

Report on Assessment of Knowledge and Practices on Occupational Safety and Health of The Sanitation workers Engaged in Mechanized Emptying of Containment



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Executive Summary

The government of Nepal has envisioned access to safe drinking water and sanitation for every citizen through its constitution. It has promulgated national sustainable development goals to access adequate and equitable sanitation and hygiene for all and end open defecation in target 6.2. The SDG emphasizes safely managed sanitation services rather than access to basic sanitation facilities. Achieving safely managed sanitation through the conventional approach in urban areas by developing a sewer network and treatment is not enough as well as affordable to everyone. Thus, City Wide Inclusive Sanitation approach with three fundamental outcomes such as equity, safety and sustainability had been put forward for achieving the target. The approach emphasizes capacity building for non-infrastructure aspects of service delivery, that has been overlooked. Particularly, the occupational safety and health of sanitation workers engaged in sanitation service providers are neglected despite the legal provision of occupational safety and health.

The occupational safety and health of the sanitation workers can be maintained only when they are educated, required safety equipment is provided and practice the safety and hygienic behaviour. Thus, this study aimed on assessing the knowledge of occupational safety and health of the sanitation workers, availability of basic personal protective equipment and health and hygiene behaviour of those engaged in mechanized desludging services.

The study was conducted in the Kathmandu Valley and Janakpur Sub-metropolitan City. The criteria for selecting these cities are:

- i. In both cities, the demand for desludging is high. It is reported that at least 30 and 20 desludging vehicles are providing services in these cities.
- ii. As per 2019, Human Development Index of the Bagmati Province is the highest with 0.669 and the lowest in the Madhesh Province with 0.519 in the country. Thus, assessment of knowledge and practices from both upper and lower region based on HDI provides in-depth understanding.

The in-depth questionnaire survey with 42 and 36 sanitation workers from the Kathmandu valley and Janakpur was conducted. Similarly, the direct observation of emptying process was observed in 10 and 18 working sites in the valley and Janakpur.

The major findings of the study were that the sanitation workers engaged in the emptying, transportation, and disposal of faecal sludge are prone to physical, chemical, and biological hazards. Lifting heavy cover slab and mishandling of the equipment has higher potential to injure them. The risk of contamination from FS has higher potential to degrade the health and wellbeing. Most of the sanitation workers are from socially marginalized and discriminated families with lower educational attainment, following the traditional profession. Also, majority of them have chosen the profession following their friends and relatives, seeking higher income. Self-awareness on importance of safety in the work and enhancing skill and capacity was high among them but were not trained accordingly. The risk of getting injured with the use of locally assembled desludging vehicles containing heavy suction pumps that needed to be lifted every time was increased, particularly in Kathmandu Valley. They were working based upon the knowledge gained by doing. Thus, it was observed knowledge on labour intensive activities such as necessary tools and precautions to be followed for clearance of site, removing the cover slab of the containment, and holding the suction hose was high. Despite having the knowledge, its implementation remained limited either due to inadequate tools or insufficient awareness about the potential risks to their safety and health from mishandling of the tools.

Executive Summary

Significant knowledge gap was observed in maintaining health and hygiene behaviour by the sanitation workers. The lack of adequate PPE despite having the knowledge of its importance, unwilling to adopt proper handwashing with soap and water and unawareness on first aid and responses toward preventing infections from minor injuries had escalated the risk of degrading health and wellbeing even with minor accidents in the workplace.

The major recommendations for occupational safety and health of the sanitation workers engaged in emptying profession of the containment are:

- i. Equipped sanitation workers with technically better equipment for emptying process. The mechanism to verify the quality of the equipment must be developed.
- ii. Ensure the availability of adequate and quality set of personal protective equipment for all the sanitation workers.
- iii. The sanitation workers should be trained on critical handwashing conditions focusing on the critical incidents in the emptying process that has potential risk to biological hazard.
- iv. The sanitation workers should be trained on first aid and preventive measures of infection from minor injuries. Also, the availability of first aid kit should be mandatory in the desludging vehicles.
- v. Provision of periodic health check-up of sanitation workers should be assured.

1. Introduction

1.1 Background

The government of Nepal has envisioned access to safe drinking water and sanitation for every citizen through its constitution. It has promulgated national sustainable development goals (SDG) to access adequate and equitable sanitation and hygiene for all and end open defecation in target 6.2. The SDG emphasizes safely managing sanitation services rather than access to basic sanitation facilities. Where safely managed sanitation is defined as an improved sanitation facility that is not shared with other households and where the excreta produced is either treated and disposed of in situ, temporarily stored and then emptied and transported to treatment off-site or transported through a sewer with wastewater and then treated off-site.

Achieving safely managed sanitation through the conventional approach in urban areas by developing a sewer network and treatment is not enough as well as affordable to everyone. The complexity in socio-economic status, spatial distribution of sanitation technologies and services in urban area, demands for innovative approaches for inclusiveness. Thus, currently City-Wide Inclusive sanitation (CWIS) approach has been put in place by World Bank and other developing agencies. The CWIS approach has following characteristics:

- It is evidence-based; implementation and design adaptation are driven by health, social and economic outcomes.
- Institutional arrangements, accountability, and regulations, with aligned incentives, are established for management, operation, and maintenance of the whole sanitation service chain.
- It includes a mix of diverse technical approaches that build on existing sewer and non-sewered sanitation systems and incorporate resource recovery and re-use where feasible.
- City leaders demonstrate political will to prioritize investment in sanitation, technical and managerial leadership, and arrange long-term funding for sustainability.
- Non-infrastructure aspects of service delivery are funded, including capacity building, household outreach and engagement, and sanitation marketing.
- Complementary urban services such as water supply, drainage, greywater management and solid waste management are integrated with sanitation planning.
- Activities and funding target unserved and underserved groups including women, minorities, informal settlements, people with disabilities.

Funding and capacity building for non-infrastructure aspects of service delivery among other characteristics of CWIS is one of the crucial features that has been overlooked in the sanitation service delivery. Particularly, the occupational safety and health of sanitation workers engaged in sanitation service providers are neglected despite the legal provision of occupational safety and health (OSH). The occupational safety and health of the sanitation workers can be maintained only when they are educated, required safety equipment is provided and practice the safety and hygienic behaviour. Thus, this study aimed on assessing the knowledge of occupational safety and health of the sanitation workers, availability of basic personal protective equipment and health and hygiene behaviour of those engaged in mechanized desludging services.

1.2 Objectives

The specific objectives of the study are:

- i. To assess the knowledge of the sanitation workers regarding safety and health in their working environment.
- ii. To assess the availability and use of safety equipment and personal protective equipment (PPE).

1.3 Methodology

1.3.1 Selection of Cities

The study was conducted in the Kathmandu Valley and Janakpurdhama Sub-metropolitan City. The criteria for selecting these cities are:

- i. In both cities the demand for desludging is high. It is reported that at least 30 and 20 desludging vehicles are providing services in these cities.
- ii. As per 2019, Human Development Index (HDI) of the Bagmati Province is the highest with 0.669 and the lowest in the Madhesh Province with 0.519 in the country. Thus, assessment of knowledge and practices from both upper and lower region based on HDI provides in-depth understanding.

1.3.2 Sample Size

It was reported that at least 30 desludging vehicles were providing desludging service in the Kathmandu Valley. Each vehicle contained at least two sanitation workers (driver and a labour) for the service. Also, owner with multiple vehicles mobilize the labours and drivers as per convenience. Thus, 42 sanitation workers were able to be contacted and conducted survey despite planning to reach 60 sanitation workers. Also, during the study period, the desludging service in the Valley was halted due to prohibition of disposing the faecal sludge into sewerage network by the government of Nepal. So many of sanitation workers had either left the profession or returned to their villages.

It was planned to conduct direct observation of 50% of the desludging vehicles and the sanitation workers during the desludging process. Due to unwillingness of the service providers in the context of unfavourable circumstances of prohibition from the government, only 10 desludging vehicles were observed during the work.

Similarly, in Janakpurdhama, the capital city of Madhesh province, though it was reported that at least 19 desludging vehicles were providing the service, one of the desludging vehicles was sold. Thus, altogether 36 sanitation workers from 18 vehicles were surveyed. All these desludging vehicles were directly observed during the work.

1.3.3 Literature Review

An in-depth literature review on occupational safety and health, guidelines and standard operating procedure from the region was reviewed. The potential physical, chemical, and biological hazards associated with the desludging service were reviewed.

1.3.1 Questionnaire survey

A questionnaire survey was conducted with the sanitation workers. The questionnaire was developed to assess knowledge on occupational safety and health. Besides, it also consists of questions for collecting the information on their involvement and incentives gained in the work. The questionnaire was built in Kobo collection mobile application.

1.3.2 Direct Observation

The data on the working environment of the sanitation workers was collected through direct observation. The work was observed during the emptying process and disposal of the faecal sludge. However, the disposal site in the Kathmandu Valley was not accessible. During the process, the possible incidents of the health hazard and use of safety equipment and personal protective equipment was documented.

1.3.3 Data analysis and reporting

The data collected, using mobile application Kobo Collect, was uploaded in the main server. The data was extracted and cleaned for analysis. A descriptive data analysis was carried using Microsoft excel. Essential knowledge for preventing physical, chemical, and biological hazards associated with the mechanized desludging for occupational safety and health of sanitation workers were assessed by providing weightage. Each sub-indicators were provided with 1 weightage and overall proportion in each indicator were calculated. To ease the comparison weightage was converted to proportionate weightage of 10.

The number of indicators used for knowledge assessment were categorized into pre-planning, precaution and procedures, and safety and health hygiene as shown in table 1-1.

Table 1-1 Indicators and allocated weightage for various knowledge in the emptying process.

S.N.	Process	Indicators	No. of Sub-indicators	Sub-Indicators	Weightage	Gain	Percent	Proportionate Weightage
1	Pre-planning	Pre-collection of detail information	1	Location	1	1	100%	10
			2	Access road and traffic condition	1	1		
			3	Last emptied year	1	1		
			4	Age of containment	1	1		
			5	size of containment	1	1		
			6	Additional problems	1	1		
2	Procedure for the vehicle Parking		1	Park in parking area	1	1	100%	10
			2	Do not block the road	1	1		
			3	Do not exceed distance above pumping c	1	1		
			4	Do not park above the containment	1	1		
3	Inspection of the containment		1	Existence of access port/manhole/covers	1	1	100%	10
			2	Cracks and damages	1	1		
			3	Existence of electric wires	1	1		
			4	Pipes and connections	1	1		
			5	Overflow & blockages	1	1		
4	Inspection of FS characteristics		1	Scum layer	1	1	100%	10
			2	Diluted/concentrated sludge	1	1		
			3	Presence of other materials	1	1		
			4	Connection of chemicals	1	1		
5	Clearance of Site		1	Herbs/Shrubs	1	1	100%	10
			2	Mud/debris	1	1		
			3	People in the working area	1	1		
			4	Electric Wires	1	1		
6	Removal of cover slab		1	Spade with long handle	1	1	100%	10
			2	Pickaxe	1	1		
			3	Shovel	1	1		
			4	Lever	1	1		
			5	Rope	1	1		
			6	Leather Gloves	1	1		
7	Handling suction hose during emptying		1	Keep stable	1	1	100%	10
			2	Self prevention from falling	1	1		
			3	Do not lift during pumping	1	1		
			4	Dip hose step by step	1	1		
			5	Check for blockage in hose	1	1		
8	Handling suction hose after emptying		1	Ensure all sludge is drained out	1	1	100%	10
			2	Wash the immersed portion	1	1		
			3	Wash the spillage area from hose	1	1		
9	Safe transportation		1	Follow the traffic rules	1	1	100%	10
			2	Seated properly to prevent from fall	1	1		
			3	Do not receive phone call	1	1		
			4	Ensure no leakage and spillage	1	1		
			5	Wash the if there is spillage on road	1	1		
			6	Do not consume without washing hand	1	1		
			7	Do not put off safety gears	1	1		
			8	As far as possible avoid touching face by	1	1		
10	Personal protective Equipment		1	Facemask	1	1	100%	10
			2	Rubber Gloves	1	1		
			3	Water proof clothes/apron	1	1		
			4	Gumboot/anti slip boot	1	1		
			5	Safety Helmet	1	1		
			6	Safety Goggles	1	1		
11	Cleaning spillage over body		1	Alert others around and inform them to s	1	1	100%	10
2			Immediately release from duty and give opportunity to take proper wash	1	1			
12	Handwashing materials		1	Use sanitizer	1	1	100%	10
			2	Wash with soap and water	1	1		
13	Handwashing at Critical Conditions		1	Before putting on PPE	1	1	100%	10
			2	After emptying the containment	1	1		
			3	After disposal of the FS	1	1		
			4	In between if something must be consum	1	1		
			5	When FS spilt on the body	1	1		
14	Prevention of Infection from minor injuries and First Aid		1	Knowledge on First Aid	1	1	100%	10
			2	Clean the wound and around	1	1		
			3	Apply antiseptic or apply adhesive banda	1	1		

2. Findings

2.1 Socio-demographic Characteristics of Sanitation Workers

Socio-demographic characteristics of the sanitation workers influence the knowledge and attitude in practicing safety measures and hygienic behaviour. The major findings on the socio-demographic of the sanitation workers from Kathmandu Valley and Janakpurdhm Sub-metropolitan City are briefly explained in this section.

2.1.1 Sex and Age Group

All sanitation workers, engaged in mechanical desludging of the containments, were male in both study sites. Almost 99% of the sanitation workers were economically active population group, i.e., age grouped between 15 to 60 years. Most of the sanitation workers in the Kathmandu Valley (21%) were between the age group 41 to 45. While, in the Janakpurdhm, the majority (25%) of the workers were in the age group between 31 to 35 years. Figure 2-1 shows graph on the percentage of age group of sanitation workers.

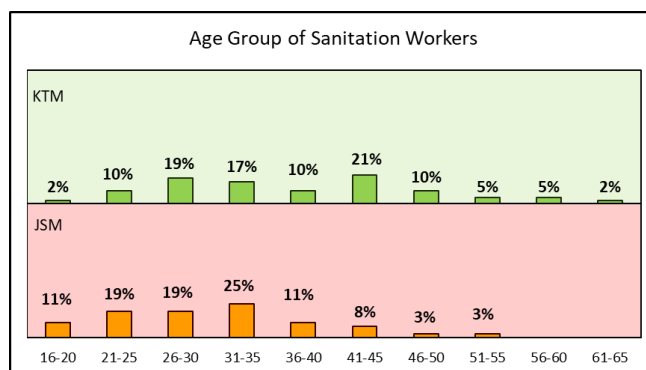


Figure 2-1 Graph on age group of sanitation workers

2.1.2 Ethnicity

In Kathmandu Valley, 67% of the sanitation workers were from the migrant ethnic communities like Tamang, Rai and Magar. Also, 31% of sanitation workers belongs to Brahmin and Chettri communities. In Janakpurdhm, 97% of the sanitation workers were from socially disadvantaged and marginalized communities (Terai dalit). Figure 2-2 shows the percentage of ethnic group of sanitation workers in Kathmandu Valley and Janakpurdhm.

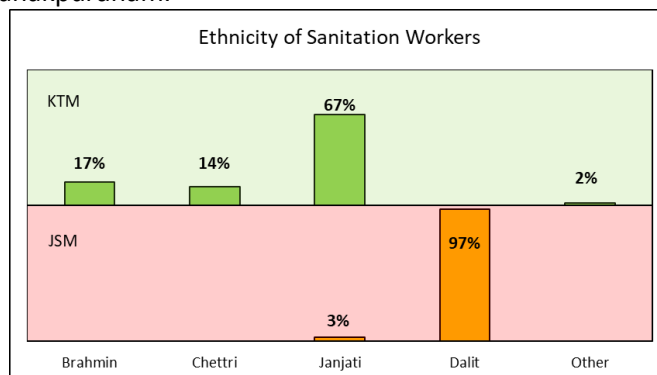


Figure 2-2 Ethnicity of sanitation workers

2.1.3 Educational Attainment

In both the study sites, majority of sanitation workers had lower educational attainment. In Kathmandu Valley, 33% of the sanitation workers had attained secondary level of school education whereas it was 40% in Janakpur. The illiterate sanitation workers were 24% and 28% in the Kathmandu Valley and Janakpur respectively. Figure 2-3 shows educational attainment of sanitation workers in Kathmandu Valley and Janakpur.

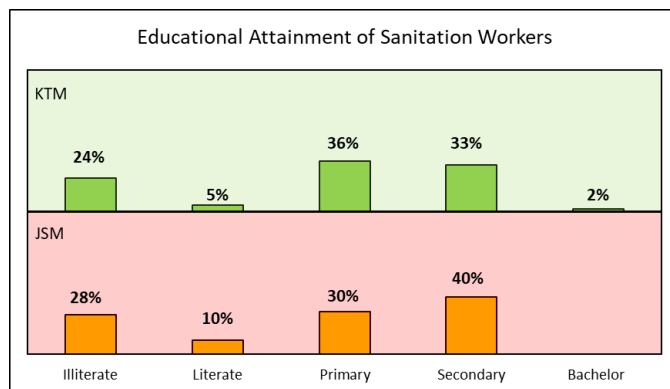


Figure 2-3 Educational attainment of sanitation workers

2.1.4 Years of engagement

Around 5% of sanitation workers from the Kathmandu Valley had been working for more than 25 years. Also, 40% and 36% of the sanitation workers had been working for 1 to 5 years and 6 to 10 years in the Kathmandu Valley. Similarly, 33% and 31% of the sanitation workers have been working for 1 to 5 years and 6 to 10 years in Janakpur. Figure 2-4 shows the percentage of years of engagement of sanitation workers in both study sites.

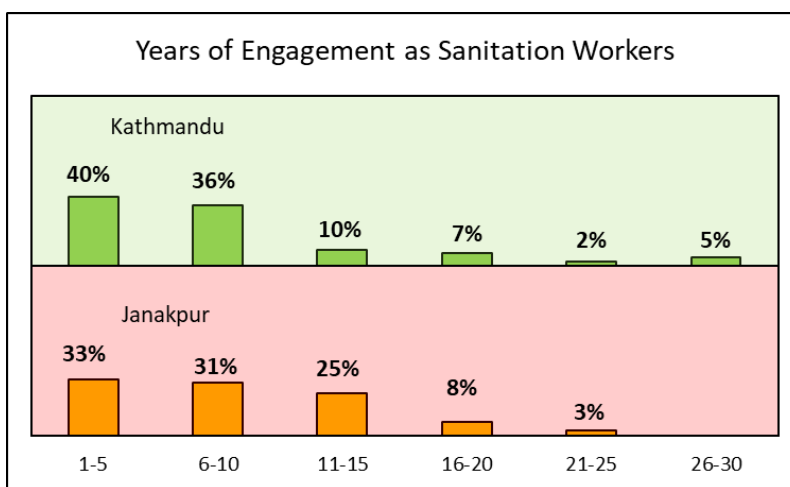


Figure 2-4 Graph on working experience of sanitation workers

2.1.5 Choosing the profession

Traditionally, the emptying service of the septic tank was performed by socially marginalized and disadvantages groups. In Kathmandu valley and Janakpur, traditionally *Pode* and *Mushar* communities manually emptied the septic tank.

At present, it was observed that *Pode* community were not engaged in the service in Kathmandu Valley. Whereas the traditional community have continued their profession in Janakpurdham through adaptation of modern equipment in the service. In Kathmandu valley, 81% of the sanitation workers engaged in the emptying profession following the work of their relatives and friends. Whereas, in Janakpurdham, 58% of the sanitation workers followed their traditional profession in the absence of alternative jobs as shown in figure 2-5.

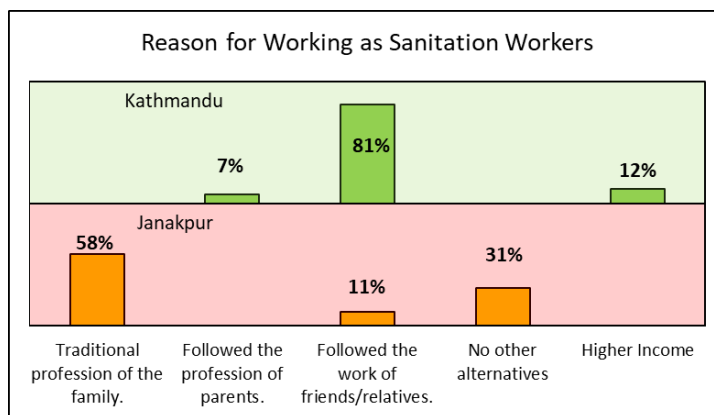


Figure 2-5 Reason for choosing the profession by sanitation workers

2.1.6 Turnover of the workers

While 54% of the sanitation workers continued their profession with single owner ever since they got engaged in the sector, 46% have worked with more than one owner. Among them 61% of the workers have experienced working with three owners. Majority of these sanitation workers stated to leave their previous owner to start their own sanitation service business. Also, untimely and less payment, and bad behaviour towards them have been some of the reasons to leave the previous employee. Similarly, other reasons were to leave their previous owners were either to start other profession or foreign employment. Figure 2-6 shows the reasons for turnover of employees.

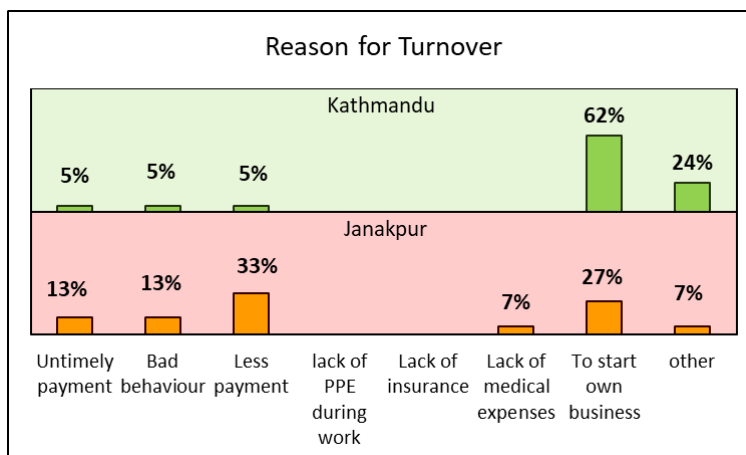


Figure 2-6 Reason for turnover of sanitation workers.

2.1.7 Means of Payment and Monthly Income

The sanitation workers were paid either on salary basis or wages per trip. However, the owner engaged in the service shared the profit. The monthly salary of the sanitation workers ranged from NRs. 4,800 to NRs.

35,000. Most of these sanitation workers were paid between NRs.15,000 and NRs. 25,000 per month. The workers working on the wage's basis were paid minimum NRs. 200 to maximum NRs. 500 per trip. Many of these workers earned NRs. 5000 to 15,000 per month. The owner earned a net profit between NRs. 15,000 to NRs. 65,000 per month. Table 2-1 shows the percentage of sanitation workers with their means of payment and ranges of monthly income from the work.

Table 2-1 Modes of payment and description of monthly income

Modes of payment	5000-15,000	15,000-25,000	25,000-35,000	35,000-45,000	45,000-65,000	Grand Total
Salaried	28%	65%	7%	0%	0%	100%
Payment per trip	60%	40%	0%	0%	0%	100%
Share the total profit	1%	13%	13%	25%	48%	100%
Grand Total	16%	32%	10%	15%	28%	100%

Based on nature of work, majority of the sanitation workers responsible for moving cover slab, connecting suction hose, and holding suction hose earned NRs. 5000 to NRs. 15,000 per month. Also, many workers designated as driver earned NRS. 15,000 to NRs. 25,000 per month. Table 2-2 shows the designation of sanitation workers and their monthly income ranges.

Table 2-2 Description on monthly income and designation of sanitation workers

Designation	5000-15,000	15,000-25,000	25,000-35,000	35,000-45,000	45,000-65,000	Grand Total
Driver and labour	0%	100%	0%	0%	0%	100%
Driver	15%	78%	7%	0%	0%	100%
Labour	47%	24%	0%	0%	28%	100%
Owner	1%	5%	17%	31%	46%	100%
Grand Total	16%	32%	10%	15%	28%	100%

2.1.8 Incentives and Medical Insurances

The sanitation workers were gifted clothes during festival and provided with additional amount for lunch during the work. Only 47% of the sanitation workers mentioned about receiving incentives. Particularly, 67% of the sanitation workers from Janakpurdham received incentives in the form of clothes during the festival once a year. In Kathmandu Valley, the sanitation workers were provided with NRs. 200 to NRs. 500 per day for lunch during the working days. Only 1% of the sanitation workers had their medical insurance.

2.2 Potential hazard in emptying

Sanitation workers are prone to physical, chemical, and biological hazards during the emptying, transportation, and disposal of faecal sludge. Injuries and dislocation of muscles during the removing and lifting of heavy cover slab, fall into the containment in the absence of anti-slip shoes, messy and congested working site, connecting of suction hose and collapse of cracked and damaged containment are potential physical hazards during the work. Similarly, probability of falling from the vehicle during the transportation particularly in assembled desludging tank mounted in tractor is high.

Encounter to chemicals in the containment is high particularly in institutions where chemicals are frequently used. The contact with such chemicals could lead to skin irritation and skin related diseases. Also, a harmful chemical may emit the gases which upon inhaling may cause serious diseases and even loss the life.

Faecal sludge contains numerous bacteria, viruses and protozoans that threatens the human health. The probability of getting in contact with these bacteria, viruses and harmful protozoans are high during the emptying process. It could lead to sever diseases not only to sanitation workers but also their family in the absence of hygienic behaviour of the workers. Table 2-3 summarize the potential hazards associated with various means during the complete emptying process of the containment.

Table 2-3 Summary on potential hazards in different process of emptying

Hazards	Complete emptying process		
	Emptying	Transportation	Disposal
Physical	Cuts and wounds during removing cover slab	Fall from vehicle during transportation	Cuts and wounds during connecting suction hose
	Muscle dislocation during lifting of heavy lifting heavy cover slab and submersible pump	Fall during inspecting level of faecal sludge in desludging tank	—
	Fall into containment	Fall during opening of the gas escape unit in assembled desludging vehicle	—
	Injuries from collapsed cracked and damaged containment	Accident in busy and congested road	—
	Cuts and wounds during connecting suction hose	—	—
	Injuries from messy and congested working site	—	—
Biological	Contamination from faecal sludge directly or indirectly from spillage, consumption without washing hand	Contamination from faecal sludge directly or indirectly from spillage, consumption without washing hand	Contamination from faecal sludge directly or indirectly from spillage, consumption without washing hand
Chemical	Unconsciousness due to inhale of gases	—	—
	Skin related diseases through direct contact with chemicals	—	—

2.3 Knowledge and Practices on Preventive Measures

2.3.1 The vehicle parking

Buildings in the congested area without open space and narrow access roads are the characteristics of urban area in the country. In such circumstances, lack of parking area adds on the challenges for sanitation workers for effective and safe service delivery. The congested area has potential to increase the incidents of physical hazard. Thus, the sanitation workers should have knowledge and practice the basic preventive measures as listed below to avoid physical hazard associated with improper parking of the vehicle. The basic preventive measures for the parking are:

- i. Always Park the vehicle in parking lot.
- ii. In the absence of parking area and the wider road with less traffic, park the vehicle without blocking the road for other vehicles.
- iii. In the absence of parking area and narrow road with heavy traffic, schedule for low traffic period and park without blocking for other vehicles.
- iv. Do not park the vehicle above the containment and
- v. Do not exceed the pumping capacity of the vehicle while parking.

The assessment of knowledge on desludging vehicle parking procedure of the sanitation workers from the Kathmandu Valley showed that they were more concerned on not to create hindrance to passerby as compared to responses from Janakpur. While the submersible pump was attached to suction hose in the desludging vehicles in the Valley, they were less concerned about the distance between the containment and the vehicle. However, knowledge on prohibition of parking the vehicle above the containment was neglected by all the sanitation workers which has been shown in figure 2-7.

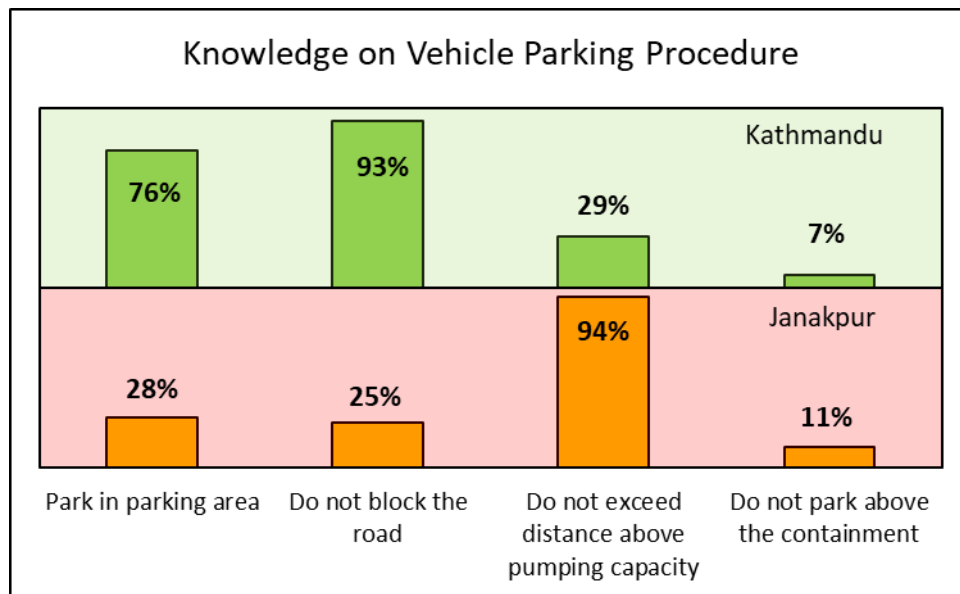


Figure 2-7 Knowledge on vehicle parking procedure.

The direct observation of the emptying process showed that as far as parking space was available in the working site, the vehicle was parked in parking lot. However, it was observed that the parking space was available in only 15% of working site in Kathmandu Valley. In 23% and 6% of sites in the Valley and Janakpur, the vehicles were parked near the containment. In both study sites, generally vehicles

were parked in the nearby road without blocking the road for other passer by. Table 2-4 shows the actual practices of vehicle parking in the Kathmandu valley and Janakpurdham.

Table 2-4 Practices of vehicle parking during emptying

Vehicle Parking Practices	Study Sites	
	Kathmandu	Janakpur
Parked in parking area	15%	0%
No Parking area, so parked near the containment	23%	6%
Parked in the nearby road without blocking for other vehicles	47%	44%
Parked in the road and blocked for other vehicles	0%	19%
Parked in narrow road but less traffic	15%	31%
Parked above containment	0%	0%
Total	100%	100%

2.3.2 Inspection of the containment prior to desludging

Emptiable containment is one of the major characteristics of technically appropriate containment, which refers to non-collapsing structure during the emptying process. However, the practices of making the containment by compiling a pre-cast concrete rings placing one above another increases risk of collapse due to wearing out of the rings. Similarly, containment constructed with dry stone walls and mud missionary has higher probability to collapse. In this context, the sanitation workers should have knowledge on inspecting the containment to avoid potential hazard prior to emptying process. The major points to inspect on containment for emptying are:

- i. Existence of access port/manhole/ cover slab.
- ii. Cracks and damages.
- iii. Pipes and connections.
- iv. Overflow or blockages and
- v. Electric wires.

In Kathmandu Valley, 44%, 32% and 36% of the sanitation workers responded that the existence of access port/ manhole, pipes and connection, and overflow respectively were inspected prior to desludging process. Only 22% of them responded for the need of inspecting cracks and damages of the containment properly. Similarly, in Janakpurdham, 53%, 56% and 36% of the sanitation workers responded that the inspection of existence of manhole, pipes and connections, and overflow were essential. Also, 33% and 22% responded importance of inspecting cracks and damages, and existence of electric wires nearby the containment. Figure shows 2-8 shows the graph on perceived knowledge on inspection of containment.

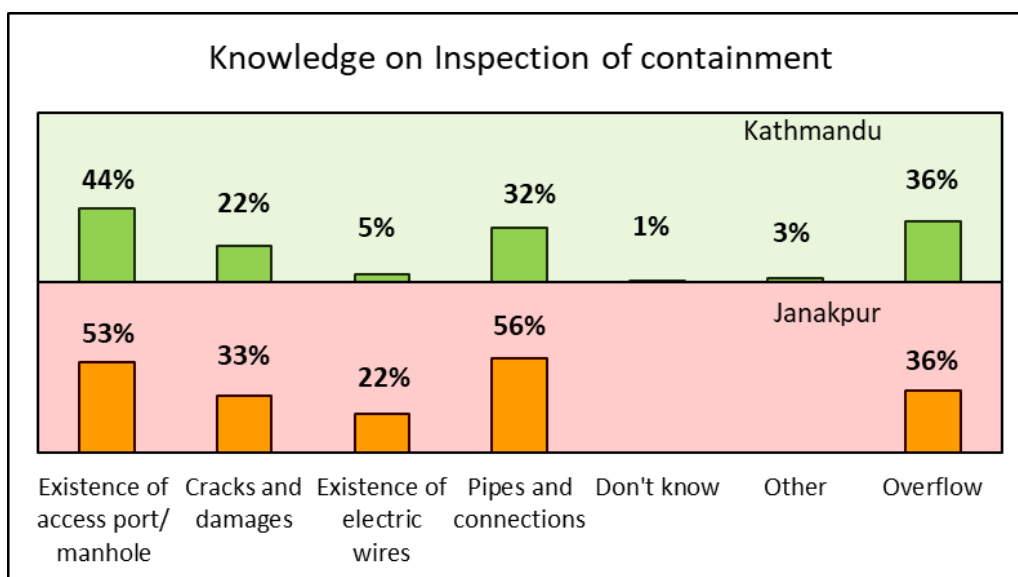


Figure 2-8 Knowledge on inspection of containment

In 64% and 45% of the sites in the Kathmandu Valley and Janakpur, the sanitation workers proceeded for opening the cover slab without inspection of the containment. Similarly, in only 27% and 45% of sites the sanitation workers inspected for access port or manhole cover in the Kathmandu Valley and Janakpur which has been shown in table 2-5.

Table 2-5 Practices of inspection of containment during emptying process

Practices of Inspection of Containment	Study Sites	
	Kathmandu	Janakpur
Inspected Existence of access port/ manhole	27%	45%
Inspected Pipes and connections	9%	9%
Proceeded for removal of cover slab without any inspection	64%	45%

2.3.3 Clearance of Site and removal of cover slab

A messy working place always increases the risk of accidents and reduces effectiveness of work. The knowledge on importance of clearance of site and associated hazards is important for safety of the workers. The list that should be cleared from working sites to avoid risk of accident are:

- i. Clearance of herbs and shrubs
- ii. Clearance of mud and debris
- iii. clearing the site by asking irrelevant people to leave
- iv. Clearance of electric wires

The perceived knowledge on clearance around the working site of the sanitation workers in the Kathmandu Valley and Janakpur is shown in figure 9. Knowledge on clearance of herbs/shrubs, mud and debris and people around the site was high among the sanitation workers of the Kathmandu Valley. However, only 10% of the sanitation workers have knowledge on importance of removing electric wires around the site. In Janakpur, majority of sanitation workers had knowledge on importance of clearance of herbs/shrubs and mud/debris around the site. Only few sanitation workers perceived that it

was important to clear people and electric wires around the containment which has been presented in figure 2-9.

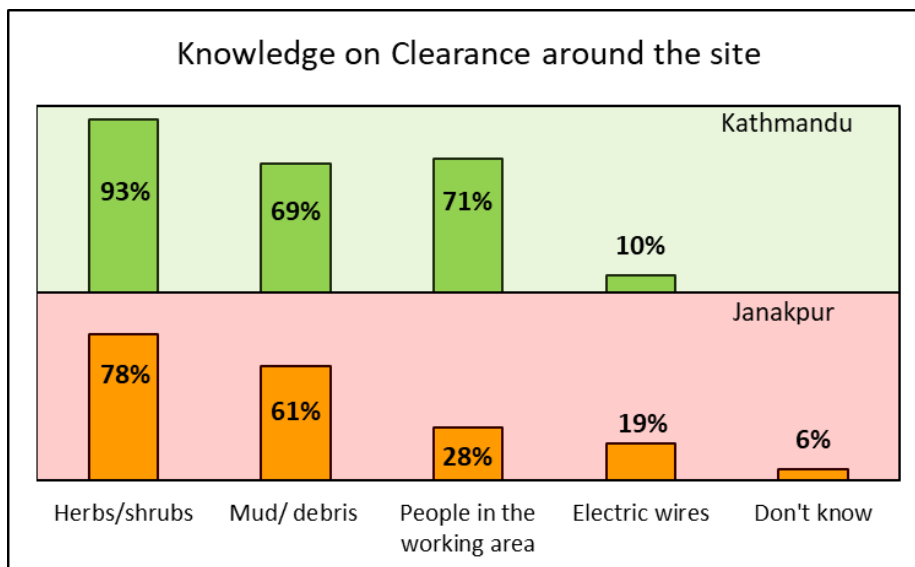


Figure 2-9 knowledge of clearance of the site

In 43% and 27% of the sites in Kathmandu valley and Janakpur, no obstacles were observed. However, in both the cities, nearly 50% of the sites were not cleared despite messiness around the containment. People nearby the containment were asked to leave in 9% of the sites in Janakpur. Table 2-6 shows the practices of clearance of the site and around it.

Table 2-6 Practices of clearance of site during emptying process

Practices of Clearance around site	Study Sites	
	Kathmandu	Janakpur
No obstacles	43%	27%
Nothing cleared, worked n messy	50%	45%
Mud/debris	7%	9%
Herbs/shrubs	0%	9%
People around the containment	0%	9%

98% of sanitation workers from Kathmandu valley were concerned on requirement of spade with long handle as compared to 64% of sanitation workers from Janakpur. Figure 3-9 shows percentage of perceived required equipment for removing cover slab.

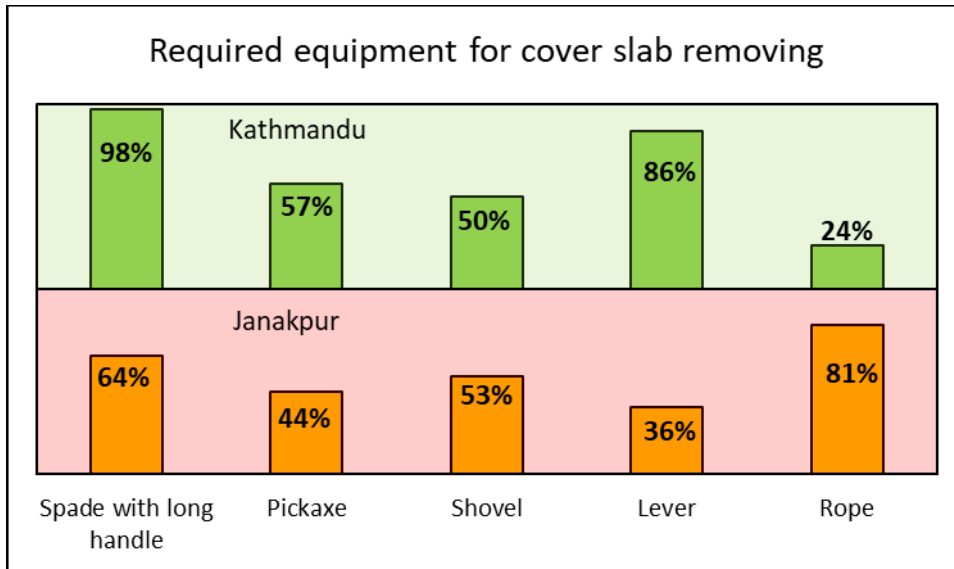


Figure 2-10 Perceived required equipment for removing cover slab in Kathmandu Valley and Janakpur

A limited set of spades with long handle together with either pickaxe or shovel, rope and lever were available in most of the desludging vehicles. Figure 2-10 shows the equipment available for removal of cover slab in the desludging vehicle. In both cities most of the vehicles were equipped with rope, shovel, and spade with long handle.

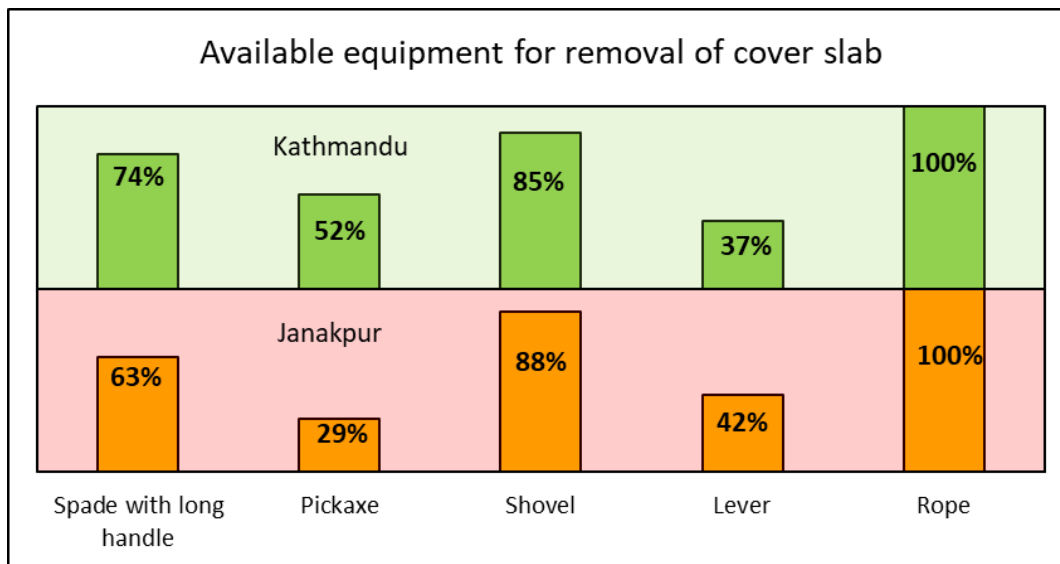


Figure 2-11 Available equipment for removal of cover slab

It was observed that, in Kathmandu Valley the service seekers themselves removed the cover slab in 20% of the sites. The sanitation workers used only lever to remove cover slab in 70% of the sites. Whereas, in Janakpur, the sanitation workers used only lever in 30% of the sites and in rest of the sites, either shovel or pickaxe with lever was used as shown in table 2-7.

Table 2-7 Equipment used for removing cover slab

Practices of equipment used for removing cover slab	Study Sites	
	Kathmandu	Janakpur
Service seekers have already removed	20%	0%
Used Pickaxe, Lever, and Shovel	0%	20%
Used Pickaxe, Lever, and Rope	0%	10%
Used Lever and shovel	0%	30%
Only Lever	70%	30%
Only Pickaxe	10%	10%

2.3.4 Inspection of Characteristics of Faecal Sludge

Inspection of characteristics of faecal sludge refers to observing the sources of waste in the containment, emission of gases, layer of scum, thickness of the sludge and presence of plastics or clothes. The inspection prevents possible chemical hazard through exposure of disposed chemicals into the containment and inhaling of the gases. Also, it helps to take necessary precautions to avoid blockage of suction hose during pumping. The things to consider for inspection of characteristics of faecal sludge are:

- i. Sources of waste in the containment
- ii. Inspection of scum layer and thickness of sludge
- iii. Disposed chemicals into containment
- iv. Presence of plastics and clothes
- v. Emission of gases

The data showed that none of the sanitation workers had knowledge on inspecting the sources of wastes in the containment. The importance of inspecting emission of gases was known to only 17% of the sanitation workers in Kathmandu Valley. However, knowledge on inspection of physical characteristics of faecal sludge such as thickness, scum layer and presence of plastics and clothes was known to majority of the sanitation workers in the valley. Contradictorily, 92% of sanitation workers in Janakpur had knowledge on importance of inspecting emission of gas from the containment. Whereas, only few sanitation workers had knowledge on inspecting physical characteristics of faecal sludge which has been shown in figure 2-11.

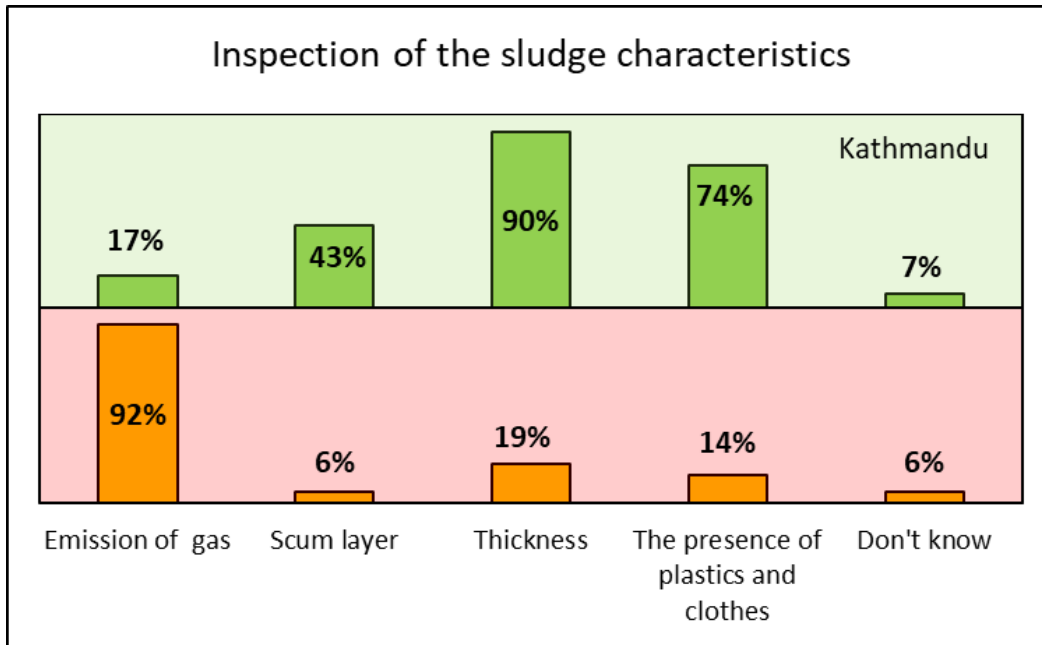


Figure 2-12 Knowledge of inspection of FS characteristics.

Irrespective of the knowledge on importance of inspecting characteristics of sludge, its implementation during the work was weak. In Kathmandu valley, the sludge level and plastics were observed in only 30% and 10% of the sites respectively. Whereas, in 60% of the sites, the faecal sludge level was not inspected, and hose pipe was immersed directly to pump out sludge. Similarly, in Janakpur, in all the sites, no such inspection of faecal sludge level was carried out. Table 2-7 shows the practices of inspection of FS in Kathmandu valley and Janakpur.

Table 2-8 Practices of inspection of characteristics of FS during emptying process

Practices of inspection of characteristics of faecal sludge	Study Sites	
	Kathmandu	Janakpur
Inserted hose pipe without any inspection	60%	100%
Inspected the thickness of sludge	30%	0%
Inspected plastics and clothes	10%	0%

2.3.5 Handling suction hose during the process

Mishandling of suction hose pipe increases the risk of fall of the labour into the containment as well as spillage of the faecal sludge causing the physical and biological hazard. The risk is even higher when the heavy submersible pump is connected to the suction hose that requires immersing to pump out. To prevent injuries and contact of the biological hazard it is essential that all labours have knowledge on proper handling of the suction hose pipe such as:

- i. Keep hose pipe stable
- ii. Prevent self from falling into containment
- iii. Do not lift the hose pipe when pumping
- iv. Immerse the hose pipe step by step
- v. Frequently check the blockages in hose pipe

The data from Kathmandu Valley and Janakpur showed similar level of knowledge regarding keeping suction hose pipe stable so as to prevent fall into the containment. However, the knowledge on not lifting the suction hose pipe during emptying process was high in Janakpur as compared to the Valley. The difference could be resulted from types of pumping mechanism used in two cities. In the Valley, the heavy submersible pump is attached to the suction hose which was immersed step by step and required frequent lifting. Figure 2-12 shows the knowledge on precautions in handling hose in Kathmandu Valley and Janakpur.

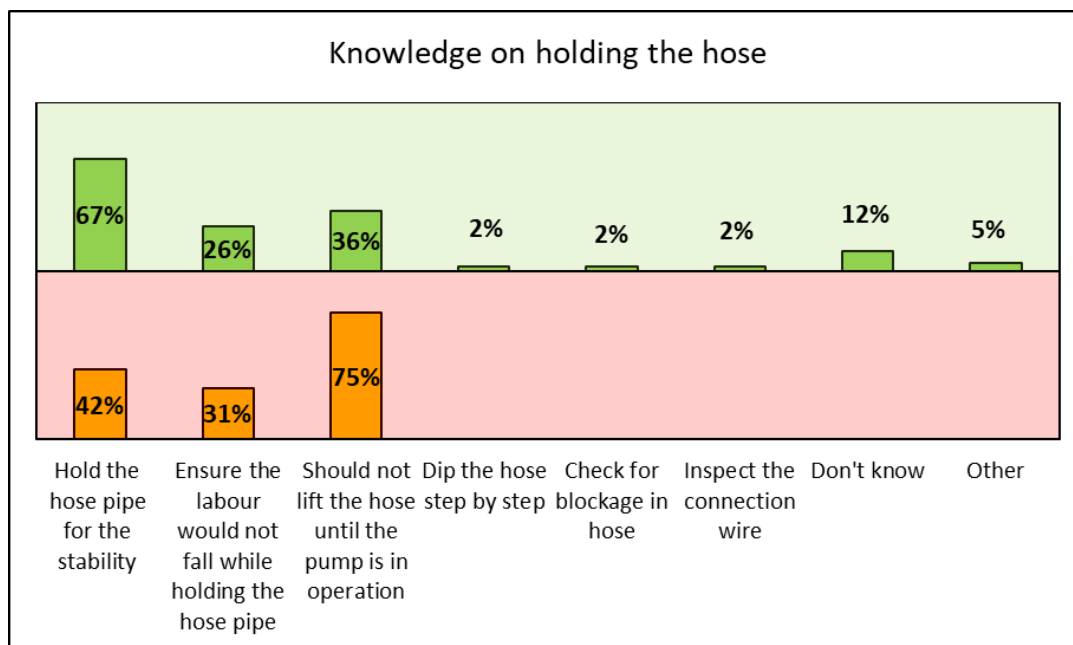


Figure 2-13 Knowledge on precautions on handling suction hose in Kathmandu Valley and Janakpur

In Kathmandu valley, the suction hose was held with the support of the lever in the 80% of the sites. Yet, it was lifted in 10% of the sites during the pumping. Whereas in Janakpur, the hose was held only in 20% of the sites. Table 2-8 shows the practices of holding suction hose during pumping of the FS.

Table 2-9 Practices of handling hose during emptying process

Practices of handling hose during emptying	Study Sites	
	Kathmandu	Janakpur
Hose pipe is hold for stability	0%	20%
Hose pipe hold carelessly	10%	40%
Hose pipe is not hold	0%	40%
Hose pipe with submergible pump is hold with care	80%	0%
Hose pipe is lifted time to time	10%	0%

2.3.6 Handling of suction hose after emptying process

Proper handling of the suction hose is essential not only during the emptying process but also after the emptying process and hence procedure and precautions are to be followed to ensure all faecal sludge trapped in the hose is emptied. The general handling process of hose pipe after emptying are:

- i. Drain out all the trapped faecal sludge in the hose
- ii. Wash the immersed portion of the hose
- iii. Wash the spillage area during draining process of FS with chlorine solution

In Kathmandu valley, 95% and 79% of the sanitation workers had knowledge of emptying the trapped FS in the hose pipe, and wash immersed portion of hose pipe as compared to 61% each of the sanitation workers in Janakpurdham. None of these workers had knowledge of applying chlorine solution in spillage area. Figure 2-13 shows the practice of handling the hose pipe after the completion of emptying faecal sludge.

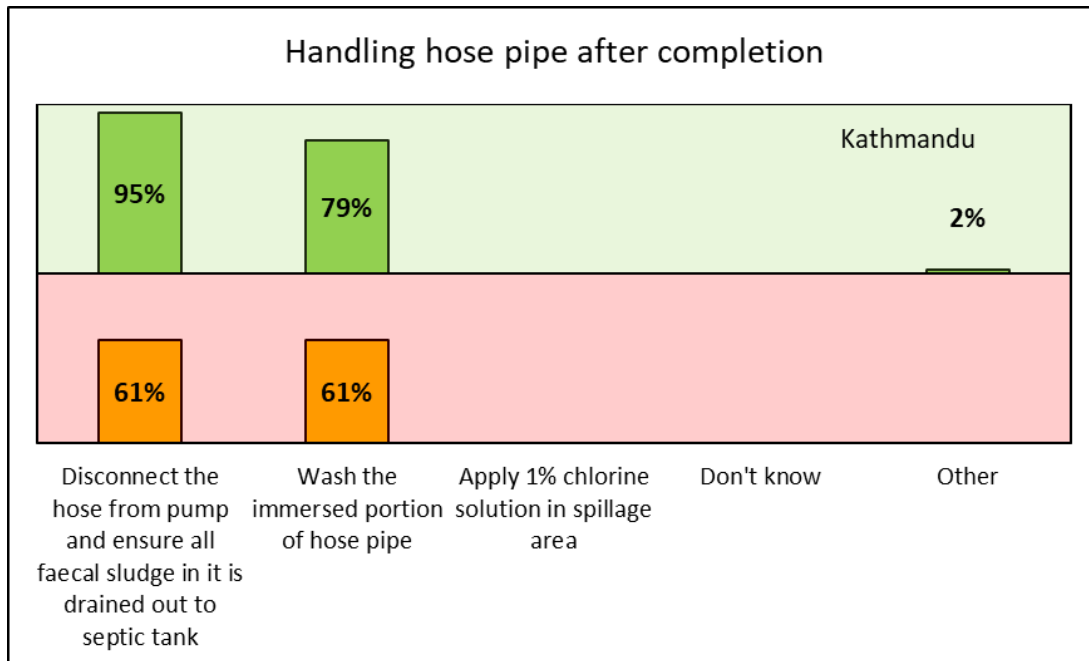


Figure 2-14 Knowledge on handling hose after emptying

The practice of disconnecting the suction hose only after emptying the trapped FS in it and washing the immersed portion was observed in 40% and 20% of the sites in Kathmandu Valley and Janakpurdham. Similarly, disconnecting the hose and emptying the trapped FS in it and handling without washing the immersed portion of the hose was observed in 40% and 70% of the sites in Kathmandu Valley and Janakpurdham as shown in table 2-9.

Table 2-10 Practices of handling hose after emptying

Practices of handling hose after emptying	Study Sites	
	Kathman du	Janakp ur
Disconnect the hose pipe after draining trapped faecal sludge	40%	70%
Wash out immersed portion	20%	10%
Disconnect the hose pipe after draining trapped faecal sludge and washed immersed portion	40%	20%

2.3.7 Precautions for safe transportation

Transportation of faecal sludge is one of the major aspects of the sanitation service chain, where the sanitation workers have higher probability of encountering to physical and biological hazard. The sanitation workers should follow precautions as listed:

- i. Always follow traffic rules
- ii. Seated properly to prevent from fall while in travel
- iii. Do not receive phone calls by drivers during driving
- iv. Ensure no leakages and spillage from the tank during transportation
- v. Wash the road if there is spillage of faecal sludge
- vi. Do not consume without washing hands during transportation of faecal sludge
- vii. Do not put off safety gears until the faecal sludge is finally disposed in treatment plant
- viii. As far as possible avoid touching the face by unwashed hand

The sanitation workers in the Kathmandu Valley were more concerned on following the traffic rules and ensuring no leakages and spillage during the transportation of faecal sludge. However, the sanitation workers from Janakpurdham were more concerned about seating properly during the transportation as travelling in the tractor possess high risk of fall. Figure 2-14 shows the percentage of perceived knowledge on precautions to be followed during the transportation.

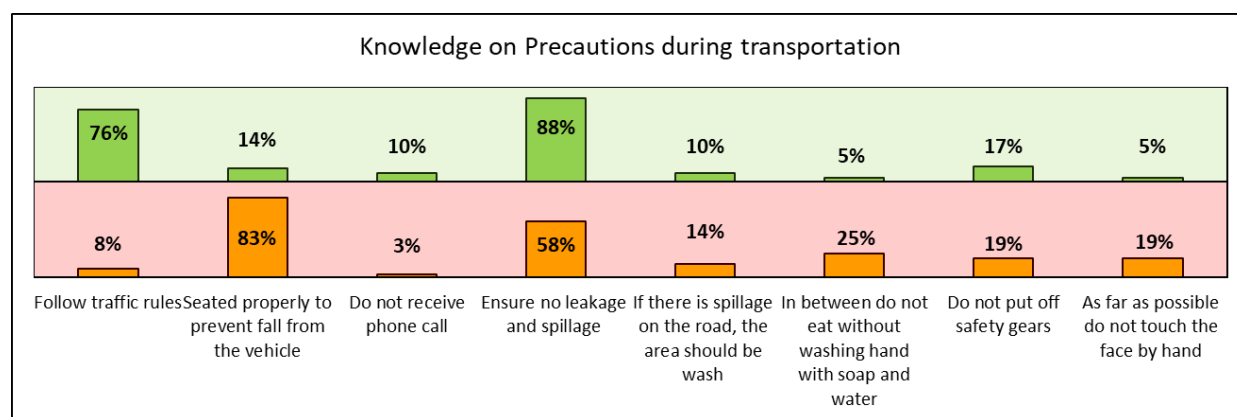


Figure 2-15 Knowledge of precautions to be followed during transportation of faecal sludge

The direct observation of the sanitation workers during the transportation of faecal sludge showed that in Kathmandu Valley all the vehicles followed traffic rules during transportation. Whereas, in Janakpurdham, in 50% of observed cases, the drivers were found to be talking with their friends and receiving phone call during the transportation. Also, 30% of the vehicles fled with the higher speed in Janakpurdham as shown in table 2-10.

Table 2-11 Practices of following precautions during transportation of faecal sludge

Practices of following precautions during transport	Study Sites	
	Kathmandu	Janakpur
Followed traffic rules	100%	20%
Speed was above the limit	0%	30%
Driver was talking in the phone during driving	0%	50%

2.4 Knowledge and Practices on Health Hygiene

2.4.1 Procedure for cleaning spillage over the body

Spillage of FS over the body during the emptying of the containment is common when the suction hose pipe is mishandled and/or in the messy working site. Though the spillage has less physical hazard, the negligence could increase the biological hazard upon contact with the FS. Thus, all sanitation workers should have knowledge on procedures for cleaning the spillage over their body.

In Kathmandu Valley, 57% of the sanitation workers responded that spillage of faecal sludge over the body would be washed immediately without halting the emptying process. While 26% of them responded that the workers with faecal sludge spilt over the body should immediately be released from the duty and provided with opportunity to take proper wash or bathing.

Whereas 83% of the sanitation workers in Janakpurdham responded that the workers with faecal sludgespilt over the body should inform their co-workers about the incident to maintain distance with him /her.

Also, 56% of them responded that the spillage should be washed immediately but the work should not be halted. Figure 2-15 shows the knowledge of sanitation workers on cleaning split FS over body of a worker.

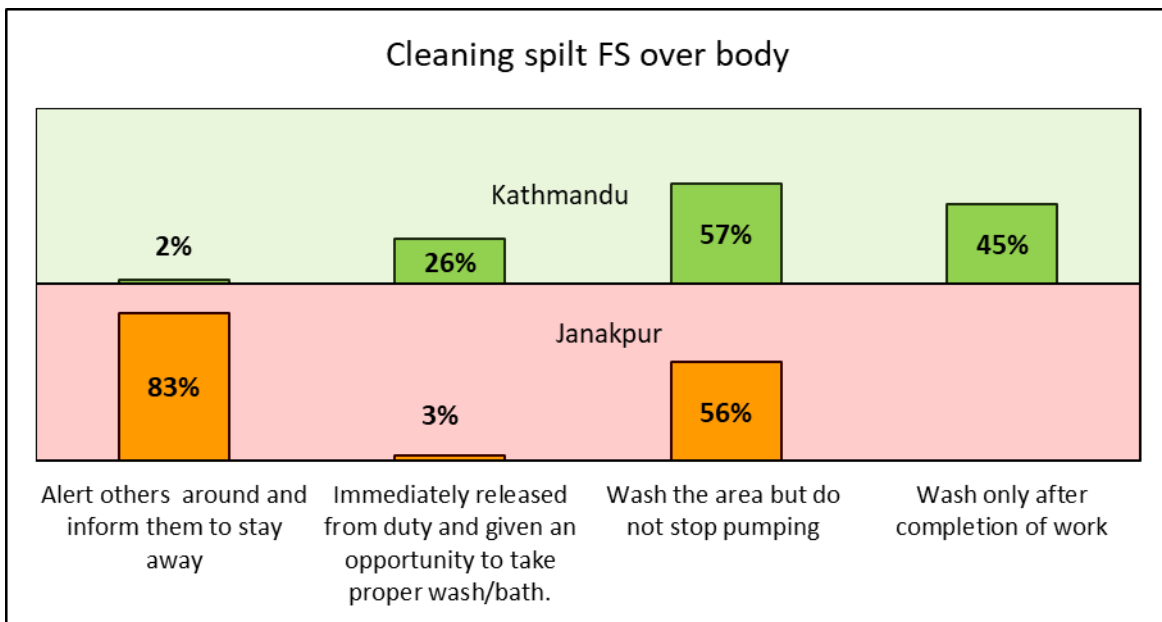


Figure 2-16 Knowledge on cleaning split FS over body

2.4.2 Personal Protective Equipment

Knowledge on personal protective equipment (PPE), its availability and proper use prevents the sanitation workers from biological hazard by avoiding direct contact with faecal sludge. The required set of personal protective equipment for the safe work are:

- i. Facemask or face shield
- ii. Rubber Gloves
- iii. Waterproof clothes/ apron

- iv. Gumboot/ anti slip boot
- v. Safety Helmet
- vi. Safety Goggles

Almost all the sanitation workers from the Valley and Janakpur had knowledge on importance of using personal protective equipment. Knowledge on importance of using facemask, gloves and gumboot were found in above 90% of sanitation workers in Kathmandu Valley. Also, 76% of the sanitation workers had knowledge on importance of wearing waterproof apron during the work. Only limited number of workers had knowledge on importance of wearing safety helmet and safety goggles.

All sanitation workers in Janakpur had knowledge on importance of using facemask and 75% had responded the importance of using rubber gloves during work. However, knowledge on the importance of other PPEs was very low. Figure 2-16 shows the data regarding knowledge of required PPE in Kathmandu valley and Janakpur.

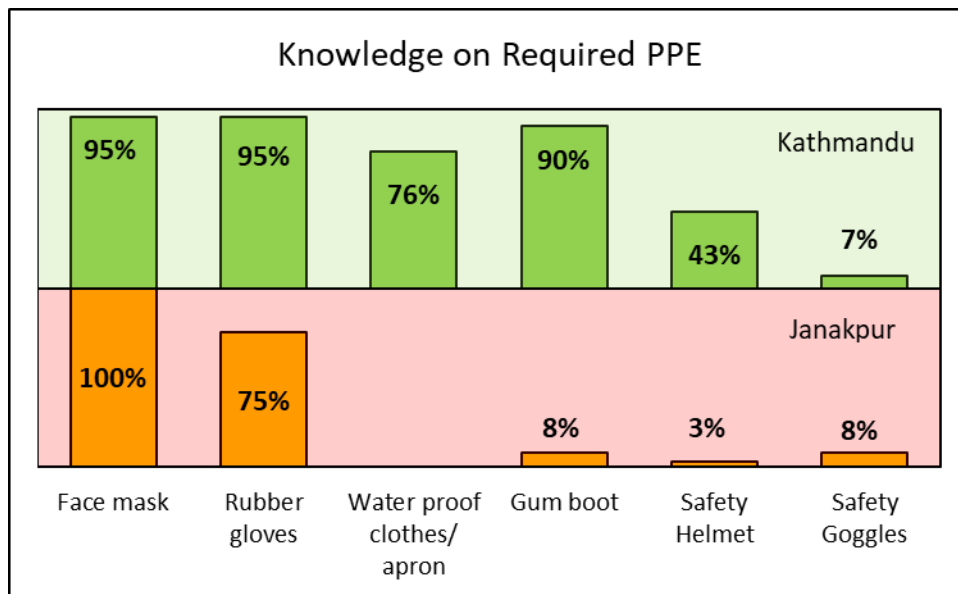


Figure 2-17 Knowledge of required PPE

Despite having the knowledge on importance of PPEs for safety of the workers during the work, none of them were provided with complete set of PPEs. Almost 70% of the sanitation workers in the Kathmandu Valley were provided with facemask and rubber gloves. Similarly, 41% of them were provided with gum boots.

Likewise, 83% and 75% of the sanitation workers in Janakpur were provided with facemask and rubber gloves for the work. Only minimal sanitation workers were provided with other important PPEs. Figure 2-17 shows the PPE materials provided to sanitation workers during the direct observation.

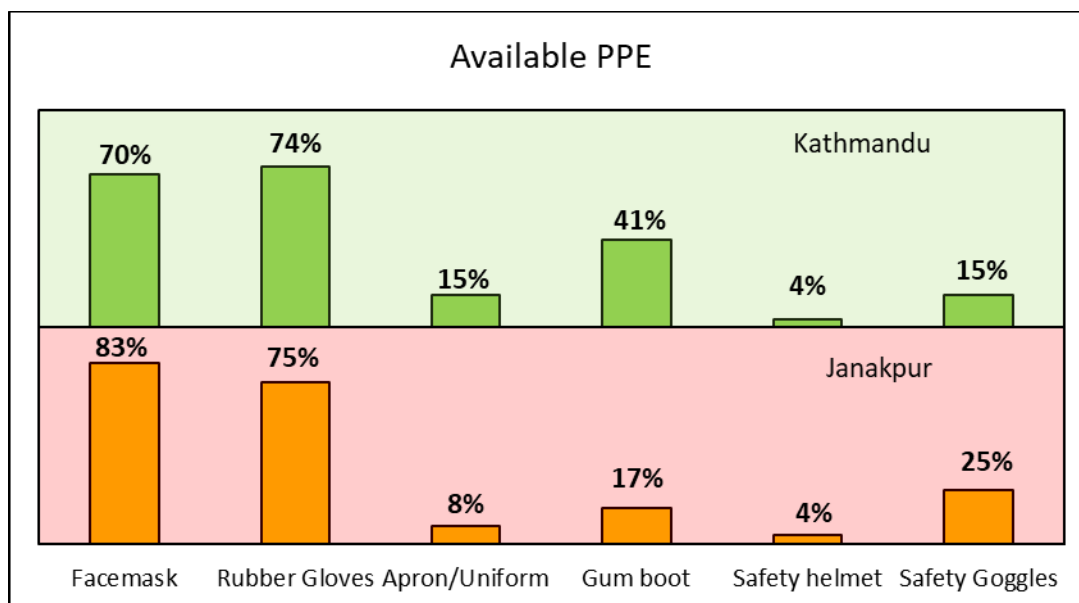


Figure 2-18 Available PPE for sanitation workers.

In 60% and 90% of directly observed sites in Kathmandu valley, the workers used facemask and rubber gloves respectively. While in Janakpur, in 80% of the sites, none of the sanitation workers used any personal protective equipment. Table 2-11 shows the used of PPE in the directly observed sites.

Table 2-12 Practices of using PPE during emptying

Practices of using PPE during work	Study Sites	
	Kathmandu	Janakpur
Facemask	60%	10%
Rubber Gloves	90%	20%
Waterproof clothes/apron	10%	0%
Gum boot	10%	0%
None	0%	80%

2.4.3 Critical handwashing Situations

Washing hand is primary and effective way to maintain health hygiene upon contact with faecal sludge. Washing hand frequently is much more essential to the sanitation workers who frequently comes under the contact with faecal sludge. The sanitation works should wash their hand:

- i. Before putting on PPE
- ii. After emptying the containment
- iii. After disposal of the FS
- iv. In between if something must consume
- v. When the FS spilt on the body and needs washing

All the sanitation workers in Kathmandu Valley responded that hands should be washed after emptying the containment. They also knew about other critical conditions of handwashing. However, 69% and 56% of the sanitation workers in Janakpur responded that the hands should be washed only after disposal of faecal sludge and when the faecal sludge was spilt over the body. Also, 33% and 22% of them responded

that hand should be washed to consume food in-between the work and after the emptying process. Figure 2-18 shows the responses of sanitation workers from the Kathmandu Valley and Janakpur on critical hand washing conditions during emptying.

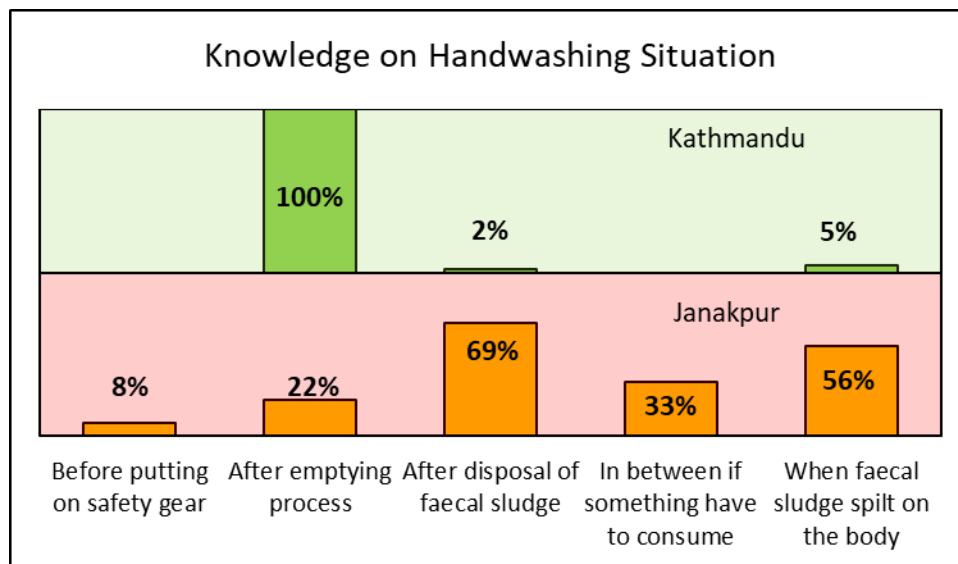


Figure 2-19 Knowledge on handwashing situation by sanitation workers

In both Kathmandu valley and Janakpur, availability of the hand sanitizer with sanitation workers was low. However other materials required for maintaining hand hygiene were available for more than 90% of the sanitation workers which has been presented in figure 2-19.

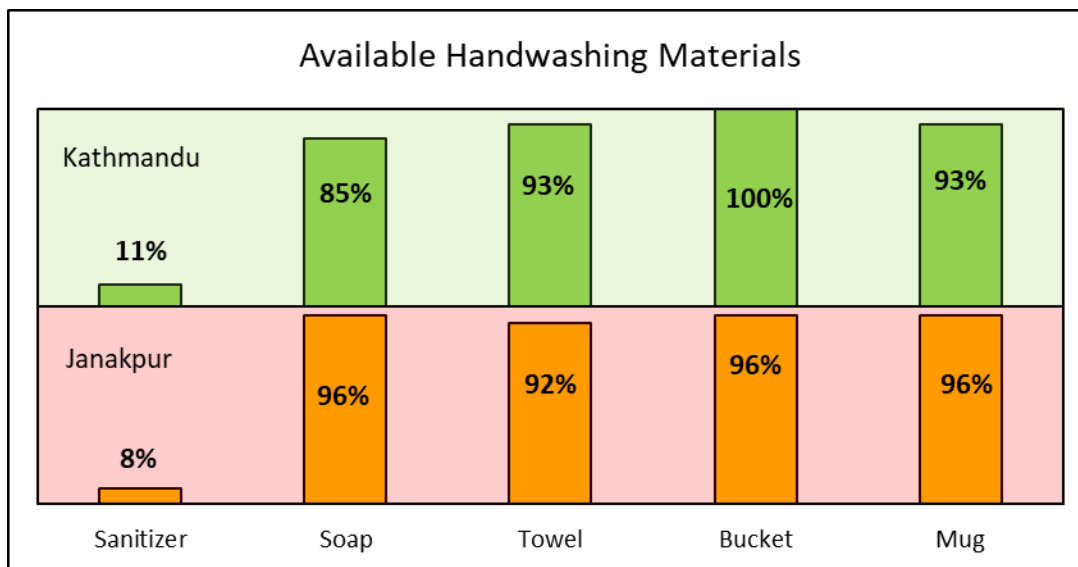


Figure 2-20 Available materials for maintaining hand hygiene in the desludging vehicles

In Janakpur, the sanitation workers were found not maintaining hand hygiene after completion of emptying the containment. The hands were washed thoroughly only with clean water by both driver and labour. However, in Kathmandu Valley, the behaviour was not uniform. The sanitation workers equipped with rubber gloves washed their gloves instead of their hands but with water only. Moreover, the workers without gloves washed their hands with soap and water.

2.4.4 First Aid

Knowledge on first aid promotes a sense of safety particularly among workers working in the hazard prone areas and those having higher potentiality of injuries during the work. In this regard, knowledge on first aid and its application is essential to sanitation workers.

Only 12% and 6% of the sanitation workers in the Kathmandu Valley and Janakpur had knowledge about first aid describing it as an immediate and temporary treatment. Surprisingly, 86% of the sanitation workers from the Valley responded no idea about the first aid. Also, 78% of the sanitation workers from Janakpur responded visiting doctors or health care facility referring it as first aid. Figure 2-20 shows the perceived knowledge among the sanitation workers related to first aid.

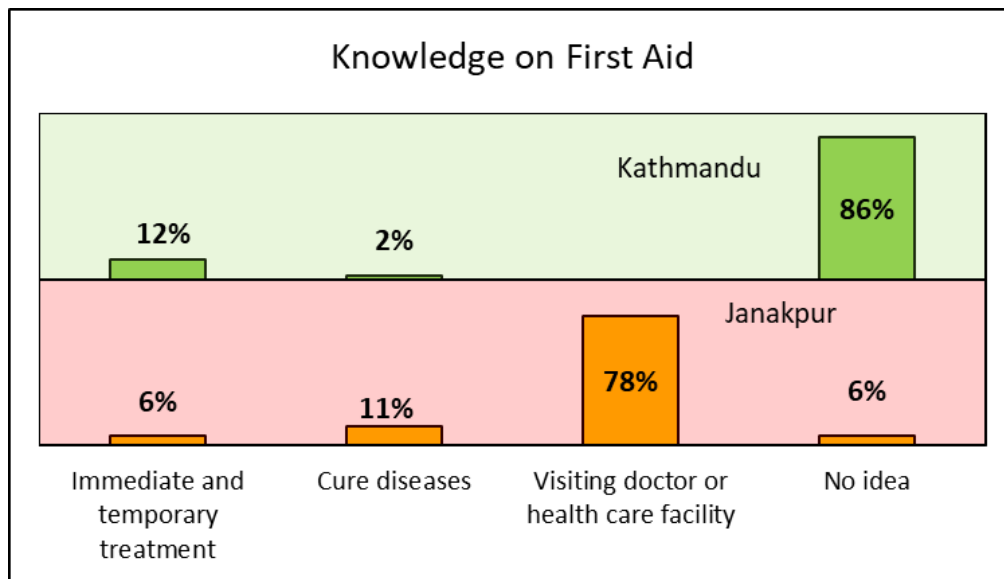


Figure 2-21 Knowledge on first aid by sanitation workers

The lack of knowledge on first aid and its importance was reflected through the absence of first aid kit in all the desludging vehicles of both the Kathmandu Valley and Janakpur.

2.4.5 Prevention from Infection from Minor Injuries

Minor injuries or wounds or cuts could lead to major infection if left untreated. The undesired infection from minor injuries could be prevented if the wound is washed with clean water, applied antiseptic ointment, apply adhesive bandage, and visit the doctor or health facilities and taken the necessary curative initiatives.

The data showed very few sanitation workers had knowledge that to prevent infection from minor wounds or cuts, first it should be washed by clean water, then apply antiseptic ointment or adhesive bandage and visit to health care facility. In the Kathmandu Valley, 43% of the sanitation workers responded cleaning the wounds and visit to health care facilities after getting minor injuries to prevent infections. While 31% responded that immediate visit to health care facility was preventive measures. Also, 83% of sanitation workers in Janakpur responded immediate visit to health care facility as preventive measure to

prevent infection from minor injuries. Figure 2-21 shows the perceived knowledge on prevention of infection from minor injuries.

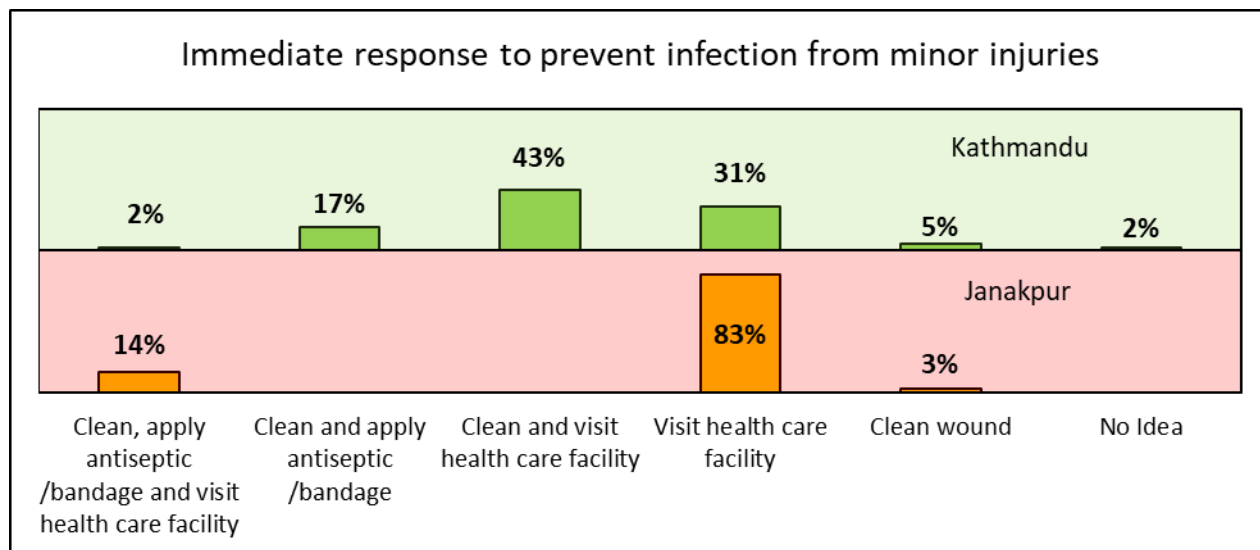


Figure 2-22 Knowledge of immediate response to prevent infection by sanitation workers

2.4.6 Regular Health Check-Up

Regular health check-up helps for healthier life. It helps in early diagnosis of the diseases, if present. It is much more essential for the sanitation workers who comes in direct contact with the suction hose as it possesses the risk for biological hazards. And thus, they need to visit health care facility for regular health checkup to remain healthy.

The data showed 88% of the sanitation workers in the Kathmandu Valley had knowledge on importance of regular health check-up. Similarly, 97% of the sanitation workers in Janakpur responded having knowledge on importance of regular health check-up as shown in figure 2-22.

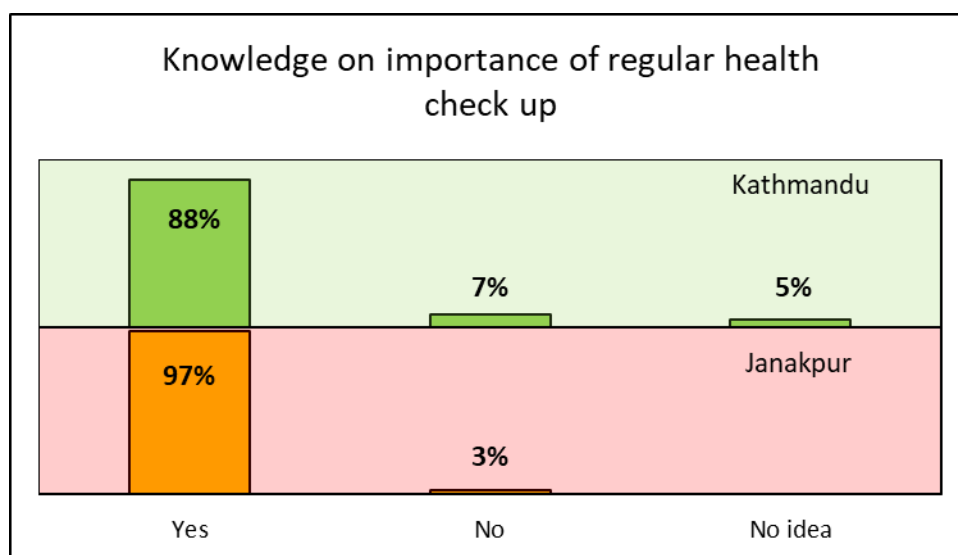


Figure 2-23 Knowledge of importance of regular health check-up

2.5 Awareness on OSH and Attainment of Training

Self-awareness on need for occupational safety and health in the working site is foremost factors to avoid potential disasters. Thus, every worker should understand underlying hazards and the importance of safety measures to minimize the risk. In the Kathmandu Valley, all the sanitation workers perceived their work possess the high risk to hazardous incidents. Moreover, 80% of the sanitation workers from Janakpurdham perceived high risk in their profession.

Furthermore, 69% of the sanitation workers in the Kathmandu Valley perceived the worker should be self-responsible for the safety during the work. Among them, 24% perceived that the responsibility of safety should be mutually shared by worker and employer. Likewise, in Janakpurdham 61% of the sanitation workers perceived safety of the workers should be mutually shared by both the employer and worker. Figure 2-23 shows the percentage on perceived responsibility for the safety of the workers during work.

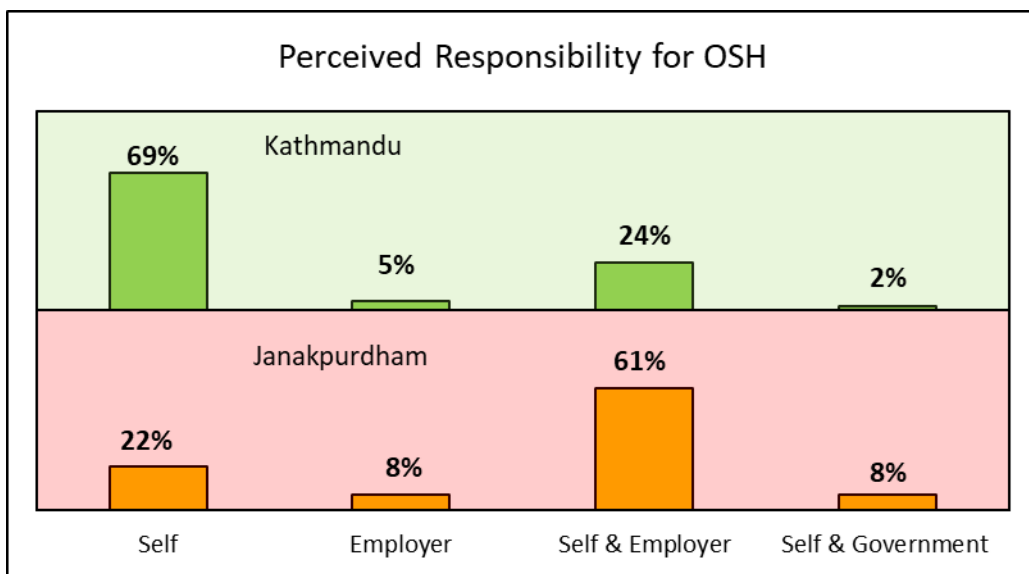


Figure 2-24 Perceived responsibility for safety during the work

Regular training on proper application of equipment, use of personal protective equipment and safety are essentials for minimizing the risk during the work. The study showed that only 43% of sanitation workers in the Kathmandu Valley had attended formal training on safety. Most of these sanitation workers attended training on occupational health and safety during COVID 19 pandemic. None of the sanitation workers in Janakpurdham had attended any forms of training.

2.6 Desludging Vehicles and its Features

In Kathmandu Valley desludging vehicles were locally assembled instead of importing the company manufactured vehicle equipped with high-capacity vacuum pump and advanced technology with blow-back system. A tank capacity of almost 3000 to 6000 litres with submersible pumps and generator is mounted on the truck. The assembled desludging vehicles have attached tractor head modified as generator for generating electricity to operate the submersible pump. The submersible pumps that weight approximately 50 kg is attached to the suction hose pipe and dipped into the containment for pumping the sludge. The tank consists of manual gas escape section which is also used to observe level of sludge

pumped out from the containment. The schematic diagram of the desludging vehicle operated in the valley is shown in figure 2-24.



Figure 2-25 An assembled motorized desludging vehicles used in the Kathmandu Valley

The schematic diagram of the desludging vehicle operated in Janakpurdhham is shown in figure 2-25. The company manufactured tank is equipped with suction pumps, level pipe for inspecting faecal sludge in the suction tank and pressure gauge.



Figure 2-26 A tractor or truck mounted motorized desludging vehicles used in Janakpurdhham Sub-metropolitan City.

The major advantages of the desludging vehicles operated in Janakpurdhham over the vehicle in the Kathmandu valley is presence of sludge monitoring system, pressure gauge and inbuilt suction pump. This ease emptying process through:

- i. Reducing the risk of fall in the containment as no heavy submersible pump required to be lifted
- ii. Preventing the injuries from fall of the vehicle as the level of the sludge in the tank could be assessed from outside
- iii. Presence of monitoring pressure gauge and gas escape section helping to maintain the pressure in the tank easily

2.7 Knowledge on Planning

2.7.1 Collection of pre-information of working site

In both study sites, more than 90% of the sanitation worker collected detail information of working site when the demand for service was received through telecommunication. In Kathmandu valley, 83% of them collected information regarding access road and traffic condition of the site. Also, 60% collected pre-information on the size and age of the containment.

Whereas in Janakpur, pre-information regarding the location site was collected. Pre-information on size and age of the containment was collected by only 25% and 22% of the sanitation workers respectively. Figure 2-26 shows the percentage of sanitation workers collecting the required information of site and containment prior to providing the service.

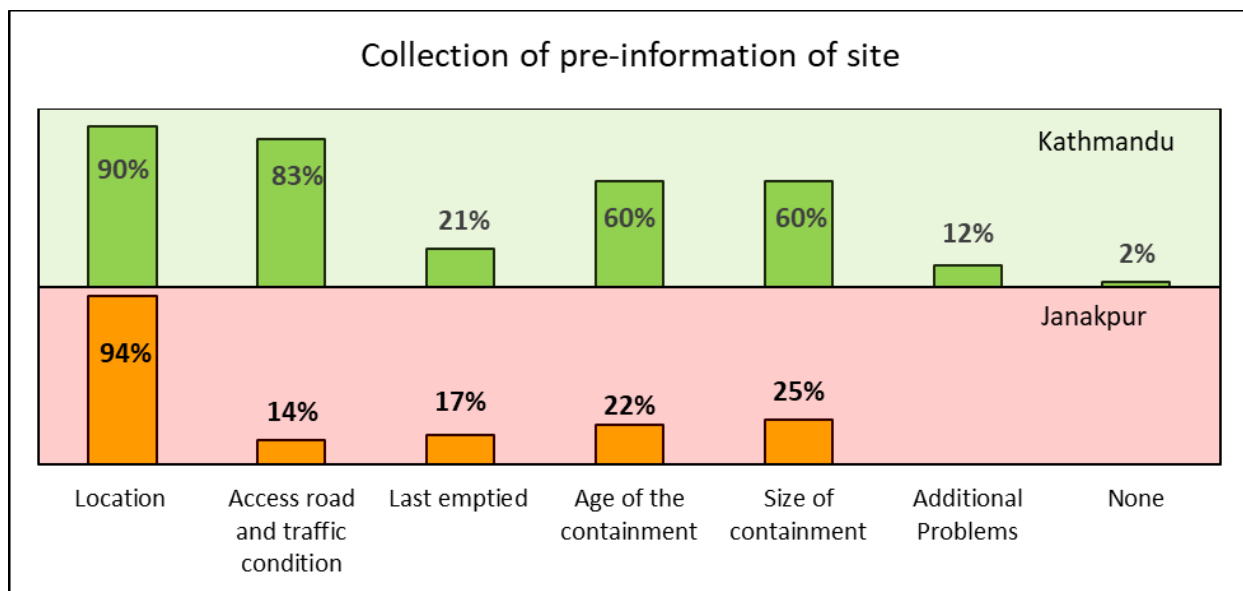


Figure 2-27 Collecting pre-information about working site in Janakpur and Kathmandu Valley

2.7.2 Division of work

The major work prior and during the emptying of the containments are:

- i. Contact with service recipients and collect pre-information of the working site
- ii. Inspection of site
- iii. Inspection of the containment
- iv. Clearance of around the site
- v. Removing cover slab
- vi. Connection of hose pipe
- vii. Operating the pump
- viii. Holding hose pipe during pumping

Figure 2-27 shows the reported work division of the sanitation workers in Kathmandu Valley. The figure reflected the driver/owner as sole responsible person to contact with the service recipients. Also, 71%, 60% and 81% of sanitation workers responded that the driver had responsibility to inspect the site, containment and operate the submersible pump. While 76%, 48% and 76% of the sanitation workers

responded that labour intensive works such as clearance of site, connecting hose pipe and holding the hose pipe during the emptying process respectively were responsibility of the labour. All the sanitation workers responded that both the driver and labours shared responsibility to remove heavy cover slab from the containment.

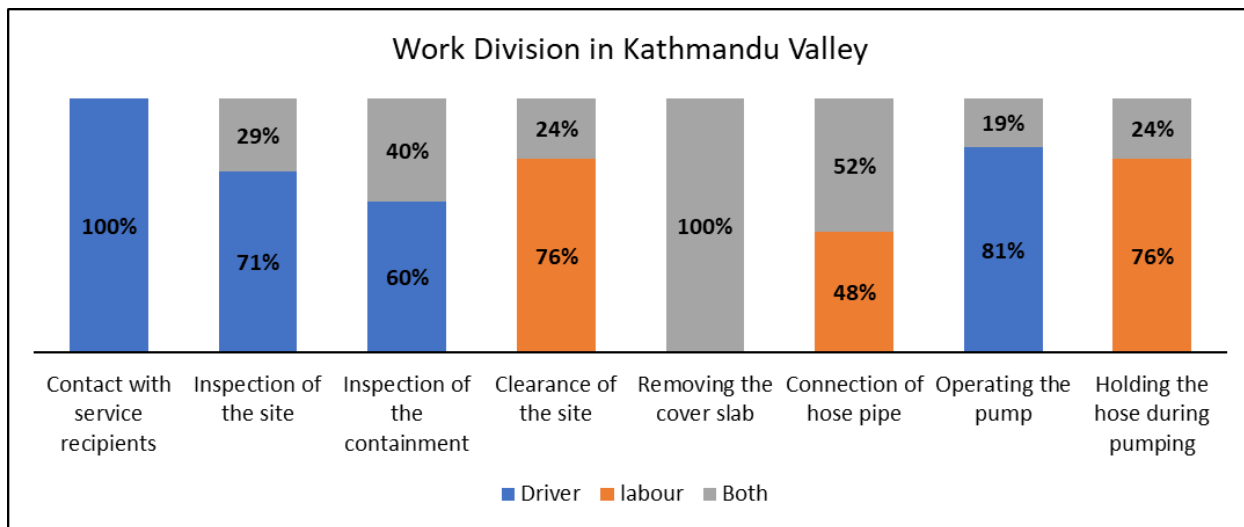


Figure 2-28 Work division of sanitation workers in Kathmandu valley

Figure 2-28 shows the work division of sanitation workers in Janakpurdham. The work division of the driver and the labour was like that of the sanitation workers in Kathmandu Valley.

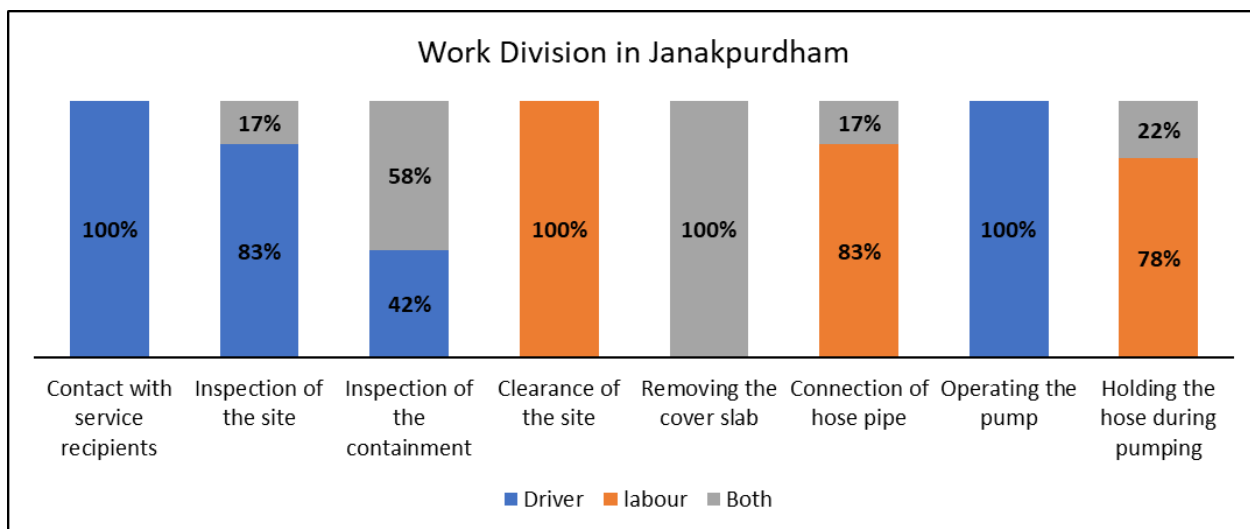


Figure 2-29 Work division of sanitation workers in Janakpurdham.

3. Average Weightage

3.1 Average Weightage for the Knowledge

The average weightage of knowledge of the sanitation workers on various indicators categorized as pre-planning, procedure and precautions, and safety and health hygiene are presented in table 3-1. It was

observed that the knowledge on prevention of physical hazard associated with required equipment for removing cover slab and clearance of working site obtained the highest weightage. Also, the knowledge on inspection of FS characteristics in the containment to prevent chemical hazard was satisfactory. Similarly, the knowledge on required PPE, handling of suction hose and materials essential for maintaining hand hygiene achieved equivalent weightage between 4.9 and 5 out of 10. It was observed minimal knowledge on preventing infections from minor injuries and first aid.

Table 3-1 Average weightage and ranking of different aspect of knowledge of sanitation workers

Rank	Knowledge on	Potential hazard	Average equivalent Weightage
1	Required equipment for removing cover slab	Physical	5.4
2	Clearance around the Site	Physical	5.4
3	Required Personal Protective Equipment	Biological	5.1
4	Handling Suction hose	Physical & Biological	5.0
5	Required material for handwashing	Biological	4.9
6	Inspection of containment	Physical	4.6
7	Knowledge on parking	Physical	4.6
8	Inspection on FS characteristics	Chemical	4.5
9	Collection of pre-information of site	Physical, Chemical, and biological	4.2
10	Procedure for removing cover slab	Physical	3.0
11	Handwashing at critical conditions	Biological	2.9
12	Safety during transportation	Physical	2.8
13	Washing Spillage over body	Biological and Chemical	2.8
14	Prevention of infection from minor injuries and First Aid	Biological	1.8

In Kathmandu Valley, the sanitation workers scored higher average weightage for knowledge on required PPE, clearance of site and handling of suction hose. Similarly, the score for knowledge on inspection of FS characteristics, equipment required for clearance of site, collection of necessary information for planning, inspection of containment and knowledge on parking achieved score above 5. While knowledge on safety during the transportation, handwashing conditions, washing spillage of FS and prevention of infections from minor injuries and first aid received lower score. The average weightage in each indicator for the sanitation workers in the Kathmandu Valley is shown in table 3-2.

Table 3-2 Average weightage on knowledge of different aspect by sanitation workers from Kathmandu

Rank	Knowledge on	Potential hazard	Average Weightage
1	Required PPE	Biological	6.8
2	Clearance around the Site	Physical	6.1
3	Handling Suction hose	Physical & Biological	5.8
4	Inspection on FS characteristics	Chemical	5.6
5	Equipment for removing cover slab	Physical	5.5
6	Collection of Pre-information of the site	Physical, Chemical, and biological	5.5
7	Inspection of containment	Physical	5.1
8	Knowledge on Parking	Physical	5.1
9	Required material for handwashing	Biological	4.9
10	Procedure for removing cover slab	Physical	3.0
11	Safety during transportation	Physical	2.8
12	Handwashing on critical conditions	Biological	2.1
13	Washing FS spillage over body	Biological	1.4
14	Prevention of infection from minor injuries and First Aid	Biological	1.6

In Janakpurdham, knowledge on equipment required for removing cover slab and materials for hand hygiene was high with 5.3 and 5 average weightages respectively out of 10. While knowledge on clearance of site, washing spillage FS over the body and handling suction hose obtained the average equivalent weightage of 4.1 to 4.7. The knowledge on importance of pre-planning and precautions of safety during the transportation, prevention of infections from minor injuries and first aid were weak. Table 3-3 shows the average weightage of each indicator in Janakpurdham.

Table 3-3 Average weightage and ranking knowledge of different aspect by sanitation workers from Janakpurdham

Rank	Knowledge on	Potential hazard	Average Weightage
1	Equipment for removing cover slab	Physical	5.3
2	Required material for handwashing	Biological	5.0
3	Clearance around the Site	Physical	4.7
4	Washing FS spillage over body	Biological and Chemical	4.4
5	Handling Suction hose	Physical	4.0
6	Inspection of containment	Physical	3.9
7	Knowledge on Parking	Physical	3.9
8	Handwashing on critical conditions	Biological	3.8
9	Inspection on FS Characteristics	Chemical	3.1
10	Required PPE	Biological	3.1
11	Procedure for removing cover slab	Physical	2.9
12	Safety during transportation	Physical	2.8
13	Collection of Pre-information of the site	Physical, Chemical, and biological	2.8
14	Prevention of infection from minor injuries and First Aid	Biological	2.0

3.2 Relation between socio-demographic characteristics and Knowledge

The relation between socio-demographic characteristics and knowledge of the sanitation workers was assessed which has been presented in the section below.

3.2.1 Relationship between Educational Attainment and Knowledge

The educational attainment of the sanitation workers reflected their knowledge regarding inspection of containment that would reduce the physical hazard. Also, the average weightage for inspection of characteristics of sludge increased with higher education. But the average weightage for knowledge on inspection of the emission of gas was higher with the illiterate sanitation workers. Also, the score on the knowledge of importance of using PPE was highest with the sanitation workers who had completed bachelor level of education. The overall average weightage on the knowledge of handwashing at critical times and prevention of infection was low irrespective of educational attainment. Figure 3-1 shows the average weightage of knowledge on various aspect to prevent physical, chemical, and biological hazard with respect to educational attainment of the sanitation workers.

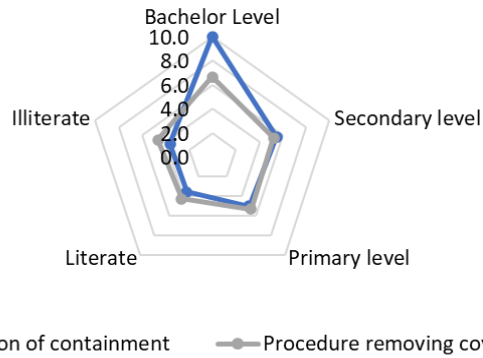
3.2.2 Relationship between work experience and knowledge

The sanitation workers who have been engaged in the profession for 21 to 25 years were found to have higher average weightage of knowledge on inspection of containment and clearance of site compared to those with lesser experience. Irrespective of the experience, the average weightage on knowledge of procedure and precautions to be taken while removing cover slab was lower. Also, the sanitation workers engaged in the profession for more than 26 years have scored higher average weightage for knowledge in inspecting the characteristics of faecal sludge. However, the average weightage for knowledge in inspection of FS characteristics was low irrespective of experiences. Similarly, the average weightage for knowledge on use of PPE, prevention of infections from minor injuries and critical hand washing conditions were low. Figure 3-2 shows the average weightage of knowledge on various aspect to prevent physical, chemical, and biological hazard with respect to working experience of the sanitation workers.

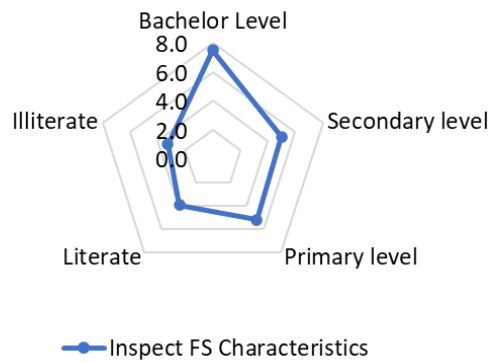
3.2.3 Relationship between choosing the profession and Knowledge

The average weightage gained by the sanitation workers who followed the work of their parents were higher than others with different reasons for choosing the profession. The proportionate weightage was higher in knowledge of inspection of containment, clearance of site and use of PPE. Whereas average proportionate weightage on knowledge of inspection of characteristics of FS was higher among those who were engaged in the sector traditionally. Figure 3-3 shows the average weightage of knowledge on various aspect to prevent physical, chemical, and biological hazard with respect to reason for choosing the profession of the sanitation workers.

Proportionate Average Weightage on Preventive Knowledge of Physical Hazard



Proportionate Average Weightage on Preventive Knowledge of Chemical Hazard



Proportionate Average Weightage on Preventive Knowledge of Biological Hazard

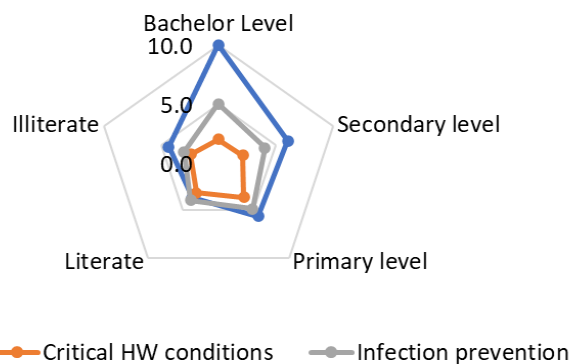


Figure 3-1 Average proportionate weightage on knowledge based on educational attainment

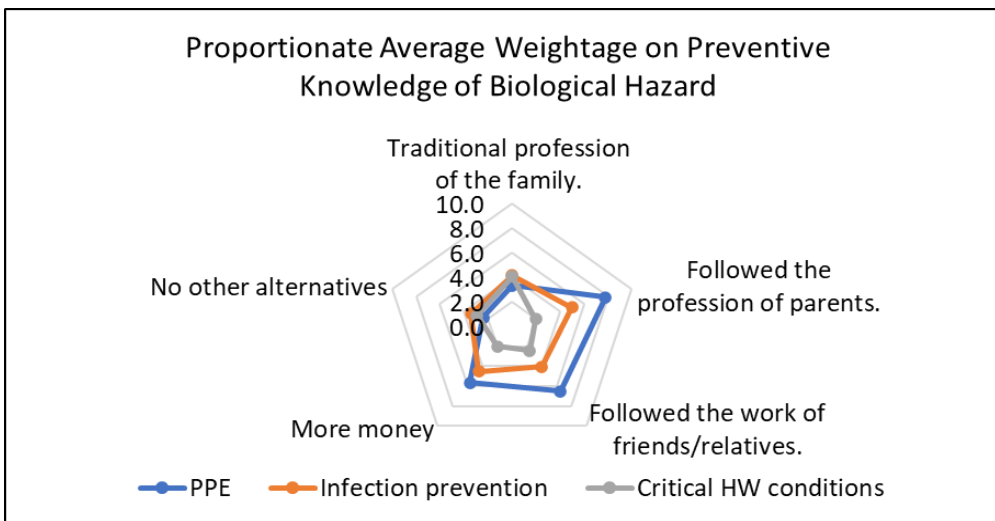
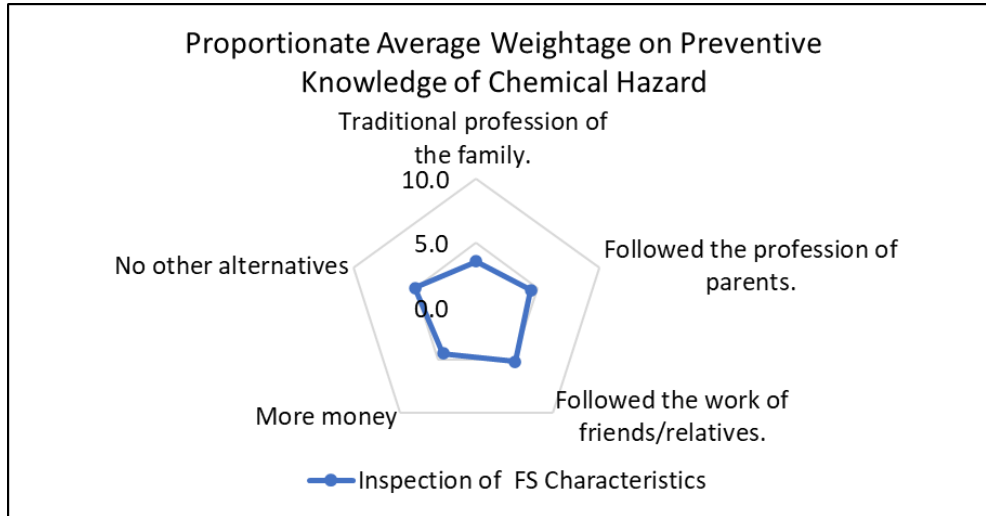
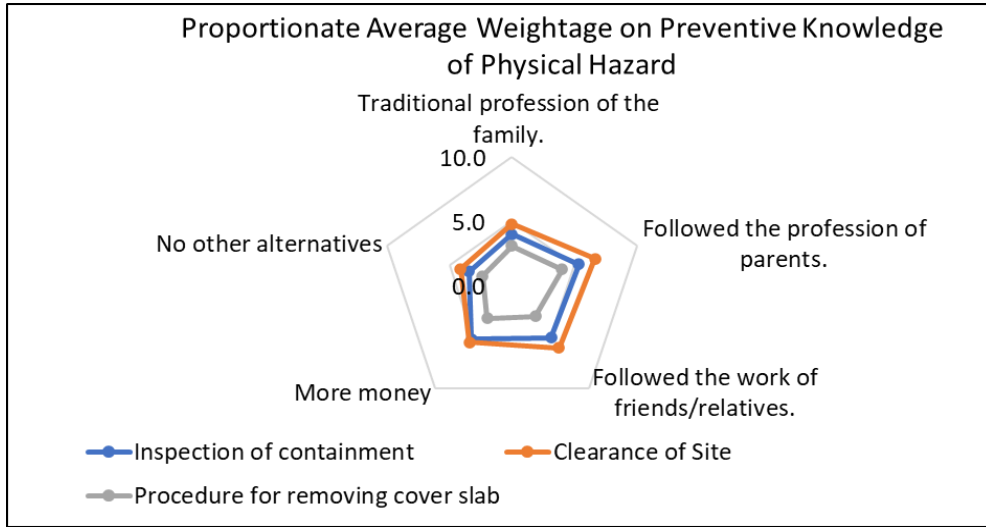


Figure 3-2 Average proportionate weightage on knowledge based on work experience

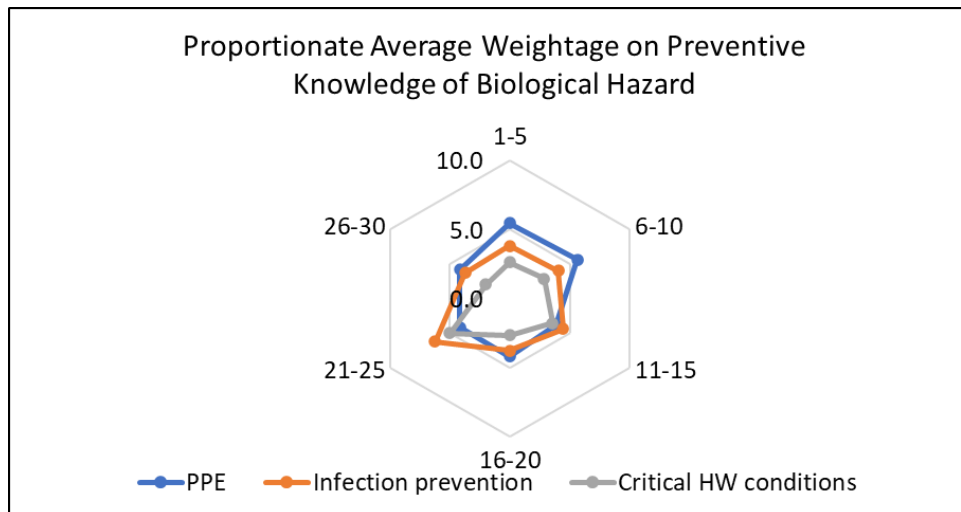
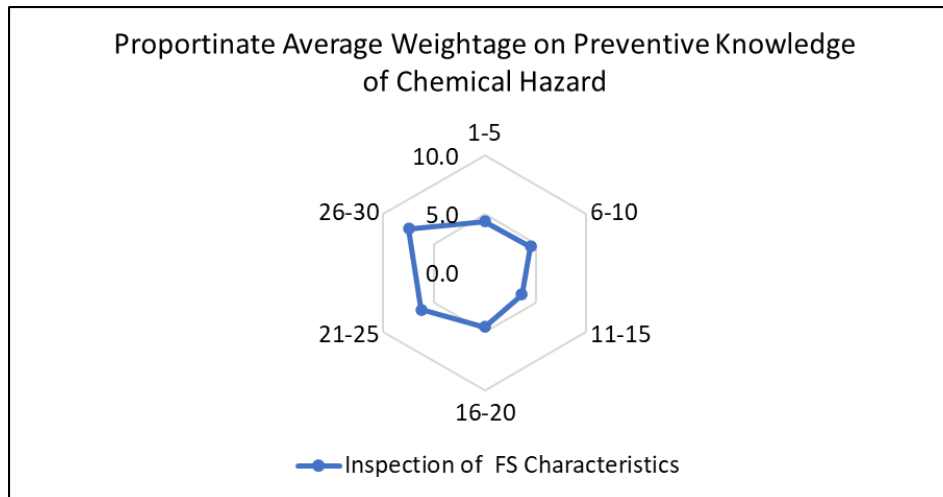
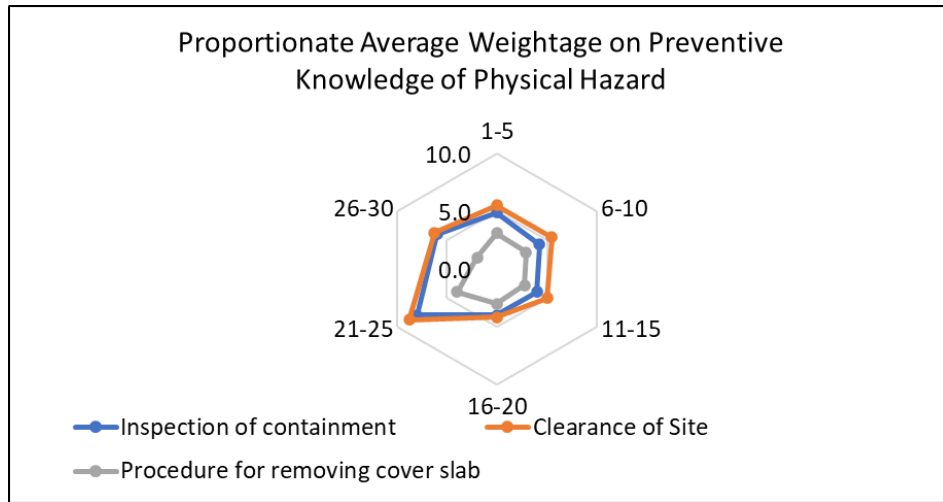


Figure 3-3 Average proportionate weightage of knowledge based on reason for choosing the profession

3.2.4 Average weightage scored by trained sanitation workers

The average weightage for the knowledge on inspection of containment, clearance of site and procedure for removing cover slab was higher among sanitation workers who have attended at least one training on safety and health hygiene as compared to untrained workers. Figure 3-4 shows the average weightage of knowledge on various aspect to prevent physical hazard with respect to training attended by the sanitation workers.

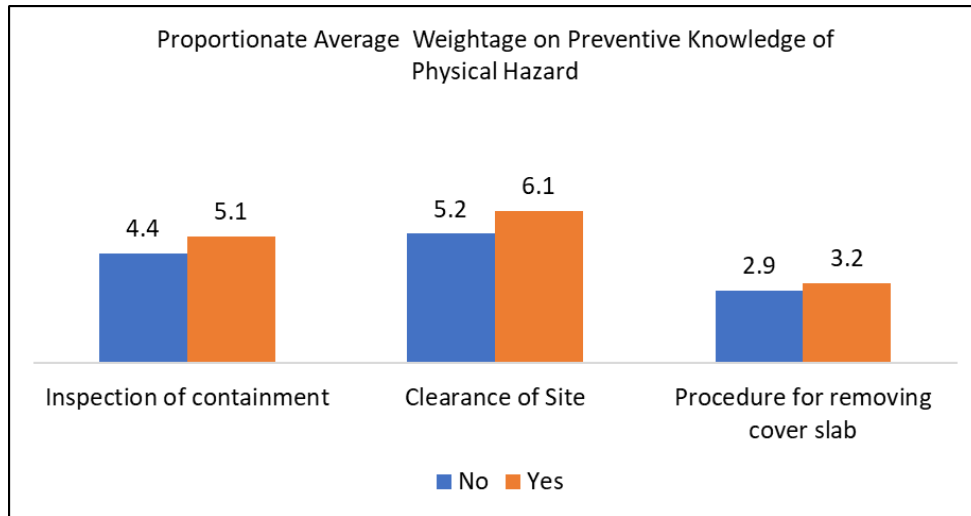


Figure 3-4 Average score of trained and untrained sanitation workers on preventing physical hazard

Similarly, the average weightage for knowledge on inspection of FS characteristics was higher among trained sanitation workers on safety and health hygiene as compared to untrained. But such trend was not observed on knowledge of inspection of gas that would help avoiding chemical hazard. Figure 5-5 shows the average weightage of knowledge on various aspect to prevent chemical hazard with respect to training attended by the sanitation workers.

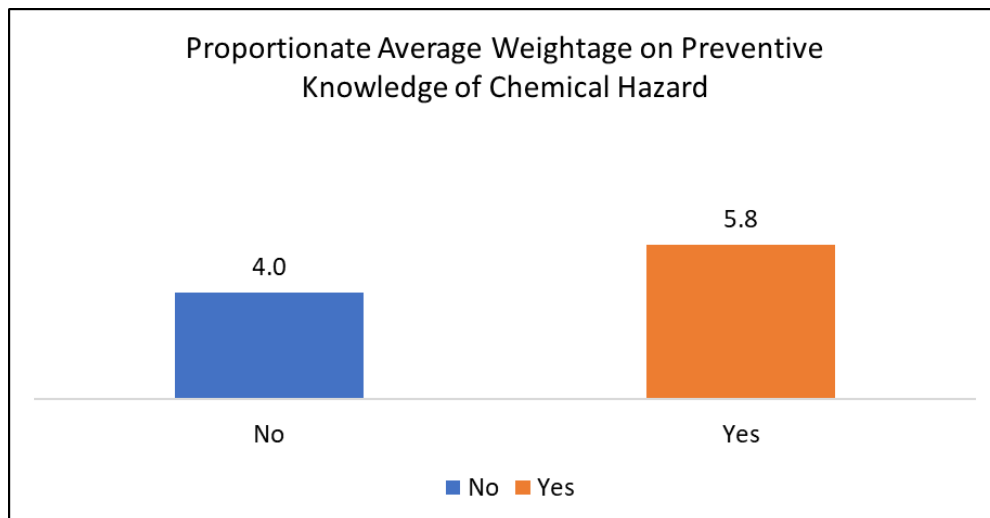


Figure 3-5 Average score of trained and untrained sanitation workers to prevent chemical hazard

The average weightage for knowledge for use of PPE was highest with sanitation workers who were trained on safety and health hygiene. However, the score on prevention of infection from minor injuries and critical handwashing conditions were not affected with the attainment of training. Figure 3-6 shows the average weightage of knowledge on various aspect to prevent biological hazard with respect to training attended by the sanitation workers.

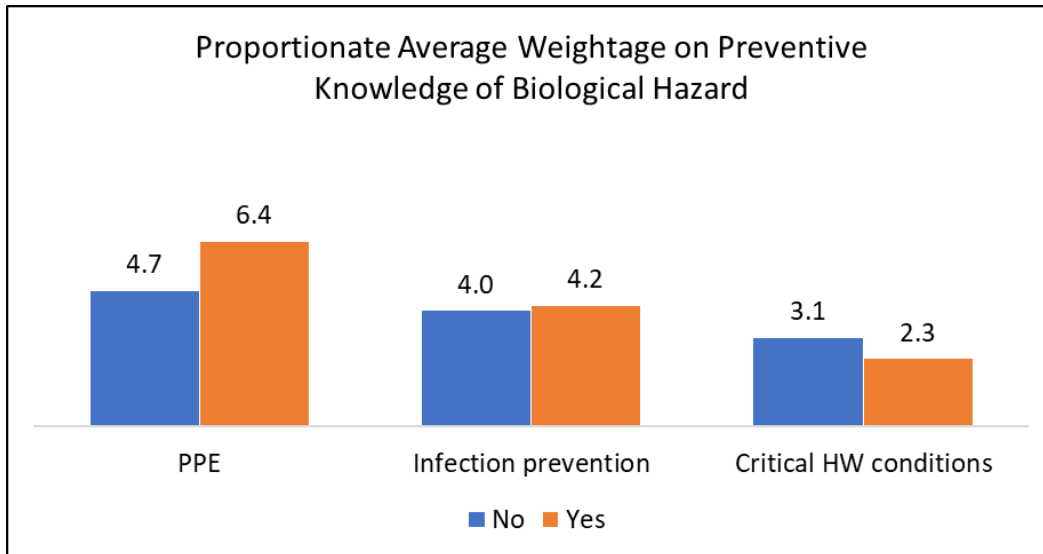


Figure 3-6 Average score of trained and untrained sanitation workers to prevent biological hazard

4. Conclusions and recommendation

4.1 Conclusions

The major conclusions from the study are:

1. The sanitation workers engaged in the emptying, transportation, and disposal of faecal sludge were prone to physical, chemical, and biological hazards. Lifting heavy cover slab and mishandling of the equipment were high potential causes to injure the sanitation workers. Inhaling of the gases and skin irritant during direct contact with faecal sludge were potential causes related to chemical hazards. The risk of contamination from FS could degrade the health and wellbeing of the sanitation workers.
2. Socio-demographic characteristics of the sanitation workers influenced the knowledge and attitude in terms of practicing precautions for occupational safety and health. Most of the sanitation workers were from socially marginalized and discriminated families with lower educational attainment, following the traditional profession. Also, majority of the workers had chosen the profession following their friends and relatives, seeking higher income.
3. Self-awareness on importance of safety in the work and enhancing skill and capacity was key to avoid and minimize the hazard in the working place. Optimistically almost all the sanitation workers were aware about high risk in their profession but were not trained accordingly. The risk to get injured had increased with the use of locally assembled desludging vehicles containing heavy suction pumps that needed to be lifted every time for emptying the containment.
4. Using technically inferior equipment, the occupational safety and health of the workers relied on their capacity to pre-plan, knowledge on precautions during entire operating process, availability and using the personal protective equipment, and following hygienic behaviour. The reality on the ground was that due to lack of formal training and capacity buildup mechanism, the knowledge they had gained was solely based on the experiences. Thus, it was observed that the sanitation workers had knowledge on labour intensive activities such as necessary tools and precautions to be followed for clearance of site, removing the cover slab of the containment, and holding the suction hose. Despite having the knowledge, its implementation remained limited either due to inadequate tools or insufficient awareness about the potential risks to their safety and health from mishandling of the tools.
5. Significant knowledge gap was observed in maintaining health and hygiene behaviour by the sanitation workers. The lack of adequate PPE despite having the knowledge of its importance, unwilling to adopt proper handwashing with soap and water and unawareness on first aid and responses toward preventing infections from minor injuries had escalated the risk of degrading health and wellbeing even with minor accidents in the workplace.

4.2 Recommendations

The major recommendations for occupational safety and health of the sanitation workers engaged in emptying profession of the containment are:

- i. sanitation workers should be equipped with technically better equipment for emptying process. The mechanism to verify the quality of the equipment must be developed.
- ii. Ensure the availability of adequate and quality set of personal protective equipment for all the sanitation workers.
- iii. The sanitation workers should be trained on critical handwashing conditions focusing on the critical incidents in the emptying process that has potential risk to biological hazard.

- iv. The sanitation workers should be trained on first aid and preventive measures of infection from minor injuries. Also, the availability of first aid kit should be mandatory in the desludging vehicles.
- v. Provision of periodic health check-up of sanitation workers should be assured.

5. Annex I

5.1 List of interviewees

S No	Janakpurdham	Kathmandu Valley
1.	Lalu Kumar Mestar	Surendra Tamang
2.	Bikash Mestar	Dhan Raj Tamang
3.	Soman Mestar	Gopi Khadkha
4.	Sunil Mestar	Bishnu Khatri
5.	Raza Kumar Mestar	Sagar Bandhari
6.	Bhola Mestar	Ram Krishna Dami
7.	Rambabu Mestar	Budha Thapa Magar
8.	Dipesh Mestar	Santosh Rai
9.	Sagar Mestar	Bijay Lama
10.	Bijay Mestar	Anil Tamang
11.	Jiban Sada	Ashim Rai
12.	Bijay Kumar Mestar	Sabin Rai
13.	Pankaj Mestar	Jiban Shrestha
14.	Sagar Mestar	Ajay Tamang
15.	Manoj Paswan	Ram Kumar Shahi
16.	Rakesh Mestar	Yad Bahadur Karki
17.	Manoj Mestar	Subash Lama
18.	Shibu Mestar	Hom Bahadur Magar
19.	Bhola Mestar	Dilip Tamang
20.	Ram Sevak Paswan	Prakash Sigtan
21.	Shankar Mestar	Anil Shrestha
22.	Naresh Marik	Gokul Bahadur Budathoki
23.	Nabin Raut	Kebal Budhathoki
24.	Bechan Mestar	Varat Moktan
25.	Bhola Mestar	Kul Bahadur Shrestha
26.	Shyam Mestar	Abhishek Podeul
27.	Satya Bahadur Singh Tamang	Rajendra Ragarkoti
28.	Ajay Mestar	Bimal Lama
29.	Raju Mestar	Gopal Ghimire
30.	Bankar Mestar	Prabin Gurung
31.	Sadhu Mestar	Durga Magar
32.	Rajesh Mestar	Kesab Khatri
33.	Rohit Mestar	Pradip Dungana
34.	Shree Kisunu Mestar	Harka Bahadur Khatri
35.	Sukhdev Mestar	Lokh Nath Dhakal
36.		Bhim Kumar Rai
37.		Bijya Tamang

S No	Janakpurdham	Kathmandu Valley
38.		Budhi Rai
39.		Sajan Magar
40.		Suman Magar

6. Annex II

6.1 References:

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