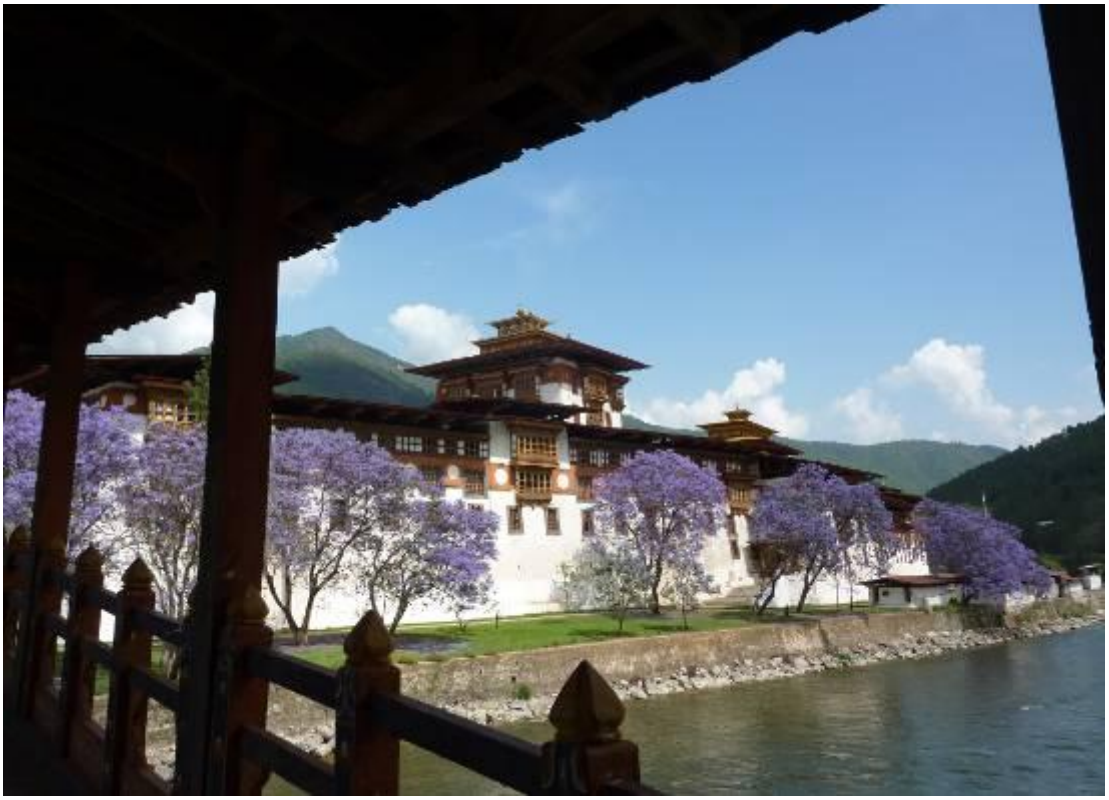
REPORT & RECOMMENDATIONS
FOR

INITIAL DUDES-SNV-JSC JOINT ASSESSMENT
for Three Small Towns in Bhutan
Chukha district – Tsimasham, Tsimalakha and Gedu Towns

(8-17 May 2011)



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Solving sanitation issues
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ACKNOWLEDGMENTS

The initial assessment of the three towns of Tsimasham, Tsimalakha and Gedu under Chukha Dzongkhag was jointly carried out by Department of Urban Development and Engineering Services (DUDES), Netherlands Development Organisation (SNV) and Japan Sanitation Consortium (JSC). This report represents the findings and recommendation of the team, based on meeting with Dzongkhag and Municipal officials, institutions, private individuals, site visits and observations. DUDES and SNV will use relevant components of the report in the development of intervention in the recently signed framework agreement on Sanitation in Small Towns.

The team would like to thank Mr. Rinchen Dorji, Director, DUDES for the guidance he provided to the team and making available his staff time to for the full duration of the assessment in the person of Ms. Dechen Yangdon. The team would like to acknowledge all the cooperation and support received from the Dzongkhag Administration of Chukha, Municipal authorities of the three towns the team visited, and the City Corporation of Puentsholing, School authority of Tsimalakha school and college authority of Gedu College of Commerce and Business Studies.

A second assessment will take place in the second half of the year which will help in the development of interventions and operationalisation of the Sanitation in Small Towns programme.

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ACRONYMS

ADB: Asian Development Bank
BOD: Biochemical Oxygen Demand
DANIDA: Danish International Development Agency
Dasho Dzongda: Elected Dzongkhag Administrator
Dasho Dzungrab: Deputy Dzongkhag Administrator
DUDES: Department of Urban Development & Engineering Services
Dzongkhag: District
JSC: Japan Sanitation Consortium
MoH: Ministry of Health
MoWHS: Ministry of Works & Human Settlement
NEC: National Environment Commission
O&M: Operation & maintenance
RGoB: Royal Government of Bhutan
SNV: Netherlands Development Organisation
UISD: Urban Infrastructure Services Division
WASH : Water, sanitation and hygiene

1. SCOPE AND METHODOLOGY

Team Members:

- Ms. Dechen Yangden, Deputy Executive Engineer, UISD-DUDES
- Mr. Kencho Wangdi, Portfolio Coordinator, SNV; Ms. Gabrielle Halcrow, Senior WASH Advisor, SNV; Mr. John Collett, Sanitation and Hygiene Specialist, SNV
- Mr. Muneharu Hamada, Sewage Works Expert, JSC; Mr. Pierre Flamand, Survey Staff, JSC

Purpose: Undertake an initial joint sanitation assessment of the selected small towns and identify potential ways to improve current sanitation conditions with a focus on equitable health, social, environmental and economic outcomes.

2. ACTIVITIES AND METHODS

The sanitation situation in three towns of Chukha district – namely Tsimasham, Tsimalakha and Gedu – has been assessed in various site visits, meetings and interviews. More specifically, the following activities were conducted:

- Meetings and consultations with Dasho Dzongda and Dasho Dzungrab of Chukha district, Chukha district and municipal engineers, head of environmental division, building inspectors, and town planners (other cities, such as Phuentsholing and Thimphu, were also visited and included meetings with representatives from international donor agencies in Thimphu, and the mayor and the City Corporation chief urban planner of Phuentsholing).

- Visits to households, including informal settlements and new development areas. Visits to institutions: shops, restaurants, offices, a school and a college. Interview with cleaners, householders, shops, restaurant owners, and a private contractor.

- Visits to a variety of sanitation facilities, ranging from sewerage (sewage treatment plants) to on-site sanitation and drainage. Visits to solid waste collecting points and treatment facilities for solid waste management (incinerator and landfill).

- Review of documentation on sanitation edited by the Royal Government of Bhutan (including the Water and Sanitation Rules, the Code of Practice for Sanitation, the Annual Health Bulletin 2010, and the Environmental Discharge Standard 2010), local maps, and reports on projects developed by international donor agencies.

The information obtained during the assessment has been used to understand the strengths the towns can build on, to identify current problems, to suggest ways of improving

the situation, and to establish the future steps (including the linkage to the ongoing and next ADB urban infrastructure program and joint planning for implementation, and DUDES-SNV-JSC 2nd joint assessment mission planned for the second half of this year). The goal is to propose different options for sanitation improvement for small towns, which will include alternatives to conventional piped sewerage.

3. DESCRIPTION OF FINDINGS

The following findings originate from observations made in the field during the assessment mission and from consultation of available documents and data on urban sanitation in Bhutan. Even if a number of lessons can be extracted and used for the later recommendations, these should be considered with caution until further assessment and thorough sanitation mapping are conducted, and additional data is assembled.

3.1 Hygienic usage and maintenance of toilets

Finding 1. Access to toilet facilities and observed types

As highlighted by the MoH Annual Health Bulletin 2010 from RGoB – which reported 88.6% latrine coverage in Chukha district, access to toilets observed during the field assessment was generally quite good. At all visited households, business institutions and informal settlements we found individual or shared toilets. At Gedu College of Commerce and Business Studies, seventeen boys and girls toilet areas comprising WCs, urinals and handwashing places were provided for about a thousand students, which is a very adequate ratio.

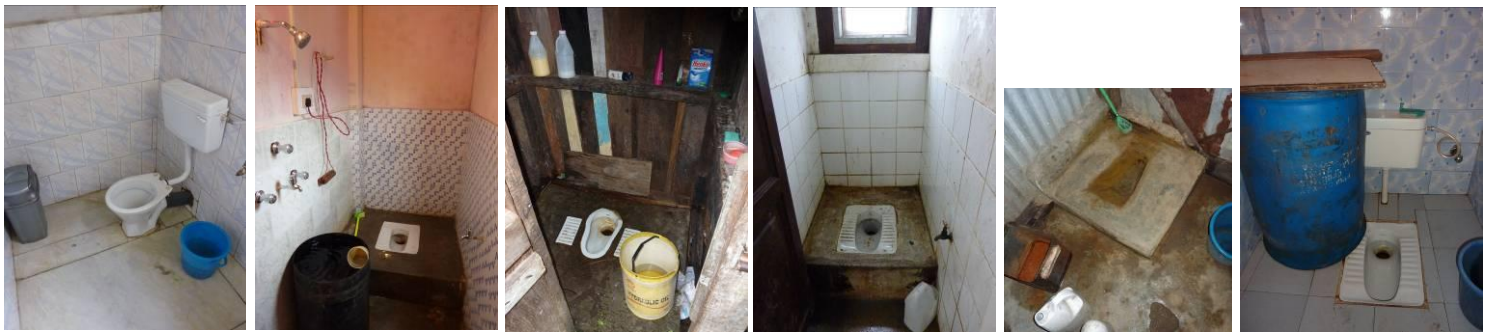
The observed types of toilet consisted of either a cistern flush system or a pour-flush system with a tap inside the cubicle or with access to water nearby. Water was often stored in barrels in the toilet area even for facilities equipped with cistern flush. This is used probably as a mitigation measure for flushing, cleaning or handwashing purposes when the piped-water supply is interrupted or when flushing mechanisms are not functioning.

Pedestal toilets and squat-down toilets are both quite common. The later type was made either of vitreous ceramic or cement mortar and mostly found in individual houses, while the former type was seen in restaurants or public institutions, such as the college in Gedu. In addition, it was positive to notice that most visited toilets in households or institutions allowed privacy, with a door that can be locked, even in the informal settlement visited in Gedu where home-made pour-flush latrines were constructed.

While access to private toilets was generally good, the situation of public toilets was noticeably different. No public toilets were visited or found in the three assessed towns,

and it was mentioned to our team that previous public toilets in Tsimasham proved difficult to maintain and were closed down.

Figure 1: Observed types of toilet facilities in houses and public institutions



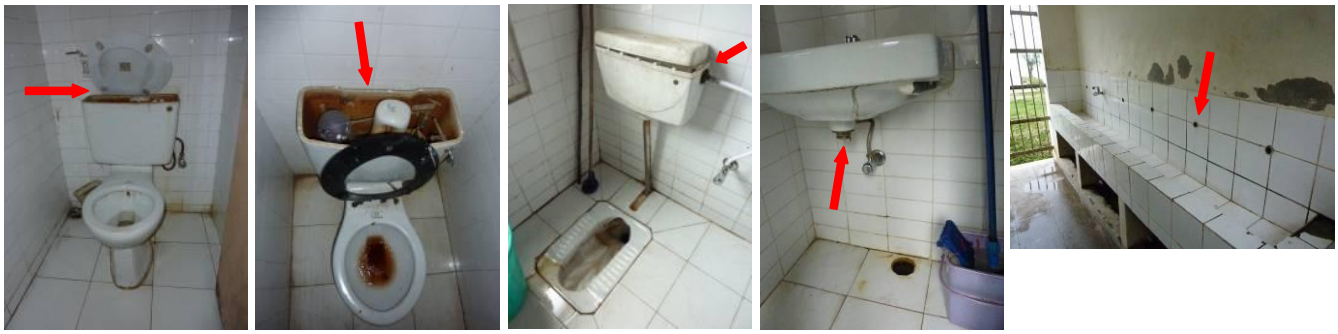
Finding 2. Toilet conditions

Toilet conditions differed from one facility to another, depending on the utilization, location, the target-users, the frequency of utilization, etc. Some of the visited toilets were kept clean, especially in households and in most of the restaurants. Toilet cleaning materials could sometimes be found in the toilets such as a toilet brush and more rarely disinfectant, detergent or cleaning liquid.

Facilities in the visited school, college and hospital were reasonably clean but in state of serious disrepair, with many toilet fittings and equipment broken. This includes toilet seats often missing or broken; broken and non-functioning cistern flushing mechanisms; damaged or missing hand-washing taps - leaking or with no water supply; and issues with plumbing (connections missing, broken or leaking). These problems are potentially due to maintenance issues, improper use, and low quality parts.

Soap was rarely available in toilet areas, as well as waste bins. There were no specific provisions or bins for menstrual hygiene materials which sometimes resulted in improper disposal inside the toilet cubicle (e.g. in broken or non-functioning toilet cisterns in the college in Gedu).

Figure 2: Example of toilet conditions observed in public institutions



3.2 Wastewater Management

Finding 3. Situation of domestic wastewater discharge

The towns selected for this assessment are not – with the exception of a small area in Gedu town – covered by piped sewerage systems. Most of the inspected households and institutions were connected to septic tanks, and for some households coupled with soak pits (but rarely due to limited space inside the house plot boundary) or only connected to leach pits.

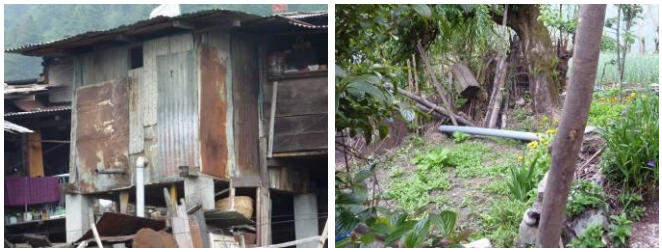
It was positive to discover that decentralized wastewater treatment systems are widely spread and compulsory with the construction of new buildings. However, even if wastewater effluent quality could not be assessed during this mission, septic tanks and soak pits' treatment efficiency can be questioned, as sludge collection is not systematically conducted yet and septage management is not yet organized. Current conditions ultimately lead to the discharge of accumulated sludge with the effluent, and/or the overflow of untreated wastewater when septic tanks are overloaded (during the mission, it was mentioned by municipal engineers that untreated wastewater from septic tanks was sometimes illegally removed and dumped into open drains at night). This is especially true for the shops in Tsimasham town, which sees many travelers stopping for a refreshment and/or toilet break. Overload can also frequently occur when the tanks are made too small in order to comply with the regulations for the minimum set-back distance of the septic tank from the plot boundary.

With the accumulation of sludge in septic tanks, malfunction caused by clogging may occur and, for instance, prevent wastewater from being flushed away from the house, or clogging may occur inside the soak pit – if existing – when accumulated sludge is partially discharged with the effluent.

Finally, it has been mentioned in our discussion with the district authorities that open defecation was not entirely eradicated.

Figure 3: Septic tank overflow

Figure 4: Improper wastewater discharge from toilet



A small sewage treatment plant was found in Gedu town, covering about 200

households, the Gedu College of Commerce and Business Studies and the local hospital. Although some parts of the infrastructure were aging and needed repair (cracks were visible in the concrete structure of one of the oxidation ditches and the sludge dewatering machine was out of order), the visited infrastructure showed good potential for efficient wastewater treatment with good effluent quality. However, the system was not being used at its full potential as it was operated intermittently, which lowers treatment efficiency and the quality of treated effluent.

Except for the area covered by the sewerage system in Gedu, all grey water from houses and/or institutions is discharged to open drains. This can potentially contribute to the pollution of the water environment. Furthermore, it was also observed that some buildings were not connected to any wastewater treatment system or misconnected hence leading to untreated wastewater being discharged into open drains and water bodies downstream.

Finding 4. Issues with the design and construction of septic tanks

In the three visited towns, individual septic tanks were widely used. The latest standards/rules for construction require each new building to include a wastewater treatment system (i.e. a septic tank, when connection to a sewer network is not available). However, for this measure to be beneficial, treatment efficiency of septic tanks must be assured by consistent design, adequate capacity, consistent construction quality and proper maintenance. Some of the observed tanks varied in size, location inside the plot boundary, and vent pipe size varied widely from one septic tank to another.

Discussion with municipal staff showed that even when the design of the septic tank for a new building is approved by the municipal engineer, the facility constructed can sometimes be different. Due to shortage of building inspectors, the lack of verification of constructed facilities, and/or the weakness of enforcement in case of inappropriate construction, can partly explain why septic tanks with inconsistent design and insufficient capacity are still built. As mentioned earlier, the remaining space in a plot boundary after the house construction sometimes does not allow the implementation of a septic tank of appropriate size.

The observed individual septic tanks were mostly located in the backyards of houses, sometimes in positions difficult for accessing and emptying by a vacuum/cesspool truck.

Figure 5: Examples of septic tanks

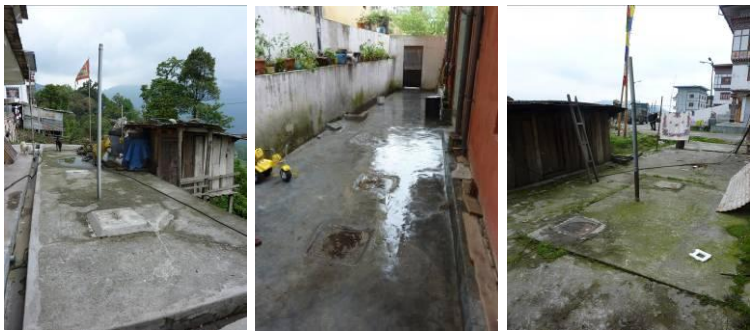


Figure 6: Difficulty of access to septic tanks

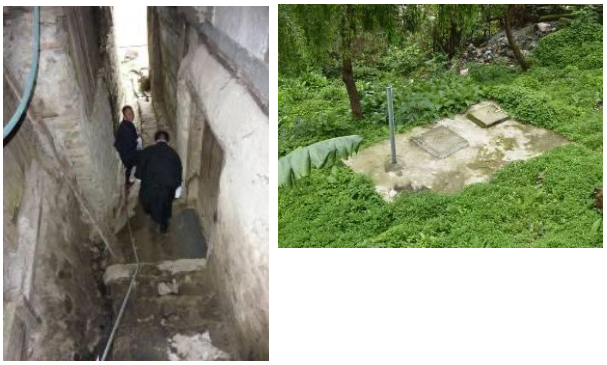
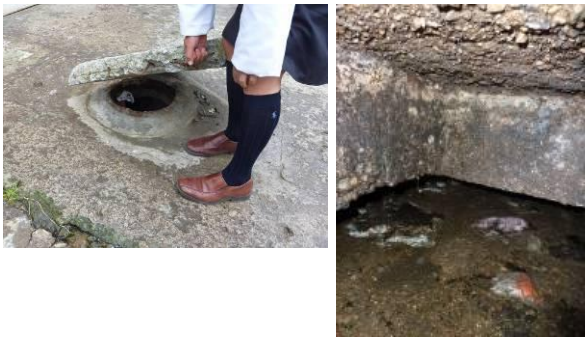


Figure 7: Issue with overload septic tanks and illegal dumping of untreated wastewater



Finding 5. The situation of temporary settlements

Temporary settlements were found at Tsimalakha town, mostly alongside the road on the way to the Chukha Hydropower Project area, with approximately 40 houses cum shops. Typically these have a rudimentary or a pour-flush toilet attached to the rear of the house or separated out-house in the backyard. It seemed that most toilet waste is piped some distance away and discharged to the environment without treatment.

Other temporary settlements were observed in Gedu, near the Meritshem Junction area. It consists of approximately 25 households that were formerly on the highway side. Discussion with local residents showed that some of them lived there for 10-15 years or more. Some are considered illegal (as they already own land elsewhere in the country) and have had electricity disconnected. Most of the households have rudimentary piped-water supply. Individual or shared home-made pour-flush latrines were connected to some kind of ground filtration system, but construction adequateness and treatment efficiency could not be inspected or assessed.

In addition to the assessment of three towns in the Chukha district, our team also visited one of the informal settlement of Phuentsholing city, located along the riverside. This settlement gathers about 10 to 15 households. The conditions found on site looked much

poorer than the other sites visited in the Chukha district. Very rudimentary and probably illegal piped-water supply could be seen but no toilets were observed on site. Discussions with some local residents showed that open defecation in the river nearby was an usual practice.

Figure 8: Informal settlements in Gedu

Finding 6. Sewage treatment plant in Gedu town

The sewage treatment plant found in Gedu town was built in 1997 as part of the Tala Hydropower Project infrastructure. Implemented to serve the residential colony, this system covers approximately 200 households, and includes the Gedu College of Commerce and Business Studies and the hospital of Gedu. This plant, using activated sludge process, features two oxidation ditches, a sedimentation tank, and a sludge dewatering machine. This machine is installed inside an open-air steel frame building with roof and concrete floor, which is designed for sludge drying process after dewatering operation. Operation and maintenance is done by a caretaker and his wife, living in a house built on site. According to the plan of the plant that our team was shown, there is a small room for a laboratory in the caretaker's quarters.

At the time of the visit, the dewatering machine was out of order and no schedule was mentioned for repair. As indicated earlier, the rotor of the oxidation ditches was not operated continuously nor the scraper bridge of the sedimentation tank. A discussion with the caretaker's wife indicated that the intermittent operation was not for energy saving purpose. If the system would be operated constantly, the plant could offer better wastewater treatment efficiency. However, better treatment quality would only be necessary if the present effluent quality fails to meet the RGoB standard for final effluent from Sewerage Treatment Plants. If not met, the actual management could signify a lack of awareness in operation and maintenance and/or, more importantly, in the sewage treatment process. In that case, it would be unfortunate that the plant is not being used to its full potential due to poor operation.

Figure 9: Sewage treatment plant in Gedu

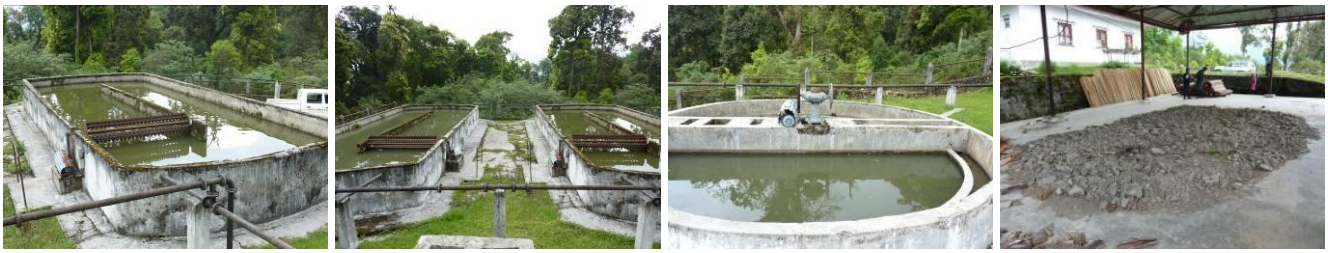


Figure 10: Sign of wear in one of the oxidation ditches

Figure 11: Broken equipment (dewatering machine)

Other sewerage systems were also observed at Phuentsholing and Thimphu city.

In Phuentsholing, the existing sewerage system was constructed between 1993 and 1996 under the assistance of DANIDA. It serves approximately 95% of the core area of the city, which represents approximately 15,000 to 20,000 persons. The system features a stabilization pond, which includes anaerobic, facultative and maturation ponds spread in five acres. A sludge drying bed was under construction at the time of the visit.

The municipal engineer that accompanied our team during the site visit expressed concern over recent increase of BOD effluent, above final effluent discharge standard. An important issue found in the field is that the site is open to public, who uses it as a recreational place and feeds the significant fish population. This practice is quite unfortunate, especially at the maturation pond, as it pollutes the treated wastewater before discharge to the river nearby. The protection of the ponds liner can be a problem during this practice, as people can damage them when they manipulate tools to bring the food to the fishes. Great care is also needed during desludging operations.

Figure 12: Maturation pond at Phuentsholing Sewage Treatment Plant
(the arrow points out the significant fish population)

Another sewage treatment system – the Eco-line – was visited in Thimphu. This technology from Denmark was found and imported by a private contractor, who also ensured O&M for more than a year. This is a good example of the possible involvement of the private sector in sanitation. This system, covering the Ministers Enclave and the Army Camp, has a 500 people capacity but only serves about 300 people. This plant features a separate baffle tank, which receives wastewater and ensures that a regular flow is lifted by a pump to the treatment unit. Wastewater treatment is then done through aerobic treatment process (contact aeration/fixed-film process, and drum screening). An optional additional process for effluent treatment is not installed and it was mentioned during the visit that effluent is discharged without chemical addition for disinfection (although this is an important step necessary to destruct the pathogens that cause disease).

Since the plant implementation in 2006, the main problem with maintenance concerned the pump in the baffle tank receiving wastewater, as plastic and other materials pass through the intake grill and prevent it from functioning properly. Effluent quality is checked by public authorities but the results are not known.

Figure 13: Eco-line Sewage Treatment Plant in Thimphu

3.3 Septage Management

Finding 7. Septage management

Sludge collection is not conducted nor septage management organized in the three assessed towns. No vacuum/cesspool truck was at their disposal at the time of the mission, but a new cesspool truck has been ordered by the Chukha district and was expected by the end of May 2011. As a result, desludging operations will start for Tsimasham and Tsimalakha towns and, as septage management has not been planned yet, emptying operations will probably rely on an “on-call” service basis when building owners experience problems associated with their septic tank. The start of regular emptying operations could be an opportunity for introducing more severe measures against the before-mentioned illegal dumping of untreated wastewater in open drains.

3.4 Drainage System

Finding 8. Situation of the drainage system

The drainage system conveys stormwater and, in areas covered by septic tanks, all grey water discharged from households, shops, restaurants and other institutions, as well as black water from the few buildings that do not have any wastewater treatment system.

Some of the drains observed were blocked by garbage or broken by trucks parking in unauthorized areas. Drain capacity or length in some of the visited areas seemed insufficient. These problems combined together could lead to overflowing drains in the event of heavy rainfall, and cause a serious public health risk especially during the monsoon period.

The accumulation of garbage was also observed in the drains of some houses, causing stagnant grey water.

Figure 14: Grey water discharged in house drain

Figure 15: House drains blocked by garbage

3.5 Solid Waste Management

Finding 9. Solid waste collection

Good practice was observed in the Chukha district with the utilization of designated solid waste collection points, with six already built or under construction. They consist of a raised rectangular plinth with rectangular chain-link wire sided garbage container in which a mixture of garbage is collected three times per week (Monday, Wednesday and Saturday).This collection system for solid waste is a positive initiative which needs to be expanded.

Figure 16: Solid waste collection point

Figure 17: improper disposal of waste in house backyards

Other types of collection points for garbage disposal (e.g. bins) could hardly be found in towns, which may partly explain why littering or inadequate disposal of waste is common, especially in drains and on open land behind houses. This widespread practice shows that health hazards are not associated with this careless practice, thus highlighting the need for hygiene awareness activities and for establishing the habit of gathering garbage and bringing it to designated collection points. Conscious of the problem, the Chukha district authorities have recently initiated a collective cleaning operation organized every Saturday in which shop-keepers are required to clean up the town. This is an excellent example that can help to contribute to improving the current situation and changing people's behavior.

At the visited hospital in Gedu, medical waste was segregated (e.g. used needles are disposed of in safety boxes), but appeared to be mixed again with other solid wastes during collection and transport for disposal at the nearby Alikha incinerator.

Another form of collection was observed in the informal settlement in Gedu, where solid waste was disposed and accumulated in a hole dug for this purpose. This practice can become a source of ground contamination, as wastewater infiltrates the soil after rainfall.

Figure 18: Example of solid waste disposal in informal settlement

Finding 10. Solid waste disposal: Alikha incinerator in Gedu

Originally built as part of the Tala Hydropower Project infrastructure, the Alikha incinerator treats the garbage gathered from the six collecting points of Gedu town. It is managed by two operators and one supervisor. This facility has been recently out of use for six months and a large accumulation of garbage was seen on the receiving ramp above the waste sorting bay. Organic waste is left on the ground and is not protected from rainwater nor disposed. This is a potential source of ground contamination as wastewater infiltrates the soil without treatment. Due to the accumulation of garbage below the receiving ramp, waste segregation is not conducted there anymore, and the garbage collection truck dumps garbage directly in front of the incinerator where some selective segregation is done, but without any protective equipment. Cardboard is bundled up and plastic bottles are removed by the operators. Accumulated garbage inside the operating building causes unsanitary conditions for workers, which are made worse by the massive presence of flies.

As for the infrastructure, the furnace chimney is deteriorated by corrosion and now ends below the roof, which allows part of the smoke to circulate in the building, resulting in obnoxious smell and hazardous respiratory conditions for the workers. The temperature of combustion appeared to be quite low at the time of the visit, and staff refresher training will probably be beneficial to enable the use of the Alikha incinerator to its full potential.

Figure 19: Alikha incinerator in Gedu Town

Figure 20: Overloaded receiving ramp

Figure 21: Corroded chimney

Figure 22: Combustion chamber and working conditions

Finding 11. Water supply

The water supply network is old (built in 1980s at the time of the Chukha Hydropower Project) and suffers from plumbing connection problems. This causes significant water losses, and adds to the problem of water shortage. As a consequence, water is not supplied continuously, which can be a problem for toilet flushing and cleaning. Empty water pipes can also present a very high risk, with negative pressure drawing contamination into water pipes through any leakage points and consequently making water unsafe to drink.

4. RECOMMENDATIONS

Based on the above findings, the JSC team recommends the following issues to be given special attention. Further assessment, collection of data, and consultation with MoWHS and the district authorities will be necessary to determine an order of priority and establish a detailed program for sustainable sanitation improvement for the three targeted towns.

4.1 Water Quality Monitoring

Recommendation 1. Regular data collection on water quality

To determine the impact on the environment, water bodies and ultimately public health of present practices and future measures in sanitation, it is essential to monitor and gather regular data on water quality. Water bodies – such as rivers, lakes – as well as discharged effluent from wastewater treatment facilities should be targeted for water quality monitoring in line with the RGoB's Discharge Standards, 2010, and samples should be analyzed by the responsible authority using nationally approved criteria. This is currently the responsibility of NEC. Water quality monitoring would enable the authorities to assess if actual standards for wastewater/night soil/sludge management are adequate or if revision is needed to sustain the preservation of a safe and healthy environment.

Criteria to consider:

- *Quality*
  Monitoring process with composite sample/single sample
  Frequency according to areas/conditions/climate/seasons/facilities
  Equipment e.g. automatic sampling machine

- *Quantity*
  Flow meter, mass loading
  How to select the sampling points
  Number of monitoring points

- *Management*
  Laboratories and expert human resources for water quality analysis
  Database collection and analysis system
  Institutional and financing system
  Regulating organization/professional body
  How to improve the existing system and where to go from now on?

4.2 Toilet Improvement

Recommendation 2. Revive and increase the number of public toilet facilities

If toilets are well spread in houses and public institutions, it is advisable to increase (or revive in areas where decrepit toilets are no longer utilized) the number of public toilets in towns, especially in areas visited by many travelers along the south-north highway. This would diminish the load on toilets of restaurants and shops and their associated septic tanks.

In addition, by increasing the access to toilets, this could contribute to the eradication of open defecation.

However, the increase or revival of public toilet facilities will imply the provision of funds from local communities, the municipalities and/or the Chukha district (to be decided). A responsible body for cleaning, maintenance and the collection of a fee for toilet utilization (if applying) will also be essential to prevent these facilities from falling into disrepair and becoming unusable.

Recommendation 3. Improve toilet maintenance and equipment quality, and draw public attention on the importance of caring more for public places

While toilets are generally in good condition at household level, the situation is notably different in public institutions (i.e. in the visited school, college, hospital, and, in some cases, restaurants), where toilet equipment and fittings were often found broken. Although the equipment quality can be blamed, proper usage is an area where much improvement could be achieved through awareness-raising campaigns and public education.

As people are more likely to appreciate and use a clean and tidy toilet area, proper and timely cleaning is vital. Equally important is having a dependable system in place that ensures the regular maintenance of public facilities, and the timely repair of broken equipment and fittings. Also it will be important to establish a financing system for public toilet usage, especially in areas highly frequented by travelers.

Recommendation 4. Increase hygienic use of toilets in households

If the wide dissemination of toilet is a positive finding, hygienic use of toilets is an area that could be improved. All wastewater from toilets should be connected to a wastewater treatment system (i.e. a septic tank, except for the sewered area in Gedu). Toilets should be regularly cleaned and maintained to function properly. They should also include soap.

4.3 Sanitation Management Improvement

Recommendation 5. Eradication of untreated wastewater discharge and system upgrade for basic wastewater treatment facilities

For public health protection, all black water from toilets should be collected and treated in a safe and hygienic manner, and never discharged untreated. In addition, where water supply is dependable, pit latrines should be upgraded to pour-flush toilets connected to a septic tank with soak pit.

Recommendation 6. Implementation of septage management

To improve wastewater treatment efficiency of septic tanks, and prevent untreated wastewater from overflowing when tanks are overloaded, regular and systematic desludging operations need to be implemented. Better septage management can be considered as an important first step of sanitation improvement for small towns, with substantial impact on the treatment efficiency of septic tanks. The organized system should be compulsory and eliminate any intervention from septic tank owners (avoid on-call service).

The frequency of emptying operations should be determined depending on the size of the septic tanks and the number of users (probably once or twice a year, or more often). This should be preliminary assessed through sanitation mapping and consultation with the public. As previously mentioned in the finding 7, a new cesspool truck has been ordered by the Chukha district and was due to be delivered at the end of May. Depending on the capacity of this truck, it may be necessary to increase the number of such vehicles for desludging operations. The acquisition of more cesspool trucks would solve the problem of overflow from septic tanks with small capacity.

A financing mechanism should also be implemented to prevent users from paying for each visit of the cesspool truck (thus ensuring regular desludging), and enable the involvement of the private sector. This would require the understanding of the public and, therefore, the implementation of communication campaigns to explain why a financial contribution is needed.

Recommendation 7. Consideration for disposal sites and construction of sludge treatment facilities

As sludge from septic tanks needs to be collected on a regular basis, it is essential to consider and implement disposal/composting sites and treatment facilities. Different options for collection, transport, treatment and disposal or recycle as compost are conceivable depending on land availability, the acceptance of the local population (for example on the possibility of using sludge compost), and the funds available (i.e. priority given for the construction of sludge treatment facilities). These options are:

- Sludge can be treated through a sludge treatment plant (to be constructed). After treatment and drying operation, dried sludge can be used for landfill, farming or combusted for example at the Alikha incinerator in Gedu.

- Sludge can also be dewatered and used as a fertilizer after compost. This would necessitate the acquisition of dewatering machines, the construction of buildings with roof and concrete floor, the provision of land, and the acceptance and needs from the local

population to use sludge as a fertilizer. If not fully utilized, part of the dewatered sludge or compost could be brought to the Alikha incinerator for disposal.

Consultation with the local population will need to be first carried out to determine what would be the most suitable way to manage sludge and if compost sludge is adequate for agriculture.

Recommendation 8. Enhancement of operation and maintenance at the sewage treatment plant in Gedu

From the monitoring of effluent's quality, it is important to confirm whether Bhutan's standard for final effluent is met or not. If not, current practices for operation could be improved through the provision of operation manuals, staff training and activities to raise awareness on sewage treatment process and knowledge on operation and maintenance. Maintenance will need to be addressed, as broken equipment and wearing infrastructure were observed. A maintenance schedule and capacity building to address these issues may be required.

There is a possibility for revitalizing the plant and there is also space for slight expansion which would allow increasing the number of sewer connections in town.

Recommendation 9. Utilization of the Alikha incinerator (Gedu) for sludge disposal

An inquiry was made by the Chukha district authorities on the possibility of disposing sludge in the Alhika incinerator in Gedu. This is possible but to allow effective combustion, sludge needs to be mixed with other wastes and to be limited to a certain amount (to be assessed).

4.4 Septic Tank Improvement

Recommendation 10. Standardize and regulate design

Septic tank design, which is submitted and checked by municipal engineers before the construction of new buildings, should be standardized (i.e. determine size according to number users, number of compartments, possible emptying frequency, etc.) Furthermore, the design and size of all septic tanks after construction should comply with what has been approved by the municipal engineer.

At municipal level, precise inspection of built facilities and, if necessary, corrective measures, such as reconstruction or penalty for insufficient capacity, should be strictly enforced by building inspectors (this may require additional laws, regulations, and staff for building inspection).

As a further step of sanitation improvement, future design of septic tanks for new buildings should include the treatment of both black and grey water.

Recommendation 11. Ensure septic tanks' durability and quality of waterproofing

The observed septic tanks were made of bricks, cement with mortar finish. From what was checked on the plan of a house under construction, the amount of cement used for the septic tank mortar finish (12 mm) was not thick enough to provide long lasting waterproofing. As a first step of improvement, it is advisable to replace bricks by a complete reinforced concrete structure.

Recommendation 12. Enable visual inspection for operation and maintenance and easy desludging operations

The actual design of septic tanks – with sealed manhole covers – does not allow visual monitoring to assess sludge depth or conditions inside the tanks, nor easy desludging operations. Even if for security purposes manhole covers should be locked, they should also be maneuverable and not sealed.

4.5 Financing Mechanism for Septage Management

Recommendations 13. Charge for sludge collection and treatment

To allow regular sludge collection and transport, a financing mechanism will need to be set up. Such mechanism is to be discussed and decided between the central government, the district authorities and the municipalities. Different systems can be considered depending on whether sanitation will be paid by each household through a charge or financed through the tax collection system, and how much the government of Bhutan will subsidize for sanitation improvement. What follows is only to consider as options.

As well as the sewer charge paid by the populations living in an area covered by the sewerage system, a compulsory charge included in the water bill (as it is done in Manila, Philippines) – which could be called 'environmental charge' – could be paid by all septic tank users living in an area targeted for sludge collection and treatment. If water meters are not widely used, another possibility would be to collect this charge through other existing local taxes.

To facilitate this new charge collection, it will be important to communicate with the public and makes everyone understand that, in order to promote good sanitation practices that will enable a safe and healthy environment with ultimately high economic return, governments/districts/people need to invest in and pay for sanitation.

The collected charge is intended to cover sludge collection and transport to the treatment facility or disposal/recycling site. The private sector could here be invited to play a role and conduct sludge collection and transport under the management of a body of

professionals (for regulatory management) from the municipality. As mentioned earlier, it is recommendable to construct one or more sludge treatment facilities and consider different options after sludge treatment: disposal or recycle as compost (if acceptable for local communities). As done in other countries, the funding for the acquisition and the construction of such facilities could be covered through local taxes or budget from the central government, as for the implementation of the sewerage system. Operation and maintenance could be covered by local taxes.

4.6 Flood Control Measures

Recommendation 14. Improvement of drainage system

To prevent public health risks from overflowing drains and sewers after heavy rainfall, these should be periodically cleaned to eliminate garbage. Further assessment will be needed to determine where the system could be improved, including size and length expansion for capacity increase.

4.7 Improvement of Solid Waste Management

Recommendation 15. Behavior change for solid waste disposal

To establish safe and hygienic living conditions, the first step of improvement is to establish a behavior of organized disposal (whatever the amount is), and eradicate the wide spread habit of indiscriminate throwing away and littering in non-dedicated areas: backyard of houses, drains, etc. Hygiene promotion and communication campaigns with the public will here play an important role to raise awareness on the health risks and other negative consequences associated with current practices.

The potential of attracting the private sector for solid waste collection and transport, and the business sustainability for small towns needs to be evaluated. It should also be determined how the cost for the solid waste collection and disposal should be covered: individually – for instance through a tax included in the water bill – or through public tax.

Recommendation 16. Increase of solid waste collection points and system improvement

To facilitate solid waste disposal, increasing the number of solid waste collection points and disposal bins should be a priority, especially in popular/well frequented areas. For example in similar locations in Japan, the distance between each collection point must not exceed 50 meters.

To prevent wastewater from contaminating the soil in the event of rainfall, and to avoid the concentration of flies or other insects, solid waste collection points should include

a roof and walls. To simplify garbage emptying, transport, and provide waterproofness, a container could be used for disposal. This type of container and associated trucks could be purchased abroad at a moderate price, for example through the acquisition of second-hand items from other countries.

Recommendation 17. Improvement and working conditions at Alikha incinerator, Gedu

It is firstly important to improve the working conditions and take strict safety measures for the staff operating the incinerator. This includes the provision of facemasks, protective clothing, gloves, boots, and measures such as pesticides to limit the presence of flies and other insects at the site.

These measures include a quick repair or replacement of the corroded chimney stack. This would prevent the smoke from entering the operating area and improve combustion efficiency. To improve working conditions inside the operating room, waste segregation should also be done at its originally designed area: the sorting bay below the receiving ramp.

Waste combustion can include organic waste, sludge, non recyclable paper, and plastic. Glass, plastic, paper (big size), cardboard, medical waste should be considered for segregation.

4.8 Sanitation and Hygiene Awareness-raising

Recommendation 18. Sanitation and hygiene awareness campaigns

Sanitation and hygiene awareness activities and campaigns need to be implemented to improve people's behavior, develop good sanitary habits, and enhance the willingness to pay for sanitation. Related activities and messages could be diffused through television, schools and other means that are able to reach the largest possible audience, including the population living in informal settlements.

Together with these activities, it is important to develop communication with the public with transparency on activities and accountability. To obtain general understanding, consensus and support for the implemented sanitation policy and associated investment, projects, it is important to inform the public about where their money goes, what is done with it and why.

4.9 Capacity Building

Recommendation 19. Increase the number of trained professionals and technical capacity, including curriculum development

As part of the process of sanitation improvement, it is crucial to increase the number of

sanitation professionals, as well as knowledge and technical capacity. This involves a good understanding of wastewater/sludge treatment processes and methods, and adequate know-how for operation and maintenance of wastewater/sludge treatment facilities. The more sanitation improvements made and greater wastewater treatment efficiencies reached, the more expertise in operation and maintenance will be needed.

Increasing the number of sanitation professionals will also be an important task for the coming years. This necessitates the development of a specific and detailed curriculum on sanitation, as well as the number of qualified and experienced teaching staff at universities/colleges.

4.10 Institutional Framework

Recommendation 20. Legal, regulatory and institutional development

The legal and institutional system for sanitation in Bhutan was not fully assessed during this first mission. Although more clarity in this matter is required, ideally, a sound institutional framework for wastewater/night soil/sludge management is needed to maintain a healthy living environment and conserve water environment. This includes the following:

- Establishment of a legal system to define the responsibility and duties of central government department, district, municipalities, the private sector and individuals for wastewater/night soil/sludge management.

- Establishment of a legal system with regulations and standards for wastewater/night soil/sludge management including the introduction of appropriate sanitary equipment/wastewater treatment technologies and standards of structure/performance/O&M for the equipment/technologies (including regulation and enforcement in relation to the construction, sitting and designs of septic tanks.)

- Establishment of a legal system to regulate the stakeholders who intend to join businesses related to wastewater/night soil/sludge management, in order to enable participation of the private sector.

- Establishment of a training system for capacity development dedicated to municipal officers in charge of or related to wastewater/night soil/sludge management, to ensure the effective application of laws, regulations and standards.

- Specification of the role and implication of non-government organizations/ community-based organizations for sanitation and hygiene awareness-raising activities

and the mobilization of local communities.

5. DISCUSSION

5.1 Option for the Protection of the Water Environment

Discussion 1. Collection and treatment of grey water and septic tank effluent

To target the preservation and protection of the water environment, ideally all grey water should be collected for treatment, and all partially treated effluent from septic tanks should receive further treatment to improve water quality before entering the environment. Even if the three assessed towns for this mission might not yet be ready for this stage of sanitation improvement, and that natural capacity (i.e. volume of water in water bodies, partial natural treatment done through the distance and time between the discharge point and the water body downstream) lowers the impact of grey water and effluent from septic tanks (to be evaluated with data on water quality of surrounding water bodies), this measure will need to be adopted in the long term to prevent water bodies from being polluted. This could be done through a small scale sewage treatment plant located downstream of the targeted small towns, collecting the discharged grey water and septic tanks effluent from households.

Another option would be to change the design standard of septic tanks for future constructions, and connect grey water for each household to this treatment facility, as well as adding or reviving proper drain field or soak pit for ground filtration.

To estimate the level of improvement to be achieved and the appropriate technology, water quality needs to be monitored and compared to national water quality standards.

5.2 Financing Mechanism for the Treatment of Grey Water and Septic Tank Effluent

Discussion 2. Financing for a small scale sewage treatment plant

As well as for the sludge treatment facility, a financing mechanism will need to be considered in order to acquire and construct one or more additional facilities for the treatment of grey water and septic tank effluent. The implementation of such facilities would ideally be done under the support of the central government, while operation and maintenance could be covered by the related districts and/or municipalities.

As for the technology required for the treatment facility, a small scale sewage treatment unit, such as the Eco-line or the johkasou, would be appropriate for this purpose.

6. NEXT STEPS FOR SANITATION IMPROVEMENT

The RGoB Annual Health Bulletin 2010 published by the Ministry of Health showed that water and sanitation-related diseases are still widespread with for example, in 2009, more

than 27,000 people suffering from dysentery and, with more than 65,000 cases of diarrhoea, which ranked among the top ten diseases in the country. To evaluate the impact of water quality and sanitation practices on public health at local level for Chukha district and the level of measures needed for sanitation improvement, further data on water quality will need to be collected and analyzed. Nonetheless, at the observed stage of sanitation management in Chukha district, two steps of improvement can be considered.

Step 1. Goal: A first step of improvement will be to target public health protection, thus rendering harmless parasites, viruses, etc. from feces, and developing countermeasures against water and sanitation-related diseases. This will imply ensuring that all black water is collected and safely treated, and that untreated wastewater from toilets is not discharged directly to the environment. Sludge needs to be regularly collected and treated in a hygienic manner to enable disposal and/or safe recycle/reuse.

Technology: This will necessitate the acquisition of an adequate number of vacuum/cesspool trucks for the collection and transport of sludge to one or more treatment sites. The size and structure of septic tanks will have to be standardized, as well as the treatment performance to render harmless parasites, viruses, etc.

Policy: A license system for sludge collection and transport businesses will need to be organized. This district and/or municipal-regulated system will manage, ensure low charges, and a stable and sound business. Sludge collection will need to be conducted at regular intervals.

Step 2. Goal: A second step of improvement will target the preservation of the water environment (water quality preservation, water reuse/recycling).

Household wastewater treatment facility: All wastewater (grey and black water) at household level will need to be collected and treated.

Technology: All wastewaters will be treated through septic tanks and adequate soak pits or drain fields for ground filtration, or collected through drains downstream and further treated in an additional small scale wastewater treatment plant.

Aerobic treatment process should be preferred for all sewage wastewater treatment plants to increase treatment efficiency. Sludge will be collected and treated in designated sites, as described in step 1.

In the interests of public health and environmental protection it will be important for the central government of Bhutan to prioritize water quality monitoring – with regular data

not only from river basins but also from influent/effluent of wastewater treatment facilities, including septic tanks – and to determine appropriate policy/laws/regulations/standards for the protection of the water environment. The standards and level of improvement desired will determine the technology and investment needed. Even if the management of sanitation and wastewater facilities is devolved to districts/municipalities (to ensure that everything is done according to the laws/regulations/standards established by central government with, ideally, support – e.g. for district and/or municipal staff training – from government sanitation professionals), the role of the responsible central government agencies is crucial for the overall leadership and direction of sanitation and hygiene improvement.

7. TASKS FOR ATTENTION

The following tasks are highlighted for future attention. To the extent possible, the next joint assessment mission scheduled for the second half of this year will begin to focus on these (order of priority to be agreed):

- Obtain data on water quality from water bodies/discharged effluent.

- Organize (with staff from districts, municipalities, students following courses related to sanitation or community development) sanitation mapping in the three targeted towns and identify what wastewater treatment systems are used and where the effluent goes.

- Assess how to organize septage management, including the selection of sites for treatment and the feasibility of involving the private sector.

- Determine in collaboration with MoWHS and the Chukha district a list of priorities and prioritized areas in towns for sanitation improvement and prepare a Master Plan, including sanitation targets and a schedule for implementation.

- Understand in detail the actual legal and institutional structure for sanitation.

- Check availability of funds and willingness to invest in sanitation.

Figure 23: SNV-JSC teams at MoWHS-DUDES