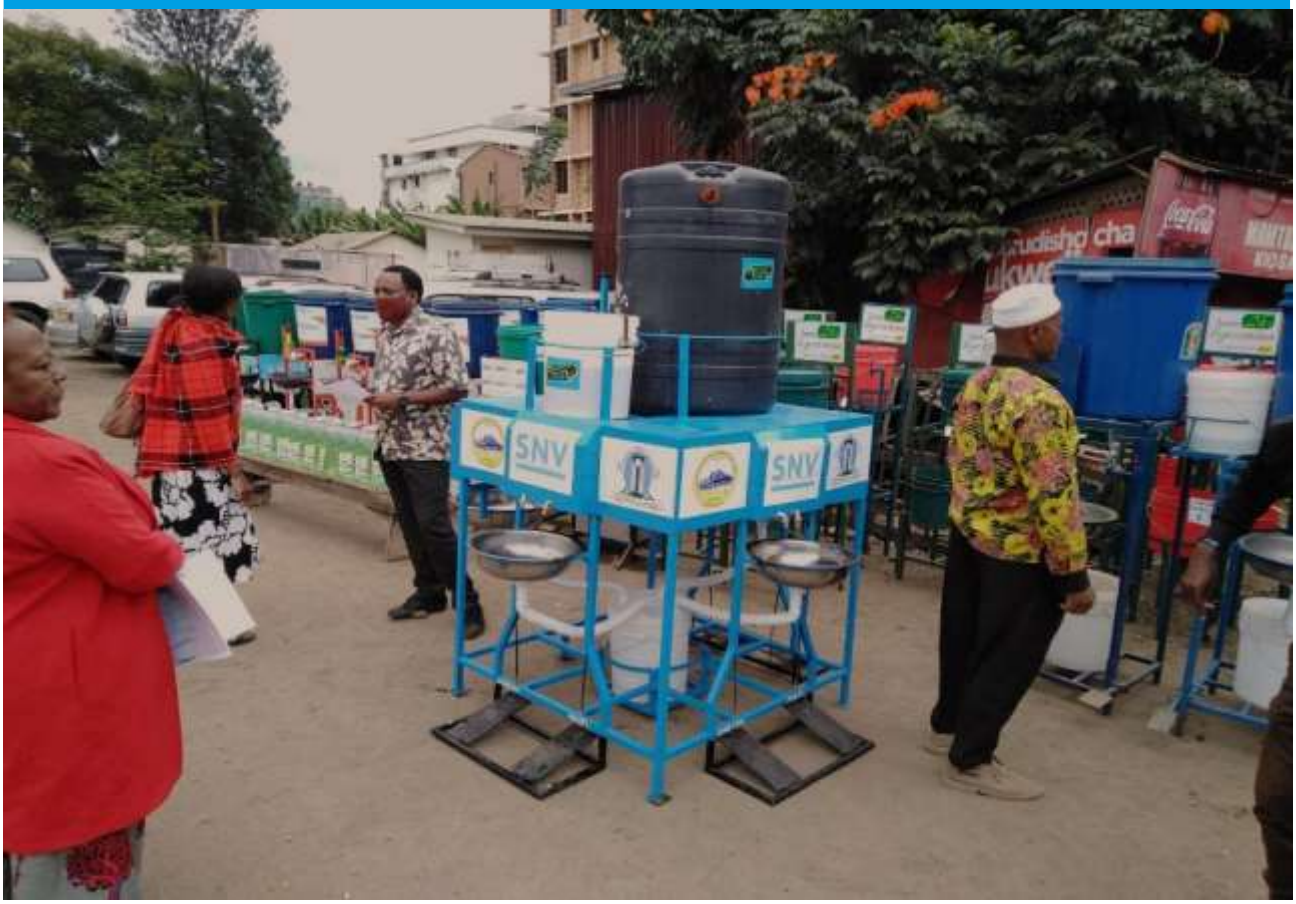
TECHNICAL PAPER

WASH SDG PROGRAMME



Practical options for hand-washing stations

A guide for promoters and producers

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About SNV

SNV is a not-for-profit international development organisation that makes a lasting difference in the lives of people living in poverty by helping them raise incomes and access basic services. Driven by the Sustainable Development Goals, we are dedicated to an equitable society in which all people are free to pursue their own sustainable development. Through our work in the Agriculture, Energy, and Water, Sanitation and Hygiene (WASH) sectors, we help realise locally owned solutions that strengthen institutions, kick-start markets, and enable people to work their way out of poverty well beyond the scope of our projects. SNV has a long-term, local presence in over 25 countries and is supported by over 1,300 staff around the world.

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Cover photo: A foot operated handwashing station in Arusha, Tanzania (SNV/Olivier Germain).

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1.1 Background

Frequent and proper hand hygiene is one of the most important measures that can prevent infections, including the COVID-19 virus. Water, sanitation and hygiene (WASH) practitioners should work to enable more frequent and regular hand hygiene by increasing access to handwashing facilities, including with soap, and by using proven behaviour-change techniques.

Handwashing stations are particularly important for densely populated environments, where people gather and congregate. Examples include in markets, bus stands, public transport meeting points, the entrance of buildings, restaurants, and in institutions such as schools and health care facilities.

As handwashing stations are becoming increasingly popular, different groups, organisations and countries have come up with different designs. The timing of this technical paper is critical, therefore, to help guide informed choices regarding the right technology in a given context.

1.2 Objectives and purpose

This brief sets out various practical options for handwashing stations based on designs adopted by different SNV countries. It describes the key characteristics of proven technologies to guide WASH promoters and producers in selecting the most suitable options for a particular context.

The paper first describes existing technologies used, including foot operated systems, automated systems, and hand operated systems. Case examples from SNV countries are given for each type of system. The paper then discusses key aspects for consideration when planning handwashing facilities, with the assessment of each technology divided into two parts:

- *A guide for promoters* with key considerations for technology and critical components; operation and maintenance (O&M); social and sustainability aspects; and comparable costs and affordability.
- *A guide for producers* (i.e. manufacturers) with information on technical specifications; the fabrication process; O&M requirements; monitoring and after-sales service; social and sustainability parameters in terms of inclusion, climate, and security; and cost and affordability, including cost estimates for materials.

1.3 Target audience

This technical paper will support decisions by:

- *Promoters*, who may include implementing partners (ministries, utilities, non-government organisations); local government authorities (councils, municipalities); and donors (interested funders).
- *Producers*, who may include the private sector (local manufacturers).

This brief may also be informative for users to select the most appropriate handwashing option for their needs.

1.4 Scope and guiding principles

This technical paper looks at both rural and urban settings and is intended to guide the selection of handwashing stations within different settings such as health care centres, markets, water collection points, bus stands, schools, and offices.

All handwashing technologies used by WASH programmes within SNV countries have been reviewed and assessed according to particular design aspects. These are grouped as: 1) technical requirements and the fabrication process, 2) management and planning considerations, 3) social and sustainability considerations, and 4) cost and affordability (see Table 1).

Table 1: Design aspects of handwashing technologies in SNV countries

Parameters	Combined aspects	To guide promoters	To guide producers
Technical requirements and fabrication process	• Technical design specifications • Technical expertise requirements • Overview of system components • Manufacturing process	Brief overview of technology and key components	Technical drawings (where available), detailed specifications and resources/materials required
Management and planning considerations	• O&M requirements • Monitoring • After-sales service	Brief overview of level of O&M and monitoring required	O&M requirement expectations; After-sale services
Social and sustainability considerations	• Gender equality and social inclusion (GESI) design aspects • Context suitability • Climate change related aspects • Safety/security aspects • Robustness of system	Brief overview of key GESI, climate, security and sustainability advantages/highlights, and suitability for different contexts	Design considerations around accessibility, suitability to different needs/contexts, water use, and security/safety aspects
Cost and affordability	• Cost range by capacity and material used • Resource/material requirements (including list of materials and quantities required)	Top-line cost range for comparative purposes (depending on capacity)	Detailed list of materials and associated costs (to be tailored by each country)

2 Existing handwashing technologies

The presence of a handwashing facility with soap and water on premises has been identified as a priority indicator for global monitoring of hygiene. The Joint Monitoring Programme (JMP) of the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) defines a handwashing facility as a device that 'may be fixed or mobile and include a sink with tap water, buckets with taps, tippy-taps, and jugs or basins designated for handwashing'.[1] Soap includes a bar of soap, liquid soap, powder detergent and soapy water but does not include ash, soil, sand or other handwashing agents.

According to UNICEF,[2] handwashing stations should be appropriate for the intended user(s) or the use (households, markets, health care facilities, schools, places of worship, public transportation hubs, refugee camps, etc.). Three sets of criteria should be taken into consideration:

1. The station should enable recommended handwashing.
2. The design should be adapted to the local context, allowing local manufacturing, management and repair, and adequate use of water and soap.
3. The design should provide a pleasant, convenient user experience for all users.

Various technologies have been developed by different stakeholders to enable people to wash their hands with soap properly at critical occasions. During the COVID-19 pandemic, even more handwashing technologies have emerged. Three categories of handwashing stations are discussed in this technical paper, which includes foot operated systems, manually operated hands-on systems, and automated handwashing stations (with sensor). This section provides information on the technological requirements and fabrication process (technical design specifications) of each type of handwashing station, plus management and operation requirements (operation and monitoring, O&M), social parameters (inclusion, context) and costs and affordability parameters. In addition to these considerations, handwashing stations should be designed to appeal to people and encourage use.

2.1 Foot operated handwashing stations

2.1.1 Tippy taps

The most common foot operated handwashing station used in the developing world is the 'tippy tap'.[3] It is said to have been developed originally in Zimbabwe by Jim Watt and Jackson Masawi. The tippy tap is a simple and economical device made with commonly available materials – often a container like a jerry can, large can, bottle or pot with a hole drilled near the top. A string and a pedal are attached at the top of the container that allows water to flow out. Tippy taps allow for a small release of water for handwashing, thereby avoiding water wastage.

[1] WHO/UNICEF JMP, *'Hygiene'*, Geneva, WHO and New York, UNICEF, n.d., https://washdata.org/monitoring/hygiene (accessed 16 November 2020).
[2] UNICEF, 'Handwashing stations and supplies for the COVID-19 response', *Factsheet*, New York, UNICEF, May 2020, https://www.unicef.org/media/75706/file/Handwashing%20Facility%20Worksheet.pdf (accessed 18 November 2020).
[3] SSWM, 'Simple handwashing devices', *Factsheet*, willisau, Switzerland, Sustainable Sanitation, Water Management & Agriculture, n.d., https://sswm.info/humanitarian-crises/rural-settings/hygiene-promotion-community-mobilisation/important/simple-handwashing-devices (accessed 10 November 2020).

Box 1: Tippy taps supported by SNV in Uganda

SNV in Uganda has long been respected for its contribution to the handwashing movement. In 2015 the organisation hosted a national handwashing campaign as part of the recently concluded Sustainable Sanitation and Hygiene for All 2014-2020 (SSH4A) programme, which is SNV's largest rural sanitation programme to date.

Tippy taps are the most commonly used handwashing technology in rural Uganda, and are generally homemade. These facilities have a shop-bought bar of soap attached or liquid soap added to the jerry can of clean water. A few households make their soap from materials such as potash (potassium ash made from banana peel ash), vegetable oil and water.

A foot operated tippy tap in a rural setting in Uganda (Photo credit: SNV in Uganda)

2.1.2 Foot pedal systems

Foot pedal-based designs are becoming popular due to their ease of use and relatively simple design. These hands-free systems have become more popular in recent times due to the COVID-19 pandemic, in an effort to limit touching and contamination. Different organisations and countries have come up with various designs for foot pedal systems, a few of which are described in the case examples below.

Box 2: The *Kanyaga Kanyaga* ('step on it') foot operated handwashing stations supported by SNV in Tanzania

SNV in Tanzania – through the WASH Sustainable Development Goal (SDG) programme – supported local producers and authorities in Shinyanga and Arusha to design and manufacture a foot operated hand-washing station to be used in different environments such as public spaces, offices and by food vendors.

The system has five main parts: 1) a clean water storage tank, 2) a soap storage container, 3) a grey (used) water storage container, 4) a frame/tower that is stable enough to hold the required containers, and 5) the operating system (made of a foot pedal and clutch cables for this particular design). The system is available in different sizes depending on needs. Stations with 20-60 litre capacity are mostly used in offices and premises preparing and serving food, and stations with 60-250 litre capacity are used in public spaces.

A 60-litre foot operated handwashing station in Arusha, Tanzania (Photo credit: Leyla Khalifa/SNV in Tanzania)

Box 3: Foot and elbow operated handwashing stations supported by SNV in Zambia

Novel handwashing models have emerged around the world since the onset of the COVID-19 pandemic. SNV Zambia has supported local entrepreneurs to develop and pilot a foot and elbow operated handwashing system. The stations are built using locally sourced materials and have the following features and advantages:

- User-friendly handwashing station for all, including a foot operated system for the able bodied and an elbow and hand lever for use by the elderly, children, and disabled persons.
- Uses an ordinary but modified garden tap which is more durable than dispenser taps for water dispensation.
- Accommodates different clean water storage buckets ranging from 20 to 65 litres.
- Water is added manually into storage buckets.
- Provision for liquid soap dispensation though bars of soap can also be stored.
- Incorporates a grey water storage bucket underneath which can be emptied manually when full.
- Facility is portable and can be relocated easily.
- Metal tube frame can be spaced for social distancing and can be secured easily.
- Dispensing mechanism uses clutch cables and bicycle chains which are sourced locally

Foot operated handwashing facility developed by local entrepreneurs in Zambia (Photo credit: SNV in Zambia)

Box 4: Pedal operated handwashing stations supported by SNV in Nepal

Pedal operated handwashing stations have been installed at the entrance of health care facilities, quarantine centres and public toilets in Bangladesh. The systems consist of an iron frame with a water tank and wash basin. The stations use a foot operated model to avoid direct contact and contamination via hands.

The stations have been designed to be user friendly and accessible. While the able-bodied use a foot pedal to operate the taps and soap dispenser, the less able (such as children, elderly people, pregnant women, and people with disability) can use a hand lever. The stations include water tanks with capacities of 200-500 litres, depending on need.

Handwashing station in Nepal. Installed in Health Care Facilities in Khadak Municipality. Photo credit: Parmeshwar Jha

2.2 Automated handwashing stations

Automated designs include a sensor to detect when a hand is brought close to a tap/dispenser so that the water (or soap) can be turned on without needing to touch the device. As with the foot operated system, automated handwashing facilities limit the contact required and therefore the risk of contamination is reduced.

Box 5: Solar-powered hands-free handwashing dispensers in Uganda

One example of an automated handwashing device has been developed by students of the Islamic University in Uganda (IUIU). The University's research and innovations laboratory developed an automatic water dispenser to promote handwashing as part of preventive measures against COVID-19.

The dispenser is fitted with motion sensor technology, a water container, and a power source (in this case for solar power). It discharges water immediately when one moves their hands closer to the tap, thus minimising contact with potentially contaminated surfaces. It costs Ush 120,000 (US$ 33) to produce one motion sensor unit and Ush 500,000 (US$ 135) to produce an entire handwashing station. This is affordable for most local authorities but may be unaffordable for household premises.

A solar-powered hands-free handwashing dispenser in Uganda (Photo credit: SNV in Uganda)

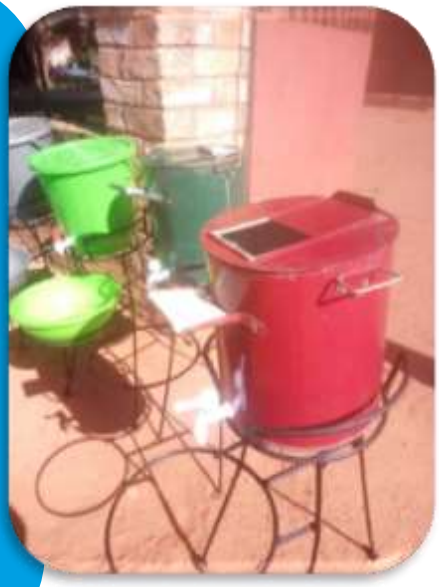
2.3 Hand operated handwashing stations

Hand operated systems are used most commonly for handwashing facilities, with several different technologies utilised. Normally they consist of a bucket container (with a tap connection) and a supporting frame. Such systems are commonly installed within health care facilities, offices, homes, and restaurants or other food vendors.

Box 6: *Kokola* handwashing stations supported by SNV In Zambia

Kokola ('long lasting') handwashing facilities have been developed with support of the SNV Sustainable Sanitation and Hygiene for All Results Programme (SSH4A – RP) in Zambia. This model is being implemented by local masons and fabricators who have been trained by SSH4A. As indicated by its name, this model lasts longer that tippy taps.

The stations consist of a water storage bucket made from new or used metal sheets, a basin and tap dispenser and a frame. The handwashing stations are for use by adults and children of a certain age. However, they are not so easy to use for people with certain disability.



Kokola handwashing station in Zambia (Photo credit: SNV in Zambia)

Box 7: *Kalingalinga* handwashing stations in Zambia

The *Kalingalinga* model used in Zambia is an older design from which *Kokola* derives. Notable differences between *Kokola* and *Kalingalinga* include the use of plastic versus metal buckets and the relatively lighter frame of the *Kalingalinga* system. In all other regards the two types of handwashing station are the same.

Kalingalinga handwashing station in Zambia (Photo credit: SNV in Zambia)

3 Key aspects to consider when planning handwashing facilities

This section is intended to guide promoters and producers when planning handwashing facilities. It discusses the three handwashing systems in turn, in relation to the following key aspects:

- technical requirements and the fabrication process;
- management and planning considerations (related to O&M requirements, monitoring and after-sales service);
- social and sustainability considerations (such as social inclusion design aspects, context suitability, climate change-related aspects, safety/security aspects and robustness of system); and
- cost and affordability considerations (linked to cost range by capacity, as well as list of materials used and quantities needed).

A simple traffic-light rating system is presented at the end of the section to summarise performance against these key aspects and to enable informed choices regarding the suitability of a technology according to context and intended use.

3.1 Foot operated systems

3.1.1 A guide for promoters (local government authorities, utilities, decision-makers in different organisations)

Overview of technology and key components	• Foot operated handwashing model for people without physical disabilities. • The system has four main parts: a clean water storage container (e.g., bucket or tank), a frame/tower that is stable enough to hold the required container, a grey water container (to collect waste water), and the operating system (e.g., a foot pedal and clutch cables). • Varying capacity depending on needs (e.g., 20-60 litres for offices, restaurants, health care facilities; 120-500 litres for public spaces like markets, bus stands and also some institutions such as schools).
Overview of level of O&M required	• Manual water replenishment (as required depending on usage), unless the system is connected to a utility supply. • Manual soap replenishment. Current systems are designed for liquid soap/soapy water which needs to be refilled manually according to use. • Manual grey water disposal (when 80% full to avoid splashes during disposal), unless connected to mains drainage system. Grey water can be disposed of in soak away pits or in drains.

Overview of key GESI, climate, security and sustainability considerations	• The inclusion of an elbow press lever in addition to a foot pedal enables use of the system by the disabled or less able-bodied. An adjustable height frame accommodates children. • Adjustable garden taps reduce the amount of water that is allowed per press and limit wastage. Controls such as gate valves allow minimum water flow. • Foot pedal mechanism controls water flow and avoids unnecessary water loss. • Safety features are incorporated to prevent vandalism, including covered valves that are not easy to tamper with. • Frames can be locked to a permanent structure for security purposes.
Comparative costs of technology (depending on capacity)	• The cost of foot operated systems vary from country to country, depending on size and capacity, materials used and context. • Fabrication costs for tippy taps are minimal or sometimes zero in areas where materials are readily available. • Fabrication cost for a 20-litre pedal operated washing station in Tanzania is around US$ 115. • Fabrication cost for a 60-100 litre pedal operated washing station in Tanzania is around US$ 147. • Fabrication cost for a 250-litre pedal operated washing station in Tanzania is around US$ 530. • Fabrication cost for a 20-litre pedal operated washing station in Zambia is around US$ 80.

3.1.2 A guide for producers (fabricators and manufacturers)

Technical requirements and fabrication

Technical specification

The frame

- Made from square hollow section (20x20mm, 25X25 mm and 30X30mm) with 1 to 2mm thickness depending capacity.
- The clean water storage tank, soapy water tank and grey water tank are supported by 12mm thick circular frames.

Water storage

- The stations can be constructed to accommodate 20 litres, 60 litres and 120-250 litres of clean water.
- Wastewater/grey water storage containers hold 20-30 litres at maximum, to enable manual disposal. The waste tanks are connected to a wash basin by an extendable drainage pipe.
- Alternatively an effluent pipe could be fitted directly from the basin to a drain, sewer system or soak away pit.

Foot pedal mechanism

- The foot pedal is connected to the soap and water taps via clutch cables.
- The clutch cables connect to a spring that allows return movement after pressing.

Elbow press mechanism

- An elbow press lever is included as an additional feature for dispensation of both soap and water. This feature is mostly included for stations that will be used in public spaces to accommodate people with disability.

Control and distribution systems

- Pipes (IPS/GS/HDPE).[4]
- Fittings (T connectors, elbows – should be short to avoid residue water or soap continuing to flow after pedal is released, socket, nipples) (GS/IPS/HDPE).
- Flexible pipes.
- Gate valves for water control and minimisation of water flow.
- Bib cock garden taps
- Manifold pipes for distribution system.

Example of a foot operated handwashing station in Tanzania: 225, 60 and 20 litre capacity (Photo credit: Hezron Magambo/SNV in Tanzania)

An elbow press mechanism

Grey water storage container

Distribution system

An example of push shower taps

[4] IPS = iron pipe size; GS = galvanized steel pipe; HDPE = high-density polyethylene.

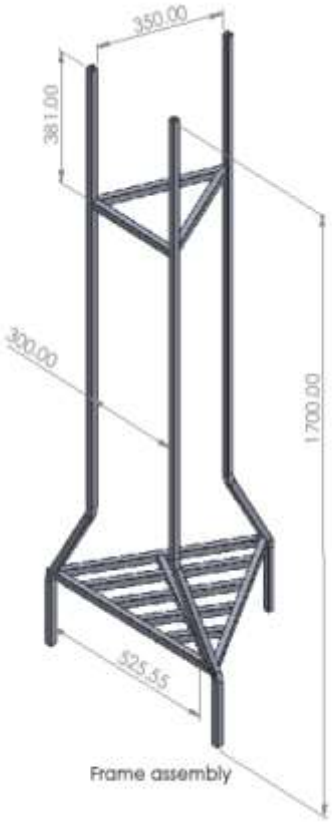
Fabrication process

Metal frame
- Cutting of metal pieces, as per drawings and required specifications
- Joining of parts for welding (temporary spot welding).
- Permanent welding.
- Drilling.
- Grinding to smoothen the frame surfaces.
- Metal paint primer (red oxide) and final gloss paint.

Dispensing mechanism
- Fitting and positioning of tap.
- Cutting and welding of dispensing supports (clutch plate, cables, etc.).
- Assembly, positioning, and attachment of all components to the tap.
- Extension of dispensing tap.

Water storage containers
- Cutting inlet and outlet holes on water buckets as per connector sizes.
- Plumbing for fittings (clean water bucket connector, grey water in and outflow connections).

Assembling and testing functionality
- Fitting all parts to the frame.
- Checking that whole system works as intended.



Assembly of 20-60 litre metal frame for foot operated washing station[5]

Technical expertise needed

Unlike with the simple tippy tap handwashing system, low-to-medium skills are required to produce a good quality metal foot operated handwashing system.

An experienced welder can manage with minimal support in terms of system design and improvements, plumbing and assembly for large-scale production of multiple stations.

Management and planning considerations

Operation and maintenance requirements

Particular O&M functions are essential to ensure foot operated systems remain in good repair and operational for the longest period of time. Some responsibilities can be carried out by a caretaker and some by a technician/fabricator. Table 2 summarises the critical O&M functions of foot operated handwashing stations.

[5] Sketch by NEPERS (Natural Energy Promotion and Environmental Reservation Services) the local company that designed the *Kanyaga kanyaga*

Table 2: Operation and maintenance requirements for foot operated handwashing stations

No.	O&M Task description	Task owner	Frequency
1	Filling clean water bucket	Caretaker	Daily as needed
2	Cleaning buckets	Caretaker	Daily
3	Refilling soap	Caretaker	Daily as needed
4	Changing towels or wipes	Caretaker	Daily as needed
5	Grey water disposal	Caretaker	Daily as needed
6	Leakage checks	Caretaker	Daily when refilling
7	Leakage control	Plumber/Technician	As needed
8	(Dis)connection of flexible water pipes	Plumber/Technician	As needed
9	Replacement of basin	Caretaker/Owner	Yearly depending on use
10	Repair of broken metal parts	Plumber/Technician	As needed
11	Repair of dysfunctional dispensing mechanisms (tap, soap dispenser, etc)	Plumber/Technician/ Welder	As needed
12	Device stability checks	Plumber/Technician/ Supplier	Twice per year
13	Repainting	Plumber/Welder	Yearly and when needed

Monitoring and after-sales service

- The performance of a system needs to be monitored daily by a caretaker or owner.
- A welder or the supplier of a system needs to periodically check the performance of handwashing stations as an after-sales activity (inclusion of the manufacturer's phone number on the device is recommended).
- Feedback from customers should be logged and used to improve future designs to meet customer needs.

Social and sustainability considerations

Gender equality and social inclusion aspects

- Provision of an elbow press lever to accommodate people with disabilities.
- Height of the soap and water dispensing taps to accommodate children and the elderly.

Climate change-related aspects

- Focusing on minimised water usage, the system uses adjustable garden taps to reduce the amount of water that is dispensed per press.
- A gate valve can be installed and adjusted to allow minimum water flow.
- The foot press mechanism allows water to flow only when pressed and avoids unnecessary water loss.
- Grey water can be reused for irrigation of kitchen gardens.

Safety/security aspects

- All valves are covered/difficult to tamper with.
- The frame can be locked to a permanent structure.
- Moving parts can be easily replaced.

Cost and affordability considerations

As mentioned previously, costs vary depending on the type of system, the materials used and the context. Tables 3, 4 and give example costs and materials required for the *kanyaga kanyaga* handwashing stations in Tanzania for capacities of 20, 60-100 and 225 litres (using market prices in August 2020).

Table 3: Cost estimate for fabrication of 20 litre pedal operated washing station

Item	Description	Unit	Quantity	Unit cost (Tshs)	Total cost (Tshs)
1	Square hallow section (20x20mmx1.5mm)	Pc	3	11,000	33,000
2	Gate valve ½ inch	Pc	2	12,000	24,000
3	Bucket (20 litre)	Pc	2	15,000	30,000
4	Bucket (5 litre)	Pc	1	5,000	5,000
5	Round bar (10mm)	Pc	1	15,000	15,000
6	Flexible pipe ½ inch	Pc	1	3,000	3,000
7	Flexibe hose pipe (3cm diameter)	Pc	1	10,000	10,000
8	GS pipe (1m length)	Pc	1	10,000	10,000
9	Clutch cable	Pc	2	5,000	10,000
10	Conduit pipe	Pc	1	2,000	2,000
11	Connector tank	Pc	1	6,000	6,000
12	Elbow	Pc	4	1,000	4,000
13	Connector	Pc	4	1,000	4,000
14	Socket	Pc	4	1,000	4,000
15	Plastic tap	Pc	2	5,000	10,000
16	Foot pedal plate (mild steel 3mm)	Pc	1	10,000	10,000
17	Paint	Pc	1	15,000	15,000
18	White tape	Pc	3	1,000	3,000
19	Spring	Pc	2	2,000	4,000
Total material costs					**202,000 (US$ 89)**
Selling price (electricity + transport + processing + profit) = material cost + 30%					**262,600 (US$ 114)**

Note: US$ 1 = 2,266 Tshs (as of August 2020).

Table 4: Cost estimate for fabrication of 60 and 100 litre pedal operated washing station

Item	Description	Unit	Quantity	Unit cost (Tshs)	Total cost (Tshs)
1	Square hallow section (25x25mmx2mm)	Pc	3	26,000	78,000
2	Gate valve ½ inch	Pc	2	12,000	24,000
3	Bucket (60 litre)	Pc	1	20,000	20,000
4	Bucket (20 litre)	Pc	1	15,000	15,000
5	Bucket (10 litre)	Pc	1	10,000	10,000
6	Round bar (10mm)	Pc	1	15,000	15,000
7	Flexible pipe ½ inch	Pc	1	3,000	3,000
8	Flexibe hose pipe (3cm diameter)	Pc	1	10,000	10,000
9	GS pipe (1m length)	Pc	1	10,000	10,000

10	Clutch cable	Pc	2	5,000	10,000
11	Conduit pipe	Pc	1	2,000	2,000
12	Connector tank	Pc	1	6,000	6,000
13	Elbow	Pc	4	1,000	4,000
14	Connector	Pc	4	1,000	4,000
15	Socket	Pc	4	1,000	4,000
16	Plastic tap	Pc	2	5,000	10,000
17	Foot pedal plate (mild steel 3mm)	Pc	1	10,000	10,000
18	Color	Pc	1	15,000	15,000
19	White tape	Pc	3	1,000	3,000
20	Spring	Pc	2	2,000	4,000
Materal costs					**257,000 (US$ 113)**
Selling price (electricity + transport + processing + profit) = material cost + 30%					**334,100 (US$ 144)**

Note: US$ 1 = 2,266 Tshs (as of August 2020).

Table 5: Cost estimate for fabrication of 225 litre facility with 4 x foot operated handwashing stations

Item	Description	Unit	Quantity	Unit Cost (Tshs)	Total Cost (Tshs)
1	Tank (255 litre)	Pc	1	75,000	75,000
2	Tank (20 litre)	Pc	2	10,000	20,000
3	Tank connectors ¾ inch	Pc	1	12,000	12,000
4	Tank connectors ½ inch	Pc	8	8,000	64,000
5	Push valve	Pc	6	35,000	210,000
6	Cork	Pc	4	12,000	48,000
7	Cork (special for disabled)	Pc	1	40,000	40,000
8	GS pipe ½ inch	Pc	1	25,000	
9	Washing basin	Pc	4	12,000	48,000
10	Flexible pipe	Pc	8	3,000	24,000
11	Extendible pipe	Pc	8	12,000	96,000
12	Hollow section (30x30x1mm)	Pc	5	17,000	85,000
13	Hollow section (25x25x1mm)	Pc	1	13,000	13,000
14	Round bar (10mm)	Pc	1	17,000	17,000
15	Red oxide	Pc	1	10,000	10,000
16	Paint	Pc	1	10,000	10,000
17	Elbow	Pc	16	2,000	32,000
18	Socket	Pc	16	2,000	32,000
19	Nipple	Pc	16	2,000	32,000
20	Spring	Pc	6	2,000	12,000
21	Mild plate (1.5'x3')	Pc	1	20,000	20,000
Material costs					**925,000 (US$ 408)**
Selling price (electricity + transport + processing + profit) = material cost x 1.30					**1,202,500 (US$ 534)**

Note: US$ 1 = 2,266 Tshs (as of August 2020)

3.2 Automated systems

3.2.1 A guide for promoters

Overview of technologies and key components	• Water and soap dispensers are fitted with motion sensor technology. Water is dispensed immediately when hands are moved close to the tap. • Stations also include a water container, power source (20 watt solar panel), metal frame, bowl and grey water collection tank. • Innovation based on the aim of minimising contact with potentially contaminated surfaces. Intended use in public institutions such as health care facilities and schools.
Overview of level of O&M required	• Manual water replenishment (as required depending on usage), unless the system is connected to utility supply. • Manual soap replenishment. Current systems are designed for liquid soap/soapy water, which needs to be refilled manually according to use. • Manual disposal of grey water (when 80% full to avoid any splashes during disposal), unless connected to mains drainage system. Grey water can be disposed of in soak away pits or in drains. However, in automated systems it is advised to install a more permanent discharge pipe linked to a drain or soakaway pit.
Overview of key GESI, climate, security and sustainability considerations	• The automated dispenser taps will only allow water to flow when hands are closer, this reduces water usage. • Power source may be solar which is climate friendly. • Safety features like raising the solar panel higher up to the roof and ensuring the system is compact may be incorporated to prevent vandalism.
Comparative costs of technology (depending on capacity)	• The cost of automate systems may vary from country to country depending on the size and capacity, materials used and context. • Fabrication costs for the model presented in the case example in this document is US$ 127, but this may go higher depending on capacity and context.

3.2.2 A guide for producers

This subsection sets out the technical specifications and key considerations for the automated handwashing stations designed by students of the IUIU in Uganda, which are primarily designed for use in public institutions such as health care facilities and schools.

Technical requirements and fabrication

Overview of system components

- Motion sensor device (connected to tap and soap dispenser to control release of water and soap), solar panel (20 watts), clean water tank, liquid soap container, metal tower/frame, basin, and collection tank for grey water.

Technical expertise needed

- Solar power technician to connect the sensor unit to the charging system.

Management and planning considerations

Operation and maintenance requirements

- Manual replenishment of clean water and soap.
- Manual disposal of grey water once the tank is 80% full (to avoid spillage on disposal).

Monitoring

- Requires a caretaker to check the system at regular intervals, including for dust on the solar panel and the water level in the battery unit. Instruction materials may be useful to guide caretaker/users.

Social and sustainability considerations

Gender equality and social inclusion aspects

- Easy to use by people of different age categories and physical abilities, including those with disability.

Climate change-related aspects

- The technology is designed for low water usage as flow can be controlled (by amount of water dispensed and time).

Safety/security aspects

- The system components can be fixed together to secure each station.
- The solar panel can be raised and/or fixed at roof level.

Robustness of system

- The motion sensor is a robust component. However, further work is needed on other components such as the size and quality of the water tanks and how they can be fixed within a frame as a single system.

Cost and affordability considerations

Table 6: Cost estimate for fabrication of 50 litre automated handwashing station

Item	Description	Unit	Quantity	Unit cost (Tshs)	Total cost (Tshs)
1	Clean water tank (50 litre)	Pc	1	65,000	65,000
2	Grey eater tank (50 litre)	Pc	1	65,000	65,000
3	Liquid soap tank (25 litre)	Pc	1	20,000	20,000
4	Sensor tap unit	Pc	1	120,000	120,000
5	Solar panel (20 watt)	Pc	1	100,000	100,000
6	Metal tower/frame	Pc	1	80,000	80,000
7	Flexible hose pipe for drainage	Pc	1	10,000	10,000
Material costs					**460,000 (US$ 115)**

Note: US$ 1 = 2,266 Tshs (as of August 2020).

3.3 Hand operated system

3.3.1 A guide for promoters

Overview of technologies and key components

- Very popular and user-friendly system that is suitable for use by adults and children of a certain age. Not as easy to use by people with disability.
- The system uses a water storage bucket made from new or used metal sheets with a dispensing tap and basin.
- Available in different capacities with clean water storage buckets ranging from 20 to 30 litres.
- Primarily used by food vendors and restaurants, in health centres, office premises and homes. Some stations for public use are branded with hand hygiene messages.
- Portable stations that can be easily relocated

Overview of level of O&M required

- Manual water replenishment (as required depending on usage).
- Manual soap replenishment
- Manual disposal of grey water for systems that include a waste container underneath the basin (when 80% full, to avoid any splashes during disposal), unless connected to mains drainage system. Grey water can be disposed of in soak away pits or in drains.

Overview of of key GESI, climate, security and sustainability considerations	• Not as easy to use by people with disability • Multiple basins/stations can be installed and adapted for height to accommodate users such as the elderly and children. • The use of adjustable garden taps is encouraged in such manual systems to reduce water flow and wastage. • Consideration can be given to re-use of grey water, for example for irrigation of kitchen gardens.
Comparative cost of technology (depending on capacity)	• The cost of hand operated systems vary from country to country, depending on size and capacity of handwashing stations, materials used and context. • For example, the *Kokola* system in Zambia costs approximately K200 (US$ 11).

3.3.2 A guide for producers

This subsection sets out the technical requirements and key considerations for the *kokola* hand operated system produced in Zambia.

Technical requirements and fabrication

Technical specification

Frame

- Constructed from Y12 (12mm) steel bars.
- The clean and grey water storage buckets are supported by 12mm ring shaped bars.
- Stations are portable and can be relocated easily.

Water storage

- Can accommodate different capacity clean water buckets between 20 and 30 litres.
- Clean water storage buckets are mostly made from 0.35–0.50mm metal sheets.
- The metal sheets come from varied sources including – but not limited to – unused flat sheets, left-over roofing sheets, metallic drums, etc.
- Improvised aluminium handles of approx. 2-6 mm diameter enable the bucket to be carried for refilling.
- The top of the clean water bucket has a sliding lid to prevent contamination. A small opening of approx. 15 x 15 cm enables water to be refilled and provides access for the bucket to be cleaned inside.

Soap holder

- The soap holder is made from an approx. 10 x 15 cm perforated metal plate which is shaped to prevent the soap from sliding.
- The soap holder is either welded or riveted to the metal bucket.

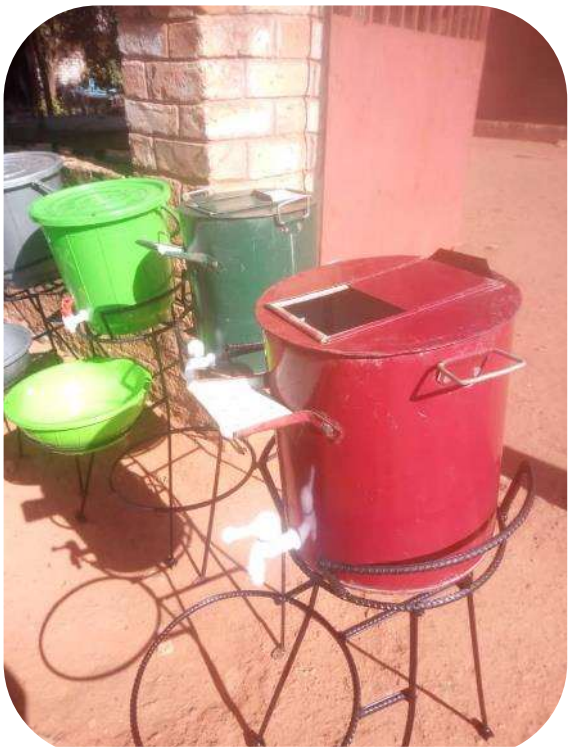
- Provision for bar or powdered soap only. In the case of powdered soap, a non-porous base is placed on top/inside the soap holder.
- Where a plastic clean water bucket is used, a standalone soap holder is provided.

Water dispensing mechanism

- Uses plastic, PVC or UPVC taps. Dispenser taps are also used in some cases.
- Water from the bucket is dispensed directly into a wash basin held in the round metal frame beneath the tap.
- Different types of taps are used depending on market available. The most commonly used taps are ½ inch plastic dispenser taps (see photo).
- Manual operation of the taps are the weakest point of this model due to the risks for contamination.

Greywater mechanism

- An open bowl or basin of up to 20 litres is used for collection and containment of grey water.
- Requires manual disposal into nearby drains or other dry spaces when basin/bucket is full.
- Use of a 20 litre basin/bowl enables one person to dispose of the waste water.



A *Kokola* handwashing station in Zambia (Photo credit: SNV in Zambia)

Perforated soap tray (Photo credit: SNV in Zambia)

Fabrication process

Metal frame

- Cutting of 12 mm metal bars, as per safe practice.
- Shaping of bars into desired ring frames to support water storage buckets and basin.

- Joining of parts (spot welding temporally followed by permanent welding).
- Drilling.
- Grinding to smoothen frame surfaces, especially welded joints.

Soap holder

- Cutting of flat metal plates into required sizes.
- Shaping of metal tray.
- Perforation of tray to allow water to drain.
- Welding of plate to clean water bucket. Rivets may be used if the clean water bucket is made from particularly thin metal.

Water storage buckets

- Cutting of flat metal plates to desired shape/size.
- Shaping of plates into required bucket shapes.
- Filling contact points and edges of bucket with putty or contact adhesives to prevent leakage.
- Cutting and shaping of aluminium handles.
- Riveting handles onto water buckets.

Assembly and testing functionality

- Fitting parts to frame, including minor plumbing works such as fitting tap into position.
- Metal paint primer (red oxide) and final gloss paint.
- Checking that whole system works as intended.

Technical expertise needed

- Medium-to-low skills required
- An experienced welder can manage with minimal support in terms of system design and improvements, painting, and assembly for large-scale production

Management and planning considerations

Operation and maintenance requirements

The *Kokola* units that have been produced and sold to customers in Zambia have not been accompanied by operation and maintenance manuals. The same is the case for similar designs.

While hand operated systems are simple to manufacture and install relative to foot operated and automated systems, it is still useful to have an O&M manual. Supporting documentation should include:

- a user manual for system owner/users; and
- a fabricator manual for welders, particularly those producing large-scale and standardised handwashing stations.

Table 7 summarises (on next page) the critical O&M functions of hand operated handwashing stations.

Table 7: Operation and maintenance requirements of hand operated stations

No	O&M task description	Task owner	Frequency
1	Filling clean water bucket	Caretaker	Daily as needed
2	Cleaning buckets	Caretaker	Daily
3	Refilling soap	Caretaker	Daily as needed
4	Changing/ replenishing towels and hand wipes	Caretaker	Daily as needed
5	Grey water disposal	Caretaker	Daily as needed
6	Leakage checks	Caretaker	Weekly
7	Leakage control	Plumber	As needed
8	Repair of joined parts (soap holder)	Welder	As needed
9	Replacement of basin	Caretaker/owner	Yearly upon on use
10	Repair of broken metal parts	Welder	As needed
11	Repair of tap	Caretaker/plumber	As needed
12	Device stability checks	Caretaker/Welder	Twice per year
13	Repainting	Welder/plumber	Yearly

Monitoring and after-sales service

- The performance of the system needs to be monitored daily by a caretaker.
- A welder or the supplier of the system needs to periodically check the performance of the handwashing station as an after-sales activity.
- Feedback from customers should be logged and used to improve the design to meet customer needs.

Social and sustainability considerations

Gender equality and social inclusion aspects

- Consideration should be given to adapting the design of *kokola* stations for improved use by groups such as children, the elderly and disabled persons.
- Features should be explored to enable the stations to be operated by people with disability (e.g., operation of taps, height of sinks/taps/soap dispenser).
- A lower frame with accessible basin, taps and soap dispenser can accommodate children and the elderly.

Climate change-related aspects

- Dispenser taps control water flow and dispense water as required by turning the tap.
- Manually operated garden taps can lead to water wastage, therefore push showers/taps or dispenser taps should be considered instead to limit flow/wastage.
- Grey water can be reused for irrigation of kitchen gardens.

Garden tap

Dispenser tap

Push taps

Safety/security aspects

- *Kokola* handwashing stations are portable but they can be secured to a permanent structure.
- Parts are inexpensive and can be easily replaced.

Cost and affordability considerations

Kokola handwashing stations are inexpensive to manufacture at approximately K200 (US$ 11 (US$ 1 = K18 as of June 2020).

3.4 Rating of handwashing systems to guide selection and planning

Table 8 uses a traffic light system to compare and rate the foot operated, automated and hand operated facilities that have been described in this technical paper. This simple comparison can be used by promoters and producers to guide their selection of a suitable technology according to the environment in which a handwashing station will be located and the needs of particular users.

Table 8: Comparative rating of handwashing systems

Key parameter or indicator	Handwashing system		
	Foot operated system	Automated system	Hand operated system
Technical requirements and fabrication process			
Management and planning considerations			
Social and sustainability considerations			
CAPEX			
OPEX			
Water usage			
Robustness			
Ability to prevent (re)contamination			
Appeal to users			

N.B. Performance against indicator/parameter — Low | Medium | High

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For further reading

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