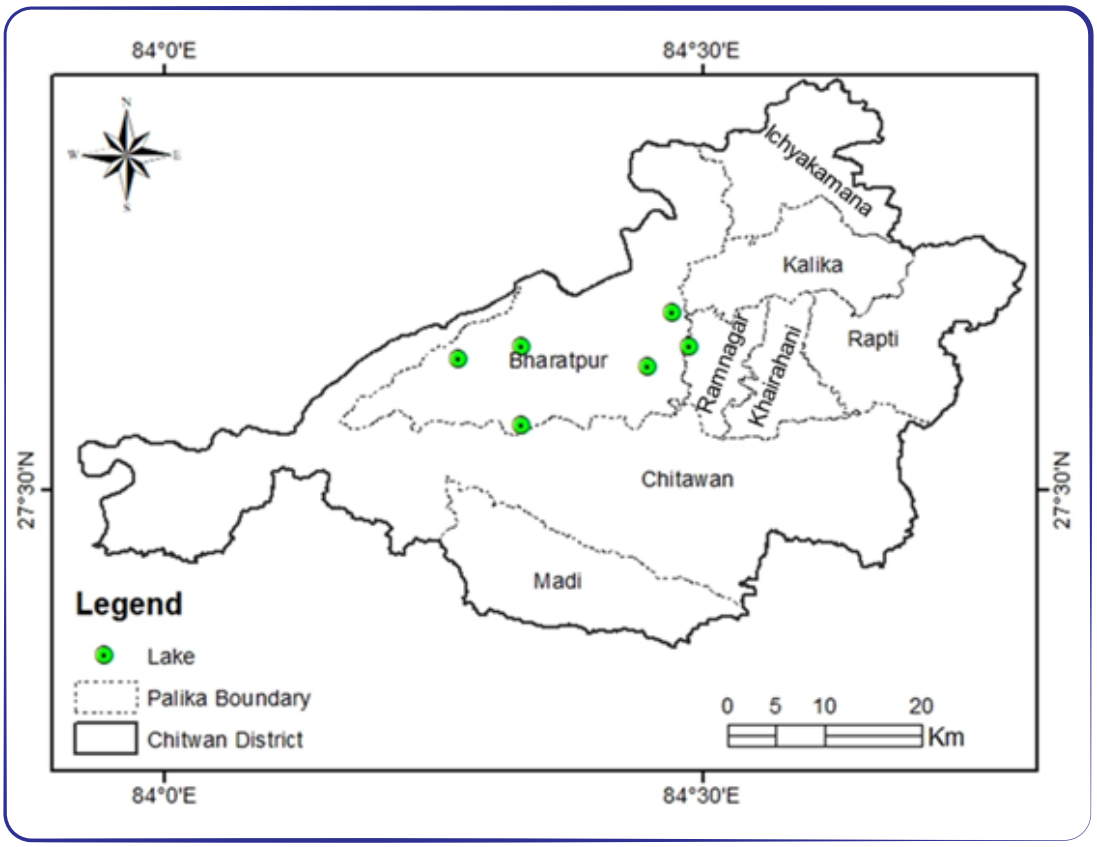

Figure 6-6 | *Spatial distribution of lakes in Chitwan district*

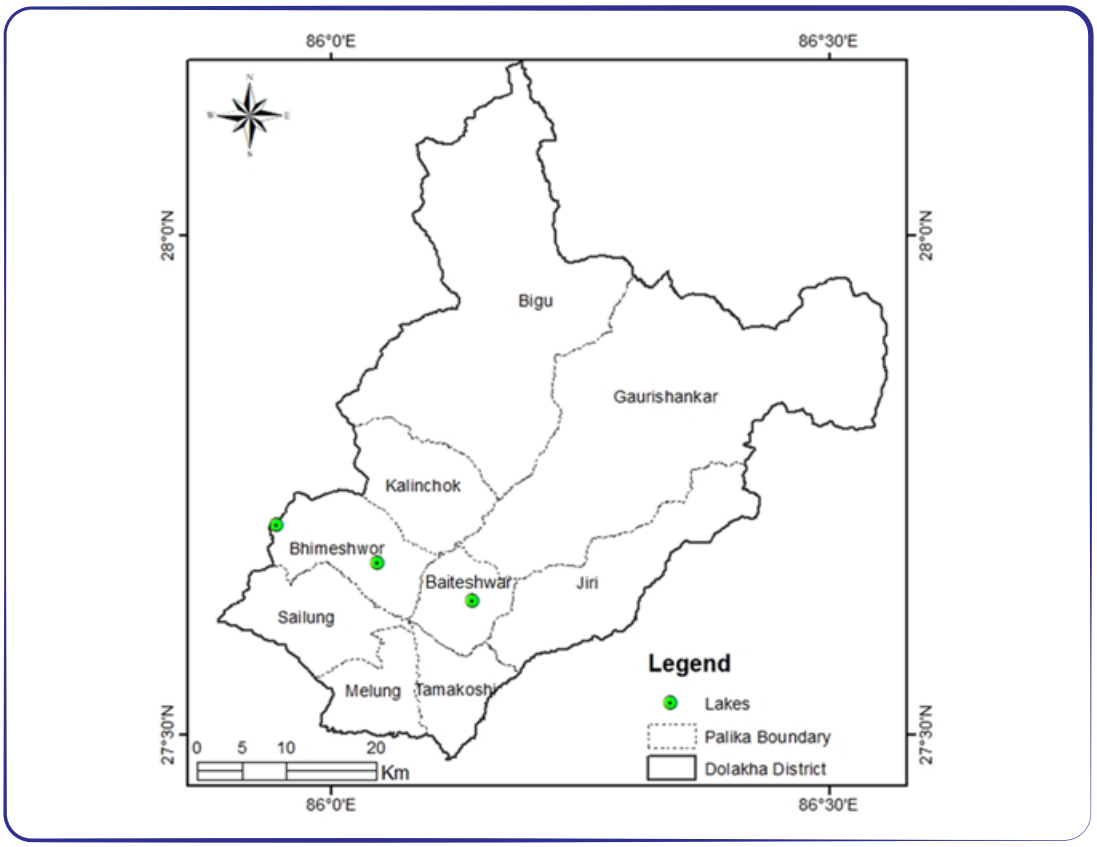

Figure 6-7 | *Spatial distribution of lakes in Dolakha district*

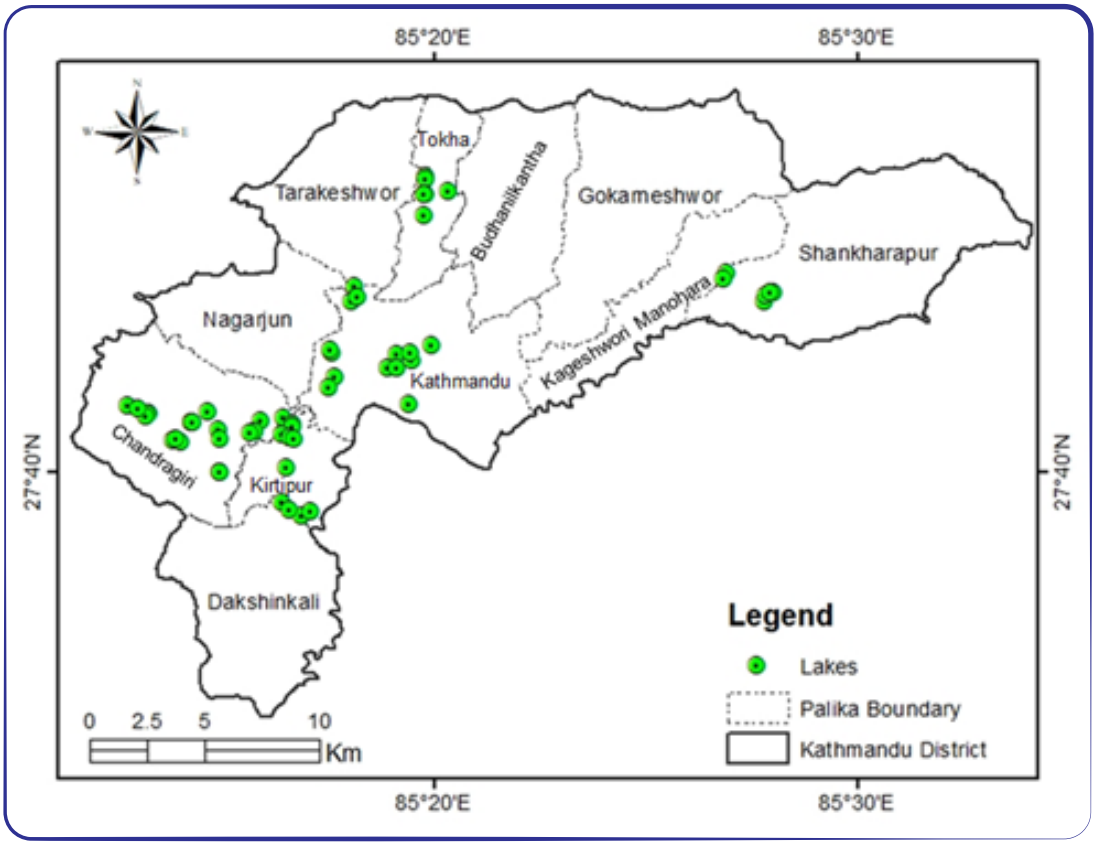

Figure 6-8 | *Spatial distribution of lakes in Kathmandu district*

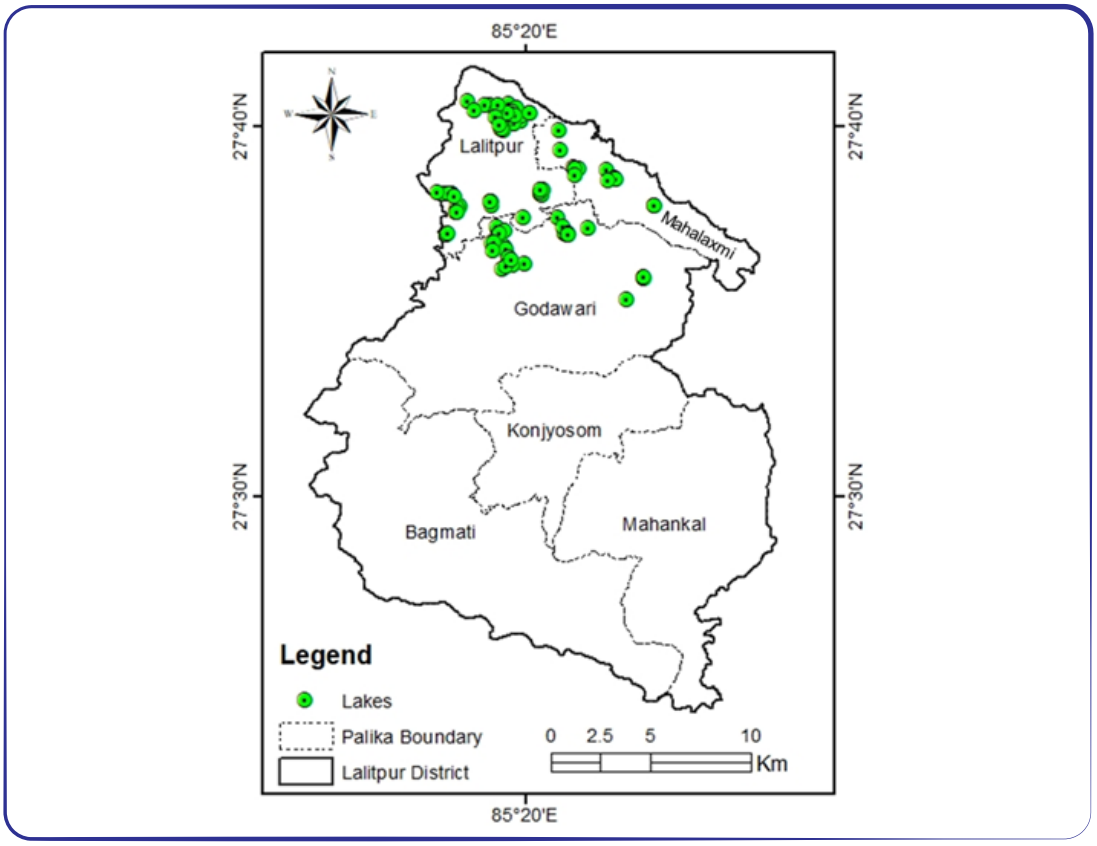

Figure 6-9| *Spatial distribution of lakes in Lalitpur district*

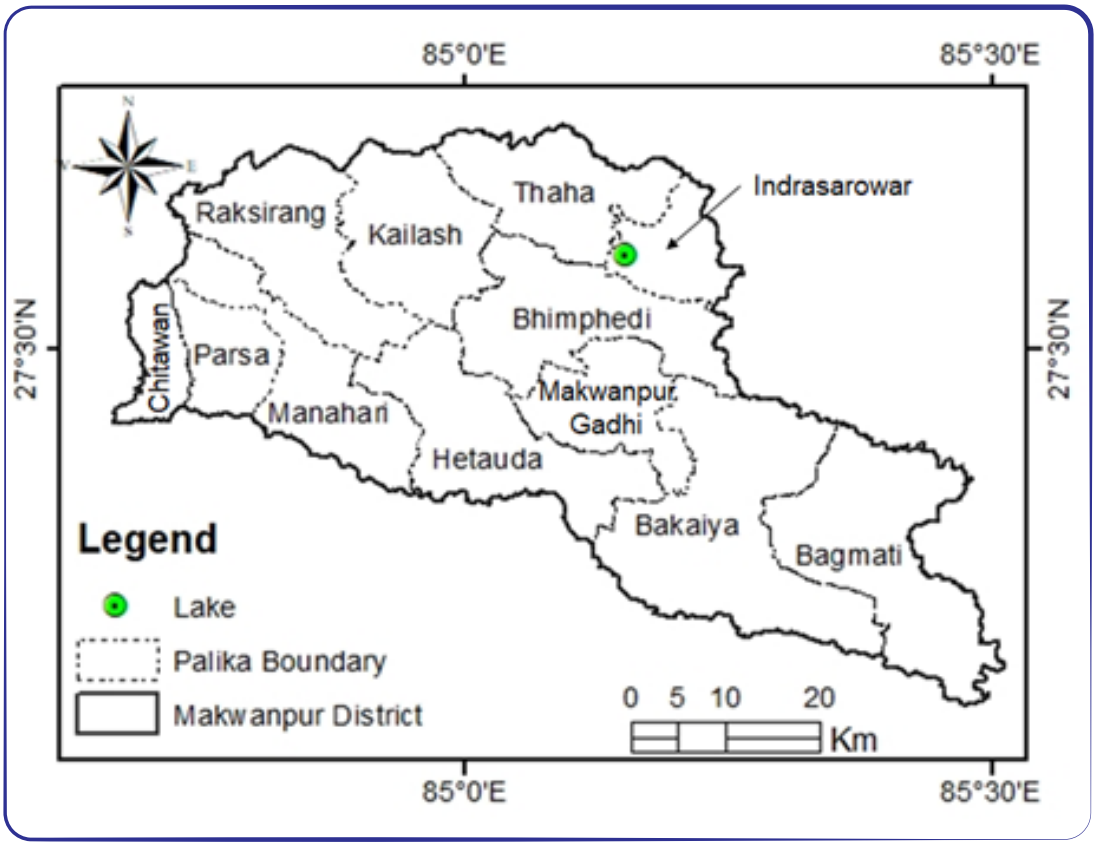

Figure 6-10| *Spatial distribution of lakes in Makwanpur district*

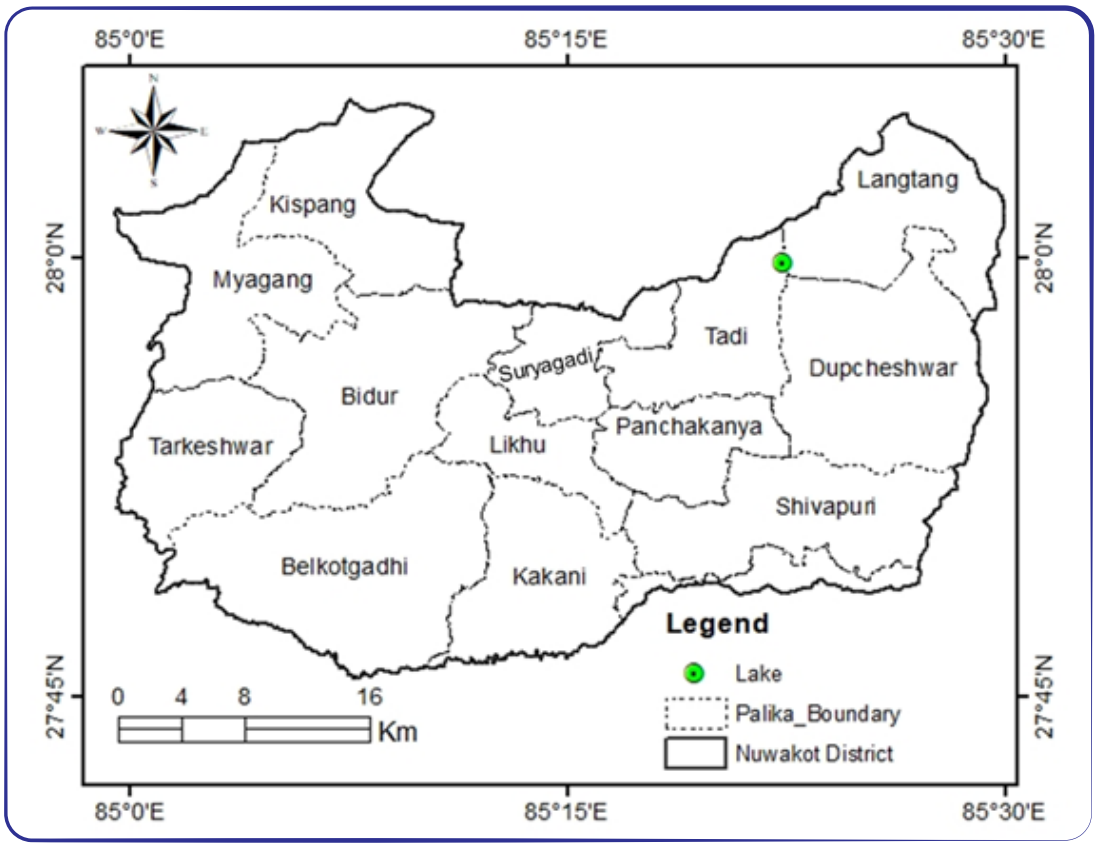

Figure 6-11| *Spatial distribution of lakes in Nuwakot district*

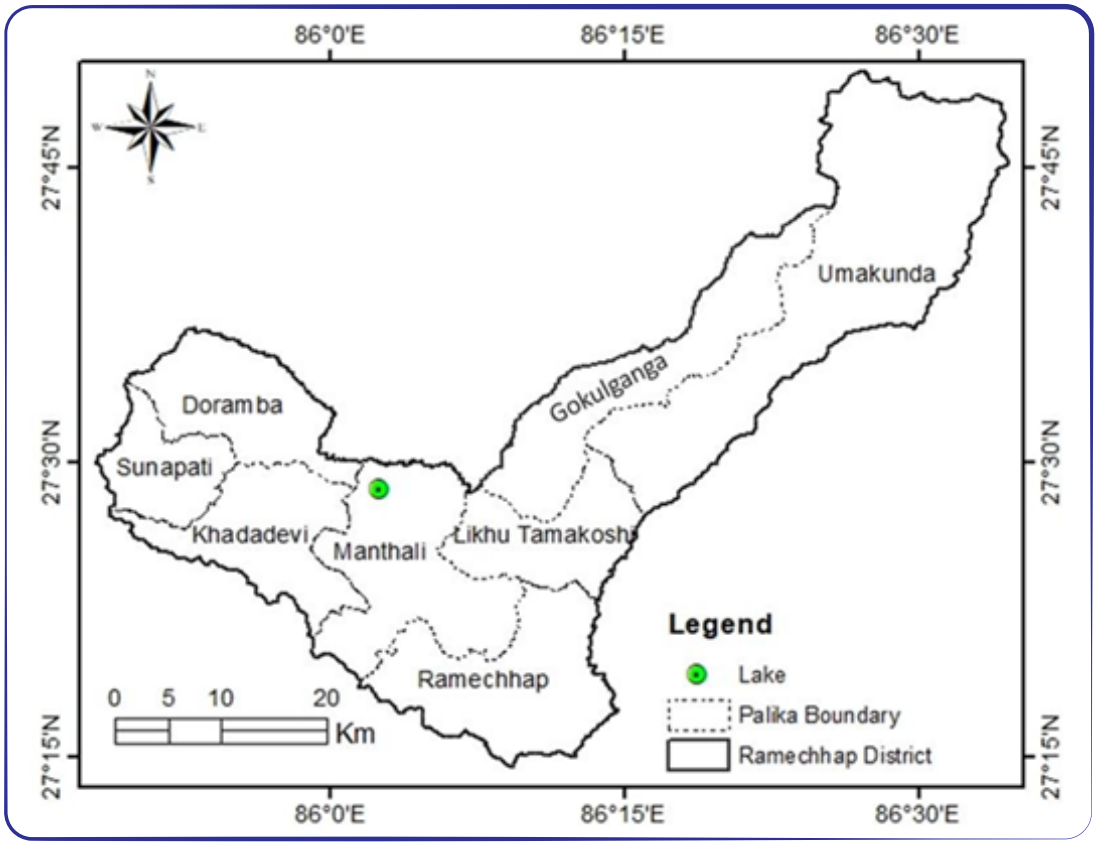

Figure 6-12| *Spatial distribution of lakes in Ramechhap district*

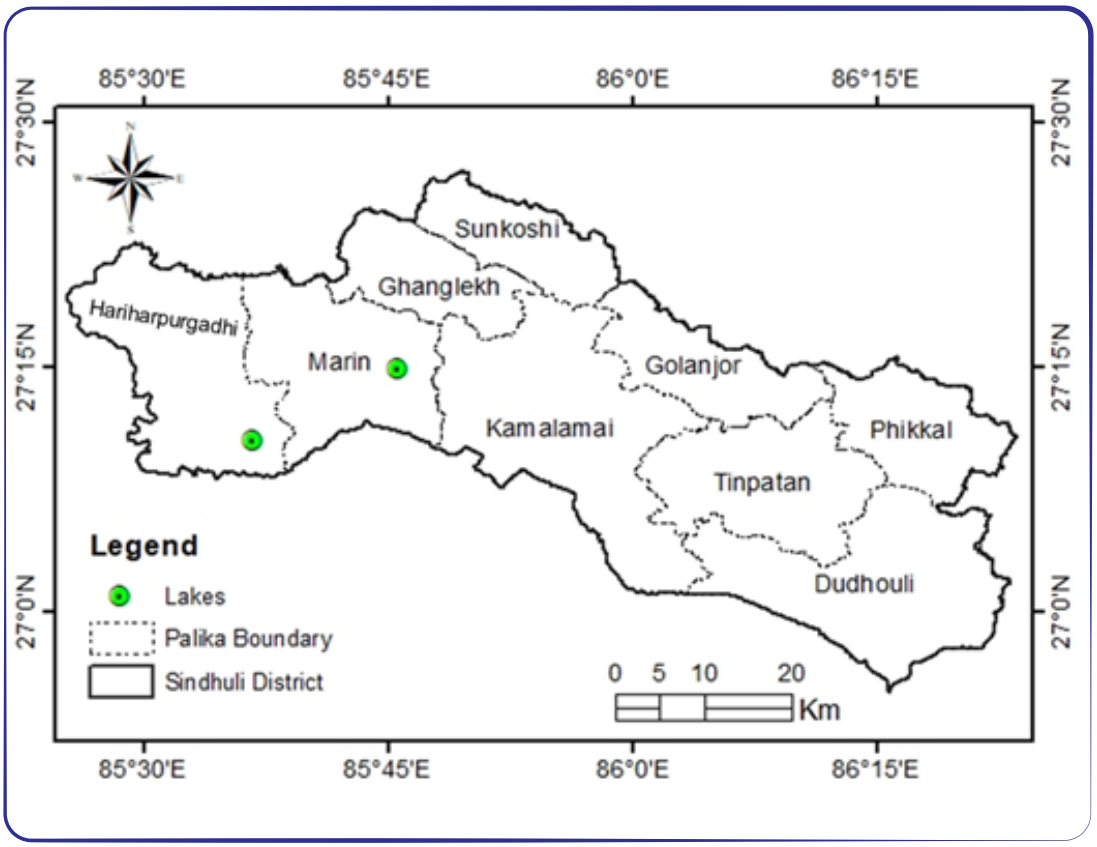

Figure 6-13| *Spatial distribution of lakes in Sindhuli district*

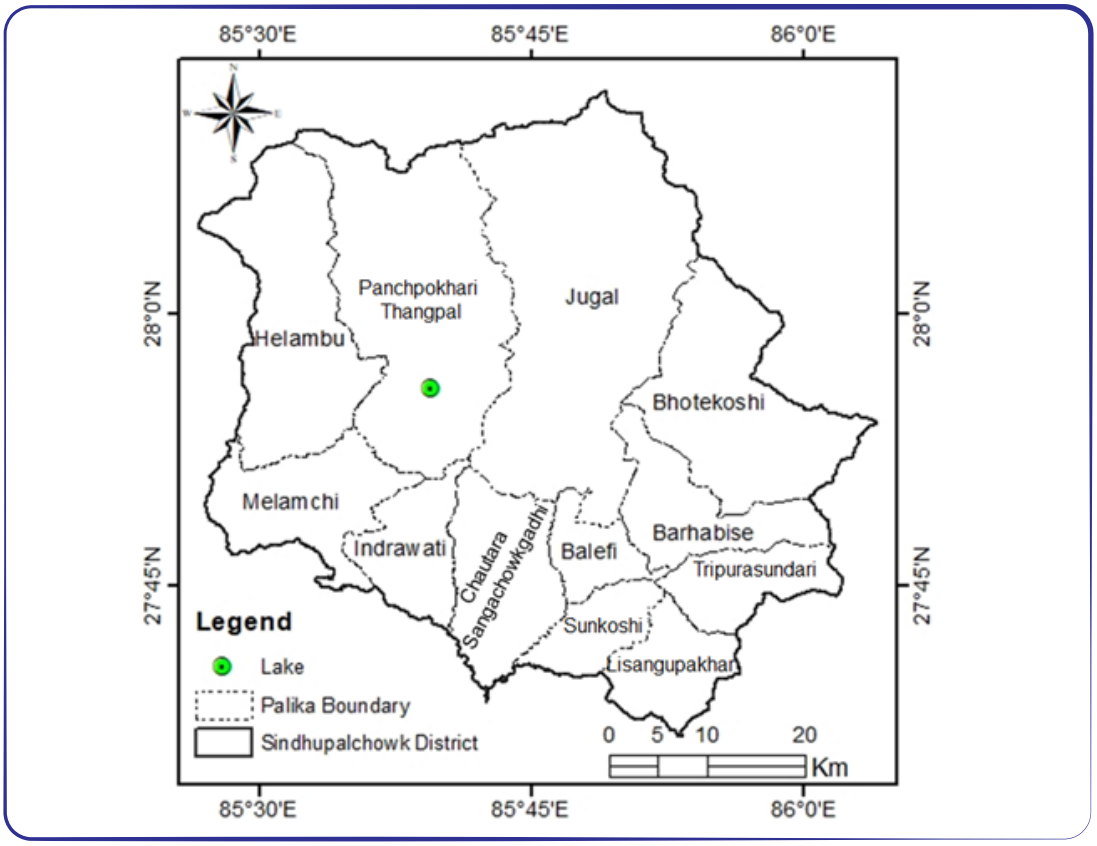

Figure 6-14| *Spatial distribution of lakes in Sindhupalchowk district*

7. LAKES IN GANDAKI PROVINCE

7.1 Biophysical and socio-economic context

7.1.1 General features

Gandaki Province lies in the western part of the country and covers 11 districts (*Figure 7-1*) and 86 Palikas, out of which, 1 is a Metropolitan City, 26 are Municipalities, and the rest are Rural Municipalities. The province stretches from the Terai in the south to the Himalayas in the north. It is home to 2.4 million people (8.3% of the country's population) and covers an area of 21,504 km^2 (14.6% of the country's land area).

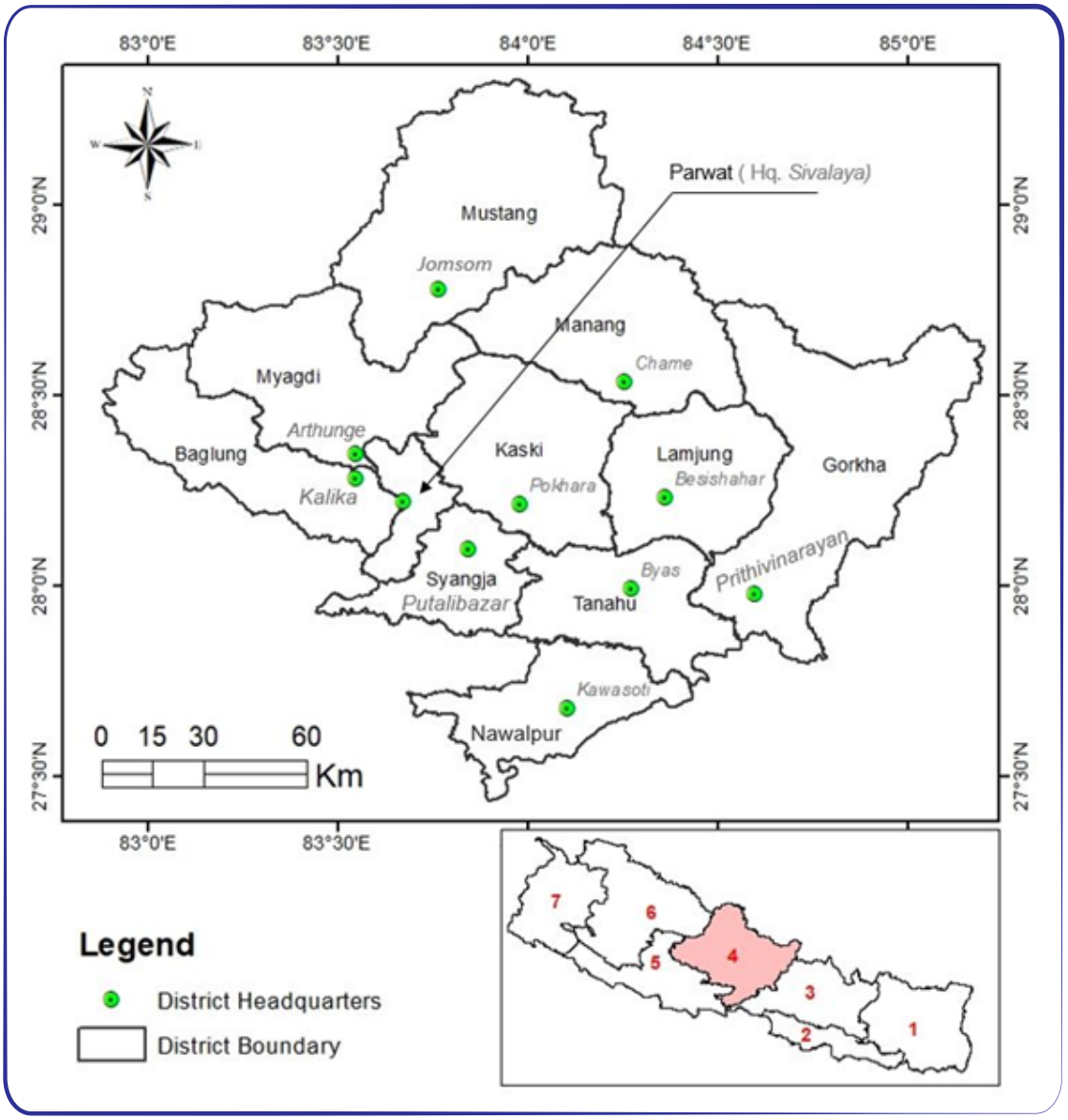

Figure 7-1 | *Location and districts covered in Gandaki Province*

Gandaki Province extends between 27°20' N - 29°20' N latitude and 82°52' E - 85°12' E longitude. In terms of terrain, it is spread over the Himalayan, Hilly, and the Terai regions; 5,919 km^2 (26.8%) of the area falls under the Himalayan region, 14,604 km^2 (67.2%) under

the Hilly region, and 1,310 km^2 (6%) under the Terai region. Annapurna and Machhapuchhre are major mountain peaks. Upper Mustang, Tilicho Lake, and Phewa Lakes are major tourist attractions. Manakamana and Muktinath temples are important religious sites.

7.1.2 Climate

Gandaki Province is characterized by different climatic conditions depending on locations and places. For example, there is a humid subtropical climate in Terai, a hot summer meridian climate in mid-hills, a sub-tropical highland oceanic climate in the mountains, and a tundra climate in the north in high mountains (Climate Data, 2017). *Table 7.1* shows the city-specific climate data of some locations.

Table 7.1 | *Meteorological parameters at meteorological stations in selected cities of Gandaki Province*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(deg. C)	Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(deg. C)
Lumle	5561	14.5	Khairini Tar	2078	21.7
Khudi Bazar	4436	17.8	Gorkha	1936	19.6
Pokhara Airport	3957	18.5	Chame	1165	10.0
Malepatan (Pokhara)	3638	19.0	Jomsom	377	8.3
Syangja	2999	19.2	Beni Bazar	142	19.0
Kushma	2855	18.6	Baglung	68	11.8

7.1.3 Hydrology/Drainage

The hydrology/drainage pattern of Gandaki Province is shown in *Figure 7-2* and is characterized by the varying nature of rivers. The major basins are the Gandaki Basin, the Marsyangdi Basin, and the East Seti Sub-basin. Out of 31,897 Km^2 area of the Gandaki Basin, 11,839Km^2 area falls in this province. Similarly, 4798Km^2 of Marsyangdi Basin falls in this province. The major rivers are Kaligandaki, Budhigandaki, Marsyangdi, Modi, Madi, Daraudi, Seti, Aandhikhola, Badigad, Uttarganga, etc.

7.1.4 Land use/cover

The province has eight types of land use/cover (*Figure 7-3*). District-wise land use/cover pattern is shown in *Table 7.2*. Forest is the major land use/cover type (32.8%) followed by agriculture (18.9%), and snow/glacial areas (16.3%) (*Table 7.2*). Water bodies cover only 0.5% of the total land. The largest areas of forest are in Baglung and Gorkha whereas the smallest forest areas are in Manang and Mustang districts. Water bodies dominated by river systems can be found in Nawalpur and Kaski districts.

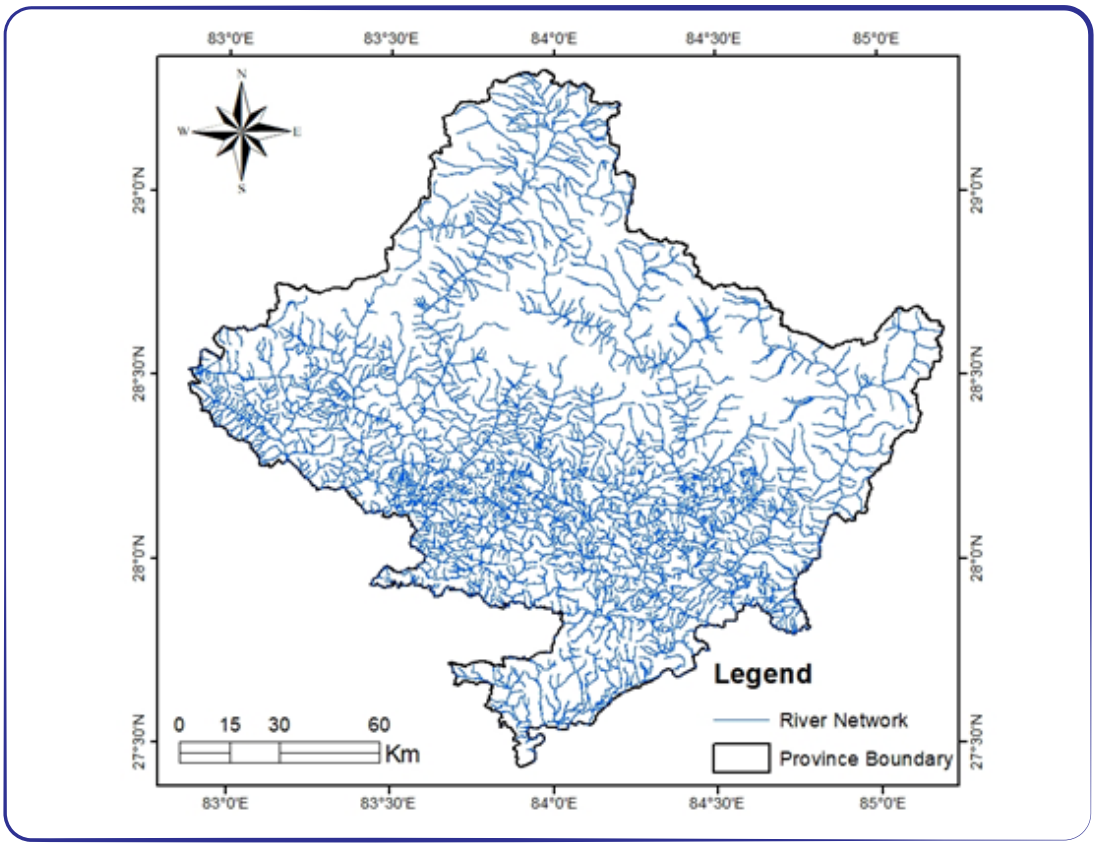

Figure 7-2 | *Spatial distribution of drainage network in Gandaki Province*

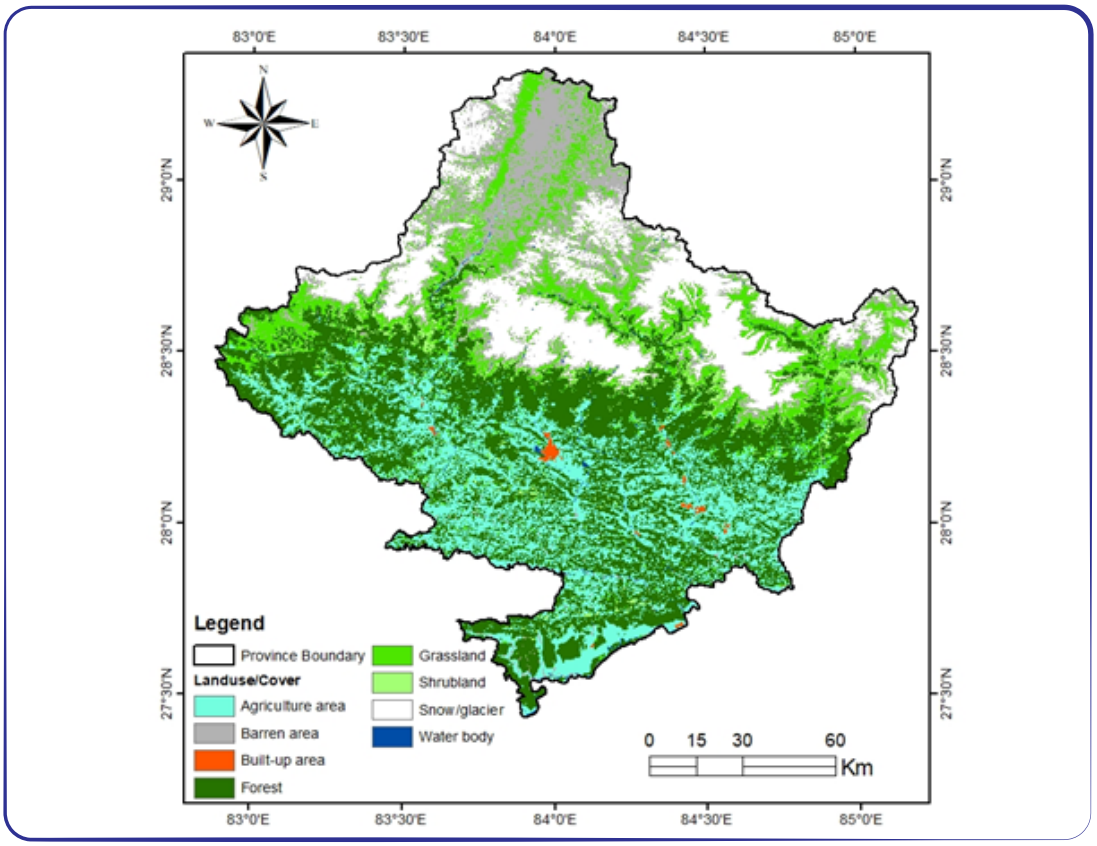

Figure 7-3 | *Land use/cover distribution in Gandaki Province*

Table 7.2 | *Land use/cover (ha) in Gandaki Province*

District	Landuse/Cover Area (ha)									
	Forests	Shrub	Grassland	Cropfield	Barren	Water	Builtup	Snow/glacier	Total	%
Baglung	104299	7258	18988	51076	1197	411	341	24	183595	8.4
Gorkha	101511	17230	75109	59944	30497	710	833	77706	363540	16.6
Kaski	92636	4940	12119	42560	9509	2188	2780	41734	208466	9.5
Lamjung	86451	8917	17468	33309	6157	569	730	12744	166346	7.6
Manang	13253	6780	59404	196	45039	1139		105962	231773	10.6
Mustang	9196	4522	95794	883	172426	1251		71427	355498	16.2
Myagdi	82517	13063	39613	25965	17447	765	92	49112	228572	10.4
Nawalpur	78008	2476	2244	53159	3920	2419	337		142563	6.5
Parbat	25056	671	1439	26604	353	32	47		54202	2.5
Syangja	42538	2048	2758	54955	1325	169			103794	4.7
Tanahun	84231	1767	2279	65945	1361	1009	647		157240	7.2
Total	719696	69671	327216	414597	289230	10662.3	5808	358708.38	2195588	
%	32.8	3.2	14.9	18.9	13.2	0.5	0.3	16.3	100	

7.1.5 Population and ethnicity

The human population is about 2.4 million (*Table 7.3*), of which, the female population consists of 54.7%. The mountain region is inhabited by Sherpas, Ghales and Gurungs. The hilly region is inhabited by Brahmin, Chettri, Magars etc. In the Terai, Tharus and Bhramins are common. Parwat is the most highly densely populated district (296 persons/km^2) followed by Nawalpur and Syangja. Manang, and Mustang have the lowest population density with just 3 persons/km^2.

Table 7.3 | *District-wise population distribution in Gandaki Province*

Districts	Area(Km^2)	Population			Major Ethnicity
		Male	Female	Total	
Baglung	1784	117997	150616	268613	Magar; Brahmin; Chhetri; Kami
Gorkha	3610	121041	150020	271061	Gurung; Brahmin; Magar
Kaski	1692	75913	91811	167724	Brahmin; Gurung; Chhetri
Lamjung	1692	75913	91811	167724	Brahmin; Gurung; Chhetri
Manang	2246	3661	2877	6538	Gurung; Tamang; Ghale
Mustang	3573	7093	6359	13452	Thakali; Gurung; Lopha
Myagdi	2297	51395	62246	113641	Magar; Chhetri; Kami
Nawalparasi	2162	303675	339833	643508	Magar; Brahmin; Tharu
Parbat	494	65301	81289	146590	Brahmin; Magar; Chhetri
Syangja	1164	125833	163315	289148	Brahmin; Magar; Gurung
Tanahun	1546	143410	179878	323288	Magar; Brahmin; Gurung; Chhetri
Total	22260	1091232	1320055	2411287	

7.2 Lakes distribution across physiography

Table 7.4 shows the finding of 42 lakes in Gandaki Province of Nepal that have mix-values for biodiversity, livelihoods, and religion and culture. The spatial distribution of lakes is depicted in *Figure 7-4*. The district-wise distribution of lakes is reported as four in Baglung, three in Gorkha, 17 in Kaski, eight in Lamjung, two each in Mustang, Myagdi, and Nawalpur, three in Parwat,

and one in Tanahun. Kaski district holds the largest number of lakes (17) followed by Lamjung (8) and Baglung (4). Many lakes dotted in the map-based inventory have disappeared.

A total of six lakes are in a good condition, the remaining 36 are degrading. The core areas of the lakes vary from less than 0.2 hectares to 451 hectares. The largest is Phewatal in the Kaski district with a core area of 451 ha. The lakes are distributed within an altitude range of 143 – 2903 m, with Pittal Kharka of Myagdi district lying high at an altitude of 2903m. Basin areas vary from 2 ha up to 12,000 ha.

Table 7.4 | *Physiographic distribution of lakes in Gandaki Province at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Baglung	4		1	3	
D-2	Gorkha	3	1	2		
D-3	Kaski	17	1	14	2	
D-4	Lamjung	8		3	5	
D-5	Mustang	2			2	
D-6	Myagdi	2			1	1
D-7	Nawalpur	2	2			
D-8	Parbat	3		1	2	
D-9	Tanahun	1	1			
Total		**42**	**5**	**21**	**15**	**1**

Lake density is highest in the Siwalik region and lesser in the Terai. There are 21 lakes in Siwaliks, followed by 16 in Mahabharat, and five in the Terai regions. Lake density gradually decreases in the mountains when altitudinal gradients increase.

Some lakes are of great tourism value like Begnas Lake and Phewa Lake of Kaski district. The Barah Tal in Baglung is of important religious significance to Hindus. Likewise, Dhumba Tal of Mustang has a great religious value for Buddhists. Most of high-altitude lakes are used for religious purposes.

All these lakes in total have an area of about 1,007 ha in Gandaki Province, which is 0.047% of the total surface area of the province.

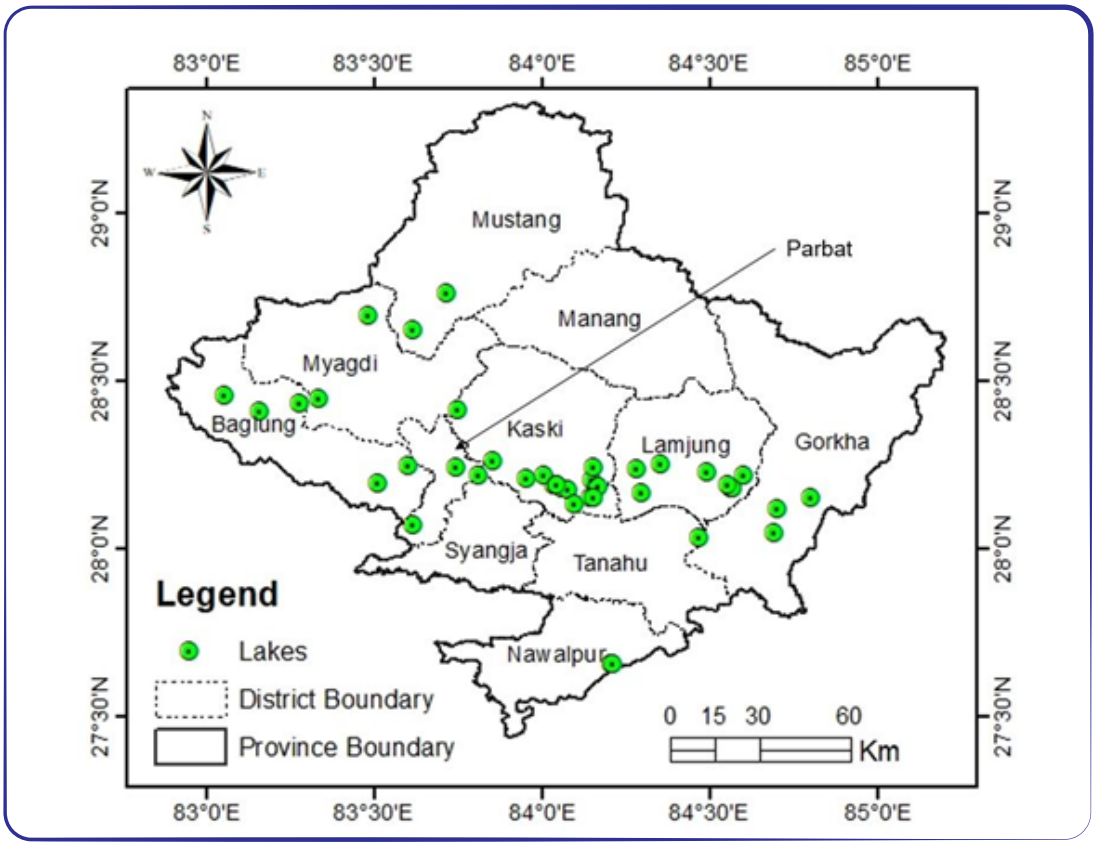

Figure 7-4 | *Spatial distribution of lakes in Gandaki Province*

7.3 Lakes distribution across districts

Gandaki province is divided into 11 districts, which are Baglung, Gorkha, Kaski, Lamjung, Manang, Mustang, Myagdi, Nawalpur, Parbat, Syangja and Tanahun. Among these, no lakes are reported in Manang and Syangja districts.

Baglung district: This district holds 4 lakes, all degrading (*Table 7.5*). Gaja Tal is the largest one (0.46 ha) and Barah-I the smallest one (0.28 ha). Please refer Annex-14 for details on features of each lake and *Figure 7-5* for spatial distribution.

Table 7.5 | *Lakes in all districts within Gandaki Province*

District	Name of Lake	Type of Lake	Area		Conditions
			Core	Basin	
Baglung	Barah Tal-I	Fresh water, Lacustrine,Permanent	0.28	4	Degrading
	Barah Tal-II	Fresh water, Lacustrine,Permanent	0.4	5	Degrading
	Gaja Tal	Fresh water, Lacustrine,Permanent	0.46	6	Degrading
	Rudra Tal	Fresh water, Lacustrine,Permanent	0.4	4	Degrading
	Total		**1.54**	**19**	
Gorkha	Ghunchok	Freshwater, Palustrine	1.25	20	Degrading
	Tal Pokhari	Freshwater, Palustrine	1.25	12	Degrading

	Thulo Pokhari	Freshwater, Seasonal	0.5	2	Degraded
	Total		**3**	**34**	
Kaski	Aalaiche Pokhari	Freshwater, Lacustrine	0.5	2	Degraded
	Bage Pokhari	Freshwater, Lacustrine	1	20	Degraded
	Barna Pokhari	Freshwater, Palustrine	1	10	Degraded
	Begnas Tal	Freshwater, Lacustrine	327	>2000	Good
	Dipang Tal	Freshwater, Lacustrine	6	193	Good
	Gunde Tal	Freshwater, Lacustrine	8.3	74	Degrading
	Kamal Pokhari	Freshwater, Lacustrine	2	133	Degrading
	Khaste Tal	Freshwater, Lacustrine	9	319	Good
	Maidi Tal	Freshwater, Lacustrine	1	122	Degrading
	Naya Pokhari	Freshwater, Emergent	0.6	7	Degraded
	Neureni Tal	Freshwater, Lacustrine	2	43	Degraded
	Phewa Tal	Freshwater, Lacustrine	451	12000	Good
	Rani Pokhari	Freshwater, Palustrine	1	30	Degrading
	Rupa Tal	Freshwater, Palustrine	107	2722	Degrading
	Sani Pokhari	Freshwater, Palustrine	0.5	6	Degraded
	Siddhi Pokhari	Freshwater, Palustrine	0.5	6	Degrading
	Thulo Pokhari	Freshwater, Lacustrine	1	4	Degraded
	Total		919	15691	
Lamjung	Damrang Pokhari	Freshwater, Seasonal	1	20	Degraded
	Deurali Sano Pokhari	Freshwater, Palustrine	0.4	25	Degrading
	Deurali Thulo Pokhari	Freshwater, Palustrine	1	10	Degrading
	Ilam Pokhari	Freshwater, Palustrine	1.5	20	Degrading
	Murunje Pokhari	Freshwater, Lacustrine	0.3	12	Degraded
	Siddi Pokhari	Freshwater, Lacustrine	0.5	20	Degraded
	Tinghare Thulo Pokhari	Freshwater, Lacustrine	**1**	10	Degraded
	Ulgera Pokhari	Freshwater, Palustrine	1	16	Degraded
	Total		6.7	133	
Mustang	Dhumba lake	Fresh water, Lacustrine, Permanent	1	10	Good
	Titi lake	Freshwater, Lacustrine, Permanent	8.29	92	Good
	Total		9.29	102	
Myagdi	Gai Kharke	Fresh water, Lacustrine, Permanent	0.2	5	Good
	Pittal Kharke	Fresh water, Lacustrine, Permanent	0.2	2	Good
	Total		0.4	7	
Nawalpur	Gaida Tal	Freshwater, Lacustrine	2.5	55	Degrading
	Sanischare	Freshwater, Lacustrine	1.5	40	Degrading
	Total		4	95	
Parbat	Patle Kharka Pokhari	Freshwater, Palustrine	0.5	15	Degrading
	Sani Pokhari	Freshwater, Lacustrine	0.5	12	Degrading
	Thulo Pokhari	Freshwater, Lacustrine	1	5	Degraded
	Total		**2**	**32**	

Tanahun	Marshyangdi Reservoir	Freshwater,Riverine,Water Storage	60	>3000	Managed
	Total		**60**		

Gorkha district: There are 3 lakes in the Gorkha district (*Table 7.5*). Ghunchok and Tal Pokhari are the largest ones both counting an area of 1.25 ha and Thulo Pokhari (0.5 ha) is the smallest one. All lakes are degrading. Please refer to Annex-30 for details of each lake and *Figure 7-6* for understanding the spatial distribution.

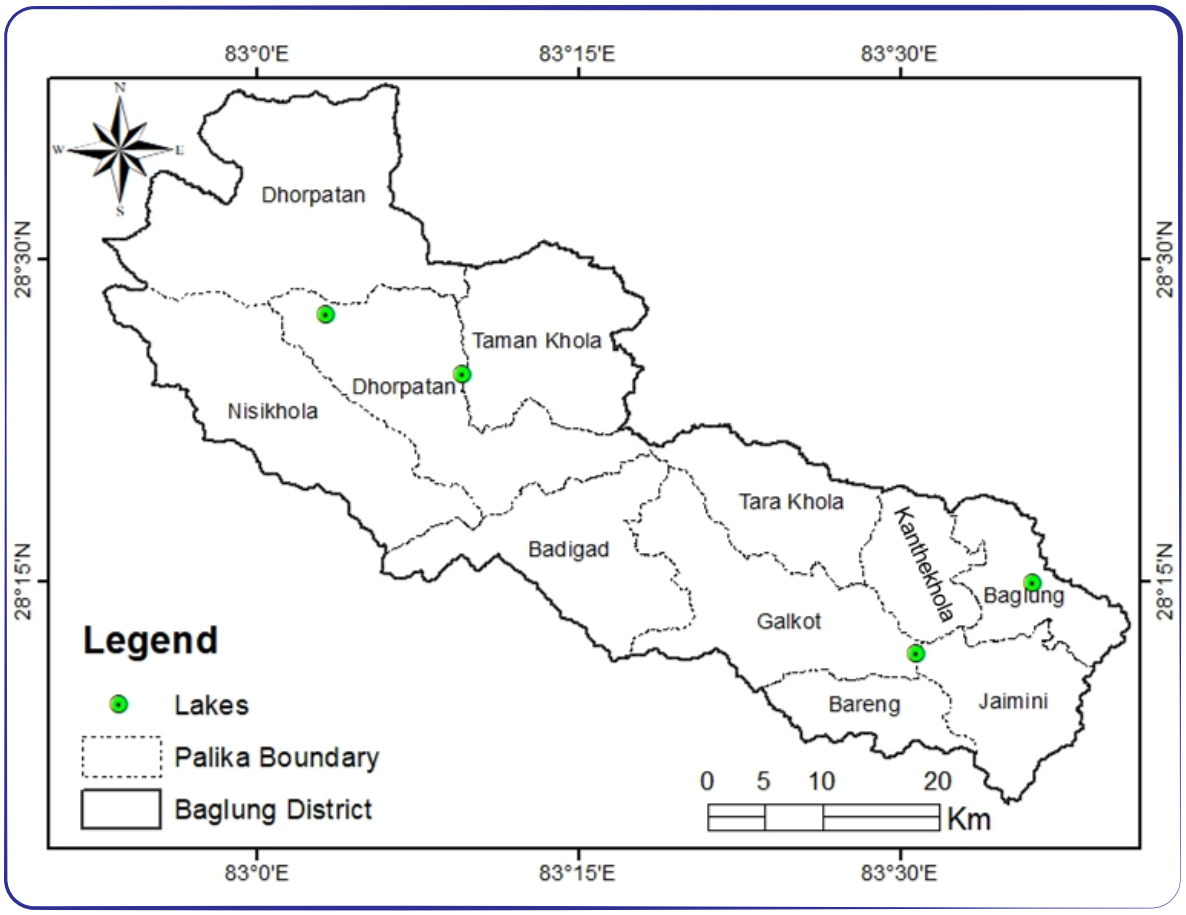

Figure 7-5 | *Spatial distribution of lakes in Baglung district*

Kaski district: There are 17 lakes/ponds in Kaski District. Phewa Lake is the largest one and Aalaiche, Sani, and Siddhi and Pokhari (0.5 ha) the smallest ones. Please refer to Annex-31 for details on the features of each lake and *Figure 7-7* for spatial distribution.

Lamjung district: There are eight lakes in Lamjung district (*Table 7.5*). Ilam Pokhari is the largest lake (1.5 ha), while Murunje Pokhari is the smallest (0.3 ha). All lakes are degrading. Some are in a degraded condition. Please refer to Annex-32 for details on the features of each lake and *Figure 7-8* for spatial distribution.

Mustang district: There are two lakes in Mustang district (*Table 7.5*). Titi lake is the larger one (8.29ha). Both lakes are in good condition. Please refer to Annex-33 for details on the features of each lake and *Figure 7-9* for spatial distribution.

Myagdi district: There are two lakes in Myagdi district (*Table 7.5*) Pittal Kharke lake is the larger one (0.2ha). Both lakes are in good condition. Please refer to Annex-34 for details on the features of each lake and *Figure 7-10* for spatial distribution.

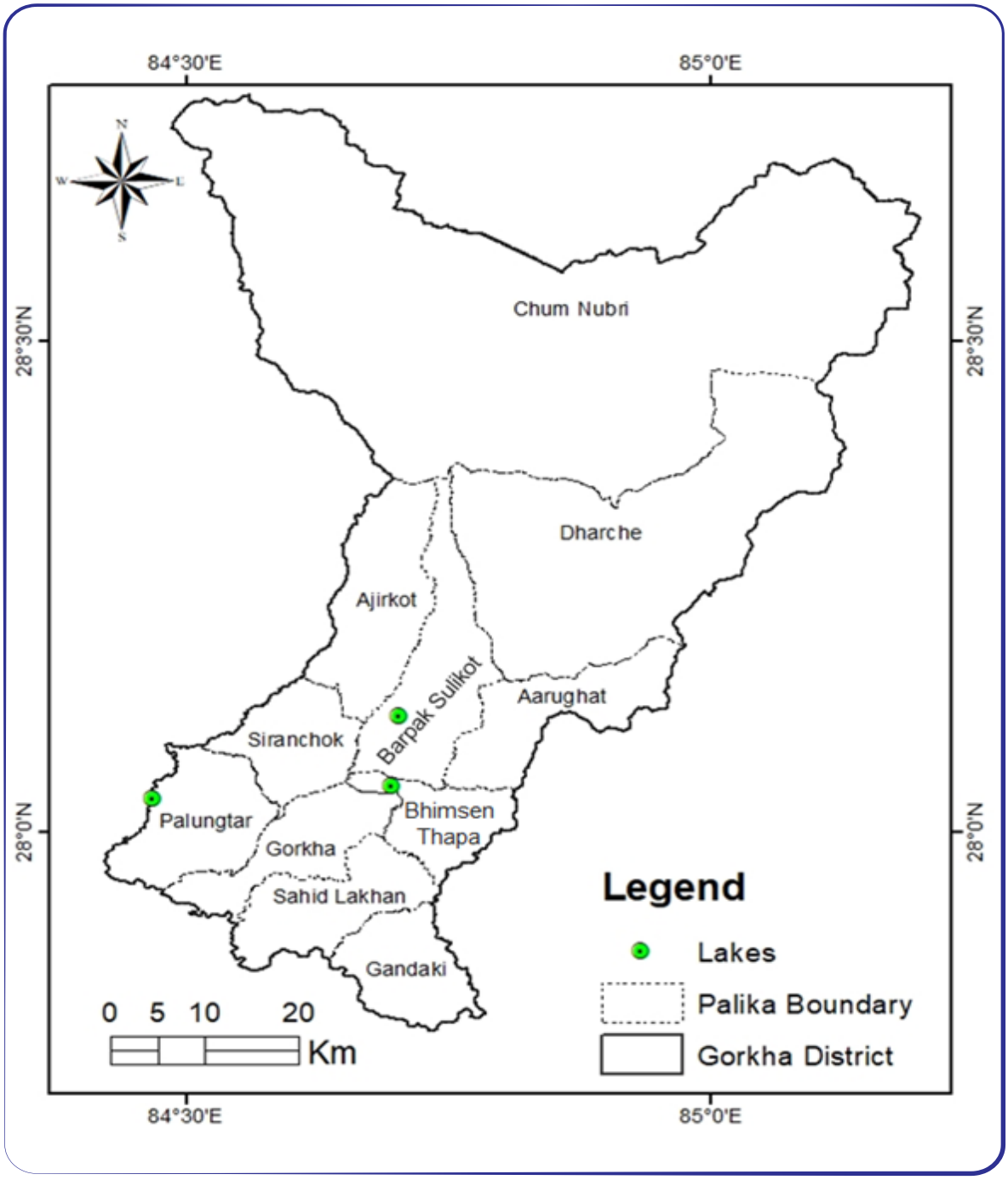

Figure 7-6| *Spatial distribution of lakes in Gorkha district*

Nawalpur district: There are two lakes in Nawalpur district. Out of these lakes, Gaida Tal is the largest one. Both lakes are in degrading condition. Please refer to Annex-35 for details on the features of each lake and *Figure 7-11* for understanding the spatial distribution.

Parbat district: There are three lakes in Parbat district. Thulo Pokhari is the largest one (1 ha) and Patle Kharka and Sani Pokhari are the smallest ones with a core area of 0.5 ha (*Table 7.5*).

All the lakes are in degrading condition. Please refer to Annex-36 for details on the features of each lake and *Figure 7-12* for understanding the spatial distribution.

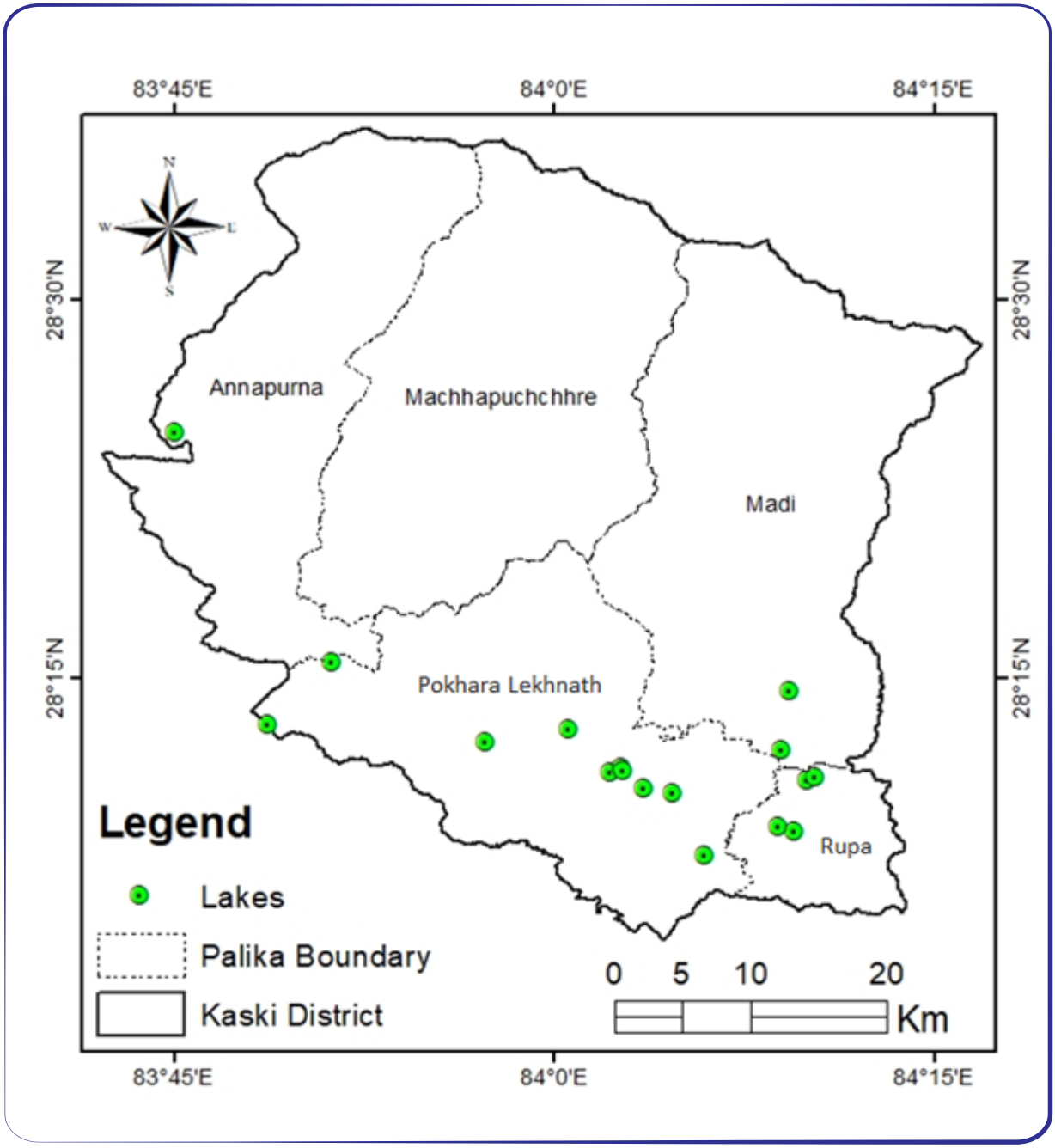

Figure 7-7 | *Spatial distribution of lakes in Kaski district*

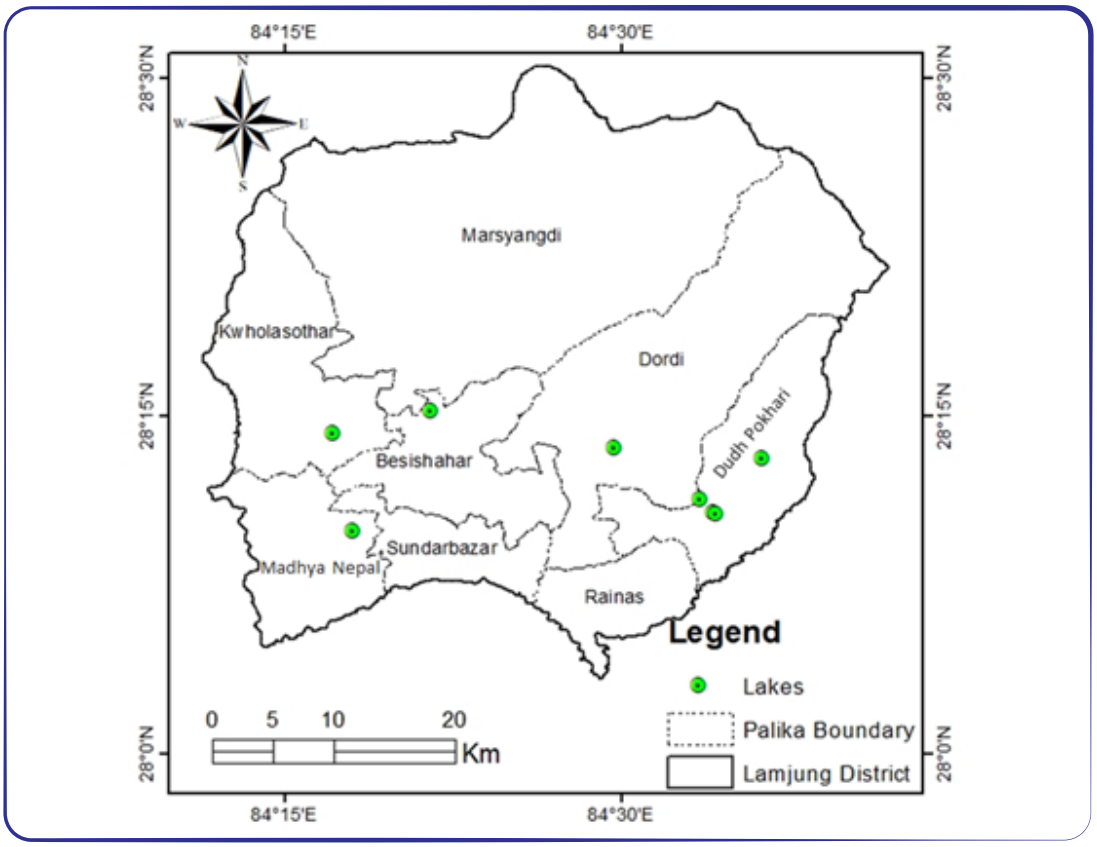

Figure 7-8 | *Spatial distribution of lakes in Lamjung district*

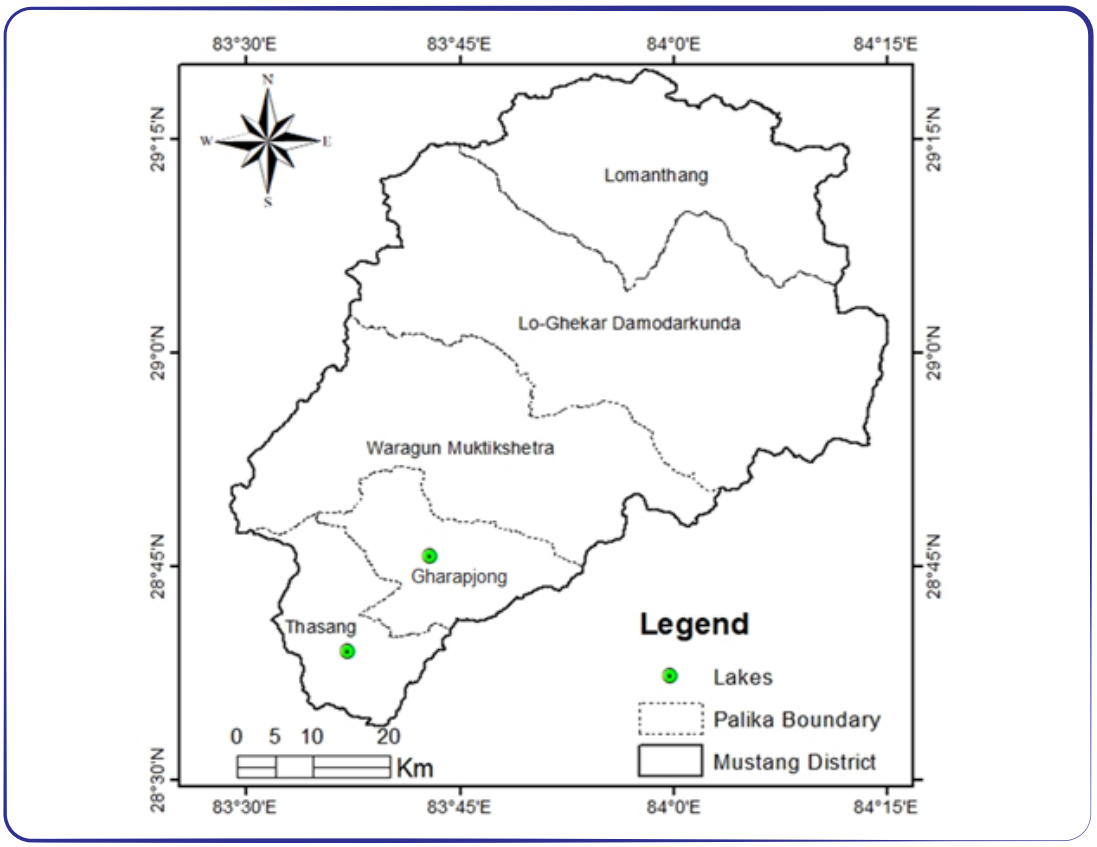

Figure 7-9 | *Spatial distribution of lakes in Mustang district*

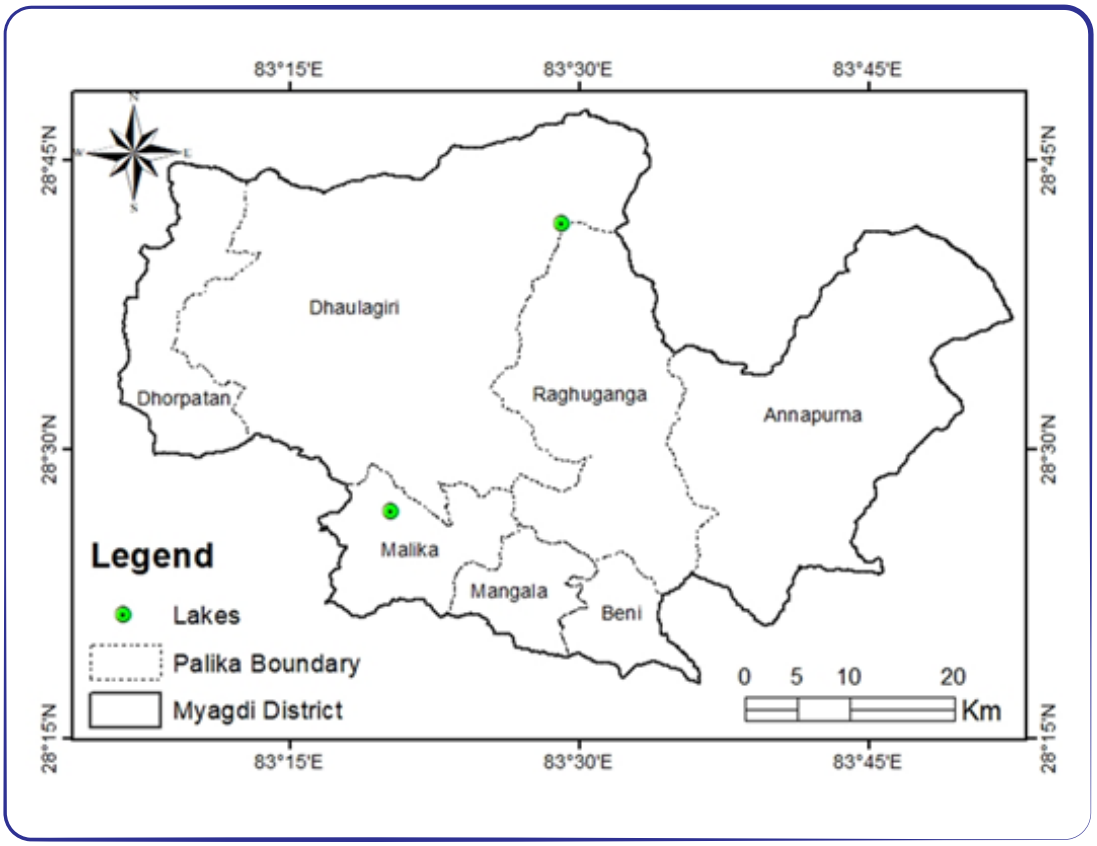

Figure 7-10| *Spatial distribution of lakes in Myagdi district*

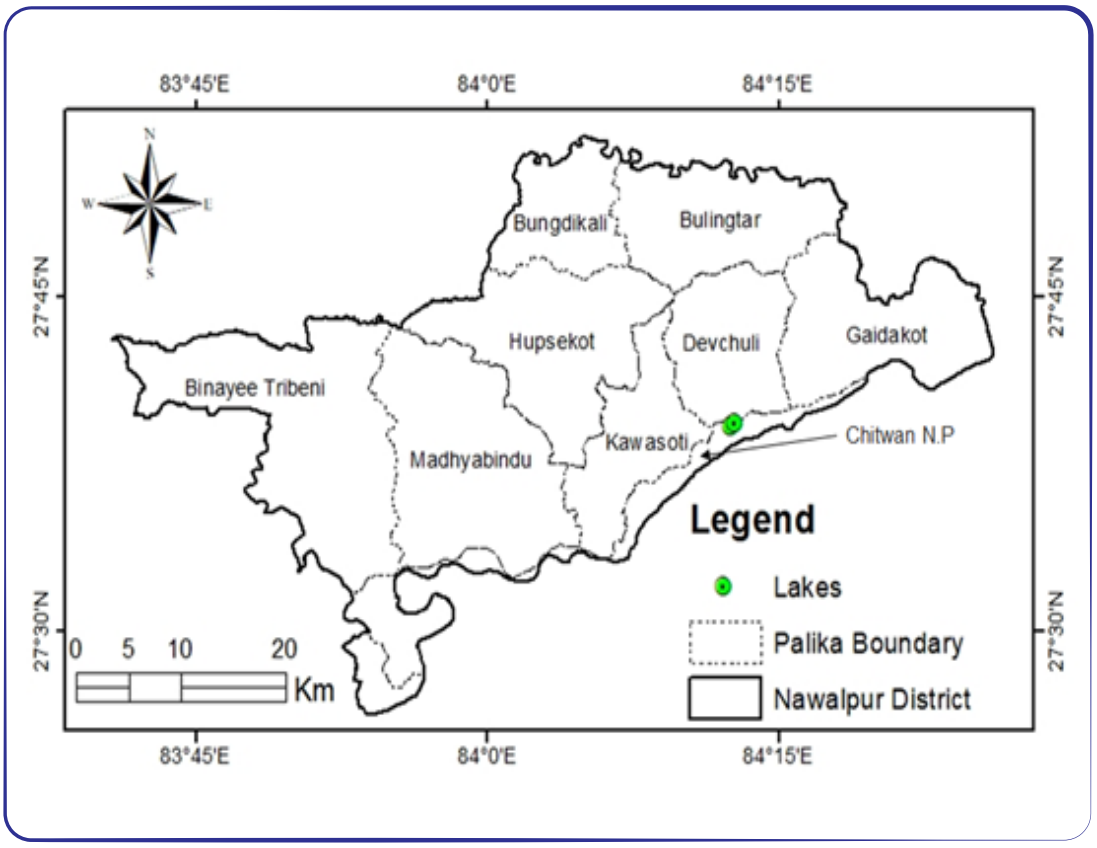

Figure 7-11| *Spatial distribution of lakes in Nawalpur district*

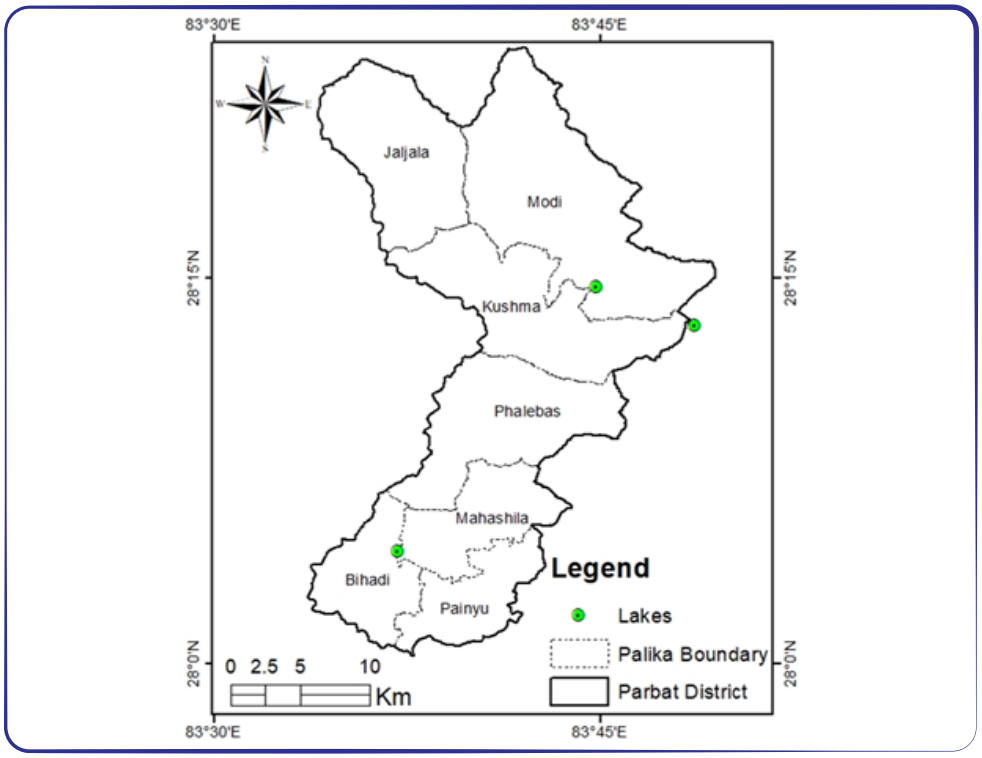

Figure 7-12| *Spatial distribution of lakes in Parbat district*

Tanahun district: Marshyangdi Reservoir is the only lake in Tanahun district with a 60 ha core area. The reservoir is made to generate hydro-electricity (*Table 7.5*). Please refer to Annex-37 for details on the features of each lake and *Figure 7-13* for understanding the spatial distribution.

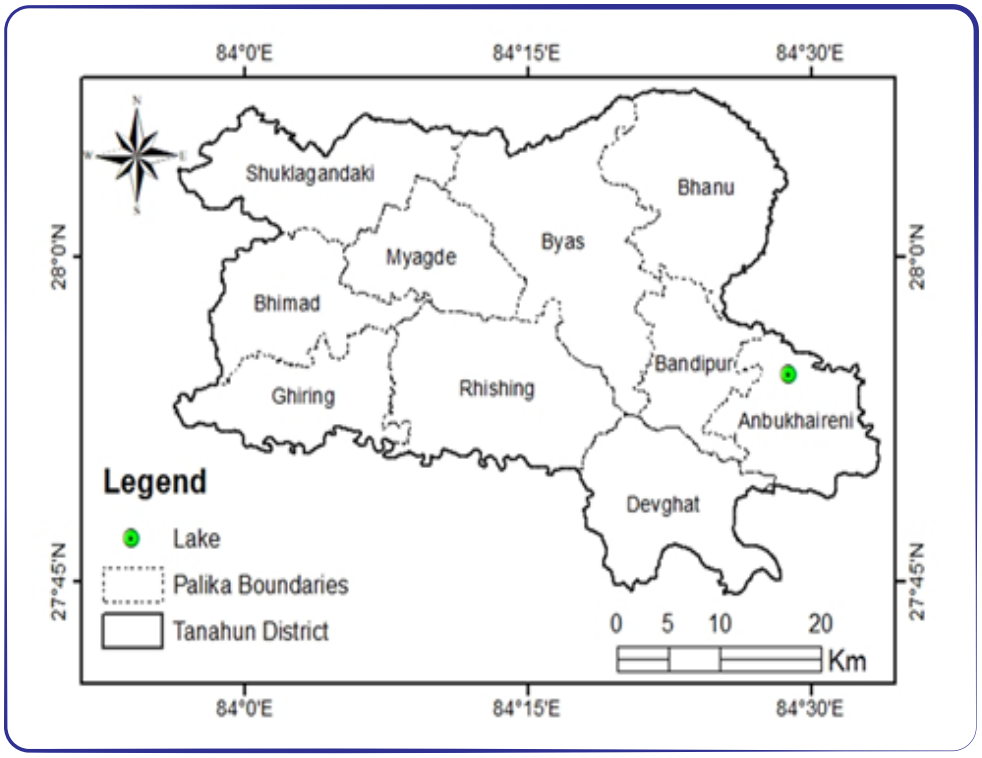

Figure 7-13| *Spatial distribution of lakes in Tanahu district*

8. LAKES IN LUMBINI PROVINCE

8.1 Biophysical and socio-economic context

8.1.1 General features

Lumbini Province is in the south-west part of the country and covers 12 districts (*Figure 8-1*) and 106 Palikas, out of which 4 are Sub-Metropolitan Cities, 33 are Municipalities, and the rest are Rural Municipalities. This province stretches from the Terai in the south to the hilly region in the north. It is the home to 4.5 million people (i.e. 16.01% of the country's population) and covers an area of 22,288Km^2 (i.e., 15.14% of the country's land area).

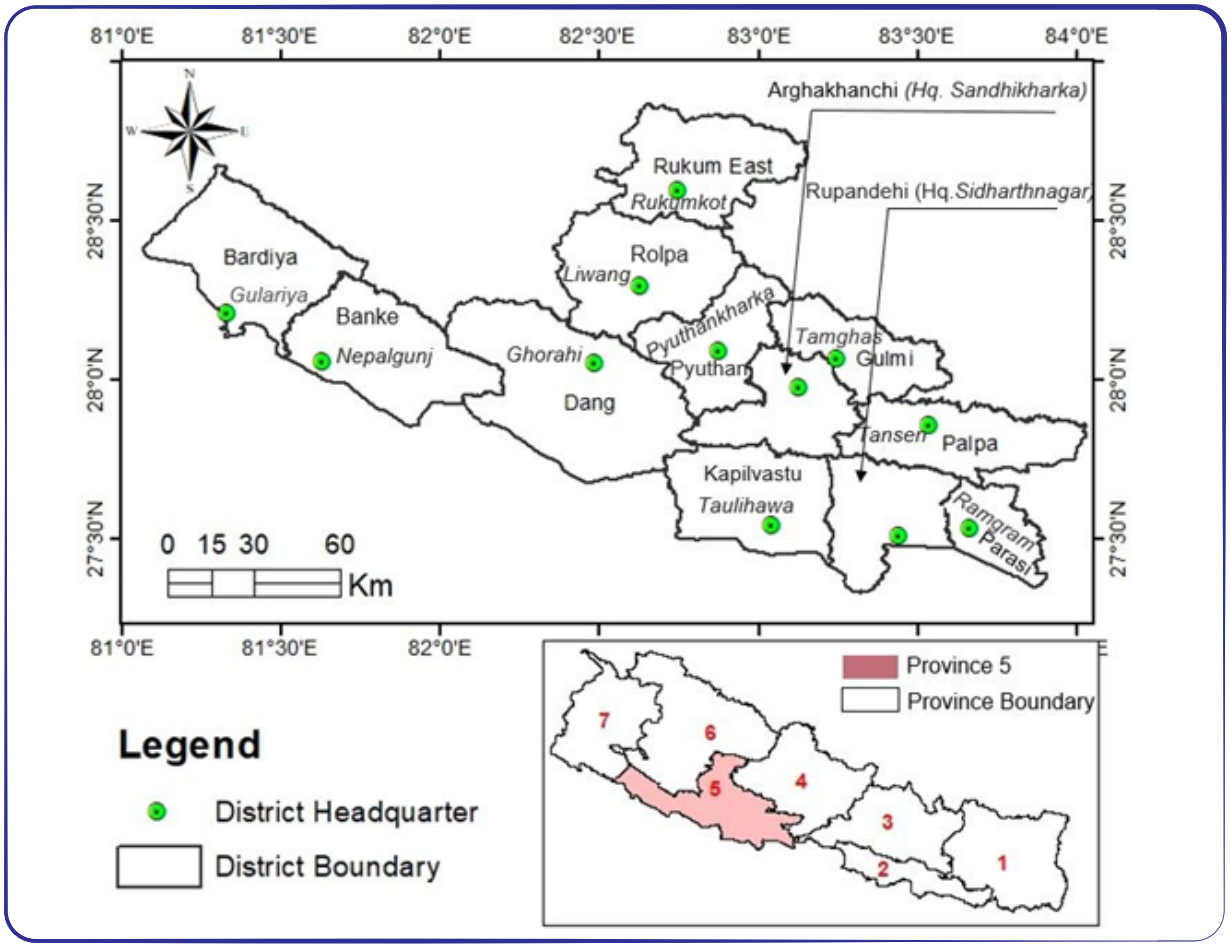

Figure 8-1 | *Location and districts covered in Lumbini Province*

It borders Gandaki Province and Karnali Province to the north, Sudurpashchim Province to the west, and Uttar Pradesh of India to the south. Major cities are Butwal and Siddharthanagar in Rupandehi district, Nepalgunj in Banke district, Tansen in Palpa district, and Ghorahiand Tulsipur in Dang district. Lumbini Province is the fastest growing province of Nepal with an annual economic growth rate of 7.1% (FY 2018/19). Mount Sisne and Mount Putha are mountain peaks. Bardiya National park is the ecological and cultural attraction, along with Lumbini, the birthplace of Lord Buddha.

8.1.2 Climate

Lumbini Province is characterized by different climatic conditions. For example, there is a humid subtropical climate in the Terai and a hot summer meridian climate in mid-hills (Climate Data, 2017). The region receives sufficient rain from the monsoon. *Table 8.1* shows city-specific climate data of some locations.

Table 8.1 | *Meteorological parameters at meteorological stations in selected cities of Lumbini Province*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp (°C)	Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp (°C)
Butwal	3252	25.7	Tulsipur	1824	19.4
Kanchikot	2418	15.2	Tansen	1634	18.2
Dumkauli	2277	22.6	Sikta	1625	22.3
Tamghas	2256	16.5	Nepalgunj (Reg. Off.)	1480	22.3
Bhairawa (Agric)	2143	23.5	Rani Jaruwa Nursery	1414	23.0
Bhairawa Airport	1979	22.1	Taulihawa	1270	27.0
Ghoria (Dang)	1914	18.4	Khajura (Nepalgunj)	822	23.0
Simari	1844	29.6			

8.1.3 Hydrology/Drainage

The hydrology/drainage pattern of Lumbini Province is shown in (*Figure 8-2*) and is characterized by the varying nature of rivers. The major basins are Gandaki Basin, Karnali Basin, Rapti Catchment, and Babai Catchment. Out of the 31,897 Km^2 area of Gandaki Basin, 2382 Km^2 area falls in this province. Similarly, 2243 Km^2 area out of 43,009 Km^2 of Karnali Basin falls in this province. Rapti and Babai cover a 6339 Km^2 and 2072 Km^2 area respectively. The major rivers are Rapti, Babai, Madi, and Jhimruk. Sikta, Babai, Banganga, and Tinau irrigation are the major irrigation projects operating.

8.1.4 Land use/cover

The Province has eight different types of land use/cover (*Figure 8-3*). District-wise land use/cover pattern is shown in (*Table 8.2*). Forest is the major land use/cover type (48.7%) followed by agriculture (41.7%), and grassland (3.7%) (*Table 8.2*). Water bodies cover only 0.6% of the total land. In the recent past, land use/cover has undergone tremendous change. For example, an increase in crop fields and urban expansion have contributed to a decrease in forests (Paudel et al., 2016). The largest proportion of forest is in Arghakhanchi, Banke, and Bardiya. Whereas forests are fewer in Parasi and Rupandehi districts. Water bodies dominated by river systems are in Bardiya and Banke districts.

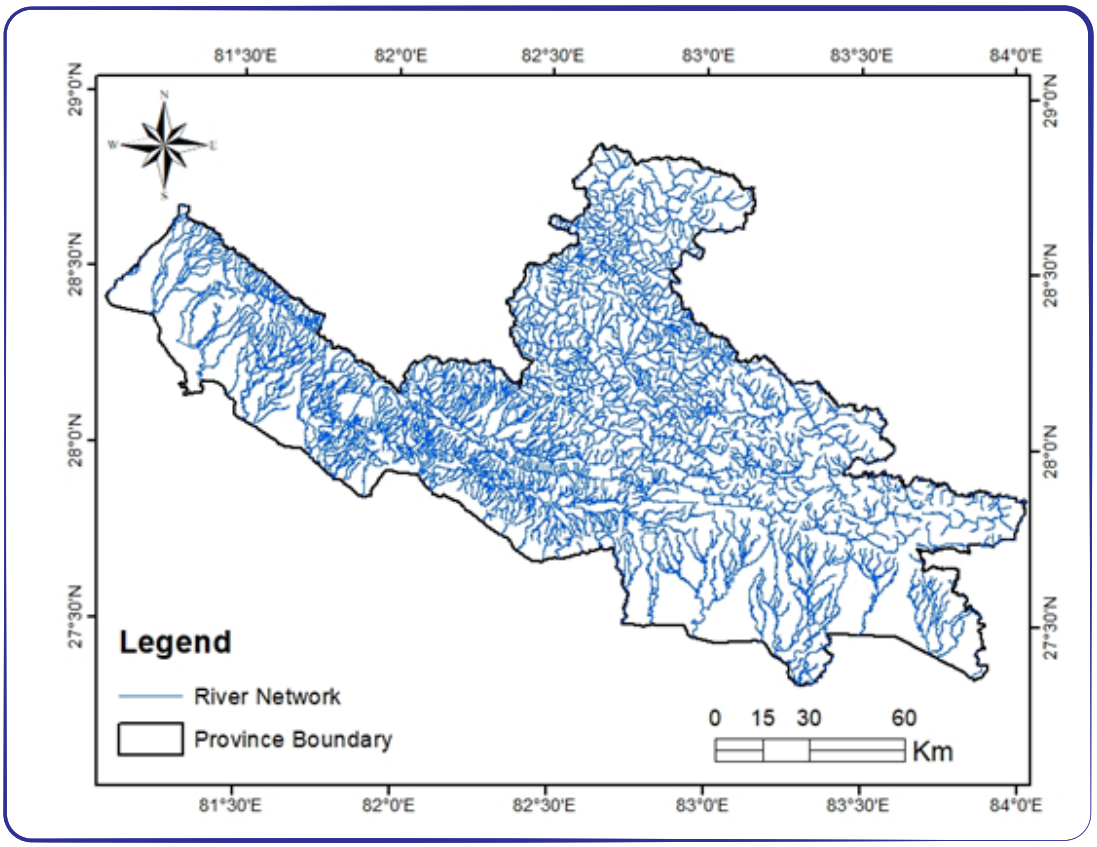

Figure 8-2 | *Spatial distribution of drainage network in Lumbini Province*

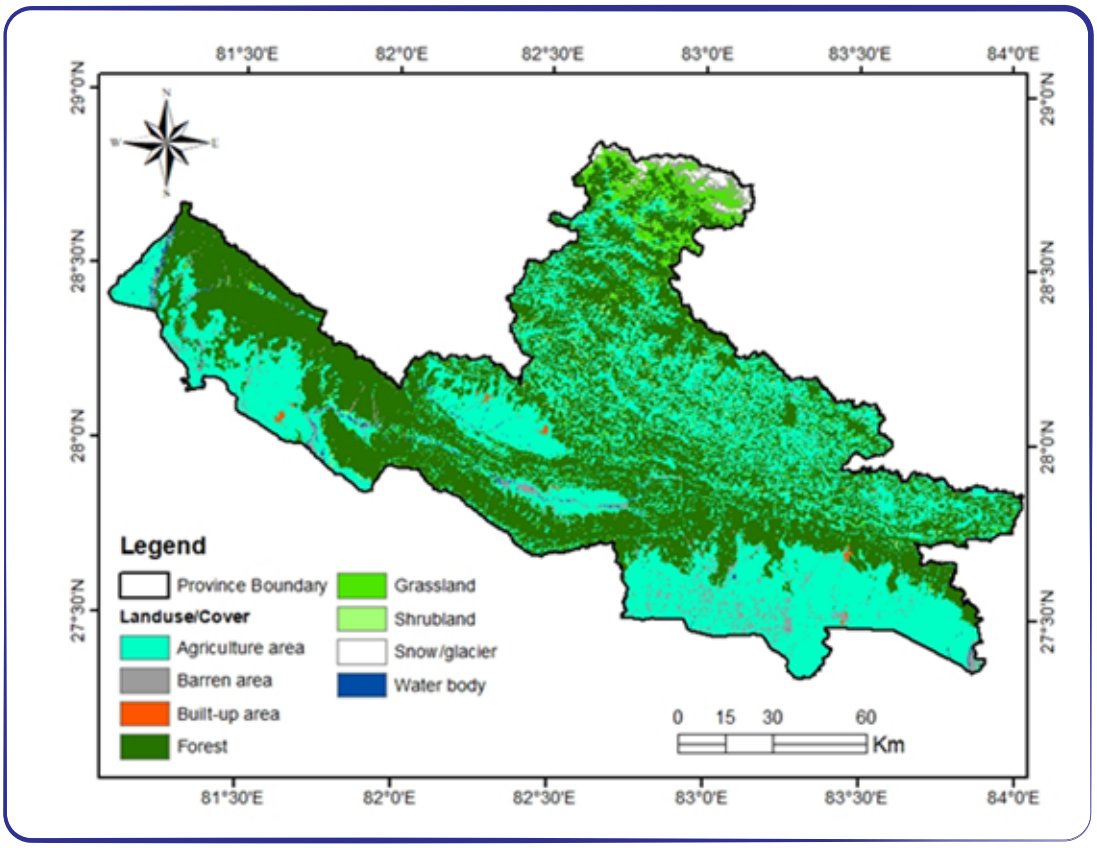

Figure 8-3 | *Land use/cover distribution in Lumbini Province*

(Source: Prepared with data from ICIMOD, 2010)

Table 8.2 | *Land use/cover (ha) in Lumbini Province*

District	Landuse/Cover Area (ha)									
	Forests	Shrub	Grassland	Cropfield	Barren	Water	Builtup	Snow/glacier	Total	%
Arghakhanchi	74747	788	2131	45516	701	64			123947	6.4
Banke	111981	1179	1821	64844	5550	1979	830		188183	9.8
Bardiya	115944	129	1813	69666	8425	4353			200330	10.4
Dang	164614	1537	5114	119840	5737	2253	1246		300340	15.6
Gulmi	47219	1925	3039	56936	1362	235	79		110796	5.8
Kapilbastu	52466	275	551	96490	15088	262			165132	8.6
Parasi	20841	149	211	47693	3161	443			72498.7	3.8
Palpa	79311	1127	3693	60024	1481	520	61		146217	7.6
Pyuthan	71462	3856	2363	53662	576	202			132121	6.9
Rolpa	106444	7102	4957	69958	61	136			188657	9.8
Rukum East	68855	6917	44917	20302	13891	353		12989	168223	8.7
Rupandehi	23477	99	193	97949	7485	99	831		130134	6.8
Total	937362	25084	70802	802879	63518	10898	3046	12989	1926579	
%	48.7	1.3	3.7	41.7	3.3	0.6	0.2	0.7	100	

8.1.5 Population and ethnicity

The human population in the province is about 4.1 million (*Table 8.3*), of which the female population consists of 52.3%. The province is inhabited by Brahmins, Magar and Chhetris. Rupandehi is the most densely populated district (647 persons/km^2) followed by Kapilvastu and Gulmi. Rolpa has the lowest population density district with only 119 persons/km^2.

Table 8.3 | *District-wise population distribution in Lumbini Province*

Districts	Area (Km^2)	Population		Total	Major Ethnicity
		Male	Female		
Arghakhanchi	1193	86266	111366	197632	Brahmin, Magar, Chhetri
Banke	2337	244255	247058	491313	Musalman, Tharu, Chhetri
Bardiya	2025	205080	221496	426576	Tharu, Chhetri, Brahmin
Dang	2955	261059	291524	552583	Tharu, Chhetri, Brahmin
Gulmi	1149	120995	159165	280160	Brahmin, Magar, Chhetri, Kami
Kapilbastu	1738	285599	286337	571936	Brahmin, Magar, Chhetri
Palpa	1373	115840	145340	261180	Magar, Brahmin, Chhetri, Kami
Pyuthan	1309	100053	128049	228102	Magar, Chhetri, Kami
Rolpa	1879	103100	121406	224506	Magar, Chhetri, Kami
Rupandehi	1360	432193	448003	880196	Brahmin, Magar, Musalman
Total	17318	1954440	2159744	4114184	

8.2 Lakes distribution across physiography

Table 8.4 shows the finding of 97 lakes in the Lumbini Province with mix-values for biodiversity, livelihoods, and religion and culture. *Figure 8-4* depicts the spatial distribution of lakes. The district-wise distribution of lakes is reported as two in Arghakhanchi, four in Banke, three in Bardiya, eight in Dang, 24 in Kapilvastu, 21in Parasi, two each in Palpa and Pyuthan, one in

Rolpa, two in Rukum, and 28 in Rupandehi. Rupandehi district holds the biggest number of lakes (28) followed by Kapilvastu (24) and Parasi (21). Many lakes dotted in the old map have now disappeared.

A total of 60 lakes are in good condition and the remaining 37 are degrading. The core areas of the lakes vary from less than 0.3 ha to 320 ha. The largest one is Bajah Sagar of Kapilvastu district with 320 ha. The lakes vary in altitude from 75 m to 2351 m, with Biwang Daha of Rolpa district lying at a high altitude of 2351m. The basin areas vary from 3 ha up to 4338 ha with the Sherpa Daha of Rukum holding the largest basin area.

Table 8.4 | *Physiographic distribution of lakes in Lumbini Province at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Arghakhanchi	2		1	1	
D-2	Banke	4	4			
D-3	Bardiya	3	3			
D-4	Dang	8	8			
D-5	Kapilvastu	24	24			
D-6	Parasi	21	21			
D-7	Palpa	2		2		
D-8	Pyuthan	2		2		
D-9	Rolpa	1			1	
D-10	Rukum	2		1	1	
D-11	Rupandehi	28	28			
	Total	**97**	**88**	**6**	**3**	

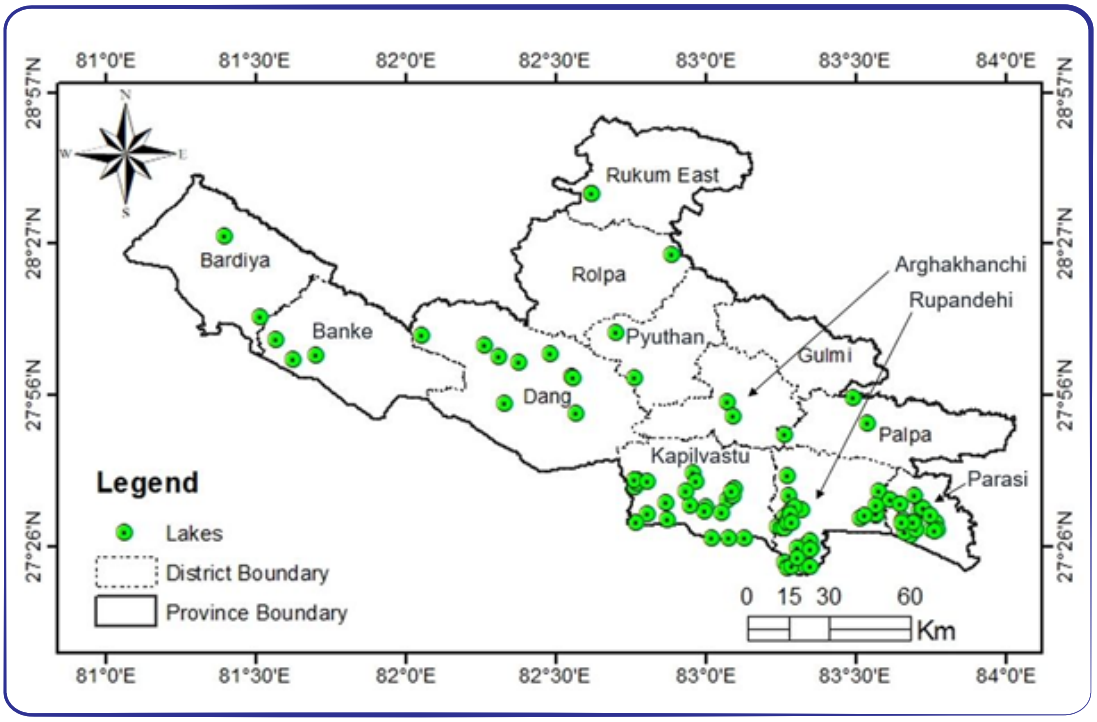

Figure 8-4 | *Spatial distribution of lakes in Lumbini Province*

Similarly, lake density is higher in the Terai region whereas it is less in the Mahabharat region. There are 88 lakes in the Terai, followed by six in Siwaliks, and three in the Mahabharat region. Lake densities gradually decrease in the mountains when altitudinal gradients increase.

Some lakes are of tourism value. The Water Park in Banke district has tourism potential thanks to its good transport links. The Barhakune Tal in Dang is of great religious importance to Hindus due to the presence of the Barahi temple. Most high altitude lakes are utilised for religious purposes.

All these lakes in total have an area of about 1056 ha, which is 0.047% of the total surface area of the province.

8.3 Lakes distribution across districts

There are 12 districts in Lumbini Province. They are Arghakhanchi, Banke, Bardiya, Dang, Gulmi, Kapilvastu, Parasi, Palpa, Pyuthan, Rolpa, Rukum, and Rupandehi. The district-wise lake distribution is shown in (*Table 8.5*). Except for the Gulmi district, in which no lakes are reported in inventories, all other districts have lakes of varying numbers and sizes.

Arghakhanchi district: There are two lakes in this district. Thada Daha has the largest core area (2.4 ha). Both lakes are in good condition. Please refer to Annex-38 for details on the features of each lake and *Figure 8-5* for spatial distribution.

Table 8.5 | *Physiographic distribution of lakes in Lumbini Province at altitudes less than 3,000 masl*

District	Name of Lake	Type of Lake	Area (ha)		Conditions
			Core	Basin	
Arghakhanchi	Sengleng Daha	Fresh water, Lacustrine, Permanent	0.5	20	Good
	Thada Daha	Fresh water, Lacustrine, Permanent	2.4	70	Good
	Total		**2.9**	**90**	
Banke	Bankatta Tal	Fresh water, Lacustrine,Permanent	20	100	Degrading
	Phultyangra Tal	Fresh water, Lacustrine,Permanent	50	100	Degrading
	Puraina Puraini tal	Fresh water, Lacustrine,Permanent	4	22	Degrading
	Rani talau	Fresh water, Lacustrine,Permanent	0.5	20	Degrading
	Teeri Tal	Fresh water, Lacustrine,Permanent	25	100	Degrading
	Water park	Fresh water, Lacustrine,Permanent	10	20	Degrading
	Total		**109.5**	**362**	
Bardiya	Badaiya Tal	Fresh water, Lacustrine,Permanent	61	120	Good
	Gonana Tal	Fresh water, Lacustrine,Permanent	5	120	Good
	Tara Tal	Fresh water, Lacustrine,Permanent	1	5	Degrading
	Total		**67**	**245**	
Dang	Barhakune Tal	Fresh water, Lacustrine, Permanent	1	45	Good
	Bhote Tal	Fresh water, Lacustrine, Permanent	1	40	Good
	Charinge Daha	Fresh water, Lacustrine, Permanent	1.5	30	Good

	Gauri Tal	Fresh water, Manmade, Permanent	6.5	70	Degrading
	Jakhera Tal	Fresh water, Lacustrine,Permanent	4.5	150	Good
	Laraina Tal	Fresh water, Manmade, Permanent	2	50	Good
	Pathkauli Tal	Fresh water, Manmade, Permanent	1	15	Good
	Rihar Tal	Fresh water, Lacustrine, Permanent	1	15	Good
	Total		**18.5**	**415**	
Kapilvastu	Ajigare tal	Fresh water, Lacustrine, Permanent	6	200	Degrading
	Badka Tal	Fresh water, Lacustrine, Permanent	7	60	Good
	Baghaiyal Tal	Fresh water, Lacustrine, Permanent	4	>200	Good
	Bajah Sagar	Fresh water, Riverine, Perennial	>320	500	Degrading
	Barkalpur Tal	Fresh water, Lacustrine, Permanent	3.5	500	Good
	Gobari Pokhari	Fresh water, Manmade, Lacustrine, Permanent	2	30	Good
	Hariharpur taal	Freshwater, Manmade, Lacustrine, Permanent	157	N/A	Good
	Jagadishpur Reservoir	Fresh water, Lacustrine, Permanent	2	25	Good
	Jam kudwa	Fresh water, Lacustrine, Permanent	3	50	Good
	Kadja Tal	Fresh water, Lacustrine, Permanent	5	440	Degrading
	Laharaula Tal	Fresh water, Riverine, Perennial	60	160	Degrading
	Mahali Tal	Fresh water, Lacustrine, Permanent	3	>30	Good
	Murdahawa Tal	Fresh water, Riverine, Perennial	4	110	Good
	Naukhane Tal	Freshwater, Manmade, Lacustrine,Temporary	1.5	55	Good
	NaukhaneTal (Sauraha)	Freshwater, Manmade, Lacustrine,Temporary	3.5	42	Degrading
	Niglihawa Tal	Freshwater, Lacustrine, Permanent	20	>300	Good
	Puraina Tal	Fresh water, Lacustrine, Permanent	3	40	Good
	Rajauriya Tal	Freshwater, Manmade, Lacustrine,Permanent	12	40	Good
	Sagar Tal	Freshwater, Manmade, Lacustrine,Permanent	3.8	40	Good
	Sagarhawa Tal	Freshwater, Manmade, Lacustrine,Permanent	2.5	40	Good
	Shakuniya Tal	Freshwater, Manmade, Lacustrine,Permanent	55	500	Degrading
	Shankarpur Tal	Fresh water, Lacustrine, Permanent	13	170	Good
	Sirsihawa Tal	Fresh water, Lacustrine, Permanent	2	40	Good
	Sisawa Tal	Fresh water, Riverine, Perennial	17	300	Degrading
	Total		**390**		
Parasi	Amar Pokhari	Freshwater, Lacustrine	1	5	Good
	Bauliya	Man-made, Aquaculture	0.5	3	Degrading
	Buddha Mangal Tal	Man-made, Aquaculture	2	5	Good
	Devdaha Pokhari	Man-made	1	9	Good
	Dhanewa Pokhari	Man-made, Aquaculture	1	10	Degrading
	Hadahiya Tal	Man-made, Aquaculture	1.3	6	Degrading
	Java Pokhari	Man-made	1.5	20	Good
	Kamal Pokhari	Man-made, Religious	1	5	Good
	Loharauli Pokhari	Man-made, Aquaculture	1.5	20	Good
	Panai Pokhari	Man-made, Aquaculture	1.5	3	Degrading

	Pokhara (Jeetpur)	Man-made, Aquaculture	2	10	Good
	Pokhara (Kushma)	Man-made, Aquaculture	1	10	Good
	Pokhara (Patkauli)	Man-made, Aquaculture	1	10	Good
	Pokhari (Pali)	Man-made, Aquaculture	1.7	7	Good
	Pokhari (Devgaun)	Man-made, Aquaculture	0.5	10	Degrading
	Pokhari Tal (Mahuwari)	Man-made, Aquaculture	0.5	15	Degrading
	Purnahawa Pokhari	Man-made, Aquaculture	1.5	20	Degraded
	Sagada Pokhari	Man-made, Aquaculture	1	15	Degrading
	Sisani Pokhari	Man-made, Aquaculture	1	10	Good
	Swathi Pokhari	Freshwater, Lacustrine	0.5	15	Degrading
	Thulo Pokhari	Man-made, Aquaculture	1	3	Good
	Total		**24**	**211**	
Palpa	Kamal Pokhari	Freshwater, Lacustrine	2	50	Degraded
	Satyawati Tal	Freshwater, Lacustrine	0.5	200	Degrading
	Total		**2.5**	**250**	
Pyuthan	Bhingri Daha	Fresh water, Lacustrine, Permanent	0.8	10	Good
	Tiram Daha	Fresh water, Lacustrine, Permanent	0.3	25	Good
	Total		**0.11**	**35**	
Rolpa	Biwang Daha	Freshwater,Lacustrine, Seasonal	2	900	Good
	Total		2	900	
Rukum	Kamal Tal	Fresh water, Riverine, Perennial	8.5	1050	Degrading.
	Serpu Daha	Fresh water, Lacustrine, Permanent	70	4338	Good
	Total		**78.5**	**5388**	
Rupandehi	Badki Gaddha Pokhari	Freshwater, Lacustrine	1.5	15	Good
	Bangai Pokhari	Freshwater, Lacustrine	2	20	Degrading
	Bhanaiya	Freshwater, Lacustrine	1.5	25	Degrading
	Bhelai Pokhari	Man-made, Aquaculture	1.5	15	Degrading
	Dube Pokhari	Freshwater, Lacustrine	0.5	10	Degrading
	Gaidahawa	Freshwater, Lacustrine	25	500	Good
	Gajedi Tal	Freshwater, Lacustrine	4	100	Good
	Ganwariya Tal	Freshwater, Lacustrine	0.5	8	Degraded
	Gidhiya Pokhari	Man-made, Aquaculture	1	4	Degrading
	Jamuhani Pokhari-I	Man-made	1	8	Degrading
	Jamuhani Pokhari -II	Man-made, Aquaculture	0.5	7	Good
	karauta Pokhari	Freshwater, Lacustrine	1	8	Degrading
	Kurmindihawa	Man-made, Aquaculture	0.3	7	Degraded
	Kuttwa Pokhari	Freshwater, Riverine	0.5	5	Degrading
	Majhagawa Pokhari	Freshwater, Lacustrine	1	5	Degrading
	Mohamadnagar Pokhari	Man-made, Aquaculture	0.5	8	Good
	Nala Pokhari	Freshwater, Lacustrine	1.25	8	Degrading
	Paschim Pokhara	Man-made, Aquaculture	1	10	Degrading
	Pipari Pokhari	Freshwater, Lacustrine	0.5	3	Degrading

	Purba Pokhara	Man-made, Aquaculture	1	13	Degrading
	Rayapur Tal	Freshwater, Lacustrine	2.5	20	Degrading
	Rohinihawa Tal	Freshwater, Lacustrine	1	4	Degrading
	Sagrahawa Tal	Freshwater, Lacustrine	1	5.5	Degrading
	Shankarpur Pokhari	Man-made, Aquaculture	1	5	Good
	Sisausemara Tal	Freshwater, Lacustrine	1	20	Degrading
	Tareni Pokhari	Man-made, Aquaculture	1	4	Good
	Tiger Top Tal	Freshwater, Lacustrine	1	6	Degrading
	Tiwari Kataiya Pokhari	Freshwater, Lacustrine	1	6	Degrading
	Thulo pokhara	Freshwater, Lacustrine	1	4	Degrading
	Yekladih Pokhari	Freshwater, Lacustrine	0.5	7	Degrading
	Total		**57**	**861**	

Banke district: There are six lakes in this district. Phultyangra lake had the largest core area size (50 ha) and both lakes are in good condition. Please refer to Annex-39 for details on the features of each lake and *Figure 8-6* for understanding the spatial distribution.

Bardiya district: There are three lakes in this district. Badaiya has the largest core area size (61 ha) and two lakes are in good condition. Please refer to Annex-40 for details on the features of each lake and *Figure 8-7* for understanding the spatial distribution.

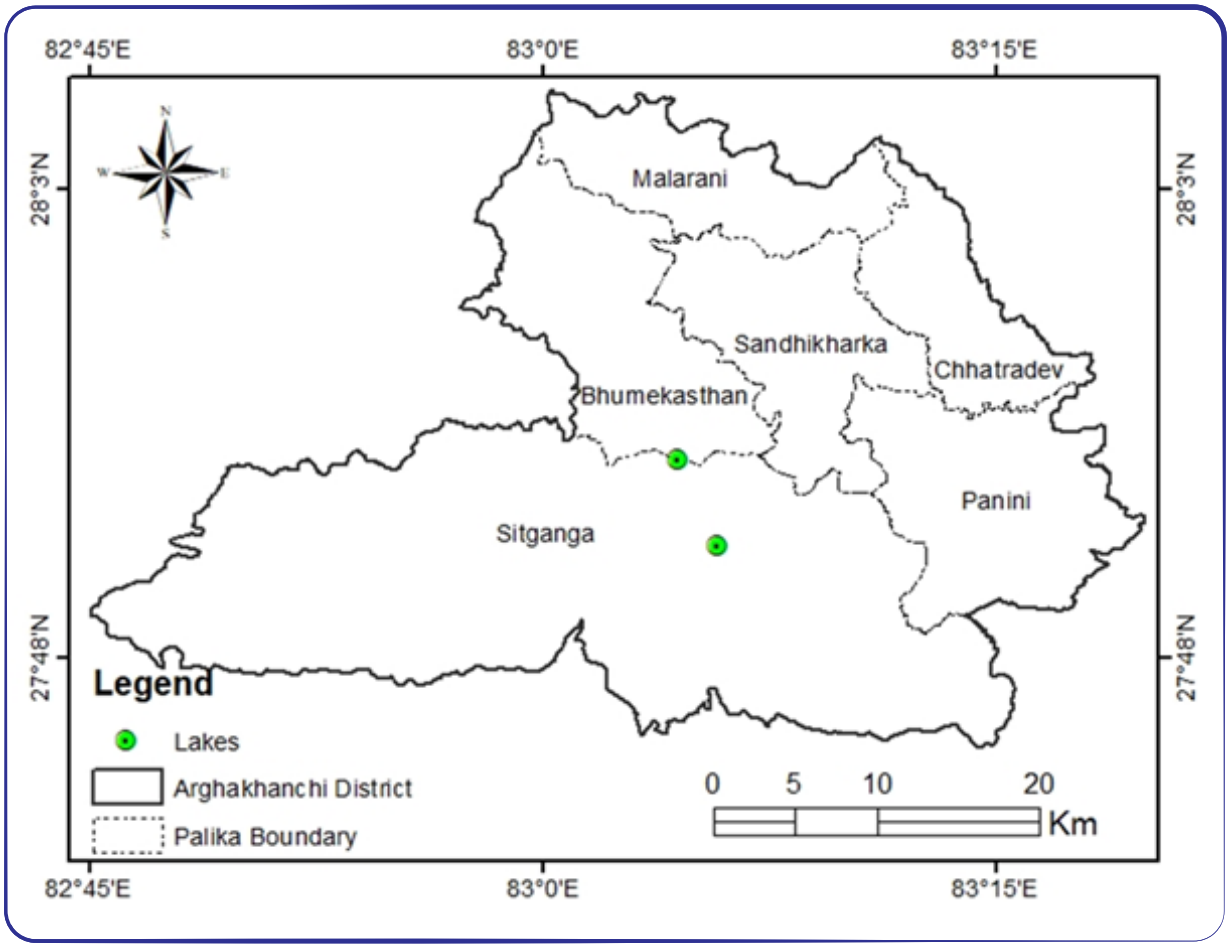

Figure 8-5 | *Spatial distribution of lakes in Arghakhanchi district*

Dang district: There are eight lakes in this district. Gauri Tal has the largest core area size (6.5 ha) and seven lakes are in good condition. Please refer to Annex-41 for details on the features of each lake and *Figure 8-8* for understanding the spatial distribution.

Kapilvastu district: There are 24 lakes in this district. Bajah Sagar has the largest core area size (>320 ha) and 16 lakes are in good condition. Please refer to Annex-42 for details on the features of each lake and *Figure 8-9* for understanding the spatial distribution.

Parasi district: There are 21 lakes in this district. Pali Pokhari has the largest core area size (1.5 ha) and 12 lakes are in good condition. Please refer to Annex-43 for details on the features of each lake and *Figure 8-10* for understanding the spatial distribution.

Palpa district: There are two lakes in this district. Kamal Pokhari has the largest core area size (2ha) and both lakes are in degrading condition. Please refer to Annex-44 for details on the features of each lake and *Figure 8-11* for understanding the spatial distribution.

Pyuthan district: There are two lakes in this district. Bhingri Daha has the largest core area size (0.8 ha) and both lakes are in good condition. Please refer to Annex-45 for details on the features of each lake and *Figure 8-12* for understanding the spatial distribution.

Rolpa district: There is only one lake in this district. Biwang Daha has an area size of 2 ha and is in good condition. Please refer to Annex-46 for details on the features of the lake and *Figure 8-13* for understanding the spatial distribution.

Rukum East district: There are two lakes in this district. Sherpu Daha has the largest core area size (70 ha) and only one lake is in good condition. Please refer to Annex-47 for the details on the features of each lake and *Figure 8-14* for understanding the spatial distribution.

Rupandehi district: There are 28 lakes in this district. Gaidahawa has the largest core area size (25 ha) and seven lakes are in good condition. Please refer to Annex-48 for details on the features of each lake and *Figure 8-15* for understanding the spatial distribution.

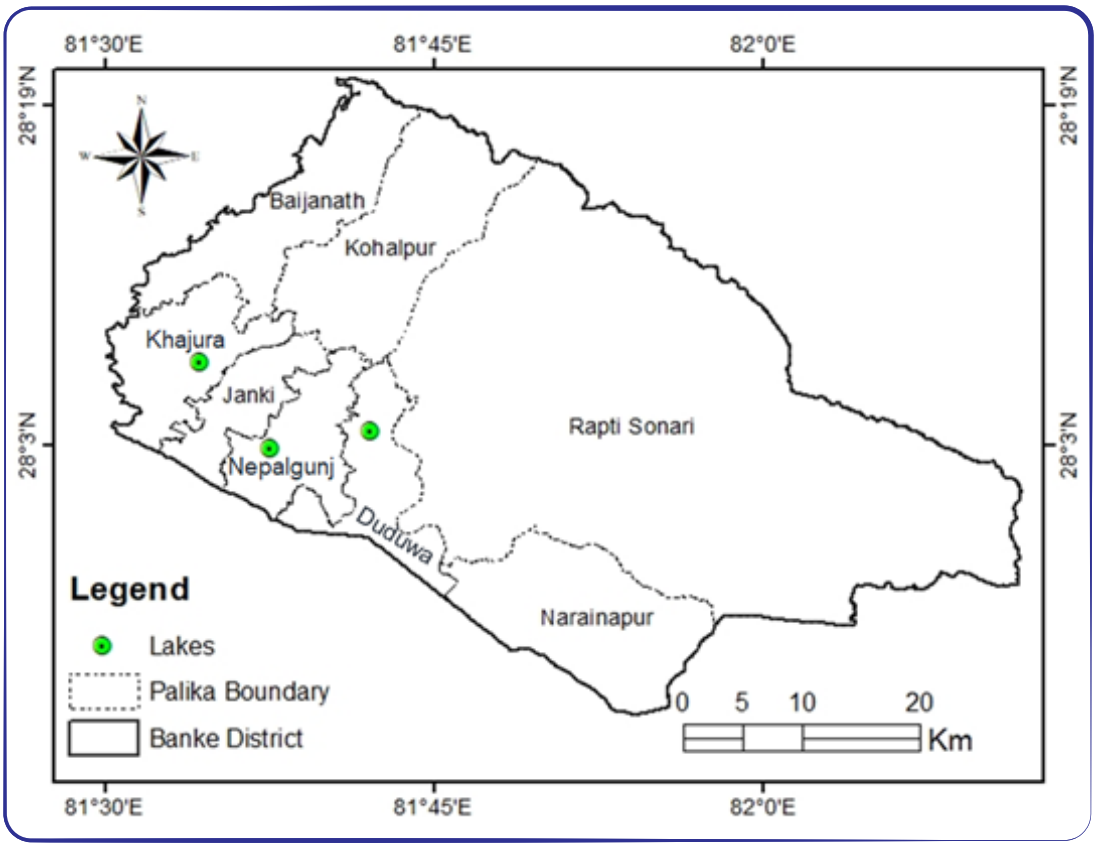

Figure 8-6 | *Spatial distribution of lakes in Banke district*

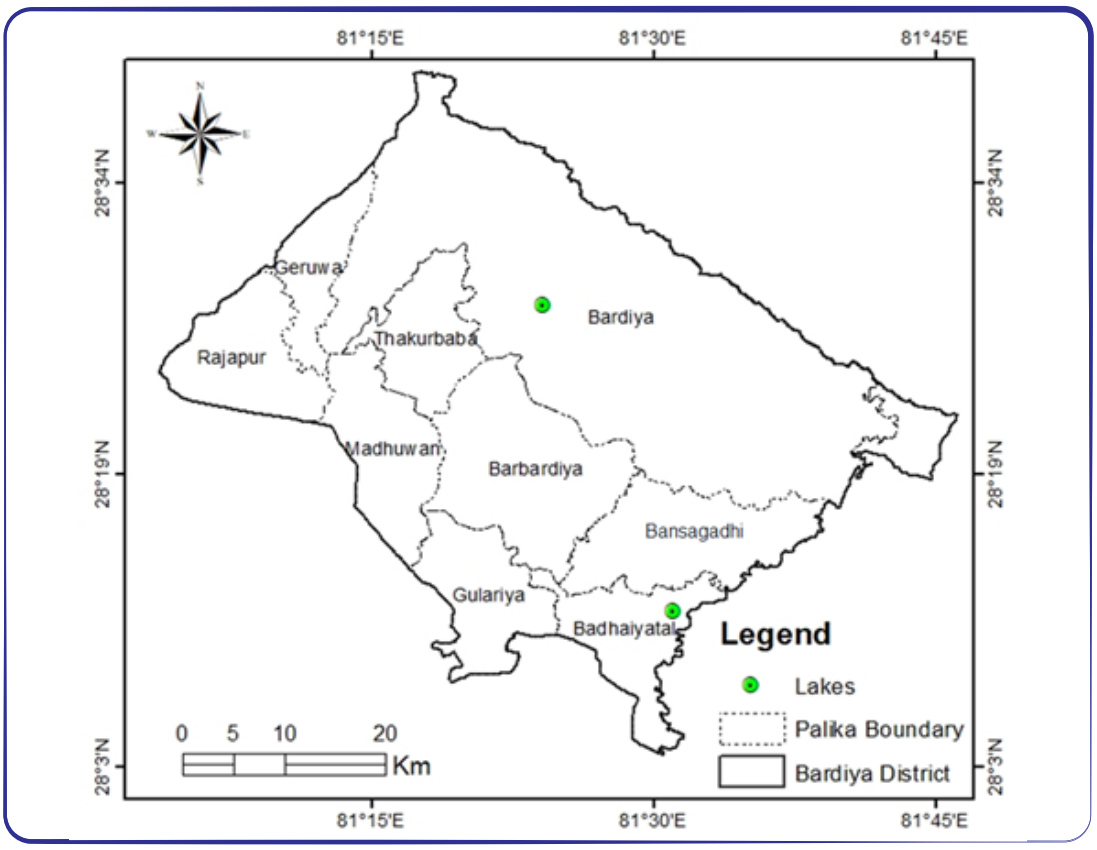

Figure 8-7 | *Spatial distribution of lakes in Bardiya district*

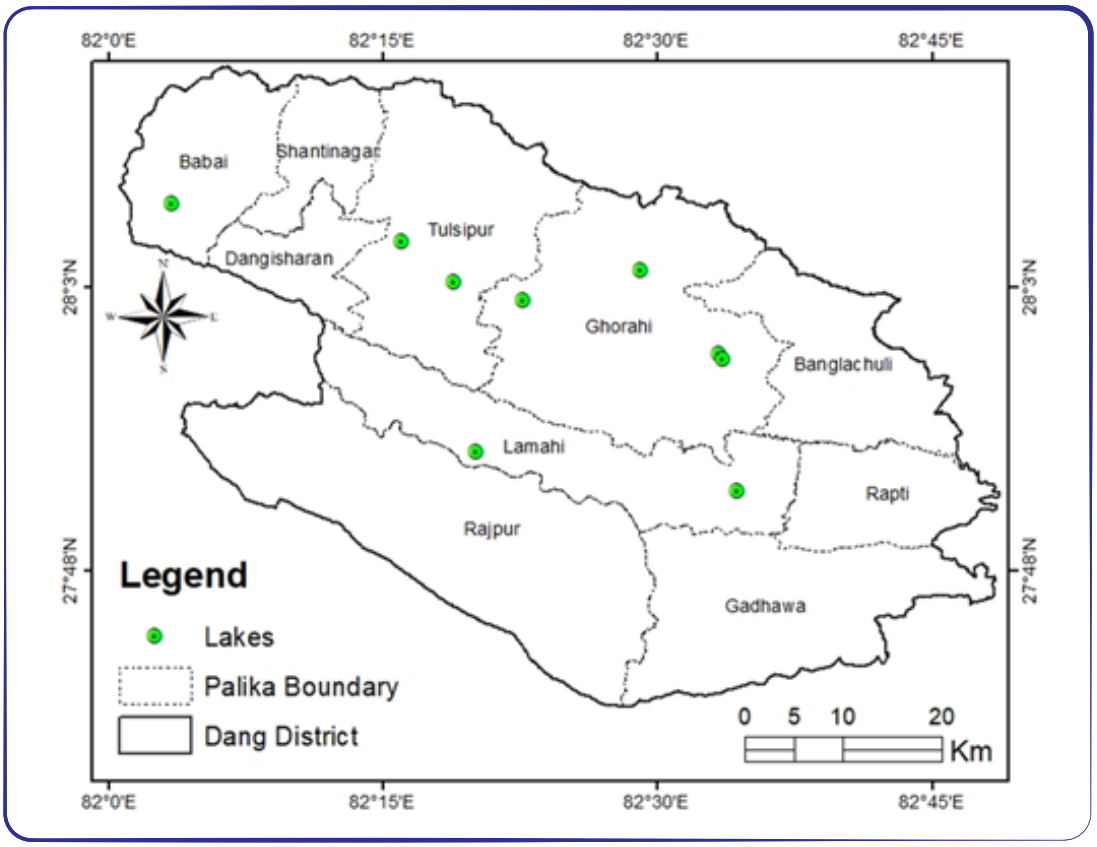

Figure 8-8 | *Spatial distribution of lakes in Dang district*

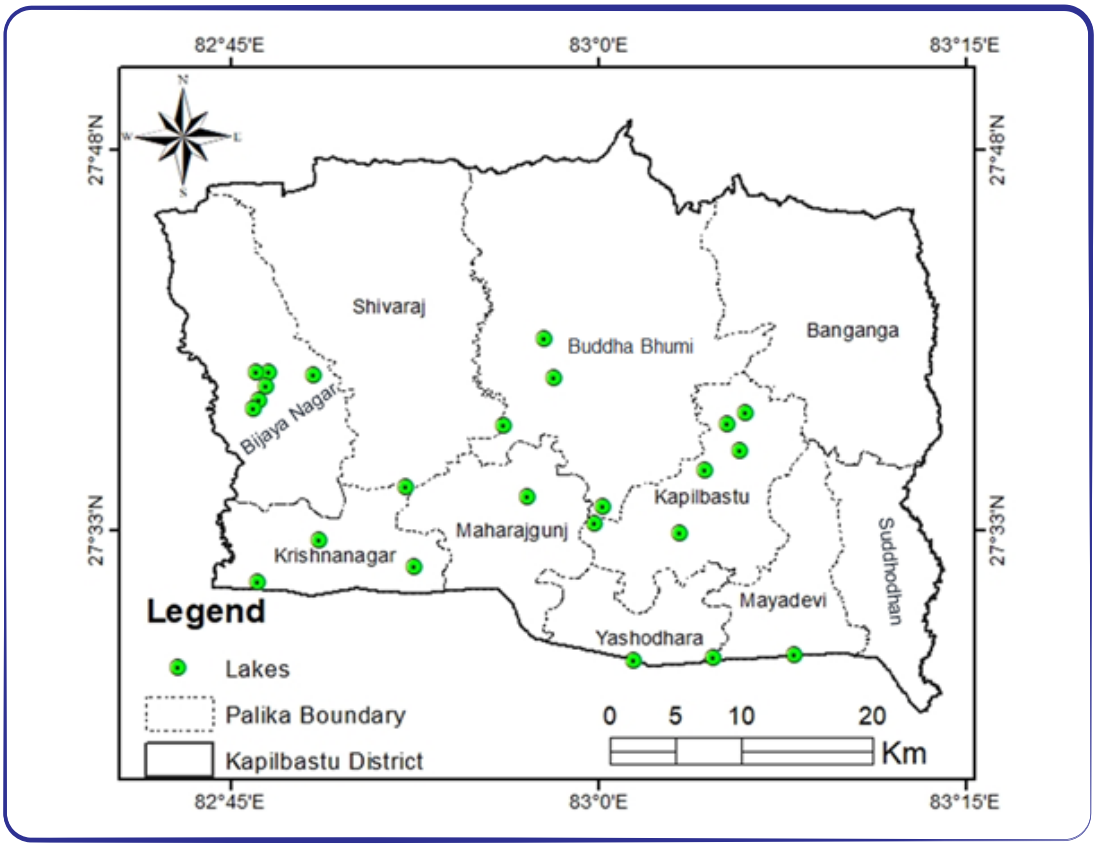

Figure 8-9 | *Spatial distribution of lakes in Kapilbastu district*

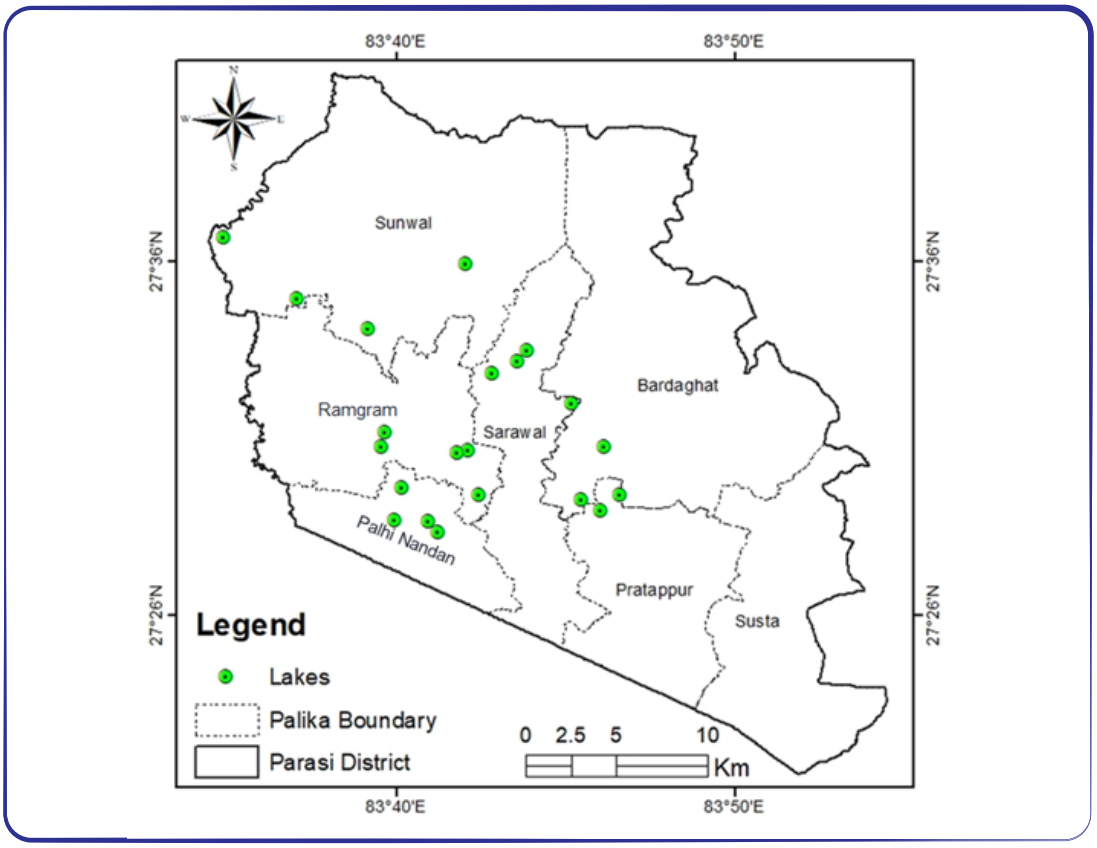

Figure 8-10| *Spatial distribution of lakes in Parasi district*

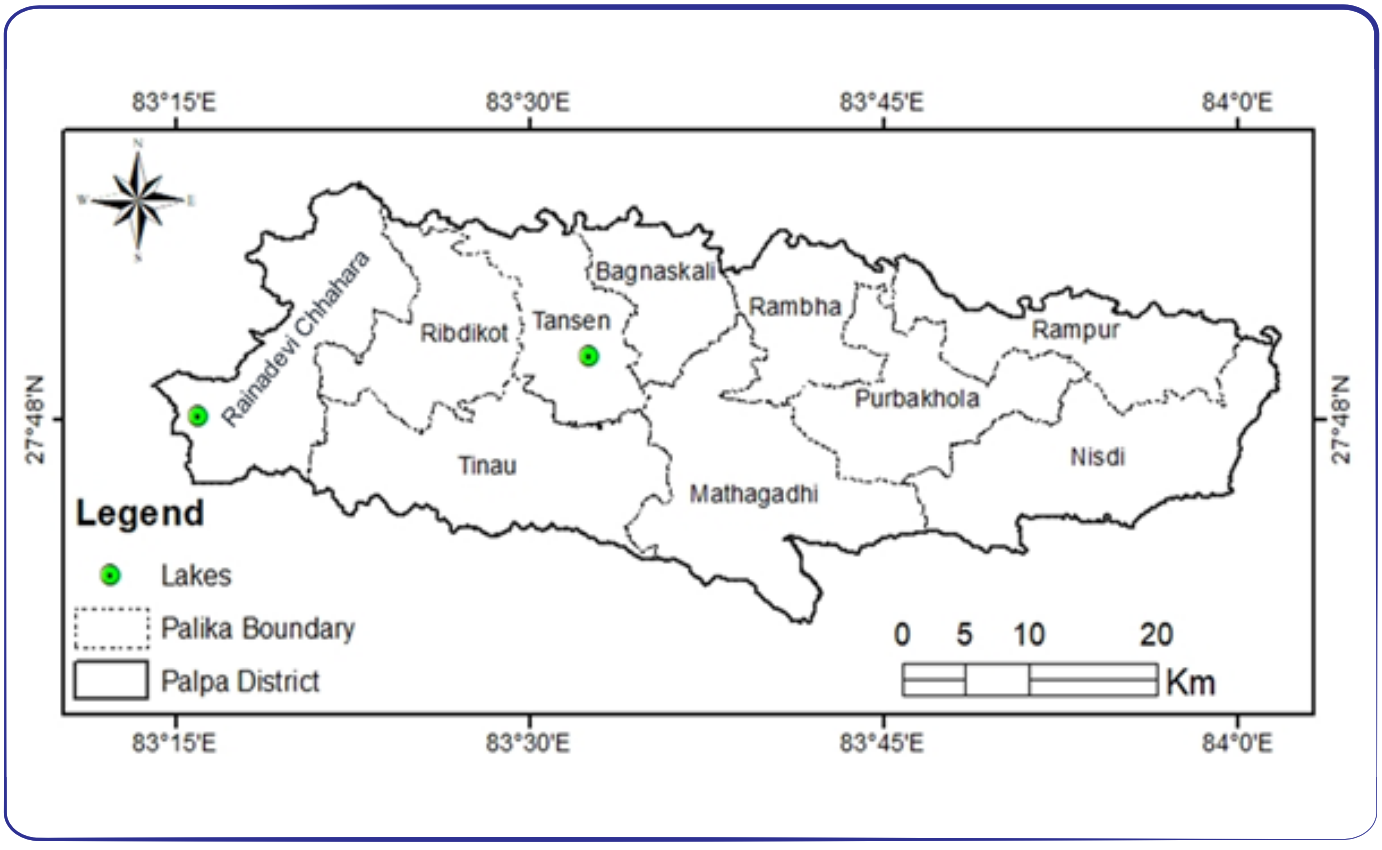

Figure 8-11| *Spatial distribution of lakes in Palpa district*

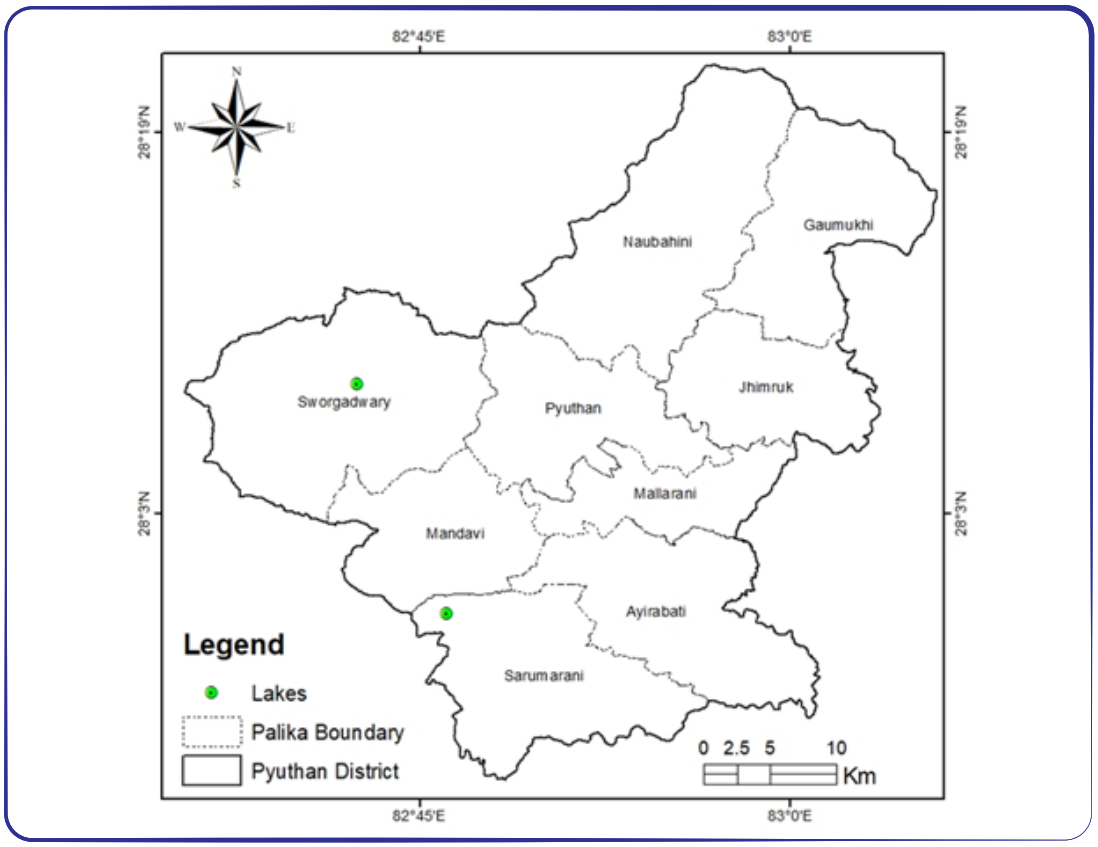

Figure 8-12| *Spatial distribution of lakes in Pyuthan district*

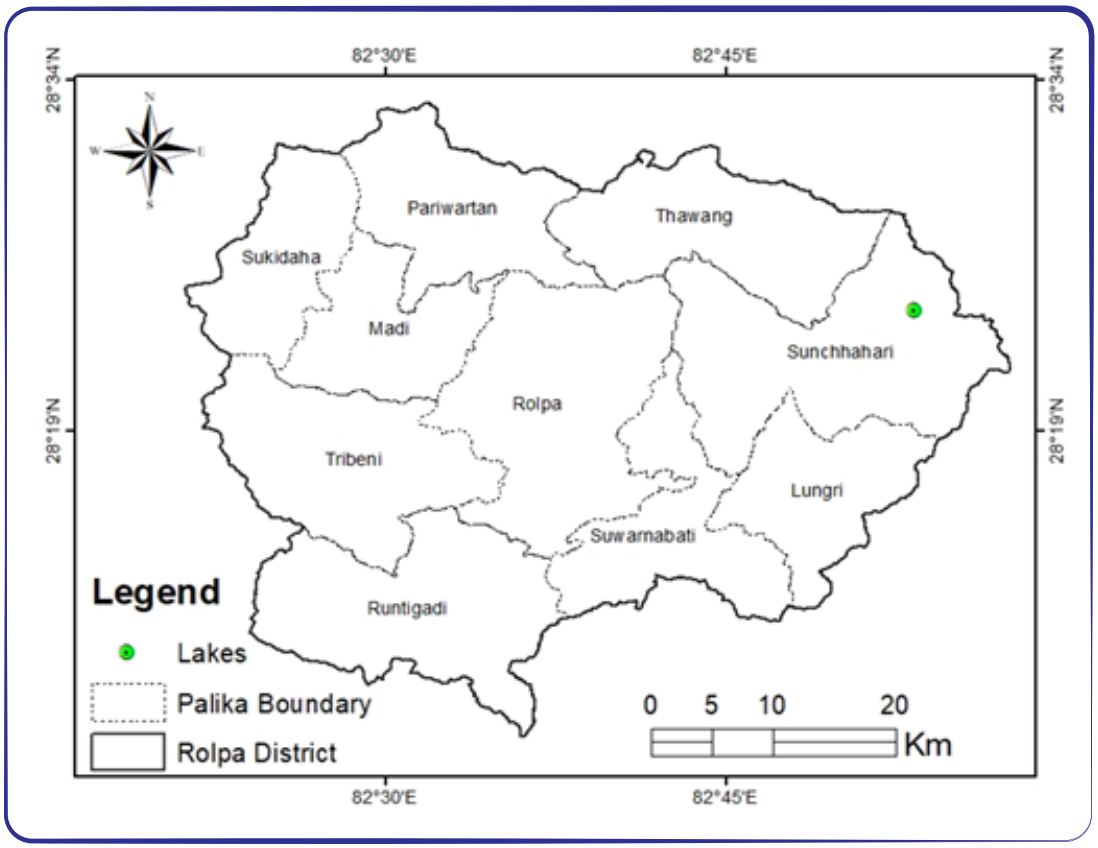

Figure 8-13| *Spatial distribution of lakes in Rolpa district*

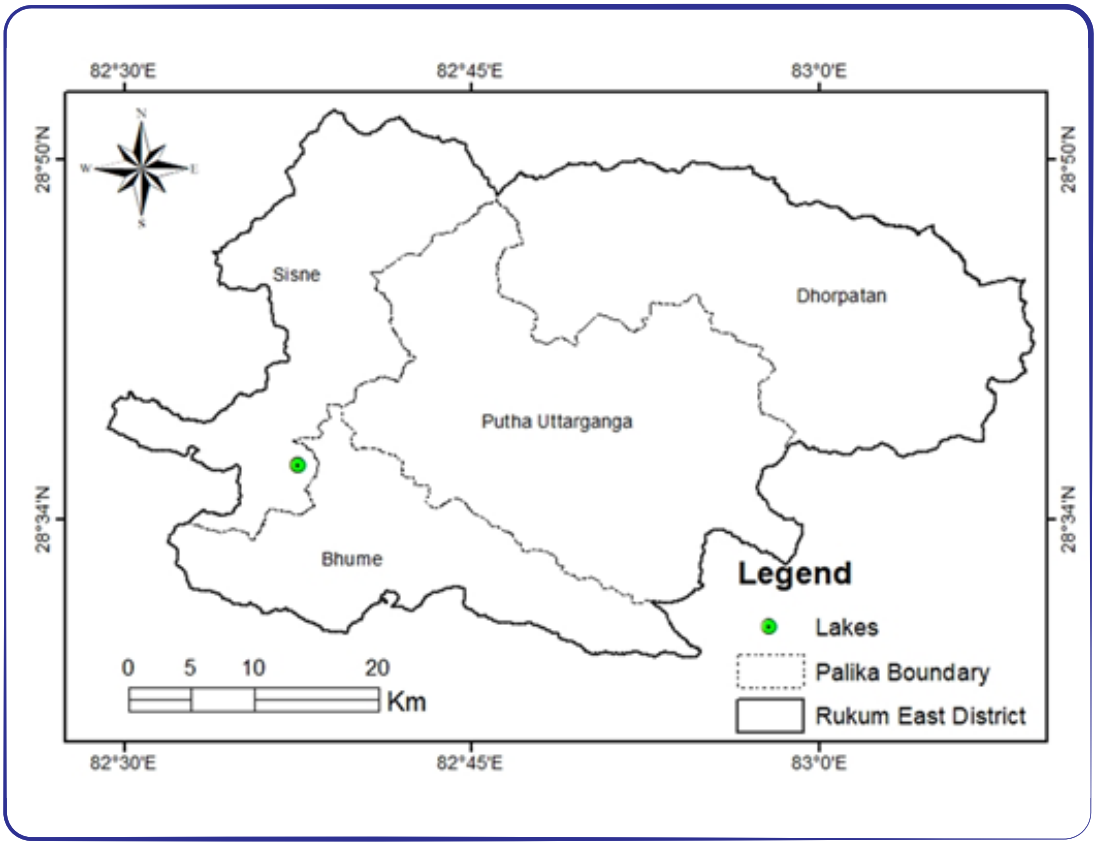

Figure 8-14 | *Spatial distribution of lakes in Rukum East district*

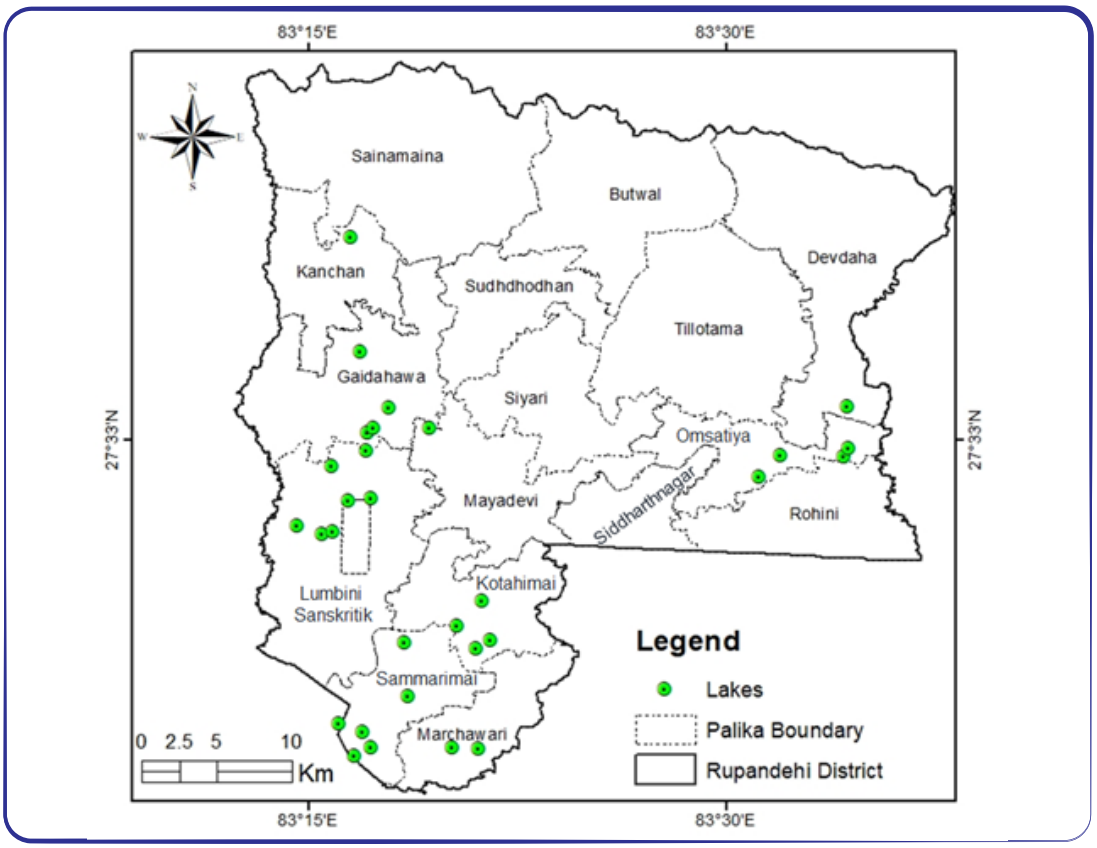

Figure 8-15 | *Spatial distribution of lakes in Rupandehi district*

9. LAKES IN KARNALI PROVINCE

9.1 Biophysical and socio-economic context

9.1.1 General features

Karnali Province is in the north-west part of the country and covers 10 districts (*Figure 9-1*) and 80 Palikas, out of which 25 are Municipalities and the rest are Rural Municipalities. This province stretches from the hilly region in the south to the Himalayas in the north. Karnali Province is home to 1.5 million people (5.6 % of the country's population). It has a total land area of 27,984 Km^2 (i.e., 18.97% of the country's land area).

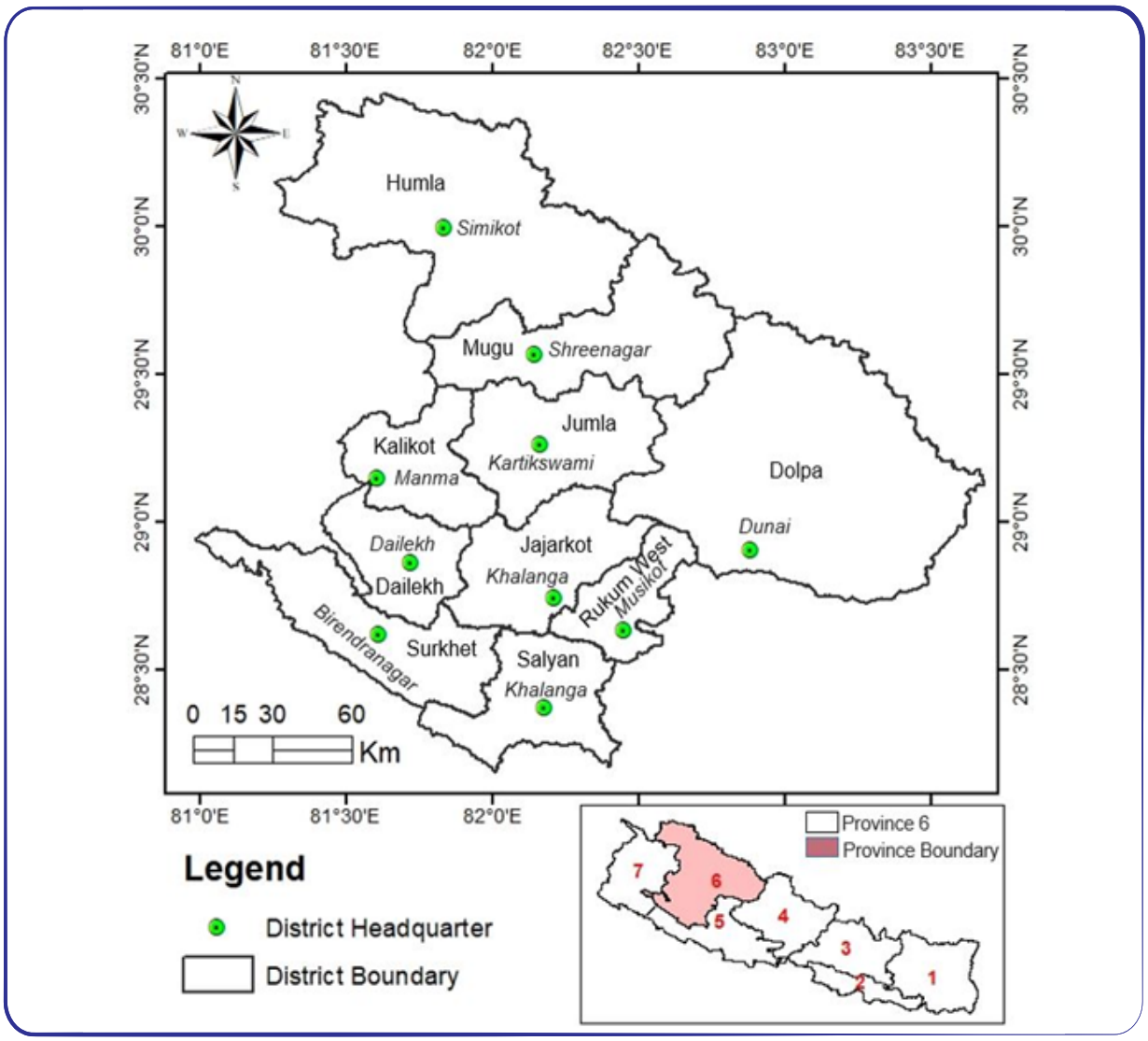

Figure 9-1 | *Location and districts covered in Karnali Province*

It borders Gandaki Province and Lumbini Province to the east, Sudurpashchim Province to the west, and Lumbini Province to the south. Major cities are Birendranagar, Dailekh and Musikot. The province contains Kubi Gangri, Changla , and Kanjiroba mountains in the north. The Shey Phoksundo National Park with Phoksundo Lake is the largest national park of Nepal

and Rara Lake is the largest national lake, located in Karnali Pradesh. Karnali River is the biggest river of the province, which is the longest river in Nepal.

9.1.2 Climate

Karnali Province is characterized by different climatic conditions. The climate is mainly influenced by the monsoon and physiography of the region. The summer monsoon, which originates from the Indian Ocean, is the main cause of precipitation in Nepal. Because the Karnali Province lies in the western part of Nepal, its influence is weaker compared to within eastern provinces. *Table 9.1* shows city-specific climate data.

Table 9.1 | *Meteorological parameters at meteorological stations in selected cities of Karnali Province*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(°C)	Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(°C)
Dailekh	3098	22.2	Salyan Bazar	1096	15.2
Musikot (Rumukot)	2188	15.6	Simikot	1027	8.5
Pusma Camp	1677	18.9	Rara	1015	10.0
Surkhet (Birendra Nagar)	1431	18.1	Jumla	833	9.4
Chaur Jhari Tar	1267	17.7	Dunai	641	13.6
Dipal Gaun	1141	10.5			

9.1.3 Hydrology/Drainage

The hydrology/drainage pattern of Karnali Province is shown in *Figure 9-2* and is characterized by the varying nature of rivers. Karnali Basin is the biggest one and some part of the Rapti Babai catchment. Out of the 43,009 Km^2 area of Karnali Basin, 29,428 Km^2 fall in this province. Similarly, a 1262 Km^2 area out of 3335 Km^2 of the Babai catchment falls in this province. The major rivers are Babai, Karnali, Bheri, and Tila nad I.

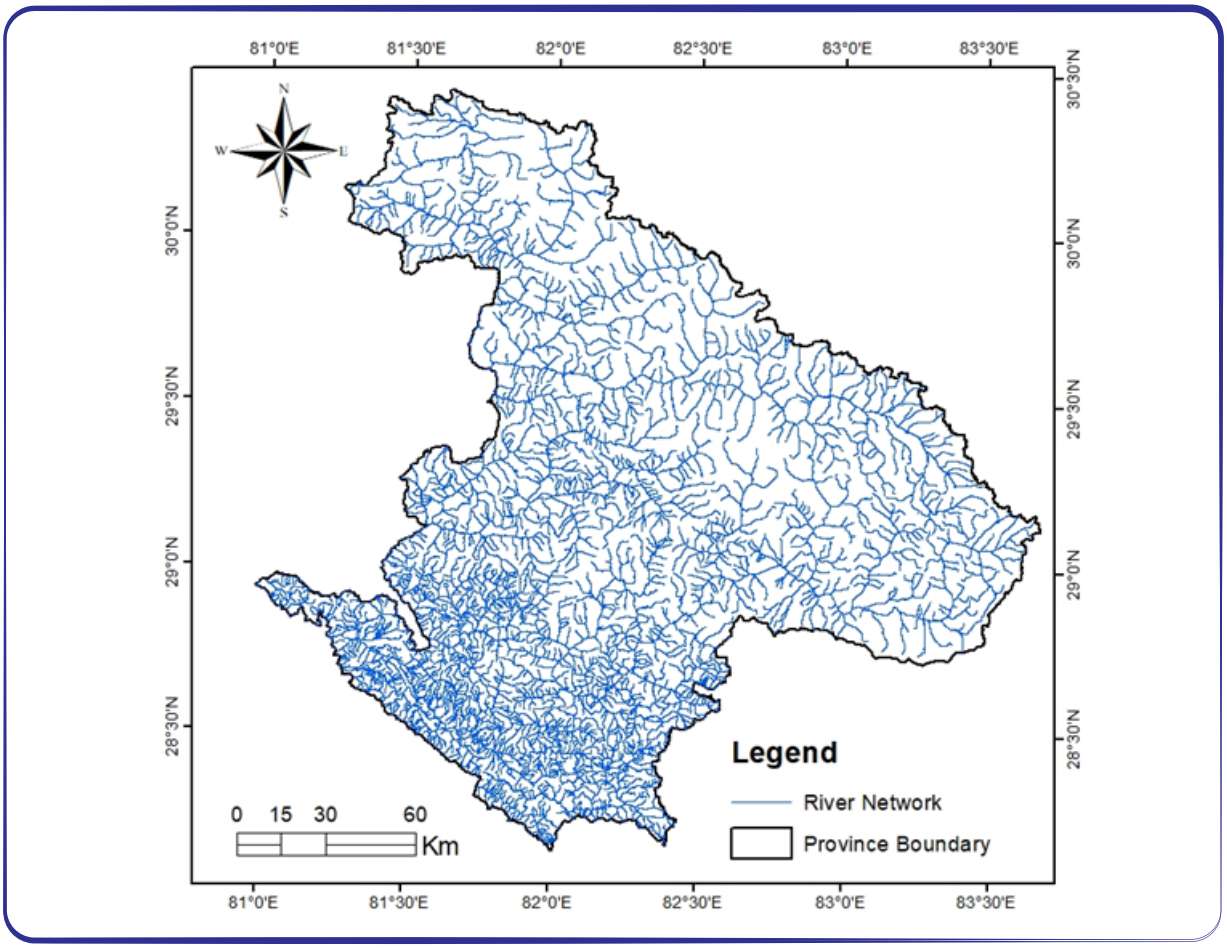

Figure 9-2| *Spatial distribution of drainage network in Karnali Province*

9.1.4 Land use/cover

The province has eight types of land use/cover (*Figure* 9-3). District-wise land use/cover pattern is shown in *Table* 9.2. Forest is the major land use/cover type (28.1%) followed by barren land (19.5%), and grassland (18%) (*Table* 9.2). Water bodies cover only 0.3% of the total land. The largest area of forest is in Surkhet, Kalikot, and Jajarkot whereas forests are the fewest in Dailekh and Dolpa districts. Water bodies chiefly dominated by river systems can be found in Surkhet and Rukum-West districts.

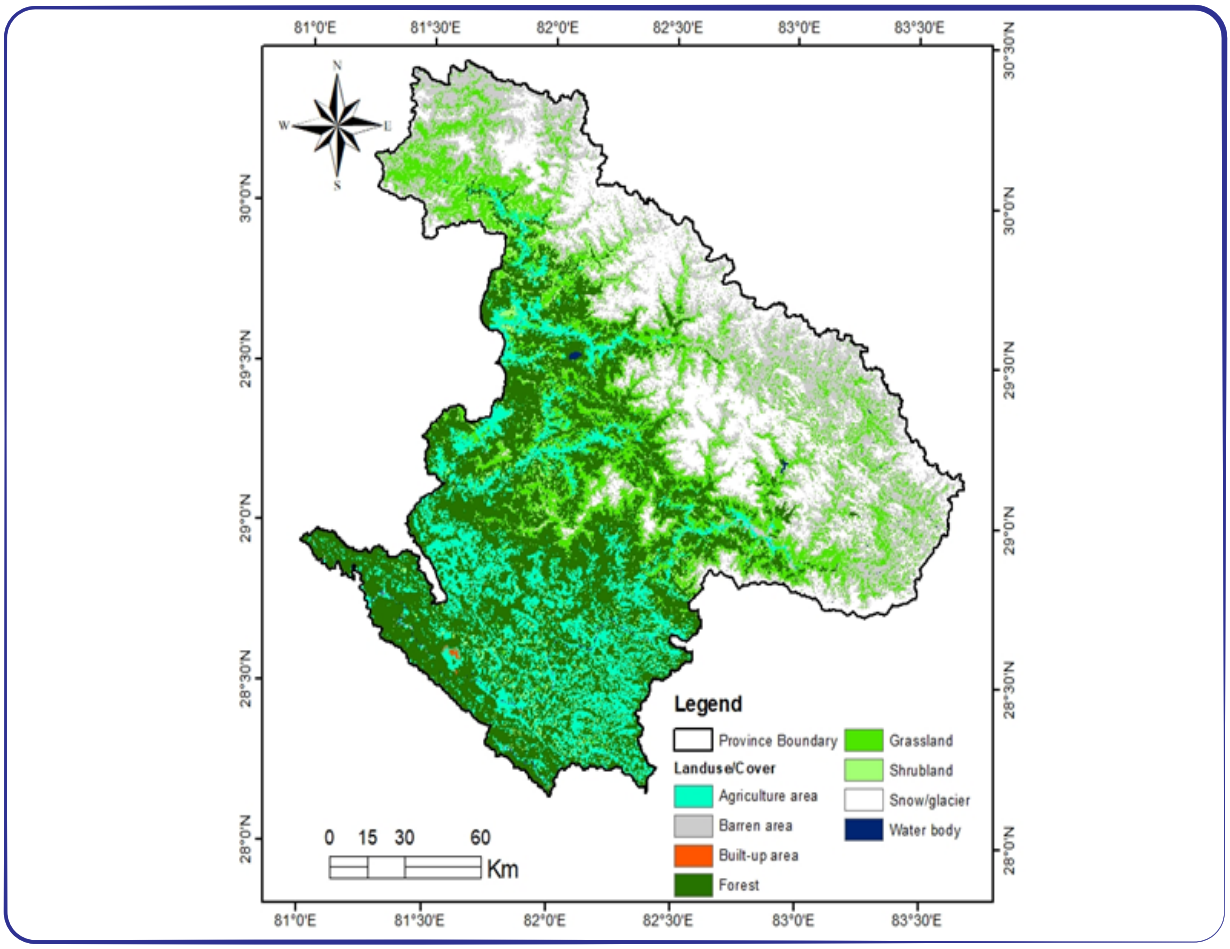

Figure 9-3 | *Land use/cover distribution in Karnali Province*

(Source: Prepared with data from ICIMOD, 2010)

Table 9.2 | *Land use/cover (ha) in Karnali Province*

District	Landuse/Cover Area (ha)									
	Forests	Shrub	Grassland	Crop field	Barren	Water	Builtup	Snow/glacier	Total	%
Dailekh	2198		2905	59360	191	181		13	64849	2.2
Dolpa	47585	5371	191874	11715	289729	1627	5	245258	793163	26.6
Humla	55109	35202	140748	23180	188776	506		156458	599979	20.1
Jajarkot	125061	6255	26911	54785	3844	760		4714	222330	7.4
Jumla	94382	9329	76267	25741	22513			27283	255516	8.6
Kalikot	100497	7729	22888	30827	1129	326		813	164209	5.5
Mugu	74596	10625	59289	26622	70875	1126		79728	322860	10.8
Salyan	104784	7185	1760	79001	97	951			193778	6.5
Surkhet	173217	7226	2181	60485	1548	2838	1323		248819	8.3
West Rukum	61569	5272	12246	35473	3607	475		2790	121432	4.1
Total	838998	94194	537070	407188	582309	8790	1328	517057	2986935	
%	28.1	3.2	18.0	13.6	19.5	0.3	0.04	17.3	100.0	

9.1.5 Population and ethnicity

The human population consists of about 1.41 million (*Table 9.3*), of which 51% is female. The province is inhabited by Brahmins, Kamis and Magars. Dailekh is the most densely populated district (174 persons/km^2) followed by Salyan and Surkhet. Dolpa district has the lowest population density with only 5 persons/km^2.

Table 9.3 | *District-wise population distribution in Karnali Province*

Districts	Area(Km^2)	Population		Total	Major Ethnicity
		Male	Female		
Dailekh	1502	126990	134780	261770	Chhetri, Kami, Thakuri
Dolpa	7889	18238	18462	36700	Chhetri, Magar, Dolpo
Humla	5655	25833	25025	50858	Chhetri, Thakuri, Tamang
Jajarkot	2230	85537	85767	171304	Chhetri, Kami, Thakuri
Jumla	2531	54898	54023	108921	Chhetri, Brahmin, Kami
Kalikot	1741	68833	68115	136948	Chhetri, Thakuri, Kami
Mugu	3535	28025	27261	55286	Chhetri, Thakuri, Kami
Salyan	1462	115969	126475	242444	Chhetri, Magar, Kami
Surkhet	2451	169421	181383	350804	Chhetri, Magar, Kami
Total	28996	693744	721291	1415035	

9.2 Lakes distribution across physiography

There are seven lakes in Karnali Province of Nepal that have mix-values for biodiversity, livelihoods, and religion and culture (*Table 9.4*). The spatial distribution of lakes within Karnali Province is presented in *Figure 9-4*. The district-wise distribution of lakes is reported as three in Dailekh, one each in Jumla, Mugu, Salyan, and Surkhet.

Dailekh district holds the biggest number of lakes (3). A total of four lakes out of eight are in good condition, and the remaining four are degrading. The core area of these lakes varies from less than 0.7 hectares to 1061 ha. The largest on is Rara Lake of Mugu district with a core area of 1061 ha. These lakes range in altitude from 730 m to 2990 m, with Rara Lake of Mugudistrict lying high at an altitude of 2990m. Basin areas vary from 1.5 ha up to a massive 15,000 ha with Rara Lake holding the largest basin area.

Table 9.4 | *Physiographic distribution of lakes in Karnali Province at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Dailekh	3			3	
D-2	Jumla	1			1	
D-3	Mugu	1				1
D-4	Salyan	1		1		
D-5	Surkhet	1		1		
	Total	7		2	4	1

Lake density is higher in Mahabharat and lesser in Siwaliks. There is one lake lying at altitude greater than 2700m. There are five lakes in Mahabharat and two in Siwaliks.

Rara lake is a great tourist attraction. It has over thousands of internal tourists annually and many external visitors (approximately 120/year). Its potential is high and will require infrastructure development and marketing promotional activities.

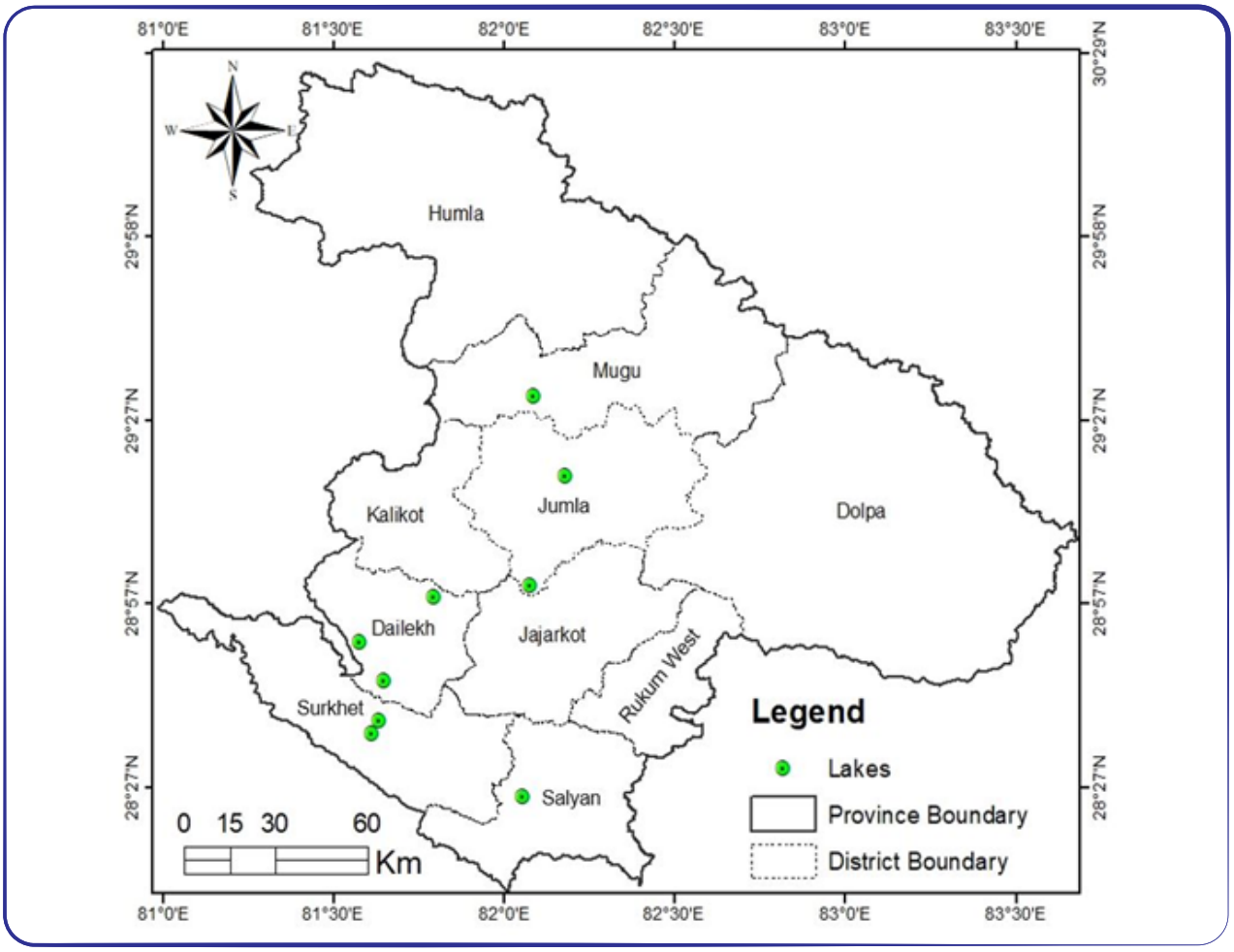

Figure 9-4| *Spatial distribution of lakes in Karnali Province*

Kubhinde Daha of Salyan district is a religious site and has Baraha temple located on its bank. The local festivals of Maghesankranti and Marga Purnima are predominant religious events.

All these lakes have a total core area of about 1071 ha in Karnali Province, which is about 0.038% of the total surface area of the province.

9.3 Lakes distribution across districts

There are 10 districts in Karnali province, namely, Dailekh, Dolpa, Humla, Jajarkot, Jumla, Kalikot, Mugu, Salyan, and Surkhet. The district-wise lake distribution is shown in *Table 9.5* and summarized hereunder.

Dailekh district: There are three (3) lakes in this district. Bada Pokhari has the largest core area (2 ha). All the lakes are in degrading condition. Please refer to Annex-48 for details of the features of each lake and *Figure 9-5* for spatial distribution.

Table 9.5 | *Distribution of lakes across districts in the Karnali Province*

District	Name of Lake	Type of Lake	Area (ha)		Conditions
			Core	Basin	
Dailekh	Bada Pokhari	Fresh water, Lacustrine,Seasonal	2	10	Degrading
	Khal Tal	Fresh water, Lacustrine, Seasonal	1	>10	Degrading
	Tal Pokhari	Fresh water, Lacustrine, Seasonal	N/A	2	Degrading
	Total				
Jumla	PaniPokhari	Freshwater, Manmade, Lacustrine, Permanent	0.2	1.5	Good
	Total		0.2	1.5	
Mugu	Rara tal(Mahendra Daha)	Freshwater,Lacustrine, Permanent	1061	12050	
	Total		1061	12050	
Salyan	Kubinde Daha	Freshwater,Lacustrine, Permanent	25	1200	Good
	Total		25	1200	
Surkhet	Bulbule Tal	Freshwater,Lacustrine, Permanent	0.7	100	Degrading
	Total		0.7	100	

Jumla district: There is only one lake in this district. Pani Pokhari has a core area size (0.2 ha) and is in good condition. Please refer to Annex-49 for details of the features of the lake and *Figure 9-6* for spatial distribution.

Mugu district: There is only one lake in this district. Rara Tal has the core area size (1061 ha) and is in good condition. Please refer to Annex-50 for details of the features of the lake and *Figure 9-7* for spatial distribution.

Salyan district: There is only one lake in this district. Kubhinde Daha has a core area size (25 ha) and is in good condition. Please refer to Annex-51 for details of the features of the lake and *Figure 9-8* for spatial distribution.

Surkhet district: There is only one lake in this district. Bulbule Tal has a core area size (0.7 ha) and is in degrading condition. Please refer to Annex-52 for details of the features of the lake and *Figure 9-9* for spatial distribution.

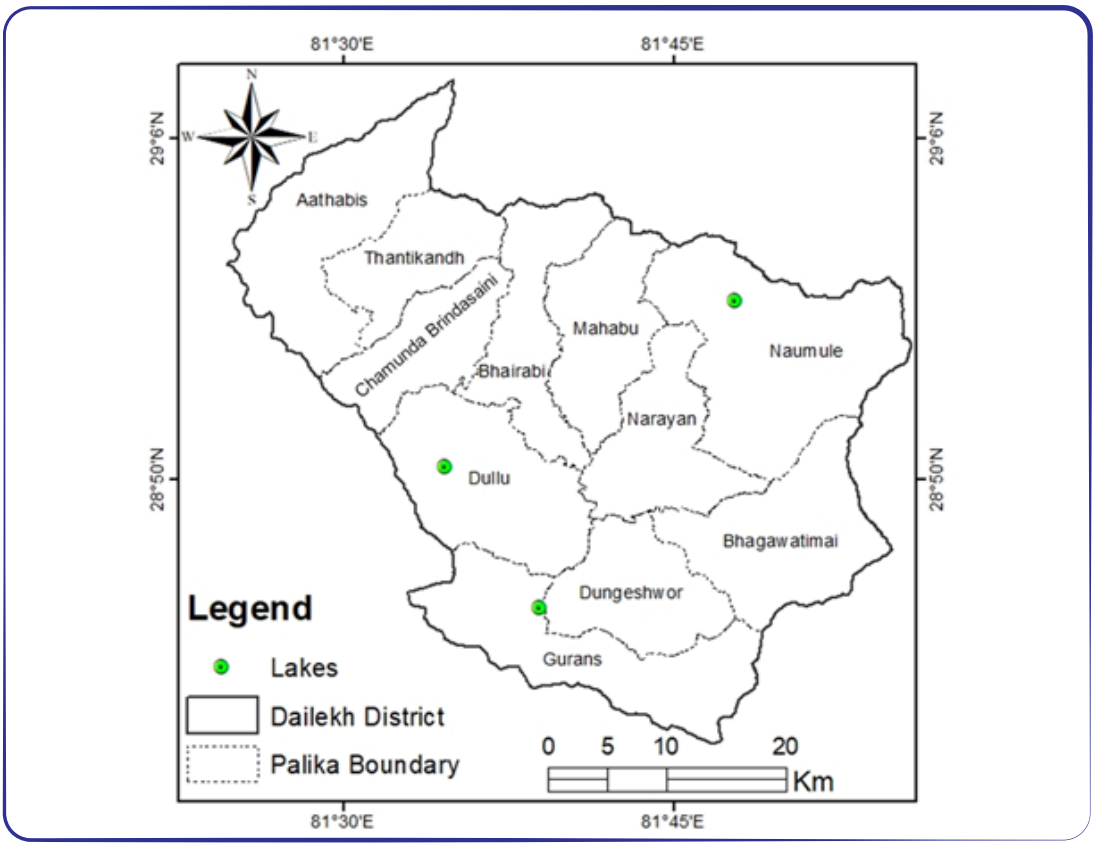

Figure 9-5 | *Spatial distribution of lakes in Dailkeh district*

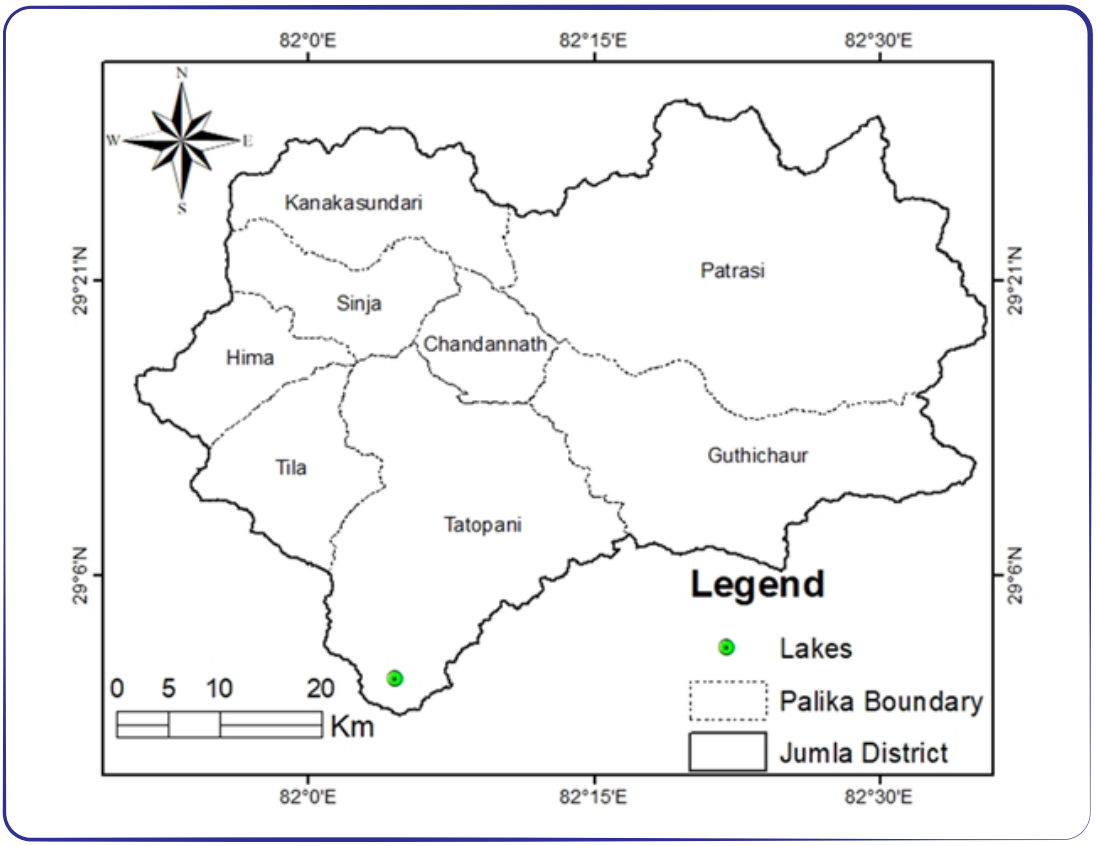

Figure 9-6 | *Spatial distribution of lakes in Jumla district*

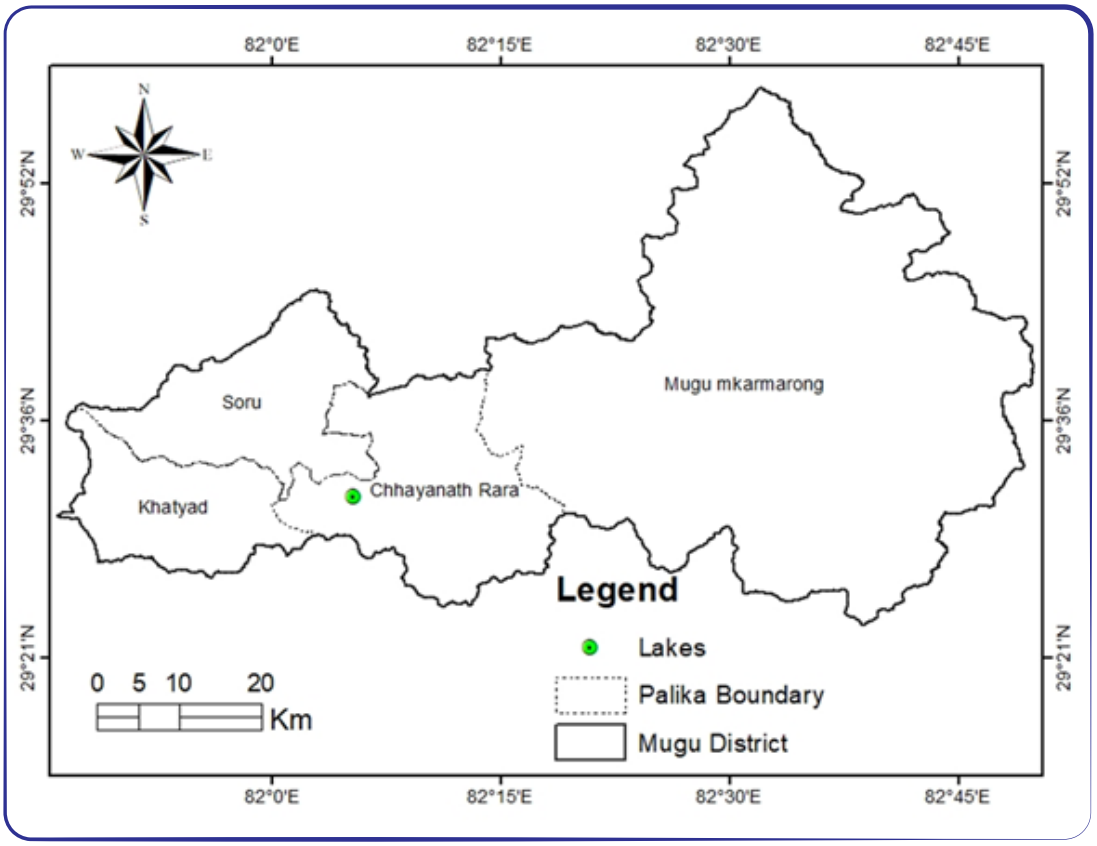

Figure 9-7 | *Spatial distribution of lakes in Mugu district*

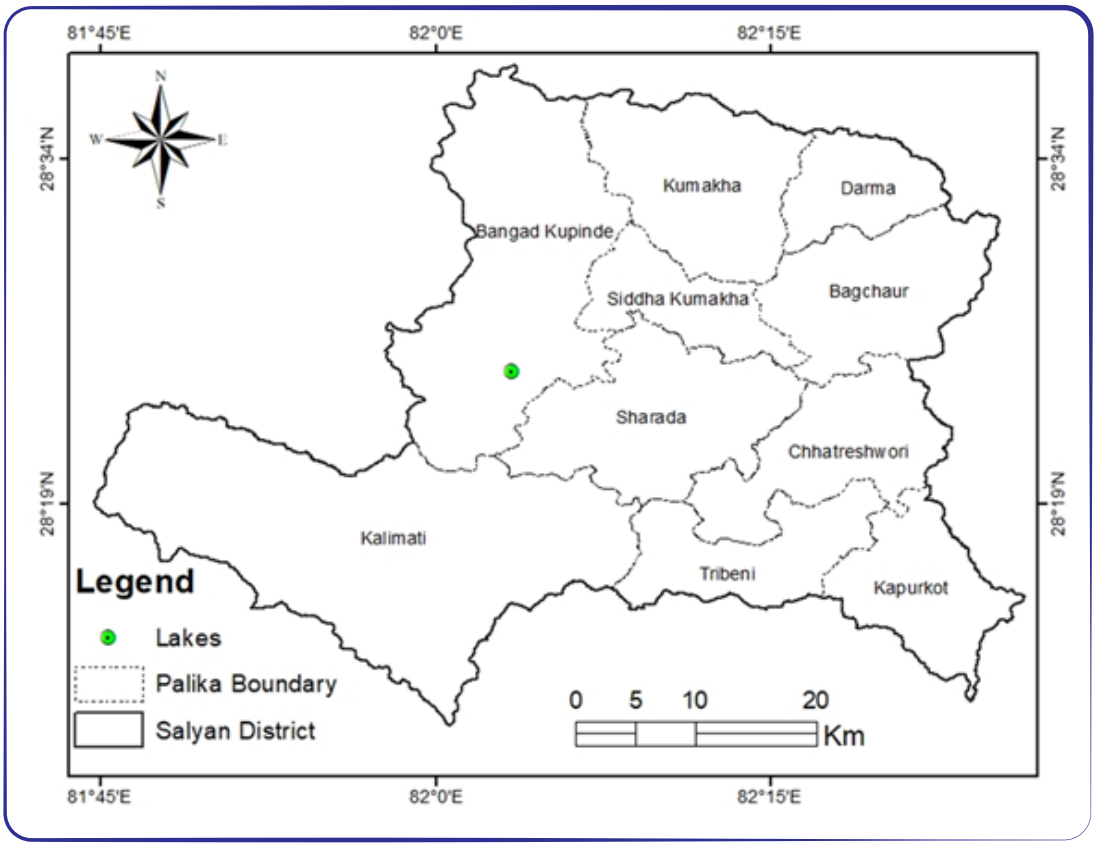

Figure 9-8 | *Spatial distribution of lakes in Salyan district*

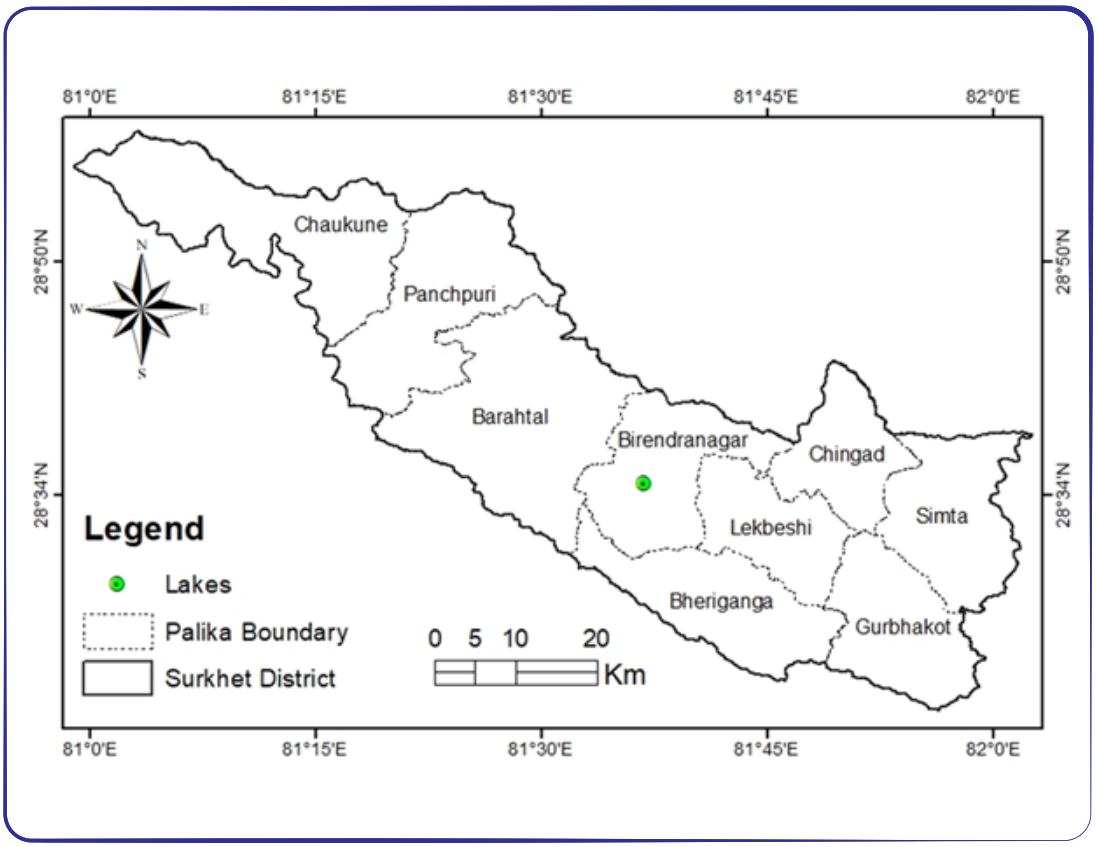

Figure 9-9 | *Spatial distribution of lakes in Surkhet district*

10. LAKES IN SUDURPASCHIM PROVINCE

10.1 Biophysical and socio-economic context

10.1.1 General features

The Sudurpaschim Province is the 7th province of Nepal, located in the western part of the country. It has nine districts (*Figure 10-1*) and 87 Palikas, of which one is a Sub-Metropolitan City, 33 are Municipalities, and the rest are Rural Municipalities. The province is surrounded by Karnali and Lumbini Province in the east, India in the southern and the western Part and Himalayas in the north. It is the home to 2.5 million people (9.4% of the country's population) and covers an area of 19,515km^2, which is 13.26% of the country's land area.

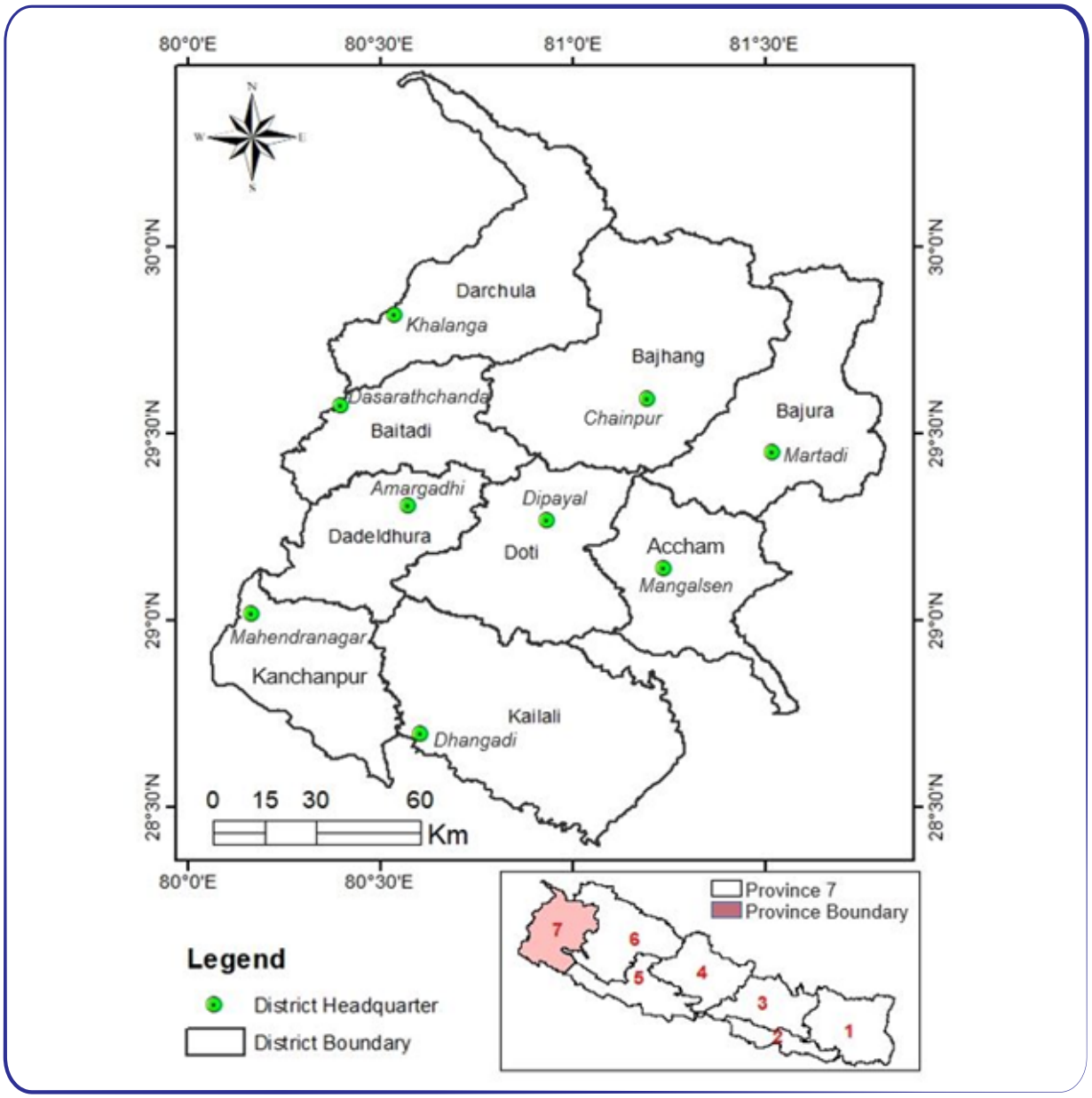

Figure 10-1 | *Location and districts covered in Sudurpaschim Province*

10.1.2 Climate

This province has a low altitude supporting deciduous, coniferous, and alpine forests and woodlands. Temperatures vary with altitude. Rainfall takes place mainly during summer. Being the 5th most populous province of Nepal, it possesses a rich cultural diversity with resident communities and casts including Tharus, Bhramins, Kamis, and Chhetris. This province has high mountains like Api and Saipal. Suklaphanta National Park is the major tourist attraction. Sudurpaschim Province is characterized by different climatic conditions depending on locations and places. For example, there is a humid subtropical climate in the Terai, hot summer meridian climate in the mid-hills, and subtropical highland oceanic climate in the mountains (Climate Data, 2017). This region also receives rainfall during the winter season. This rainfall occurs due to the Westerlies. Table 10-1 shows the climatic characteristics of the major cities in the province.

Table 10.1 | *Climatic conditions in the major cities of Sudurpaschim Province*

Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(°C)	Major Cities	Annual Avg. Rainfall(mm)	Annual Avg. Temp(°C)
Darchula	2220	16.7	Mahendra Nagar	1643	21.8
Godavar (West)	2132	24.7	Dadeldhura	1255	12.5
Chisapani (Karnali)	2070	20.6	Silgadhi Doti	1199	20.0
Dhangadi	1732	20.6	Dipayal (Doti)	1039	18.4
Tikapur	1723	23.0	Patan (West)	975	15.1
Chainpur (West)	1650	13.7			

10.1.3 Hydrology/Drainage

The hydrology/drainage pattern of Sudurpaschim Province is shown in *Figure 10-2* and is characterized by the varying nature of rivers. The major basins are Karnali Basin and Mahakali Basin. Out of the 43,009 Km^2 area of Karnali Basin, a 10,630 Km^2 area fall in the province. Similarly, the Mahakali basin covers an area of 4,995 Km^2 in the province. The major rivers are Karnali, Mahakali, Seti, and Mohana.

10.1.4 Land use/cover

Sudurpaschim Province has eight different types of land use/cover (*Figure 10-3*). District-wise land use/cover pattern is shown in *Table 10.2*. Forest is the major land use/cover type (52.4%) followed by agricultural Land (24.6%), and grassland (10.6%) (*Table 10.2*). Water bodies cover only 0.7% of the total land. The largest proportion of forest is in Dadeldhura, Doti, and Acchham whereas forests are fewer in Bajhang and Darchula districts. Water bodies chiefly dominated by river systems can be found in Kanchanpur and Kailali districts.

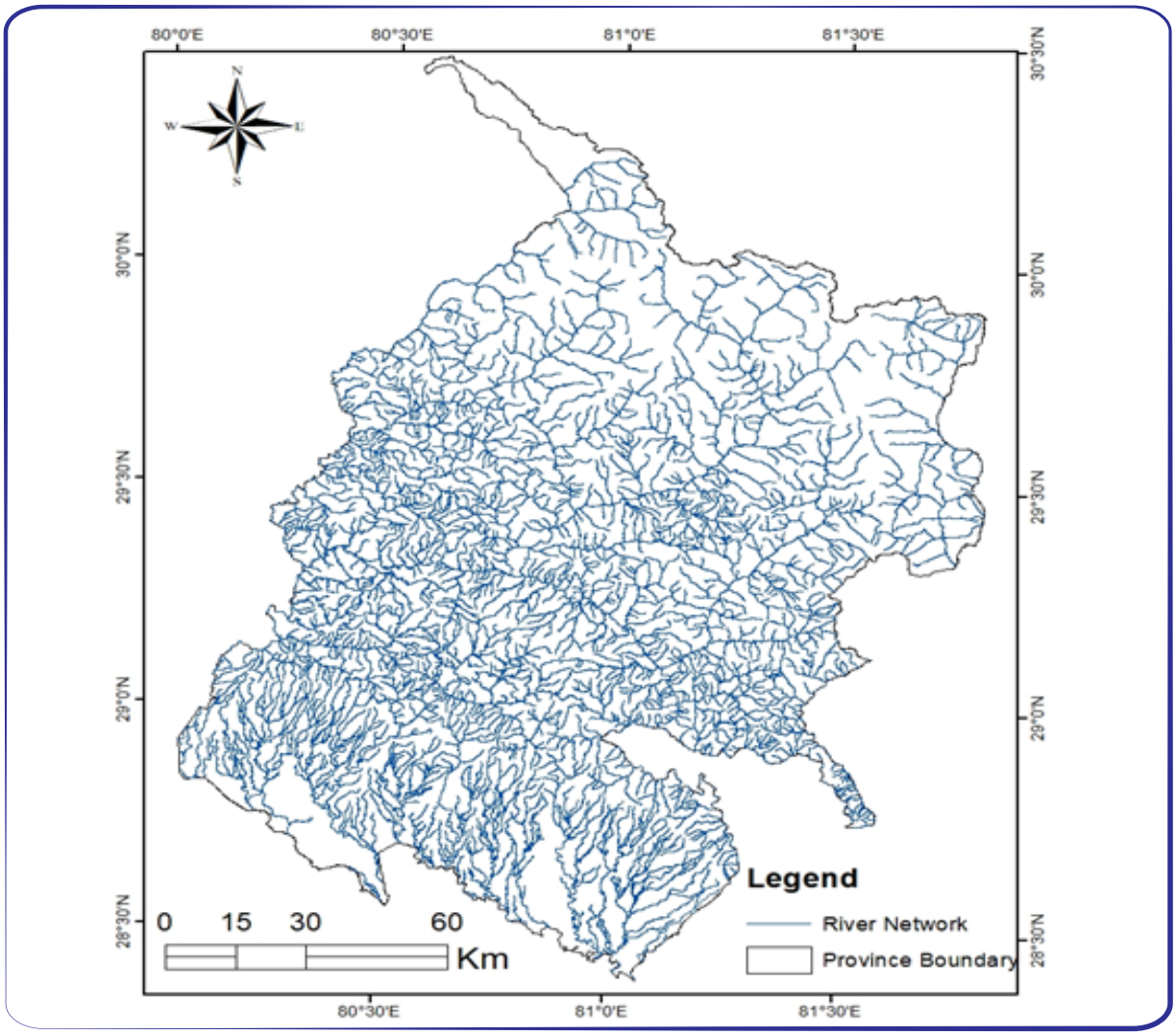

Figure 10-2| *Spatial distribution of drainage network in Sudurpaschim Province*

Table 10.2 | *Land use/cover (ha) in Sudurpaschim Province*

District	Landuse/Cover Area (ha)									
	Forests	Shrub	Grassland	Cropfield	Barren	Water	Builtup	Snow/glacier	Total	%
Achham	106928	1083	2603	57306	1293	1090			170303	8.6
Baitadi	74583	1582	6035	66406	655	356	5		149621	7.6
Bajhang	111418	17554	84654	49815	38342	881	7	43600	346271	17.5
Bajura	107671	14070	54163	38626	8436	297		6775	230038	11.6
Dadeldhura	118206	143	1564	28380	1916	392			150601	7.6
Darchula	79205	14810	50860	38181	22317	273		28592	234238	11.8
Doti	154418	865	3837	43919	1557	956			205553	10.4
Kailali	203314	765	2950	102430	12543	5454	1594		329050	16.6
Kanchanpur	80000	1791	3074	61637	11180	3324	1039		162046	8.2
Total	1035743	52663	209740	486701	98239	13024	2645	78966	1977721	
%	52.4	2.7	10.6	24.6	5.0	0.7	0.1	4.0	100.0	

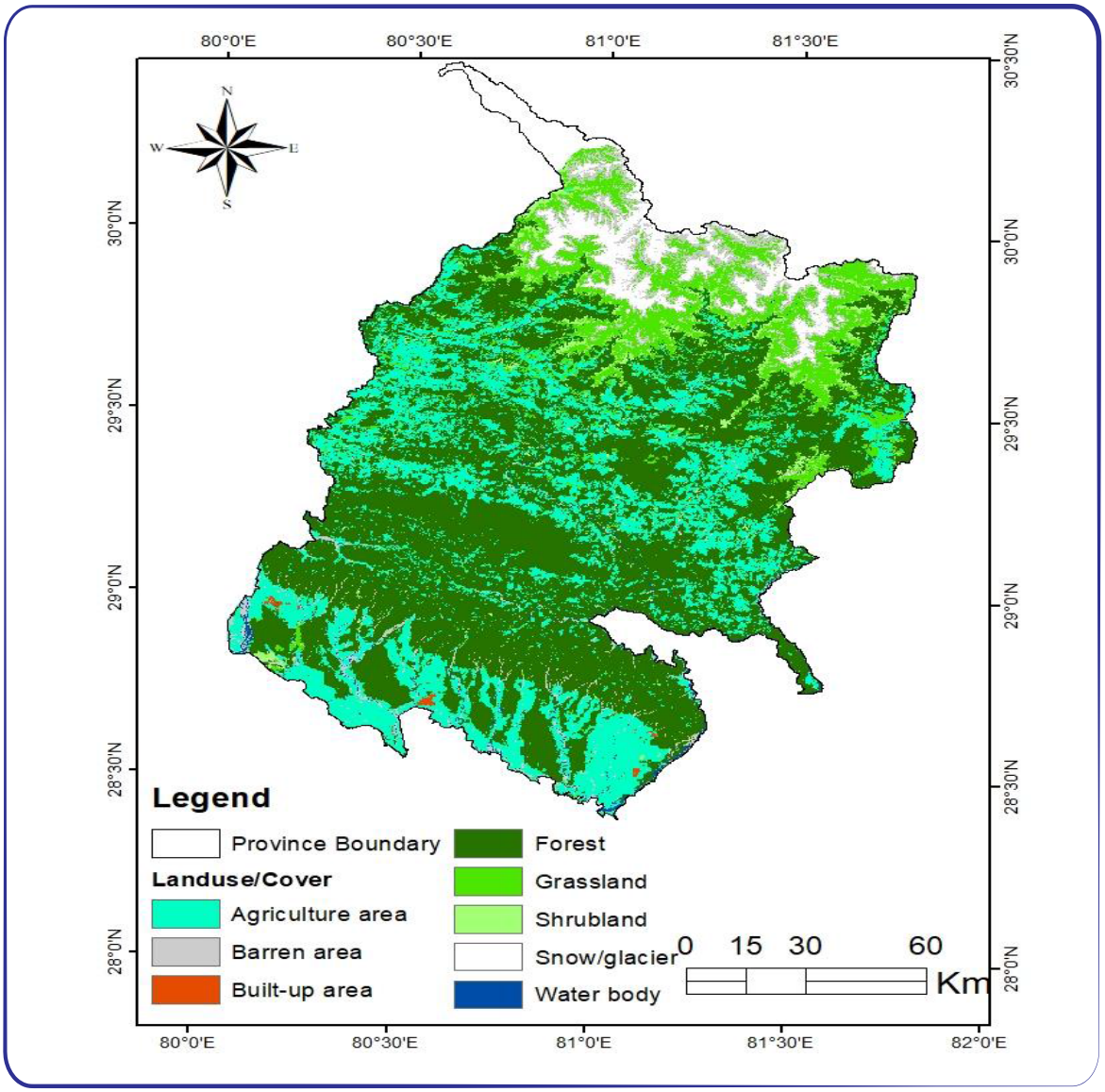

Figure 10-3 | *Land use/cover distribution in Sudurpaschim Province*

(Source: Prepared with data from ICIMOD, 2010)

10.1.5 Population and ethnicity

The human population in the province is about 2.5 million (*Table 10.3*), of which the female population consists of 52.4%. Brahmins, Kamis, Chhetris and Tharus inhabit this province. Kanchanpur is the most densely populated district (280 persons/km^2) followed by Kailali and Baitadi. Bajhang is the lowest population density district with only 57 persons/km^2.

Table 10.3 | *Population distribution across districts in Sudurpaschim Province*

Districts	Area (Km^2)	Population			Major Ethnicity
		Male	Female	Total	
Achham	1680	120008	137469	257477	Chhetri, Dalit, Kami
Baitadi	1519	117407	133491	250898	Chhetri, Brahmin, Thakuri
Bajhang	3422	92794	102365	195159	Chhetri, Brahmin, Kami
Bajura	2188	65806	69106	134912	Chhetri, Kami, Brahmin
Dadeldhura	1538	66556	75538	142094	Chhetri, Brahmin, Kami
Darchula	2322	63605	69669	133274	Chhetri, Brahmin, Kami

Doti	2025	97252	114494	211746	Chhetri, Kami, Brahmin
Kailali	3235	378417	397292	775709	Tharu, Chhetri, Brahmin
Kanchanpur	1610	216042	235206	451248	Chhetri, Tharu, Brahmin
Total	19539	1217887	1334630	2552517	

10.2 Lakes distribution across physiography

Table 10.4 shows a summary of 87 lakes and *Figure 10-4* depicts their spatial distribution in Sudurpaschim Province that has mix-values for biodiversity, livelihoods, religion and culture. The district-wise distribution of lakes is reported as seven in Achham, one each in Baitadi and Bajhang, two in Bajura, one in Dadeldhura (two in Doti, 47 in Kailali, and 26 in Kanchanpur.

Kailai district holds the maximum number of lakes (47) followed by Kanchanpur (26) and Achham (7). Many lakes dotted in the old map-based inventory have disappeared.

Only four lakes are in a good condition, whereas the remaining 83 are degrading. The core area of these lakes varies from less than 0.5 hectares to 78.1 ha. The largest one is Ghodaghodi Tal of Kailali district with a core area of 78.1 ha. The variation of these lakes, altitude wise, ranges from 129m to 2528 m, with Dhalpuri Lake of Bajuradistrict lying high at an altitude of 2528 m. The basin area variation in this province occurs from 1.2 ha up to 96,48.4 ha.

Table 10.4 | *Physiographic distribution of lakes in Province-1 at altitudes less than 3,000 masl*

S.N.	District	Lake nos.	Physiographic Regions			
			Terai	Siwaliks (7000-1500)	Mahabharat (1500-2700)	Above 2700m
D-1	Achham	7			7	
D-2	Baitadi	1			1	
D-3	Bajhang	1			1	
D-4	Bajura	2			2	
D-5	Dadeldhura	1		1		
D-6	Doti	2		2		
D-7	Kailali	47	47			
D-8	Kanchanpur	26	26			
	Total	**87**	**73**	**3**	**11**	

Lake density is higher in the Terai whereas it is lesser in Siwaliks. There are 73 lakes in the Terai, followed by 11 in Mahabharat and three in Siwaliks. Lakes densities gradually decrease in the mountains when altitudinal gradients increase.

Some lakes of great tourism values are Lamadaya Tal and Lisedali Tal in Achham district. They have a good tourism potential as transport facilities are available for access. About 5000 visitors are recorded per year in these two lakes.

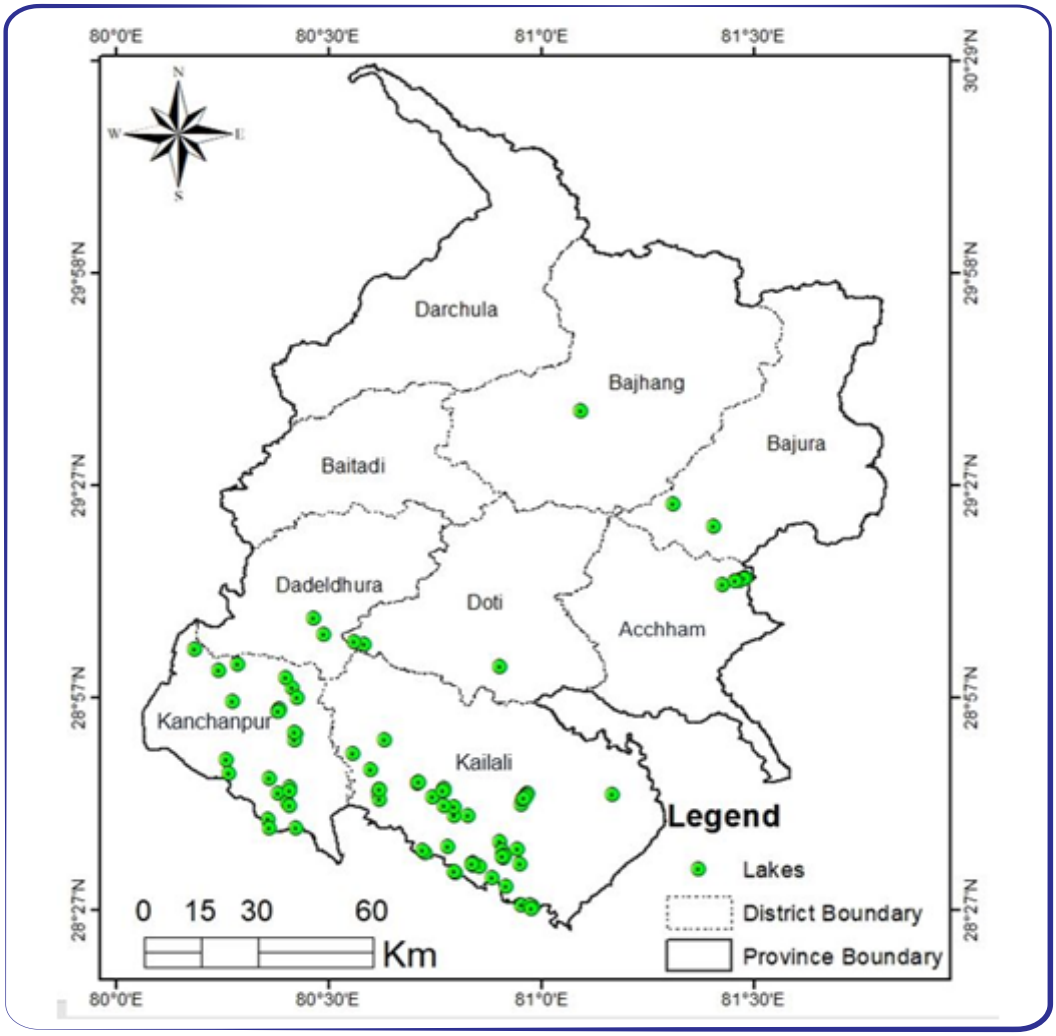

Figure 10-4| *Spatial distribution of lakes in Sudurpaschim Province*

Ghodaghodi Tal in Kailali is of great religious importance as well as a religious tourism destination where over 35,000 visitors are recorded annually. It is a Hindu destination due to the presence of Siddha Baba temple on its bank. Most high altitude lakes are utilised for religious purposes.

All these lakes have a total core area of 801 ha, which is 0.041% of the total surface area of the province.

10.3 Lakes distribution across districts

There are altogether nine districts in Sudurpaschim province. They are Acchham, Baitadi, Bajhang, Bajura, Dadeldhura, Darchula, Doti, Kailali and Kanchanpur. No lakes are reported in available inventories in Darchula district. The district-wise lake distribution of lakes are provided in *Table 10.5* and summarized hereunder.

Accham district: There are seven lakes in this district. Lamadaya Tal has the largest core area size (21.5 ha) and only 4 lakes are in good condition. Please refer to Annex-53 for details on features of each lake and *Figure 10-5* for spatial distribution.

Table 10.5 | *Lakes in nine districts within Sudurpaschim Province*

District	Name of Lake	Type of Lake	Area (ha)		Conditions
			Core	Basin	
Accham	Batula Tal	Freshwater, Lacustrine, Permanent	3.2	249.8	Degrading
	Geraya Bonda	Freshwater, Lacustrine, Permanent	2.2	238.6	Good
	Jingale Tal	Freshwater, Lacustrine, Permanent	1.1	118.5	Good
	Lamadaya Tal	Freshwater, Lacustrine, Permanent	21.5	249.8	Good
	Lisedali Tal	Freshwater, Lacustrine, Permanent	2.6	118.5	Good
	Mathillo Dhaune Tal	Freshwater, Lacustrine, Permanent	1.63	535	Degrading
	Tallo Dhaune Tal	Freshwater, Lacustrine, Permanent	0.6	531	Degrading
	Total		**32.8**	**2041**	
Baitadi	Patal Bhumeshor Tal	Freshwater, Lacustrine, Permanent	0.5	1.2	Degrading
	Total		**0.5**	**1.2**	
Bajhang	Dau Tal	Freshwater, Lacustrine, Permanent	1.6	193.6	Degrading
	Total		**1.6**	**193.6**	
Bajura	Chhede Daha	Freshwater, Lacustrine, Permanent	1.1	7.8	Degrading
	Dhalpuri	Freshwater, Lacustrine, Permanent	1.8	36.6	Degrading
	Total		**2.9**	**44.4**	
Dadeldhura	Ali Tal	Freshwater, Lacustrine, Permanent	7	72.8	Degrading
	Total		**7**	**72.8**	
Doti	Chhatiwan Tal	Freshwater, Lacustrine, Permanent	1.9	66.7	Degrading
	Rangeni Tal	Freshwater, Lacustrine, Permanent	0.5	8.2	Degrading
	Total		**2.4**	**74.9**	
Kailali	Ajuwa Lake	Freshwater, Lacustrine, Permanent	4.1	9648	Degrading
	Baba Lake	Freshwater, Lacustrine, Permanent	2.6	9648	Degrading
	Bahuliya Tal	Freshwater, Lacustrine, Permanent	12.0	90	Degrading
	Badka Lake	Freshwater, Lacustrine, Permanent	3.6	48.1	Degrading
	Bhairbuwa Lake	Freshwater, Lacustrine, Permanent	19.8	260	Degrading
	Bhaiswa Lake	Freshwater, Lacustrine, Permanent	7.0	9648	Degrading
	Budi Nakror	Freshwater, Lacustrine, Permanent	0.9	9648	Degrading
	Chamraiya Tal	Freshwater, Lacustrine, Permanent	14.9	321.2	Degrading

Chhaya Tal	Freshwater,Lacustrine, Permanent	1.5	250	Degrading
Charra Lake	Freshwater,Lacustrine, Permanent	3.3	101.2	Degrading
Chiriya Lake	Freshwater,Lacustrine, Permanent	2.5	9648	Degrading
Dubri Lake	Freshwater,Lacustrine, Permanent	1.8	96.2	Degrading
Dudhawa Tal	Freshwater,Lacustrine, Permanent	4.4	80	Degrading
Faurahawa Lake	Freshwater,Lacustrine, Seasonal	1.0	23.4	Degrading
Gaichkatuwa Lake	Freshwater,Lacustrine, Permanent	5.4	9648	Degrading
Ghod Lake	Freshwater,Lacustrine, Permanent	36.0	382.5	Degrading
Ghodaghodi Lake	Freshwater,Lacustrine, Permanent	78.1	9648	Degrading
Ghodchittiya Lake	Freshwater,Lacustrine, Permanent	0.9	48.1	Degrading
Gurduhawa Lake	Freshwater,Lacustrine, Permanent	2.8	50.4	Degrading
Guldrahawa Tal	Freshwater,Lacustrine, Permanent	4.1	60	Degrading
Jakhor Lake	Freshwater,Lacustrine, Permanent	13.4	314.1	Degrading
Jogniya Lake	Freshwater,Lacustrine, Permanent	8.8	63.8	Degrading
KamalPokhari	Freshwater,Lacustrine, Permanent	21.0	349.3	Degrading
Kohilai Lake	Freshwater,Lacustrine, Permanent	60.4	350.2	Degrading
KorkoTala Lake	Freshwater,Lacustrine, Permanent	20.3	287.1	Degrading
Lami Lake	Freshwater,Lacustrine, Permanent	7.3	209.5	Degrading
Laukabhauka Lake	Freshwater,Lacustrine, Permanent	46.1	583.2	Degrading
Lukli Lake	Freshwater,Lacustrine, Permanent	6.5	623.6	Degrading
Mahadev Lake	Freshwater,Lacustrine, Permanent	21.3	193.4	Degrading
Mohana Oxbow Lake	Freshwater,Lacustrine, Permanent	30.0	150	Degrading
Nami Tal	Freshwater,Lacustrine, Permanent	3.0	250	Degrading
Narkor	Freshwater,Lacustrine, Permanent	26.6	9648	Degrading
Nardahuwa	Freshwater,Lacustrine, Permanent	13.7	1023	Degrading
Nathuniya lake	Freshwater,Lacustrine, Permanent	5.8	1023	Degrading
Paiparawa lake	Freshwater,Lacustrine, Permanent	40.0	190	Degrading
Puraina lake (a)	Freshwater,Lacustrine, Permanent	13.1	1023	Degrading

	Puraina lake (b)	Freshwater,Lacustrine, Permanent	1.7	100	Degrading
	Raji tal	Freshwater,Lacustrine, Permanent	1.3	100	Degrading
	Rara tal	Freshwater,Lacustrine, Permanent	2.1	34	Degrading
	Rupiya lake	Freshwater,Lacustrine, Permanent	6.7	623.6	Degrading
	Sahadeva lake	Freshwater,Lacustrine, Permanent	9.4	193.4	Degrading
	Sarkiniya	Freshwater,Lacustrine, Permanent	9.0	1023	Degrading
	Siddhababa	Freshwater,Lacustrine, Permanent	0.6	30	Degrading
	Soniya	Freshwater,Lacustrine, Permanent	24.1	623.6	Degrading
	Sukhaiya	Freshwater,Lacustrine, Permanent	5.9	165.5	Degrading
	Sunhara	Freshwater,Lacustrine, Permanent	5.0	50	Degrading
	Thongruwa	Freshwater,Lacustrine, Permanent	0.6	48.1	Degrading
	Total		**610.0**	**88622**	
Kanchanpur	Ajayan Kunda	Freshwater,Lacustrine, Permanent	1.9	100	Degrading
	Ajingar Tal	Freshwater,Lacustrine, Seasonal	0.7	11.4	Degrading
	Banda Tal	Freshwater,Lacustrine, Permanent	21.0	78.1	Degrading
	Baijyanath Tal	Freshwater,Lacustrine, Permanent	1.0	20	Degrading
	Bantaria	Freshwater,Lacustrine, Permanent	6.0	60	Degrading
	Betkot	Freshwater,Lacustrine, Permanent	5.0	35.5	Degrading
	Copre	Freshwater,Lacustrine, Permanent	0.9	90	Degrading
	Gangla	Freshwater,Lacustrine, Permanent	1.9	50	Degrading
	Godbijula Tal	Freshwater,Lacustrine, Permanent	8.8	96	Degrading
	Jhilmila Lake	Freshwater,Lacustrine, Permanent	4.3	40.2	Degrading
	Jharan	Freshwater,Lacustrine, Permanent	0.6	15	Degrading
	Kalikich Tal	Freshwater,Lacustrine, Permanent	10.0	50	Degrading
	Karki Lake	Freshwater,Lacustrine, Permanent	15.4	148.7	Degrading
	Kulla Tal	Freshwater,Lacustrine, Permanent	5.9	150	Degrading
	Mudka Lake	Freshwater,Lacustrine, Permanent	0.7	17.7	Degrading
	Naini Tal	Freshwater,Lacustrine, Permanent	3.0	50	Degrading

	Naranga thulo Tal	Freshwater,Lacustrine, Permanent	0.9	25.5	Degrading
	Naranga Sano Tal	Freshwater,Lacustrine, Seasonal	1.1	25.5	Degrading
	Newland Lake	Freshwater,Lacustrine, Permanent	0.8	18.7	Degrading
	Pipermandi Tal	Freshwater,Lacustrine, Permanent	1.0	100	Degrading
	Peli Tal	Freshwater,Lacustrine, Permanent	3.4	79.3	Degrading
	Puraina Tal	Freshwater,Lacustrine, Permanent	2.4	26.8	Degrading
	Pyara Tal	Freshwater,Lacustrine, Permanent	0.8	32.3	Degrading
	Shova Tal	Freshwater,Lacustrine, Permanent	25.0	250	Degrading
	Siddhas Sarobar Banda	Freshwater,Lacustrine, Permanent	21.1	20	Degrading
	Sundeu Lake	Freshwater,Lacustrine, Permanent	0.8	11.1	Degrading
	Total		**144**	**1602**	

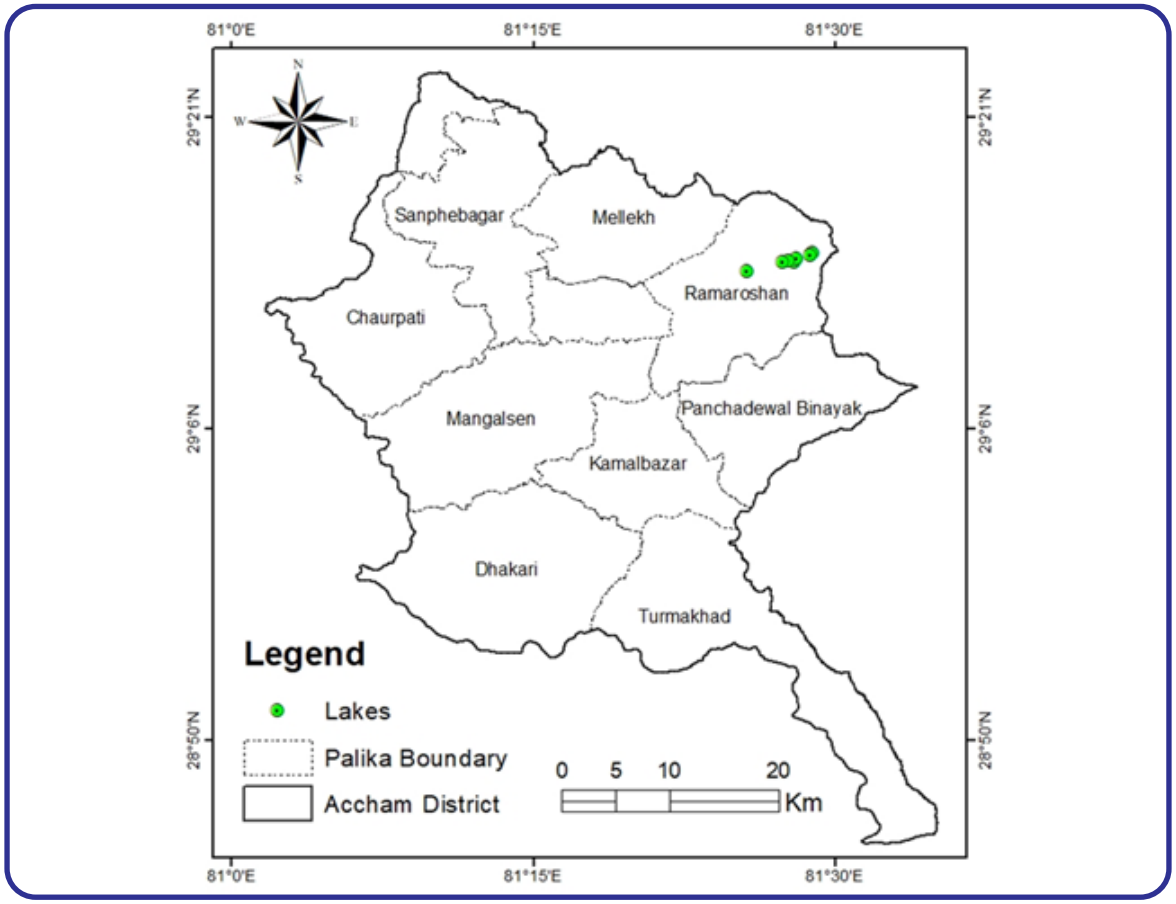

Figure 10-5 | *Spatial distribution of lakes in Accham district*

Baitadi district: There is only one lake in this district. Patal Bhimeshwar Tal has the largest core area size (0.5 ha) and is in degrading condition. Please refer to Annex-54 for details on the features of each lake and *Figure 10-6* for spatial distribution.

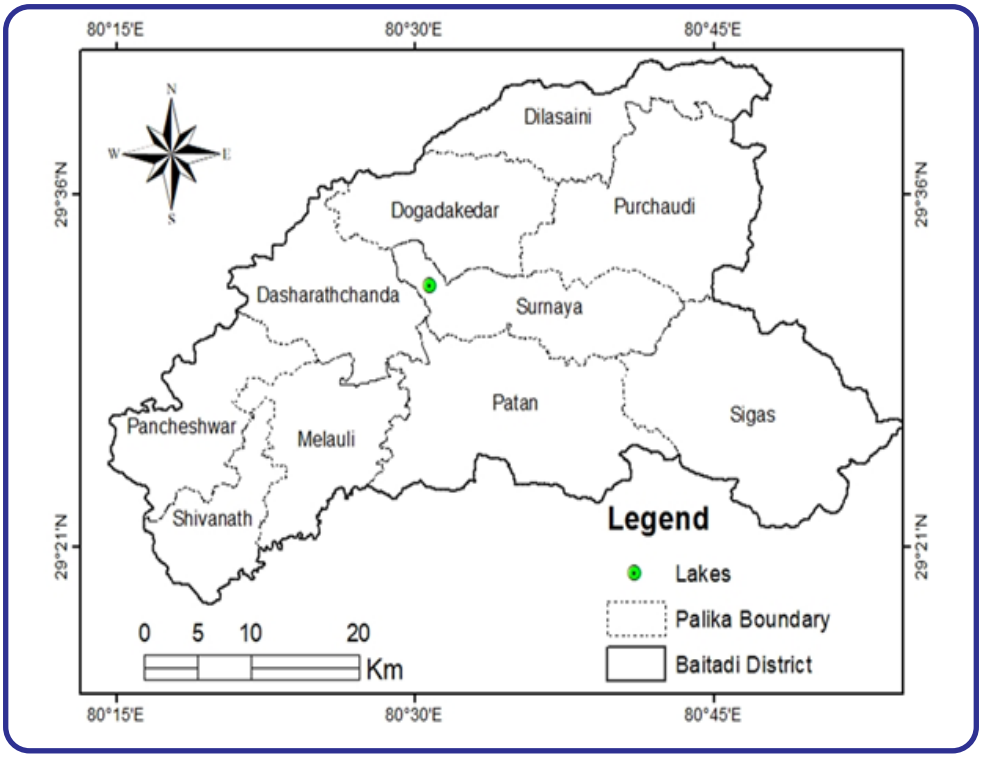

Figure 10-6| *Spatial distribution of lakes in Baitadi district*

Bajhang district: There is only one lake in this district. Dau Tal has the largest core area size (1.6 ha) and is in degrading condition. Please refer to Annex-55 for details on the features of the lake and *Figure 10-7* for spatial distribution.

Bajura district: There are only two lakes in this district. Dhalpuri Tal has the largest core area size (1.8 ha) and both are in degrading condition. Please refer to Annex-56 for details on features of each lake and *Figure 10-8* for spatial distribution.

Dadeldhura district: There is only one lake in this district. Ali Tal has the largest core area size (7 ha) and is in degrading condition. Please refer to Annex-57 for details on the features of the lake and *Figure 10-9* for spatial distribution.

Doti district: There are only two lakes in this district. Chatiwan Tal has the largest core area size (1.9 ha) and both are in degrading condition. Please refer to Annex-58 for details on the features of each lake and *Figure 10-10* for spatial distribution.

Kailali district: There are 47 lakes in this district. Ghodaghodi Lake has the largest core area size (78 ha). All the Lakes are in degrading condition. Please refer to Annex-59 for details on the features of each lake and *Figure 10-11* for spatial distribution.

Kanchanpur district: There are 26 lakes in this district. ShovaTal has the largest core area size (25 ha). All lakes are in degrading condition. Please refer to Annex-60 for details on the features of each lake and *Figure 10-12* for spatial distribution.

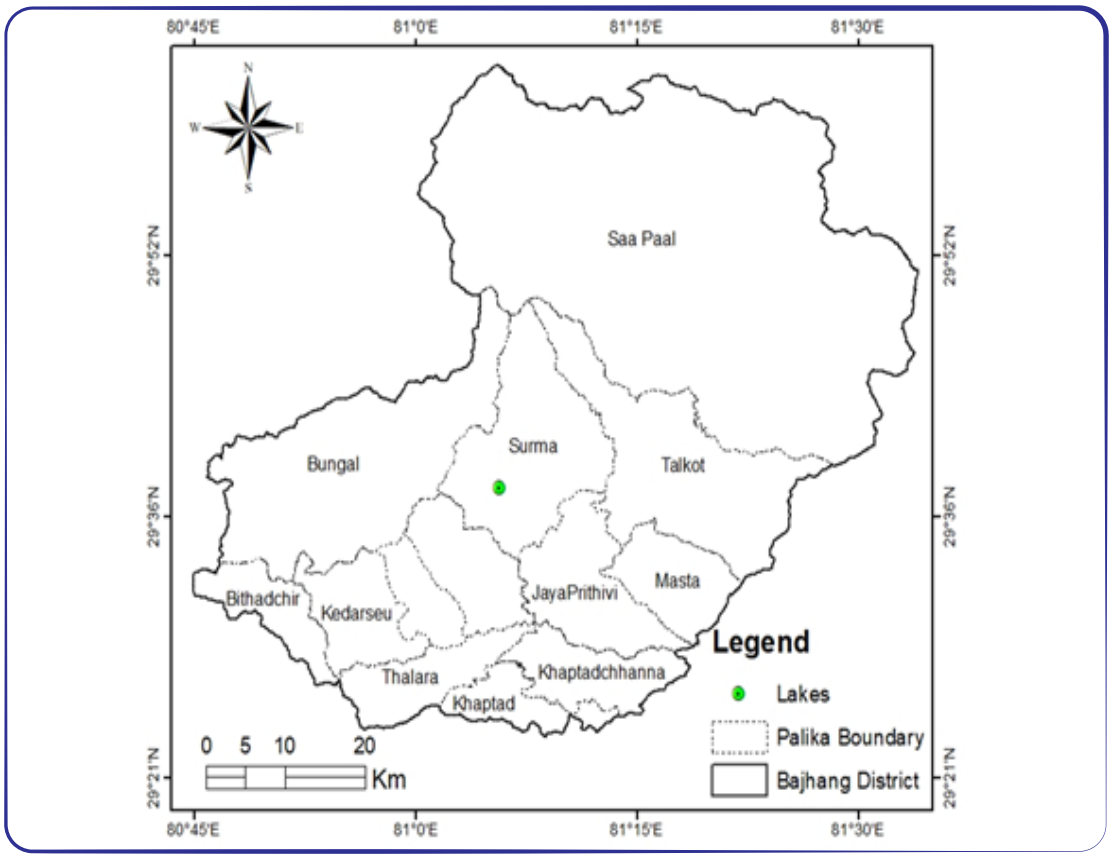

Figure 10-7 | *Spatial distribution of lakes in Bajhang district*

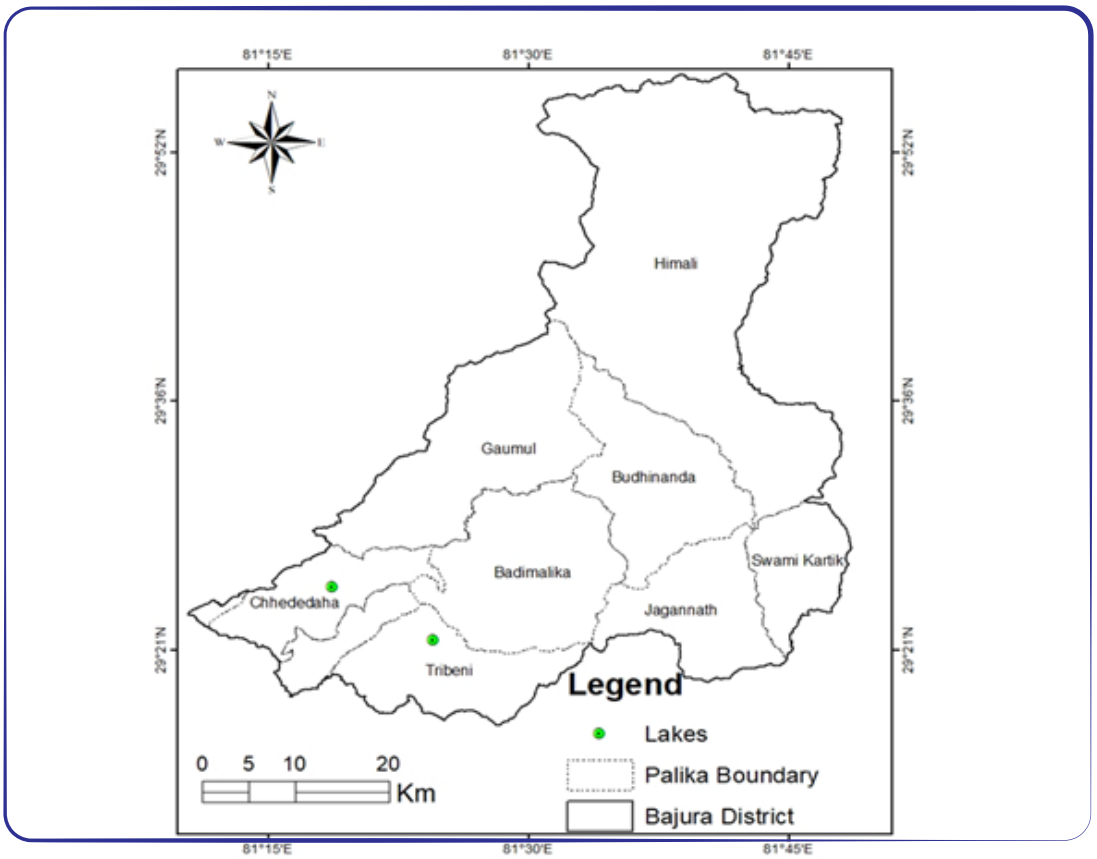

Figure 10-8 | *Spatial distribution of lakes in Bajura district*

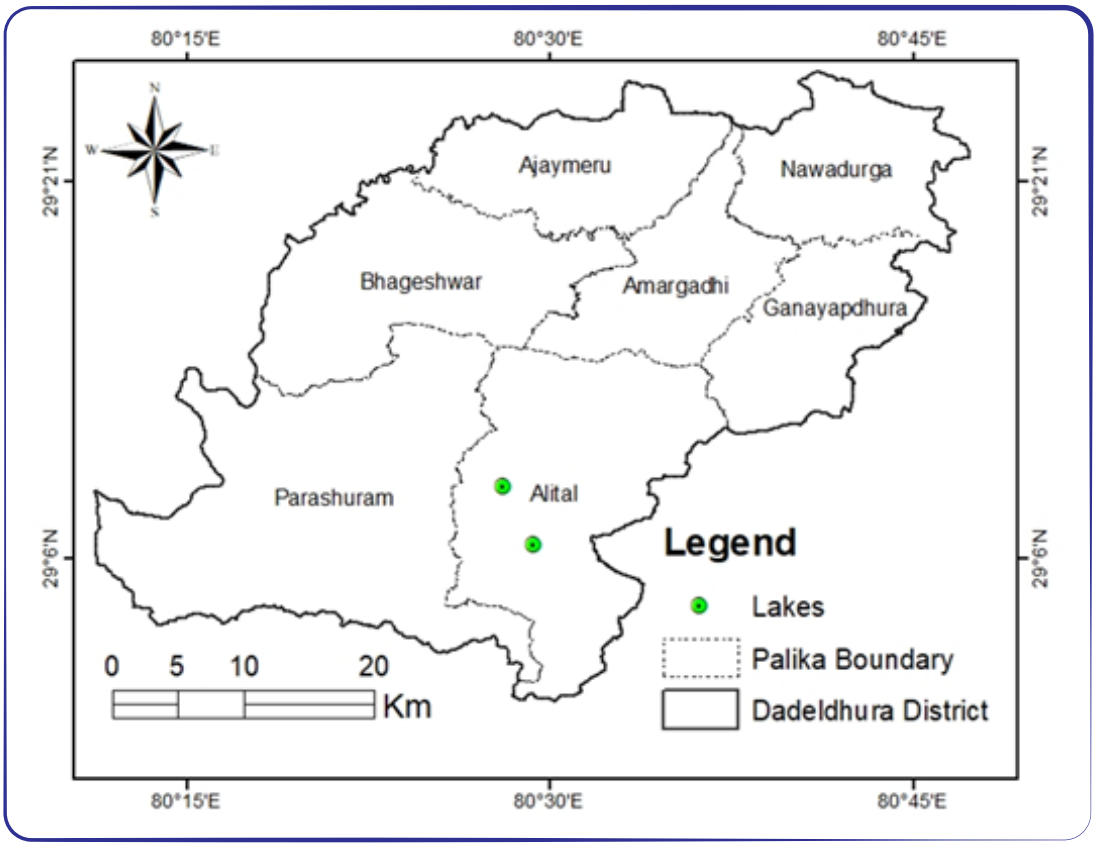

Figure 10-9| *Spatial distribution of lakes in Dadeldhura district*

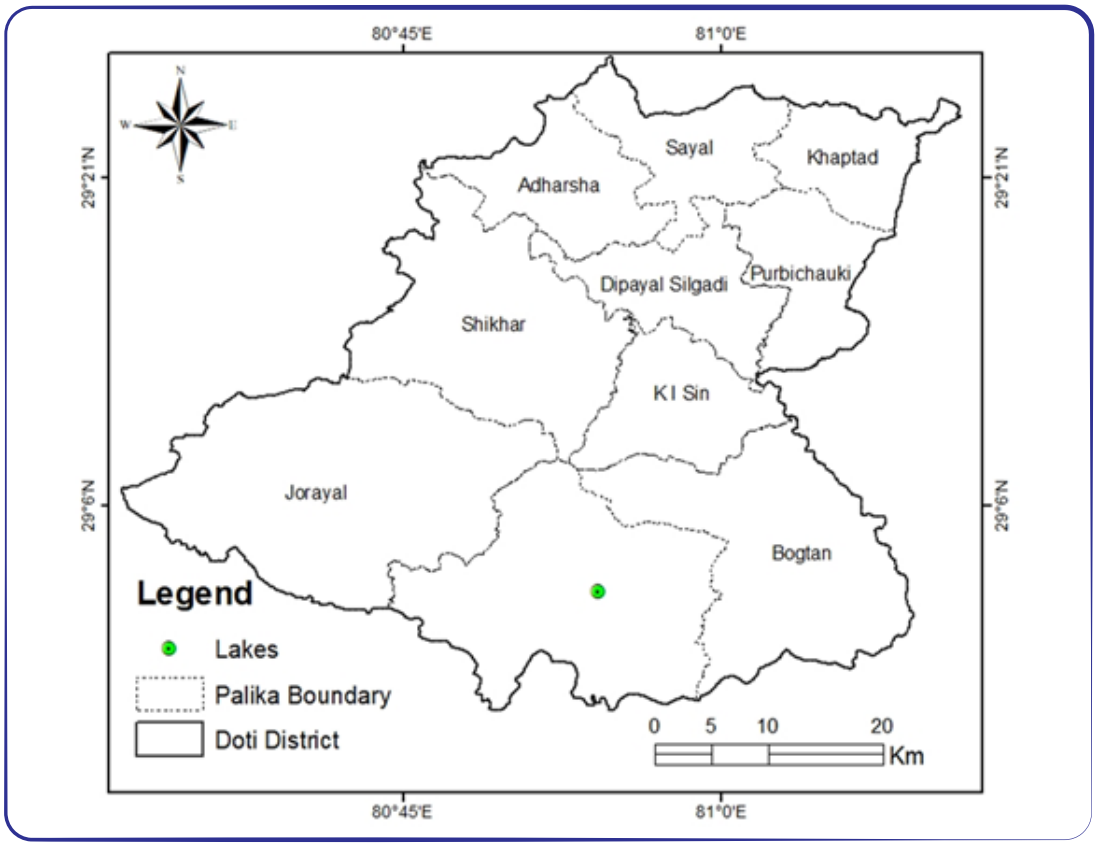

Figure 10-10| *Spatial distribution of lakes in Doti district*

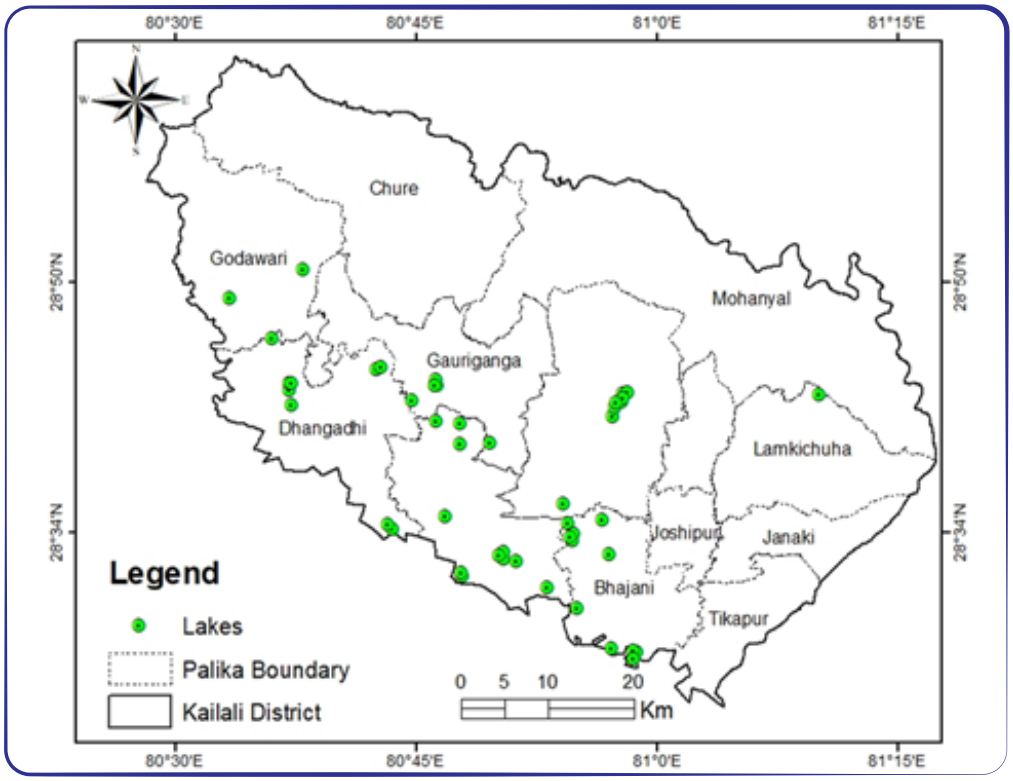

Figure 10-11 | *Spatial distribution of lakes in Kailali district*

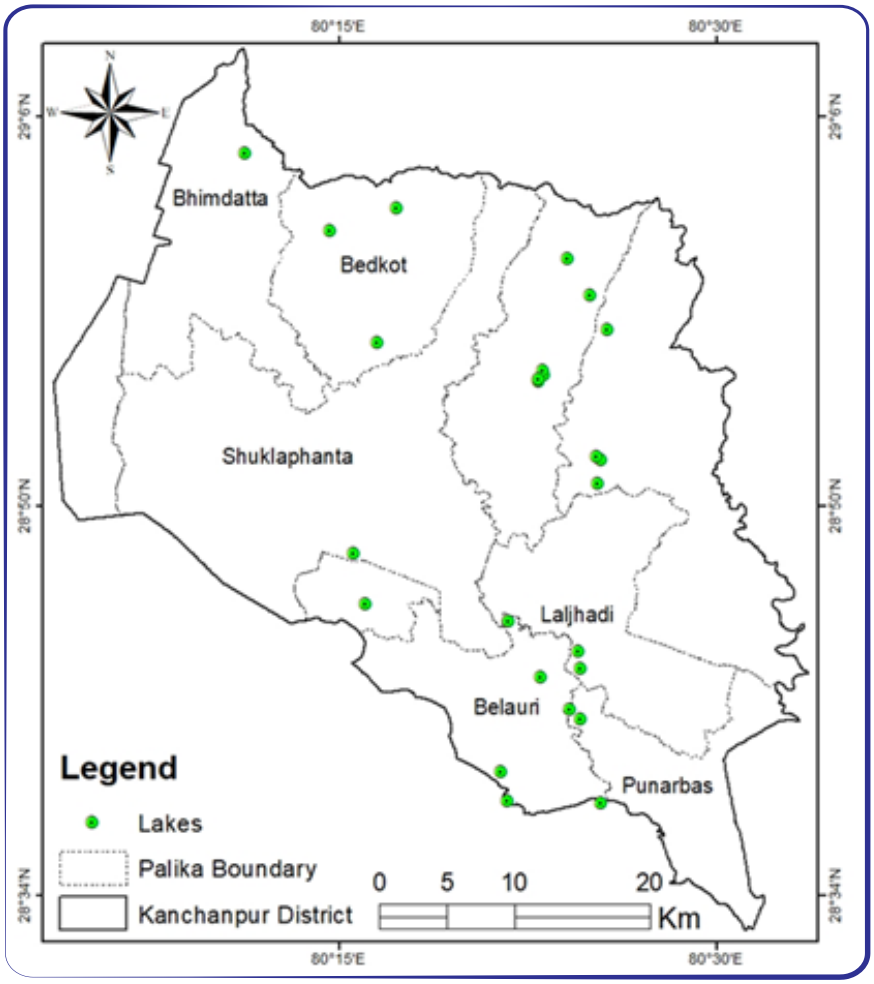

Figure 10-12 | *Spatial distribution of lakes in Kanchanpur district*

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