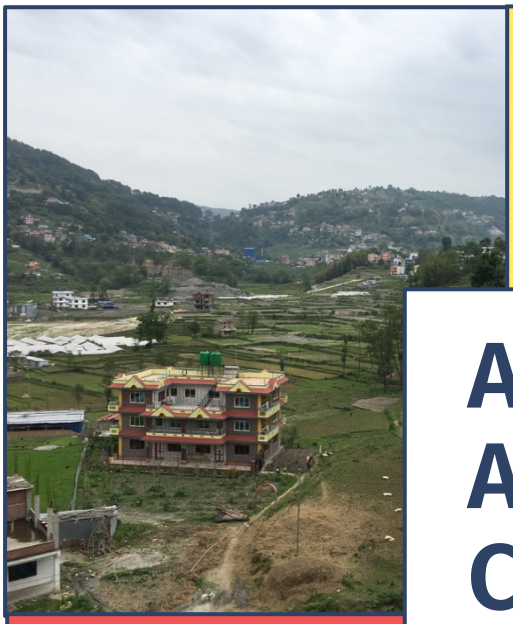

A Systematic Approach to CWIS Planning

Learning Brief from the Experiences in Changunarayan Municipality

September 2023

Highlights:

- A systematic facilitated City-wide Inclusive Sanitation (CWIS) planning process was carried out in six steps.
- This included the assessment of the current situation, the demarcation of types of settlements, the identification of appropriate sanitation technologies and system options, and possible service delivery models.
- The final plan highlights key strategies to address current gaps (1) the upgradation of onsite containments, (2) the development of affordable and safe emptying services, and (3) the installation of a disposal and treatment site for faecal sludge treatment.
- This is complemented with technology designs, cost estimations (both for investments and service delivery), and possible institutional settings.
- The planning process piloted in Changu as well as the resulting technology and service delivery options can serve as a template for other municipalities in Nepal currently doing CWIS plan development.

Key Policy Implications:

- CWIS planning requires an external support to facilitate the coordination between stakeholders and to provide expert advice on technical, financial and legal issues.
- Nevertheless, leadership has to be created at the municipality level that needs to be in the driving seat for the planning process.
- SaniChoice can help to find appropriate technology options for different types of settlement considering the geo-physical, technical, socio-cultural, financial, and institutional conditions. This enhances transparency and ownership.
- Demarcation of type of settlements allows to have an early decision between sewered and non-sewered areas and to identify land for infrastructure construction.
- Demarcation of zones, sanitation system and service delivery choices, and land allocation all have political implications and SaniChoice therefore needs to be applied in facilitated and participatory process.
- Based on capital and operational costs estimations and stakeholder analysis possible financial models can be developed mixing grants, taxes, tariffs, revolving funds and public-private partnerships.
- In summary, a CWIS plan should describe the current situation and main gaps, strategies for improvements along with settlement types, technology options, service delivery models, management plans, cost estimations and resources planning, as well as institutional framework with clear roles, responsibilities and accountability mechanism. A set of indicators to measure CWIS outcomes and service functions is available through the Ministry of Water Supply (MoWS).
- To scale up CWIS planning in Nepal, capacity development at all level,

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Figure 1: Location of Changunarayan municipality and impressions from one of the planning workshop. Source: P. Moktan

SUMMARY

City-wide inclusive sanitation (CWIS) aims at providing safe sanitation services to the entire population in line with SDG 6.3. In urban Nepal, the situation is challenging as only 11% of dwellers have access to toilets connected to sewers and the rest of the population relies on onsite sanitation with often no safe containment and no regular emptying, collection, treatment and disposal or reuse of sludge.

CWIS requires a mix of different sanitation and service delivery models to guarantee equal access to safe and sustainable sanitation. It also requires an enabling environment to guarantee responsibility, accountability and adequate resource planning and management.

While there is a consensus what CWIS is, there is little experience how to get there. It requires a facilitated participatory planning process where multiple stakeholders supported by an expert team go through several steps.

In this project such a process was piloted building upon the CWIS planning guide published by the Ministry of Water and tools from Eawag such as SaniChoice and the quantification and qualification of faecal sludge (Q&Q).

The process started with creating demand and defining a joint vision. Based on detailed sanitation situation analysis, decision criteria were defined jointly. SaniChoice was then used to select technologies and system options. In a next step, these systems were discussed in detail with stakeholders and a number of systems were prioritized. For the selected systems, basic designs along with service delivery model options. Currently, the detailed design including bills of quantities and the estimation of money flows for the service delivery models is under process.

The situation analysis revealed three main gaps: (1) the poor quality of onsite systems, (2) the lack of affordable mechanical emptying services for low-income households leading to the common practice of manual emptying without any safety measures; and (3) the lack of a disposal and treatment site for emptied and collected sludge. To address these issues, the CWIS plan suggest a combination of activities including strengthening the regulatory framework, upgradation of onsite containments, licencing of private emptier for better control, construction of a faecal sludge treatment plant management sites, and regulation of the emptying service providers.

These activities were presented together with a CWIS outcome monitoring framework to the municipality. The next step consists now in setting up the institutional frameworks for the future service delivery model and to acquire funds for the capital costs of onsite upgradation and faecal sludge treatment plant.

A key challenge remains to develop a service delivery model and taxes or tariffs that guarantee affordability also for all. Furthermore, it is recommended that special attention is paid to the decommission of the faecal sludge treatment plant to guarantee its sustained functioning.

This learning brief should serve as a guidance for other municipalities in Nepal that would like to go the same journey.

BACKGROUND

Nepal has made remarkable progress in water and sanitation services since the implementation of the Sanitation and Hygiene Master Plan in 2011. Improved sanitation facilities are now available to 62% of households, compared to just 6% in 1990. At the same time, Nepal is undergoing rapid urban expansion, with 11% of urban households connected to sewer systems, while 83% rely on onsite sanitation systems often without emptying, collection and treatment of faecal sludge. As a result, urban areas face challenges in managing excreta and wastewater in the absence of proper treatment plants. The government and various other organizations are actively working to improve the sanitation situation. The Constitution of Nepal recognizes access to safe water and sanitation as a fundamental right. The institutional

framework for sanitation primarily involves government organizations at different levels, along with non-governmental organizations and other stakeholders. Various legal frameworks are in place to support sanitation initiatives in Nepal. For the improvement of sanitation, the country follows the Community-Led Total Sanitation approach, emphasizing community participation and behaviour change. Besides, emphasizing behaviour change, initiatives for waste-to-resource conversion and the establishment of sustainable sanitation infrastructure are required for further development of sanitation. Nevertheless, CLTS most often only leads to the construction of toilets without considering the entire sanitation value chain for collection, treatment and safe disposal or reuse as indicated by SDG 6.3. This is a particular problem in urban area.

CITY-WIDE INCLUSIVE SANITATION (CWIS)

The Citywide Inclusive Sanitation (CWIS) approach has gained prominence in Nepal, emphasizing the need to look at a service provision for the entire sanitation value chain. The goal of CWIS is to provide sustainable sanitation services, including effective human waste management, in urban areas for the entire population at an affordable cost. The approach recognizes that sewer-based sanitation systems will not allow to reach the SDG6.3 because of their long-planning horizons, high investment costs, and the high requirements of water and energy. To address these gaps CWIS focusses to leverage of faecal sludge management (FSM) as a safe sanitation solution protection the human health and the environment. Through an evaluation of the existing sanitation condition of the municipality, it primarily offers recommendations on upgrading the sanitation system, providing emptying service and treatment facilities, along with the proper mechanism of service delivery.

CWIS in Nepal was adopted with the passing of Water and Sanitation Bill by the Ministry of Water Supply in July 2022. The bill incorporates elements of CWIS to guide local authorities in developing their own CWIS plans and contribute to the national target of achieving universal access to sanitation and clean water by 2030, with a focus on connecting urban households to sewer systems or providing faecal sludge management facilities.

While CWIS is still under development, there is broad agreement on six of key principles (Narayan and Lüthi, 2020) as shown in Box 1.

An additional important element of CWIS is the "inclusiveness" which means that *everyone is served with appropriate and accessible sanitation services*. Accessible means that services are affordable in terms of capital investment and operational cost. This highlights the need to consider a variety of sewered and non-sewered sanitation solutions of different level of technical complexity coexisting in the same city, depending on the local conditions and the affordability. Even for basic latrines, the responsible authority must ensure at least a containment that is safe also in the rainy season and propose a financing mechanism for upgrading of existing systems and organising sludge collection and treatment. Current technological innovation provides flexible onsite, hybrid and centralized non-sewered solutions that are particularly appropriate for developing urban areas as they are more flexible and less reliable on energy and water supply (Spuhler and Lüthi, 2020). To monitor CWIS currently, a CWIS service framework is suggested (Schrecongost et al., 2020) with three system outcomes and three system functions as described in Figure 2.

Service Outcomes	**EQUITY** 'Fairness' in distribution and prioritization of services, service quality, service prices, and use of public finance/subsidies	**SAFETY** All human waste is managed to protect public goods* for customers, workers and all communities	**SUSTAINABLITY** Management of revenues and resources--financial, labor, energy, water--sustain performance
System Functions	**RESPONSIBILITY** Authority or authorities execute a clear mandate to ensure inclusive, safe sanitation services	**ACCOUNTABILITY** Performance is monitored and managed with transparency, data, incentives and penalties	**RESOURCE PLANNING & MANAGEMENT** Resources are managed to support implementation of mandate and achieve goals across time / space

*Figure 2: CWIS service framework (Schrecongost et al., 2020). *Public Goods are the elements of sanitation service delivery system characterized by market failures –technically, non-excludability and non-rivalry. Practically, they are the elements of sanitation service that are outside of individuals' direct private interests and can include safe on-site containment, network connections, transporting waste to safe disposal, and other activities required for long-term protection of water, land and public health along the value chain.*

Box 1 – CWIS Principles

The six principles from the Maniala declaration for CWIS (Narayan and Lüthi, 2020):

1.Equity
Everyone in an urban area – including communities marginalized by gender, social, and economic reasons – benefit from equitable, affordable, and safe sanitation services.
2.Environment and public health
Human waste is safely managed along the entire sanitation service chain, starting from containment to reuse and disposal.
3.Mix of technologies
A variety of sewered and non-sewered sanitation solutions coexist in the same city, depending on contextual appropriateness and resource recovery potential.
4.Comprehensive planning
Planning is inclusive and holistic with participation from all stakeholders including users and political actors – with short- and long-term vision and incremental perspective and is synergistic with other urban development goals.
5.Monitoring and accountability
Authorities operate with a clear, inclusive mandate, performance targets, monitoring requirements, human and financial resources, and accountability.
6.Mix of business models
Sanitation services are deployed through a range of business models, funding sources, and financial mechanisms to reach all members equitably.

A SYSTEMATIC APPROACH TO CWIS PLANNING IN CHANGUNARAYAN

Even though there exists a sector-wide consensus on what CWIS is, there is yet little guidance how to achieve objective. The first element on the journey to CWIS, is a strategic plan, similar to the WASH plans widely known in Nepal. The Ministry of Water has therefore recently published CWIS planning guideline for a strategic planning process (M/SNSRConsult, 20211) based on international experiences on CWIS, and earlier frameworks such as Community-led Urban Environmental Sanitation (CLUES), City Sanitation Planning, CSP (GoI, 2008)) or Sanitation21 (Parkinson et al., 2014). It outlines six steps: (1) developing consensus and commitment; (2) conduct situation analysis; (3) setting targets and strategies; (4) identify potential technology options and sources of funding; and (5) finalize the draft CWIS plan for implementation.

While the guide explains each of these steps, it does not provide specific instructions how to implement them and how to develop a draft CWIS plan.

500B together with Eawag-Sandec have a longstanding history of joint action-research for strategic urban sanitation planning. They have therefor joined forces to pilot the CWIS planning guide with the objective to develop first evidence and guidance for future applications.

The pilot took place in Changunarayan municipality, which showed strong leadership to improve the local sanitation situation by the mayor and the local WASH task force. Moreover, it is fast growing urban areas with a high degree of heterogeneity in terms of topography, water and sanitation situation, density and access; and therefore, provides a good example for many other municipalities in Nepal (see Box 2). The project was initiated in early 2022 and officially started with the signature of a Memorandum of Understanding between 500B and the municipality. Eawag supported with expertise and specific tools while ETH4D and Skat Foundation (both Switzerland) supported financially. The tools tested in the process where the shit or excreta flow diagram, SFD (Initiative, 2018), the quantification and qualification of faecal sludge, Q&Q (Strande et al., 2018), and SaniChoice (Spuhler et al., 2022), an open-source online tool for the selection of locally appropriate and sustainable technologies and systems.

Figure 3: Changunarayan is a typical rapidly developing peri-urban municipality with a high heterogeneity in terms of settlement structures.

Box 2 – Changunarayan Municipality

Peri-urban municipality near Kathmandu

- Population :64'260
- Households: 16'984 (avg HH size: 3.8)
- Density: 520 - 2220 cap/km2
- Growth rate+ 4.4%/yr

Environment:

- 20-25 degree Celsius
- Annual rainfall of 56 mm
- Most of the land is used for agriculture followed by forest land, residential areas, and some industrial zones.

Economic activities

- Agriculture as first source of income
- Less than 1h by road to Kathmandu
- A road network serves the nine Wards of the municipality with mostly earthen roads (67.91%) and only 19.86% of paved roads.

Health and Hygiene

- 99% of households have toilets.

Sanitation

- Majority have pour-flush with cess-pits
- Emptying in only 50% of cases
- No treatment facility for sewage or faecal sludge

Step 1. Develop Understanding and Commitment to prepare CWIS planning

To create demand and engage the different stakeholders to engage in, 500B organised several inception visits and workshops. Participants included the mayor, ward representatives and municipal authorities. This process resulted in three key main outputs:

1. A Memorandum of Understanding (MoU) between the municipality and 500B
2. The MoU included a detailed implementation strategy, or roadmap for CWIS planning. It is based on the steps outlined in the CWIS planning guide and is complemented with additional steps and specific activities and outputs for each step see Box 3.
3. The formation of a task force for CWIS planning including the mayor, the chief administrative officer, different ward chairs, municipality executive member, WASH focal person, sanitation user committee, a sanitation expert, and a civil society representative.

This implementation strategy was adapted to six steps as outlined in table x and can serve as a blueprint for other municipalities engaging in CWIS planning.

Step 2. Analyse the Current Sanitation Situation

To support the understanding of the current sanitation situation mixed qualitative and quantitative approach was used. This included: Focal Group Discussions (FGDs), a household surveys, a Shit Flow Diagram (SFD) light, and a sampling to estimate quantities and qualities of faecal sludge.

Household Survey

The analysis revealed that the 99.4% of the households have access to basic sanitation and 0.2% still practiced open defecation. For the basic sanitation 91.4% of the population is connected to cistern and pour flush toilet producing black water and connecting to an underground holding tank of different qualities. 8.6% of the households uses simple pit latrines producing sludge mixed with the anal cleansing water. From the holding tanks, 56.2% are lined sealed tanks. 19.96 % of the tanks are lined with impermeable wall and open bottom, followed by 11.9% lined pits with semi-permeable walls and open bottoms. There are also 3.7% of the population that are connected

to a biogas reactor. Almost 2.0% have unlined pits. 40% of the containment in the municipality were emptied once in their life time. Manual emptying mostly carried by family members themselves is predominant in the rural areas of the municipality. In addition to this, mechanical emptying is also provided by private service providers in the municipality. Since, there is no standard design of containments, the emptying frequencies varies from months to more than 10 years. During the survey, most of the respondents feel the emptying fees charged by the mechanical emptying services are very expensive. It was found that the tipping charge range from NRs 500 to NRs 10000 per trip and maximum are paying around NRs1500 per trip. There is no availability of treatment plant facility in the municipality. The nearest treatment plant available is in Sallaghari which is currently under construction or in Kathmandu, the central treatment plant. The majority of manually emptied faecal sludge is buried on the own premises (farmland) or dumped in the nearest open drain or water bodies. 31.0% of mechanically emptied faecal sludge is transferred to Kathmandu and the others are either dumped in farmlands or near by rivers or on other open areas. Illegal discharge of faecal sludge to open drains and directly on the roads by residents during rainy season to avoid emptying fee is a common practice in the municipality. The survey also revealed that majority of the public are against reuse of the emptied faecal in any forms. Very few who do reuse, either use in isolation or in combination in the form of compost/fertilizer, or energy/biogas.

Shit Flow Diagram

48.0% of the excreta generated in the municipality are safely managed whereas the remaining proportion 52.0% is handled unsafely or released in the environment at different phase of the sanitation service chain. The safely manage part is based on onsite containment which is not emptied. 38% onsite sanitation is emptied in different time periods but is not delivered to treatment plants. 4% ends up in unsealed pits and 1% is open defecation. This shows clearly the need for an improvement of (1) onsite containment and (2) emptying schedule and (3) delivery and treatment of collected sludge.

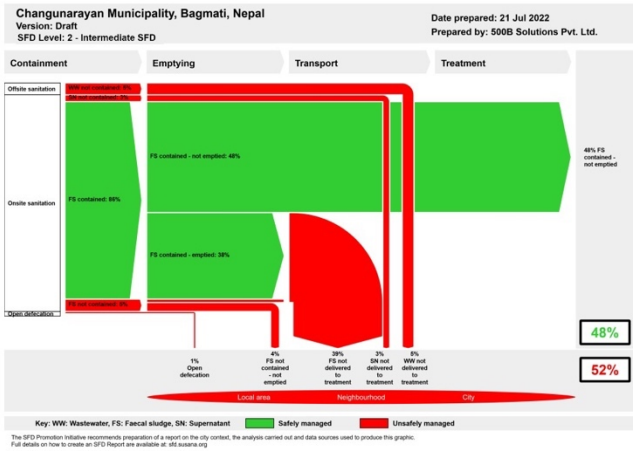


Figure 3: Shit Flow Diagram of Changunarayan. 52% of the human waste is not safely managed.

Quantities and Qualities of Faecal Sludge Generation

9.41 m3/day of faecal sludge are currently collected: 6.33m3/day from mechanical emptying and 3.08m3/day from manual emptying. If all the containment types were accessible and mechanically emptied the potential amount of faecal sludge generated would be 21.31 m3/day.

Additionally, 30 samples were taken from 13 fully lined sealed tank, 11 from lined tank with impermeable walls and open bottom, 4 from lined pit with semi permeable walls and open bottom and 2 from unlined pits. Total Solids (TS) and Chemical Oxygen Demand (COD) were analysed to define the strength of the sludge but differences were not significant.

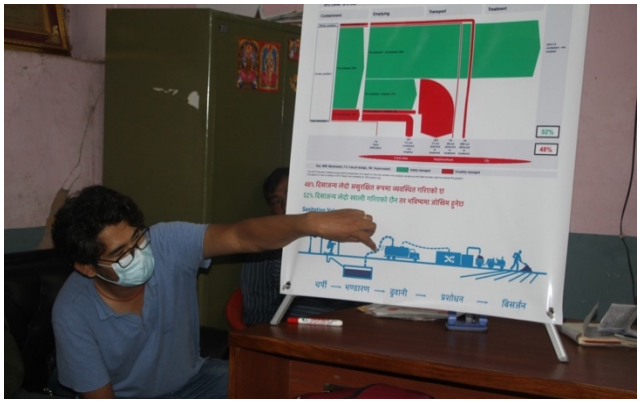


Figure 4: Presenting the SFD during a planning workshop. Source: B. Weber

Box 3 – Detailed implementation plan for CWIS planning based on the experiences from Changunarayan municipality

Step 1. Develop understanding and commit to prepare CWIS

1.1. Creation of demand for sanitation and conduct CWIS orientation workshop

1.2. Establish of linkages and sign a MoU to move forward with the plan

1.3. Agree on tentative road map of CWIS planning process and form a CWIS planning task force

Step 2. Analyse the current sanitation situation

2.1 Carry out consultations, field visit, identifying spatial boundaries

2.2 Review of secondary information, collection of baseline maps, demographic data, GIS maps and any other relevant information

2.3 Assess stakeholders

2.4 Design, plan and implement baseline assessment

2.5 Conduct Focus Group Discussions (FGDs) in each zone to identify local needs and priorities (WASH team and communities)

2.6 Implement a Shit Flow Diagram light

2.7 Quantify and qualify faecal sludge to inform technology design

2.8 Develop of a situational assessment report identifying main gaps

Step 3. Define a joint vision and identify decision criteria (stakeholder and expert workshops)

3.1 Present situational assessment and community priorities; collectively define a joint vision

3.2 Expert workshop to identify criteria for technology selection

Step 4. Identify appropriate sanitation technology and system options using SaniChoice

4.1 Demarcate different zone within the municipality based on physical criteria

4.2 Quantify technology appropriateness for each zone and identify most appropriate technologies, validated with experts

4.3 Build three most appropriate sanitation system options from appropriate technologies for each zone

4.4 Analyse sanitation results and do a detailed assessment of preselected systems

4.5 Conduct stakeholder workshop to prioritise system options

4.6 Identify synergies among different system options with WASH and solid waste plans

Step 5. Analyse prioritised sanitation system options

5.1 Develop service delivery model options

5.2 Identify potential land for faecal sludge treatment

5.3 Estimate expected capital and operational investment requirements

Step 6. Finalisation of CWIS draft plan

6.1 Develop draft CWIS plan incorporating strategies related to infrastructure, service delivery models, regulatory and institutional arrangement and financial resource planning and management

6.2 Conduct workshop to share the draft CWIS plan

6.3 Endorsement of the plan by the municipal authorities

Step 7. Implementation of CWIS draft plan

7.1 Create the regulatory body to ensure responsibilities and accountability

7.2 Conduct detailed costing analysis and define financing mechanism

7.3 Acquire grants for infrastructure implementation

7.4 Run service delivery model through public or a public-private model

7.5 Monitor CWIS

Institutional Framework

The municipality is responsible for preparing, implementing and monitoring of plans and policies including for sanitation. This means it is responsible of creating laws and process for onsite sanitation where sewers are not available. There exist a WASH team that is dedicated to improving total sanitation within the municipality. In the future, the municipality should create a specific sanitation cell to implement the CWIS plan.

Stakeholders

Stakeholders relevant for the CWIS plan in are in general from the public sector, NGOs, the private sectors, the civil society, cooperatives, and development partners such as 500B, Eawag, and Skat foundation. The main stakeholders in Changunarayan are listed below.

Table 1: Stakeholders for CWIS planning in Changunarayan

Stakeholder	Institution/Organisation
Public	Municipality, Ministry of Water Supply (MoWS), Ministry of Urban Development (MoUD), Department of Agriculture, Ministry of Health and Population (MoHP)
Non-governmental Organizations	Nepal Red Cross Society, Environment and Public Health Organization (ENPHO)
Private Sector	Nepsemyak Sewa Pvt Ltd, Nepal Swachchha Batabaran Srijana Kendra Pvt. Ltd, Informal waste collector (Khalisisi)
Civil Society	Water Users and Sanitation Committees (WUSCs), Women Groups, Community Forest Users' Groups
Others	Cooperatives
Development Partners, Donors	500B Solutions Pvt Ltd, Eawag, FHI360

Main Gaps Identified

Table 2: Gaps related to sanitation identified in Changunarayan

Sanitation System	Gap identified
Sanitation bylaws and policies	No sanitation policy and faecal sludge management bylaws to regulates services across sanitation service chain.
Institutional set up	No or low budget allocated for faecal sludge management
Containment	More than 50 % of the holding tanks are not fully lined. Lack of awareness and knowledge on construction of standard septic tanks. No regulation on enforcement of standard septic tank in new building construction permits.
Conveyance	Mechanical emptiers barely reached to low economic people The emptying fee charged by FS service providers are not uniform
Treatment	No treatment facility available in the municipality
Use / Safe disposal	No proper disposal of collected FS due to lack of designated areas Unaware of use of treated FS

Step 3. Definition of Joint Vision and Decision Criteria

CWIS Planning Workshop and Decision Objectives

The results of the sanitation situation analysis were discussed with and validated by all stakeholders in several workshops at ward level. The outcome was then presented

to the municipality to define a joint vision and main decision criteria to guide the further planning process. For this purpose, the Eawag team developed a decision objective hierarchy (see Figure 5) as an input into the application of SaniChoice in the next step.

The decision objectives served as a basis to define the criteria for technology and system selection and the demarcation of zones. The decision criteria used for technology selection are listed in Box 4. An expert workshop was held to validate these criteria.

Identification of Technology Selection Criteria

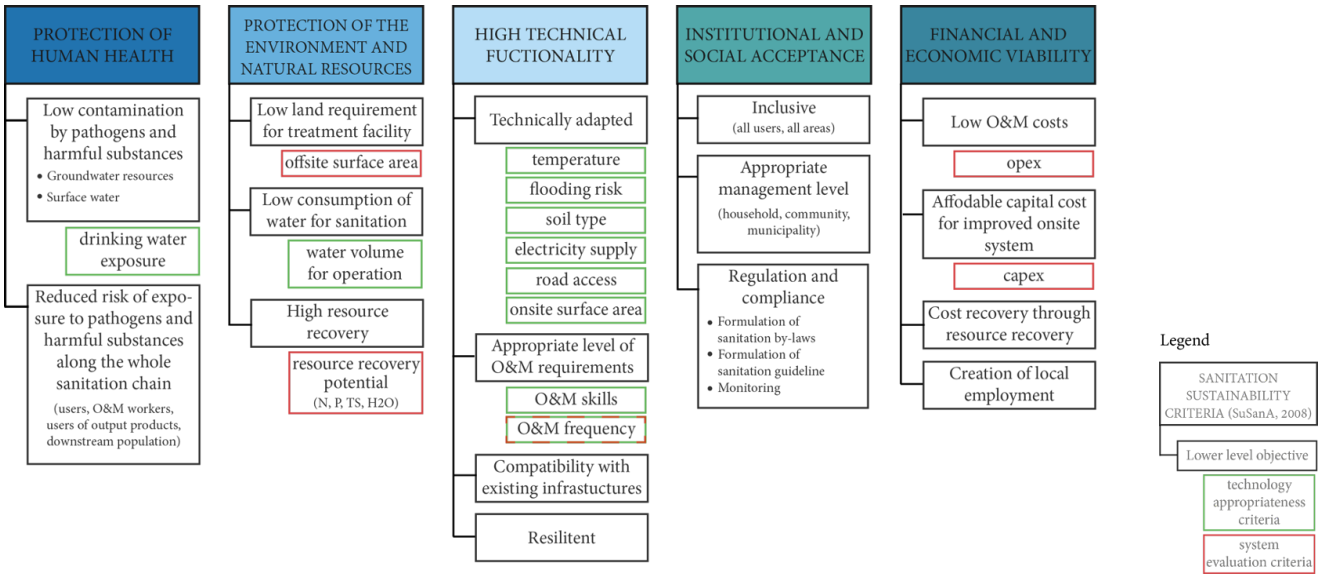


Figure 5: Decision objectives to identify sanitation technology and system options for CWIS planning

Step 4. Identify appropriate sanitation technology and system options using SaniChoice

SaniChoice is a open source online technology selection and system option development tool that was developed by Eawag with the support of 500B and other partners. It is designed to be applied as part of the strategic planning process for step 4, identification of appropriate technology and system options. The advantage of SaniChoice is it allows to systematically quantify the appropriateness of individual technologies as well as system configurations regarding the identified criteria. As it contains a technology database of over 90 technologies with performance data for 30 criteria to select of, it makes the process more efficient. SaniChocie is explained in detail in Box 5. Figure 7 provides an overview of the integration of SaniChoice with planning process.

Figure 6: Expert workshop and stakeholder consultations to identify technology selection criteria. Source: P. Moktan

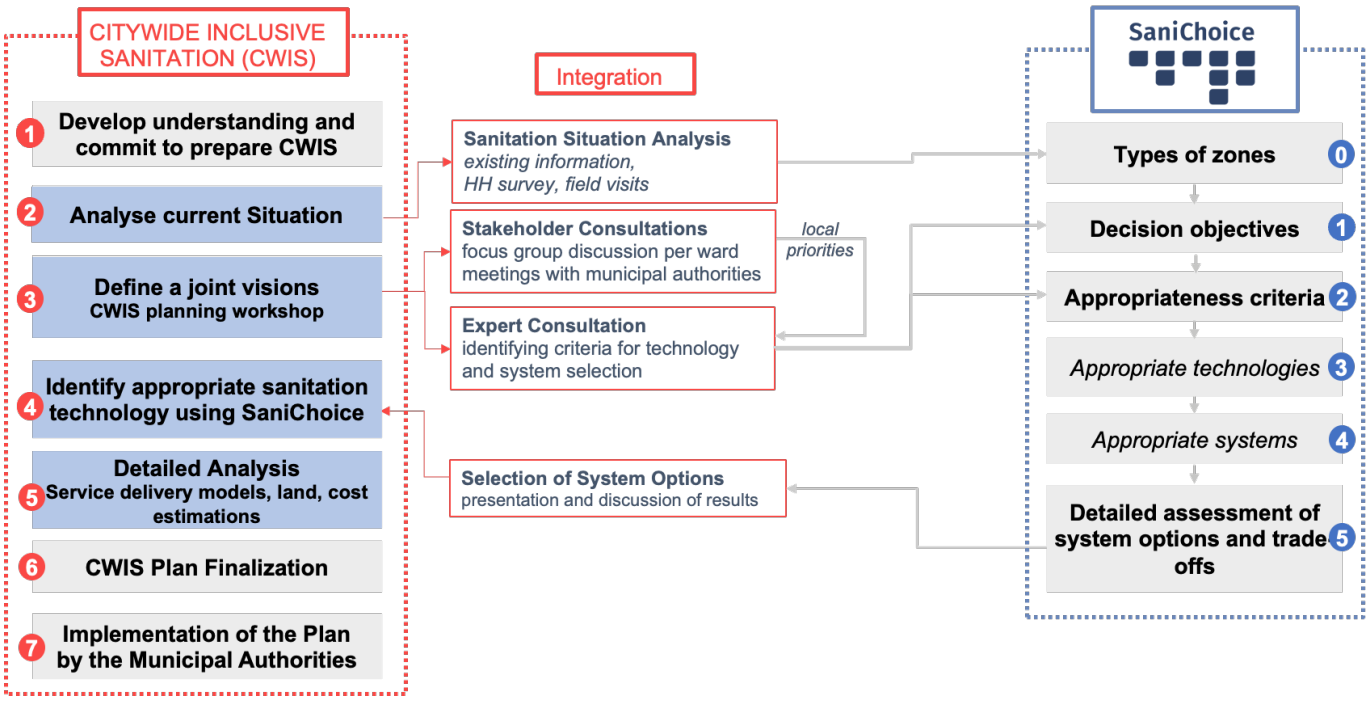


Figure 7: Integration of SaniChoice main activities in the CWIS planning guideline developed for Changunarayan

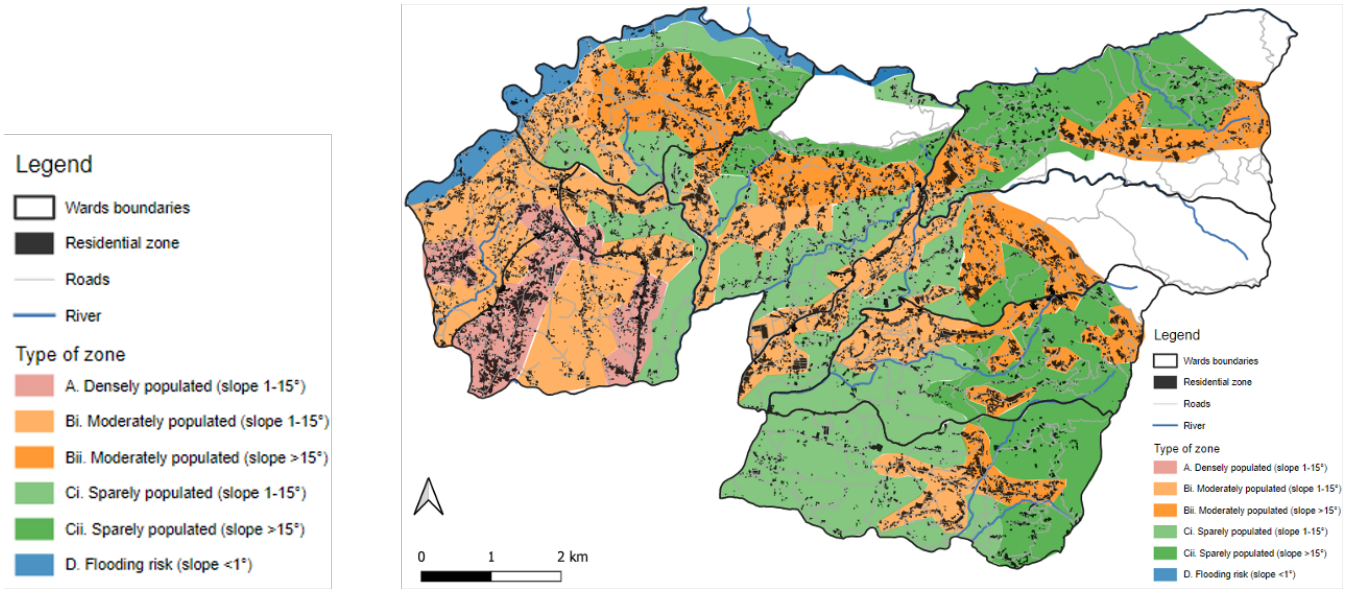


Figure 8: Different types of zones used to identify appropriate technology and system options in Changunarayan

Box 5 – What is SaniChoice?

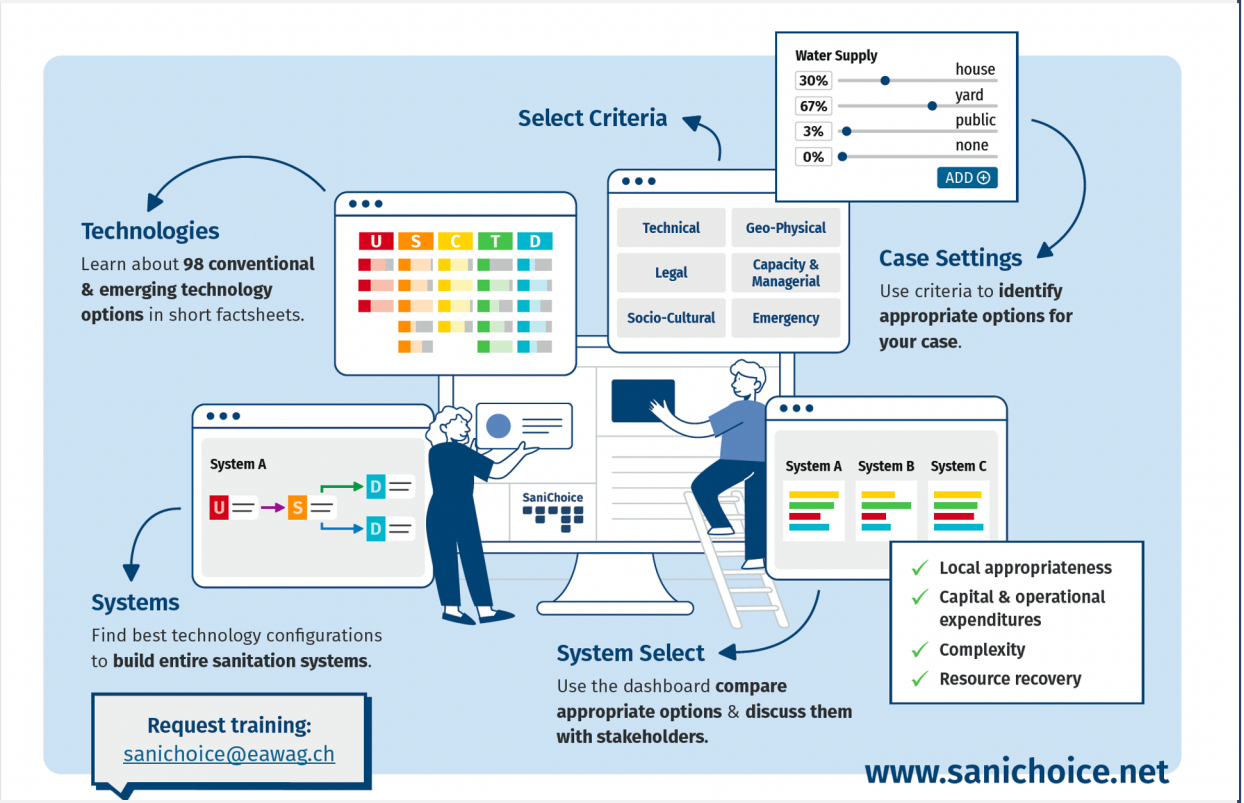
SaniChoice is an open-source online tool for capacity development and decision support. The aim is to make sanitation technology and system selection more evidence based. It consists of a sanitation technology and system selection web-application, tutorial videos, a practitioners' guide, and a training package with presentations and exercises. The web-application SaniChoice App assists in finding appropriate sanitation technologies and system options in four steps:

1. Provide your case settings to find appropriate technologies choosing five to 10 criteria from a list of 28 geo-physical, technical, socio-cultural, legal, and management criteria.
2. View technologies and compare their appropriateness scores.
3. View systems and compare their appropriateness, resource recovery, financial requirements, and technical complexity.
4. Select system templates to further narrow down your options defining the type (dry, wet) and degree of centralization (onsite, decentralized, centralized, hybrid).

The application contains information on over 90 technologies drawn from (Gensch et al., 2018; Mcconville et al., 2020; Tilley et al., 2014) and complemented with technologies requirement data (Spuhler, 2020). The specific case settings contain 28 criteria related to geo-physical, technical, socio-cultural, legal, financial and management aspects to choose from. The dashboard provides the appropriateness performance of the technologies as well as a system overview. The system overview allows to compare the system based on the chosen appropriateness criteria, resource recovery potentials (phosphorus, nitrogen, total solids, and water), financial requirements, technical maturity, and system complexity – all specifically evaluated based on the provided local context.

SaniChoice is designed to provide input into Step 3 of CWIS planning and provides the basis for Step 4. It needs however the data from Step 2 to define what criteria should be used to screen for appropriate technologies. SaniChoice is based on three key principles:

- Appropriateness depends on the context
- Performance depends on the entire system and the technology combinations not only on single technology elements
- What is the best options depends on priorities of different stakeholders



Box 4 – Criteria used for Sanitation Technology Selection

Criteria for the demarcation of zones:

- Population density
- Slope
- Watersheds
-
- Vehicular access
- Flooding

Technology appropriateness criteria:

- Water volume availability,
- Electricity supply
- Frequency of operation and maintenance,
- Temperature
- Flooding
- Vehicular access
- Slope
- Soil type
- Surface area onsite
- Water source exposure
- Operation and maintenance skills

System selection criteria:

- Expected exposure of user to pathogens
- Expected flow of nutrients and pathogens to river
- Expected odour nuisance
- Cost per household
- Capital expenditure requirements
- Operational expenditure requirements
- Risk of failure
- Reusability of products
- Maintenance frequency at household level
- Resource recovery potentials

Demarcation of Different Zones for Technology Selection

The most influential criteria for the demarcation of the different zones were the slope and the population density. Based on a spatial analysis of the entire municipality, six types of zones were identified ranging from densely populated flat to sparsely populated steep as shown in Figure 8. It is important to note, that 4.9% of the population have already access to sewer lines and there is the potential for expansion of the sewer network in the future. However, for this CWIS plan, the focus was on the near future and thus on non-sewered sanitation.

Assessment of Technology Appropriateness

For each of the zones, SaniChoice was used to quantify the appropriateness of different technology options along the sanitation value chain using the technology selection criteria. Figure 9 shows a sample result for all technologies for the Type of zone A. Figure 10 shows the detailed criteria scores for the technology “twin pits for pour flush” for all zones. Each technology was evaluated for each zone and each criteria. The criteria scores where then aggregated to provide a single appropriateness score for each technology and zone.

Figure 9: Technology appropriateness overview for t zone of type A.

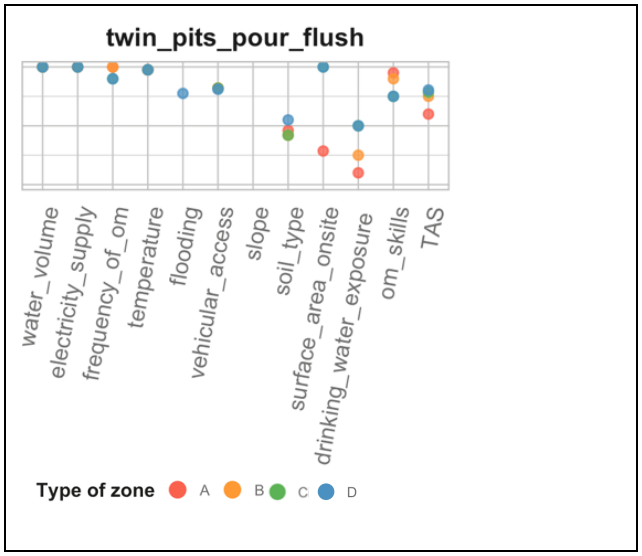


Figure 10: Detailed appropriateness profile of twin-pits for all type of zones.

Development and Prioritisation of Sanitation System options

In a next step, SaniChoice was used to identify the 10 most appropriate sanitation system combinations per zone. A sanitation system is a combination of technologies from the user interface to the final reuse and disposal in such a way, that all sanitation products are either transferred or managed in a safe way. In consultation with experts from 500B, the Eawag team then reduced the number of systems to be further evaluated to five systems per type of zone, in total 12 systems. These systems were then discussed with stakeholders for each zone separately in a concerned ward and prioritised using the system evaluation criteria. It is important that this discussion happens around systems and no single technology options (e.g. cistern flush toilet) as the entire system is only as appropriate as it the least appropriate technology (e.g. if there is no sewer). Figure 12 shows an example a sanitation system dashboard comparison generated by SaniChoice to support the discussion and evaluation.

The results were then presented to and validated with the municipality. This process has led to the prioritisation of four systems to be further evaluated as shown in Table 3: SanSys_2: upgraded onsite sanitation (twin-pits with soak pits), SanSys_3: upgraded onsite containment with FSM (septic tank, mechanical collection, Faecal Sludge Treatment Plant (FSTP), SanSys_4: onsite wet biogas system, and SanSys_5: simplified sewerage with decentralised treatment.

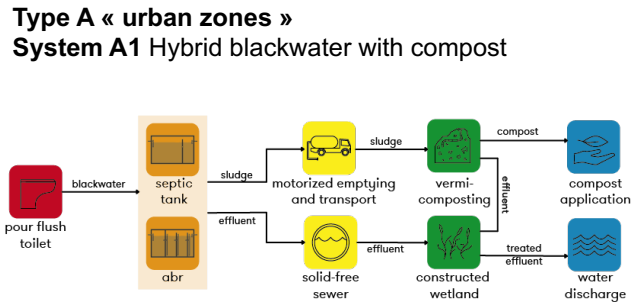


Figure 11: example of sanitation system generated with SaniChoice.

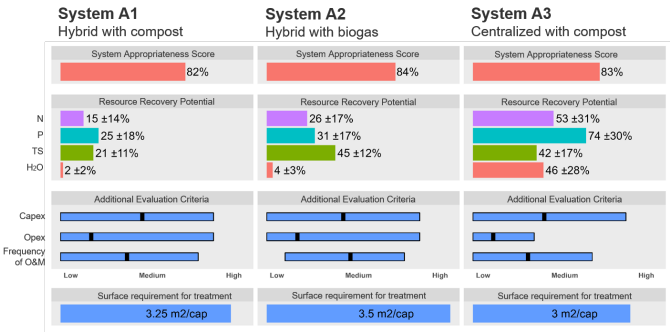


Figure 12: Example of system comparison dashboard generated with SaniChoice

Table 3: Prioritised sanitation systems for Changunarayan municipality.

Types of Zones	Wards included	Zonal profile	Recommended sanitation system options	Sanitation system	Overall Zonal Priority
Zone A	1,2,3	Urban settlement	SanSys_3: FSM	Water sealed flush/pour flush toilet → septic tank with soak pit → mechanical emptying → FSTP → Agricultural use/Treated effluents discharge into water bodies	1

			SanSys_4: Biogas	Water sealed flush/pour flush toilet → biogas digester → Agricultural use/Treated effluents discharge into water bodies	2
			SanSys_2: Fill and cover	Water sealed flush/pour flush toilet → twin pits for pour flush→ safe manual emptying → Fill and cover/Agricultural use	2
Zone B	4,5,7,8	Peri-urban settlement	**SanSys_5: Simplified sewerage**	Water sealed flush/pour flush toilet → simplified sewer→ FSTP → Agricultural use/Treated effluents discharge	2
			SanSys_2: Fill and cover	Water sealed flush/pour flush toilet → twin pits for pour flush→ safe manual emptying → Fill and cover/Agricultural use	3
			SanSys_3: FSM	Water sealed flush/pour flush toilet → septic tank with soak pit → mechanical emptying → FSTP → Agricultural use/Treated effluents discharge into water bodies	**1**
Zone C	6,9	Rural to peri-urban settlement	**SanSys_5: Simplified sewerage**	Water sealed flush/pour flush toilet → simplified sewer→ FSTP → Agricultural use/Treated effluents discharge	**1**
			SanSys_4: Biogas	Water sealed flush/pour flush toilet → biogas digester → Agricultural use/Treated effluents discharge into water bodies	1
			SanSys_3: FSM	Water sealed flush/pour flush toilet → septic tank with soak pit → mechanical emptying → FSTP → Agricultural use/Treated effluents discharge into water bodies	2

Step 5. Detailed Analysis of Sanitation System Options

Development of service delivery and financing options

For each of the selected system options, a matching service delivery model was identified as presented in Table 4.

Table 4: Recommended service delivery models for the prioritised sanitation systems.

Sanitation system options	Recommended service delivery model
SanSys_2: Fill and cover	Services managed by households
SanSys_3: FSM	Integrated service model where both conveyance and treatment are operated jointly.
SanSys_4: Biogas	Services managed by households
SanSys_5: Simplified sewerage	Community-managed service delivery (e.g. through WASH committee)

The service delivery models will also influence the financial flows. External funds in the form of grants will be required to subsidize household level upgradation of containment as well as the construction of a FSTP. Operational costs can then be covered through a combined system of taxes and fees. In Figure 13 a conceptual model of money flows is illustrated.

This model can be implemented in a first phase with upgradation and emptying based on demand and the municipality taking care of the operation of the FSTP. In the mid-term, scheduled emptying can be introduced through a licencing system of emptying businesses per ward or zone. Once scheduled emptying and the tax or tariff system is in place, operation of the FSTP can also be handed over to a private contractor.

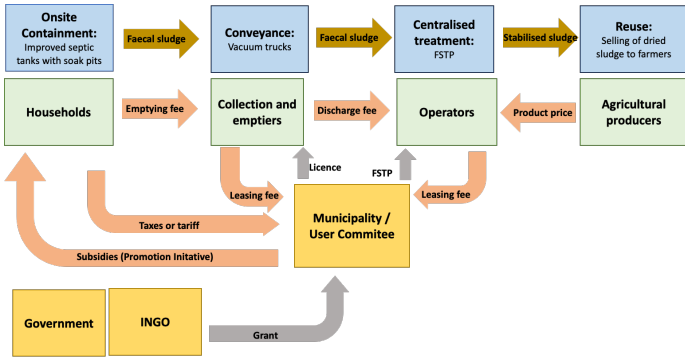


Figure 13: Overview on possible responsibilities and money flows for service delivery.

Identify Potential Land for Faecal Sludge Treatment

The identification of suitable land for the FSTP depends on various criteria. The site should not be too closed to habitats and far from collection centre. The flood prone area possesses high health risk during rains. The unfavourable geographical areas can increase the cost of excavation and fillings. Considering these criteria, five potential sites were proposed to the municipality (Ghattekulo, Gurungtar, Dahatole, Sallepakho and Mathilosaudol). Based on a municipal validation conducted on March 17, 2023, Ghattekulo was selected.

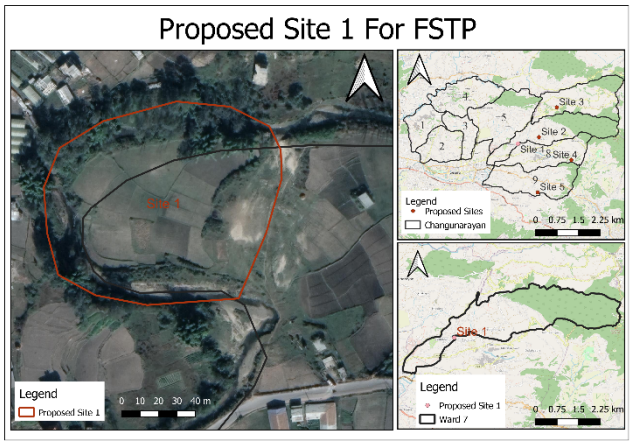


Figure 14: Proposed site for the Faecal Sludge Treatment Plant (FSTP).

Step 6. Finalisation of Draft CWIS Plan

The analysis of the previous step resulted in the formulation of a set of activities including strengthening the regulatory framework, upgradation of onsite containments, construction of a faecal sludge management sites, and regulation of the emptying service providers. These strategies are summarized in Table 5.

Based on this implementation strategies, the tentative costs were estimated (Table 6) and a CWIS outcome monitoring framework were prepared. This will serve as a basis for step 7: implementation and monitoring of the CWIS plan.

Table 5: Activities recommended as part of the CWIS plan for Changunarayan municipality.

Sanitation service delivery chain	**Key gaps**	**Short term (within 1 year)**	**Mid term (2-3 years)**	**Long term (4-5 years)**
Onsite Containments	• No standard containments available in the municipality • More than 50 % are holding tanks and remaining are pits and tanks	• Train municipality engineers on improved containments and prepare standard designs • Build capacity of builders on construction of standard containments	• Upgrade the septic tanks either by retrofitting or replacement	• Continue the adoption of standard designed containments
Emptying	• Unavailability of mechanical emptiers • Mechanical emptiers barely reached to low economic people • The emptying fee charged by FS service providers are not uniform	• Prepare human resource for service delivery through various incentives and promotion packages.	• Procure the desludging vehicles • Finalize the service fee • Licensing provision	• Shift from manual to mechanical emptying • Discard manual emptying
Treatment	• No treatment facility available in the municipality • No knowledge in FS treatment technologies	• Allocate proper areas for disposal and acquired land for FSTP	• Design and initiate construction of FSTP	
Regulatory framework	**Key gaps**	**Short term**	**Mid term**	**Long term**
Municipal level	• Lack of awareness and knowledge on construction of standard septic tanks • Unavailability of strict regulation on enforcement of standard septic tank in new building construction permits	• Ensure new house design permits have standard design septic tank with soak pits • Awareness campaign on importance of mechanical emptying • Safety guidelines and protocols of safe emptying		• Develop and implement monitoring plan
Service delivery	**Key gaps**	**Short term**	**Mid term**	**Long term**
Resource planning and management	• Very low or no budget allocated for FSM • Planning for construction of the treatment plants has not in placed yet. • No availability of dedicated staffs for CWIS/FSM.	• Allocate budget for campaigning sanitation system upgradation • Allocate basket fund for the system upgradation • Explore market potential for faecal sludge-based soil conditioner/fertilizer • Allocate fund for the construction of treatment plant, desludging vehicle.	• Assigned dedicated staffs for FSM activities • Promote enabling environment for private sector engagement through policy and regulatory mechanisms	• Regular operation and management of FSTP • Mobilise market for use of stabilised sludge in agriculture • Provision of subsidy mechanism for reaching the pro-poor and marginalized groups

Table 6: Estimated costs for infrastructure improvement and operation and maintenance of the Faecal Sludge Treatment Plant.

NRP/US$	Per household	To implement CWIS plan (in Miollions)
Onsite upgradation		
Sealed ventilated single pit	53'410 NPR 407.29 $	19.96 Mio NPR 0.15 Mio $
Twin pits for pour flush	23'081 NPR 176.01 $	52.66 Mio NPR 0.4 Mio $
Septic tank	160'068 NPR 1220.63 $	2'475.6 Mio NPR 18.88 Mio $
Biogas digester	65224 NPR 497.38 $	36.45 Mio NPR 0.28 Mio $
Emptying and transportation	420 NRP 3.2 $	
Treatment		
FSTP	1'414 NRP 10.78 $	24.01 Mio NRP 0.18 Mio $
O&M	40 NRP .31 $	0.67 Mio NRP 0.005 Mio $

Implications and Recommendations

This learning brief report on the process of CWIS planning carried out in Changunarayan and the tools used. It should serve as a template to help other municipalities to go the same journey. Key challenges in Changunarayan are typical for developing urban areas in Nepal: the poor quality of onsite containments (often unsealed), the lack of affordable emptying services, and the lack of a disposal and treatment site for faecal sludge. Therefore, also the draft CWIS plan can serve as a template for other municipalities. However, the process is still not completely understood, in particular when it comes to setting up the enabling environment to implement the service delivery models ensuring responsibility, accountability and resource planning and management. The key implications and policy recommendations are listed below:

- CWIS or any other planning processes requires an external facilitator that provides support to execute the planning steps and the process thereafter. With the limited technical capacity of municipalities, especially the newly established, design and commissioning support are essential to ensure that sanitation services planned are delivered in an equitable and sustainable manner. A programmatic approach is essential to see visible changes in towns and cities where CWIS is implemented.

- At the very beginning, it is important to build up strong leadership at the municipality side to enable a programmatic approach that allows so see needed to see changes over time. A participatory process is required to ensure this ownership of all stakeholders over time.

- A mixed approach of quantitative and qualitative information gathered through focus group discussions, household surveys, a shit flow diagram, and the quantification and qualification of faecal sludge will help to create a joint understanding of the current situation.

- Having an early decision between sewered and non-sewered zones is crucial such that the planning process follows accordingly. Demarcation of the zones often requires a political consensus.

- SaniChoice can help for this demarcation as it allows to evaluate the appropriate technologies and system different types of zones systematically and thus transparently. Households and communities in emerging towns and cities, often aspire to connect to sewers owing to its convenience. However, generating evidence on costs for entire sanitation system

components (including collection and treatment), assessing the availability of funds and likelihood of investments, accounting of the public health and environmental benefits, could be some of the factors that could support to come to a decision on the zoning.

- The preferred systems need to be prioritised by the main stakeholders and not by the external experts to allow for the discussion of trade-off for differing preferences and to ensure future ownership. This usually requires some education to bring all participants to the same level of understanding. Once prioritisation has been done, then experts will still be required to finalize the detailed designs.

- Typical areas of improvement for towns like Changunarayan are the upgradation of onsite containments (towards standard twin-pits or septic tanks with soak pits), the affordability and safety of emptying services (gradually eliminating manual emptying), and the installation a site for faecal sludge disposal and treatment (that is well equipped and safely operated).

- These improvements will require capital investments that cannot be covered by the municipality on its own.
  - For onsite upgradation, a revolving fund could be set up that subsidises the construction costs depending on the income.
  - For the faecal sludge treatment plant grants at the provincial or federal level could be made available.
  - For the emptying services, private actors could be regulated through a licencing system.
- Digital data management systems can be helpful to clearly identify which households would need to benefit to subsidies and to what extent.

- Along with the detailed standard design of infrastructures including bill of quantities, CWIS planning should also come up with:
  - Service delivery models that define who does what and how does the money flow. This cand be based on public service delivery or public-private partnerships and financed through a tariff or tax system.
  - Institutional framework that defines responsibilities and accountability mechanism.
  - And a mechanism for resource planning and management over time.
- Land for building the Faecal Sludge Treatment Plant (FSTP) needs to be identified by the municipality at an early stage otherwise land issues become a bottle neck for the entire project of the process.

- A set of indicators for the CWIS outcomes and service functions has been approved by MoWS. Local government units will require a guidance and support to operationalize these indicators. A WASH system strengthening approach could be a way forward to prioritize and further build on these indicators.

Conclusions

Key factor for success of this project was the strong engagement and leadership of the municipality and the WASH task force itself as well as the financial support from Eawag to 500B to support the municipality in the process. The shit flow diagram (SFD), the analysis of qualities and quantities (Q&Q) of faecal sludge were important to understand the current situation and raise awareness at the municipality for the need for faecal sludge management. After a demarcation of zone, the situation analysis data was used to identify a set of appropriate sanitation technologies and system configurations using SaniChoice. Four of the systems were prioritised for different types of zones including urban, peri-urban and agricultural zones. The application of SaniChoice allowed a partly automated generation of sanitation system and technology options without losing transparency and participation of stakeholders. It allows to consider a broad range of options as well as to streamline the process by eliminating inappropriate options early and by open up the option space for innovative solutions. The data on technology performance regarding different criteria allowed stakeholders understand why and how some technologies are more or less inappropriate. Moreover, it also provided the information to prioritise systems regarding capital and operational expenditures requirements or resource recovery.

The situation analysis also revealed the poor design of the onsite containment posing a risk to human and

environmental health through overflow and groundwater infiltration especially during raining events. Three priority improvement strategies could be identified: the upgradation of onsite containments, the development of a reliable and affordable emptying service, and the need for a site for feacal sludge disposal and treatment. All these strategies need to be complemented with a detailed design, cost estimations, service delivery model and a money flows for operational costs. Based on this detailed analysis, the institutional framework and appropriate financing mechanism can be developed. There will be a need for a mix of private and public grants, development aid money, and taxes and fees in such a way that affordability is guaranteed for all segments of the population. The capital investments for upgradation and fees for emptying will fall under the responsibility of households, and it is yet to be determined through which legal and financial incentives these improvements can be enforced.

Finally, a draft CWIS plan including an implementation strategy in three phases until 2030 was endorsed by the municipality and needs now to be implemented. Also, outcome monitoring framework is suggested that should enable to monitor CWIS for the key outcomes and service functions: equity, safety, sustainability, responsibility, accountability, and resource planning and management.

Disclaimer

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For more information, or to comment on this report, email to Dr. Dorothee Spuhler (dorothee.spuhler@eawag.ch) or Dr. Mingma Sherpa (ming_sherpa527@yahoo.co.uk).

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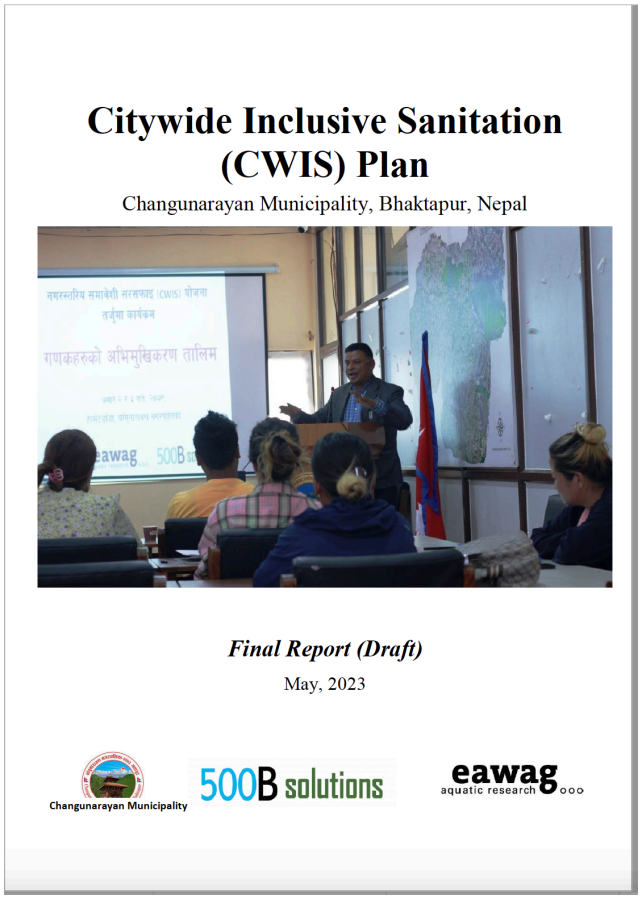

Figure 15: Draft CWIS Plan submitted to Changunarayan Municipality in June 2023

SaniChoice

This learning brief was written as a result of a joint project between 500B Solutions and Changunarayan Municipality in Nepal and Eawag. It summarizes the results from piloting CWIS planning in Changunarayan from 2022-2023 using SaniChoice and is intended to provide guidance for other municipalities on this journey.

www.sanichoice.net
sanichoice@eawag.ch