

# **SFD Report**

## **Dhankuta Municipality Nepal**

### **Final Report**

This SFD Intermediate Report - SFD level 2 - was  
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## SFD Report Dhankuta Municipality, Nepal, 2026

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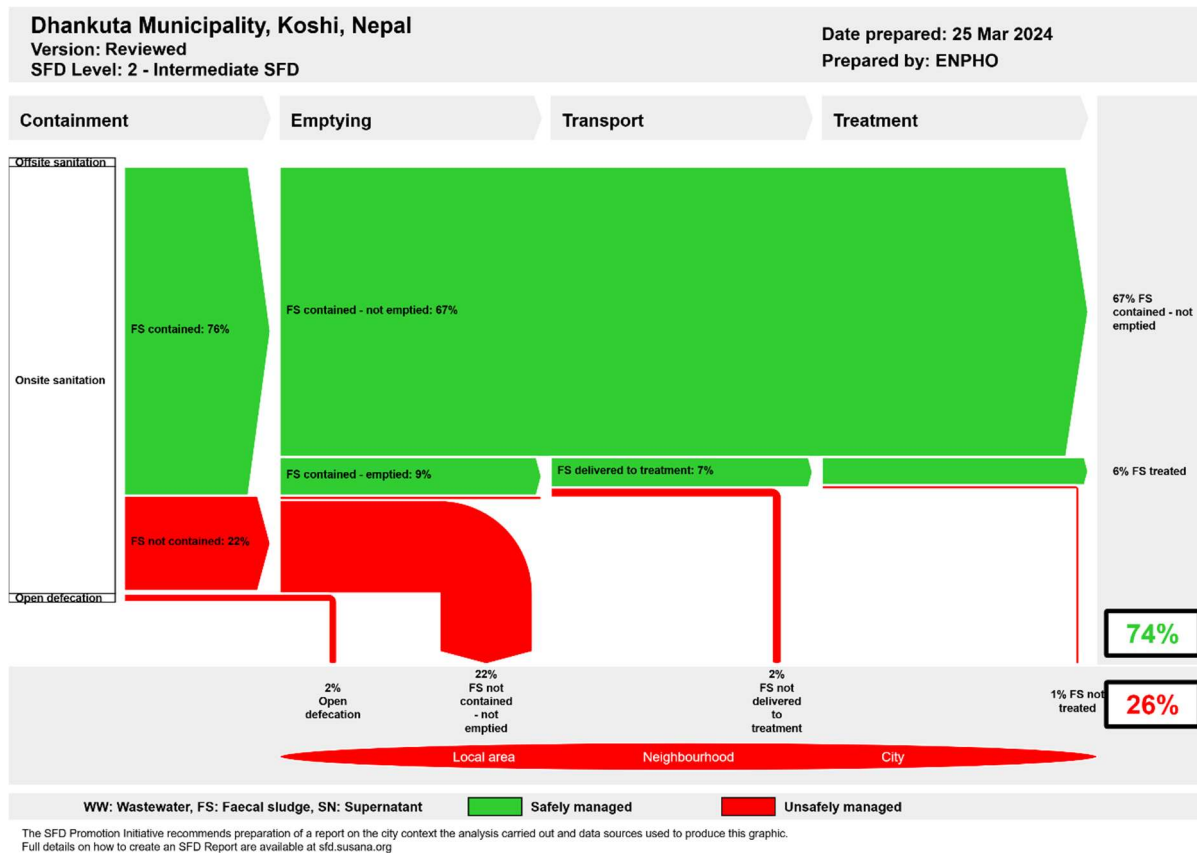
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## 1. The SFD Graphic



## 2. Diagram information

### SFD Level:

This SFD is a level 2 - Intermediate report.

### Produced by:

Environment and Public Health Organization (ENPHO).

### Collaborating partners:

Dhankuta Municipality

Municipal Association of Nepal (MuAN)

United Cities and Local Governments Asia-Pacific (UCLG ASPAC)

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## 3. General city information

Dhankuta Municipality is located in the Dhankuta district of Koshi Province, eastern Nepal. It comprises 10 wards spread across an area of 111 sq.km. It had a population of 35,983 individuals residing in 9,637 households as of the 2021 census. The population density is 324.6 persons/km<sup>2</sup>. The city is also known as the "Cleanest City" in Nepal.

Dhankuta has a warm, temperate climate (Cwa) with an average temperature of 19.3 °C | 66.7 °F. It is situated between 250 m to 2,144 m above sea level, and susceptible to landslides and earthquakes due to its fragile geology. The municipality is approximately 48 km north of Dharan, 89 km from Biratnagar, and around 350 km east of Kathmandu. Geologically, it lies within the Mahabharata range, characterised by various rocks and predominantly sandy soil, with loamy soil in the eastern part.

## 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 study (ENPHO, 2024).

**Containment:** Of the total population of the municipality, 98% has access to improved sanitation, relying on onsite sanitation systems. Notably, 9% installed fully lined tanks, 7% used biogas digesters, 44% used lined tanks with impermeable walls and open bottoms, and 38% had unlined pits.

All 37 surveyed institutions in the municipality have access to a safely managed sanitation system: 22% have fully lined tanks, 73% have lined tanks with impermeable walls and open bottoms, 5% have constructed unlined pits.

**Emptying and transportation:** Among the households with containment, 12.1% have emptied their containment due to faecal sludge overflow using mechanical desludging vehicles. About 35.2% of the population opts for mechanical emptying, while a significant 64.8% relied on manual emptying using traditional sanitation workers. The municipal desludging services has a vehicle of capacity 5,000-litre, offers on-demand emptying services, with costs varying based on containment shape. Within the municipality, the cost is \$26.20 (Rs. 6,000) per trip for rectangular tanks. Notably, only 8% of institutions undergo mechanical desludging, highlighting a critical gap in maintenance practices across both household and institutional sanitation infrastructure.

**Treatment and Disposal:** There is faecal sludge drying bed constructed to treat collected sludge from municipal desludging vehicles in Dhankuta Municipality. The effluent from the drying bed flows to stone masonry-lined soak pits. This drying bed was established under the Small Towns Water Supply and Sanitation Sector Project, Phase II, led by the Government of Nepal and the Asian Development Bank. The dried sludge serves as fertilizer for local farmers. Furthermore, individuals who manually emptied pits apply the sludge directly onto farmland. Moreover, many individuals opt to dig new pits, abandoning the old ones.

**Risk Assessment:** The survey findings indicated that 56.6% had a private tap at home, and 6.8% depended on public taps. Additionally, 35.2% consumed spring source, while 1.4% used jar water. Key Informant Interviews (KIIs) findings showed Dhankuta Municipality Water Supply and Sanitation Users Committee supplied piped drinking water to households in wards 3, 4, 5, 6, and 7 covering 3,700 households.

People who use open-bottom tanks and handpumps with a horizontal distance of less than 25 feet (7.6 m) from the source of pollutants are thought to be at significant risk of groundwater pollution. Additionally, some communities directly consume untreated water from sources like springs, posing serious health risks. The proximity of spring sources to open-bottom containment systems play a crucial role in contamination risk assessment, with springs located above residential areas posing a lower risk. Thus, various water quality tests conducted on different water sources were assessed to calculate the risk of contamination from open-bottom containment. E. coli, indicating faecal contamination, was examined in accordance with WHO guidelines and the National Drinking Water Quality Standard of 2022.

The SFD graphic showed that 74% of the excreta or faecal sludge generated are safely managed, while 26% are unsafely managed. The safely managed Faecal Sludge (FS) generated by 67% of the population is temporary as this FS is only contained. So, once the containment gets filled and the FS from the containment is emptied, the percentage of unsafely managed FS would increase.

## 5. Service delivery context

Access to safe 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 citizens embedded in the constitution, the Government of Nepal (GoN) has endorsed the Water Supply and Sanitation Act 2022 which has emphasised 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 need of people.

Particularly, the National Sanitation and Hygiene Master Plan (NSHMP) 2011 has proved as an important strategic document for all stakeholders to develop uniform programs and implementation mechanisms at all levels. It strengthens institutional set up with the formation of water and sanitation coordination committees at every tier of government to actively engage in sanitation campaigns.

The municipality is actively engaged in solid waste management and has been recognised as the cleanest city in Nepal. A significant aspect of their efforts involves faecal sludge management, exemplified by the construction of drying beds to treat collected sludge from municipal desludging vehicles.

## 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 / Organisations                                                       |
|----------------------------------------------|------------------------------------------------------------------------------------|
| Public Institutions at Federal Government    | Ministry of Water Supply                                                           |
| Public Institutions at Provincial Government | Ministry of Water Supply, Irrigation and Energy                                    |
| Public Institutions at Local Government      | Dhankuta Municipality, Dhankuta Water Supply and Sanitation Users Committee (WSUC) |
| Non-governmental Organisations               | Environment and Public Health Organization (ENPHO)                                 |
| Private Sector                               | Public toilet operators                                                            |
| Development Partners, Donors                 | MuAN, BMGF, UCLG ASPAC                                                             |

## 7. Credibility of data

The data was collected from proportionate stratification random sampling. Altogether, 369 households and 81 institutions were surveyed from 10 wards of the municipality. Primary data on emptying, transportation, and current sanitation practices in the municipality was validated from Key Informant Interviews (KIIs) with municipal desludgers, water service providers, public toilet caretaker and other

different sanitation and environmental stakeholder. The overall data and findings were shared with the stakeholders of the municipality and validated through a sharing program on April 25, 2024.

## 8. Process of SFD development

Data on sanitation situation was collected through household and institutional surveys (ENPHO, 2024). Enumerators from the municipality were mobilised after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, KOBACOLLECT for collection of data for survey. Along with this, KIIs were conducted with officers of municipality to understand the situation practices across the service chain. Types of sanitation technologies used in different locations were mapped using ARCGIS. To produce the SFD graphic, initially a relationship between sanitation technology used in questionnaire survey and SFD PI methodology was made. Then, data was fed into SFD graphic generator to produce the SFD graphic.

## 9. List of data sources

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

- Dhankuta Municipality. (2019). Municipal Profile of Dhankuta Municipality.
- ENPHO. (2024). Assessment of Sanitation Status of Dhankuta Municipality.
- NSO. (2022). National population and housing census 2021. Kathmandu: National Statistics Office.

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## ABBREVIATIONS

|            |                                                          |
|------------|----------------------------------------------------------|
| AEPC       | Alternative Energy Promotion Centre                      |
| ADB        | Asian Development Bank                                   |
| BMGF       | Bill and Melinda Gates Foundation                        |
| DWSSM      | Department of Water Supply and Sewerage Management       |
| ENPHO      | Environment and Public Health Organization               |
| FS         | Faecal Sludge                                            |
| FSM        | Faecal Sludge Management                                 |
| GoN        | Government of Nepal                                      |
| HH         | Household                                                |
| IRF        | Institutional and Regulatory Framework                   |
| KII        | Key Informant Interview                                  |
| KM         | Kilometres                                               |
| MDG        | Millennium Development Goal                              |
| MICS       | Multiple Indicator Cluster Survey                        |
| MuNASS-II  | Municipalities Advocacy on Sanitation in South Asia – II |
| MoH        | Ministry of Health                                       |
| MoHP       | Ministry of Health and Population                        |
| MoWS       | Ministry of Water Supply                                 |
| MuAN       | Municipal Association of Nepal                           |
| NGO        | Non-Governmental Organisation                            |
| NPC        | National Planning Commission                             |
| NWSSP      | National Water Supply and Sanitation Policy              |
| ODF        | Open Defecation Free                                     |
| PPP        | Public Private Partnership                               |
| RWSSNP     | Rural Water Supply and Sanitation National Policy        |
| SDP        | Sector Development Plan                                  |
| SFD        | Shit Flow Diagram                                        |
| SSTWSSSP   | Small Towns Water Supply and Sanitation Sector Project   |
| SFD PI     | Shit Flow Diagram Promotion Initiative                   |
| UCLG ASPAC | United Cities and Local Governments Asia Pacific         |
| UNICEF     | United Nations Children's Education Fund                 |
| VDC        | Village Development Committee                            |
| WASH       | Water, Sanitation and Hygiene                            |
| WHO        | World Health Organization                                |
| WSUC       | Water Supply and User's Committee                        |



## 1.2 Climate

Dhankuta has a warm and temperate climate. According to Köppen and Geiger (Figure 2), it is classified as Cwa. The average temperature in Dhankuta is about 19.3 °C | 66.7 °F. Summer runs from late June to September. December has the least rain, about 18 mm | 0.7 inches, while July gets the most rain, around 660 mm | 26.0 inches. August is the hottest month, with temperatures averaging around 23.5 °C | 74.3 °F and January is the coldest, with an average of 12.1 °C | 53.8 °F. The temperature ranges from 10 to 24 degrees Celsius (Climate-data, 2024).

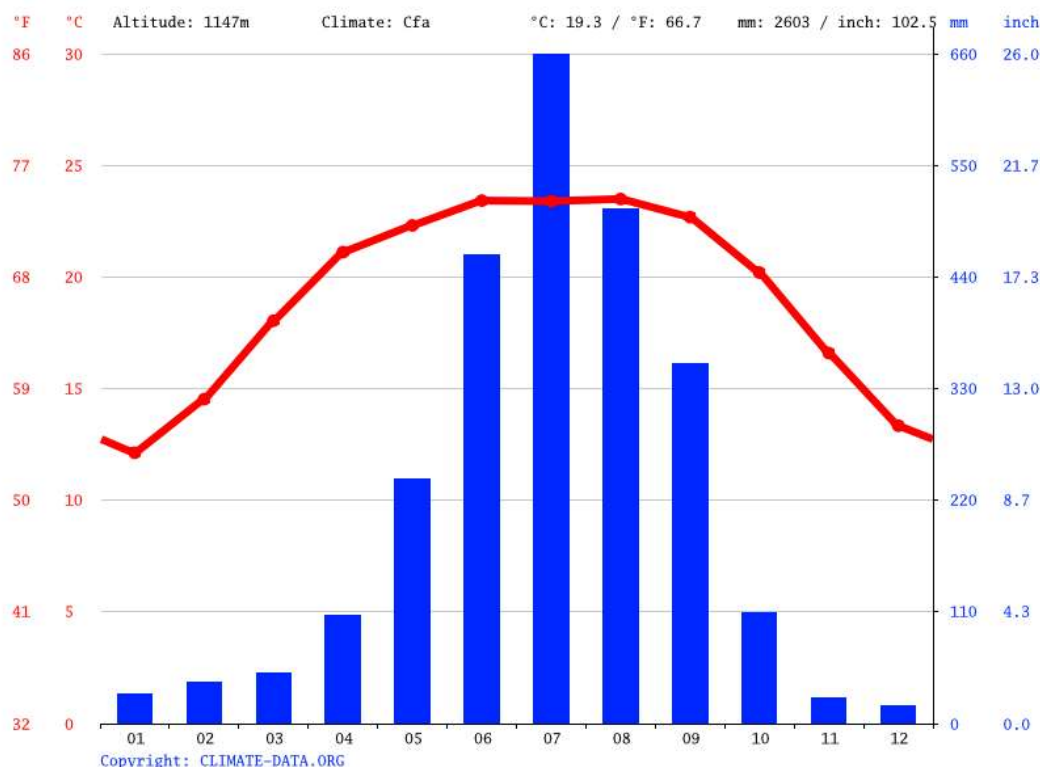


Figure 2: Climate data of Dhankuta Municipality.

## 1.3 Topography

The municipality lies between an elevation of 250 m to 2144 m above mean sea level. The municipality has geographical coordinates ranging from 26°53' to 27°19' north latitude and 87°8' to 88°33' east longitude (Topographic map.com, 2024). The municipality is around 48 km north of Dharan, and 89 km far from Biratnagar and lies approximately 350 kilometers east of the capital, Kathmandu (Dhankuta Municipality, 2021). The fragile geology and steep slopes make the municipality vulnerable to landslides and earthquakes. However, Dhankuta bazaar, located on a hill ridge, is less prone to these hazards. It lies within the Mahabharata range and is characterised by rocks such as gneiss, granite gneiss, and quartzite schist. Sandy soil prevails overall, while loamy soil is more common in the eastern part of the area (Nepal Geological Society, 2018).

## 2 Service Outcomes

### 2.1 Overview

The country has persistently worked towards achieving its current sanitation status for over three decades. On September 30, 2019, the Government of Nepal declared the nation free of open defecation, marking universal access to improved sanitation facilities nationwide (DWSSM, 2019). Meanwhile, Dhankuta municipality achieved Open Defecation Free (ODF) status in 12/29/2014 AD (2071/09/14 B.S) (Nepal ODF, 2019). The municipality has initiated a new phase of sanitation management to address the challenges of treating faecal waste collected from toilets.

Data on sanitation situations was collected through household and institutional surveys (ENPHO, 2024). To assess the sanitation status across the entire sanitation value chain, a household survey was conducted in 369 sampled households using a proportionate sampling across the 10 wards of Dhankuta municipality (further details are presented in section 4). The results obtained after the triangulation and validation of the data with all the data sources including literature reviews, Key Informant Interviews (KIIs) and a validation workshop is presented in this section.

#### 2.1.1 Sanitation systems in household buildings

The National Population and Housing Census, 2021 indicated that 4.5% of the population lacks access to basic sanitation facilities (CBS, Nepal, 2021). Additionally, findings from this survey in 2024 revealed that 2% of the sampled households don't have access to improved sanitation facilities. An improved sanitation facility is defined as one that hygienically separates human excreta from human contact. Improved sanitation facilities include flush or pour flush to piped sewer systems, septic tanks, or pit latrines, ventilated improved pit latrines, pit latrines with slabs and composting toilets (MICS, 2019).

In the municipality, 98% of the households have access to improved sanitation facilities all relying on onsite sanitation technology. Any sanitation technology or system involving the collection and storage of excreta (referred to as faecal sludge) on the plot where it is generated is known as onsite sanitation (Susana, 2018). In Hile, ward 9, the municipality is building a sewer system. However, the work is not finished yet, and the system hasn't started working (KII-1, KII-2, 2024). In the municipality, none of households have a well-designed septic tank for storing faecal sludge from toilets. Around 9% of households install fully lined tanks with a single or double chamber, and 7% have built biogas. Additionally, 44% of households have constructed lined tanks with impermeable walls and an open bottom and 38% have built unlined pits.

Table 1 illustrates the various types of onsite sanitation technologies used in the municipality and the corresponding proportion of households utilising each.

**Table 1: Sanitation system showing proportion of open defecation, and different onsite sanitation technologies installed at households in Dhankuta municipality. (ENPHO, 2024).**

| Types of containment                              | Construction material used in the wall of the containment | Construction material used in the bottom of the containment | Number of Chambers          | Number of containments | %   | Recategorised as SFD                              | %           |
|---------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------|-----------------------------|------------------------|-----|---------------------------------------------------|-------------|
| Biogas Digester                                   | NA                                                        | NA                                                          | NA                          | NA                     | 7%  | Fully lined tank                                  | 16%         |
| Fully Lined tank                                  | Cemented brick/stone walls or concrete walls              | PCC or plaster                                              | One or two                  | NA                     | 9%  |                                                   |             |
| Lined tank with impermeable walls and open bottom | Cemented brick/stone walls or concrete walls              | Soiling or nothing                                          | One or two or more than two | NA                     | 44% | Lined tank with impermeable walls and open bottom | 44%         |
| Unlined Pit                                       | Mud mortar stone or brick wall                            | Soiling or nothing                                          | NA                          | NA                     | 38% | Unlined Pit                                       | 38%         |
| Open Defecation                                   | NA                                                        | NA                                                          | NA                          | NA                     | 2%  | Open defecation                                   | 2%          |
|                                                   |                                                           |                                                             |                             |                        |     | <b>Total</b>                                      | <b>100%</b> |

**Biogas:** A biogas digester, an effective energy conversion technology, treats household-generated faecal sludge through anaerobic digestion. This process reduces sludge size, eliminates harmful pathogens, and yields biogas and nutrient-rich slurry, biologically stable to use as a soil conditioner (Linda Strande, 2014). The Alternative Energy Promotion Centre (AEPIC) has promoted biogas technology in 77 districts of Nepal, contributing to improved health and sanitation (AEPIC, 2018). In the municipality, 7% of households have biogas digesters. Usually, faecal sludge along with the cow dung and other organic solid waste are mixed in digester. The average capacity of these digesters is 6 m<sup>3</sup>. When creating a SFD graphic, biogas is reclassified as SFD containment, considering it as a fully lined tank.

**Fully Lined Tank:** A fully lined tank is a rectangular tank with impermeable walls and a base, engineered to prevent leakage or seepage of faecal sludge into the surrounding environment. This design ensures the safe storage of faecal sludge, protecting against groundwater contamination (Linda Strande, 2014). In the municipality, 9% of households have fully lined tanks.

**Lined Tank with Impermeable Walls and Open Bottom:** This rectangular onsite technology involves constructing tanks with impermeable walls and a permeable base, allowing the infiltration of effluents that could potentially contaminate groundwater (Peal, et al., 2020). In the municipality, 44% of households have installed this type of containment.

**Unlined Pit:** An unlined pit is a pit appropriately designed, constructed, and maintained, featuring permeable walls and a base for liquid infiltration. However, it poses a concern as the

walls are made of materials like mud mortar stone/brick or dry stone, and the base with soiling or nothing, making it permeable. This increases the risk of groundwater contamination. Most households in the municipality, 38%, use unlined pits. This practice heightens the risk of contamination of water sources. Figure 3 shows a map locating different types of containment in Dhankuta Municipality.

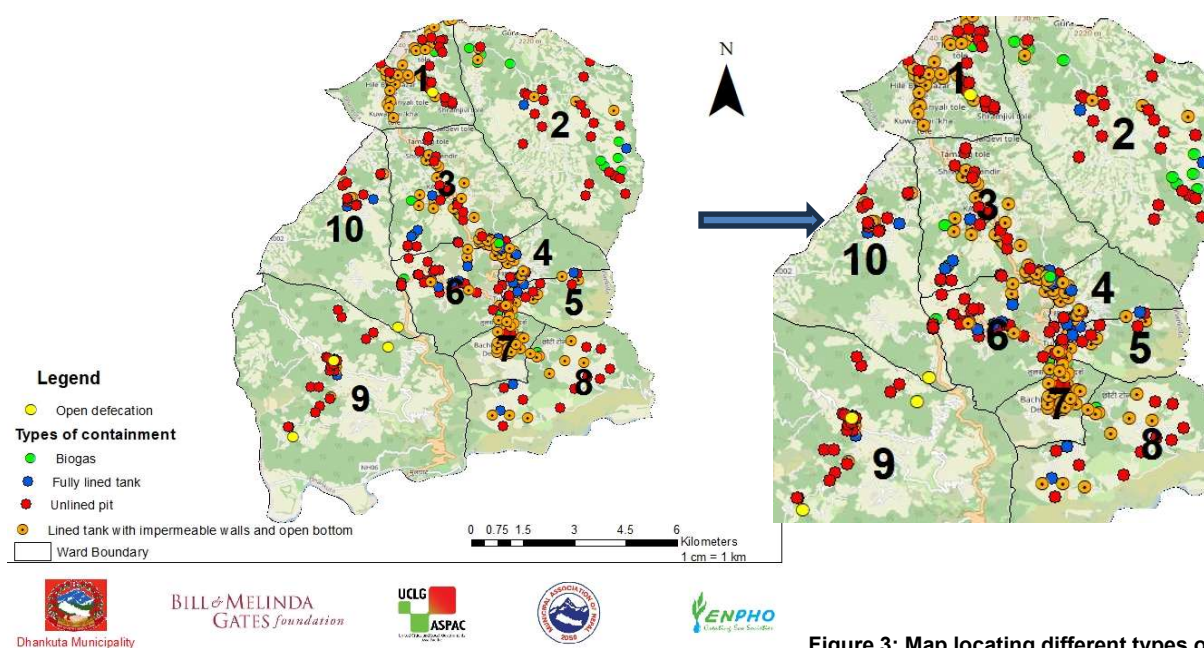


**Figure 3: Map locating different types of containment in Dhankuta Municipality.**

## 2.1.2 Sanitation system in institutional buildings

All the 37 surveyed institutions had access to a safely managed sanitation system in the municipality. Different educational institutes, government and non-government offices, health care centres and hotels with lodging facilities were surveyed.

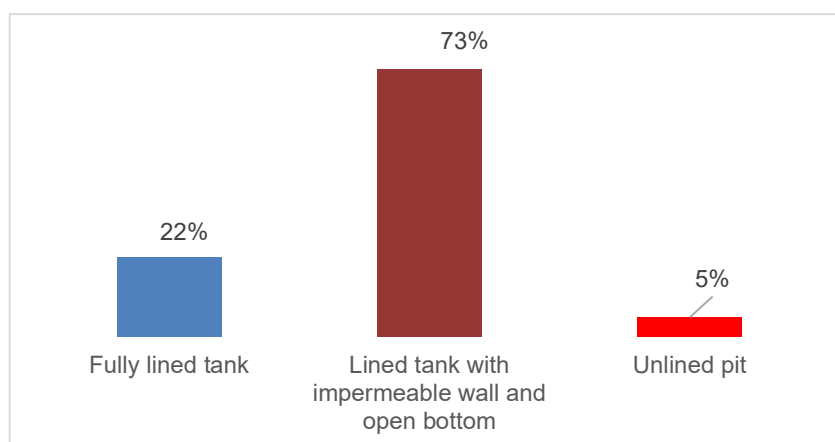


**Figure 4: Types of containments used in institutional buildings.**

The findings showed that 22% of institutional buildings had made fully lined tanks, 73% had lined tanks with impermeable walls and open bottom, 5% had unlined pits. The proportion of

different types of sanitation technologies are shown in sampled institutions as shown in Figure 4. Only 8% of the institutions have been emptied using mechanical desludging vehicles.

### 2.1.3 Public toilets

In total, there are 4 public toilets constructed in different areas targeting places with increased flow of people, 2 in Hile bazaar, 1 around buspark area, and 1 in Bihibare Hatiya (Figure 5).

#### Public toilet in Bihibare Hatiya

In Bihibare Hatiya, there's one public toilet mainly used on Thursday market. It was constructed by the municipality and has separate sections for men and women, but it's not accessible for people living with disabilities. A caretaker managed and maintained the cleanliness of toilet with the money collected. Though not many people use it regularly, it's busy on market days (Thursday). The excreta goes into a rectangular tank whose walls and base are plastered.



Figure 5: Public toilet in Bihibare Hatiya.

#### Public toilet in buspark area and Hile Bazaar

Another public toilet has been constructed and is managed by the Buspark Tole Development Organisation. It's located near the bus park, on average more than 100 people uses it daily. This toilet has separate sections for men and women. The infrastructure also has a single separate bathroom. The sanitary condition of the toilet is in good condition. The toilet has a water storage capacity of 1,000 liters, and there are five tanks of this size, consuming about 5,000 liters of water in every two days. Initially, the excreta from this toilet was connected to a biogas system, but it's not working anymore, so a new rectangular containment system has been built for excreta storage (KII-4, 2024) as shown in Figure 6.



Figure 6: Public toilet near buspark area.

Likewise, another public toilet constructed in Hile Bazaar is shown in Figure 7.



Figure 7: Public toilet near temple premises.

## 2.1.4 Emptying and transportation services of containment

### Emptying of containment

Emptying is one of the major components of the sanitation service chain. Regular emptying of the containment prevents sludge overflow and blockages (Strande, 2014). Interestingly, of the total sampled households with containment, only 12.1% have emptied their containment due to faecal sludge overflow. The municipality is providing desludging services since 2016 A.D (2073 B.S). The municipal desludging vehicle has a capacity of 5,000 liters, offering on-demand services within the area. During study period, there were 22 sanitation workers working to manage solid waste in the municipality, and they're also deployed for desludging services when needed. Each desludging trip costs \$45.1 (Rs. 6,000) (KII-2, 2024). Despite the municipality's efforts, only 35.2% of containments are mechanically desludged, while the rest, 64.8% are manually emptied by traditional sanitation workers (Figure 8). People manually empty containments in geographically difficult areas due to lack of access of roads and vehicles. Additionally, the cost of using mechanical desludging services also contributed to it resulting to dig and dump practices (KII-2, 2024).



Figure 8: Municipal desludging vehicle of Dhankuta Municipality.

### 2.1.5 Treatment and disposal/reuse of faecal sludge

In the municipality, there's a faecal sludge drying bed built to treat the collected faecal sludge by municipal desludging vehicles. The sludge that's mechanically emptied is taken to these beds. The effluent produced from the sludge drying bed gravitates to stone masonry-lined soak pits. The drying bed is constructed on the premises of the Municipal Solid Waste Management Centre, built as part of the second phase of the Small Towns Water Supply and Sanitation Sector Project (SSTWSSSP) of the Government of Nepal (Asian Development Bank, n.d.). Farmers later use this dried sludge as fertilizer for their fields (KII-2,2024). The following picture 9 shows the desludging drying bed with sludge being drying out and the premises of solid waste management center where it is kept (Figure 9).



Figure 9: Drying bed built in premises of Municipal solid waste management center.

Those who manually emptied the containments, applied the sludge directly on farms, and many people dig new pits and leave the old ones behind practicing dig and dump method, and very less proportion opt for composting of sludge. This adds to the problem of unsafe faecal sludge disposal and may increase the risk for the environment and public health (Figure 10).

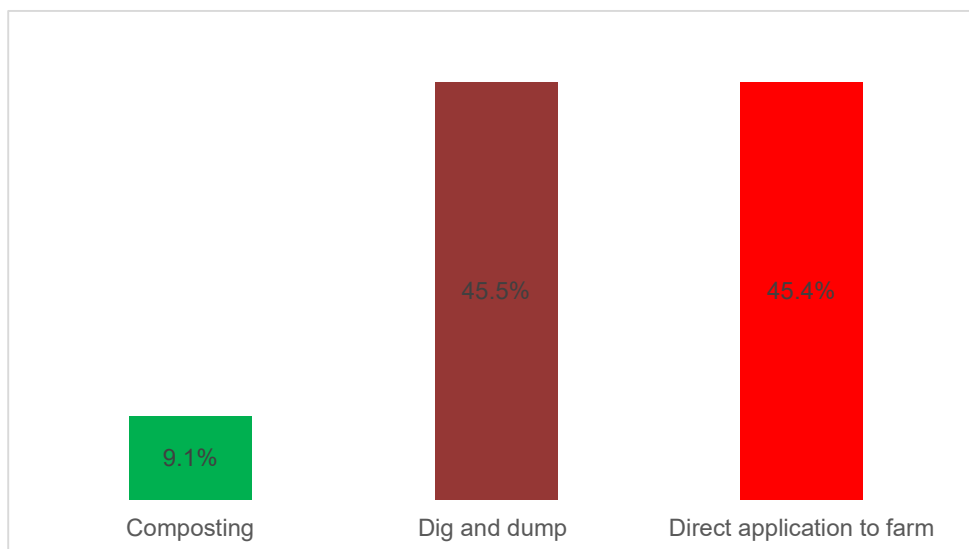


Figure 10: Disposal practices after manual emptying.

### 2.1.6 Risk assessment of drinking water source contamination from open bottom containment

The risk of contamination was assessed based on the source of drinking water, secondary data on water quality and lateral spacing between sanitation system and water sources.

#### a. Sources of Drinking Water

As per the findings of this survey, 56.6% had private taps in their home and 6.8% relied on public taps. Likewise, 35.2% depends on spring source, and 1.4% used jar water for drinking purposes (Figure 11).

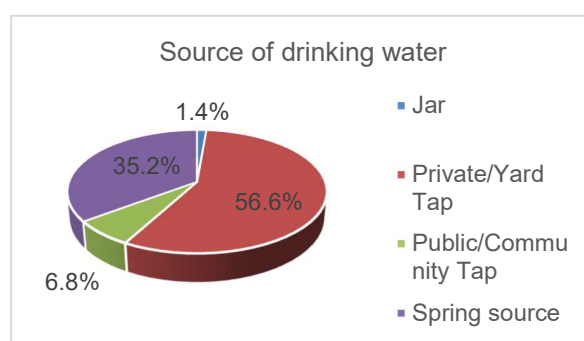


Figure 11: Proportion of drinking water sources in Dhankuta Municipality.

The key informant interviews (KII-3, 2024) findings highlighted that the Dhankuta Municipality Water Supply and Sanitation Users Committee (WSUC) provides piped drinking water to households in wards 3, 4, 5, 6, and 7 covering 3,700 households. The source of water is surface sources which operate by gravity systems and pumping water from Nibuwa stream. Additional water is also transported from the Tankhuwa stream to the collection chamber, considering the scarcity of water in the dry season. The other sources are charchari, Aitabare, Regmi Khola, Sisne Lungdang, and Raniban. The WSUC consists of water treatment facilities and ground reservoirs from where water will be distributed through distribution pipelines. There

are four reservoir tanks with capacities of 300m<sup>3</sup>, 200 m<sup>3</sup>, 150m<sup>3</sup>, and 65m<sup>3</sup> liters (KII-3, 2024). Following Figure 12 are the reservoir tanks observed.



**Figure 12: Reservoir tank of Dhankuta Municipality WSUC.**

For considering the contamination risk of water source from open bottom containment, different water quality test reports from sources of water were observed and analysed. In accordance with the World Health Organization's (WHO) guidelines for drinking water quality, the presence of E. coli serves as an indicator of potential faecal contamination. As per the National Drinking Water Quality Standard of 2022, drinking water should be free of E. coli, indicated by a count of 0 colony-forming units (CFU) per 100 milliliters of water (World Health Organization WHO, 2024).

Thus, a thorough analysis of the risk posed by water distributed by WSUCs, particularly in terms of open-bottom containment systems was analysed. There are some areas and communities where people prefer drinking water directly from spring sources, without any treatment. This could lead to serious health hazards in the future. There is a lack of regular water-tests for drinking water in the municipality. The municipality should proactively focus on this matter and take necessary actions ensuring the access to safe drinking water. Furthermore, the proximity between spring sources and open-bottom containment systems is a critical factor in assessing contamination risk. Springs located approximately 500 meters above residential areas are deemed to pose a lower risk of contaminating drinking water compared to those situated below residential areas.

## 2.2 SFD selection grid

The SFD grid consists of different containment technology used in list A and its connection in list B. Sanitation technologies selected in the SFD grid in Dhankuta Municipality are shown in figure 13. The vertical column on the left side of the SFD selection grid has a list of technologies to which the toilet is connected to, and households without toilet resorting to open defecation. Similarly, horizontal row at the top of the selection grid shows options for connection made for the outlet or overflow of discharge from the toilet.

| List A: Where does the toilet discharge to? (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                  |                                                                                                                              |                                    |                                  |                                      | Significant risk of GW pollution |                              |               |                |                       | Not Applicable                   |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      | Low risk of GW pollution         |                              |               |                |                       |                                  |
| Septic tank                                                                                     |                                                                                                                              |                                    |                                  |                                      | Significant risk of GW pollution |                              |               |                |                       |                                  |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      | Low risk of GW pollution         |                              |               |                |                       |                                  |
| Fully lined tank (sealed)                                                                       |                                                                                                                              |                                    |                                  |                                      | Significant risk of GW pollution |                              |               |                |                       | T1A3C10                          |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      | Low risk of GW pollution         |                              |               |                |                       |                                  |
| 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 |                              |               |                |                       | T2A4C10                          |
|                                                                                                 | Low risk of GW pollution                                                                                                     | 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 |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      |                                  |                              |               |                |                       | Low risk of GW pollution         |
| Unlined pit                                                                                     |                                                                                                                              |                                    |                                  |                                      |                                  |                              |               |                |                       | T2A8C10                          |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      |                                  |                              |               |                |                       | T1A6C10                          |
| Pit (all types), never emptied but abandoned when full and covered with soil                    | Not Applicable                                                                                                               |                                    |                                  |                                      |                                  |                              |               |                |                       | Significant risk of GW pollution |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      |                                  |                              |               |                |                       | Low risk of GW pollution         |
| Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil        | Not Applicable                                                                                                               |                                    |                                  |                                      |                                  |                              |               |                |                       | Significant risk of GW pollution |
|                                                                                                 |                                                                                                                              |                                    |                                  |                                      |                                  |                              |               |                |                       | 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 13: SFD selection grid for Dhankuta Municipality.

As per the containment definition by Shit Flow Diagram Promotive Initiative (SFD PI), various containments are categorised into different SFD categories. For example, biogas is reclassified as a fully lined tank, given that the walls and bottom of the biogas structure are water-sealed and share similar features with a fully lined tank. However, fully lined tanks, lined tanks with impermeable walls and open bottom and unlined pits do not require reclassification and remain unchanged. After the reclassification of these containments, the types of sanitation technologies and their connections are chosen in the SFD selection grid, as illustrated.

A brief explanation of terms used to indicate different frames selected in the SFD selection grid is explained in Table 2.

Table 2: Explanation of terms used to indicate frame selected in the SFD selection grid.

|         |                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T1A3C10 | A correctly designed, properly constructed, and well maintained fully lined tank with impermeable walls and base. Since the tank is not fitted with a supernatant/effluent overflow this system is considered 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. However, since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.                                                                                                                 |
| T2A4C10 | A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained. |
| T1A6C10 | This is 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.                                                                                                                                                |

|               |                                                                                                                                                                                                                                                                                                                               |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T2A6C10       | This is 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 but since there is a 'significant risk' of groundwater pollution this system is considered NOT 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

In the second step of developing an SFD graphic, the proportion of faecal sludge (FS) in each type of sanitation technology is calculated. Following detailed instructions in SFD PI, a default "100%" value is applied when onsite containers are connected to soak pits, water bodies, or open ground, representing the entire contents as faecal sludge, with a portion being periodically emptied.

For onsite containers connected to a sewer network or open drains, a "50%" value is used, indicating that half the contents are modelled as faecal sludge, with periodic emptying. The remaining fraction contains faecal sludge in the container and infiltrates (for open-bottomed tanks), while the other half is modelled as supernatant discharging into the sewer network or open drains. The formula for calculating FS proportion is provided 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:

- The proportion of FS in septic tanks is 0% as there are no septic tanks in municipality.
- The proportion of FS in fully lined tanks is calculated as 100% as there are no connections made to an open drain, the tank maintains a 100% FS proportion.
- The FS proportion from lined tanks with open bottoms and all types of pits is 100%, as there are no connections of lined tanks with impermeable walls and open bottoms to open drains.

After determining the proportion of FS in each type of sanitation technology, the corresponding population proportions from the selected technologies in the SFD selection grid are set. Figure 14 illustrates the SFD matrix of the municipality.

Dhankuta, Koshi, Nepal, 25 Mar 2024. SFD Level: 2 - Intermediate SFD

Population: 35983

Proportion of tanks: septic tanks: 0%, fully lined tanks: 100%, lined, open bottom tanks: 100%

| Containment                                                                                                                                              |                                                        |                                                                       |                                                                             |                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| System type                                                                                                                                              | Population                                             | FS emptying                                                           | FS transport                                                                | FS treatment                                                                |
|                                                                                                                                                          | Pop                                                    | F3                                                                    | F4                                                                          | F5                                                                          |
| System label and description                                                                                                                             | Proportion of population using this type of system (p) | 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 |
| <b>T1A3C10</b><br>Fully lined tank (sealed), no outlet or overflow                                                                                       | 16.0                                                   | 37.0                                                                  | 100.0                                                                       | 95.0                                                                        |
| <b>T1A4C10</b><br>Lined tank with impermeable walls and open bottom, no outlet or overflow                                                               | 29.0                                                   | 5.0                                                                   | 29.0                                                                        | 80.0                                                                        |
| <b>T1A6C10</b><br>Unlined pit, no outlet or overflow                                                                                                     | 31.0                                                   | 5.0                                                                   | 43.0                                                                        | 80.0                                                                        |
| <b>T1B11 C7 TO C9</b><br>Open defecation                                                                                                                 | 2.0                                                    |                                                                       |                                                                             |                                                                             |
| <b>T2A4C10</b><br>Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution | 15.0                                                   | 0.0                                                                   | 0.0                                                                         | 0.0                                                                         |
| <b>T2A6C10</b><br>Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution                                       | 7.0                                                    | 6.0                                                                   | 0.0                                                                         | 0.0                                                                         |

Figure 14: SFD matrix of Dhankuta Municipality.

### 2.3.2 Proportion of faecal sludge emptied (F3)

The column labelled "Population (Pop)" in Figure 14 displays the proportion of contents for each type of onsite container (fully lined tanks (sealed), lined tanks with impermeable walls and open bottom, and unlined pit). The variable F3 represents the proportion of contents in each type of onsite container that undergoes at least one emptying after construction. The calculation of the proportion of faecal sludge emptied (F3) is based on the percentage of containment emptied (ENPHO, 2024) and the amount of faecal sludge (FS) emptied (KII-2,2024) during the process.

According to findings from household surveys and Key Informant Interviews (KII-2, 2024), approximately 80% of the FS in the containment is emptied. However, an average of 20% of the FS in the containment is characterised by high thickness and poor water solubility, thus certain proportion of FS remains unremoved during emptying. The calculation of the emptied proportion of FS is adjusted accordingly as following, (Table 3).

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

**Table 3: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2024).**

| SN | Sanitation Technologies                                                                                      | SFD Reference Variable | Percentage of Emptied Containment (1) | Emptied Proportion of FS during emptying (2) | Actual Proportion of Emptied FS (F3) |
|----|--------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------|----------------------------------------------|--------------------------------------|
| 2  | Fully lined tank (sealed), no outlet or overflow                                                             | T1A3C10                | 47%                                   | 80%                                          | 37%                                  |
| 3  | Lined tank with impermeable walls and open bottom, no outlet or overflow (High Risk)                         | T2A4C10                | 0%                                    | 80%                                          | 0%                                   |
| 4  | Lined tank with impermeable walls and open bottom, no outlet or overflow                                     | T1A4C10                | 6%                                    | 80%                                          | 5%                                   |
| 6  | Unlined pit, no outlet or overflow                                                                           | T1A6C10                | 6%                                    | 80%                                          | 5%                                   |
| 7  | Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (High Risk) | T2A6C10                | 8%                                    | 80%                                          | 6%                                   |

### 2.3.3 Proportion of FS emptied which is delivered to treatment plant and treated (F4 and F5)

The municipality transports the collected faecal sludge to drying bed which is considered as delivered to treatment plant (F4). Since the treatment options only included the drying bed, it can't be considered 100% treated, thus 80% efficacy (F5) is considered for treated. Additionally, operational biogas systems are also classified as treated (F5). In the provided SFD matrix, 16% of fully lined tanks, including 7% with functioning household biogas digesters, are considered treated with 95% efficiency.

## 2.4 Summary of assumptions

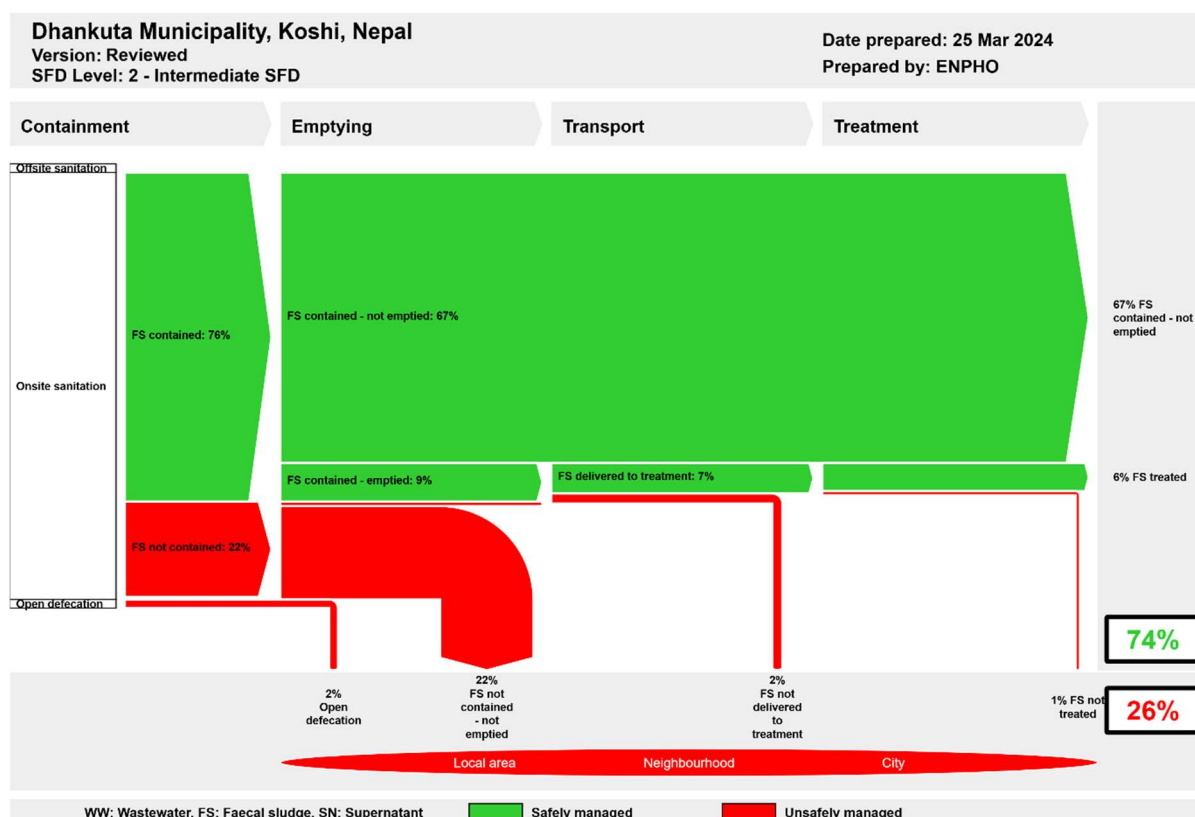
- ✓ The proportion of FS in septic tanks was set to 0%, the proportion of FS in fully lined tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 100% according to the relative proportions of the systems, as per the guidance provided by SuSanA.
- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the household survey and cross-checked with KIIs conducted.
- ✓ 37% of the emptied FS from fully lined tank connected to no outlet (system T1A3C10) is delivered to treatment and treated in the FSTP (F4 = 100% and F5 = 95%).

- ✓ 5% of the emptied FS from lined tanks with impermeable walls and open bottom, no outlet or overflow (system T1A4C10) is delivered to treatment and treated in the FSTP (F4 = 29% and F5 = 80%).
- ✓ 5% of the emptied FS from unlined pits, no outlet or overflow (system T1A6C10) is delivered to treatment (F4 = 43% and F5 = 80%).
- ✓ 6% of the emptied FS from unlined pits, no outlet or overflow (system T2A6C10) where there is significant risk of groundwater pollution is delivered to treatment (F4 = 0% and F5 = 0%).

## 2.5 SFD Graphic

Figure 15 presents diagrammatic representations of the excreta flow within Dhankuta Municipality. The color scheme signifies the nature of sanitation systems, with green indicating safely managed systems and red denoting unsafely managed ones. The diagram reveals that FS generated from 74% of the population is safely managed, represented by "Green" arrowheads, indicating FS stored in containment without significant risk on water source. Conversely, FS from 26% of the population is unmanaged, represented by "Red" arrowheads. This signifies FS not contained and openly dumped FS emptied from the containments, both considered unsafe. The diagram illustrates four different factors – containment, emptying, transport and treatment – across the sanitation value chain, arranged from left to right.

Figure 15: SFD Graphic of Dhankuta Municipality.



### 2.5.1 Onsite sanitation

All the households in Dhankuta Municipality utilise onsite sanitation technologies. Among them, FS from 76% of the population is appropriately stored in technically effective containment, as depicted by "FS contained" in the SFD graphic. FS from the remaining 22% of the population is stored in unsafe containment, represented as "FS not contained."

### **FS contained**

The term 'FS contained' refers to faecal sludge within an onsite sanitation technology that ensures a safe level of protection from excreta, limiting pathogen transmission to the user or the public. These containment systems, such as tanks or pits, are correctly designed, properly constructed, fully functioning, and pose little to no risk of polluting water used for drinking (Susana, 2018). FS generated by 76% of the population is contained.

The value of FS contained (76%) is derived from the summation of the percentage of the population using the following containment systems: fully lined tank without outlet or overflow (T1A3C10), lined tank with impermeable walls and open bottom without outlet or overflow (T1A4C10), and unlined pit, no outlet or overflow.

### **FS not contained**

The term 'FS not contained' refers to faecal sludge within an onsite sanitation technology that does not ensure a safe level of protection from excreta, with a likely risk of pathogen transmission. These containment systems, such as tanks or pits, are incorrectly designed, poorly constructed, poorly functioning, and/or pose a 'significant' risk of polluting groundwater used for drinking (Susana, 2018). FS generated by 22% of the population is not contained.

The value of FS not contained (22%) is obtained from the summation of the percentage of the population using the following containment systems: lined tank with impermeable walls and open bottom without outlet (T2A4C10) and unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A6C10).

### **FS contained - not emptied**

It is faecal sludge that is contained within an onsite sanitation technology but if not removed may persist within the container or infiltrate into the ground, depending on the type of sanitation technology in use (Susana, 2018). The value of 67% is obtained from the proportion of the population using sanitation systems where the FS is contained and have not emptied their containment. However, this 67% 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**

It is faecal sludge which is removed from an onsite sanitation technology where it is contained and can be emptied, utilising either mechanical or manual emptying. The value of 9% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

### **FS not contained - not emptied**

It is faecal sludge that is not contained within onsite sanitation technology and not removed. It may persist within the container or infiltrate into the ground, depending on the type of sanitation technology in use. The value of 22% is obtained from the proportion of the population using sanitation systems where the FS is not contained and not emptied.

**FS not delivered to treatment**

The proportion of FS not delivered to treatment, i.e. 2%, is the summation of FS contained - emptied and FS not contained - emptied. Since there is no FSTP, FS are not delivered to treatment plant. The emptied FS is disposed of untreated to farmlands or disposed in water bodies. Therefore, this proportion of disposed FS possesses risk to local area and neighbourhood.

**FS delivered to treatment**

The proportion of FS delivered to treatment, i.e. 7%, is the FS generated from biogas digester which is considered treated 6%.

**2.5.2 Open Defecation**

It is a situation where no toilet is in use, and people resort to open defecation in fields, forests, bushes, bodies of water, or other open spaces. Despite municipality having ODF free status, 2% of population still defecate openly.

**3 Service delivery context description**

### 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 recognises citizen's rights to access to clean drinking water and sanitation. In addition, Right to Clean Environment, Article 30 (1) recognises 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 towards accessing clean drinking water and sanitation services, the government has promulgated and amended necessary laws. The most relevant legislation for the promotion of safe sanitation services is discussed here.

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

Local Governance Operation Act 2017 was 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 responsibilities 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 inspectors 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 citizens 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 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.

#### **3.1.1. Policy**

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 marginalised and vulnerable groups. Participatory approach, community leadership project development, optimisation of local resources and installation of locally appropriate technologies were major principles in the policy (DWSSM, 2004). However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery (DWSSM, 2009). 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 recognised that the 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. The National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened the institutional setup tier of government in a participatory approach. In an alignment, the 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 harmonisation 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 systems (70%) that require 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, 2017), however, the target of 90% households with toilets connected to sewer system or proper FSM is yet to be achieved.

There has been no specific policy made on faecal sludge management. However, many exemplary works on solid waste management have been carried out by the municipality. The municipality has made a Solid Waste, Forest, Environment, and Natural Resources Act.

### 3.1.2. 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 (NPC):** At the federal government, the National Planning Commission is the specialised 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 (MoWS):** 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, the 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 organisational structure of DWSSM is shown in Figure 16.

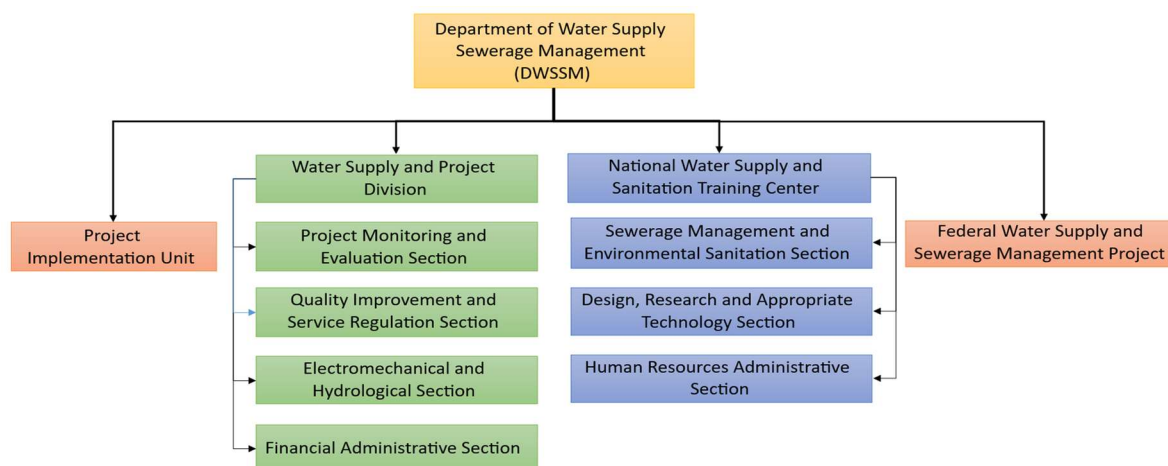


Figure 16: Organisational Structure Department of Water Supply and Sewerage Management (DWSSM).

## At Provincial Government

**Ministry of Water Supply, Irrigation and Energy (MoWSIE):** Ministry of water supply, Irrigation and Energy in Koshi province is major executing body for planning, developing, and implementing water supply and sanitation programs. Planning and implementation of water supply and sanitation infrastructure in the province is executed through Drinking Water, Irrigation and Energy Development Office (DWIEDO). DWIEDO 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 500 to 1,000 in Himalayan region.

## At Local Government

**Municipal Council:** Figure 17 shows the proposed organography of the municipality. The sanitation related works comes under the forest, environment, disaster management and municipal sanitation management subsection which is actively working on solid waste management. Nepal's Solid Waste Management Technical Support Center declared the Dhankuta as "Cleanest City" in the country in 2017 (World Bank, 2017). The municipality has put lots of effort into solid waste management, drainage, and sewerage system, greening and beautification. Solid landfill site was started in 2066 B.S with 3 service tractors and 18 municipal staff (Dhankuta Municipality, 2024). The section's principal responsibilities are Solid Waste Management, Environment Management, and Disaster Risk Reduction (DRR).

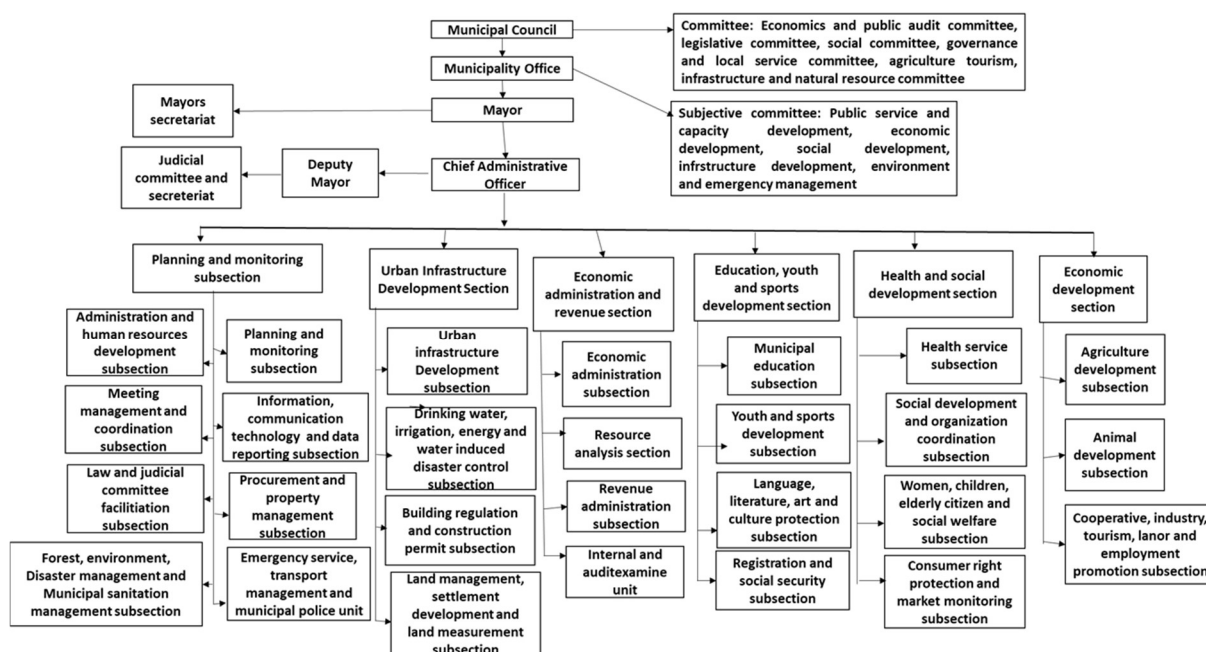


Figure 17: Organogram of Dhankuta Municipality.

### 3.1.3. Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasised the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, the 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).

### 3.1.4. 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 4. However, FSM specific standards have yet to be developed and implemented.

Table 4: 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 grey water                            | ✓    | ✓      | ✓     |
| 6 | Small-bore sewer collection for toilet and septic tank effluent, low-cost treatment, and disposal  |      | ✓      |       |
| 7 | Sanitary sewers for wastewater collection, transmission, non-                                      | ✓    |        |       |
| 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 (KIIs)

During the study, Key Informant Interviews (KIIs) were conducted to gather insights from different key stakeholders working in the sanitation sector of Dhankuta Municipality. The objective was to obtain a comprehensive understanding of current sanitation service practices. Mr. Dashrath Rai, Chief Executive Officer of Dhankuta municipality, and Mr. Upendra Khanal Environment Section Head were interviewed specifically regarding sanitation service practices, covering technical, institutional, and financial aspects. Additional interviews were conducted with stakeholders of WSUC, and public toilet operators (Table 5).

**Table 5: List of Key Informant Interviewed personnel.**

| S.N. | Name                        | Designation                        | Organisation/<br>Company                   | Purpose of KII                                                                                            | Date           |
|------|-----------------------------|------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------|
| 1.   | Dashrath Rai<br>(KII-1)     | Chief<br>Administrative<br>Officer | Dhankuta<br>Municipality                   | Sanitation status, Ongoing<br>projects on Sanitation,<br>Policies, and plan for<br>Sanitation development | 25 April, 2024 |
| 2.   | Upendra Khanal<br>(KII-2)   | Municipal Staff                    | Dhankuta<br>Municipality                   | Sanitation status, Ongoing<br>projects on Sanitation,<br>Policies, and plan for<br>Sanitation development | 25 April, 2024 |
| 3.   | Jeev lal Thakuri<br>(KII-3) | Chairperson                        | Dhankuta<br>Municipality WSUC              | Water supply services                                                                                     | 25 April, 2024 |
| 4.   | Bijaya Malik (KII-<br>4)    | Caretaker                          | Public toilet,<br>Dhankuta<br>Municipality | Sanitation status of toilet                                                                               | 25 April, 2024 |

### 4.2 Household survey

Household survey was conducted in all wards of the municipality through mobilisation of local enumerators selected by the municipality. The enumerators were given two days orientation about sanitation and methods for conducting the household survey. The household survey was conducted using the mobile application “KOBACOLLECT” after orientation. SFD team members went on field visits in households to encourage enumerators and observe household sanitation status. The municipal focal person, Mr. Upendra Khanal, provided encouragement and motivated the enumerators before the survey. The pictures below depict the glimpses of the orientation given to enumerators by SFD team members (Figure 18).

Figure 18: Glimpses of SFD orientation to enumerators in municipal hall.



#### 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  $n_o = \frac{z^2pq}{e^2}$  and its finite population correction for the proportion  $n = n_o / (1 + (n_o - 1) / N)$ , where,

|   |       |                                                                                                                                                                                                                                                                                                              |
|---|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Z | 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 | +/-5% | Level of precision or sampling error.                                                                                                                                                                                                                                                                        |
| N |       | A total number of population (households in the municipality).                                                                                                                                                                                                                                               |

This was followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample size required in each ward is calculated as  $n_h = (N_h / N) * n$ , where  $N_h$  is a total population in each stratum. Thus, a total of 369 households were sampled from 9,637 households distributed in 10 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 19.

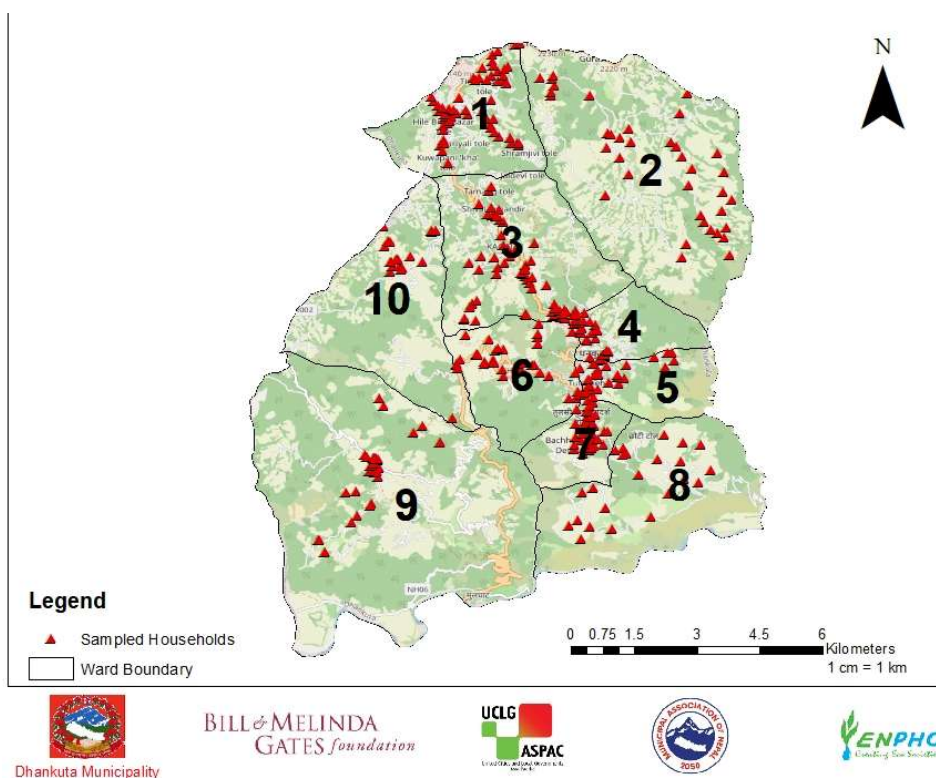


Figure 19: Distribution of sampling points in different wards of Dhankuta Municipality.

### 4.3 Direct observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept. Also, observation in different water sanitation user committees, and public toilets was done (Figure 20).



Figure 20: Pictures during the field observation.

#### 4.4 Sharing and validation of data

The SFD sharing and validation workshop was conducted in the municipality to share the findings of the sanitation situation survey and receive suggestions from municipal stakeholders (Figure 21). Altogether, 20 participants including the deputy mayor, ward chairpersons and other members from the municipal executive council, sectoral staff, etc. actively participated in the workshop and provided the valuable suggestions. The list of participants with their designation is attached to Appendix 3.

**Figure 21: Discussion on SFD by stakeholder of the municipality in validation sharing program.**



## 5 Acknowledgements

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

We extend our sincere appreciation to the individuals who provided invaluable support and guidance during the study: Mr. Chintan Tamang, Mayor, Ms. Bhima Devi Khanal, Deputy Mayor of Dhankuta Municipality, for continuous support in the study. We would also like to thank Mr. Dashrath Rai, Chief Administrative Officer of the municipality, and Mr. Upendra Khanal, from the sanitation management subsection, for facilitating the enumerators and continuous support throughout the study.

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

Our heartfelt appreciation also goes to Ms. Bhawana Sharma, Executive Director, and Mr. Rajendra Shrestha, Program Director of Environment and Public Health Organization (ENPHO) for their tremendous support and guidance throughout the study. We are grateful to the entire ENPHO team for their gracious support, as well as the MuNASS-II team, without whom this study would not have been possible.

Finally, we extend our thanks to the enumerators: Mr. Ujwal Khanal, Mrs. Samjhana Ghimire, Mr. Sanjaya Rai, Mr. Prem Prasad Niraula, Mrs. Saraswoti Luitel, Mrs. Niran Kumari Rai, Ms. Samikshya Adhikari, Mr. Jeevan Neupane, Mr. Sanjay Kumar Rai for their support during the survey.

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## 7 Appendix

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                       |
| <b>Small</b>          | Onsite sanitation         | Water Supply and Sanitation Technician (WSST) | Federal and or Provincial Government | User+/ community+/ other                             |                     |                  |                                  |
| <b>Medium</b>         | Septage Management        | Sub-engineer                                  | Federal and or Provincial Government | Provincial+/ Local Govt+/ Community+/ Private Sector |                     | Local Govt       | Users committee/ Utility manager |
| <b>Large</b>          | Septage or FSM Management | WASH Engineer + finance & admin staff         | Federal and or Provincial Government | Provincial+/ Local Govt+/ Community+/ Private Sector |                     | Local Govt       | Utility Manager                  |
| <b>Mega</b>           | Septage/ FSM Management   | WASH Engineer + finance & admin staff         | Federal and or Provincial Government | Provincial+/ Local Govt+/ Community+/ Private Sector |                     | Local Govt       | Utility Manager                  |

## Appendix 2: List of enumerators in SFD orientation

UCIG ASPAC ENPHO Municipalities Network Advocacy on Sanitation in South Asia (MuNASS) - II

Program: SFD orientation at Dhankuta Municipality  
Date: 3-3 Magh, 2080  
Venue: Dhankuta Municipality Hall

Attendance Sheet

| S.N | Name                | Organization | Designation | Phone no   | Signature   |             | Age | Gender | Ethnicity |
|-----|---------------------|--------------|-------------|------------|-------------|-------------|-----|--------|-----------|
|     |                     |              |             |            | Day 1       | Day 2       |     |        |           |
| 1)  | Ujjwal Kharel       | Ward no. 4   | Enumerator  | 9710595481 | [Signature] | [Signature] | 29  | male   | 2         |
| 2   | Samjhana Ghimire    | ward no. 4   | "           | 9862281322 | [Signature] | [Signature] | 23  | female | 2         |
| 3   | Sanjay Rai          | " 97         | "           | 9812366544 | [Signature] | [Signature] | 22  | Male   | 3         |
| 4   | Prem Prasad Niraula | " 2          | "           | 9842111484 | [Signature] | [Signature] | 32  | male   | 2         |
| 5   | Saraswati Luitel    | " 10         | "           | 9863782040 | Saraswati   | Saraswati   | 29  | female | 2         |
| 6   | Niran Kumari Rai    | " 5          | "           | 9800929407 | Niran       | Niran       | 30  | Female | 3         |
| 7   | Samiksha Adhikari   | ward no. 6   | "           | 9842296728 | [Signature] | [Signature] | 19  | female | 3         |
| 8   | Jeevan Neupane      | " - 6        | "           | 9840977532 | [Signature] | [Signature] | 40  | male   | 2         |
| 9   | Sanjaya K. Rai      | " - 2        | "           | 9741825882 | [Signature] | [Signature] | 33  | male   | 3         |

UCIG ASPAC ENPHO Municipalities Network Advocacy on Sanitation in South Asia (MuNASS) - II

Program: SFD orientation at Dhankuta Municipality  
Date: 3-3 Magh, 2080  
Venue: Dhankuta Municipality Hall

Attendance Sheet

| S.N | Name            | Organization          | Designation         | Phone no   | Signature   |             | Age | Gender | Ethnicity |
|-----|-----------------|-----------------------|---------------------|------------|-------------|-------------|-----|--------|-----------|
|     |                 |                       |                     |            | Day 1       | Day 2       |     |        |           |
| 1.  | Dashrath Rai    | Dhankuta Municipality | C.A.O               |            | [Signature] | [Signature] |     |        |           |
| 2.  | Upendra Ichanal | Dhankuta Municipality | Environment Officer | 9852050504 | [Signature] | [Signature] | 54  | M      | Brahmin   |
| 3.  | Asmita Shrestha | ENPHO                 | A.P.O               | 9861960579 | [Signature] | [Signature] |     |        |           |
| 4.  | Anita Bhuj      | "                     | A.P.O.              | 9849358157 | [Signature] | [Signature] |     |        |           |

## Appendix 3: List of participants present in sharing and validation meeting of SFD

आज मिति २०८१ साल वैशाख १३ गतेका दिन धनकुटा नगरपालिकामा नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो) को प्राविधिक सहयोग, The United Cities and Local Government Asia Pacific (UCLG ASPAC) को कार्यान्वयन र Bill and Melinda Gates Foundation (BMGF) को आर्थिक सहयोगमा Municipalities Network Advocacy on Sanitation in South Asia (MuNASS II) कार्यक्रम अन्तर्गत संचालन गरिएको Shit Flow Diagram (SFD) सम्बन्धी फलफल र प्रमाणीकरण कार्यशाला कार्यक्रममा निम्न अनुसार मुख्य शरीका रवालहरुको सहभागिता रह्यो।

## उपस्थिति

| क्र.सं. | नाम                 | कार्यालय         | पद                | फोन नं.    | हस्ताक्षर |
|---------|---------------------|------------------|-------------------|------------|-----------|
| १.      | मिलन तामाङ          | धनकुटा नगरपालिका | नगर प्रमुख        | ९८२२०७०५३३ |           |
| २.      | बिमा देवी खनाल      | धनकुटा नगरपालिका | नगर उप-प्रमुख     | ९८२२०७०८८८ | (२) ११३   |
| ३.      | दशरथ राई            | धनकुटा नगरपालिका | प्र. प्र. अ.      | ९८२२०२५१११ |           |
| ४.      | गोविन्द कुँडु       | ध.न.पा. ८        | कार्यपालिका सदस्य | ९८०८६५१२७  | गोविन्द   |
| ५.      | बिना पाण्डे         | धनकुटा नपा       | वरिष्ठ पोर्चो     | ९८४५४३८४३६ | बिना      |
| ६.      | मुकुन्द भण्डारी     | धनकुटा न.पा.     | फिल्ड हेल्थ       | ९८४२०७९८८४ | मुकुन्द   |
| ७.      | प्रेम प्रसाद निरौला | धनकुटा न.पा.     | MIS Operator      | ९८४२१११४८४ | प्रेम     |
| ८.      | आशा कु. प्रेमकाजी   | " "              | अधिकृत/होस्ट      | ९८४९३०४१०९ | आशा       |
| ९.      | रमेश राई            | धनकुटा-९         | वडाअध्यक्ष        | ९८४२०१२४६४ | रमेश      |
| १०.     | रमेश राई            | ध.न.पा. ८        | वडा अध्यक्ष       | ९८४२०६०६३४ | रमेश      |
| ११.     | गुणवत्ता अधिकृत     | धनकुटा न.पा.     | अधिकृत/होस्ट      | ९८४२१०६०८८ | गुणवत्ता  |
| १२.     | कारिना अधिकारी      | ध.न.पा. ८        | नर्सिङ निस्त्रिज  | ९८०२३२३४२३ | कारिना    |

| क्र.सं. | नाम              | कार्यालय     | पद                | फोन नं.    | हस्ताक्षर |
|---------|------------------|--------------|-------------------|------------|-----------|
| १८.     | चन्द्रका पाण्डे  | धनकुटा       | म. वि. नि.        | ९८६४००५५४८ | चन्द्रका  |
| १९.     | मुसवाण प्रेम     | धनकुटा न.पा. | स्वा. वि. अ.      | ९८४२०४४६०४ | मुसवाण    |
| २०.     | राजबहादुर राई    | धनकुटा-१०    | वडा अध्यक्ष       |            | राजबहादुर |
| २१.     | विपना थापा       | ध.न.पा. -२   | एम. अ. प्र. अ.    | ९८४२२१०११९ | विपना     |
| २२.     | बेजिना छिन्ना    | ध.न.पा. -६   | कार्यपालिका सदस्य | ९८४२०६०६४० | बेजिना    |
| २३.     | रजिन्द्र श्रेष्ठ | ENPHO        | P.D.              | ९८५१०४२१४८ | रजिन्द्र  |
| २४.     | कुन्द बस्नार्य   | "            | P.C.              | ९८४९१३२०२० | कुन्द     |
| २५.     | अनिता भुजु       | "            | A.P.O.            | ९८४९३५८१९७ | अनिता     |

#### Appendix 4: Glimpses of the SFD survey





SFD Dhankuta Municipality, Nepal, 2026

Produced by:

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