Mapping Water Sources in Godawari Municipality With Geographic Information System (GIS)

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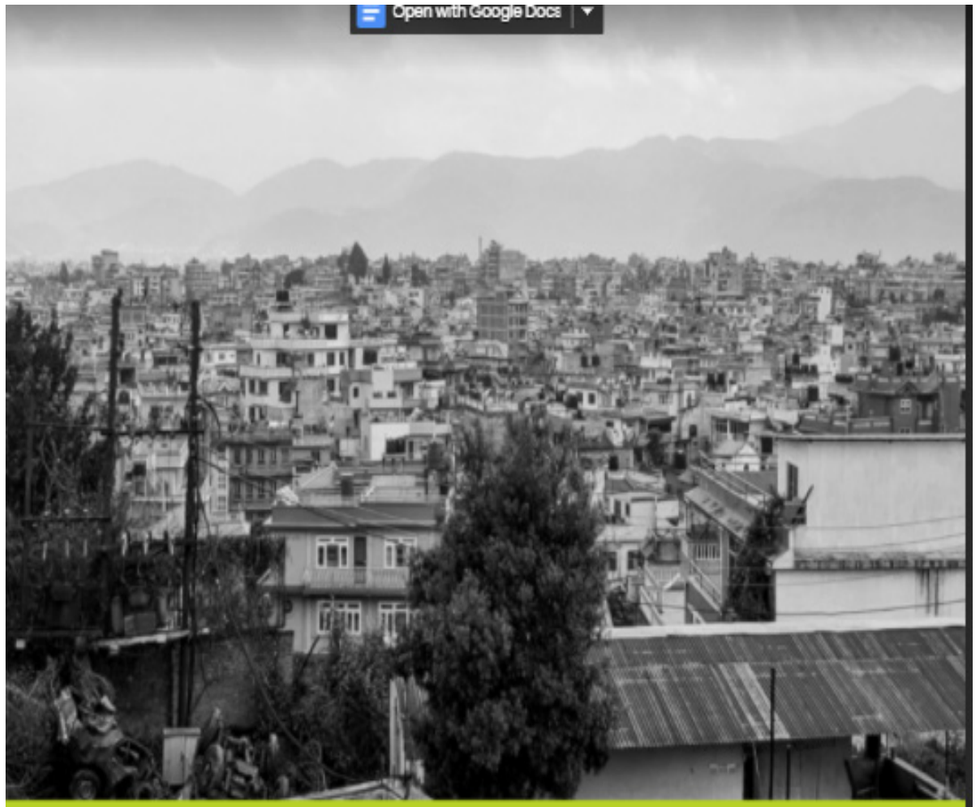
IUWM Project Description

Environment and Public Health Organization (ENPHO) in the partnership with BORDA is implementing a project 'Integrated Urban Water Management at the Center of Municipal Service' in Godawari and Kirtipur municipalities. The project aims to support municipalities and environmental service providers to improve the living conditions of all inhabitants, protect natural resources and develop livable inclusive cities. The first phase of the project had been completed in December 2020 and currently the joint venture has been continued through second phase of the same project for the year 2021.

The project envisions to support small and medium towns for improving municipal water and sanitation services to be provided to disadvantaged citizens. The specific objectives of the project are:

- Improved infrastructure provision (Integrated/decentralized solutions as pilot demonstrations) and sustainable services delivery;
- Institutional and personnel capacity strengthening of municipalities;
- Improving the systems, guidelines, and standards to introduce integrated/ decentralized water and sanitation solutions;
- Advocating the water and sanitation agenda of small municipality and the decentralized and integrated approach.



I U W M

Integrated Urban Water Management

RAPID ASSESSMENT

GODAWARI • NEPAL

ENPHO

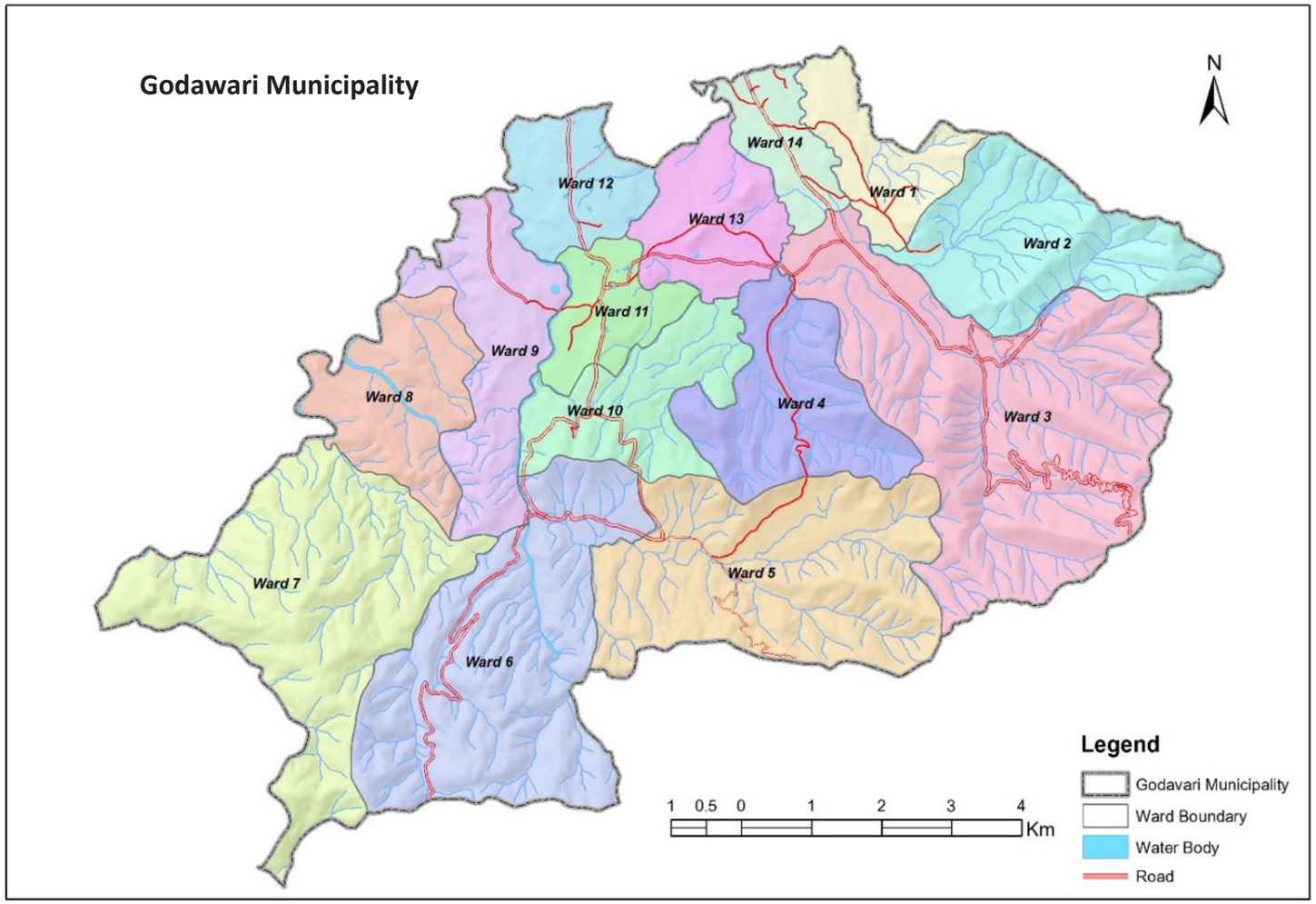
BORDA

City Profile

Godawari Municipality is located in Lalitpur district of Bagmati Province. This municipality has been formed merging former 12 VDCs- Godamchaur, Vishankhunarayan, Godawari, Badikhel, Lele, Devichaur, Dukuchap, Chhampi, Chapagaon, Thecho, Jharuvarasi on 10 March 2017 (27 Falgun 2073 B.S.). The municipality boundaries include Konjyosom Rural Municipality and Kavrepalanchok district in the east, Makwanpur district, Lalitpur municipality and Kathmandu district in the west, and Lalitpur and Mahalaxmi municipality in the north and Konjyosom and Bagmati Rural municipality in the south. It extends to 85^0 15' 8" °E longitude to 85^0 24' 57" °E longitude and 27^0 31' 40" °N latitude to 27° 38' 57" °N.

Godawari municipality is located in the southern part of Lalitpur district, encompassing a total area of 96.11 sq. km, which is divided into 14 wards. The municipality with temperate climate is in height of about 457 m to 2831 m from sea level.

According to census of 2011 AD, there are 39,715 male and 40,661 female populations residing in the municipality, whereas the population for 2077 BS (2021 AD) has been estimated to consist of 57,743 (49.8%) male and 58,302 (50.2%) female populations. The municipality has an average number of 4.8 family size with population density of 46.3 per sq. km. Regarding the ward level compositions, there are a total of 1,16,045 populations residing in 18,262 households with mix type of income status. Also, there are 657 commercial building, 40 government schools, 47 private schools, 133 government, I/NGOs and CBOs and 18 health centers in the municipality.



Kathmandu Upatyaka Khanepani Limited (KUKL) supplies water for three wards (ward 4, 10 and 14) using the available water sources in the municipality. Several other local Water Supply and Sanitation User's Committees manage water supply in the other wards of the municipality (Benchmarking Report of WSS design, Godawari). According to field survey conducted by ENPHO in 2021, 83 local water sources were identified which include 72 springs sources, 5 river intake, 4 underground sources and 2 stone spouts. The water supply coverage ranges from 74% to 98% and on average 85.53% coverage is done from six Water Supply System reported in the benchmarking report.

Map book

This map book is the compilation of Geographic Information System (GIS) maps of water sources available in Godawari Municipality. Each map consists of different attributes of 83 water sources available in the municipality such as geographical location, type, household coverage, flow system, road accessibility, vulnerability of natural hazards and presence/absence of coliform. Moreover, detail information is added for each map to make easy to understand. It also provides analytical view of collected data and highlights the use of maps for different purposes.

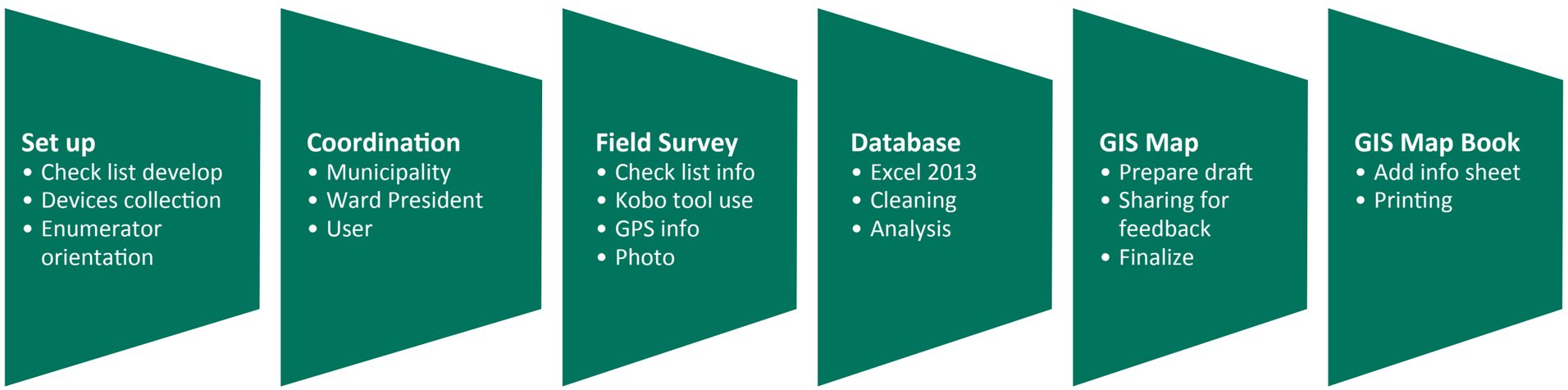
Objective

The objective of this document is to present the standardized spatial Geographic Information System (GIS) maps of water sources in Godawari Municipality to different actors - municipality, Drinking Water Supply and Sanitation Division Office (DWSSDO), Kathmandu Upatyaka Khanepani Limited (KUKL) as well as non-government organization and community-based organization to support in planning and executing the projects on drinking water management in future.

Steps Applied

A rigorous process was followed to create a database of the various types of water resources present in the Godawari municipality. The details of the process are as follows:

- **Set up:** A set of the checklist was prepared to collect the basic information of local water sources like discharge rate, water quality, number of user committees, serving households, accessibility, vulnerability, etc. and oriented the enumerators for collecting data using the checklist and devices like GPS, measuring cylinders, P/A vial, etc.
- **Coordination:** A preliminary consultation was carried out with key stakeholders, municipal staff, and ward representatives to share the survey information, its objective, and the necessary coordination support during the process.
- **Field survey:** Field survey was conducted for each drinking water source present in the municipality and the necessary data was collected using checklist and GPS devices. Collected data was uploaded in the server for further processing.
- **Create database:** The collected data was then collated and refined with the help of GIS software and coding to generate different attributes associated with each water source.
- **GIS map generation:** Standard spatial view in the form of Geographic Information System (GIS) maps was generated using Arc GIS V10.4 software for separate attributes in each map to make them more comprehensible. Specific legends were used to show the status of each drinking water source in regard to different attributes. Altogether seven GIS maps have been developed; namely water source location, type of water sources, household coverage and reservoir capacity, presence/absence of coliform in water sources, the vulnerability of natural hazard on the water sources, road access to the water source, and flow system of water sources.
- **Develop GIS map book:** A map book is developed with the descriptions of each map about the i. Background ii. Data analytical and iii. Application of map. This map book guides the readers to understand the map and apply that information while designing and implementing water-related projects.



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Background

Godawari municipality is enriched with many water sources spread across in 14 wards. As per the location, the water sources are distributed unevenly in different wards and 8 out of 14 wards have lesser number of water sources than average making them rely on the water sources from other wards to meet water demand.

Data Analysis

Godawari municipality is rich in water sources with 83 identified various water sources. Among the 14 wards of the municipality, the ward number 6 has 19 water sources, mostly being spring water source and river intakes. As per the data, there is no water sources assessed in the ward number 11, 12 and 14. There are two water sources available at each ward number 1 and 9. Those wards which have no water source or have limited sources need to fetch water from neighboring wards to meet the water demands. Moreover, there are also the distribution lines of KUKL in adjoining areas of Lalitpur Metropolitan City; Satdobato area to ensure that the locality gets sufficient water.

Locationwise, stone spouts exist in wards 8 and 9 while river intakes only in ward 6 of the municipality. Similarly, underground water sources are found in the ward number 9, 10, and 13. All the sources are perennial with 96% irregular water flow in sources.

Application of the Map 1

This map presents the location of water sources in different wards and can be used to develop and implement projects and plans related to water supply schemes, establish new water sources; deep boring, water source protection as well as developing a municipal annual plan on the water section.

Figure 1: Spring source in Godawari Municipality

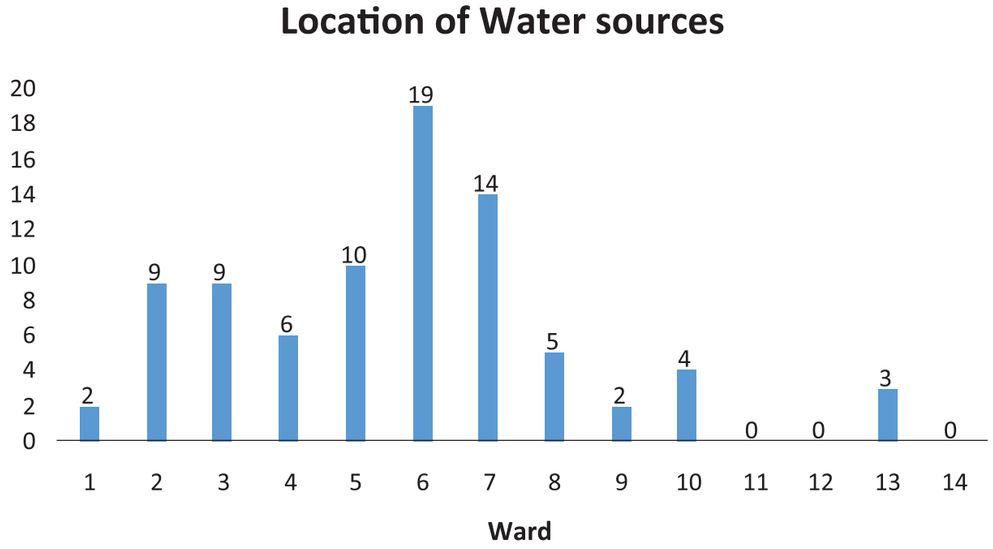
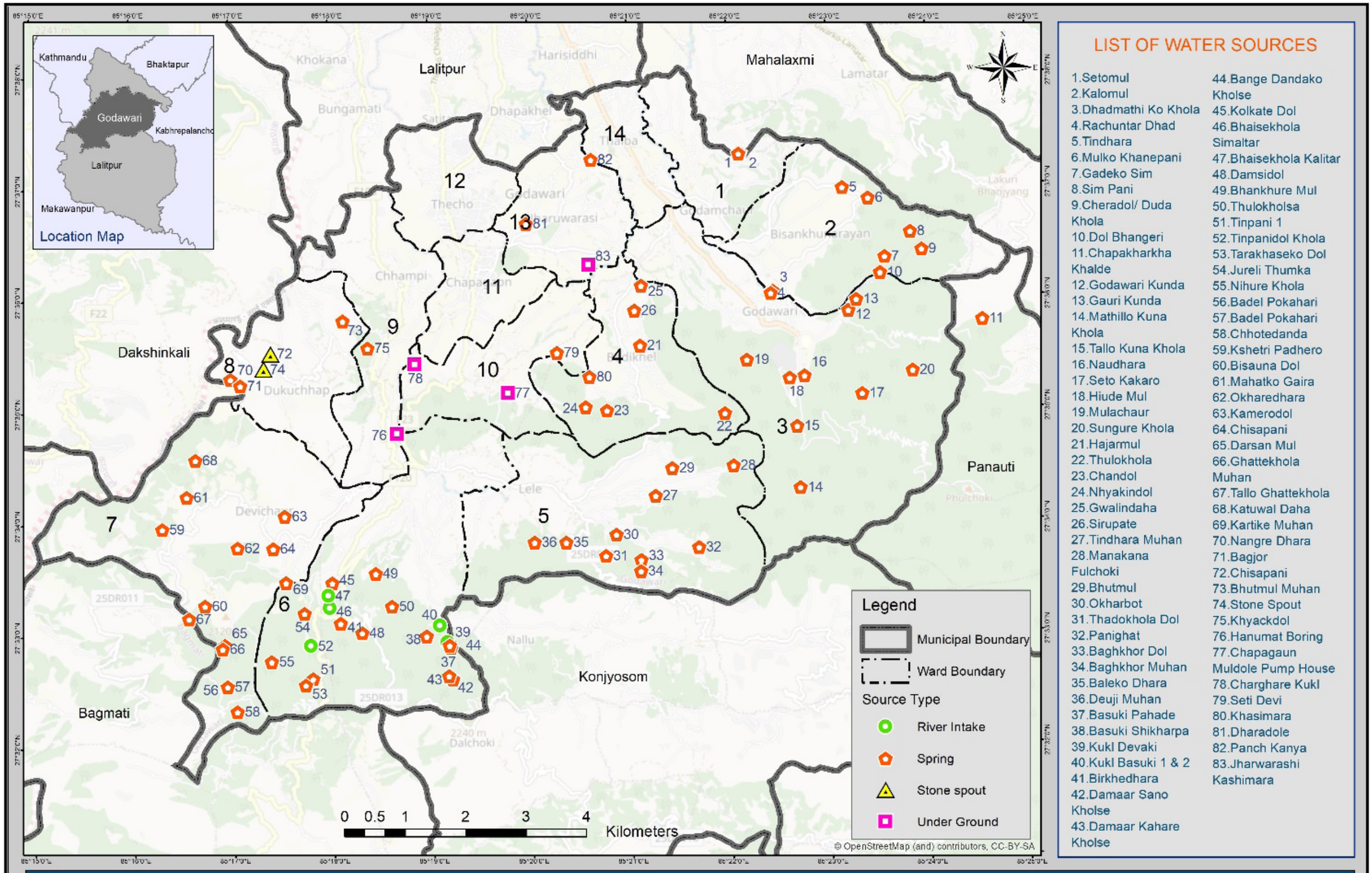


Chart 1: Location of water sources



LIST OF WATER SOURCES

1.Setomul
2.Kalomul
3.Dhadmathi Ko Khola
4.Rachuntar Dhad
5.Tindhara
6.Mulko Khanepani
7.Gadeko Sim
8.Sim Pani
9.Cheradol/ Duda Khola
10.Dol Bhangeri
11.Chapakharkha Khalde
12.Godawari Kunda
13.Gauri Kunda
14.Mathillo Kuna Khola
15.Tallo Kuna Khola
16.Naudhara
17.Seto Kakaro
18.Hiude Mul
19.Mulachaur
20.Sungure Khola
21.Hajarmul
22.Thulokhola
23.Chandol
24.Nhyakindol
25.Gwalindaha
26.Sirupate
27.Tindhara Muhan
28.Manakana Fulchoki
29.Bhutmul
30.Okharbot
31.Thadokhola Dol
32.Panighat
33.Baghkhor Dol
34.Baghkhor Muhan
35.Baleko Dhara
36.Deuji Muhan
37.Basuki Pahade
38.Basuki Shikharpa
39.Kukl Devaki
40.Kukl Basuki 1 & 2
41.Birkhedhara
42.Damaar Sano Kholse
43.Damaar Kahare Kholse
44.Bange Dandako Kholse
45.Kolkate Dol
46.Bhaisekhola Simaltar
47.Bhaisekhola Kalitar
48.Damsidol
49.Bhankhure Mul
50.Thulokholsa
51.Tinpani 1
52.Tinpanidol Khola
53.Tarakhaseko Dol
54.Jureli Thumka
55.Nihure Khola
56.Badel Pokahari
57.Badel Pokahari
58.Chhotedanda
59.Kshetri Padhero
60.Bisauna Dol
61.Mahatko Gaira
62.Okharedhara
63.Kamerodol
64.Chisapani
65.Darsan Mul
66.Ghattekhola Muhan
67.Tallo Ghattekhola
68.Katuwal Daha
69.Kartike Muhan
70.Nangre Dhara
71.Bagjor
72.Chisapani
73.Bhutmul Muhan
74.Stone Spout
75.Khyackdol
76.Hanumat Boring
77.Chapagaun Muldole Pump House
78.Charghare Kukl
79.Seti Devi
80.Khasimara
81.Dharadole
82.Panch Kanya
83.Jharwarashi Kashimara

Map 1

Water Source Location

Godawari Municipality, Bagmati Province

Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
Data Source: Field Survey
May, 2021

Map 2: Types of water sources in ward

Background

Godawari municipality is enriched with many water sources, mostly being spring sources. Thus, the municipality has also been serving neighboring municipalities with its drinking water source. The municipality has four types of water sources: spring, underground, stone spout, and river intake) of water sources spread across it 14 wards.

Spring Source: A spring source is a water resource formed when the side of a hill, a valley bottom, or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water.
Underground Source: Groundwater is the water found underground in the cracks and spaces in soil, sand, and rock. It is stored in and moves slowly through geologic formations of soil, sand, and rocks called aquifers.
Stone Spout: Stone spout '*Dhunge dhara*' is a traditional stone drinking fountain found in Nepal. It is an intricately carved stone waterway through which water flows uninterrupted from underground sources.
River Intake: It is the structure constructed to withdraw water from the nearby river. Usually, it is constructed when the water is required in large amounts for a large community. River intakes are located in such a way that even during the low water level, water remains available at the intake in sufficient quantity.
Water supply user committee: A group of people registered legally in local authority for the regular operation and maintenance of specific water supply scheme.

Figure 2: Deuji Muhan Spring Source

Data Analysis

Among four different types of water sources, spring water sources accounts for 87%, river intake for 6%, underground water sources for 5%, and stone spouts for 2% of the existing water sources. (Refer *Chart 2: Water sources*)

An intake is constructed nearby water source, then the water is collected into the reservoir tanks and supplied to the households. Water Supply User Committee has been established to provide water to every household in the community. There are 62 water and sanitation user committees (WSUCs) for 70 water sources within Godawari Municipality but non formal committees are available for the 13 water sources; however, water is being consumed by the residents even without their formal registration. Also, 12 WSUCs are using multiple water sources to meet their water demands.

Usually, water sources are protected from landslides, mudslides, and also from animal encroachment with fenced wires, so no animals could pollute the water source. An example spring source is shown in *Figure 2: Spring Source.*

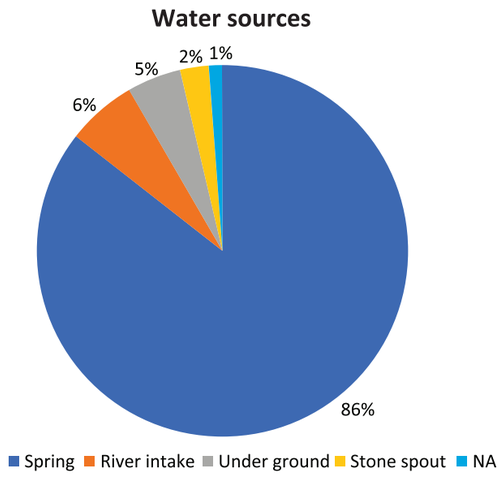


Chart 2: Water Sources

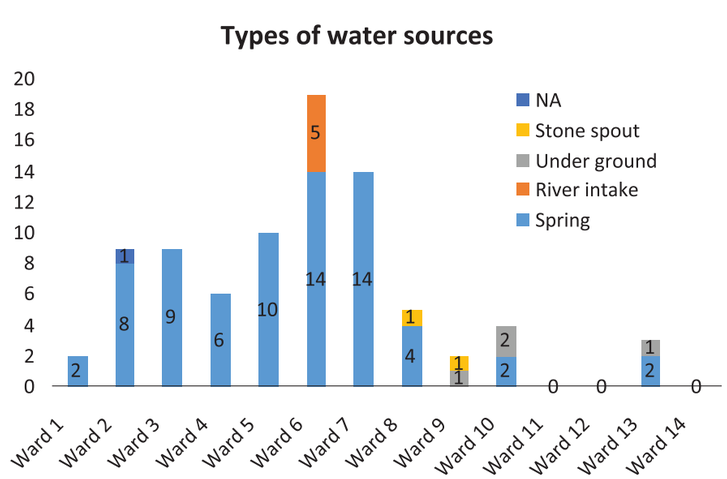
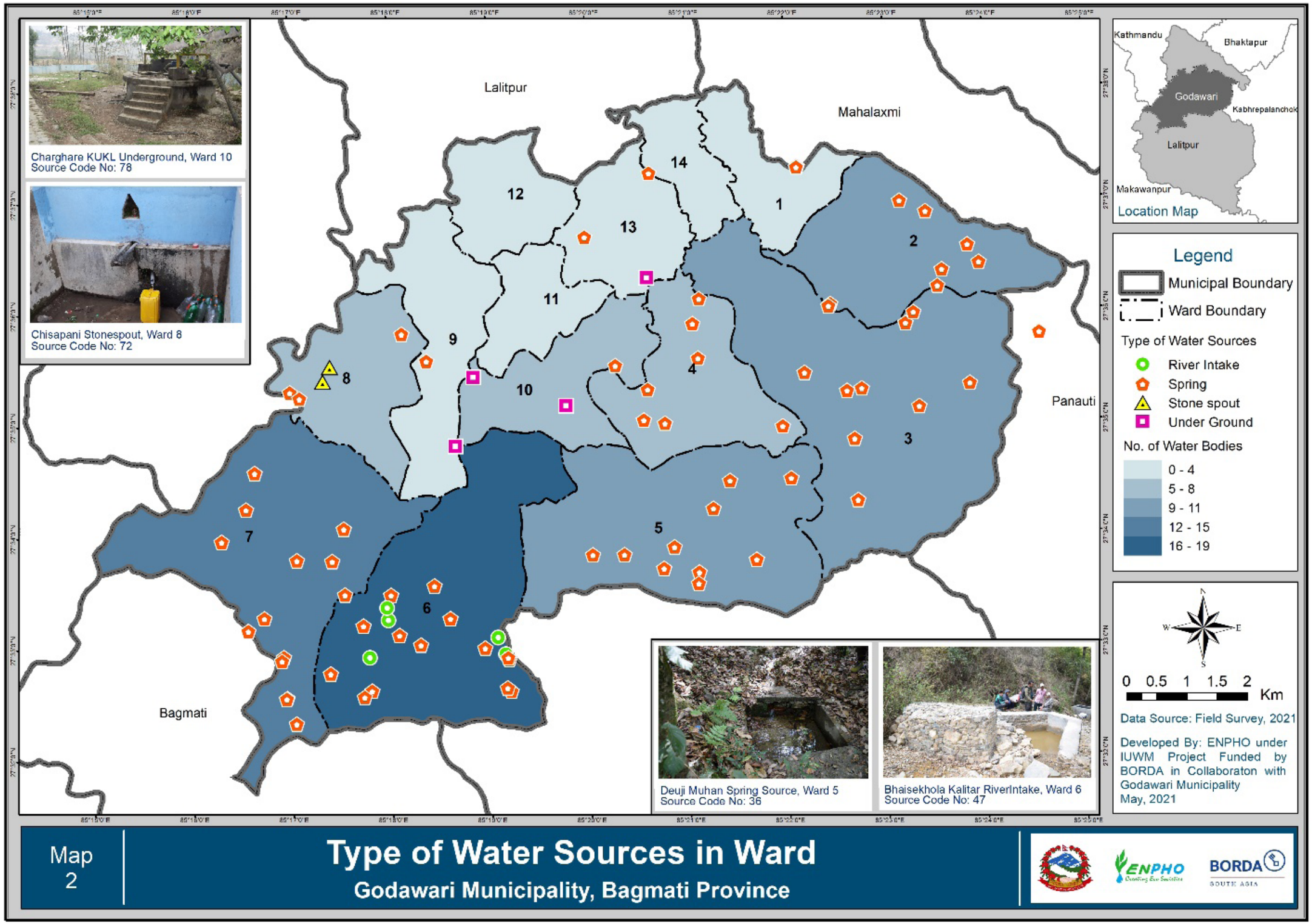


Chart 3: Types of water sources

Application of Map 2

This map can be used to assess different types of water source available in a particular locality and to design the water supply system from it. The map depicts that due to the presence of a large number of water sources in wards 2, 3, 5, 6, and 7, planning water supply system in these wards will be comparably easier. Similarly, the construction cost for the reservoirs and pipeline construction will be minimum in the wards 6 and 7 as the water sources are located nearby the communities. But, the construction cost might be higher in wards 11, 12, 13 and 14, as the water sources are observed to be farther from the communities.


Charghare KUKL Underground, Ward 10
Source Code No: 78
Chisapani Stonespout, Ward 8
Source Code No: 72
Lalitpur
Mahalaxmi
Panauti
Bagmati
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Kathmandu
Bhaktapur
Godawari
Kabhrepalanchok
Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Type of Water Sources
River Intake
Spring
Stone spout
Under Ground
No. of Water Bodies
0 - 4
5 - 8
9 - 11
12 - 15
16 - 19
0 0.5 1 1.5 2
Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
May, 2021
Deuji Muhan Spring Source, Ward 5
Source Code No: 36
Bhaisekhola Kalitar RiverIntake, Ward 6
Source Code No: 47
Map 2
Type of Water Sources in Ward
Godawari Municipality, Bagmati Province
ENPHO
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Map 3: Household Coverage and Water Reservoir Capacity

Background

Even though water sources in Godawari Municipality are perennial, the water flow is irregular during the dry phase of the year. The assessment conducted by ENPHO in April 2021 shows that water discharge from the sources ranges from 0.05-24.16 liter per second. Due to the irregularity in water flow, the WSUCs have constructed reservoir tanks for continuous water supply throughout the year. The reservoir tanks are constructed depending on the communities' water demand, distance from source to beneficiaries' household or community and household coverage. The reservoir tanks (overhead, ground, semi-ground and underground) are constructed based on the availability of land.

Data Analysis

Out of 83 water sources, 13 are being operated without the formal water supply committee among which 7 sources have at least 1 reservoir tank while 6 do not have any. Similarly, out of 62 water supply users' committees, 54 have at least one reservoir tank while 8 do not have any. The beneficiaries of these reservoir tanks are categorized as per their capacity which is shown in table 1.

Table 1: Beneficiaries from reservoir tank

Reservoir tank Capacity (in Ltr.)	Beneficiaries (HHs)	
	Minimum	Maximum
0 to 50000	17	1500
50001 to 200000	58	1400
200001 to 500000	200	1500
500001 to 1000000	320	700
1000001 to 5000000	177	900

Irrespective of the capacity of reservoir tanks, the minimum beneficiaries being served at the municipality ranged from 17-320 HHs. Similarly, the maximum number of beneficiaries being served irrespective of the capacities of the reservoir tanks ranges from 700-1500 HHs at the municipality. Interestingly, both 50,000- liter reservoir tanks and tanks that range from 2-5 lakhs capacity serve a maximum of 1500 HHs.

Out of 89 reservoir tanks, 34 are grounded reservoir tanks, 26 semi-grounded, 19 underground, and one is overhead reservoir tank among the registered user's committee. Whereas a total of 9 water sources has been identified with no users committee with different reservoir types, among which majority (7) are grounded tanks. (*Chart 4: Types of reservoir tank in Godawari Municipality).*

Application of Map 3

This map will be helpful to plan the construction of new reservoir tanks that would benefit the larger group of populations. The map is also beneficial to plan for water storage in different forms of reservoir tanks to those wards where the sources are limited. Also, the map will be supportive to interpret the efficiency of household coverage and the reservoir tank's capacity, to ensure the communities receives a sufficient amount of water from their water supply schemes.

Figure 3: Ground Reservoir tank

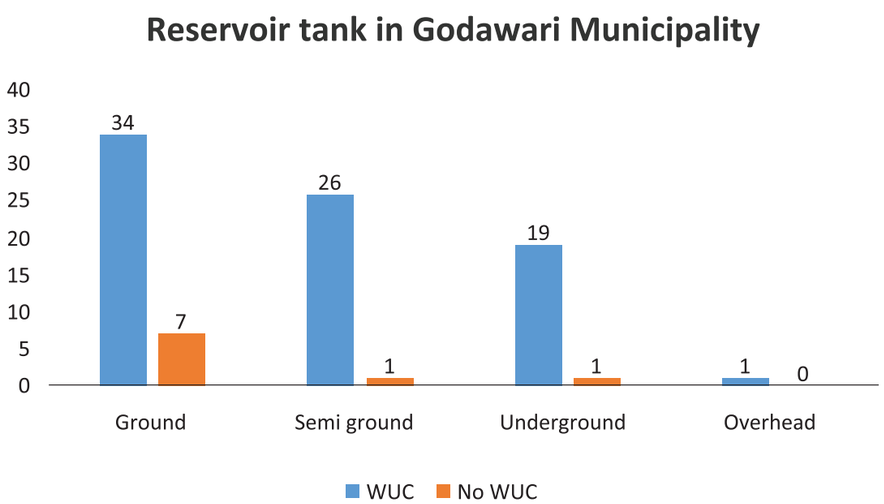
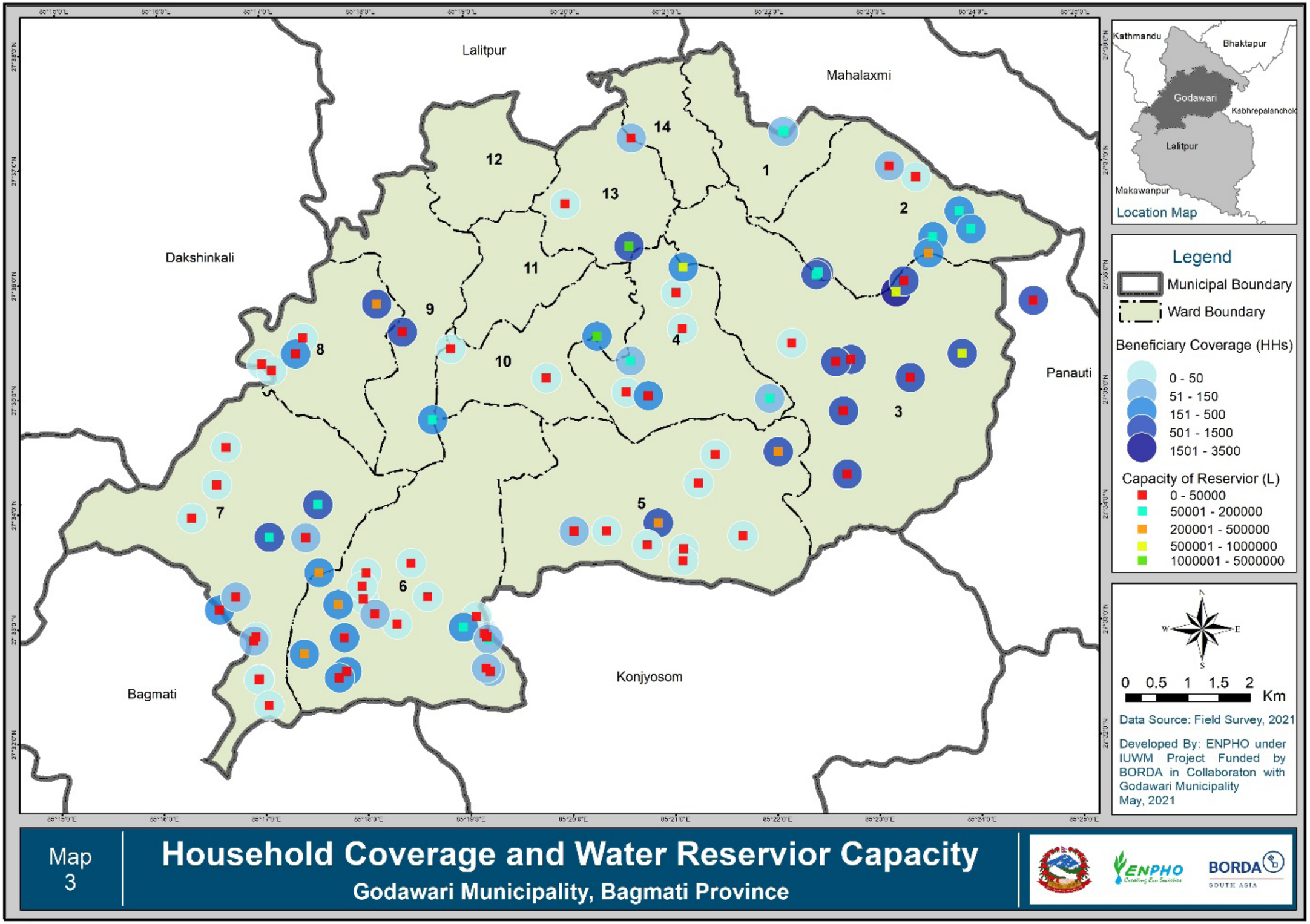


Chart 4: Types of reservoir tank in Godawari Municipality


Lalitpur
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Panauti
Bagmati
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Bhaktapur
Godawari
Kabhrepalanchok
Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Beneficiary Coverage (HHs)
0 - 50
51 - 150
151 - 500
501 - 1500
1501 - 3500
Capacity of Reservior (L)
0 - 50000
50001 - 200000
200001 - 500000
500001 - 1000000
1000001 - 5000000
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Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
May, 2021
Map 3
Household Coverage and Water Reservior Capacity
Godawari Municipality, Bagmati Province
ENPHO
BORDA
SOUTH ASIA

Map 4: Presence/Absence of Coliform in Water Source

Background

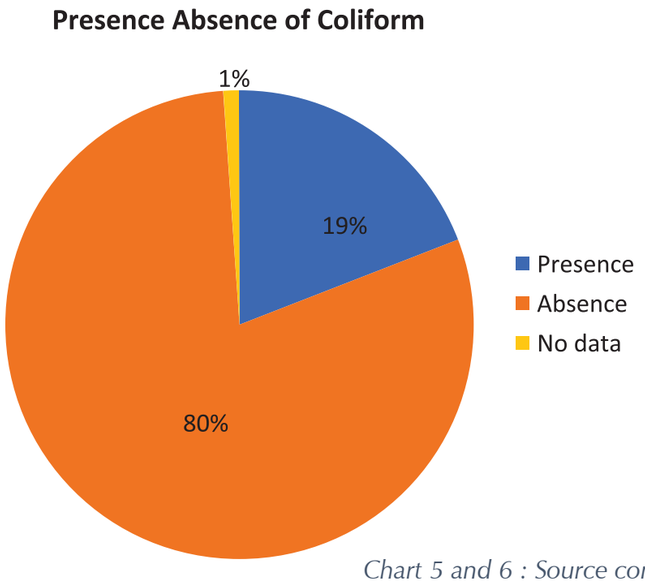
Water supply systems are required to deliver safe and reliable drinking water to the community throughout the year. If the water sources are contaminated, the probability of the spread of water-borne diseases in the community increases. Thus, the water supply user's committee has to take many preventive steps to ensure that the water being supplied is safe and reliable. To assess the safety of water sources and to identify safe and fecal contamination-free sources, ENPHO conducted presence/absence vial test during an assessment in April 2021.

Coliform Presence/Absence (P/A) Vial is used for the qualitative detection of fecal contamination in drinking water. It has been used by different national and international agencies for water quality testing. If the water sample contains any form of fecal contamination, the water color would turn black within 48 hours of retention time at room temperature. If there is no contamination, the vial would remain colorless, indicating there is an absence of coliform.

Figure 4: Results of presence absence vial

Data Analysis

A majority (80%) of the water samples collected for the P/A vial test reported having an absence of any fecal contamination, while 19% of water samples collected from the source are found contaminated with coliform, whereas data for the rest of the water sample (1%) is not available. Among the contaminated water sources, the majority of the samples from spring sources (94%) followed by river intakes (6%) were found to be contaminated. Spring sources from wards. 2, 4, 5, 6, 7, 10, and 13 and river intake from ward 6 showed evidence of coliform contamination. Whereas, no contamination was found among the samples received from underground sources and stone spout sources during the assessment.



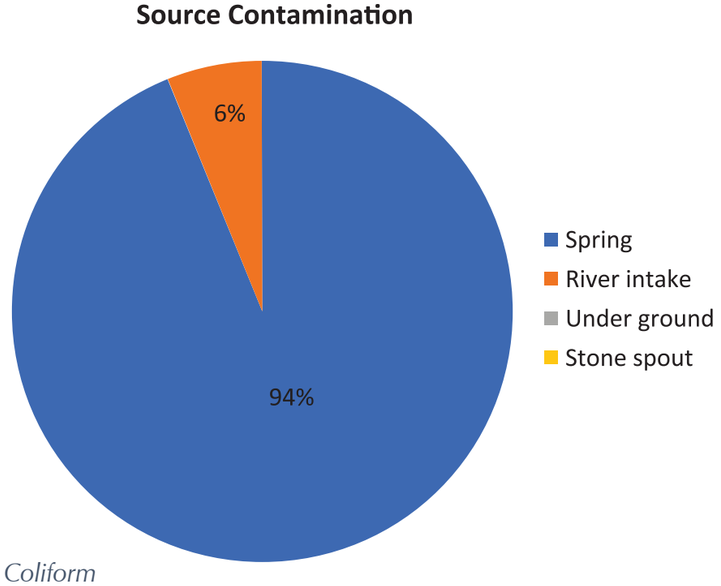
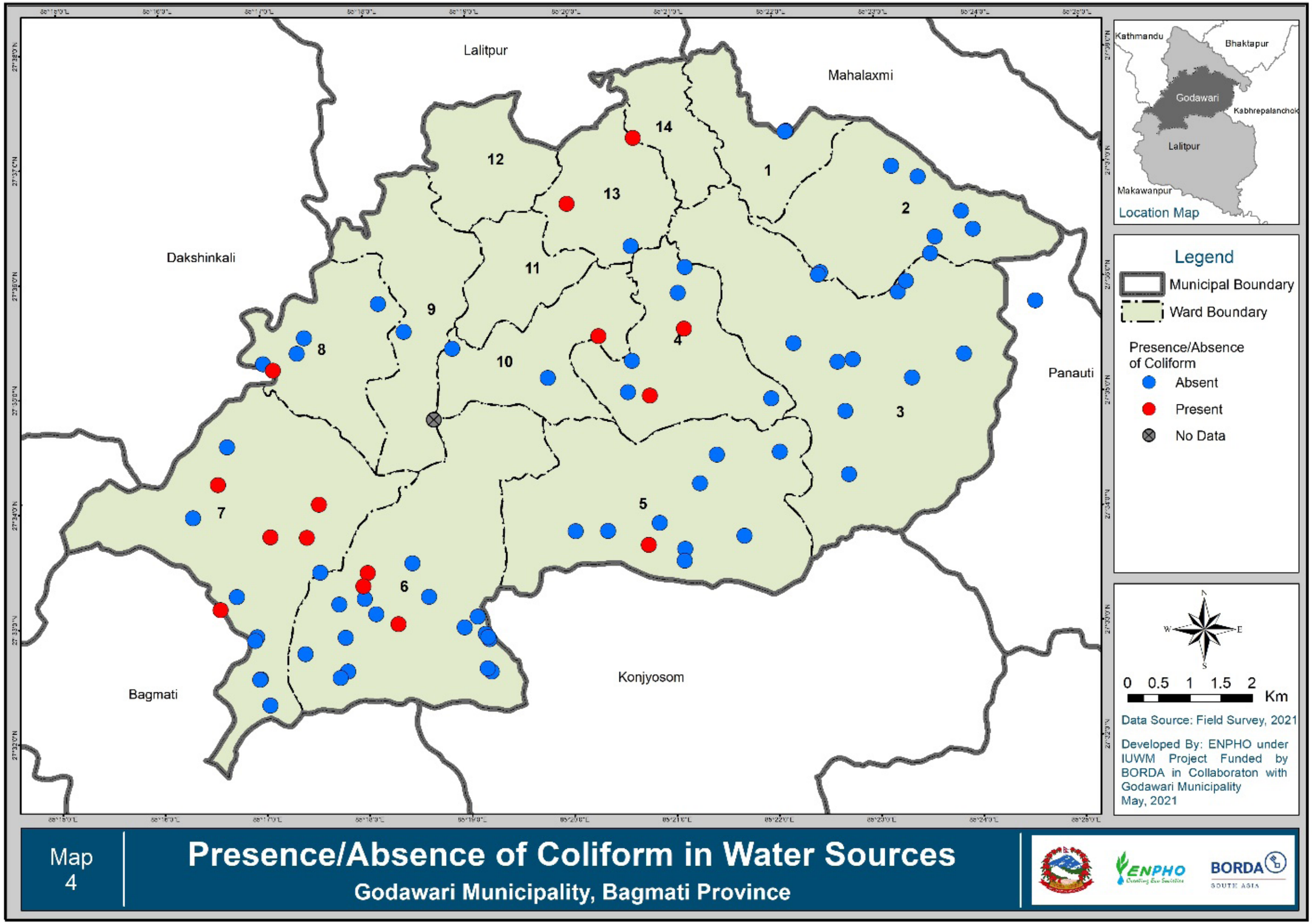


Chart 5 and 6 : Source contaminated by Coliform

Application of Map 4

The map is beneficial to locate the safe and unsafe water sources before conducting any preventives measures at the sources. The map indicates the water resources and associated water supply systems which need proper water treatment mechanism in place. This map is also helpful to the stakeholders for the proper implementation of the water safety plan for the mentioned sources.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Panauti
Bagmati
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Kathmandu
Bhaktapur
Godawari
Kabhrepalanchok
Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Presence/Absence of Coliform
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Present
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Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
May, 2021
Map 4
Presence/Absence of Coliform in Water Sources
Godawari Municipality, Bagmati Province
ENPHO
BORDA
SOUTH ASIA

Map 5: Vulnerability of Natural Hazards on Water Sources

Background

Nepal is prone to multiple hazards, which creates a multitude of disasters throughout the country. These disasters claim a large number of lives and cause significant economic loss every year. The geography, geological position, and the impact of climate change are the primary causes of disasters. The rapid and unplanned urbanization, environmental degradation, variations in rainfall, different types of disasters, and inadequate understanding of disaster risk management have further intensified the disaster risk in Nepal. Aftermath of disasters results in repeated loss of lives and huge financial losses.

Figure 5: Landslide affecting the pipelines from water sources

Data Analysis

Water sources in Godawari Municipality also have the risk of flood, landslide and mudslide. Altogether, 48 water sources including 44 spring sources, 2 stone spouts and 2 underground sources are in the risk of mud/landslide. Similarly, 45 water sources (37 spring, 6 river intake, 2 underground) are in the risk of flood, and 8 spring water sources are in the risk of both flood and landslides. Flood incidents are more apparent in wards 3, 4, 5, 6, 7 and 9 of Godawari Municipality. Whereas, landslides/mudslides occur in most of the wards except 4, 11, 12 and 14. Flood and landslide/mudslide is observed collectively in wards 4, 6, 7, and 13.

These disasters carry away the intake structures and the distribution pipelines. Sometimes, it pollutes the water sources (usually during monsoon season). The user's committee clean the water sources once to twice a year after the monsoon.

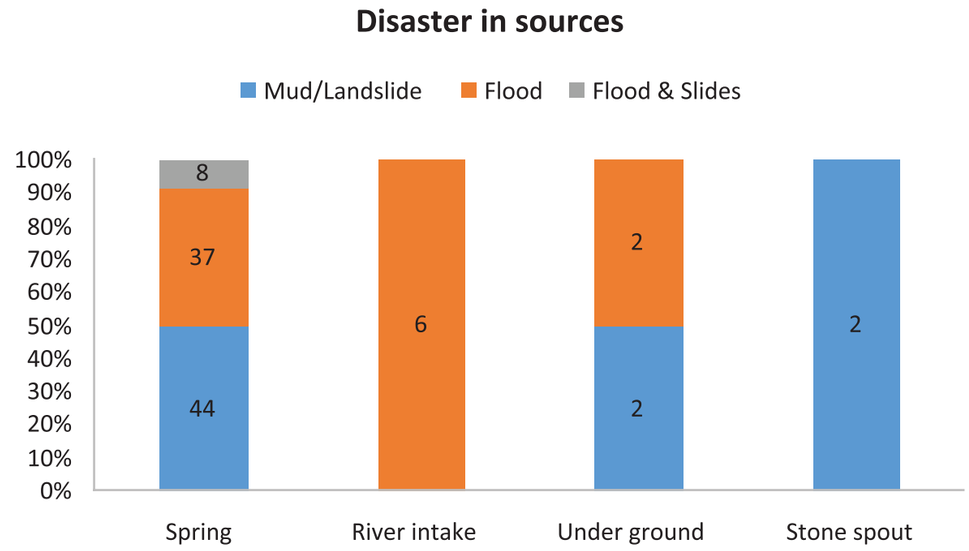


Chart 6: Disaster in sources

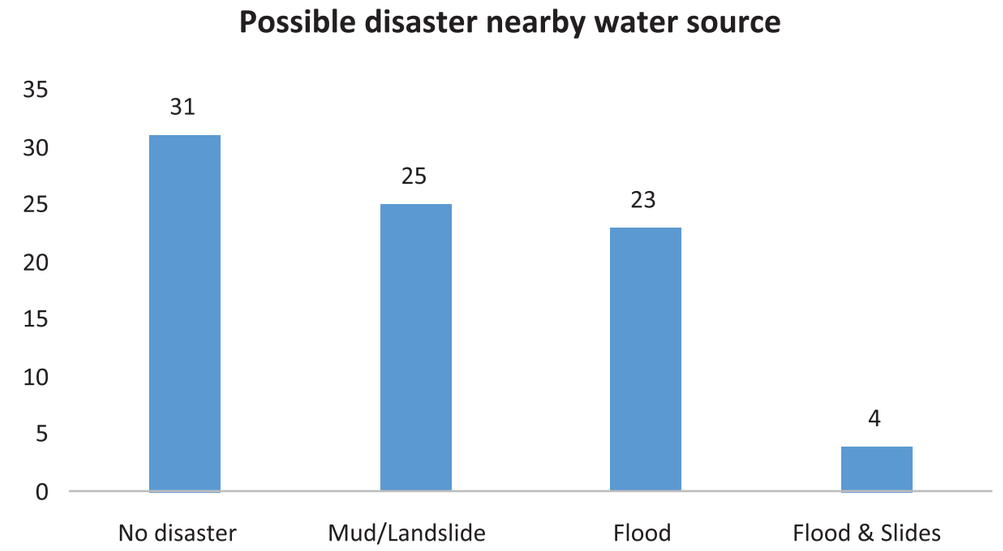
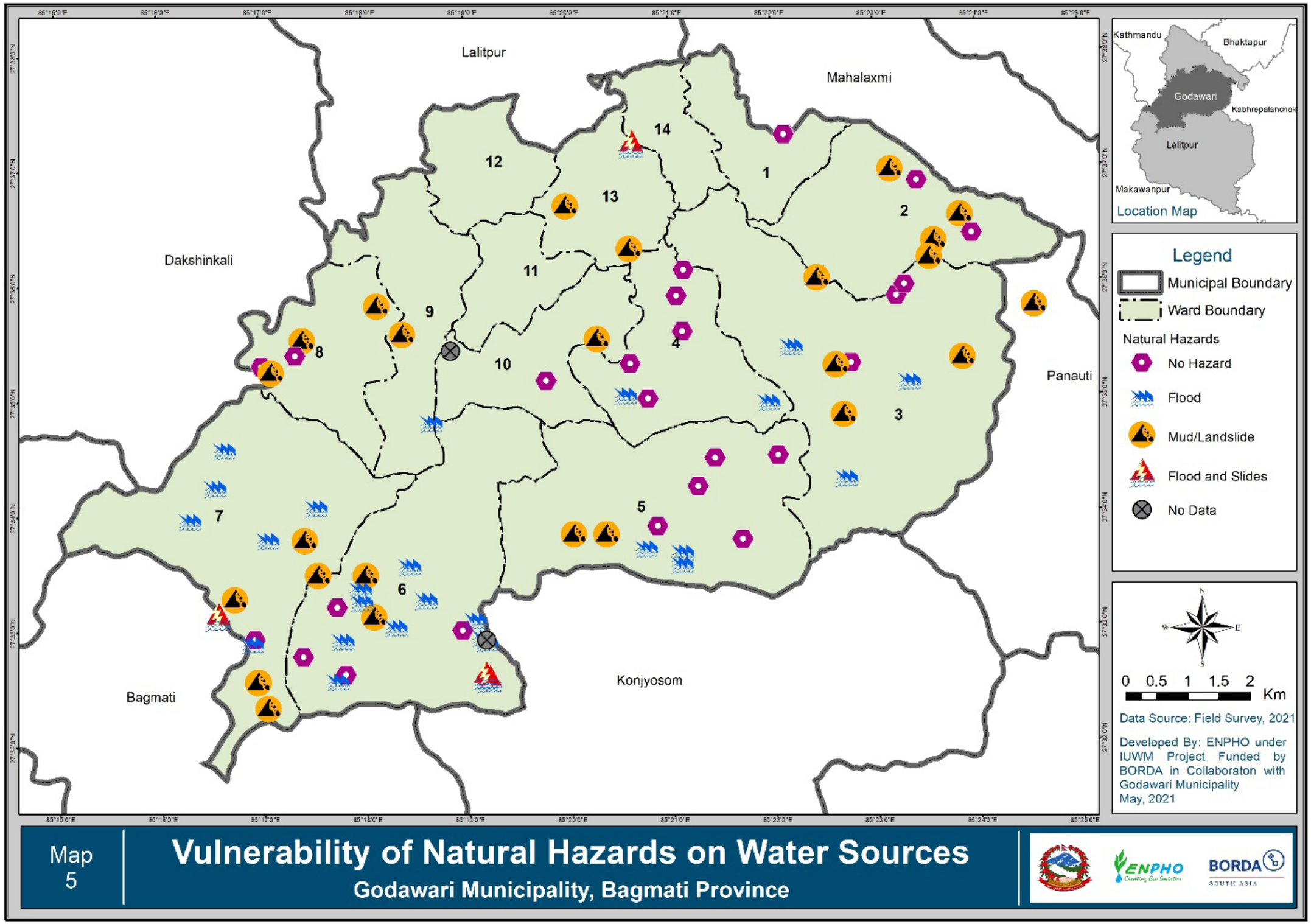


Chart 7: Disaster nearby sources

Application of Map 5

This map intends to show disaster incidences that have occurred near the water sources in Godawari Municipality. This map will help the planning team analyze all the vulnerabilities and risks associated with the disasters and around the water sources. Overall, the map will help to assess the vulnerability, prepare and minimize the damages. Thus, the map will be used in the decision-making process of the policymakers, researchers, municipality for future planning.


Lalitpur
Mahalaxmi
Dakshinkali
Panauti
Bagmati
Konjyosom
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Bhaktapur
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Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Natural Hazards
No Hazard
Flood
Mud/Landslide
Flood and Slides
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0 0.5 1 1.5 2
Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
May, 2021
Map 5
Vulnerability of Natural Hazards on Water Sources
Godawari Municipality, Bagmati Province

Map 6: Road Accessibility to Water Sources

Background

All-weather road, earthen road, gravel road, and river-way are some road types to reach the water sources located at the nooks and corners of Godawari Municipality. Water sources are accessible through these roads.
All-weather road: All-weather Road is a road that is trafficable in all weather conditions. Typically, this means a road that is constructed in such a way that excessive rain does not cause it to be flooded or sodden to such an extent that vehicles traveling over it are likely to become bogged.
Gravel road: A gravel road is a type of unpaved road surfaced with gravel that has been brought to the site from a quarry or stream bed. They are common in less developed nations, and also in the rural areas of the developed nation.
Earthen road: Earthen roads are laid with soil. They are cheaper than all types of roads. This type of road is provided for fewer traffic areas or countryside areas.
River-way: the segment of a river or route on a river used for travelling. This route is difficult to use during the monsoon season due to higher flow.

Data Analysis

There are 35% all-weather roads which lead to 36 water sources of Godawari Municipality from wards 2, 3, 4, 5, 6, 7, and 13. There are 26% gravel roads which lead to 21 water sources from different wards 1, 3, 4, 5, 6, 7, 8, 9 and 10. There are 29% of the earthen roads which lead to 25 water sources from wards 2, 4, 5, 6, 9, 10 and 13. Water sources with earthen road are difficult to reach in the rainy season as the road is filled with slippery water and mud. There are also 4 water sources which are reached through riverway, which is the 5% among the road types available in Godawari Municipality to reach the water sources. Riverways are found in wards 3 and 7. These sources are difficult to reach during the monsoon season.

Application of Map 6

This road accessibility map of water sources within Godawari Municipality will be helpful for planning the project of water resources and other developmental activities nearby the water sources. The operation and maintenance work, water safety plan can be implemented and the moderate activities can be performed easily to access water sources (sources led by all-weather road and gravel road).

Figure 6: Contaminated intake

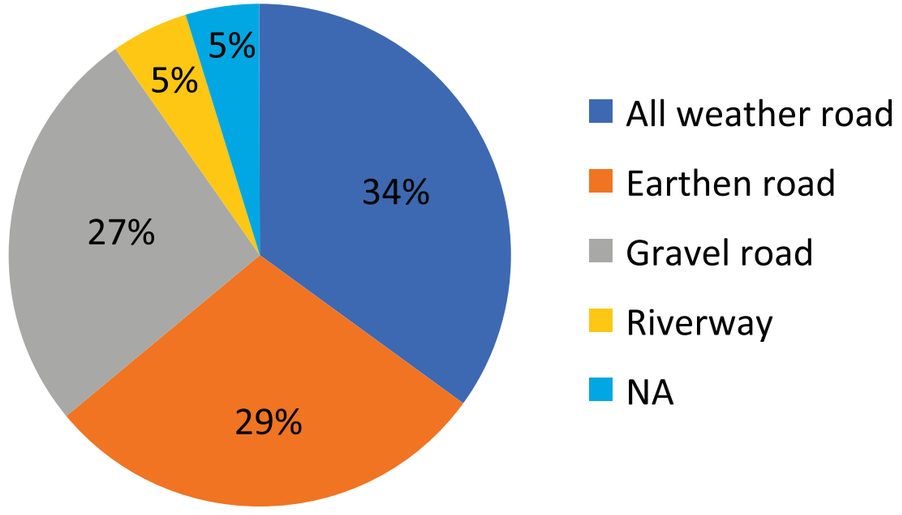
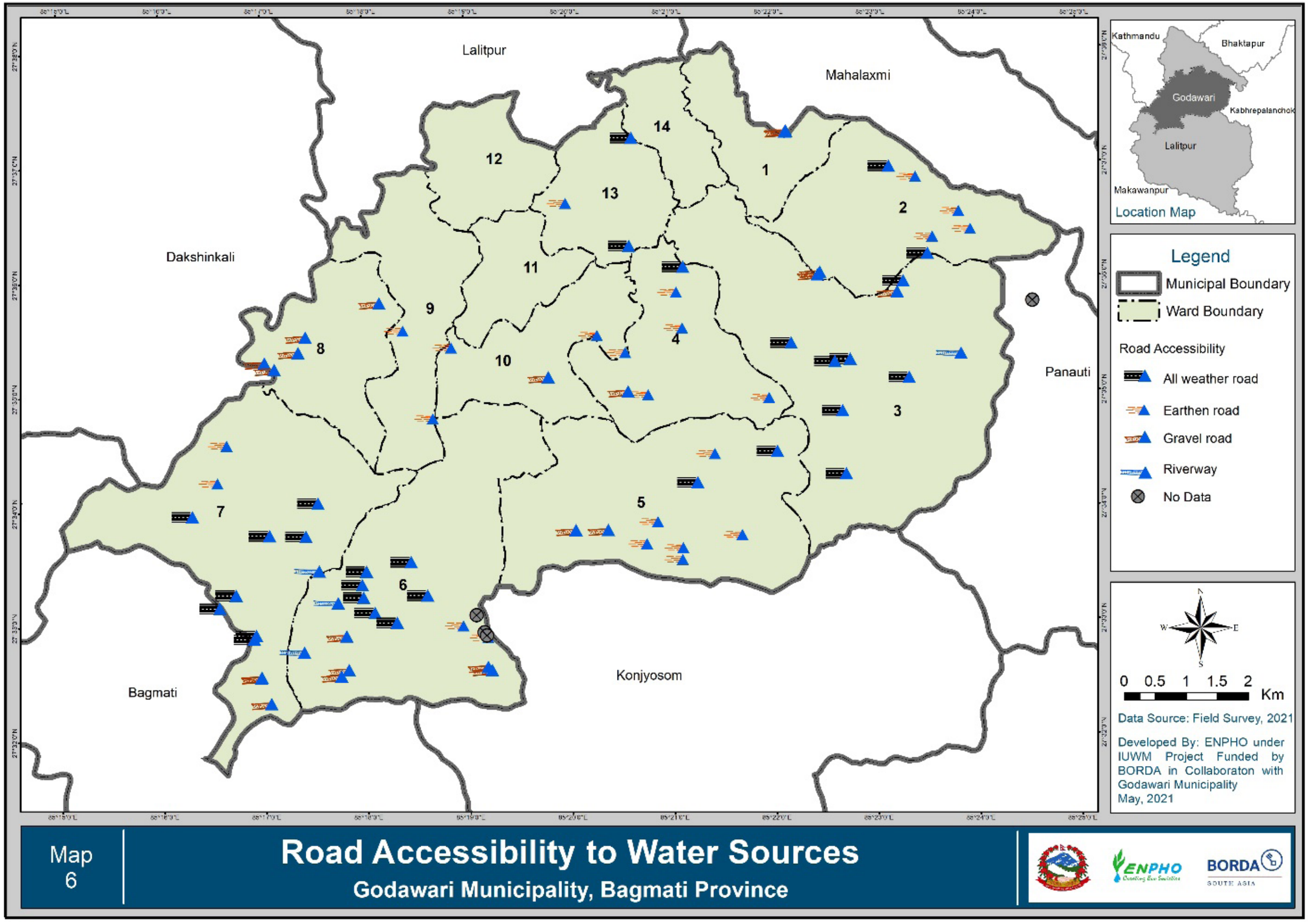


Chart 8: Road accessibility


Lalitpur
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Dakshinkali
Panauti
Bagmati
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Kathmandu
Bhaktapur
Godawari
Kabhrepalanchok
Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Road Accessibility
All weather road
Earthen road
Gravel road
Riverway
No Data
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0 0.5 1 1.5 2
Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
May, 2021
Map 6
Road Accessibility to Water Sources
Godawari Municipality, Bagmati Province
ENPHO
BORDA
SOUTH ASIA

Map 7: Flow System of Water Sources

Background

Gravity flow: This refers to the systems in which the water falls due to the forces of gravity, from a source above, to the end-users.
Lifting: When the source is located at the lower elevation and the service area is in higher elevation, water needs to be lifted through a mechanized lifting system to the height in order to provide it to the service area. Lifting devices can be used to raise groundwater, rainwater stored in an underground reservoir, river water, etc.

Even though the drinking water to rural communities in Nepal seems adequate both in terms of quantity and quality, it continues to be a challenge for the overall development. Many rural households still spend more than two hours per day in fetching water from the closest water source. Gravity flow systems have the advantage of gravity to transport water from a source to a service area located at a lower elevation and are the most popular and widespread in rural mid-hills of Nepal. From the intake, water is transported continuously by a transmission line to one or several storage tanks which is then supplied to the public and/or private tap stands.

Data Analysis

The water sources of the Godawari Municipality are located at different altitudes. Some are located at higher altitudes whereas some at lower altitudes. In the municipality, 76% of water sources have a gravity flow system, 12% have a lifting system, and 7% have both gravity flow system and lifting system. Ward 7 has the highest gravity flow systems among its water sources, all of which are spring sources. The lifting system is highest in the ward 10 which includes both the spring sources and underground sources. Both gravity flow & lifting systems are present in the spring sources of wards 1, 2, 4, 5, and 8

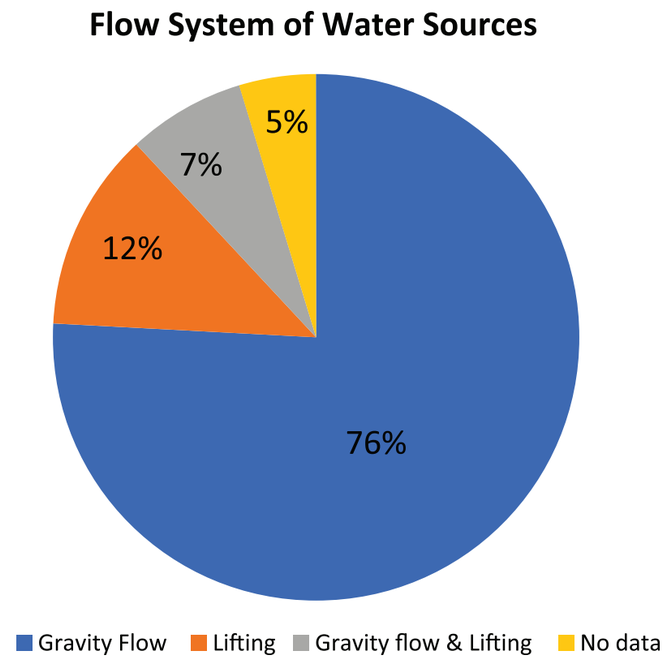
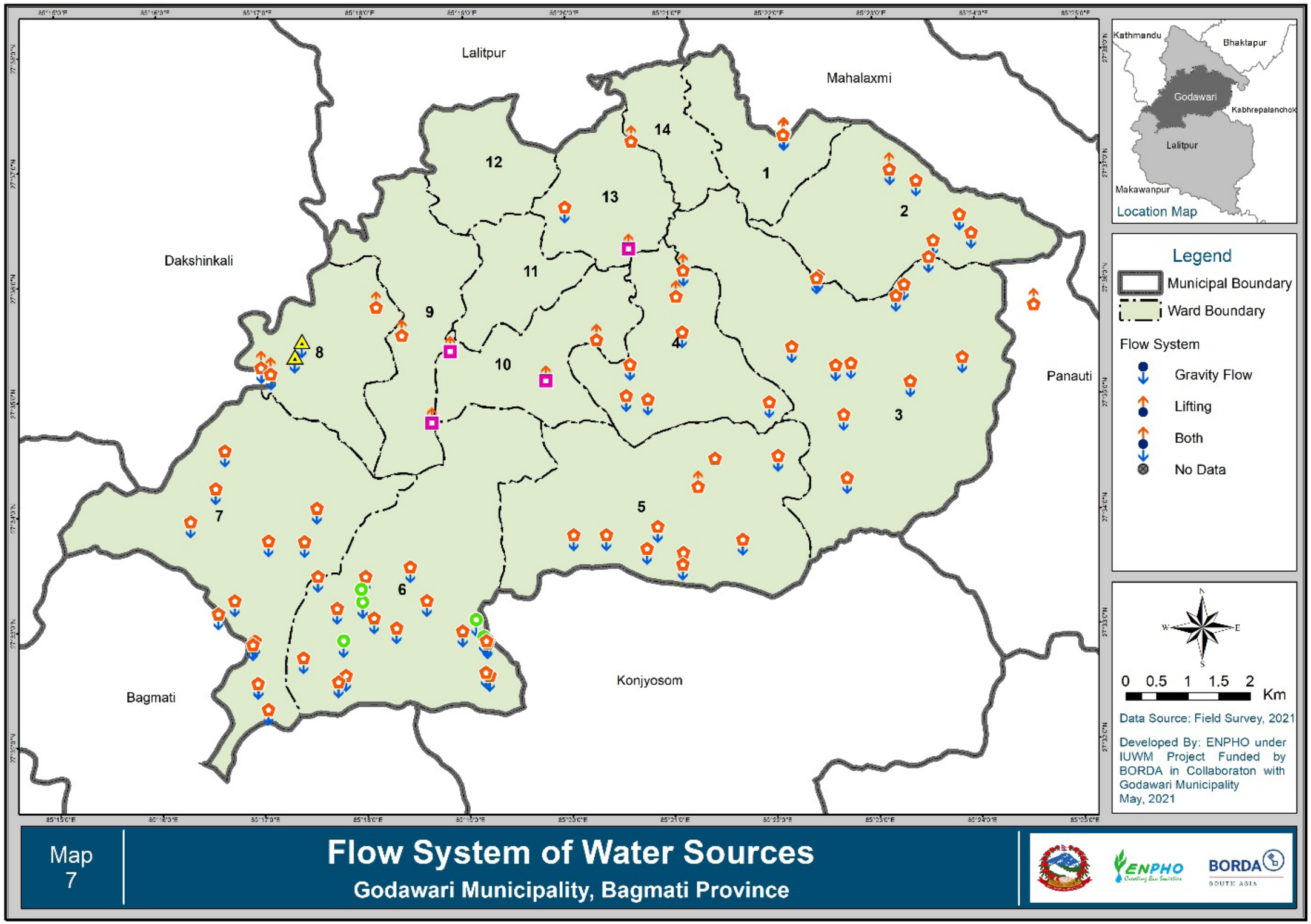


Chart 9: Water flow system in sources

Application of Map 7

This map will be beneficial to understand the external energy being utilized and the sustainability aspect of the existing water supply systems, particularly, how the system is being managed in terms of tariff and financial management. Thus, the map will guide to understand and plan for any sustainability features. The map will also be helpful to identify the target audience for any capacity-building activities to be conducted, specifically, on the types of systems.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Bhaktapur
Godawari
Kabhrepalanchok
Lalitpur
Makawanpur
Location Map
Legend
Municipal Boundary
Ward Boundary
Flow System
Gravity Flow
Lifting
Both
No Data
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0 0.5 1 1.5 2
Km
Data Source: Field Survey, 2021
Developed By: ENPHO under IUWM Project Funded by BORDA in Collaboraton with Godawari Municipality
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Map 7
Flow System of Water Sources
Godawari Municipality, Bagmati Province
ENPHO
BORDA
SOUTH ASIA