SFD Report

Dakneshwori Municipality
Nepal

Final Report

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Environment and Public Health Organization (ENPHO)

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SFD Report Dakneshwori Municipality, Nepal, 2023

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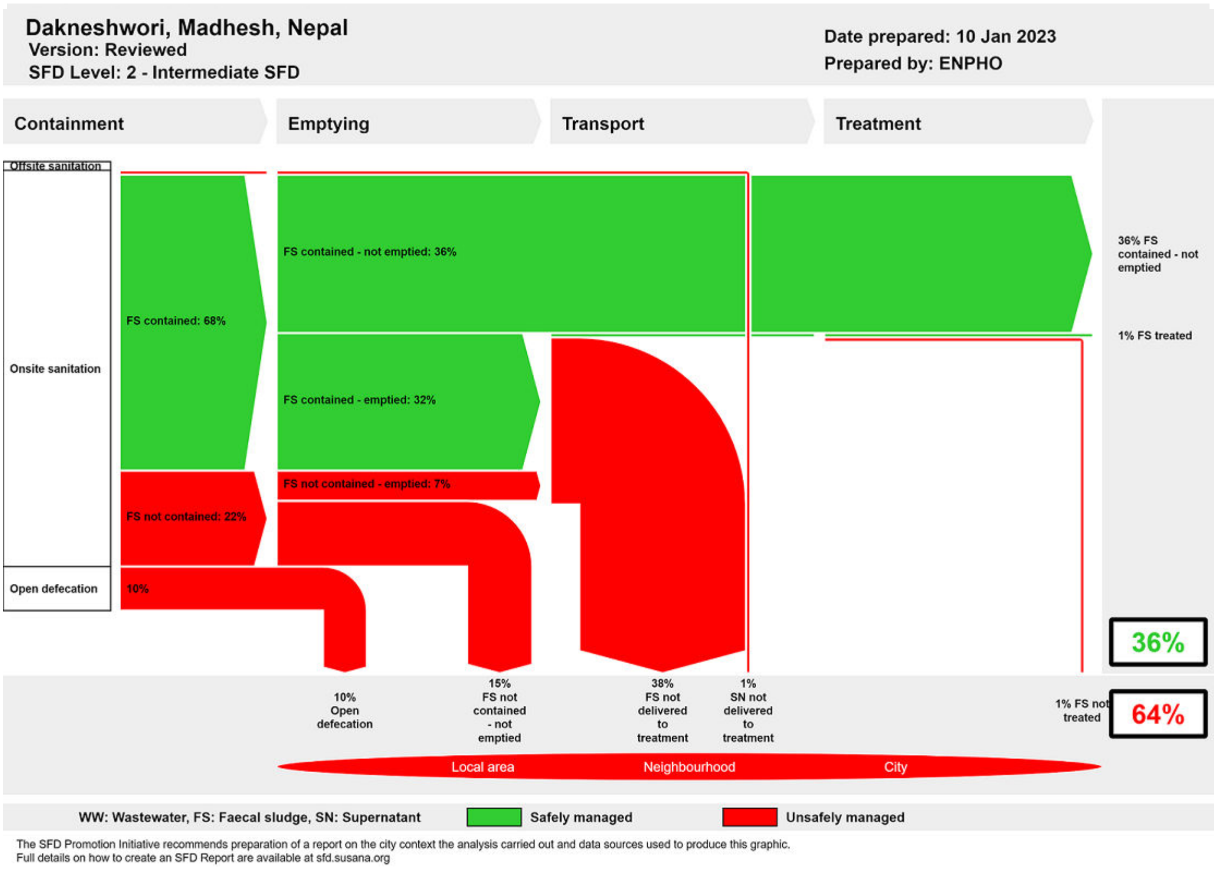
1. The SFD Graphic



2. Diagram information

SFD Level:

This SFD is a level 2 - Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO).

Collaborating partners:

Deutsche Welthungerhilfe e.V.

Dakneshwori Municipality.

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Status:

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3. General city information

Dakneshwori municipality is in southern terai region of Nepal. The municipality was formed in 2016 by merging Kabilasa, Harihara, tarahi, Bhutahi, pato, Aurahi, Barhmapur, Banaula, Patthargada and Gamhariya VDCs. The geographical coordinate of the municipality is 26.50o North and 86.62o East.The municipality is divided into 10 political ward boundaries. The total population of the municipality is 35,654 as per the municipal profile 2018.

The municipality has a tropical climate. The months of April to August are summer season and the temperature ranges from 23°C to 44°C. The winter part of the year prevails from the month of October to March.

Groundwater is the source of drinking water in the Terai region. In addition, shallow groundwater aquifers are mostly used for the purpose of drinking water. The shallow groundwater originates from unconfined or semi-confined aquifers.

4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section. The municipality has declared an open defecation free zone. Despite the Open Defecation Free (ODF) zone, the sanitation coverage in the municipality is 90%. The families without their own toilet defecate in open places.

All the households with access to sanitation facilities rely on onsite sanitation. Fully lined tanks and lined tanks with impermeable walls and open bottom are used by population residing in 11% and 12% of households. While 76% of the population use either twin pits or single pits termed as lined pits with semi-permeable walls and open bottom. Only 36% of containments have been emptied at least once since the installation. Mechanical emptying and transportation are popular in the municipality. However, the municipality lacks treatment facility for faecal sludge. Thus, the Faecal Sludge (FS) emptied and transported is disposed of directly into farmland, riverbanks, and barren land.

The SFD graphic shows that 36% of the excreta generated are safely managed while 64% of the excreta generated are unsafely managed. The safely managed percentage of FS generated by 36% of the population is temporary until the tanks and pits become full and FS from the containment is emptied.

Groundwater is a major source of drinking water in the municipality. Almost every household has installed handpumps. Recently, in 2022, Sundarpur Water Supply Users Committee have initiated piped drinking water supply. The water supply system was constructed with the support of Welthungerhilfe (WHH) and Mahauli Community Development Center (MCDC).

5. Service delivery context

Access to drinking water and sanitation has been defined as fundamental rights to every citizen by the constitution of Nepal. To respect, protect and implement the rights of citizen embedded in the constitution, the Government of Nepal (GoN) has endorsed the Water Supply and Sanitation Act 2022 which has emphasized the 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 mechanism at all levels. It strengthens institutional set up with the formation of water and sanitation coordination committee at every tier of government to actively engage in sanitation campaigns. Currently, the municipality has formed a Water, Sanitation and Hygiene (WASH) Plan with technical support from WHH. The sanitation programs will be developed and implemented as per the WASH plan.

6. Overview of stakeholders

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

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organizations
Public Institutions at Federal Government	Ministry of Water Supply
Public Institutions at Provincial Government	Ministry of Water Supply and Energy Development
Public Institutions at Local Government	Dakneshwori Municipality
Non-governmental Organizations	Environment and Public Health Organization (ENPHO), Mahauli Community Development Center (MCDC)
Private Sector	Private FS Emptying and Desludging facility providers, public toilet operators.
Development Partners, Donors	WHH, MuAN,

7. Credibility of data

The major data were collected from random household sampling. Altogether, 367 households and 37 institutions were surveyed from 10 wards of the municipality. Primary data on emptying, transportation, and current sanitation practices in the municipality were validated from Key Informant Interviews (KIIs) with private desludgers, public toilet management, sanitation and environmental section. The overall data and findings were shared with the stakeholders of the municipality and validated through a sharing program.

8. Process of SFD development

Data on sanitation situation were collected through household and institutional surveys. Enumerators from the municipality were mobilized after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, and KOBOCOLLECT for collection of data for survey. Along with this, KIIs were conducted with officers and engineer of municipality city and private desludging service providers 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 were fed into SFD graphic generator to produce the SFD graphic.

8. List of data sources

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

- WASH Plan. (2022). Water, Sanitation and Hygiene Plan 2020-2030. Dakneshwori Muncipality.
- Daknshwori Municipality. (2018). Municipal Profile of Dakneshwori Municipality.
- ENPHO. (2022). Sanitation situation analysis of selected municipalities in Siraha and Saptari District. unpublished.
- MoFAGA. (2017). Ministry of Federal Affairs & General Administration. Retrieved from Government of Nepal, Ministry of Federal Affairs & General Administration: https://www.sthaniya.gov.np/gis/

  MoH, N. N. (2017). Nepal Demographic and Health Survey 2016. Ramshah Path, Kathmandu, Nepal: Ministry of Health

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Abbreviations

CBS	Central Bureau of Statistics
DHM	Department of Hydrology and Metrology
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
GW	Groundwater
IRF	Institutional and Regulatory Framework
KII	Key Informant Interview
MCDC	Mahauli Community Development Center
MDGs	Millennium Development Goals
MEAL	Monitoring, Evaluation and Learning
MICS	Multiple Indicator Cluster Survey
MoWS	Ministry of Water Supply
MUAN	Municipal Association Nepal
NPC	National Planning Commission
NPR	Nepalese Rupees
NSHMP	National Sanitation and Hygiene Master Plan
NUWSSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
PPP	Private Public Partnership
RWSSNP	Rural Water Supply and Sanitation National Policy
SDP	Sector Development Plan
SFD	Shit Flow Diagram
VDC	Village Development Committee
WASH	Water Supply and Sanitation Hygiene
WHH	Welthungerhilfe
WHO	World Health Organization
WSSDO	Water Supply and Sanitation Divisional Office
WSST	Water Supply and Sanitation Technician
WSUC	Water Supply and Users Committee

1 City context

Dakneshwori municipality is in southern terai region of Nepal. The municipality was formed in 2016 by merging 10 Village Development Committees (VDCs). The merged VDCs are Kabilasa, Harihara, Tarahi, Bhutahi, Pato, Aurahi, Barhmapur, Banaula, Patthargada and Gamhariya Parwaha. The municipality is divided into 10 political ward boundaries. The municipality is extended to 69.11 square kilometres (WASH Plan, 2022). Figure 1 shows the ward map of Dakneshwori municipality.

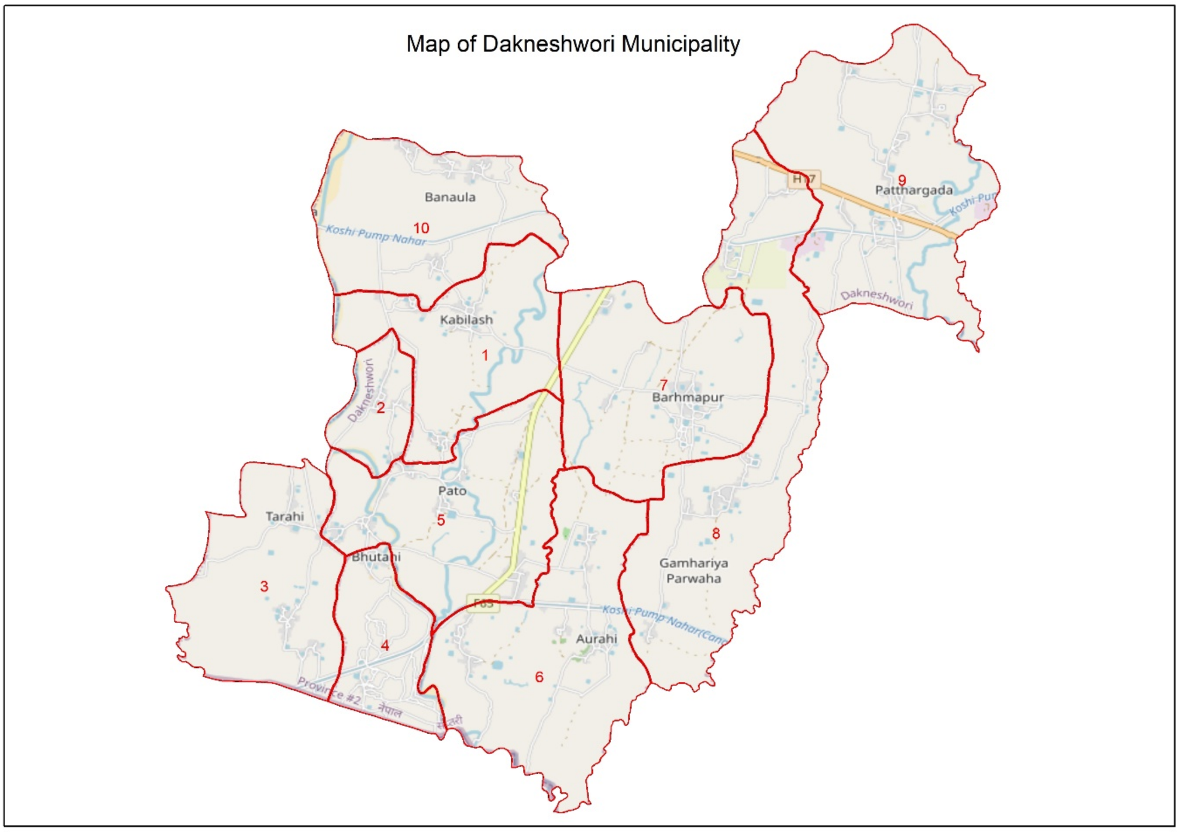

Figure 1: Map of Dakneshwori Municipality with ward boundaries.

1.1 Population

The total population was 44,314 residing in 10,090 households as reported in the Water Supply, Sanitation and Hygiene (WASH) profile 2022. The total male and female populations were 24,055 and 24,259 respectively (WASH Plan, 2022). The total population was 35,654 with total 9459 households as per municipal profile published in 2018 (Dakneshwori Municipality, 2018) . The annual growth rate of the population in the municipality was observed to be 0.8% per annum.

1.2 Climate

The municipality has a tropical climate. The months of April to August are summer season and the temperature ranges from 23°C to 44°C. The winter part of the year prevails from the month of October to March. Figure 2 shows the average monthly maximum and minimum temperature for the year 2019 recorded by the Department of Hydrology and Metrology (DHM).

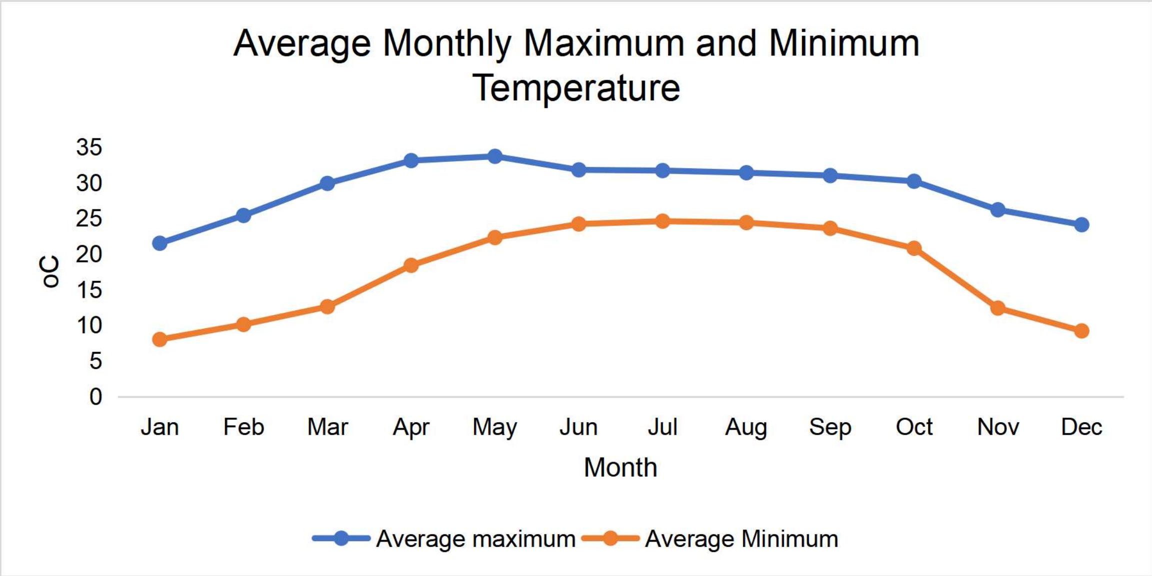

Figure 2: Average monthly maximum and minimum temperature.

The monsoon arrives in the month of June. The average total annual precipitation was 1,944.5 mm for the year 2019 as reported by the DHM. The maximum precipitation was received during the month of July with 545.8 mm.

1.3 Topography

The municipality is in the Southern Terai Region of the country. The geographical coordinate of the municipality is 26.50° North and 86.62° East. The geological structure of the city contents alluvial sediments i.e., sand, silt and clay (Dahal, 2006). Groundwater is the source of drinking water in the Terai region. In addition, shallow groundwater aquifers are mostly used for the purpose of drinking water. The shallow groundwater originates from unconfined or semi-confined aquifers.

2 Service Outcomes

2.1 Overview

The government of Nepal on 30th September 2019 has declared the nation free of open defecation and have achieved universal access to improved sanitation facilities throughout the country. Yet 10.1% of households from poor and marginalized communities in Dakneshwori municipality do not have access to improved sanitation facilities. Where improved sanitation is referred as sewered and non-sewered sanitation facilities with cistern flush or pour flush toilets connected to sewer or septic tanks or pits, ventilated improved pit latrines, pit latrines with cover slabs and compositing toilets.

2.1.1 Sanitation Systems in household buildings

Any toilet system designed to handle or treat faeces or sewage at its source rather than transporting to another location is termed an onsite sanitation system (Augustine Chioma Affam, 2021) . All the households with sanitation facilities in the municipality rely on onsite sanitation systems. The blackwater from the toilet is stored in the containment. Where, well-designed septic tank is installed in only 1.5% of households. Instead, fully lined tanks and lined tanks with impermeable walls and open bottom containments are constructed by 22% of the households. Twin pits and single pits are popular in the municipality. Together, 76% of households have such types of pits installed by assembling pre-cast concrete rings one after another. Remarkably, 0.3% of the households have connected toilet waste into anaerobic biogas digester. Figure 3 shows the percentage of households with different types of containments.

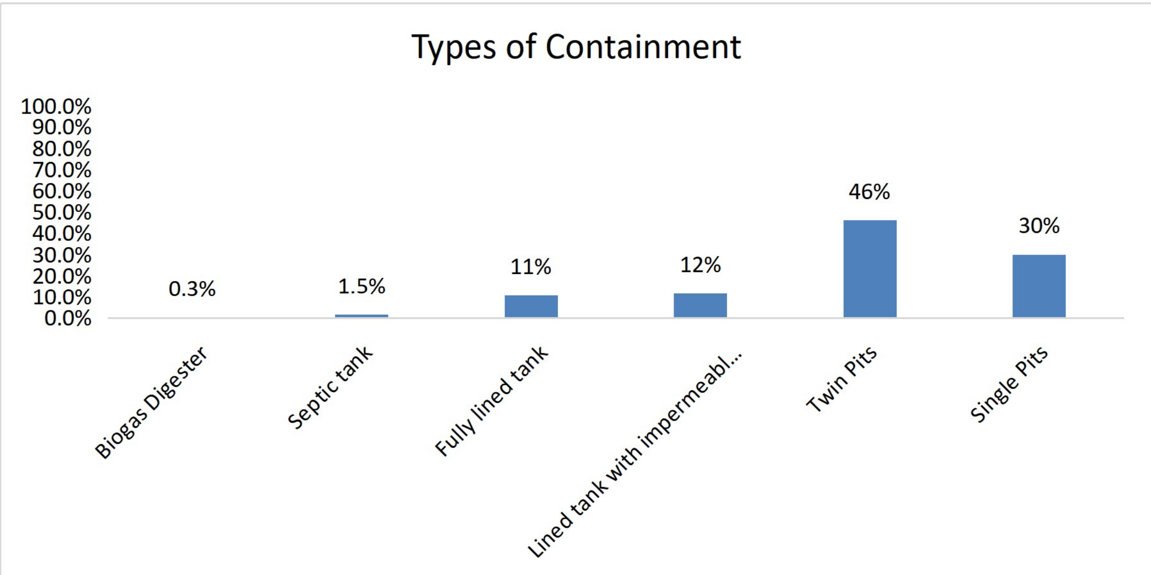

Figure 3: Percentage of households with different types of containments in Dakneshwori Municipality

Ideally twin pits are designed to safely store and treat faecal sludge on suite. The facility consists of two sets of pits used alternatively to store blackwater dug or made from assembling pre-cast concrete rings at the minimum horizontal distance of 1.2m. Both pits are connected from a diversion box. However, most twin pits installed by the households are not as per the design. The minimum distance between two sets of pits is not maintained. Also, the connection pipes to the pits are in series. Thus, these pits function only as lined tanks with semi-permeable walls and open bottom. Figure 4 shows the design of twin pits and pits installed at household level.

Figure 4: Inappropriate design of the twin pits, where the distance between two pits is less than 1.2 m.

Also, in many areas the plinth level of the containments has been raised above ground to prevent inflow of runoff during rainy season. Figure 5 shows the plinth level raised containment.

Figure 5: Containment with plinth level raised above ground to prevent inflow of runoff.

Moreover, 8,0% of households have provision of discharging effluent from containment to either soak pit, open drain, open ground/farm, or water resources. The discharge of effluent from containment to soak pit can be considered as good practice. However, there is a higher risk of polluting groundwater and surface water through discharging effluent to open drain, water resources and open ground/farm. Figure 6 shows the map locating households with different types of containments in the municipality.

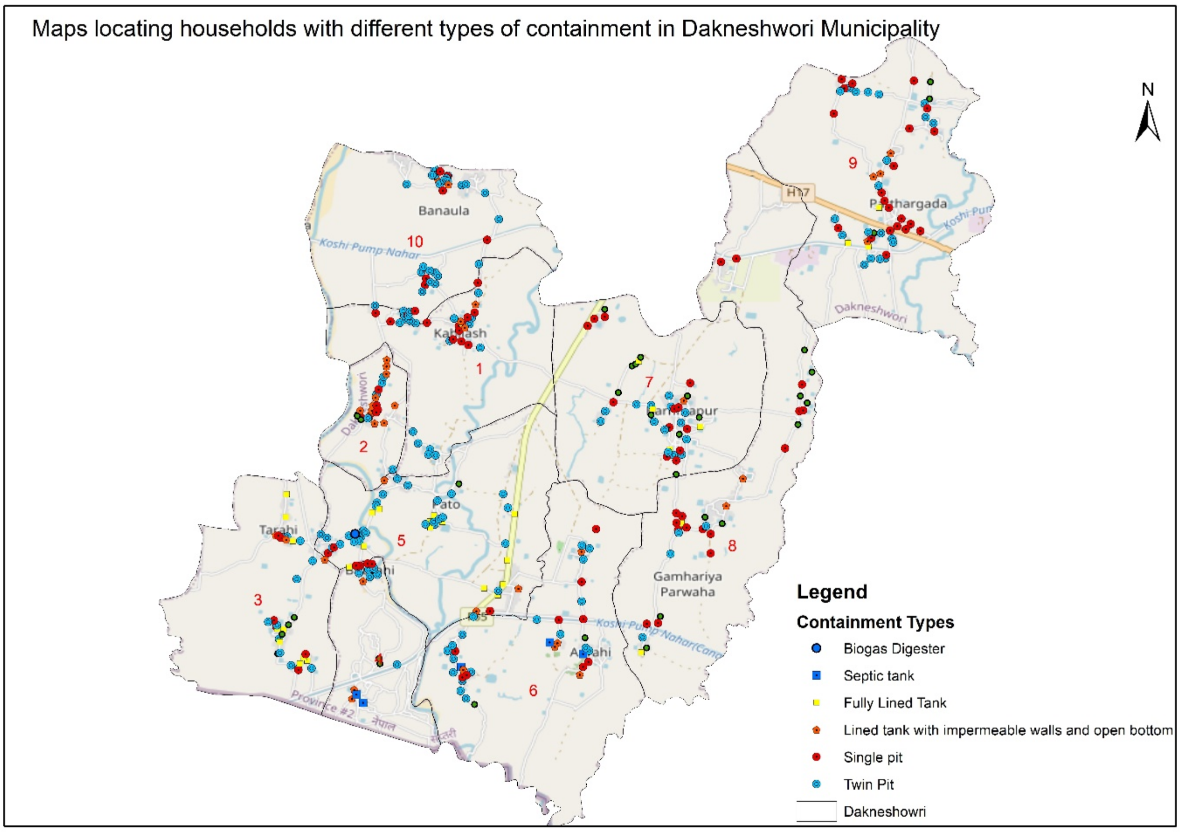

Figure 6: Map locating households with different types of containment in Dakneshwori Municipality.

2.1.2 Sanitation Systems in institutional buildings

Altogether 37 buildings designed and built for the purpose of operating institutions were observed during the sanitation assessment survey in 2022. Among these, one building which is still under construction does not have a toilet facility. Fully lined tanks are installed in 86% of the buildings. While 8,0% and 6,0% of the institutional buildings have lined tanks with impermeable walls and open bottom and single pits, respectively.

2.1.3 Public Toilets

The Water Supply and Sanitation Hygiene (WASH) Plan reported two public toilets in the municipality. None of these public toilets have enough water and provision of handwashing station. The report has emphasized that daily operation and maintenance and overall management of public toilets is a major challenge (WASH Plan, 2022).

2.1.4 Emptying and Transportation Services of Containment

Emptying is one of the major components of the sanitation service chain. It ensures the proper functioning of containment basically for the septic tanks which functioned well until the volume of sludge is one-third of the total volume of the tanks. Also, in other containments, regular emptying prevents overflow of the sludge and blockages. However, only 36.4% of the households have emptied their containment due to overflow of faecal sludge.

Furthermore, twin pits are emptied more than other types of containment in the household buildings. Among the households with emptied containment at least once, 46%, 30% and 12% of households with twin pits, single pits and lined tanks with impermeable walls and open bottom, respectively have been emptied. While only 11% of the households with fully lined tanks have emptied their tanks.

Emptying rate of the containment is determined by number of users, duration of use, types, and size of the containment. 84% and 69% of the containments installed 0 to 2 years and 3 to 5 years ago have not been emptied. During this period, 56.8% of the toilets were constructed among which, 80% are connected to twin pits and single pits. Also, the average number of users and size of pits are 6.0 and 2.2 m^3, respectively. Table 1 shows the types of containment with emptying status and years of construction.

Table 1: Descriptions on types of containment with emptying status and years of installation

Types of containment		Years of Construction						
		0-2	**3-5**	**6-10**	**11-15**	**16-20**	**>20**	**Grand Total**
Septic tank		**0%**	**1%**	**1%**	**0%**	**0%**	**0%**	**2%**
Emptied Status	No	0%	1%	0%	0%	0%	0%	1%
	Yes	0%	0%	0%	0%	0%	0%	0%
Fully Lined Tank		**1%**	**5%**	**3%**	**1%**	**0%**	**1%**	**11%**
Emptied Status	No	1%	3%	2%	1%	0%	1%	8%
	Yes	0%	1%	1%	0%	0%	0%	2%
Lined tank with impermeable walls and open bottom		**1%**	**3%**	**5%**	**2%**	**0%**	**0%**	**12%**
Emptied Status	No	1%	2%	3%	1%	0%	0%	7%
	Yes	0%	2%	2%	2%	0%	0%	5%
Twin Pit		**4%**	**23%**	**17%**	**2%**	**1%**	**0%**	**46%**
Emptied Status	No	3%	16%	8%	1%	0%	0%	29%
	Yes	1%	7%	9%	1%	0%	0%	17%
Single pit		**4%**	**16%**	**10%**	**1%**	**0%**	**0%**	**30%**
Emptied Status	No	3%	10%	5%	0%	0%	0%	19%
	Yes	1%	5%	5%	1%	0%	0%	12%
Grand Total		**10%**	**47%**	**35%**	**6%**	**1%**	**1%**	**100%**

Mechanical emptying is popular in the municipality. 91.6% of the emptied containment was mechanically emptied. While manual emptying is still in practice. However manual emptying practices were not observed in institutional buildings. The private desludging service providers from neighbouring municipality serve mechanical desludging in the municipality.

Superpower Safety Tanki Safai owned by Mr. Khursid Alam from Rajbiraj and S*afety Tanki Safai* owned by Mr. Arjun Mukhiya are two private desludger serving in the municipality. Besides, other private desludger from Kamala Municipality keeps on serving on the demand as shown in Figure 7.

Superpower Safety Tanki Safai has been engaged in the service for the last two years. It owns a desludging vehicle of 6,000 litres capacity. It serves Rajbiraj municipality, Dakneshwori municipality and other parts of Sunsari District. In Dakneshwori municipality, it only serves if there is demand from at least 3 households. It has been charging NPR. 3,500 (USD 27) per trip and additionally charge for the distance travelled. In an average, it makes two trips per week and during festive season it makes an average of 4 trips per day. They have been disposing of the faecal sludge in Khado, which is at 4 km distance from the nearest residential area, Hatiya in Rajbraj. While the faecal sludge collected in Dakneshwori is disposed in the farmlands.

Similarly, Mr. Arjun Mukhiya owns two desludging vehicles of 3,000 litres and 5,500 litres capacity. According to him, there are 6 desludging vehicles serving in Saptari District. Additionally, 15 to 20 desludging vehicles from Siraha District are also serving in the Saptari District. These desludging vehicles keep on travelling in the cities and serve those households in their route that need to empty their containment. Also, the service is provided after receiving demand from the regular customers. He has been charging NPR. 3,500 (USD 27) to NPR. 4,000 (USD 31) for each trip to the households with rectangular containment, i.e., fully lined tanks or lined tanks with impermeable walls and open bottom. While he charges NPR. 500 (USD 4) for emptying each concrete ring from circular pits made by assembling pre-cast concrete rings. He is making on average 4 trips per day. The faecal sludge is dumped in barren land or nearby river.

Figure 7: Mechanical emptying of the containment in Dakneshwori Municipality.

2.1.5 Treatment and Disposal of Faecal Sludge

Treatment and safe disposal of faecal sludge is essential to ensure environmental protection and prevent health hazards. Neither the municipality nor the neighbouring municipalities possess a faecal sludge treatment plant. In the absence of the faecal sludge treatment plant, the community has adopted dumping faecal sludge into water bodies and open ground.

2.2 SFD Selection Grid

The types of household containments in the municipality are re-categorized to match the containments defined by Shit Flow Diagram Promotive Initiative (SFD PI). Particularly, twin pits and single pits constructed by assembling pre-cast concrete rings one above another are classified as lined pits with semi-permeable walls and open bottom. Upon reclassification of the containments, the types of sanitation technologies and their connections are selected in the SFD selection grid as shown in Figure 8.

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 Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution T1A2C5	T1A2C6				
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution	T1A3C6		T1A3C8		T1A3C10
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution T1A4C5	T1A4C6	T1A4C7	T1A4C8		T2A4C10 T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10 T1A5C10
Unlined pit										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
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 8: SFD selection grid for Dakneshwori Municipality.

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 different frame selected in the SFD selection grid.

T1A2C5	This is a correctly designed, properly constructed, fully functioning septic tank with an outlet connected to soak pit without significant risk of groundwater pollution, therefore all the excreta in this system is considered contained.
T1A2C6	This is a correctly designed, properly constructed, fully functioning septic tank with an outlet connected to an open drain or storm sewer. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, therefore all the excreta in this system is considered not contained.
T1A3C6	A correctly designed, properly constructed, and well maintained fully lined tank with impermeable walls and open bottom. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer the excreta in this system are considered not contained.
T1A3C8	A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and open bottom. Since the tank is fitted with a supernatant/effluent overflow connected to open ground the excreta in this system is considered not contained.
T1A3C10	A correctly designed, properly constructed, and well maintained fully lined tank with impermeable walls and base. Since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.
T1A4C5	A correctly designed, properly constructed, and well maintained fully lined tank with impermeable walls and base, the overflow is connected to soak pit without significant risk to groundwater, therefore excreta in this system is considered contained.
T1A4C6	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer, the excreta in this system are considered not contained.
T1A4C7	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to water body, the excreta in this system are considered not contained.
T1A4C8	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered not contained.
T1A4C10	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. 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.
T1A5C10	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow, so this system is considered contained.
T2A5C10	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow 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

The second step in the process of developing a SFD graphic is the calculation of the proportion of faecal sludge (FS) contained in each type of sanitation technologies. A detailed instruction on how to calculate the proportion of FS in SFD PI was followed. It is stated that the default "100%" value is used where onsite containers are connected to soak pits, to water bodies or to open ground. It will model the contents as 100% faecal sludge and a proportion of this may be emptied periodically. The remaining not emptied fraction is made up of one or more of the following: faecal sludge which remains in the container, supernatant (when discharging to water bodies or to open ground), and infiltrate. Where onsite containers are connected to a sewer network or to open drains, a value of "50%" is used which means that half the contents are modelled as faecal sludge; a proportion of this may be emptied periodically.

The remaining not emptied fraction will comprise faecal sludge which remains in the container and, in the case of open-bottomed tanks, infiltrate. The other half of the contents is modelled as supernatant discharging into the sewer network or to open drains. The formula used for FS proportion calculation is shown below:

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

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

i. The proportion of FS in septic tanks is 89%, as all the septic tanks are connected to stormwater drain or open drain in the municipality. This implies that almost 50% of FS from such types of containment is discharged into open or stormwater in the form of supernatant.

ii. The proportion of FS in fully lined tanks is 93%, as the FS from fully lined tanks connected to open drain could not be contained.

iii. The proportion of FS from lined tanks with open bottoms and all types of pits is 100%, as the proportion of lined tanks with impermeable walls and open bottom connected to open drain is only 0.3% which is negligible.

Upon calculation of proportion of FS in each type of sanitation technologies, the proportion of population using the technology selected in the SFD selection grids is fed in. Figure 9 shows the SFD matrix of the municipality.

Dakneshwori, Madhesh, Nepal, 10 Jan 2023. SFD Level: 2 - Intermediate SFD
Population: 35654
Proportion of tanks: septic tanks: 89%, fully lined tanks: 93%, lined, open bottom tanks: 100%

Containment						
System type	Population	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	**F3**	**F4**	**F5**	**S4e**	**S5e**
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	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A2C5 Septic tank connected to soak pit	1.1	60.0	0.0	0.0		
T1A2C6 Septic tank connected to open drain or storm sewer	0.3	0.0	0.0	0.0	0.0	0.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	7.6	20.0	14.0	95.0		
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	1.4	48.0	0.0	0.0	0.0	0.0
T1A3C8 Fully lined tank (sealed) connected to open ground	0.8	0.0	0.0	0.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	5.7	41.9	0.0	0.0		
T1A4C5 Lined tank with impermeable walls and open bottom, connected to a soak pit	2.2	30.0	0.0	0.0		
T1A4C6 Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	0.3	0.0	0.0	0.0	0.0	0.0
T1A4C7 Lined tank with impermeable walls and open bottom, connected to a water body	0.5	40.0	0.0	0.0		
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	0.8	0.0	0.0	0.0		
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	51.2	51.5	0.0	0.0		
T1B11 C7 TO C9 Open defecation	10.1					
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	0.8	0.0	0.0	0.0		
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	17.2	35.6	0.0	0.0		

Figure 9: SFD Matrix of Dakneshwori Municipality.

2.3.2 Risk Assessment of Groundwater Pollution

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

a. Sources of Drinking Water and Water Production

The major source of drinking water in the municipality is groundwater. Almost all households in the municipality rely on handpumps for drinking water supply. Recently in 2022 a community water supply scheme was inaugurated and operated in ward number 4 of the municipality. The water supply scheme is operated by Sundarpur Water Supply and User's Committee. Altogether, 68 household piped drinking water supply have been distributed so far from the system. The system was installed from the support of Welthungerhilfe (WHH) and implemented by Mahauli Community Development Center (MCDC). Figure 10 shows the overhead water tank of the system.

Figure 10: Overhead tank of Sundarpur Water Supply Scheme.

b. The vulnerability of the aquifer and lateral spacing between sanitation systems and groundwater source

The term aquifer pollution vulnerability is intended to represent the varying level of natural protection afforded by the contaminant attenuation capacity of the unsaturated zone or semi-confining beds above an aquifer, because of physicochemical processes (filtration, biodegradation, hydrolysis, adsorption, neutralization, volatilization, and dispersion)—all of which vary with their texture, structure, clay content, organic matter, pH, redox and carbonate equilibria. Groundwater vulnerability is specific to containment type and pollution scenarios (Andreo, 2013) Here, among the various types of onsite sanitation technologies, lined tanks with impermeable walls and open bottom and lined pits are more prone to contribute to aquifer pollution as the nature of such containments impose more containment load from the land surface to groundwater.

A key determinant of risk variation is the soil and geological setting. Especially for consolidated hard rock sediments with poor soil cover and shallow water tables, the risk is higher. According to WHO criteria, if the travel time of pollutant to groundwater source is less than 25 days, there is significant risk to contamination; low risk, if the travel time is between 25 and 50 days; and very low risk if the travel time is greater than 50 days (Krishnan, 2011). The size of pores in the soil determines the infiltration rate. In the sandy loam soil, the permeability is approximately 2.5 cm per hour. Thus, between 25 and 50 days the pollutant could travel to the depth of approximately 30 metres (98.67 feet) in sandy loam soil. Hence, the people using open bottom tanks and consuming water from the handpumps with the depth up to 100 feet (30.48 m) and horizontal distance of the pump within 25 feet (7.62 m) from the source of pollutants are assumed at significant risk to groundwater pollution.

Figure 11 demonstrates the depth of handpumps and horizontal distance of it from source of pollutant by lined tanks with impermeable walls and open bottom. Almost 18% of the people using lined tanks and open bottom containments are at significant risk to consumption of groundwater pollution from their containment.

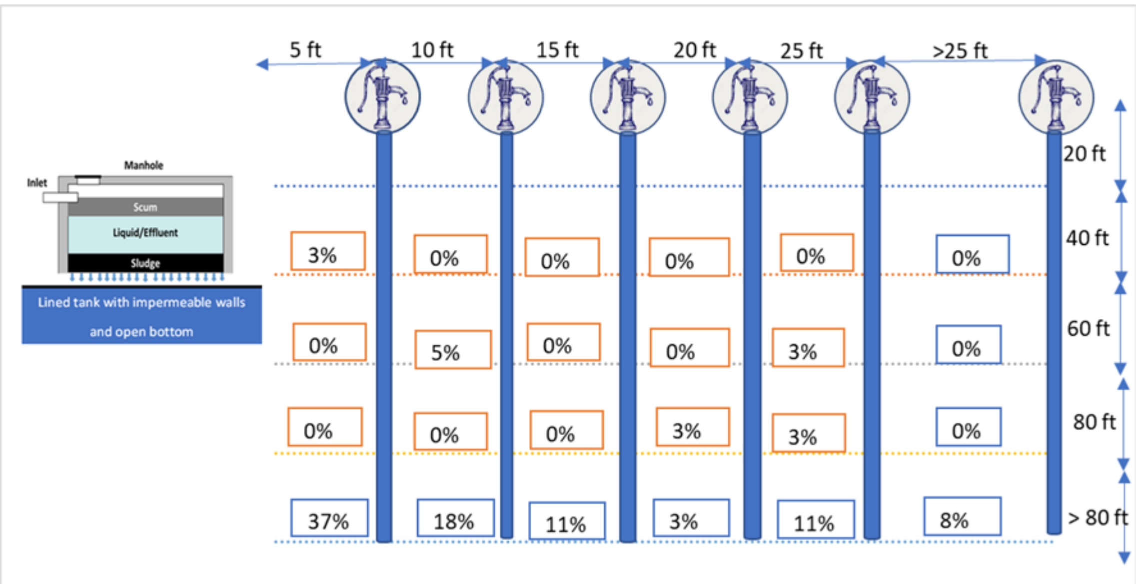

Figure 11: Depth of handpumps and lateral spacing of it with containment types lined tank with impermeable walls and open bottom.

Similarly, Figure 12 demonstrates the depth of hand pumps and horizontal distance of it with the containment type lined pits with semi-permeable walls and open bottom. It shows that 27% of the households are at high risk of groundwater contamination as the water is pumped through handpump in these households.

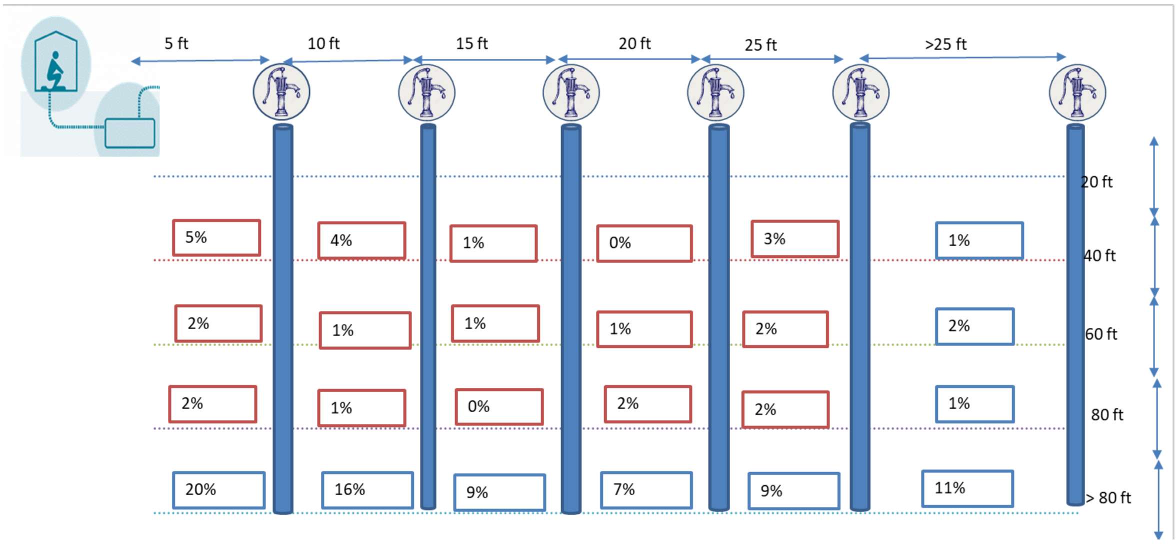

Figure 12: Depth of hand pumps and lateral spacing of it with containment types lined pit with semi-permeable walls and open bottom.

2.3.3 Proportion of Faecal Sludge Emptied (F3)

The proportion of faecal sludge emptied (F3) is calculated based on percentage containment emptied and amount of FS emptied during the process. The information on FS emptied from containment is obtained from Key Informant Interviews (KIIs) with desludging service providers. It is revealed most of the containment gets filled due to intrusion of the groundwater into the containment. Thus, the portion of liquid in the FS is high which can be easily pumped out by the desludging vehicle. So, almost 90% of the FS content in the containment is removed during emptying. Hence, actual proportion of FS emptied from each containment is calculated as:

$$Actual\ Proportion\ of\ FS\ emptied\ (F3) = percentage\ of\ containment\ emptied \times proportion\ of\ FS\ removed\ during\ emptying$$

Table 3 shows the actual proportion of FS emptied from each containment.

Table 3: Sanitation technologies and proportion of emptied faecal sludge.

SN	Sanitation Technologies	SFD Reference Variable	Percentage of Population Using the System	Percentage of Emptied Containment	Emptied Proportion of FS	Actual Proportion of Emptied FS (F3)
1	Septic tank connected to soak pit, low risk of GW pollution	T1A2C5	1.1%	75%	80%	60%
2	Septic tank connected to open drain or storm sewer	T1A2C6	0.3%	0%	0%	0%
3	Fully lined tank (sealed), no outlet or overflow	T1A3C10	7.6%	25%	80%	20%
4	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	1.4%	60%	80%	48%
5	Fully lined tank (sealed) connected to open ground	T1A3C8	0.8%	0%	0%	0%
6	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	5.7%	52.4%	80%	41.9%
7	Lined tank with impermeable walls and open bottom, connected to a soak pit	T1A4C5	2.2%	37.5%	80%	30%
8	Lined tank with impermeable walls and open bottom, connected to an open drain or storm water	T1A4C6	0.3%	0%	0%	0%
9	Lined tank with impermeable walls and open bottom, connected to water body	T1A4C7	0.5%	50%	80%	40%
10	Lined tank with impermeable walls and open bottom, connected to an open ground	T1A4C8	0.8%	0%	0%	0%
11	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	51.2%	64.4%	80%	51.5%
12	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	0.8%	0%	0%	0%
13	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A5C10	17.2%	44.4%	80%	35.6%

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

The municipality does not have any form of treatment plant to treat faecal sludge. Also, the people using twin pits reclassified as lined pits with semi-permeable walls and open bottoms are not using them properly.

The FS emptied from the containments is dumped openly in farmland or water bodies. Thus, variables F4 and F5 for all sanitation systems are set to 0%. However, FS from anaerobic biogas digesters, classified as fully lined tanks (system T1A3C10) that accounts for 14% of total fully lined tanks, is considered as transported and treated with a treatment efficiency estimated at 95% (F5 = 95%).

2.3.5 Proportion of Supernatant in Open Drain or storm sewer delivered to treatment (S4e)

The actual proportion of supernatant from the containment to open drain and storm water drain is not possible to observe. Thus, the proportion is estimated at 50% of the faecal sludge in the containment connected to open drain and storm water drain. While the proportion delivered to treatment plant and treated is 0% as no treatment facility is available.

2.4 SFD Graphic

Figure 13 represents the fate and flow of faecal sludge through each sanitation service chain. It shows that FS generated from 36% of the population is safely managed represented by "Green" colour arrowhead. However, 36% resemble the FS stored in the containment without significant risk to groundwater. Thus, the safely managed percentage of FS generated by 36% of the population is temporary and lasts until the FS from the containment is emptied. Only FS from less than 1% of population collected in anaerobic biogas digesters is treated.

The FS from 63% of the population is unsafely managed, represented by "RED" arrow heads. The percentage of unsafely managed FS is generated from containments where FS is not contained - not emptied (15%), openly dumped FS emptied (38%) which is disposed of untreated in the environment, supernatant not delivered to treatment (1%), FS not treated (1%) and people practising open defecation (10%).

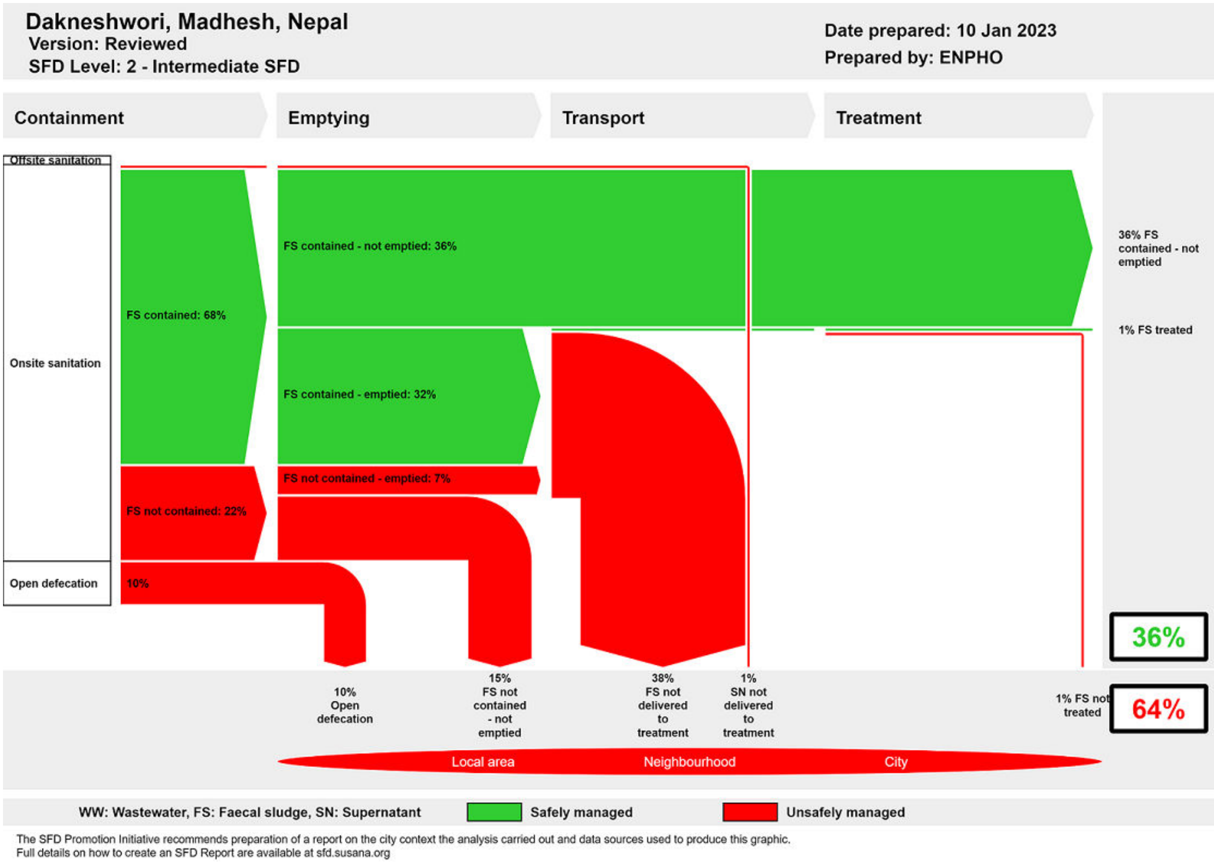

Figure 13: SFD Graphic of Dakneshwori Municipality.

2.4.1 Offsite Sanitation

Nepal Multiple Indicator Cluster Survey (MICS) reported that among the total households in Nepal, 10.7% of households has a toilet connected to sewer network and in Madhesh province it is only 1.1% (CBS, 2020). The offsite sanitation system was not observed in Dakneshwori municipality.

2.4.2 Onsite Sanitation

All the population with access to toilets relies on the onsite sanitation system in the municipality. Among them, FS from 68% of the population is properly stored in technically effective containment represented as FS contained in the SFD graphic. While FS from 22% of the population is stored in unsafe containment represented as FS not contained.

FS contained

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

The value is the summation of the percentage of population using septic tanks connected to soak pit with low risk to groundwater pollution (T1A2C5), fully lined tanks (sealed) without outlet or overflow (T1A3C10), lined tanks with impermeable walls and open bottom without outlet or overflow and connected to soak pit with low risk to groundwater pollution (T1A4C10 and T1A4C5) and lined pits with semi-permeable walls and open bottom without outlet or overflow (T1A5C10) multiplied by proportion of FS contained in each containment. Thus, the FS generated by 68% of the population is contained in the municipality.

FS not Contained

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

FS generated by 15% of the population in the municipality is not contained. The value is obtained from the summation of percentage of population using, septic tanks connected to open drain or storm sewer (T1A2C6), fully lined tanks connected to open drain or storm sewer and open ground (T1A3C6 and T1A3C8) and lined tanks with impermeable walls and open bottom without outlet or overflow, connected to an open drain or storm sewer, water body and open ground (T2A4C10, T1A4C6, T1A4C7 and T1A4C8) and lined pits with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A5C10) multiplied by proportion of FS in each containment.

FS contained Emptied and Not Emptied

The proportion of FS contained emptied is the summation of proportion of FS emptied from sanitation technologies where FS is safely stored. The calculation is shown in Table 4.

Table 4: Calculation of FS contained emptied, and FS contained not emptied.

SN	Sanitation Technologies	SFD Reference Variable	Proportion of FS	Proportion of Emptied FS (F3)	FS contained emptied	FS contained not emptied
1	Septic tank connected to soak pit, low risk of GW pollution	T1A2C5	1.1%	60%	0.7%	0.4%
2	Fully lined tank (sealed), no outlet or overflow	T1A3C10	7.6%	20%	1.5%	6.1%
3	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	5.7%	42%	2.4%	3.3%
4	Lined tank with impermeable walls and open bottom, connected to a soak pit	T1A4C5	2.2%	30%	0.7%	1.5%
5	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	51.2%	52%	26.4%	24.8%
				Total FS contained emptied	32%	-
					Total FS contained not emptied	36%

FS not contained emptied

The proportion of FS contained emptied is summation of proportion of FS emptied from either technically appropriate or inappropriate containment with potential risk on direct contact with human or contamination of groundwater. The calculation of FS not contained emptied is shown in Table 5.

Table 5: Calculation of FS not contained emptied.

SN	Sanitation Technologies	SFD Reference Variable	Proportion of FS	Proportion of Emptied FS (F3)	FS contained emptied	FS contained not emptied
1	Septic tank connected to open drain or storm sewer	T1A2C6	0.2%	0.0%	0.0%	0.2%
2	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	1.3%	48.0%	0.6%	0.7%
3	Fully lined tank (sealed) connected to open ground	T1A3C8	0.8%	0.0%	0.0%	0.8%
4	Lined tank with impermeable walls and open bottom, connected to an open drain or storm water	T1A4C6	0.3%	0.0%	0.0%	0.3%
5	Lined tank with impermeable walls and open bottom, connected to water body	T1A4C7	0.5%	40.0%	0.2%	0.3%
6	Lined tank with impermeable walls and open bottom, connected to an open ground	T1A4C8	0.8%	0.0%	0.0%	0.8%
7	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	0.8%	0.0%	0.0%	0.8%
8	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A5C10	17.2%	35.6%	6.1%	11.1%
Total FS not contained emptied					7%	-
Total FS not contained not emptied						15%

FS not delivered to treatment

The municipality does not have treatment facility to treat faecal sludge. So, all the FS emptied from contained and not contained containments is disposed into farmland, riverbank, and jungle. However, the FS from anaerobic biogas digesters is considered as treated. The portion of FS in biogas digester is 14% of the fully lined tanks. Hence, the FS treated accounts to 1% of total FS generated by all the people in the municipality.

Supernatant (SN) not delivered to treatment

The proportion of supernatant is obtained from containments connected to open drain or stormwater sewer calculated as 50% of FS contained in each containment. The total proportion of supernatant (SN) is 1% of FS generated by the total population. Since the municipality lacks proper sewer network and treatment plant, the supernatant is disposed directly into water bodies. Hence the proportion of SN not delivered to treatment is 1%.

2.4.3 Open Defecation

Despite Open Defecation Free (ODF) free status, people residing in 10% of households still go for open defecation. The people living in poverty and those who do not own land mostly do not have toilets.

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

Local Government Operation Act, 2017

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

Environment Protection Act, 2019

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

Water Supply and Sanitation Act, 2022

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

Environment Friendly Local Governance Framework 2013

The environment-friendly local governance framework 2013 has been issued to add value to environment-friendly local development concept encouraging environmental protection through local bodies. The framework has set basic and advanced indicators for households, settlement, ward, village, municipality, and district levels for declaration of environment friendly. The use of water sealed toilets in households as basic indicators for sanitation and health. Provision of toilet with safety tank and use as advanced indicators for sanitation. Provision of gender, children and disabled friendly public toilets in parks, petrol pumps and main market as basic indicator for municipal level. Advance indicators such as drainage discharged only after being processed through biological or engineering technique. While it has failed to identify the necessity of faecal sludge treatment plants as it has assumed safety tank in the households is sufficient for treating faecal sludge.

Institutional and Regulatory Framework for Faecal Sludge Management, 2017

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

Total Sanitation Guideline, 2017

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

3.2 Policies

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

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

Nepal is a signatory of the historical resolution of 2010 United Nations General Assembly on the Human Right to Water and Sanitation. Nepal committed to Millennium Development Goals (MDGs) for 2000- 2015 The goal was accomplished through declaration of the country as free from open defecation on 30th September 2019. National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened institutional setup tier of government in a participatory approach. In an alignment total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

Similarly, Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (SDP 2016-2030) was formulated in 2016 for sector convergence, institutional and legal reforms, capacity development and establishing coordination and harmonization in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on Faecal Sludge Management in the sector for effective planning, implementation, and service delivery.

3.3 Institutional roles

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

At Federal Government

National Planning Commission: At the federal government, the National Planning Commission is the specialized and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs, identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policy, plans and programs. It supports, facilitates, and coordinates with federal, provincial, and local government for developing policy plans and implementation.

Ministry of Water Supply: Ministry of Water Supply (MoWS) is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015). Under the MoWS, Department of Water Supply and Sewerage Management (DWSSM) plan and implement water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015) . The organizational structure of DWSSM is shown in Figure 14.

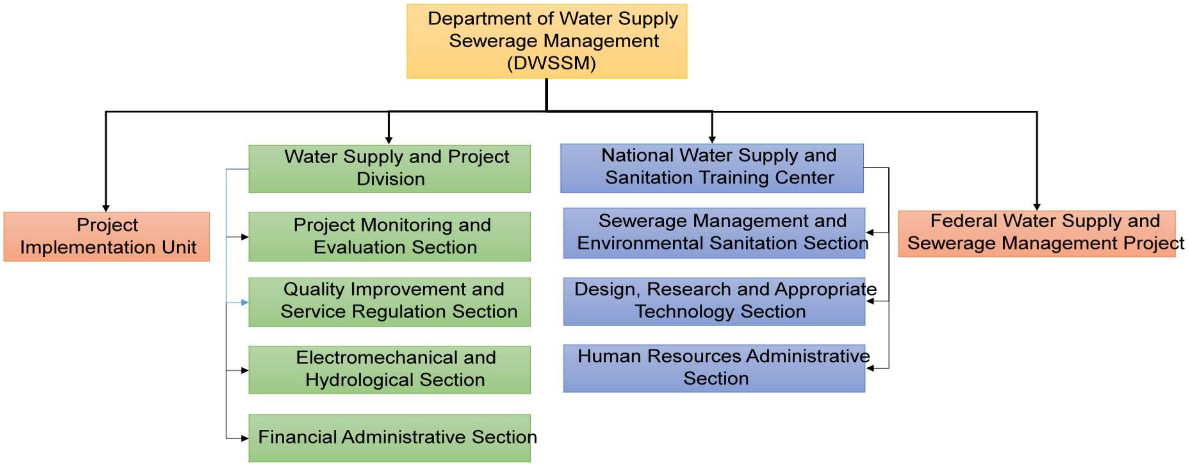

Figure 14: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

At Provincial Government

Ministry of Physical Infrastructure: Ministry of water supply and energy development of provincial government in Madhesh 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 Water supply and Sanitation Divisional Office (WSSDO). WSSDO implements the water and sanitation programs meeting the following criteria:

i. Inter local government projects.

ii. Beneficiaries between 5,000 to 15,000 in terai region, 3,000 to 5,000 in hilly region and 5,00 to 1,000 in Himalayan region.

At Local Government

Municipal council: Figure 15 shows the organizational structure of the municipality. The sanitation sub-section under the Infrastructure Development and Environment Management Section. The sub-section has initiated door to door solid waste collection service in the municipality. Besides, MCDC, a non-government organization has been implementing water and sanitation program in community level through the support of Welthungerhilfe (WHH).

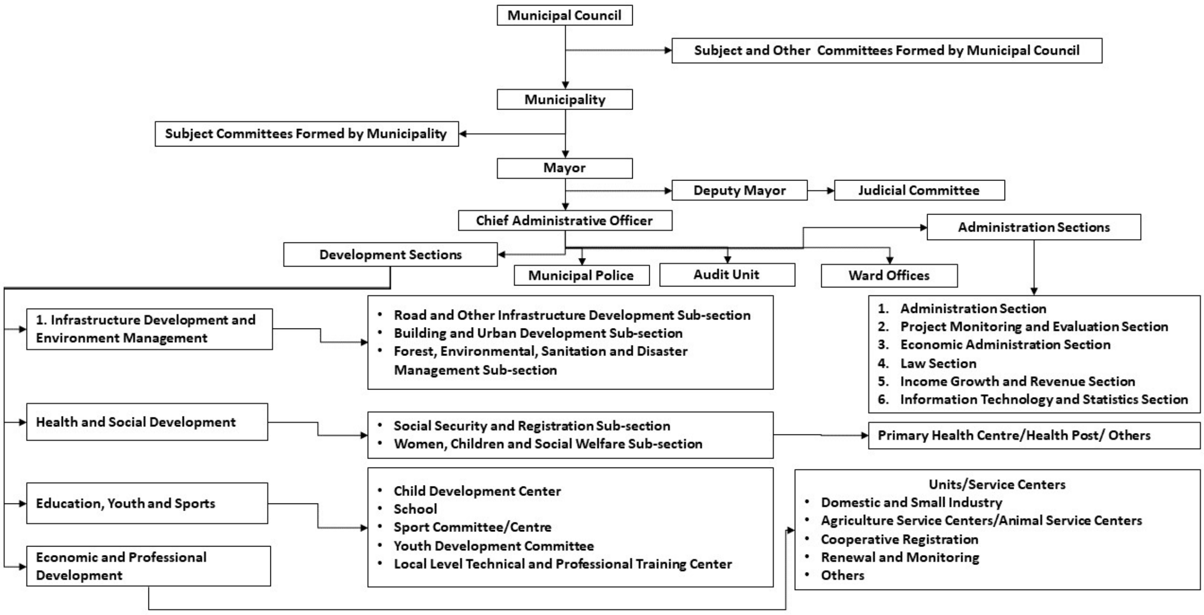

Figure 15: Organizational Structure of Dakneshwori Municipality.

3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasized the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, the Public-Private Partnership Policy, 2015 encourages private sector investment in the development and operation of public infrastructure services for comprehensive socio-economic 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).

3.5 Service standards

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

Table 6: Sanitation Service Level and its Components.

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

4 Stakeholder Engagement

4.1 Key Informant Interviews (KIIs)

Key Informant Interviews (KIIs) and objective sharing of the study were conducted with the major stakeholders of sanitation sector of the municipality. Interaction regarding the sanitation situation and planning of the municipality was conducted with Mr. Ram Lakhan Mallaha, Mayor and Ms. Mira Kumari Yadav, Deputy-mayor of the municipality. Interviews were performed with Mr. Ram Kishun Yadav, Chief Administrative Officer, Shiva Shankar Thakur, Health Coordinator and Mr. Mahesh Kumar Pandit, WASH Focal Person of the municipality on sanitation services provided by the municipality.

Similarly, private desludging service providers were interviewed to understand faecal sludge management practice and the business opportunities of the sector. List of KIIs conducted with their designation in the organization are working is shown in Table 7.

Table 7: List of Key Informant Interviewed Personnel.

S.N.	Name	Designation	Organization/ Company	Purpose of KII	Date
1.	Ram Kishun Yadav (KII-1)	Chief Administrative Officer	Dakneshwori Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	September 15, 2022
2.	Shiva Shankar Thakur (KII-1)	Health Coordinator	Dakneshwori Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	September 15, 2022
3	Mahesh Kumar pandit	WASH Focal Person	Dakneshwori Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	September 15, 2022
4.	Khursid Allam (KII-3)	Private Desludging Service Provider	Private Desludging Service Provider in Rajbiraj Municipality	Emptying practices, finances, requirement, disposal and treatment	September 16, 2022
5.	Arjun Mukhiya (KII-4)	Private Desludging Service Provider	Private Desludging Service Provider	Emptying practices, finances, requirement, disposal and treatment	September 20, 2022

4.2 Household Survey

Household surveys were conducted in all wards of the municipality through mobilization of 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 “KOBOCOLLECT” after orientation. SFD team members along with municipal focal person went on field visits in households to encourage enumerators and observe household sanitation status (Figure 16).

Figure 16: Household survey and field monitoring visit.

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 $no = \frac{z2pq}{e2}$ 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	If 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 is followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample sized required in each ward is calculated as

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

Thus, a total of 367 households were sampled from 9,459 households distributed in 10 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 17.

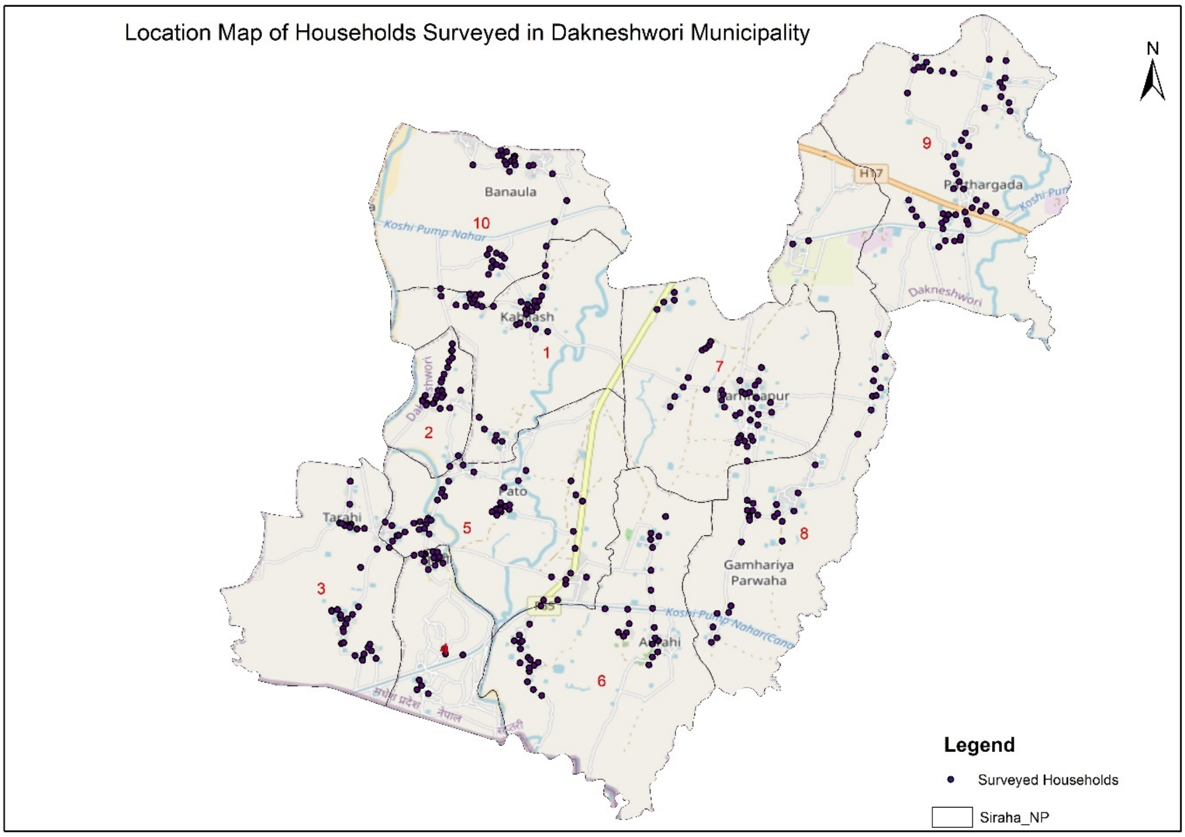

Figure 17: Distribution of sampling points in different wards of Dakneshwori Municipality.

4.3 Direct Observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept (Figure 18). Also, observation of the emptying of containments and transportation of faecal sludge were carried out. The disposal site of private entrepreneur was observed during the usage.

Figure 18: Household survey observation.

4.3.1 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation workshop was conducted in the municipality to share the finding of the sanitation situation survey and receive the suggestion from municipal stakeholders. Altogether, 32 participants including the deputy mayor, ward chairpersons, other members from municipal executive council, sectoral staffs, faecal sludge desludging service providers etc. actively participated on the workshop and provided the valuable suggestions (Figure 19, 20 and 21). The list of participants with their designation is attached in Appendix 2.

Figure 19: Sharing program being facilitated by WHH and the program headed by Deputy mayor of the municipality.

Figure 20: A remark from Deputy mayor of the municipality in sharing and validation workshop.

Figure 21: Sharing findings in the sharing and validation workshop.

5 Acknowledgements

We would like to acknowledge Mr. Ram Lakhan Mallaha, Mayor and Ms. Mira Kumari Yadav, Deputy Mayor of Dakneshwori Municipality for continuous support in the study. We would also like to thank Mr. Ram Kishun Yadav, Chief Administrative Officer of the municipality.

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We are grateful to Mr. Giri Khatri, Technical Expert- WASH, Mr. Padam Lamsal, Project Coordinator and Mr. Niroj Giri, MEAL officer at Welthungerhilfe for guidance and support for the study. We are grateful to Ms. Bhawana Sharma, Executive Director and Mr. Rajendra Shrestha, Program Director of Environment and Public Health Organization (ENPHO) for tremendous support and guidance during the whole process of the study.

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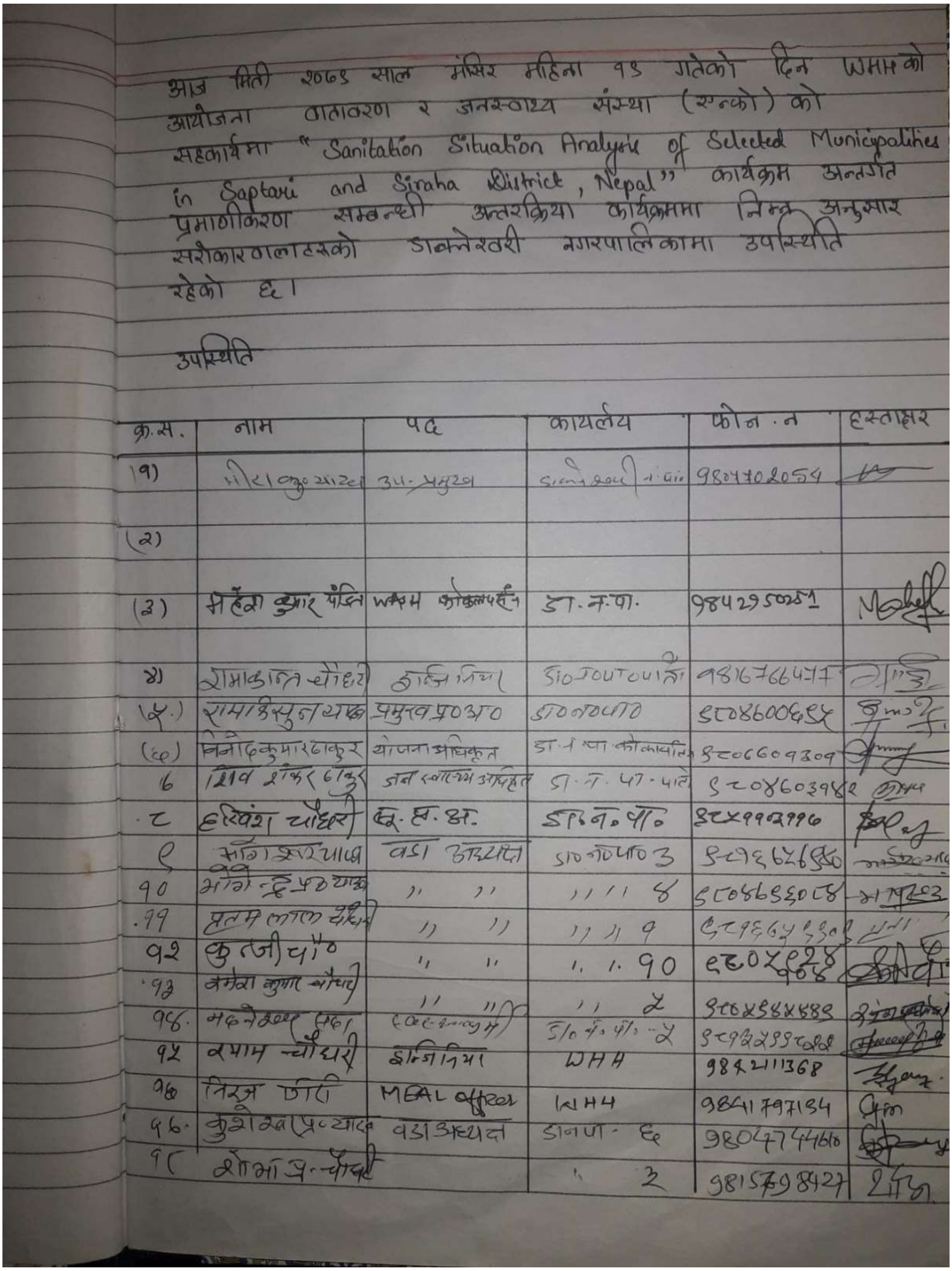
7 Appendix

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

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

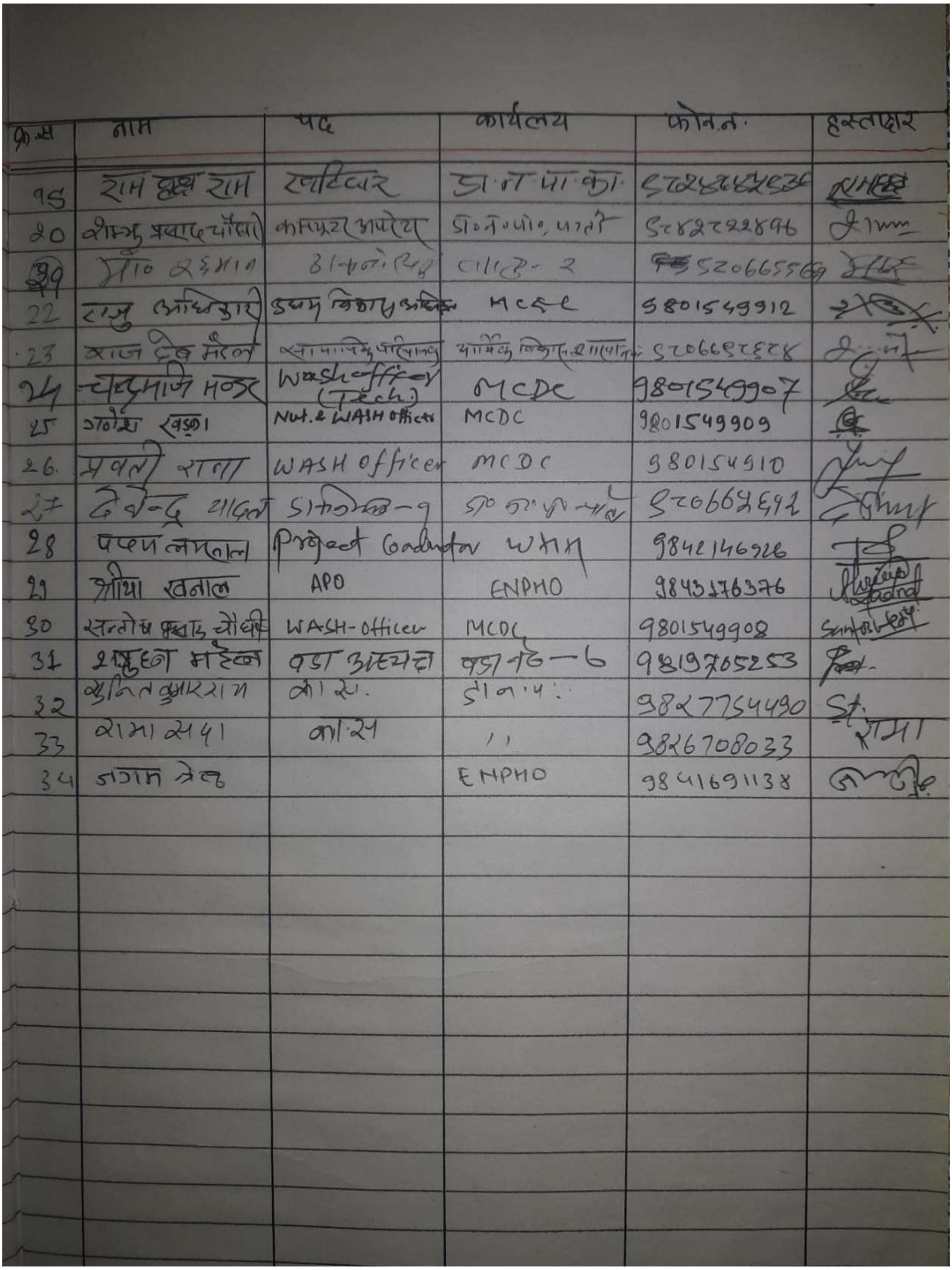
7.2 Appendix 2: List of Participants present in Sharing and Validation meeting of SFD report



आज मिती २०७३ साल मंसिर महिना १३ गतेको दिन WHH को आयोजना वातावरण र जनस्वास्थ्य संस्था (एन्को) को सहकार्यमा "Sanitation Situation Analysis of Selected Municipalities in Saptari and Siraha District, Nepal" कार्यक्रम अन्तर्गत प्रमाणीकरण सम्बन्धी अन्तरक्रिया कार्यक्रममा निम्न अनुसार सरोकारवालाहरूको डाक्नेश्वरी नगरपालिकामा उपस्थिति रहेको छ।

उपस्थिति

क्र.स.	नाम	पद	कार्यलय	फोन.न	हस्ताक्षर
(१)	[illegible]	उप-प्रमुख	डाक्नेश्वरी न.पा.	9807702054	[illegible]
(२)					
(३)	महेन्द्र कुमार पंडित	WASH कोअर्डिनेटर	डा.न.पा.	9842950251	[illegible]
४)	रामाकान्त चौधरी	इन्जिनियर	डा.न.पा.	9816766477	[illegible]
(५)	रामकिसुन यादव	प्रमुख प्र.अ.	डा.न.पा.	९८०४६००६९५	[illegible]
(६)	विनोद कुमार ठाकुर	योजना अधिकृत	डा.न.पा. को कार्यालय	९८०६६०१३०१	[illegible]
७	शिव शंकर ठाकुर	जन स्वास्थ्य अधिकृत	डा.न.पा.	९८०४६०३१४२	[illegible]
८	हरिवंश चौधरी	[illegible]	डा.न.पा.	९८४११०२११६	[illegible]
९	[illegible] यादव	वडा अध्यक्ष	डा.न.पा. ३	९८१६६२६९८०	[illegible]
१०	[illegible] यादव	,, ,,	,, ,, ४	९८०४६९३०८४	[illegible]
११	प्रेम लाल चौधरी	,, ,,	,, ,, १	९८१६६५३३०२	[illegible]
१२	कृतजी चौ.	,, ,,	,, ,, १०	९८०५९२८	[illegible]
१३	[illegible] कुमार चौधरी	,, ,,	,, ,, ५	९८०४५८४४८३	[illegible]
१४	[illegible]	[illegible]	डा.न.पा. ५	९८१३२१९८२२	[illegible]
१५	श्याम चौधरी	इन्जिनियर	WHH	984211368	[illegible]
१६	निरुज [illegible]	MEAL officer	WHH	9841797134	[illegible]
१७	कुशेश्वर प्र. यादव	वडा अध्यक्ष	डा.न.पा. ६	9804744610	[illegible]
१८	शोभा प्र. चौधरी		,, २	9815798427	[illegible]



क्र.सं	नाम	पद	कार्यालय	फोन.नं.	हस्ताक्षर
१९	राम कृष्ण राम	[illegible]	डा.न.पा.का.	[illegible]	[illegible]
२०	शम्भु प्रसाद चौधरी	कम्प्युटर अपरेटर	डा.न.पा., [illegible]	९८४२८२२४९६	[illegible]
२१	मो० रहमान	ओभरसियर	वार्ड- २	९८०६६५५६९	[illegible]
22	राजु अधिकारी	[illegible]	MCDC	९८०१५४९९१२	[illegible]
23	राज देव मण्डल	सामाजिक परिचालक	आर्थिक विकास शाखा	९८०६६९८६९८	[illegible]
24	चन्द्रमाजि मण्डल	Wash officer (Tech)	MCDC	9801549907	[illegible]
25	गणेश खड्का	Nut. & WASH Officer	MCDC	9801549909	[illegible]
26.	प्रबत्ती राना	WASH officer	MCDC	980154910	[illegible]
२७	देवेन्द्र यादव	सचिव वडा-१	डा.न.पा. [illegible]	९८०६६४६९२	[illegible]
28	पवन लम्साल	Project Coordinator	WHH	9842146926	[illegible]
29	श्रीया खनाल	APO	ENPHO	9843176376	[illegible]
30	सन्तोष प्रसाद चौधरी	WASH-Officer	MCDC	9801549908	Santosh [illegible]
31	शत्रुघ्न महतो	वडा अध्यक्ष	वडा नं- ६	9819705253	[illegible]
32	सुनित कुमार राम	का.स.	डा.न.पा.	9827754490	St.
33	रामा साफी	का.स	,,	9826708033	रामा
34	जगन श्रेष्ठ		ENPHO	9841691138	[illegible]

SFD Promotion Initiative

SFD Dakneshwori Municipality, Nepal, 2023

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