

# **SFD Report**

## **Chandragiri Municipality Nepal**

### **Final Report**

This SFD Report - SFD level 2 - was prepared by  
Environment and Public Health Organization (ENPHO)

Date of production: 11/06/2024

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## SFD Report Chandragiri Municipality, Nepal, 2026

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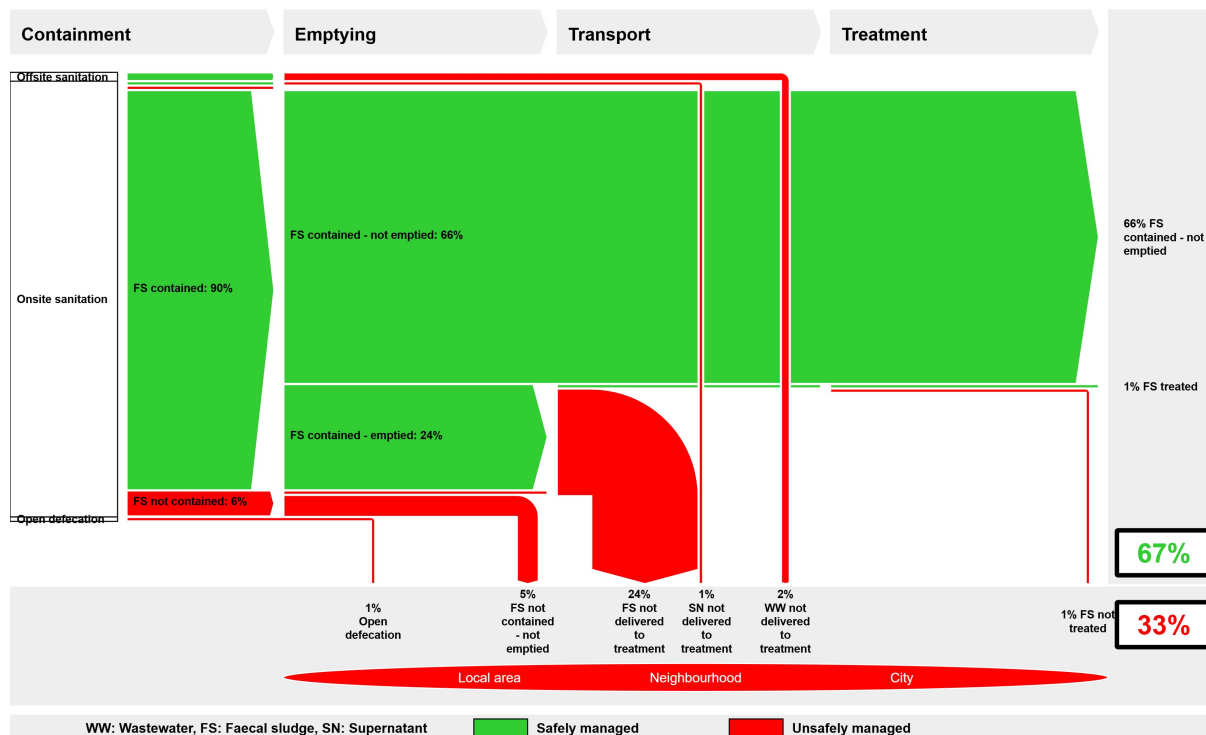
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## 1. The SFD Graphic

**Chandragiri Municipality, Bagmati, Nepal**  
Version: Reviewed  
SFD Level: 2 - Intermediate SFD

Date prepared: 13 May 2024  
Prepared by: ENPHO



The SFD Promotion Initiative recommends preparation of a report on the city context the analysis carried out and data sources used to produce this graphic. Full details on how to create an SFD Report are available at [sfd.susana.org](http://sfd.susana.org)

## 2. Diagram information

**SFD Level:**

This SFD is level 2– Intermediate report.

**Produced by:**

Environment and Public Health Organization (ENPHO).

**Collaborating partners:**

Chandragiri Municipality, Municipal Association of Nepal (MuAN), United Cities and Local Government- Asia Pacific (UCLG- ASPAC).

**Status:**

Final SFD report.

**Date of production:** 11/06/2024

## 3. General city information

Chandragiri Municipality is situated in Kathmandu District of Bagmati Province in the central region of Nepal. It is divided into 15 wards and covers an area of 3,117.54 km<sup>2</sup>. It is formed by merging 11 Village Development Committees (VDCs) namely Thankot, Dahachowk, Naikap Nayabhanjyang, Wodabhanjyang, Balambu, Mahadevsthan, Teenethana, Satungal, Matatirtha, Machhegaun and Naikap puranobhanjyang. It lies on 27°38'10" to 27°43'38" N latitude and 85°06'12" to 85°16'30" E longitude and the altitude ranges from 898 metres above sea level (masl) to 2,525 masl (Chandragiri Municipality, 2024).

A population of 136,860 is residing on 35,994 households in the municipality (National Statistics Office, 2023). The annual population growth rate of the municipality is 3.77%. The municipality has a temperate climate (Cwb) with warm summers and dry winters. The annual average temperature of the municipality is 16.1°C and receives 2,812 mm rainfall per year (Climate-Data, 2021).

#### 4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section. All data in this section is from the household and institutional surveys conducted for this survey (ENPHO, 2024). Chandragiri district was declared Open Defecation Free (ODF) on September 17, 2019. But 1% of households do not have toilets, while 99% of households have the coverage of improved sanitation facility. The households without improved sanitation facility opt for open defecation.

##### *Containment:*

Among households with improved sanitation facilities, about 2% of households rely on an offsite sanitation system and 97% rely on onsite sanitation systems. In the municipality, scanty households have sewer network. Here toilet with sewer network, outlet to an open environment and open/stormwater drain are taken as offsite sanitation systems. Households with onsite sanitation systems have different sanitation technologies. About 1% of household have septic tanks, 29%, have fully lined tanks, 55% have lined tanks with impermeable walls with open bottom, 11% have lined pit with semi-permeable walls with open bottom and 1% have unlined pits.

Here, all the institutional buildings have toilets with 93% of institutional buildings having onsite sanitation systems and 7% having offsite sanitation systems. Among the institutional buildings with onsite sanitation systems, 47% have fully lined tanks, 42% have lined tanks with impermeable walls and open bottom and 4% have lined pits with semi-permeable walls and open bottom.

Chandragiri municipality has four public toilets. Among which two were observed for the study. The toilets at *Nagdhunga Buspark*, was jointly constructed by Chandragiri Municipality and Lumanti and toilet at *Naya Naikap* was constructed by Chandragiri Municipality only. Almost 350 people use the toilet at *Nagdhunga Buspark*. The restrooms are mostly used by local bus passengers, temple visitors and city dwellers.

##### *Emptying and Transport:*

Among the buildings with onsite sanitation systems, about 33% of households and 21% of institutional buildings have emptied their containment. Both manual and mechanical emptying is practiced at households and institutional buildings while some households also practice open emptying in the municipality.

Moreover, mechanical emptying is prevalent in the municipality.

The municipality has private desludging providers. Among them one service provider has a vehicle with a tank capacity of 4,000 litres. The service charge for each trip is NRs. 4,500 - NRs.5,000 (USD 33.8 - USD 37.6) to empty a containment.

##### *Treatment and Disposal/Reuse:*

Here, mechanically emptied Faecal Sludge (FS) is disposed of in privately owned land without treatment. The manually emptied FS is dig and dumped, applied into farmlands, composted or released into stormwater drain/sewer. While, FS generated at households in Amarawati colony is being managed at FTSP owned by the colony. Apart FSTP at the colony, all the emptied FS is disposed unsafely into an open environment or water bodies.

Approximately 86% of households have piped drinking water supply services in the municipality. Among other service providers, Matatirtha Mahadevsthan Water and Sanitation Users' Committee is one of the major drinking water services providers in Chandragiri Municipality. It serves in wards 5, 6 and 7. It has distributed more than 4,500 taps to households and institutions. Also, Tinthana Water and Sanitation Users' Committee is another water supply service provider. It serves in ward 15 and has distributed 1,520 taps in the ward. Apart from private taps, 6% rely on community taps, 1% on groundwater, 1% on spring sources, 1% on tanker water and 5% on jar water for drinking water supply.

Spring sources are vulnerable of contamination. The vulnerability of sources depends on lateral spacing between sanitation systems and the sources. However, sample water from boring and reservoir tanks of Tinthana water supply scheme showed absence of *E. coli* contamination concluding, drinking water from private taps are at less risk of contamination.

The SFD graphic shows that excreta generated from 67% of the population are safely managed while 33% of the population are unsafely managed. Only 1% of FS generated in the municipality was treated which is delivered to FSTP and biogas digester at household. While safely managed FS generated from 66% of population is temporary as the FS has not been emptied. The proportion of safely managed FS will soon become unsafely managed once the containments start filling up.

#### 5. Service delivery context

Access to drinking water and sanitation has

been defined as fundamental rights to every citizen by the constitution of Nepal. To respect, protect and implement the rights of citizen embedded in the constitution the Government of Nepal (GoN) has enforced the Water Supply and Sanitation Law 2022 which emphasized on a right to quality sanitation services and prohibited direct discharge of wastewater and sewage into water bodies or public places.

Several policies have been in place to accomplish the sanitation needs of people. Particularly, NSHMP 2011 has proved to be an important strategic document for all stakeholders to develop uniform programs and implementation mechanisms at all levels. It strengthened institutional set up with the formation of Water and Sanitation Coordination Committee (WASH-CC) to actively engage in sanitation campaigns. The sanitation campaign was implemented throughout the country mainly focusing on achieving universal access to improved sanitation.

Ministry of Water Supply through its Department of Water Supply and Sewerage Management (DWSSM) articulated and endorsed Institutional and Regulatory Framework (IRF) for Faecal Sludge Management in Urban Areas of Nepal in 2017. The main objective of the IRF is to define the specific roles and responsibilities of key institutions for the effective management and regulation of Faecal Sludge Management (FSM).

## 6. Overview of stakeholders

Based on the regulatory framework for Faecal Sludge Management (FSM), the major stakeholders for effective and sustaining service delivery as presented in Table 1.

**Table 1: Overview of Stakeholders.**

| Key Stakeholders                             | Institutions / Organizations                                        |
|----------------------------------------------|---------------------------------------------------------------------|
| Public Institutions at Federal Government    | Ministry of Water Supply                                            |
| Public Institutions at Provincial Government | Ministry of Water Supply, Energy and Irrigation                     |
| Public Institutions at Local Government      | Chandragiri Municipality                                            |
| Non-governmental Organizations               | Environment and Public Health Organization (ENPHO)                  |
| Private Sector                               | Water Supply Users Committee<br>Private Desludging Service Provider |
| Development Partners, Donors                 | MuAN, BMGF, UCLG ASPAC                                              |

## 7. Process of SFD development

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2024). Enumerators of the municipality were mobilized after orientating on sanitation technologies and proper use of mobile application (KOBOLLECT) to collect data for survey. The Key Informant Interviews (KIIs) were conducted with WASH focal person of the municipality, Water and Sanitation Users' Committee and caretakers of public toilets. Types of sanitation technologies used in various locations have been mapped using ARCGIS. For the Shit Flow Diagram (SFD) graphic production, initially, a relationship between sanitation technology used in questionnaire survey and Shit Flow Diagram Promotive Initiatives (SFD PI) methodology was made. Then, data were fed into SFD graphic generator to produce the SFD graphic.

## 8. Credibility of data

The major data were collected from random household sampling. Altogether, 1037 households and 44 institutions were surveyed from 15 wards of Chandragiri Municipality. Primary data on emptying, transportation and current sanitation practices in the municipality were validated from KII with public toilet management, municipal representatives, and water service providers. The overall data and findings were shared with the stakeholders of the municipality and validated through a sharing program.

## 9. List of data sources

The list of data sources to produce this executive summary is as follows:

- Chandragiri Municipality, 2024. *Chandragiri Municipality*. [Online] Available at: <https://www.chandragirimun.gov.np/en>.
- Climate-Data, 2021. *Climate-Data*. [Online] Available at: <https://en.climate-data.org/asia/nepal/central-development-region/kathmandu-1137/>.
- ENPHO, 2024. *Sanitation Situation Assessment of Chandragiri Municipality*. Unpublished, s.l.: s.n.
- MoWS, 2020. *Open Defecation Free Nepal: Narration of the Journey*, Kathmandu: Secretariat of National Sanitation and Hygiene Coordination Committee, Nepal.
- National Statistics Office, 2023. *National Population and Housing Census 2021 National Report*, Kathmandu: National Statistics Office.



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## Table of Content

|                                                                                                               |    |
|---------------------------------------------------------------------------------------------------------------|----|
| 1 City context .....                                                                                          | 1  |
| 1.1 Population .....                                                                                          | 1  |
| 1.2 Topography and Geography .....                                                                            | 2  |
| 1.3 Climate .....                                                                                             | 2  |
| 2 Service Outcomes .....                                                                                      | 3  |
| 2.1 Overview .....                                                                                            | 3  |
| 2.1.1 Sanitation System in Household Buildings .....                                                          | 3  |
| 2.1.2 Sanitation Systems in Institutional Buildings .....                                                     | 9  |
| 2.1.3 Public Toilets .....                                                                                    | 10 |
| 2.1.4 Emptying and Transport .....                                                                            | 12 |
| 2.1.5 Treatment and Disposal/Reuse .....                                                                      | 13 |
| 2.1.6 Risk Assessment of Water Source Pollution .....                                                         | 14 |
| 2.2 SFD Selection Grid .....                                                                                  | 18 |
| 2.3 SFD Matrix .....                                                                                          | 19 |
| 2.3.1 Proportion of Faecal Sludge from types of sanitation technologies .....                                 | 19 |
| 2.3.2 Proportion of Faecal Sludge Emptied (F3) .....                                                          | 21 |
| 2.3.3 Proportion of WW transported which is delivered to Treatment Plant (W4a and W5a) .....                  | 22 |
| 2.3.4 Proportion of FS emptied which is delivered to Treatment Plant and treated (F4 and F5) .....            | 23 |
| 2.3.5 Proportion of Supernatant in Sewer System delivered to Treatment Plant (S4d and S5d) .....              | 23 |
| 2.3.6 Proportion of Supernatant in Open drain or Storm sewer delivered to Treatment Plant (S4e and S5e) ..... | 23 |
| 2.4 SFD Graphic .....                                                                                         | 23 |
| 3 Service delivery context .....                                                                              | 27 |
| 3.1 Policy, legislation, and regulation .....                                                                 | 27 |
| 3.2 Policies .....                                                                                            | 28 |
| 3.3 Institutional roles .....                                                                                 | 29 |
| 3.4 Service provision .....                                                                                   | 31 |
| 3.5 Service standards .....                                                                                   | 31 |
| 4 Stakeholder Engagement .....                                                                                | 32 |
| 4.1 Key Informant Interviews .....                                                                            | 32 |

|                                                                                                                      |    |
|----------------------------------------------------------------------------------------------------------------------|----|
| 4.2 Household Survey .....                                                                                           | 33 |
| 4.2.1 Determining Sample Size .....                                                                                  | 33 |
| 4.3 Direct Observation .....                                                                                         | 34 |
| 4.4 Sharing and Validation of Data .....                                                                             | 35 |
| 5 Acknowledgements .....                                                                                             | 36 |
| 6 References .....                                                                                                   | 37 |
| 7 Appendix Annexes .....                                                                                             | 39 |
| 7.1 Appendix 1: Roles and Responsibility of Various Tiers of Governments Delineated in Drafted SDP 2016 – 2030 ..... | 39 |
| 7.2 Appendix 2: Total number of population and household in each ward and number of surveyed households .....        | 40 |
| 7.3 Appendix 3: List of Participants on SFD Survey Orientation .....                                                 | 41 |
| 7.4 Appendix 4: List of Participants in Sharing and Validation Workshop .....                                        | 42 |

## List of Tables

|                                                                                                                                           |    |
|-------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1: Types of onsite sanitation technologies at households of Chandragiri Municipality. ...                                           | 5  |
| Table 2: Types of sanitation technologies recategorized according to SFD Pl. ....                                                         | 8  |
| Table 3: Type and number of surveyed institutions .....                                                                                   | 9  |
| Table 4: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 18. ....                      | 18 |
| Table 5: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2024 <sup>(1)</sup> ; KII-2, 2024 <sup>(2)</sup> ). .... | 22 |
| Table 6: Sanitation Service Level and its Components. ....                                                                                | 31 |
| Table 7: List of Key Informant Interviewed personnel. ....                                                                                | 32 |

## List of figures

|                                                                                                                          |    |
|--------------------------------------------------------------------------------------------------------------------------|----|
| Figure 1: Ward boundary map of Chandragiri Municipality. ....                                                            | 1  |
| Figure 2: A graph showing the monthly average for precipitation and temperature of Chandragiri Municipality. ....        | 2  |
| Figure 3: Sanitation technologies at households of Chandragiri Municipality. ....                                        | 3  |
| Figure 4: Location map of households with status of access to improved sanitation. ....                                  | 4  |
| Figure 5: Sludge disposal in an open drain in Chandragiri Municipality. ....                                             | 5  |
| Figure 6: Biogas digesters found at households in Chandragiri Municipality. ....                                         | 6  |
| Figure 7: Single pits found in Chandragiri Municipality. ....                                                            | 7  |
| Figure 8: Inappropriate design of twin pits, the distance between two pits is less than 1.2m. .                          | 7  |
| Figure 9: Unlined pits found at households in Chandragiri Municipality. ....                                             | 8  |
| Figure 10: Location map of household with different types of containment. ....                                           | 9  |
| Figure 11: Location map of institutional buildings with different types of containment in Chandragiri Municipality. .... | 10 |
| Figure 12: Public toilet at its status located at <i>Nagdhunga Buspark</i> . ....                                        | 11 |
| Figure 13: Public toilet and its status at <i>Naya Naikap</i> . ....                                                     | 12 |
| Figure 14: Status of emptying of different types of containment. ....                                                    | 13 |
| Figure 15: Picture showing groundwater and community tap in Chandragiri Municipality. ....                               | 14 |
| Figure 16: Water quality test report of spring source of Tinthana Water Supply Scheme. ....                              | 16 |
| Figure 17: Water quality test report of drinking water from Tinthana Water Supply Scheme. ....                           | 17 |
| Figure 18: SFD selection grid for Chandragiri Municipality. ....                                                         | 18 |
| Figure 19: SFD Matrix of Chandragiri Municipality. ....                                                                  | 21 |
| Figure 20: SFD Graphic of Chandragiri Municipality. ....                                                                 | 24 |
| Figure 21: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM). ....                     | 30 |
| Figure 22: KII with municipal representatives and representatives of WSUCs at Chandragiri. ....                          | 32 |
| Figure 23: SFD orientation to local enumerators for data collection. ....                                                | 33 |
| Figure 24: Location map of surveyed households. ....                                                                     | 34 |
| Figure 25: Enumerators during household survey at Chandragiri Municipality. ....                                         | 34 |
| Figure 26: Sharing of findings during validation workshop. ....                                                          | 35 |

## Abbreviations

|            |                                                           |
|------------|-----------------------------------------------------------|
| DWSSM      | Department of Water Supply and Sewerage Management        |
| DUDBC      | Department of Urban Development and Building Construction |
| ENPHO      | Environment and Public Health Organization                |
| FS         | Faecal Sludge                                             |
| FSM        | Faecal Sludge Management                                  |
| FSTP       | Faecal Sludge Treatment Plant                             |
| GoN        | Government of Nepal                                       |
| HH         | Household                                                 |
| IRF        | Institutional and Regulatory Framework                    |
| KII        | Key Informant Interview                                   |
| KM         | Kilometre                                                 |
| Lps        | Liters per second                                         |
| masl       | metres above sea level                                    |
| mm         | Millimetre                                                |
| MoWS       | Ministry of Water Supply                                  |
| MuAN       | Municipal Association of Nepal                            |
| NPC        | National Planning Commission                              |
| NSHMP      | National Sanitation and Hygiene Master Plan               |
| NWSSP      | National Water Supply and Sanitation Policy               |
| ODF        | Open Defecation Free                                      |
| PPP        | Public Private Partnership                                |
| RWSSNP     | Rural Water Supply and Sanitation National Policy         |
| SDG        | Sustainable Development Goal                              |
| SDP        | Sector Development Plan                                   |
| SFD        | Shit Flow Diagram                                         |
| SFD PI     | Shit Flow Diagram Promotion Initiative                    |
| SN         | Supernatant                                               |
| SuSanA     | Sustainable Sanitation Alliance                           |
| UCLG ASPAC | United Cities and Local Governments Asia Pacific          |
| VDC        | Village Development Committees                            |
| WASH       | Water, Sanitation and Hygiene                             |
| WSUC       | Water and Sanitation Users Committee                      |
| WW         | Wastewater                                                |
| WWTP       | Wastewater Treatment Plant                                |

## 1 City context

Chandragiri Municipality is situated in west end of Kathmandu District in Bagmati Province of Nepal. It was established on December 2, 2014 (Chandragiri Municipality, 2024) and was reformed on March 10, 2017. The municipality was formed by merging 11 Village Development Committees (VDCs) namely, Thankot, Dahachowk, Naikap Nayabhanjyang, Wodabhanjyang, Balambu, Mahadevsthan, Teenthana, Satungal, Matatirtha, Machhegaun and Naikap puranobhanjyang. It is divided into 15 wards. It shares its boundary with Kathmandu Metropolitan City and Kritipur Municipality of Kathmandu on the east, Dhunibesi Municipality of Dhading on the west, Nagarjun Municipality of Kathmandu on the north and Thaha Municipality, Makawanpur and Indra Sarowar Rural Municipality of Makawanpur on the south (Chandragiri Municipality, 2024). Figure 1 shows the ward boundary map of Chandragiri Municipality.

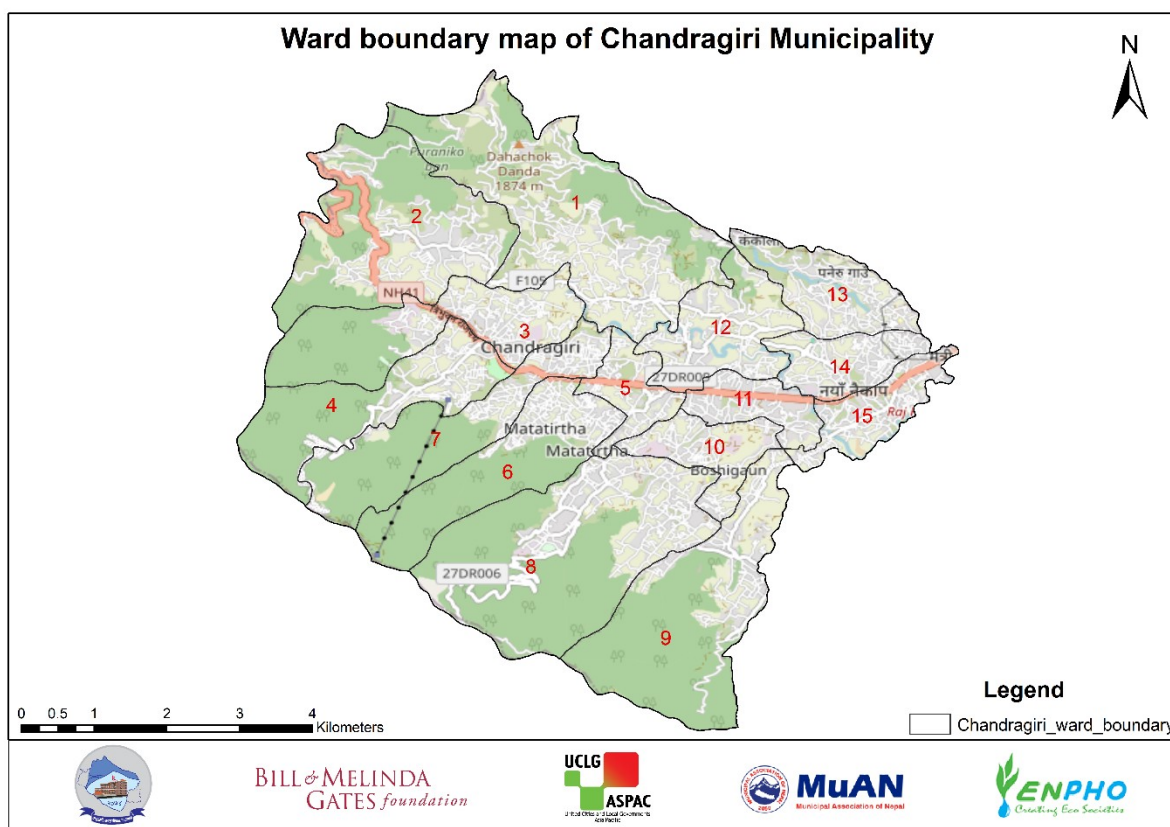


**Figure 1: Ward boundary map of Chandragiri Municipality.**

### 1.1 Population

As per the national population and housing census conducted in 2021, Chandragiri Municipality has a total population of 1,36860 with 68,303 male and 68,557 female population. There are altogether 35,994 households. The average household size is 3.80 (National Statistics Office, 2023) and population density is 3,117.54 per km<sup>2</sup>. The annual population growth rate of the municipality is 3.77%. This shows that the municipality has increasing migration.

## 1.2 Topography and Geography

The elevation of Chandragiri Municipality ranges from 898 metres above sea level (masl) to 2525 masl (Elevation API, 2024). The municipality lies at 27°38'10" to 27°43'38" N latitude and 85°06'12" to 85°16'30" E longitude. It covers a total area of 43.9 sq. km. on the central region of Nepal (Chandragiri Municipality, 2024). The municipality lies in the Mahabharat range based on the physiographic division of Nepal. Thus, it has the topography based on the range. The region has a composition of Phyllites, Schist, gneiss, quartzite, granite and limestone as well as alluvial sediments i.e. sand, silt and clay along-with coarse gravels is found in the municipality (Upreti, 1999).

## 1.3 Climate

Köppen–Geiger classification is one of the most used systems for climatic categorization. This classification is a widely used method for portraying climates worldwide, based on monthly air temperature and precipitation. The climatic condition of Chandragiri Municipality falls on temperate climate (Cwb) based on Köppen–Geiger classification. This climatic condition has warm summers and dry winters (Karki, et al., 2015). The warmest month of the year is June with an average temperature of 20.5°C and coldest month is January with average temperature of 9.2°C. The annual average temperature of the municipality is 16.1°C. It receives 2812 mm rainfall on average annually. The most rainfall occurs in July and the least in December (Climate-Data, 2021). Figure 2 shows the graph of the monthly average for precipitation and temperature of Chandragiri Municipality.

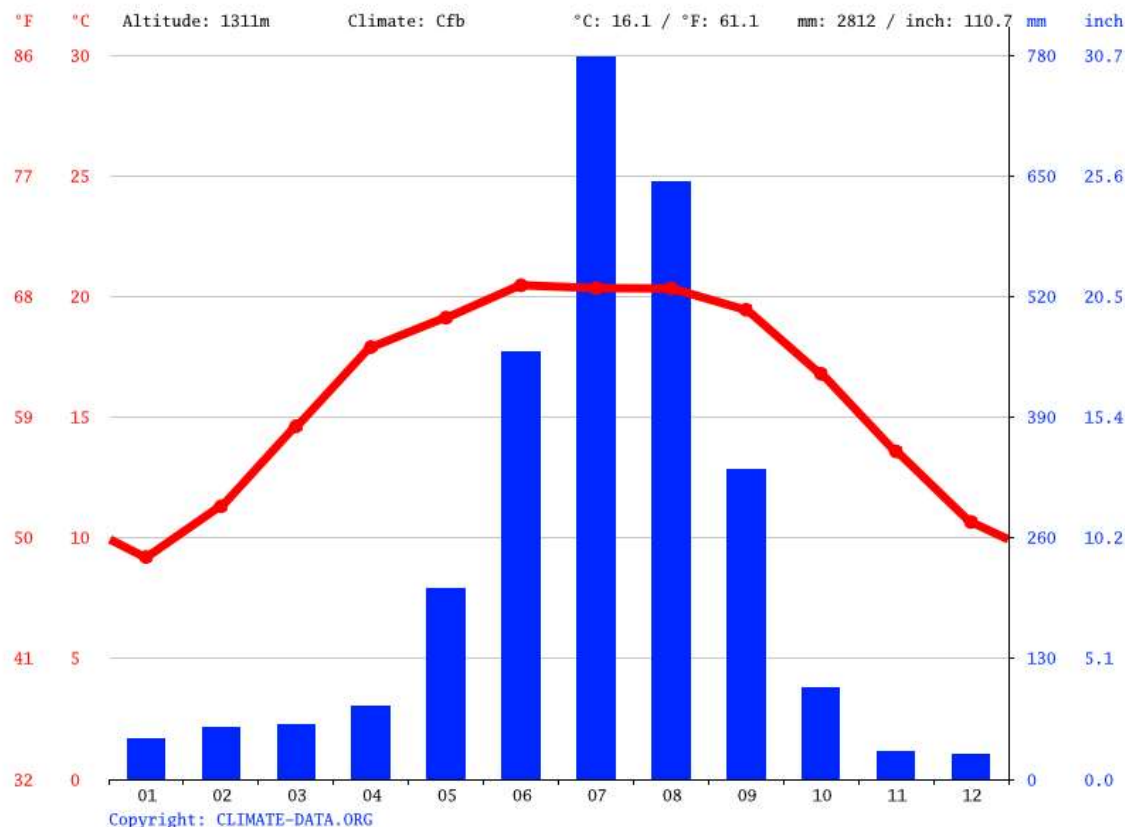


**Figure 2: A graph showing the monthly average for precipitation and temperature of Chandragiri Municipality.**

## 2 Service Outcomes

### 2.1 Overview

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2024). A total of 1037 households were sampled from 35,994 households distributed in 15 wards (further details are presented in section 4). The results obtained after the triangulation and validation of the data with all the data sources including secondary data, Key Informant Interviews (KIIs) and a validation workshop is presented in this section.

Sanitation is defined as infrastructures, facilities or services provided for safe management of human excreta emanating from toilet while handling, storage, and treatment onsite or offsite conveying it safely to the end use or disposal to protect human health and environment (Affam & Ezechi, 2021).

#### 2.1.1 Sanitation System in Household Buildings

Kathmandu district was declared Open Defecation Free (ODF) on September 17, 2019 (MoWS, 2020). The status of ODF indicates accessibility to basic sanitation on each household (HH). In Chandragiri Municipality, still 1% of the households do not have toilets and practice open defecation. The households practising open defecation goes to an open space. Figure 3 shows sanitation technologies present at households in Chandragiri Municipality.



**Figure 3: Sanitation technologies at households of Chandragiri Municipality.**

The remaining 99% of the households have improved sanitation facilities either with offsite or onsite sanitation systems. Offsite sanitation refers to a sanitation system in which excreta (referred to as wastewater) is collected and transported away from the plot where they are generated. An offsite sanitation system relies on sewer technology for transport. Onsite sanitation refers to a sanitation technology or sanitation system in which excreta (referred to as faecal sludge) is collected and stored and emptied from or treated on the plot where they are generated (SuSanA, 2018). In the municipality, 2% of the households have offsite sanitation systems whereas 97% have onsite sanitation systems. Figure 4 presents the location map of households with status of access to improved sanitation.

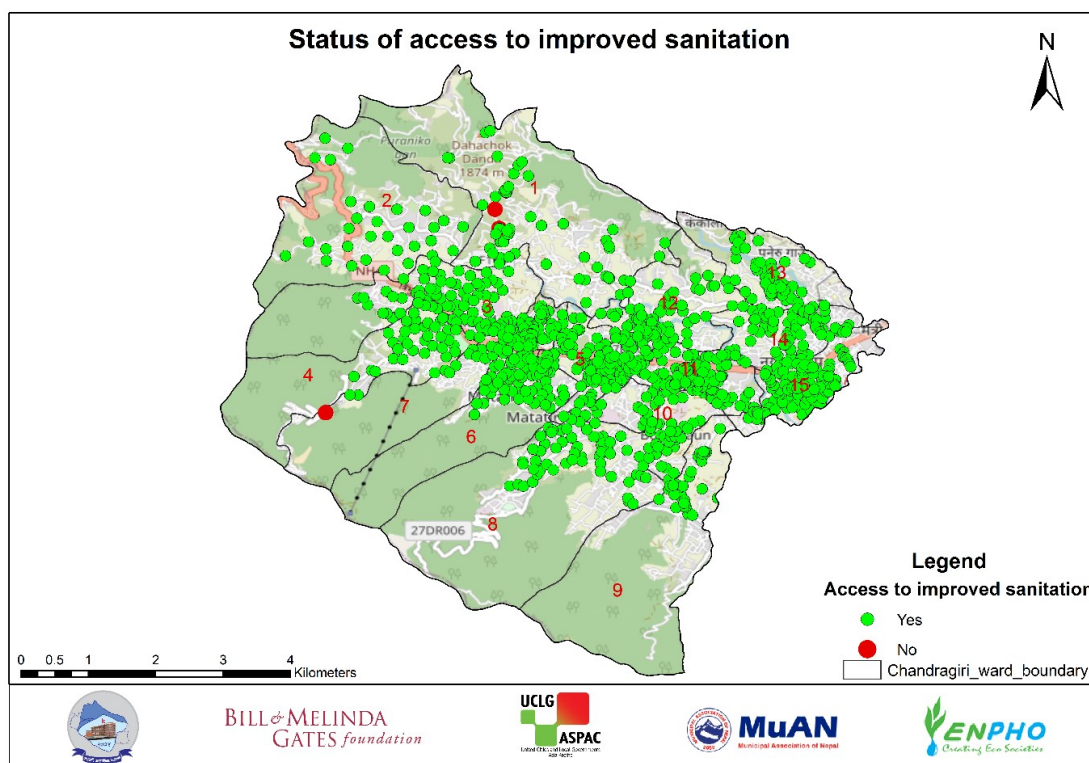


**Figure 4: Location map of households with status of access to improved sanitation.**

### ***Types of Offsite Sanitation Systems***

Chandragiri Municipality does not have authorized sewerage network but 2% of households in the municipality have offsite sanitation system. Among the households with offsite sanitation system, about 8% of households in wards 10 have sewer line while remaining households have the outlet of toilet directly connected to a stormwater/open drain or open environment. Here, households that have the outlet of toilet connected to a sewer line or to an open/stormwater drain or to an open environment is considered as offsite sanitation system. It is taken as toilet with no onsite container for the SFD graphic. Figure 5 shows sludge in an open drain.



**Figure 5: Sludge disposal in an open drain in Chandragiri Municipality.**

### ***Types of Onsite Sanitation Systems***

In the municipality, 97% of the households have onsite sanitation systems. Table 1 shows the types of onsite sanitation technologies and percentage of households using it at Chandragiri Municipality.

**Table 1: Types of onsite sanitation technologies at households of Chandragiri Municipality.**

| Containment                                       | Wall construction materials                                           | Bottom of containment | Chamber                     | Number | Connected to                                                       | %   |
|---------------------------------------------------|-----------------------------------------------------------------------|-----------------------|-----------------------------|--------|--------------------------------------------------------------------|-----|
| Septic tank                                       | Concrete walls<br>OR<br>Cemented brick/stone walls                    | PCC or plastered      | Two or more than two        | NA     | Soak pit<br>Sewer<br>Open drain/ open ground                       | 1%  |
| Biogas digester                                   | NA                                                                    | NA                    | NA                          | NA     | No outlet/ overflow                                                | 1%  |
| Fully Lined Tank                                  | Concrete walls<br>OR<br>Cemented brick/stone walls                    | PCC or plastered      | One or Two                  | NA     | Soak pit<br>Sewer<br>Open drain/open ground<br>No outlet/ overflow | 28% |
| Lined tank with impermeable walls and open bottom | Concrete walls<br>OR<br>Cemented brick/stone walls                    | Soiling or Nothing    | one<br>two<br>More than two | NA     | Soak pit<br>Sewer<br>Open drain/open ground<br>No outlet/ overflow | 55% |
| Twin pits                                         | Concrete rings piled one after other                                  | Soiling<br>Nothing    | NA                          | Two    | NA                                                                 | 1%  |
| Single pit                                        | Concrete rings piled one after other                                  | Soiling<br>Nothing    | NA                          | One    | NA                                                                 | 10% |
| Unlined pit                                       | Mud mortar brick wall/Mud mortar cement wall/No lining/Dry stone wall | Nothing               | NA                          | NA     | NA                                                                 | 1%  |

**Septic tank** is a watertight rectangular chamber with two or more than two compartments for better storage and stabilization of faecal sludge (FS). The technology is properly sealed, and the effluent is discharged into soak pit (SuSanA, 2018). 1% of households in the municipality have septic tank.

**Biogas Digester** is a waste to energy conversion technology designed to treat household organic waste and faecal sludge (FS) to generate biogas. 1% of households have built biogas digester in their houses. Alternative Energy Promotion Centre (AEPC) have promoted biogas technology at households in 77 districts of Nepal. The installation of biogas at households have supported in improving situation of health status and sanitation status in Nepal (AEPC, 2018). Figure 6 shows the types of biogas digester in Chandragiri Municipality.



**Figure 6: Biogas digesters found at households in Chandragiri Municipality.**

**Fully lined tank** is a rectangular tank with impermeable walls and base to safely store FS. It does not have outlet for the discharge of effluent (Strande, et al., 2014). 28% of households have fully lined tanks.

**Lined tank with impermeable walls and open bottom** is a rectangular onsite technology where the walls of the tank are lined and sealed, and a permeable base. The facility allows infiltration of effluents which could contaminate groundwater (Peal, et al., 2020). 55% of households have these types of containments in the municipality.

**Single Pit** is a circular onsite technology made from concrete rings. There is no lining between rings, and it allows infiltration of effluents from walls and as well as bottom of the pit. No outlet or overflow for effluent is observed in this type of containment (SuSanA, 2018). 10% of households have single pits in the municipality. Figure 7 shows pictures of a single pit found in the municipality.



**Figure 7: Single pits found in Chandragiri Municipality.**

**Twin Pit** is also a circular onsite sanitation technology with two sets of concrete rings. It has semi-permeable walls and a permeable base (SuSanA, 2018). Each pit is used alternatively after filled. This technology is ideally designed to safely store and treat FS. It effectively treats FS if there is no exfiltration of water (Saxena & Den, 2022). The facility consists of two sets of pits with the minimum horizontal distance of 1.2m. Both the pits are connected from diversion box. However, most twin pits installed by the households are not as per the design. 1% of households have twin pits. Figure 8 shows the inappropriate design of twin pits in the municipality.

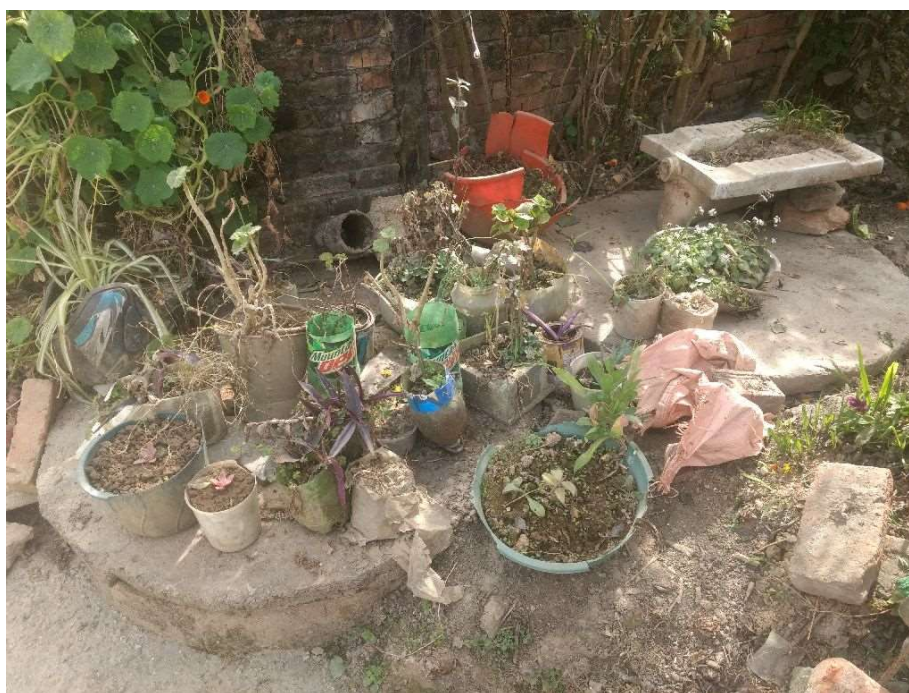


**Figure 8: Inappropriate design of twin pits, the distance between two pits is less than 1.2m.**

**Unlined Pit** is a dug pit in the ground. It has no lining in walls and a permeable base. It allows infiltration of effluents from walls and as well as bottom of the pit (SuSanA, 2018). 1% of households have unlined pits. Figure 9 shows unlined pits found in Chandragiri Municipality.



**Figure 9: Unlined pits found at households in Chandragiri Municipality.**

Table 2 shows the types of sanitation technologies recategorized according to the Shit Flow Diagram Promotion Initiative (SFD PI).

**Table 2: Types of sanitation technologies recategorized according to SFD PI.**

| Sanitation System                                                                      | Percentage  |
|----------------------------------------------------------------------------------------|-------------|
| <b>No toilet/Open defecation</b> (T1B11 C7 TO C9)                                      | 1%          |
| <b>No onsite container</b> (T1A1C1)                                                    | 2%          |
| <b>Onsite Sanitation System</b>                                                        |             |
| Septic tank (T1A2C1)                                                                   | 1%          |
| Fully lined tank (T1A3C1, T1A3C6, T1A3C8 and T1A3C10)                                  | 29%         |
| Lined tank with impermeable walls and open bottom (T1A4C1, T1A4C6, T1A4C8 and T1A4C10) | 55%         |
| Lined pit with semi-permeable walls and open bottom (T1A5C10)                          | 11%         |
| Unlined pit (T1A6C10)                                                                  | 1%          |
| <b>Grand Total</b>                                                                     | <b>100%</b> |

According to SFD PI, biogas digester and fully lined tanks are recategorized as fully lined tanks and single pits and twin pits are recategorized as lined pits with semi-permeable walls and open bottom. Thus, 29% of households have fully lined tanks and 11% of households have lined pits with semi-permeable walls and open bottom. Figure 10 shows location map of households with different types of containment at Chandragiri Municipality.

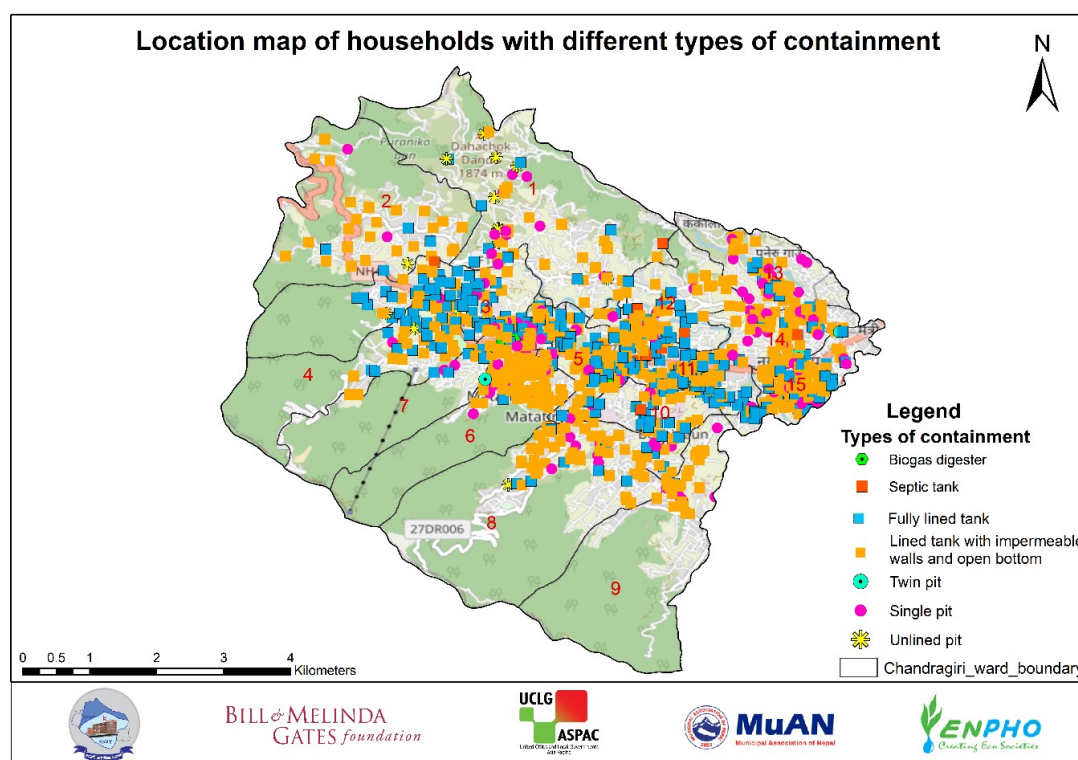


**Figure 10: Location map of household with different types of containment.**

### 2.1.2 Sanitation Systems in Institutional Buildings

Altogether 45 institutional buildings were surveyed. The sanitation data of institutional buildings were obtained from different types of institutions. Table 3 shows the types and number of surveyed institutions.

**Table 3: Type and number of surveyed institutions**

| Type of Institution               | Number of Surveyed Institutions |
|-----------------------------------|---------------------------------|
| Educational Institution           | 19                              |
| Government /Non-government Office | 15                              |
| Health Care Centre                | 9                               |
| Commercial Buildings              | 2                               |
| <b>Grand Total</b>                | <b>45</b>                       |

All the institutional buildings in the municipality have toilets with 93% of institutional buildings with onsite sanitation systems and 7% have offsite sanitation systems. Various containment types are found in the institutional buildings. About 47% of the buildings have fully lined tanks, 42% have lined tanks with impermeable walls and open bottom and 4% have single pits. The data shows that only 47% of the institutional buildings have safer FS collecting containments whereas 46% of the institutional buildings have improperly built containments that possesses risk to groundwater contamination. Figure 11 shows the location map of institutional buildings with different types of containments in Chandragiri Municipality.

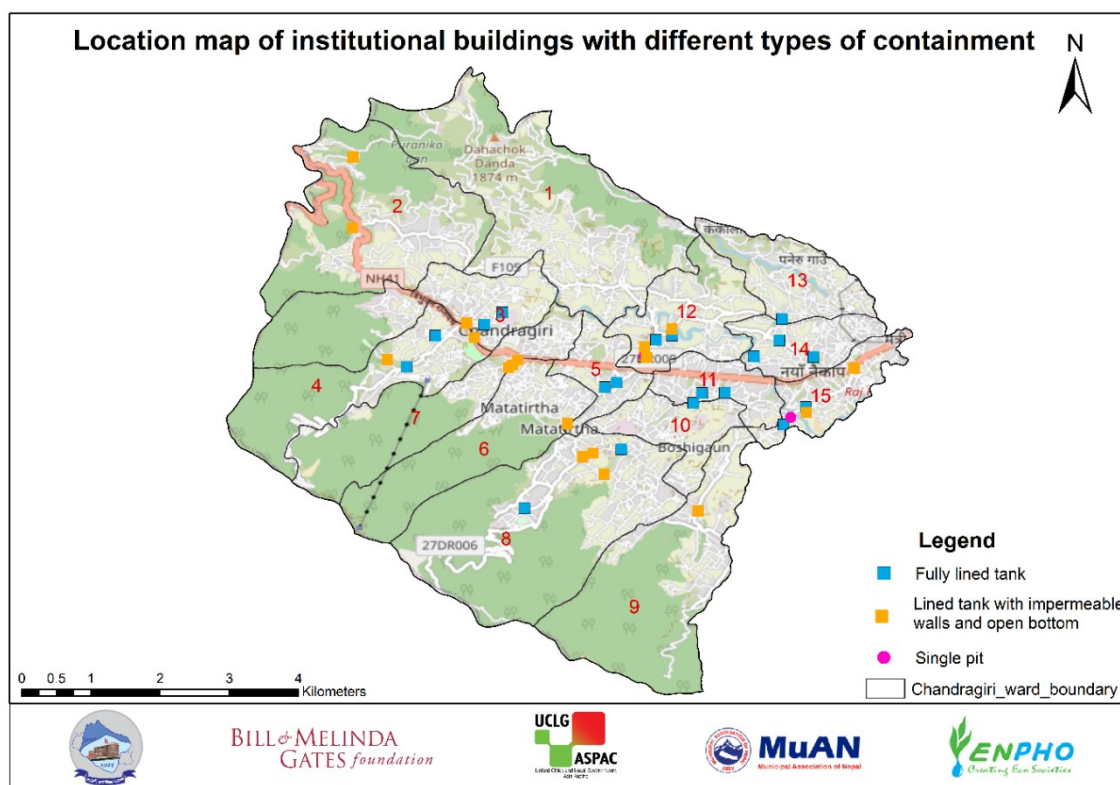


**Figure 11: Location map of institutional buildings with different types of containment in Chandragiri Municipality.**

### 2.1.3 Public Toilets

There are four public toilets in Chandragiri Municipality (KII-1, 2023). Among which two were observed for the study. The information about public toilets obtained during KII and observation are fed in this report.

#### **Public toilet at Nagdhunga Buspark**

The toilet located at *Nagdhunga Buspark* in ward 2 was constructed jointly by the Chandragiri Municipality and Lumanti on 2019. It has a separate male and female compartments. It serves 9 users at a time with 1 pan and 4 urinals in male compartment and 4 pans in female compartment. The public vehicle passengers are the major service recipients of this toilet. About 300-400 users uses the toilet per day. The users are charged NRs. 10 (USD 0.08) for urination and NRs. 15 (USD 0.11) for defecation.

The outlet of the toilet is connected to two circular containments. These separate containments are used to collect urine and faeces separately. Each circular containments are about 5,000 litres. The containment is emptied every month and service provider charge NRs. 6,000 (USD 45.11) for a trip. The toilet is cleaned regularly. Water required for the toilet is supplied from a 500 litres overhead tank on the taps of each compartment. The toilet compartments have a ventilation. Handwashing basins are placed outside the compartment for the handwashing facility. A caretaker is responsible for overall management of the toilet. The toilet was handed over to a caretaker on contract basis and must pay municipality from

the earnings. The initial payment was agreed on NRs. 80,000 (USD 601.5) per year which increases by 10% every year (KII-4, 2024).



**Figure 12: Public toilet at its status located at Nagdhunga Buspark.**

### Public toilet at *Naya Naikap*

The toilet located at *Naya Naikap* in ward 14 was constructed by the Chandragiri Municipality. It has separate male and female compartments. The public vehicle temple visitors and city dwellers are the service recipients of the toilet. The toilet compartments have ventilation (Figure 13).



Figure 13: Public toilet and its status at *Naya Naikap*.

#### 2.1.4 Emptying and Transport

Emptying is one of the key elements of sanitation service chain. It basically assures the proper operation of containment. Regular emptying of the containment prevents sludge overflow and blockages (Strande, et al., 2014). Moreover, emptying of containment is determined by the number of users, duration of years and types and size of containment.

Among the households with onsite sanitation systems, about 33% of the households have emptied their containment whereas 67% have not emptied yet. Similarly, about 21% of the institutional buildings have emptied their containments while 79% have not emptied. Here, the emptying ratio of containment types of septic tanks, lined tank with impermeable walls and open bottom and unlined pits are less than the remaining containment types.

The containment types with open bottom allows effluents to infiltrate (Peal, et al., 2020), preventing them from filling up quickly. In addition, the sizes of containments are larger, and the outlets are connected to sewer network, open drain and open ground. Thus, this has reduced the frequency of emptying of these containments. Figure 14 shows emptying status of different types of containment at households.

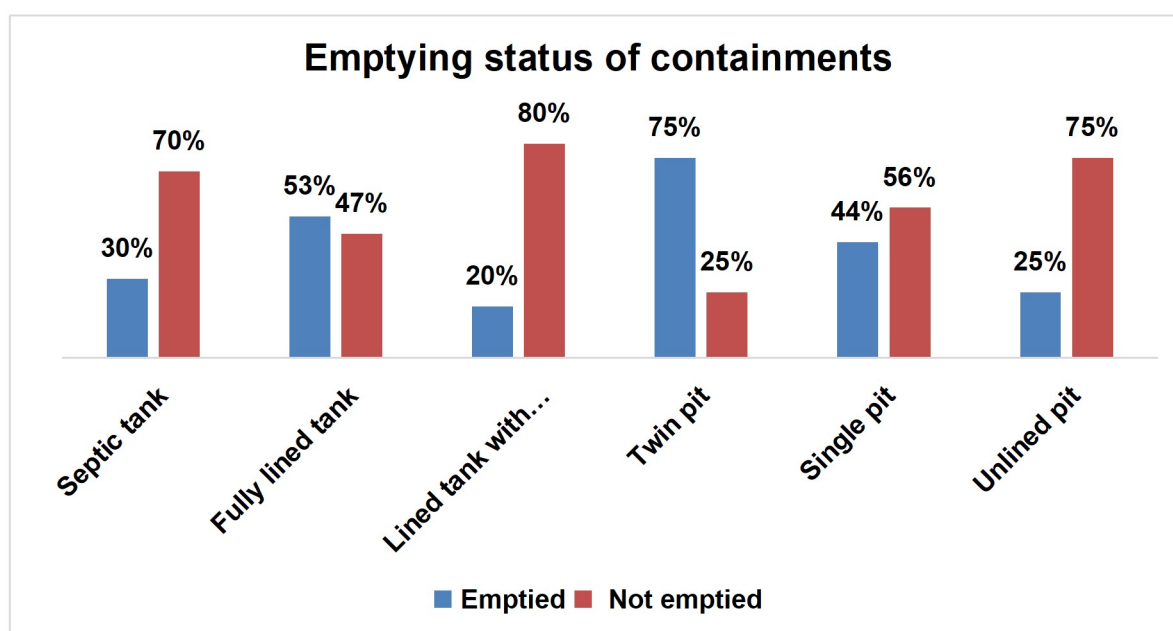


**Figure 14: Status of emptying of different types of containment.**

The municipality does not have regular containment emptying practice as most containments are with open bottom and does not get filled in standard time as per the containment size. Thus, on-demand emptying practice is found in the municipality (KII-2, 2023). Here, both manual and mechanical emptying is practiced while mechanical emptying is prevalent. In addition, households also practice open emptying. Open emptying method is the practice of discharging effluent into an open/stormwater drain during rainy season. Among the households that have emptied their containments, 12% of households emptied manually, 79% emptied mechanically and 9% practiced open emptying. Similarly, 11% of institutional buildings practiced manual emptying and 89% practiced mechanical emptying (ENPHO, 2024). The easy access of desludging service and availability of motorable road networks are the reasons for more mechanical emptying practice in the municipality.

The municipality does not provide and manage any desludging services. Also, there is no provision for registration of the service. However, there are few private desludging service providers serving in the municipality.

*Kathmandu Safety Tanki Sarsafai Sewa* is one of the private desludging service providers in the municipality among few others. It started the desludging service on 2018, but the company is not registered in any governmental agencies. The service provider has desludging vehicle with a tank capacity of 4,000 litres. The service charge for each trip is NRs. 4,500 - NRs.5,000 (USD 33.8 - USD 37.6). It generally has an average of 5-7 trips per week but not limited within Chandragiri Municipality. A driver and a helper are assigned for the desludging service (KII-2, 2023).

### 2.1.5 Treatment and Disposal/Reuse

Chandragiri Municipality has an emerging issue of FS treatment and its safe disposal (KII-1, 2023). It lacks adequate capacity of Faecal Sludge Treatment Plant (FSTP) that can treat FS generated within the municipality. However, there is a small-scale decentralized Faecal Sludge Treatment Plant in Amarawati Colony located in ward 8. The FSTP treats FS

generated from 85 households within the colony (KII-2, 2023). Additionally, 1% of households have installed biogas digester to treat their FS (ENPHO, 2024). To fuel up the improved sanitation in the municipality, a Wastewater Treatment Plant (WWTP) is being planned for 250 households in ward-10 at Boshigaun of the municipality (KII-1, 2023).

Currently, manually emptied FS is dig and dumped, applied into farmlands, composted or released into stormwater drain/sewer (ENPHO, 2024) while mechanically emptied FS is disposed of on privately owned land (KII-2, 2023). Though municipality has a small-scale FSTP and biogas digester installed at households, major portion of FS generated and collected are not treated or safely disposed safely.

### 2.1.6 Risk Assessment of Water Source Pollution

The risk of water source pollution was assessed based on source of drinking water, secondary data on water quality and the vulnerability of water source in regard to lateral spacing between sanitation system and the sources.

#### a. Sources of drinking water and water production

Approximately 86% of households in the Chandragiri Municipality have piped drinking water supply services while 6% of households get drinking water from community taps, 1% of households rely each on groundwater sources, spring sources, tanker water and 5% of households uses jar for drinking water. About 34 Water and Sanitation Users' Committee (WSUCs) are providing drinking water supply service at households and institutions in the municipality (ENPHO, 2024). Figure 15 shows groundwater and community tap in the municipality.



**Figure 15: Picture showing groundwater and community tap in Chandragiri Municipality.**

Matatirtha Mahadevsthan Water and Sanitation Users' Committee is one of the major water service providers in the municipality. It has been providing water supply services in ward 5, 6 and 7. It serves drinking water services to more than 4,500 households. Initially, the scheme supplied water from Matatirtha Kunda but at present, the scheme lifts water from 9 boring.

The lifted water from sources is collected on reservoir tank and distributed through pipeline at private taps in households. The WSUC tests water quality of the scheme in the interval of 3 months. The sample water from boring, reservoir tank and final outlet is taken for the testing.

However, the system does not use any water treatment option for the supplied water (KII-3, 2023).

Similarly, Tinthana Water and Sanitation Users' Committee is another water service provider in the municipality. Initially, Tinthana WSUC was established in 1960, later the water supply system was upgraded. The present water supply scheme was established in 2012. It supplies drinking water to 1520 households in ward 15 and has been planning to add 560 more service recipients next year. The scheme collects water from deep boring at a depth of 255 m located at Bhisnudevi Temple. The lifted water is collected and further processed for treatment. Water is treated through different components including sedimentation tank. It is further collected in reservoir tanks and distributed on taps at households. Water quality is tested regularly and water samples are taken from boring and final outlet i.e. tap (KII-3, 2023).

Apart from this water service provider, Bosigaun, Machhegaun, Satungal, Setidevi and Kalyanpur are some WSUC among others in the municipality (ENPHO, 2024) (KII-1, 2023). The water supply service is not uniformly distributed in the municipality thus, locals are obliged to rely on spring sources for drinking water supply.

#### **b. The vulnerability of spring source and water pollution**

The households using drinking water directly from spring source have their source located in less than 5 metres to more than 25 metres horizontally from their containment. A study suggests that *E. coli* can travel up to hundreds of meters horizontally in fractured rocks and gravels (Krishnan, 2011). As the geology of Chandragiri Municipality consists of rocky landscape, such as quartzite, granite and limestone as well as alluvial sediments i.e. sand, silt and clay along-with coarse gravels (Upreti, 1999), *E. coli* contamination is easy in groundwater and spring sources.

The water quality test report showed absence of *E. coli* on sample water tested from boring and reservoir tanks (Figure 16 and 17). Many study suggests that humic matter such as microorganisms in water can be removed naturally, in a period of time and in continuous flow of water (Balke & Zhu, 2008) (Odling, et al., 2020). Thus, it can be said that population consuming water from private taps are at insignificant risk of *E. coli* consumption while population accessing water directly from groundwater and spring sources can be at possible risk of it (Figure 16 and Figure 17).

According to the risk assessment carried out, all sanitation systems that could potentially pose a high risk of groundwater contamination were found to be located in areas classified as having a low risk of groundwater contamination, based on the considerations of the SFD methodology (T1A4C1, T1A4C10, T1A5C10 and T1A6C10).



**Government of Nepal**  
**Ministry of Water Supply**  
**Department of Water Supply and Sewerage Management**

**Central Water Quality Testing Laboratory**  
Panipokhari, Kathmandu

**WATER QUALITY TEST REPORT**

Name of Client:- Tinthana Khanepani WSP  
 Sampled By :- Client  
 Source of Sample:- Boring Water  
 Sampling Point:- Direct Boring  
 Location :- Chandragiri, Kathmandu  
 GPS:-

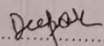
Date of Collection:- 2080/02/21  
 Date of Analysis:- 2079/02/21  
 Date of Completion:- 2079/02/28

| S.No. | Category        | Parameters                            | Observed Values | NDWQS, 2079 BS | Methods Used                                            |
|-------|-----------------|---------------------------------------|-----------------|----------------|---------------------------------------------------------|
| 1     | Physical        | Turbidity (NTU)                       | 4.8             | 5              | 2130 B, APHA, 21 <sup>st</sup> EDITION                  |
| 2     |                 | Temp. °C                              | 22              | -              | 2550 B, APHA, 21 <sup>st</sup> EDITION                  |
| 3     |                 | pH                                    | 7.16            | 6.5 - 8.5 *    | 4500-H <sup>+</sup> B, APHA, 21 <sup>st</sup> EDITION   |
| 4     |                 | Electrical Conductivity (µs/cm)       | 517             | 1500           | 2510 B, APHA, 21 <sup>st</sup> EDITION                  |
| 5     | Chemical        | Iron (mg/L)                           | 0.91            | 0.3 (3)        | 3111 B. APHA, 21 <sup>st</sup> EDITION                  |
| 6     |                 | Manganese (mg/L)                      | 0.5             | 0.2            | 3111 B. APHA, 21 <sup>st</sup> EDITION                  |
| 7     |                 | Arsenic (mg/L)                        | <0.01           | 0.05           | 3114 C, APHA, 21 <sup>st</sup> EDITION                  |
| 8     |                 | Ammonia (mg/L)                        | <0.2            | 1.5            | 4500-NH <sub>3</sub> C., APHA, 17 <sup>th</sup> EDITION |
| 9     |                 | Residual Chlorine (mg/L)              | -               | 0.1-0.5*       | COLORIMETRY                                             |
| 10    | Microbiological | Faecal coliform<br>E.coli(CFU/100 ml) | 0               | 0              | 9222 D., APHA, 21 <sup>st</sup> EDITION                 |

APHA: American Public Health Association, Standard Methods for Examination of Water & Waste Water  
 \* These values show lower and upper limits.

( ) Values in parentheses refer the acceptable values only when alternative is not available.

Note: - The entire test was conducted as per the National Drinking Water Quality Standard Guideline.  
 This test report refers only to the samples submitted to test.

  
 Analyzed By:

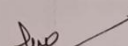
  
 Approved By:

Figure 16: Water quality test report of spring source of Tinthana Water Supply Scheme.



**Government of Nepal**  
**Ministry of Water Supply**  
**Department of Water Supply and Sewerage Management**  
**Central Water Quality Testing Laboratory**  
 Panipokhari, Kathmandu

### WATER QUALITY TEST REPORT

Name of Client:- Tinthana Khanepani WSP  
 Sampled By :- Client  
 Source of Sample: - Boring Water  
 Sampling Point: - RVT (Tank)  
 Location :- Chandragiri, Kathmandu  
 GPS:-

Date of Collection: - 2080/02/21  
 Date of Analysis: - 2079/02/21  
 Date of Completion: - 2079/02/28

| S.No. | Category        | Parameters                                    | Observed Values | NDWQS, 2079 BS | Methods Used                                           |
|-------|-----------------|-----------------------------------------------|-----------------|----------------|--------------------------------------------------------|
| 1     | Physical        | Turbidity (NTU)                               | 0.4             | 5              | 2130 B, APHA, 21 <sup>st</sup> EDITION                 |
| 2     |                 | Temp. °C                                      | 22              | -              | 2550 B, APHA, 21 <sup>st</sup> EDITION                 |
| 3     |                 | pH                                            | 7.85            | 6.5 - 8.5 *    | 4500-H <sup>+</sup> B, APHA, 21 <sup>st</sup> EDITION  |
| 4     |                 | Electrical Conductivity (µs/cm)               | 402             | 1500           | 2510 B, APHA, 21 <sup>st</sup> EDITION                 |
| 5     | Chemical        | Iron (mg/L)                                   | 0.03            | 0.3 (3)        | 3111 B, APHA, 21 <sup>st</sup> EDITION                 |
| 6     |                 | Manganese (mg/L)                              | 0.03            | 0.2            | 3111 B, APHA, 21 <sup>st</sup> EDITION                 |
| 7     |                 | Arsenic (mg/L)                                | -               | 0.05           | 3114 C, APHA, 21 <sup>st</sup> EDITION                 |
| 8     |                 | Ammonia (mg/L)                                | <0.2            | 1.5            | 4500-NH <sub>3</sub> C, APHA, 17 <sup>th</sup> EDITION |
| 9     |                 | Residual Chlorine (mg/L)                      | -               | 0.1-0.5*       | COLORIMETRY                                            |
| 10    | Microbiological | Faecal coliform<br><i>E.coli</i> (CFU/100 ml) | 0               | 0              | 9222 D., APHA, 21 <sup>st</sup> EDITION                |

APHA: American Public Health Association, Standard Methods for Examination of Water & Waste Water  
 \* These values show lower and upper limits.

( ) Values in parentheses refer the acceptable values only when alternative is not available.

Note: - The entire test was conducted as per the National Drinking Water Quality Standard Guideline.  
 This test report refers only to the samples submitted to test.

  
 Analyzed By:

  
 Approved By:

**Figure 17: Water quality test report of drinking water from Tinthana Water Supply Scheme.**

## 2.2 SFD Selection Grid

Figure 18 shows the types of sanitation technologies present in the Chandragiri Municipality selected in the Shit Flow Diagram (SFD) selection grid. The vertical column on the left side of grid represents sanitation technologies to which toilet is connected to, and horizontal row at top is connection of the technologies. The households with single pit and twin pits are selected as lined pit with semipermeable walls and open bottom in this selection grid.

| List A: Where does the toilet discharge to?<br>(i.e. what type of containment technology, if any?) | List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?) |                                    |                                  |                                      |                                                              |                              |               |                |                       |                                  |
|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------|--------------------------------------|--------------------------------------------------------------|------------------------------|---------------|----------------|-----------------------|----------------------------------|
|                                                                                                    | to centralised combined sewer                                                                                                | to centralised foul/separate sewer | to decentralised combined sewer  | to decentralised foul/separate sewer | to soakpit                                                   | to open drain or storm sewer | to water body | to open ground | to 'don't know where' | no outlet or overflow            |
| No onsite container. Toilet discharges directly to destination given in List B                     | T1A1C1                                                                                                                       |                                    |                                  |                                      | Significant risk of GW pollution<br>Low risk of GW pollution |                              |               |                |                       | Not Applicable                   |
| Septic tank                                                                                        | T1A2C1                                                                                                                       |                                    |                                  |                                      | Significant risk of GW pollution<br>Low risk of GW pollution |                              |               |                |                       |                                  |
| Fully lined tank (sealed)                                                                          | T1A3C1                                                                                                                       |                                    |                                  |                                      | Significant risk of GW pollution<br>Low risk of GW pollution | T1A3C6                       |               | T1A3C8         |                       | T1A3C10                          |
| Lined tank with impermeable walls and open bottom                                                  | Significant risk of GW pollution                                                                                             | Significant risk of GW pollution   | Significant risk of GW pollution | Significant risk of GW pollution     | Significant risk of GW pollution                             | T1A4C6                       |               | T1A4C8         |                       | Significant risk of GW pollution |
|                                                                                                    | T1A4C1                                                                                                                       | Low risk of GW pollution           | Low risk of GW pollution         | Low risk of GW pollution             | Low risk of GW pollution                                     |                              |               |                |                       | T1A4C10                          |
| Lined pit with semi-permeable walls and open bottom                                                | Not Applicable                                                                                                               |                                    |                                  |                                      |                                                              |                              |               |                |                       | Significant risk of GW pollution |
|                                                                                                    |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       | T1A5C10                          |
| Unlined pit                                                                                        |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       | Significant risk of GW pollution |
|                                                                                                    |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       | T1A6C10                          |
| Pit (all types), never emptied but abandoned when full and covered with soil                       |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       | Significant risk of GW pollution |
| Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil           | Low risk of GW pollution                                                                                                     |                                    |                                  |                                      |                                                              |                              |               |                |                       |                                  |
|                                                                                                    |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       |                                  |
| Toilet failed, damaged, collapsed or flooded                                                       |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       |                                  |
| Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded             |                                                                                                                              |                                    |                                  |                                      |                                                              |                              |               |                |                       |                                  |
| No toilet. Open defecation                                                                         | Not Applicable                                                                                                               |                                    |                                  |                                      |                                                              |                              |               | T1B11 C7 TO C9 |                       | Not Applicable                   |

**Figure 18: SFD selection grid for Chandragiri Municipality.**

The detail description of selected terms in the selection grid is provided in Table 4.

**Table 4: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 18.**

|        |                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T1A1C1 | A fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning centralised combined sewer. The excreta is raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system will contribute to variable W2.                                                                                                          |
| T1A2C1 | A correctly designed, properly constructed, fully functioning septic tank with an effluent outlet connected to a correctly designed, properly constructed, fully functioning centralised combined sewer. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, but since it is captured in the sewer, all the excreta in this system is considered contained. |
| T1A3C1 | A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults. Since the tank is fitted with a supernatant/effluent                         |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | overflow connected to a correctly designed, properly constructed and fully functioning centralised combined sewer, the excreta in this system is considered contained.                                                                                                                                                                                                                                                                                                                      |
| T1A3C6        | A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer the excreta in this system is considered NOT contained. |
| T1A3C8        | A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults. Since the tank is fitted with a supernatant/effluent overflow connected to open ground the excreta in this system is considered NOT contained.                  |
| T1A3C10       | A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults. However, since the tank is NOT fitted with a supernatant/effluent overflow this system is considered contained.                                                 |
| T1A4C1        | A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. Since the tank is fitted with a supernatant/effluent overflow connected to a centralised combined sewer, the excreta in this system is considered contained                           |
| T1A4C6        | A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer, the excreta in this system is considered NOT contained.                      |
| T1A4C8        | A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered NOT contained.                                       |
| T1A4C10       | A correctly designed, properly constructed and well maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks (e.g. cubluks in Indonesia). However, since the tank is NOT fitted with a supernatant/effluent overflow this system is considered contained.                                            |
| T1A5C10       | A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow, so this system is considered contained.                                                                                                                                                                                                     |
| T1A6C10       | A correctly designed, properly constructed and well maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow so this system is considered contained.                                                                                                                                                                                                                                         |
| T1B11C7 to C9 | With no toilet, users defecate in water bodies, on open ground and to don't know where; consequently, the excreta is NOT contained.                                                                                                                                                                                                                                                                                                                                                         |

## 2.3 SFD Matrix

### 2.3.1 Proportion of Faecal Sludge from types of sanitation technologies

The second step in the process of developing the SFD graphic is the calculation of the proportion of contents of each type of onsite container which is faecal sludge. SFD matrix

calculates the proportion of people using each type of system and the proportion of each system, from which FS and supernatant is emptied, transported and treated. A detailed instruction on how to calculate SFD proportion in SFD PI was used as guide to calculate SFD proportion. As stated on SFD PI, the default “100%” value is used for onsite containers which are connected to soak pits, water bodies or to open ground. This will model the contents as 100% faecal sludge and a proportion of this may be emptied periodically. The remaining not emptied fraction is made up of one or more of the following: faecal sludge which remains in the container, supernatant (when discharging to water bodies or to open ground), and infiltrate. The value for onsite containers that are connected to a sewer network or to open drains is used as “50%” which means half of the contents are modelled FS and a proportion of this may be emptied periodically. The remaining not emptied fraction will comprise faecal sludge which remains in the container and, in the case of open-bottomed tanks, infiltrate. The other half of the contents is modelled as supernatant discharging into the sewer network or to open drains. The formula obtained from SFD PI used for FS proportion calculation is shown below:

$$\frac{(\text{Onsite container connected to soak pit, no outlet, water bodies or open ground}) * 100 + (\text{Onsite container connected to sewer network or open drain}) * 50}{\text{Onsite Container}}$$

The calculated FS proportion in each type of sanitation technologies are:

- i. The proportion of FS in septic tanks is 50%, as all septic tanks are connected to sewer network in the municipality.
- ii. The proportion of FS in fully lined tanks is 95%, as the percentage of fully lined tanks which are connected to an open/stormwater drain and sewer network is only 3%.
- iii. The proportion of FS from lined tanks with open bottom and all types of pit is 99%, as the percentage of lined tanks with impermeable walls and open bottom and any pits which are connected to an open/stormwater drain and sewer network is only 2%.

Upon calculation of proportion of FS in each type of sanitation technologies, the population using the system selected in the SFD selection grid are fed in. The column Population (Pop) gives the proportion of population using type of sanitation system.

Figure 19 shows the SFD matrix of Chandragiri Municipality.

Chandragiri Municipality, Bagmati, Nepal, 13 May 2024. SFD Level: 2 - Intermediate SFD

Population: 136860

Proportion of tanks: septic tanks: 50%, fully lined tanks: 95%, lined, open bottom tanks: 99%

| Containment                                                                                            |                                                        |                                                                                              |                                                                                      |                                                                       |                                                                             |                                                                             |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| System type                                                                                            | Population                                             | WW transport                                                                                 | WW treatment                                                                         | FS emptying                                                           | FS transport                                                                | FS treatment                                                                | SN transport                                                                      | SN treatment                                                                                      | SN transport                                                                                          | SN treatment                                                                                                          |
|                                                                                                        | Pop                                                    | W4a                                                                                          | W5a                                                                                  | F3                                                                    | F4                                                                          | F5                                                                          | S4d                                                                               | S5d                                                                                               | S4e                                                                                                   | S5e                                                                                                                   |
| System label and description                                                                           | Proportion of population using this type of system (p) | Proportion of wastewater in sewer system, which is delivered to centralised treatment plants | Proportion of wastewater delivered to centralised treatment plants, which is treated | Proportion of this type of system from which faecal sludge is emptied | Proportion of faecal sludge emptied, which is delivered to treatment plants | Proportion of faecal sludge delivered to treatment plants, which is treated | Proportion of supernatant in sewer system, which is delivered to treatment plants | Proportion of supernatant in sewer system that is delivered to treatment plants, which is treated | Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants | Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated |
| T1A1C1<br>Toilet discharges directly to a centralised combined sewer                                   | 2.0                                                    | 0.0                                                                                          | 0.0                                                                                  |                                                                       |                                                                             |                                                                             |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A2C1<br>Septic tank connected to a centralised combined sewer                                        | 1.0                                                    |                                                                                              |                                                                                      | 24.0                                                                  | 0.0                                                                         | 0.0                                                                         | 0.0                                                                               | 0.0                                                                                               |                                                                                                       |                                                                                                                       |
| T1A3C1<br>Fully lined tank (sealed) connected to a centralised combined sewer                          | 1.0                                                    |                                                                                              |                                                                                      | 26.0                                                                  | 0.0                                                                         | 0.0                                                                         | 0.0                                                                               | 0.0                                                                                               |                                                                                                       |                                                                                                                       |
| T1A3C10<br>Fully lined tank (sealed), no outlet or overflow                                            | 25.0                                                   |                                                                                              |                                                                                      | 47.0                                                                  | 3.0                                                                         | 95.0                                                                        |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A3C6<br>Fully lined tank (sealed) connected to an open drain or storm sewer                          | 2.0                                                    |                                                                                              |                                                                                      | 0.0                                                                   | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   | 0.0                                                                                                   | 0.0                                                                                                                   |
| T1A3C8<br>Fully lined tank (sealed) connected to open ground                                           | 1.0                                                    |                                                                                              |                                                                                      | 40.0                                                                  | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A4C1<br>Lined tank with impermeable walls and open bottom, connected to centralised combined sewer   | 1.0                                                    |                                                                                              |                                                                                      | 26.0                                                                  | 0.0                                                                         | 0.0                                                                         | 0.0                                                                               | 0.0                                                                                               |                                                                                                       |                                                                                                                       |
| T1A4C10<br>Lined tank with impermeable walls and open bottom, no outlet or overflow                    | 51.0                                                   |                                                                                              |                                                                                      | 15.0                                                                  | 3.0                                                                         | 95.0                                                                        |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A4C6<br>Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer | 1.0                                                    |                                                                                              |                                                                                      | 0.0                                                                   | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   | 0.0                                                                                                   | 0.0                                                                                                                   |
| T1A4C8<br>Lined tank with impermeable walls and open bottom, connected to open ground                  | 2.0                                                    |                                                                                              |                                                                                      | 26.0                                                                  | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A5C10<br>Lined pit with semi-permeable walls and open bottom, no outlet or overflow                  | 11.0                                                   |                                                                                              |                                                                                      | 36.0                                                                  | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1A6C10<br>Unlined pit, no outlet or overflow                                                          | 1.0                                                    |                                                                                              |                                                                                      | 16.0                                                                  | 0.0                                                                         | 0.0                                                                         |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |
| T1B11 C7 TO C9<br>Open defecation                                                                      | 1.0                                                    |                                                                                              |                                                                                      |                                                                       |                                                                             |                                                                             |                                                                                   |                                                                                                   |                                                                                                       |                                                                                                                       |

Figure 19: SFD Matrix of Chandragiri Municipality.

### 2.3.2 Proportion of Faecal Sludge Emptied (F3)

The proportion of faecal sludge emptied (F3) is calculated based on percentage of containment emptied (ENPHO, 2024) and amount of FS emptied during the process (KII-2, 2023). The information on FS emptied from containment is obtained from the survey and from KII with desludging service providers. In an average 20% of the FS in the containment which is very thick and does not dissolve in water, is not removed during emptying (KII-2, 2023). Hence, actual proportion of FS emptied from each containment is calculated as:

$$\begin{aligned}
 &\text{Actual Proportion of FS emptied (F3)} \\
 &= \text{percentage of containment emptied} \\
 &\times \text{proportion of FS removed during emptying}
 \end{aligned}$$

Table 5 shows the actual proportion of FS emptied from each containment.

**Table 5: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2024<sup>(1)</sup>; KII-2, 2024<sup>(2)</sup>).**

| Sanitation Technologies                                                                      | SFD Reference Variable | Percentage of Population using | Empited Proportion of FS (1) | FS Empited from Containment (2) | Actual Proportion of Empited FS (F3) |
|----------------------------------------------------------------------------------------------|------------------------|--------------------------------|------------------------------|---------------------------------|--------------------------------------|
| Toilet discharges directly to a centralised combined sewer                                   | T1A1C1                 | 2%                             | 0%                           | 0%                              | 0%                                   |
| Septic tank connected to a centralised combined sewer                                        | T1A2C1                 | 1%                             | 30%                          | 80%                             | 24%                                  |
| Fully lined tank (sealed) connected to a centralised combined sewer                          | T1A3C1                 | 1%                             | 33%                          | 80%                             | 26%                                  |
| Fully lined tank (sealed) connected to an open drain or storm sewer                          | T1A3C6                 | 2%                             | 0%                           | 0%                              | 0%                                   |
| Fully lined tank (sealed) connected to open ground                                           | T1A3C8                 | 1%                             | 50%                          | 80%                             | 40%                                  |
| Fully lined tank (sealed), no outlet or overflow                                             | T1A3C10                | 25%                            | 59%                          | 80%                             | 47%                                  |
| Lined tank with impermeable walls and open bottom, connected to centralised combined sewer   | T1A4C1                 | 1%                             | 33%                          | 80%                             | 26%                                  |
| Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer | T1A4C6                 | 1%                             | 0%                           | 0%                              | 0%                                   |
| Lined tank with impermeable walls and open bottom, connected to open ground                  | T1A4C8                 | 2%                             | 32%                          | 80%                             | 26%                                  |
| Lined tank with impermeable walls and open bottom, no outlet or overflow                     | T1A4C10                | 51%                            | 19%                          | 80%                             | 15%                                  |
| Lined pit with semi-permeable walls and open bottom, no outlet or overflow                   | T1A5C10                | 11%                            | 45%                          | 80%                             | 36%                                  |
| Unlined pit, no outlet or overflow                                                           | T1A6C10                | 1%                             | 20%                          | 80%                             | 16%                                  |
| Open defecation                                                                              | T1B11 C7 TO C9         | 1%                             | 0%                           | 0%                              | 0%                                   |

### 2.3.3 Proportion of WW transported which is delivered to Treatment Plant (W4a and W5a)

The variable W4a is the proportion of wastewater in decentralised sewer network that is delivered to treatment plant and variable W5a is the proportion of wastewater delivered to treatment plant and treated. The amount of wastewater (WW) generated could not be measured and the municipality does not have wastewater treatment plant (WWTP).

Therefore, the wastewater is not treated and the value for variables W4a and W5a is set to 0%.

#### *2.3.4 Proportion of FS emptied which is delivered to Treatment Plant and treated (F4 and F5)*

The variable F4 is the proportion of FS that is delivered to treatment plant and F5 is the proportion of FS that is treated. Here, 3% of FS in Lined tank with impermeable walls and open bottom with no outlet or overflow (T1A4C10) is delivered to treatment plant. Also, 3% of FS from the biogas digester which is reclassified as fully lined tanks with no outlet or overflow (T1A3C10) is treated. Thus, the emptying proportion of FS for both systems are 3% ( $F4 = 3\%$ ) and the capacity of fully functioning FSTP and biogas digester is taken to 95% ( $F5 = 95\%$ ). Apart from biogas digester and FS delivered to FSTP, FS emptied from other sanitation technologies are applied in farmlands without treatment, disposed in an open environment, open/stormwater drain or in water bodies. Hence, the portion of FS delivered to treatment plant for the remaining technologies (F4) and treated (F5) is 0%.

#### *2.3.5 Proportion of Supernatant in Sewer System delivered to Treatment Plant (S4d and S5d)*

The variable S4d is the proportion of Supernatant (SN) in sewer system that is delivered to treatment plant and S5d is the proportion of SN that is treated. Since the municipality does not have WWTP, SN is disposed into waterbodies without treatment. Therefore, the value for variable S4d and S5d is set to 0%.

#### *2.3.6 Proportion of Supernatant in Open drain or Storm sewer delivered to Treatment Plant (S4e and S5e)*

The variable S4e is the proportion of Supernatant (SN) in open drain or storm sewer that is delivered to treatment plant and S5e is the proportion of SN that is treated. As there is no WWTP, SN is not treated and therefore, the value for variable S4e and S5e is set to 0%.

### 2.4 SFD Graphic

Figure 20 shows the SFD graphic of Chandragiri Municipality. The graphic shows that excreta generated from the proportion of the population that are safely managed is shown in green coloured arrowhead whereas unsafely managed excreta are shown in red coloured arrowhead. It shows that excreta from 67% of the population are safely managed and excreta from 33% of the population are unsafely managed. It also represents the sanitation value chain going from left to right.

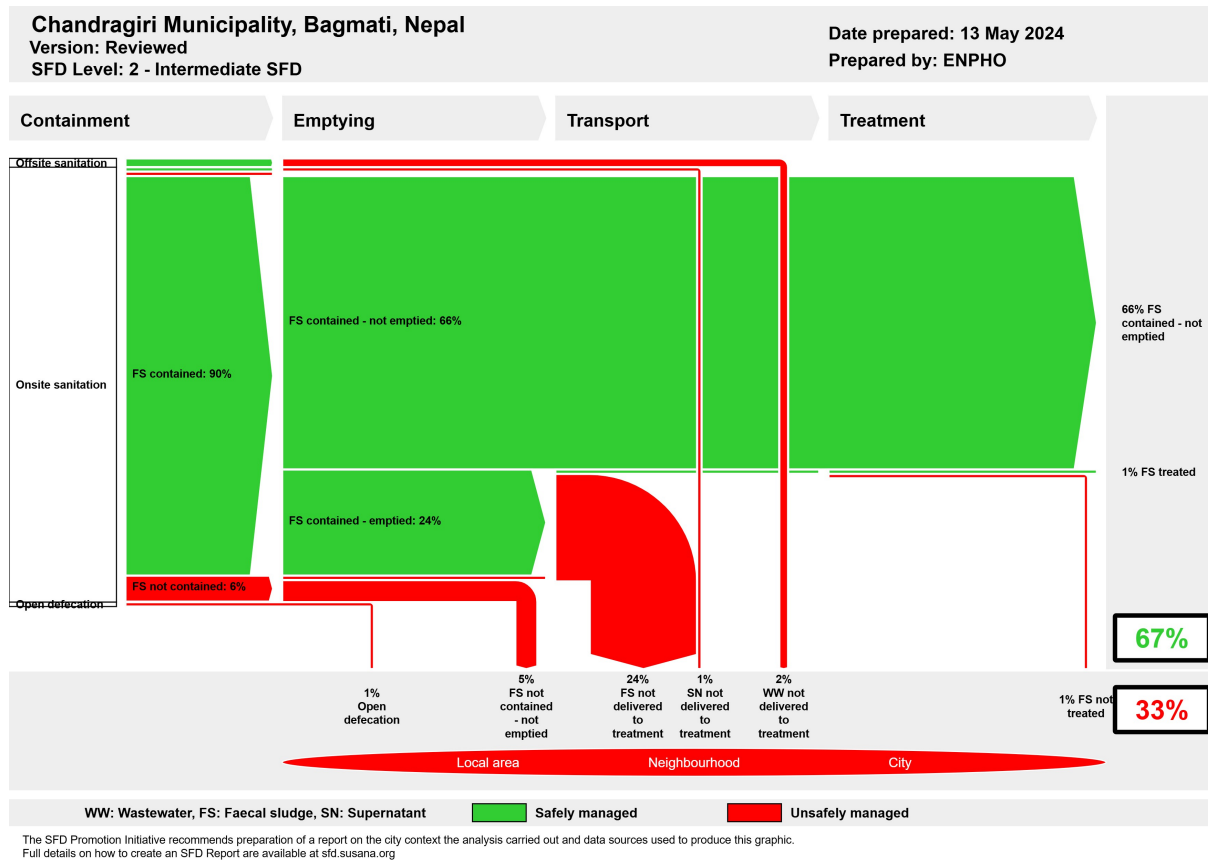


**Figure 20: SFD Graphic of Chandragiri Municipality.**

### Offsite Sanitation

Chandragiri Municipality has unauthorized sewer networks in some areas of different wards without WWTP. Thus, here 2% of households have offsite sanitation systems. The wastewater generated from these households is disposed to water bodies. Therefore, wastewater from 2% of the population is not treated and is unsafely managed.

### Onsite Sanitation

In the municipality, 97% of households rely on onsite sanitation systems. Of the total households having an onsite sanitation system, FS from 90% of the population is contained, while FS from 6% of population is not contained.

### **FS contained**

The definition of 'FS contained' is faecal sludge contained within an onsite sanitation technology which ensures safe level of protection from excreta i.e. pathogen transmission to the user or general public is limited. These are tanks or pits that are correctly designed, properly constructed, fully functioning, and/or are causing no risk- or only a 'low' risk- of polluting groundwater used for drinking (SuSanA, 2018).

The value of FS contained i.e. 90% is obtained from the summation of population using septic tanks connected to centralized combined sewer (T1A2C1), fully lined tanks connected to centralized combined sewer and with no outlet or overflow (T1A3C1 and T1A3C10), lined tanks with impermeable walls and open bottom connected to centralized combined sewer and with no outlet or overflow (T1A4C1 and T1A4C10), lined pits with semi-permeable walls

and open with no outlet or overflow (T1A5C10) and unlined pit with no outlet or overflow (T1A6C10) without posing a significant risk to groundwater.

***FS not Contained***

The definition of 'FS not contained' is faecal sludge contained within an onsite sanitation technology which does not ensure safe level of protection from excreta i.e. pathogen transmission to the user or general public is likely. These are tanks or pits that are incorrectly designed, or poorly constructed, or poorly functioning, and/or are causing a 'significant' risk of polluting groundwater used for drinking (SuSanA, 2018).

The value of FS not contained i.e. 6% is obtained from the population using fully lined tanks connected to an open drain or storm sewer and open ground (T1A3C6 and T1A3C8), lined tanks with impermeable walls and open bottom connected to an open drain or storm sewer and open ground (T1A4C6 and T1A4C8).

***FS contained not Emptied***

The value of 66% is obtained from the proportion of the population using sanitation systems where the FS is contained and have not emptied their containment. However, this 66% of safely managed FS should be considered as only temporary, as most of the pits and tanks have not yet filled up and the FS generated remains 'not emptied'. Therefore, these systems will require emptying services in the short and medium term as they fill up.

***FS contained - Emptied***

The value of 24% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

***FS not contained - Emptied***

The value of 1% is obtained from the proportion of the population using sanitation systems where the FS is not contained and have emptied their containment.

***FS not contained - not Emptied***

The value of 5% is obtained from the proportion of the population using sanitation systems where the FS is not contained and have not emptied their containment.

***FS not delivered to treatment***

The proportion of FS not delivered to treatment, i.e. 24%, is obtained from the FS contained emptied and FS not contained emptied which have not been delivered to biogas digester and FSTP.

***FS treated***

In the municipality, 1% of households have biogas digester and small-scale FSTP is in ward 10. Therefore, the amount of FS delivered to the FSTP and biogas digesters at households are treated. Thus, the proportion of FS treated i.e. 1% is obtained from the containment type fully lined tank with no outlet or overflow (T1A3C10) and lined tank with impermeable walls and open bottom with no outlet or overflow (T1A4C10).

***Supernatant (SN) not delivered to treatment***

The proportion of supernatant is obtained from containments connected to sewer networks, open drain or storm sewer. As the municipality does not have WWTP, the generated SN is disposed to water bodies directly. Hence, the proportion of SN not delivered to treatment is 1%.

***Open Defecation***

Despite Open Defecation Free (ODF) status, people residing in 1% of households still go for open defecation. Mostly, people living in poverty and who do not own land, do not have toilets.

### 3 Service delivery context

#### 3.1 Policy, legislation, and regulation

The constitution of Nepal 2015 has established right to access to clean drinking water and citizen as fundamental right. In Article 35 (4) related to right to health recognizes citizen's rights to access to clean drinking water and sanitation. In addition, Right to Clean Environment, Article 30 (1) recognizes that every person shall have the right to live in a healthy and clean environment (GoN 2015). To respect and promote the right of citizens to wards accessing clean drinking water and sanitation services, the government has promulgated and amended necessary laws. The most relevant legislation for promotion of safe sanitation services is discussed here.

##### **Local Government Operation Act, 2017**

Local Governance Operation Act 2017 has promulgated to implement the rights of local government and promote co-operation, co-existence, and co-ordination among federal, provincial, and local government. The act defined roles and responsibility of municipalities along with provision and procedure for approving laws and regulations at local level. Regarding the management of sanitation, the act entitles local government to conduct awareness campaigns, design and implement sanitation programs at the local level.

##### **Environment Protection Act, 2019**

Environment protection act 2019 is promulgated to prevent and control pollution from different development activities. It defines "Pollution" as the activities that significantly degrade, damage the environment, or harm the beneficial or useful purpose of the environment, by changing the environment directly or indirectly because of wastes, chemical, heat, noise, electrical, electro-magnetic wave, or radioactive ray. It provides the mechanism for appointing environmental inspector to control pollution by federal, provincial, and local government.

##### **Water Supply and Sanitation Act, 2022**

The act was promulgated to ensure the fundamental right of citizen to easy access on clean and quality drinking water, sanitation services and management of sewerage and wastewater. It defines sewerage and wastewater management as construction of sewer networks and treatment plants to preserve sources of water. It has entitled federal, provincial, and local level for the operation and management of water and sanitation services. The act also explicitly defines the responsibility of every citizen to preserve, conserve and maintain the sources of water and use responsibly.

##### **Environment Friendly Local Governance Framework 2013**

The environment-friendly local governance framework 2013 has been issued to add value to environment-friendly local development concept encouraging environmental protection through local bodies. The framework has set basic and advanced indicators for households, settlement, ward, village, municipality, and district levels for declaration of environment friendly. The use of water sealed toilets in households as basic indicators for sanitation and health. Provision of toilet with safety tank and use as advanced indicators for sanitation. Provision of gender, children and disabled friendly public toilets in parks, petrol pumps and main market as basic indicator for municipal level. Advance indicators such as drainage

discharged only after being processed through biological or engineering technique. While it has failed to identify the necessity of faecal sludge treatment plants as it has assumed safety tank in the households is sufficient for treating faecal sludge.

### **Institutional and Regulatory Framework for Faecal Sludge Management, 2017**

Ministry of Water Supply through its Department of Water Supply and Sewerage Management (DWSSM) articulated and endorsed Institutional and Regulatory Framework (IRF) for Faecal Sludge Management in Urban Areas of Nepal in 2017. The main objective of the IRF is to define the specific roles and responsibilities of key institutions for the effective management and regulation of faecal sludge management (FSM). The framework primarily envisioned featuring FSM in the national policy and issuing policy directives into local government to incorporate FSM in their urban planning along with strengthening and enhancing the capacity of the local government to deliver effective services. A local government has been endowed with overall responsibility to plan, implement, and regulate the FSM services within its jurisdiction. The provision of the ability to engage the private sector and other relevant stakeholders such as the Water and Sanitation Users Committee (WSUC) in the framework reflects a participatory approach that would help in sustaining the interventions.

### **Total Sanitation Guideline, 2017**

Total Sanitation Guideline was promulgated by the Ministry of Water Supply in April 2017 after the successful implementation of National Sanitation and Hygiene master Plan (NSHMP) 2011. It provides guidelines for sustaining ODF outcomes and initiating post-ODF activities through an integrated water, sanitation and hygiene plan at municipalities and districts. The guideline redefined sanitation as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish a hygienic environment and promote public health. Indicators are set to guide total sanitation movement with an arrangement for resource management, monitoring and evaluation, capacity building.

## **3.2 Policies**

Historically, the National Sanitation Policy (1994) was the guideline for the planning and implementation of sanitation programs. The policy had promoted sanitation issues together with issues on water supply in rural communities. Also, Rural Water Supply and Sanitation National Policy (RWSSNP) 2004, has set a new target to provide safe, reliable, and affordable water supply with basic sanitation facilities. The policy focused on delivering quality services on water and sanitation to the marginalized and vulnerable groups. However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery. Thus, the National Urban Water Supply and Sanitation Sector Policy (NUWSSSP) was formulated and enforced in 2009. It focused on achieving coherent, consistent, and uniform approaches of development in urban areas with the involvement of different agencies and institutions. Both these policies were limited to addressing emerging issues and challenges in the rural and urban areas. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by GON to address the emerging challenges and issues with the adoption of new approaches and resolve the inconsistency in RWSSNP and NUWSSSP.

The goal of the NWSSP was to reduce urban and rural poverty by ensuring equitable socio-economic development, improving health and the quality of life of the people and protection of environment through the provision of sustainable water supply and sanitation services. It adopted innovative technologies and knowledge emerged in the sector. Remarkably, it was the first official document that recognized discharge of untreated wastewater and dumping of septic sludge heavily polluted the surface water sources in urban areas.

Nepal is a signatory of the historical resolution of 2010 United Nations General Assembly on the Human Right to Water and Sanitation. Nepal committed to Millennium Development Goals (MDGs) for 2000- 2015. The goal was accomplished through declaration of the country as free from open defecation on 30<sup>th</sup> September 2019. After the MDGs, United Nations General Assembly set 17 global goals as Sustainable Development Goals (SDGs). Sanitation is prioritized on SDG 6. The target 6.2 of SDG 6 majorly focuses on sanitation. It mentioned to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations by 2030. In line with SDG 6.2, Nepal has targeted to provide improved sanitation to 95% households that are not shared and urban households with toilets connected to sewer system or proper FSM to 90% by 2030 (NPC, 2017). National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened institutional setup tier of government in a participatory approach. In an alignment total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

Similarly, Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (SDP 2016-2030) was formulated in 2016 for sector convergence, institutional and legal reforms, capacity development and establishing coordination and harmonization in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on Faecal Sludge Management in the sector for effective planning, implementation, and service delivery. Nepal was declared ODF nation on September 23, 2019 (MoWS, 2020) however, the target of 90% households with toilets connected to sewer system or proper FSM is yet to be achieved.

### 3.3 Institutional roles

Federal, provincial, and local government are entitled for implementation of water and sanitation programs to ensure the rights on access to safe water and sanitation.

#### **At Federal Government**

**National Planning Commission:** At the federal government, the National Planning Commission is the specialized and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs,

identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policy, plans and programs. It supports, facilitates, and coordinates with federal, provincial, and local government for developing policy plans and implementation.

**Ministry of Water Supply:** Ministry of Water Supply is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015). Under the MoWS, Department of Water Supply and Sewerage Management (DWSSM) plan and implement water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015). The organizational structure of DWSSM is shown in Figure 21.

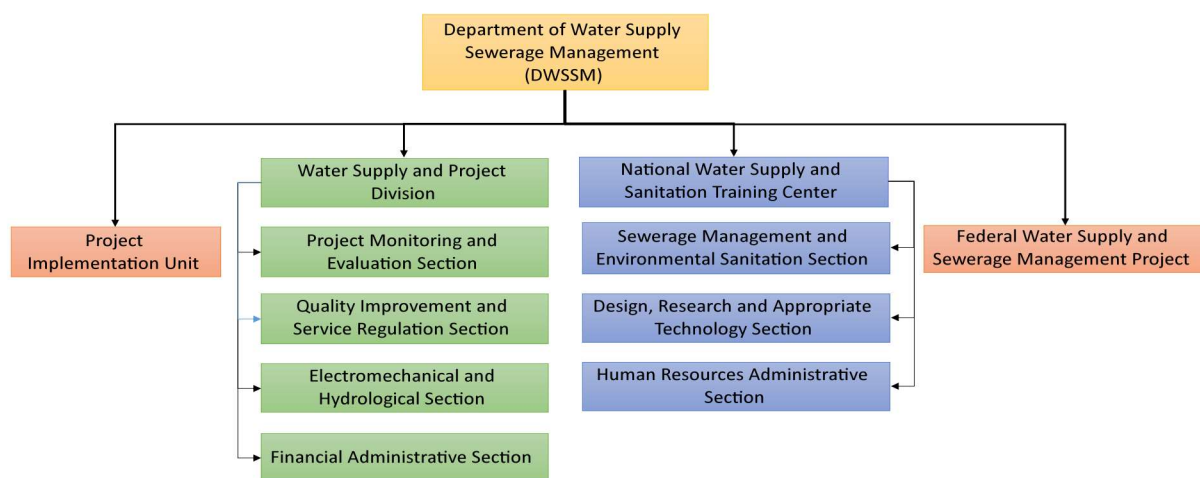


**Figure 21: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).**

**Ministry of Urban Development:** The Ministry of Urban Development (MoUD) works on integrated urban planning and development in municipalities, including faecal sludge management. Department of Urban Development and Building Construction (DUDBC) under MoUD is implementing body and sets the standards for safe, affordable building construction and implementation for managed residential environment.

#### At Provincial Level

**Ministry of Water Supply, Energy and Irrigation:** Ministry of Water Supply, Energy and Irrigation of provincial government in Bagmati Province is major executing body in the province for planning, developing, and implementing water supply and sanitation programs. Planning and implementation of water supply and sanitation infrastructure in Chandragiri is executed through Department of Water Supply and Sewerage Management (DWSSM), Kathmandu. DWSSM implements the water and sanitation programs meeting the following criteria:

- i. Inter local government projects.
- ii. Beneficiaries between 5,000 to 15,000 in terai region, 3,000 to 5,000 in hilly region and 5,00 to 1,000 in Himalayan region.

## At Local Level

The Environment and Disaster Risk Management Section in the Chandragiri Municipality is responsible for overall management of water supply and sanitation. This section oversees all the planning and operation related to environment, water supply, sanitation and disaster risk management.

### 3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasized the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, Public-Private Partnership Policy, 2015 encourages private sector investment in the development and operation of public infrastructure services for comprehensive socioeconomic development. The policy has aimed to remedy challenges such as structuring of projects, land acquisition, coordination and approval, payments to private sectors and approval for environment impact (MoF, 2015).

The municipality does not have a sewer network. The toilet system is directly connected to open drain, water bodies or open ground. The toilets that are connected to containments are emptied mechanically by desludging suction truck from municipality or private service providers whereas manually emptied by traditional desludgers.

### 3.5 Service standards

The sanitation service standards have been set by Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). It classifies sanitation services as high, medium, and basic based on sanitation facilities in place. The sanitation service levels with indicators are shown in Table 6. However, FSM specific standards have yet to be developed and implemented.

**Table 6: Sanitation Service Level and its Components.**

| S.N. | Service Components                                                                                 | Service Level |        |       |
|------|----------------------------------------------------------------------------------------------------|---------------|--------|-------|
|      |                                                                                                    | High          | Medium | Basic |
| 1    | Health and Hygiene Education                                                                       | ✓             | ✓      | ✓     |
| 2    | Household Latrine                                                                                  | ✓             | ✓      | ✓     |
| 3    | Public and School Toilets                                                                          | ✓             | ✓      | ✓     |
| 4    | Septic tank sludge collection, transport, treatment, and disposal                                  | ✓             | ✓      | ✓     |
| 5    | Surface drains for collection, transmission, and disposal of greywater                             | ✓             | ✓      | ✓     |
| 6    | Small-bore sewer collection for toilet and septic tank effluent, low-cost treatment and disposal   |               | ✓      |       |
| 7    | Sanitary sewers for wastewater collection, transmission, non-conventional treatment, and disposal  | ✓             |        |       |
| 8    | Sanitary sewers for wastewater collection, the transmission of conventional treatment and disposal | ✓             |        |       |
| 9    | Limited solid waste collection and safe disposal                                                   | ✓             | ✓      | ✓     |

## 4 Stakeholder Engagement

### 4.1 Key Informant Interviews

The Key Informant Interviews (KIIs) and objective sharing of the study were conducted with major stakeholders of the sanitation sector in the municipality. The focal person at the municipality was interviewed on current sanitation services with respect to technical, institutional, and financial aspects. Also, the KII was performed with the private desludging service provider to understand the emptying practice, disposal and treatment of FS as well as finance requirement. Similarly, information related to drinking water supply was obtained from Water Supply Users' Committee. Also, an interview was performed with caretaker of public toilet along with observation to find sanitation status and management practice of public toilet. The list of stakeholders and pictures of KII is present in the Table 7 and Figure 22.

**Table 7: List of Key Informant Interviewed personnel.**

| S.N. | Name                         | Designation            | Organization/Company                                          | Purpose of KII                                                                                  | Date              |
|------|------------------------------|------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------|
| 1.   | Bhadra Aryal (KII-1)         | Senior Section Officer | Chandragiri Municipality                                      | Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development | 23 December, 2023 |
| 2.   | Gunja Bahadur Tamang (KII-2) | Driver                 | Private Desludging Service Provider                           | Emptying practices, finances requirement, disposal and treatment                                | 23 December, 2023 |
| 3.   | Toran Thapa (KII-3)          | Chairperson            | Tinthana Water and Sanitation Users' Committee                | Water supply services and water quality in Chandragiri Municipality                             | 23 December, 2023 |
| 4.   | (KII-3)                      | Chairperson            | MahadevsthanMat atirtha Water and Sanitation Users' Committee | Water supply services and water quality in Chandragiri Municipality                             | 23 December, 2023 |
| 5.   | Birendra Deula (KII-4)       | Caretaker              | Public toilet-Nagdhunga Buspark                               | Quantitative and qualitative management on public toilet and public toilet operation            | 9 February, 2024  |



**Figure 22: KII with municipal representatives and representatives of WSUCs at Chandragiri.**

## 4.2 Household Survey

A random household survey was conducted in all wards of the municipality. The local enumerators selected from the municipality were oriented prior to the survey and were mobilized for data collection. A mobile application “KOBOLLECT” was used for data collection from the households. In the orientation, enumerators were clarified on survey objectives, technical terms concerning sanitation, use of the mobile application and procedure of random sampling survey based on the provided map (Figure 23).



Figure 23: SFD orientation to local enumerators for data collection.

### 4.2.1 Determining Sample Size

The number of households to be sampled in the municipality was determined by using Cochran (1963:75) sample size formula  $n_o = \frac{z^2 p q}{e^2}$  and its finite population correction for the proportion  $n = n_o / (1 + (n_o - 1) / N)$ .

Where,

|                |       |                                                                                                                                                                                                                                                                                                              |
|----------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Z <sup>2</sup> | 1.96  | At the confidence level of 95%                                                                                                                                                                                                                                                                               |
| p              | 0.5   | Assuming that about 50% of the population should have some sanitation characteristics that need to be studied (this was set at 50% since this percentage would yield the maximum sample size as the percentage of the population practising some form of sanitation is not known at the intervention sites). |
| q              | 1-p   |                                                                                                                                                                                                                                                                                                              |
| e              | +/-3% | Level of precision or sampling error.                                                                                                                                                                                                                                                                        |
| N              |       | A total number of population (households in the municipality).                                                                                                                                                                                                                                               |

This is followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample sized required in each ward is calculated as

$n_h = (N_h / N) * n$ , where  $N_h$  is a total population in each stratum.

A total of 1037 households were sampled from 35,994 households distributed in 15 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 24.

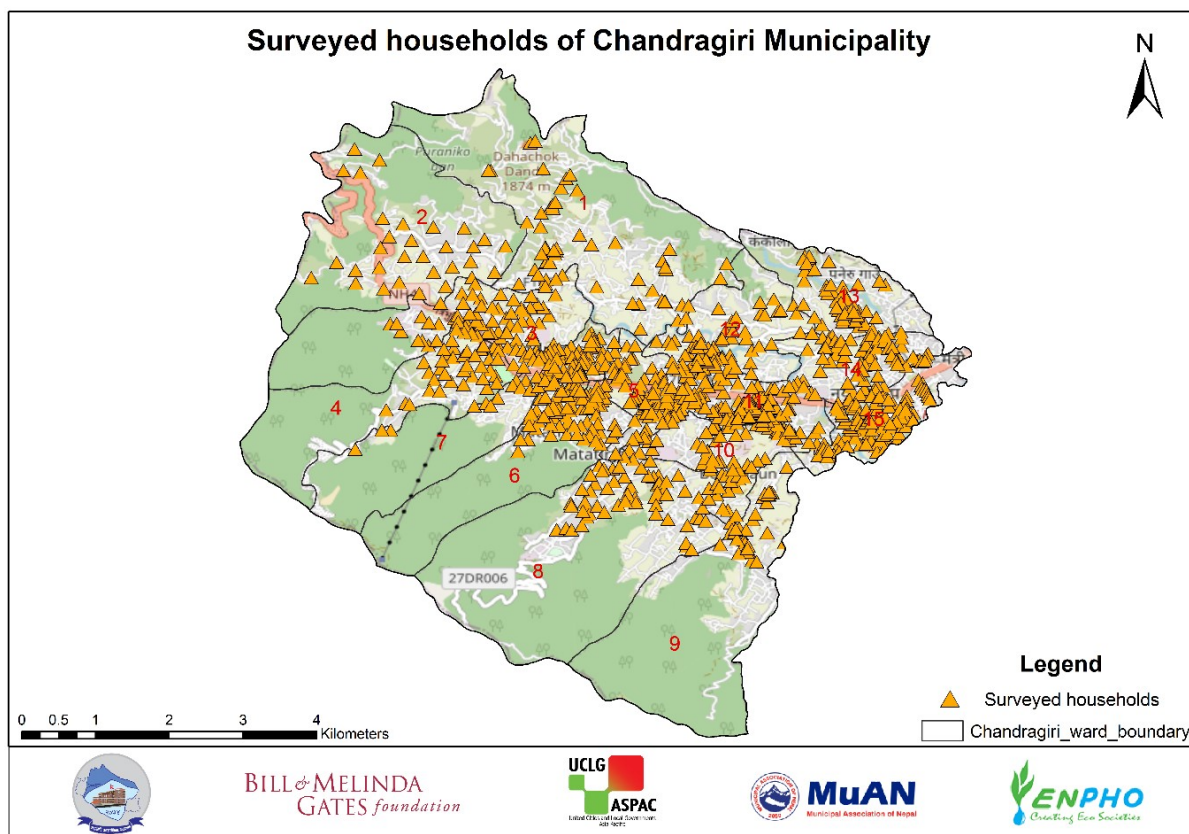


**Figure 24: Location map of surveyed households.**

### 4.3 Direct Observation

Various sanitation technologies in the households were observed and visual references were kept. Also, observation of the public toilets was carried out. Figure 25 shows status of open/stormwater drain in the localities of Chandragiri Municipality.



**Figure 25: Enumerators during household survey at Chandragiri Municipality.**

#### 4.4 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation Workshop was conducted at Chandragiri Municipality to share the findings on sanitation situation survey and receive the suggestions from the municipal stakeholders. Altogether, 36 participants including Mayor, Deputy Mayor, CAO, ward chairpersons, municipal council members, sectoral staffs and other relevant stakeholders actively participated on the workshop and provided valuable suggestions. Participants recognized the pressing need on FSM in the municipality and agreed to keep it as an agenda for municipal planning meeting. Figure 26 shows the picture of SFD findings sharing to the participants. The list of participants with their designation is attached in Appendix 4.



Figure 26: Sharing of findings during validation workshop.

## 5 Acknowledgements

We would like to acknowledge the executing agency, United Cities Local Government – Asia Pacific (UCLG ASPAC) and implementing agency Municipal Association of Nepal (MuAN) of the Municipalities Advocacy on Sanitation in South Asia – II (MuNASS-II) for coordination with the municipality.

We offer sincere acknowledgement to Mr. Ghanashyam Giri, Mayor, Ms. Basanti Shrestha, Deputy Mayor and Ms. Bhadra Aryal, Senior Section Officer of Environment and Disaster Risk Management Section of the municipality for providing valuable time and information during study. Similarly, we would like to thank all the respective staffs of the municipality and key stakeholders involved during the study, without whose help this study would not have been completed.

We would like to appreciate Dr. Roshan Raj Shrestha, Deputy Director of Bill and Melinda Gates Foundation (BMGF), Mr. Ashok Kumar Byanju Shrestha, Former President, UCLG ASPAC and Dr. Bernadia Irawati Tjandradewi, Secretary General, UCLG ASPAC. Similarly, we are very much obliged to Mr. Bhim Prasad Dhungana, President, MUAN and Co-President, UCLG ASPAC, Mr. Kalanidhi Devkota, Executive Director and Mr. Muskan Shrestha, Sanitation Advocacy Specialist of MuAN for their support during the study.

We are grateful to Ms. Bhawana Sharma, Executive Director and Mr. Rajendra Shrestha, Program Director of Environment and Public Health Organization (ENPHO) for tremendous support and guidance during the whole process of the study. Together, we would like to thank the entire team of ENPHO for their support and MuNASS-II team without whom the study would not have been possible.

We are grateful towards the enumerators, Ms. Radha Maharjan, Ms. Bhawana Suwal, Mr. Amrit Maharjan, Ms. Neha Basnet, Mr. Deepak Maharjan, Ms. Bimala Shahi Thakuri, Ms. Satya Devi Thapa, Ms. Puspa Pudasaini, Ms. Babita Bhadel, Ms. Binu Shrestha, Ms. Gyani Shova Maharjan, Mr. Regain Maharjan, Mr. Samir Pariyar, Ms. Sangeeta Kharel, Mr. Shashank Gopali and Ms. Shristina Maharjan for their support during the survey.

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KII-2, 2023. *FS Emptying, Disposal and Treatment Practice in Chandragiri Municipality*. Chandragiri: s.n.

KII-3, 2023. *Water Supply and quality of water in Chandragiri Municipality*. Chandragiri: s.n.

KII-4, 2024. *Public toilet operation, management and services data of Chandragiri Municipality*. Chandragiri: s.n.

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## 7 Appendix Annexes

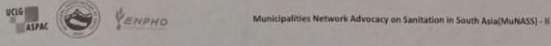
### 7.1 Appendix 1: Roles and Responsibility of Various Tiers of Governments Delineated in Drafted SDP 2016 – 2030

| System Classification |                           | Minimum Key HR Required                       | Regulation & Surveillance            | Financing & Construction                                | Ownership of System | Service Delivery                  |            |
|-----------------------|---------------------------|-----------------------------------------------|--------------------------------------|---------------------------------------------------------|---------------------|-----------------------------------|------------|
| Size                  | Sanitation                |                                               |                                      |                                                         |                     | Provision                         | Production |
| Small                 | Onsite sanitation         | Water Supply and Sanitation Technician (WSST) | Federal and or Provincial Government | User+ / community+ / other                              |                     |                                   |            |
| Medium                | Septage Management        | Sub-engineer                                  | Federal and or Provincial Government | Provincial+ / Local Govt+ / Community+ / Private Sector | Local Govt          | Users committee / Utility manager |            |
| Large                 | Septage or FSM Management | WASH Engineer + finance & admin staff         | Federal and or Provincial Government | Provincial+ / Local Govt+ / Community+ / Private Sector | Local Govt          | Utility Manager                   |            |
| Mega                  | Septage/ FSM Management   | WASH Engineer + finance & admin staff         | Federal and or Provincial Government | Provincial+ / Local Govt+ / Community+ / Private Sector | Local Govt          | Utility Manager                   |            |

## 7.2 Appendix 2: Total number of population and household in each ward and number of surveyed households

| Wards        | Total Population | Total Household | No. of Surveyed Households |
|--------------|------------------|-----------------|----------------------------|
| 1            | 7,320            | 1,837           | 53                         |
| 2            | 5,295            | 1,292           | 37                         |
| 3            | 9,827            | 2,578           | 74                         |
| 4            | 6,294            | 1,491           | 43                         |
| 5            | 11,407           | 3,068           | 90                         |
| 6            | 9,458            | 2,489           | 72                         |
| 7            | 8,582            | 2,350           | 69                         |
| 8            | 8,716            | 2,238           | 64                         |
| 9            | 6,069            | 1,457           | 42                         |
| 10           | 10,640           | 2,974           | 87                         |
| 11           | 8,100            | 2,222           | 64                         |
| 12           | 12,977           | 3,397           | 97                         |
| 13           | 7,735            | 1,963           | 57                         |
| 14           | 11,661           | 3,092           | 88                         |
| 15           | 12,779           | 3,546           | 100                        |
| <b>Total</b> | <b>136,860</b>   | <b>35,994</b>   | <b>1,037</b>               |

### 7.3 Appendix 3: List of Participants on SFD Survey Orientation



**Program:** SFD orientation on chandragiri municipality  
**Date:** 2080/09/12  
**Venue:** Chandragiri Municipality office

Attendance Sheet

| S.N | Name                    | Organization | Designation | Phone no   | Signature   |             | Age | Gender | Ethnicity |
|-----|-------------------------|--------------|-------------|------------|-------------|-------------|-----|--------|-----------|
|     |                         |              |             |            | Day 1       | Day 2       |     |        |           |
| 1   | Bhawana Suwal           | Ward-03      | Enumerator  | 9813053551 | [Signature] | [Signature] | 22  | F      | 3         |
| 2   | Sangeeta Kharel         | Ward-08      | "           | 9841867738 | [Signature] | [Signature] | 36  | F      | 2         |
| 3   | Amrit Maharjan          | Ward-05      | "           | 9860803073 | [Signature] | [Signature] | 28  | M      | 3         |
| 4   | Uttam Shrestha Maharjan | Ward-10      | "           | 9841938161 | [Signature] | [Signature] | 39  | F      | 3         |
| 5   | Shashank Gopal          | Ward-04      | "           | 9860980778 | [Signature] | [Signature] | 20  | M      | 3         |
| 6   | Puspa Pudasaini         | Ward-15      | "           | 9860149801 | [Signature] | [Signature] | 27  | F      | 2         |
| 7   | Shristina Maharjan      | Ward-11      | "           | 9808004990 | [Signature] | [Signature] | 20  | F      | 3         |
| 8   | Bimala Shah Thakuri     | Ward-13      | "           | 9849936002 | [Signature] | [Signature] | 38  | F      | 2         |
| 9   | Satyadev Thapa          | Ward-02      | "           | 9849475220 | [Signature] | [Signature] | 28  | F      | 2         |
| 10  | Samip Pokka             | Ward-14      | "           | 9803127667 | [Signature] | [Signature] | 20  | M      | 2         |
| 11  | Rohit Maharjan          | Ward-12      | "           | 9843686289 | [Signature] | [Signature] | 26  | M      | 3         |
| 12  | Jamir Panyar            | Ward-2       | "           | 9869070143 | [Signature] | [Signature] | 22  | M      | 1         |
| 13  | Regain Manandhar        | Ward-9       | "           | 9861755635 | [Signature] | [Signature] | 21  | M      | 3         |
| 14  | Neha Basnet             | Ward-6       | "           | 9877393999 | [Signature] | [Signature] | 20  | F      | 3         |
| 15  | Binu Shrestha           | Ward-7       | "           | 9808259187 | [Signature] | [Signature] | 26  | F      | 3         |
| 16  | Regain Manandhar        | Ward-9       | "           | 9861755635 | [Signature] | [Signature] |     |        |           |
| 16  | Bimala Shah Thakuri     | Ward-13      | "           | 9849936002 | [Signature] | [Signature] | 38  | F      | 2         |

## 7.4 Appendix 4: List of Participants in Sharing and Validation Workshop

आज मिति २०२५ साल जेठ २५ गतेको दिन चन्द्रागिरि नगरपालिका नेपाल नगरपालिका संघको आयोजनामा, काठमाडौं र जलवाह्य सेवा (खानेपानी)को प्राविधिक सहयोग, The United Cities-Local Government Asia Pacific (UCLG-ASPAC) को सहकार्यमा र Bill and Melinda Gates Foundation (BMGF) को आर्थिक सहयोगमा मानव मलसु र रक्षाक्षित प्रवाह चित्र (Shit Flow Diagram-SFD) को समीक्षा र दस्तावेज तथा प्रमाणिकरण कार्यक्रममा निम्न अनुसारको सहभागिता भएको उपस्थिति रहेको छ।

| क्र.सं. | नाम                 | पद                      | कार्यलय           | फोन नं.    | हस्ताक्षर   |
|---------|---------------------|-------------------------|-------------------|------------|-------------|
| १.      | चन्द्रशम शिरी       | नगर-प्रमुख              | चन्द्रागिरि न.पा. | ९८५१०५०१६  | [Signature] |
| २.      | बसन्ती श्रेष्ठ      | नगर उप-प्रमुख           | "                 | ९८५१५४९१७  | [Signature] |
| ३.      | हेमराज अर्याल       | प्रमुख प्रशासकीय अधिकृत | "                 | ९८५१३५३२१३ | [Signature] |
| ४.      | नेवराज उपाध्याय     | का.वा.अध्यक्ष           | "                 | ९८५१६३९७०५ | [Signature] |
| ५.      | जिमिला पुला         | का.पा.सदस्य             | "                 | ९८५१५९५५५  | [Signature] |
| ६.      | सुलना कार्की        | का.पा.सदस्य             | "                 | ९८६०९७३५५  | [Signature] |
| ७.      | पारिजात महर्जन      | का.पा.सदस्य             | "                 | ९८१८६२०३१३ | [Signature] |
| ८.      | विष्णु शर्मा शिवा   | नगर-प्रमुख              | नगर-प्रमुख        | ९८४२०८८३५३ | [Signature] |
| ९.      | राजेश्वर शर्मा      | नगर-प्रमुख              | "                 | ९८४२०८८३५३ | [Signature] |
| १०.     | दामोदर शर्मा        | नगर-प्रमुख              | नगर-प्रमुख        | ९८४६५२४२०२ | [Signature] |
| ११.     | राजेश्वर शर्मा      | नगर-प्रमुख              | नगर-प्रमुख        | ९८४६५२४२०२ | [Signature] |
| १२.     | कुषण प्रसाद श्रेष्ठ | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १३.     | राजेश्वर शर्मा      | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १४.     | श्रीकृष्ण शर्मा     | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १५.     | चन्द्रशम शिरी       | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १६.     | नरेन्द्र शर्मा      | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १७.     | अमिता शर्मा         | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १८.     | उमा शर्मा           | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| १९.     | चन्द्र शर्मा        | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| २०.     | प्रकाश शर्मा        | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |
| २१.     | श्रीका शर्मा        | नगर-प्रमुख              | नगर-प्रमुख        | ९८५१०४०२०५ | [Signature] |

| क्र.सं. | नाम               | पद               | कार्यालय   | फोन नं.    | हस्ताक्षर |
|---------|-------------------|------------------|------------|------------|-----------|
| ११.     | आमिता खलकोटी      | कार्यालयिका सहाय | चन्द्रगिरि | ९८८१३८७६०२ |           |
| १२.     | सुजन राज खनाल     | प्रशिक्षण दस्ता  | च.ग.म.     | ९८४९८५५८९६ |           |
| १३.     | अरुण अरुण         | वी.डी.डी.        | "          | ९८६०५५५८३९ |           |
| १४.     | महेश्वरी महर्जन   | म.स.             | "          | ९८१०२५६१३३ |           |
| १५.     | अरुण गजरा         | र.               | "          | ९८५५१९७२२५ |           |
| १६.     | विजय परियार       | न.प्र.ज.         | "          | ९८८९९४२९८२ |           |
| १७.     | प्रेम प्रसाद जोशी | न.प्र.ज.         | "          | ९८४०८६९१६७ |           |
| १८.     | हेमकुमार खड्का    | न.प्र.ज.         | "          | ९८२३३८१४४० |           |
| १९.     | पारस महर्जन       | मालिक            | "          | ९८५१८०६०४४ |           |
| २०.     | सुशान्त लकमी      | "                | "          | ९८६०४०७५०५ |           |
| २१.     | सागरनाथ पाण्डे    | व.सहाय           | "          | ९८४०६२९०९  |           |
| २२.     | उमा गिरी          | न.प्र.ज.         | "          | ९८४८८८५९८८ |           |
| २३.     | सुरेश्वरी खत्री   | "                | "          | ९८४८५६९१०  |           |
| २४.     | सिजेना आचार्य     | "                | "          | ९८४८५४७३५  |           |
| २५.     | अनिश्वर लाम्छे    | "                | "          | ९८४८५४७३५  |           |
| २६.     | धुव योन्          | "                | "          | ९८४८५४७३५  |           |
| २७.     | अनिता कुँ         | A.P.O.           | ENPHO      | ९८४९३५८१९७ |           |

## SFD Chandragiri Municipality, Nepal, 2026

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