Norges miljø- og biovitenskapelige universitet

Masteroppgave 2018 30 stp
Faculty of Environmental Sciences and Natural Resource Management
Petter D. Jenssen

Improvement of the environmental situation in a school by integrating water and sanitation with school farming : A case study of schools in the districts of Chitwan and Kavre, Nepal.

Øystein Fure Mæhlum
Environment and Natural Resources
Faculty of Environmental Sciences and Natural Resource Management

Preface

I have chosen to start this thesis with a general assessment of the water and sanitation situation in Nepal as the background of a case where I have considered different solutions for implementing ecological sanitation for two different schools I have visited in March 2018. It is a project funded by NORHED based on a PhD proposal called Ecosan in schools: A Participatory Action Research on integrating water and sanitation to farming in schools of Nepal through school garden projects. My stay in Nepal lasted from 13th of March till 12th of April.

I need to thank my supervisors Manoj K. Pandey and Petter D. Jenssen for making this journey possible. I am very grateful for being a part of this project and the unique experience I had in Nepal. I also need to thank Bipana Sharma and Kamal Prasad Acharya for their warm welcoming on the airport when I landed. A special thanks to Bishnu Paudel and Shree Krishna Wagley for helping me collecting data as interpreters, as well as enduring with me all that time. Lastly, I need to thank Iswaar Man Amatya and Bhimsen Devkota for lending me equipment and tools to conduct my study.

Ås, 14th of May 2018

Øystein Fure Mæhlum

Abstract

Nepal is one of the poorest developing countries in Asia. Political tension and nature disasters has severely stunted development the last few decades. At the same time, modernization trends from the western world are adopted without realizing the consequences they may bring. This has especially been an issue for Water, Sanitation and Hygiene (WASH) where water and wastewater has been poorly managed. The current trend is to dump untreated sludge in lakes, rivers, streams or soak pits that contaminate groundwater and lead to eutrophication in lakes and rivers.

Traditionally in Nepal, all sludge was put back to agriculture. However, with the modernization of toilet facilities, recycling of human waste has been going out of fashion. One measure to counteract this negative trend is implementation of ecological sanitation (EcoSan). EcoSan recognizes the value of human excreta, where EcoSan toilets are designed to recycle human waste for agricultural purposes. Introduction of EcoSan in schools is a great way of building acceptance for these kind of solutions in the community. With the nutrients recycled from excreta, a school kitchen garden can easily be maintained. This is a great arena for students to learn science and importance of nutrition.

A knowledge Attitude and Practice (KAP) survey designed to uncover WASH customs, general acceptance of human excreta recycling and health related issues was conducted in two different study areas. The study areas are Jana Jeevan Secondary school in the district of Chitwan and Jana Hit secondary school in the district of Kavre. They are upgrading their sanitation facilities and have expressed a wish to utilize EcoSan systems for nutrient recovery. The KAP surveys showed a positive attitude towards human excreta recycling among the surrounding community. The state of WASH was good in the more developed district of Chitwan and more lacklustre in Kavre. This was particularly visible in hygiene habits among the students of Jana Hit.

The new sanitation system of Jana Jeevan will have urine diversion and a biogas reactor with sludge dewatering beds. Urine will be transported with pipelines next to the school kitchen garden. Jana Hit in Kavre have recently built a new sanitation system with septic tanks. Urine diversion is possible to implement, but building a new sludge handling facility was not seen feasible. However, sludge dewatering are possible to implement if they find the space for them.

Abbrevations

WASH	Water, Sanitation and Hygiene
EcoSan	Ecological Sanitation
KAP-study	Knowledge, Attitude and Practice-study
SDG	Sustainable Development Goals
NDHS	Demographic and Health Survey
DWSS	The Department of Water Supply and sewerage
ODF	Open Defecation Free
DVUD	Double Vault Urine Diversion toilets
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
SDRB	Sludge Dewatering Reed Beds
DAP	Diammonium Phosphate

Table of contents

1 INTRODUCTION

1.1 General introduction

Malnutrition, intestinal parasitic infections and diarrhoeal diseases are common public health problems for children in low- and middle-income countries. In 2013, the Global Atlas of Helminth Infection estimated diarrhoeal diseases being responsible for 7 % of deaths for school-aged children in low- and middle-income countries, with more than 96 % of the cases being directly connected to unsafe water, inadequate sanitation and hygiene (Erismann et al., 2016). Because problems with water and sanitation is such a substantial problem worldwide, goal six in the 2030 agenda for sustainable development states to "ensure availability and sustainable management of water and sanitation for all" (UNwater 2015). All goals in this sixth point for sustainable development include: "(1) to achieve universal and equitable access to safe and affordable drinking water for all. (2) Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation. (3) Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials. (4) Substantially increase water-use efficiency across all sector. (5) Implement integrated water resources management at all levels and (6) protecting and restore water related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes" (Government of Nepal 2017).

In addition to diarrhoeal diseases, malnutrition and anaemia are also very common problems for children under 5 years of age. Demographic and health surveys in Nepal conducted in 2010 and 2011 showed that almost 41 % of all children were underdeveloped for their age and 46 % were anaemic (Erismann et al. 2016). The physical underdevelopment and anaemia are a result of poor nutrition. There is a strong relationship between education and health outcomes across the life course, with healthier children achieving better results at school, leading to higher productivity, improved livelihood prospects and health outcomes later in life. Given the global persistence of malnutrition and ill-health, the research and international development communities are increasingly paying attention to enhancing nutrition and health as the primary goals and outcomes of food production and delivery systems. Agriculture as a source of nutritious food and well-being has recently been recognised and is addressed in the new Sustainable Development Goals (SDGs), particularly in SDG 2: "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". There is, however, an insufficient evidence-base which supports these agriculture, nutrition and health linkages (Erismann et al. 2016). Access to safe water and sanitation are important foundations to ensuring good health and overall poverty reduction. Schools that lack basic water supply and sanitation facilities are likely to have a higher incidence among both teachers and students of waterborne and diarrheal diseases. Which in turn affects the ability and quality of teaching and learning because of absent students and teachers suffering from illness. This contributes to poor educational outcomes including dropout, especially among girls of menstruation age. In addition, longer-term impacts include malnutrition, cognitive and developmental delays (Norad 2016).

Implementation of ecological sanitation systems is one step towards higher food security and a way to promote sustainable agriculture. However, in a country like Nepal with strong cultural believes, big geographic and demographic variations, the one-size-fits-all approach is not appropriate to influence a change of people's behaviour. This has also been the case with implementation of EcoSan technologies, where communities react differently depending on local believes and geographic location. While many communities show interest in these technologies after demonstrations of improved crop production due to the value of excreta as organic fertilizers, other communities show scepticism and little interest towards excreta re-use (WaterAid 2008b). As the main goal of EcoSan is to improve the current sanitation issues, and recover nutrients from the excreta to create a renewable cycle of nutrients going from soil to plants to humans and back to soil again (UNICEF 2012). Promoting such a system might be more successful when it is presented as one option among a range of several different technologies rather than as "the expert's choice". This may partly be because of the belief that costly and high water consuming toilets are best, and the fact that construction of most Ecosan toilets are subsidised and built in financially lacking communities. Which is, unfortunately feeding the existing misconception that the EcoSan toilets have been developed for financially stressed communities (WaterAid 2008b).

The goal of this thesis is to conduct Knowledge, Attitude and Practice studies in Jana Jeevan and Jana Hit secondary schools and the surrounding community, and then to evaluate and suggest sustainable water and sanitation systems.

1.2 Objectives of the study

Overall objectives for this thesis is to evaluate and propose a sanitation system for Jana Jeevan secondary school in Chitwan and Jana Hit secondary school in Kavre. A sanitation system with EcoSan principles will be proposed to recover the nutrients from the excreta, and make them readily applicable as fertilizers to the school kitchen gardens that will be used for educational purposes. Another objective is to evaluate implementation of an EcoSan system in Jana Hit secondary school in the area of Kavre. The systems should be economically reasonable, simple to operate and nutrient recovery leftovers should be easily accessible for local farmers to buy and retrieve.

Because the fertilizer production will be higher than the needs of the school garden, another important study of this thesis include mapping the general acceptance for use of human excreta as fertilizer, and the local people's willingness to pay for this product comparable to chemical fertilizer. I will also assess the general state and norms towards WASH in the surrounding study areas.

2 Background

Nepal borders to China and India, has 31.5 million inhabitants and a huge geographic diversity, with flat plains in the southern part and the Himalayas in the north. The population is very young, 53% being below 24 years old, with an annual population growth rate of 1.8% (WaterAid 2015). Back in 2006, 15.5 % of the people were living in urban cities. The following ten years, the urban population had increased to 19 %, still making Nepal a very rural country, but with urbanization happening at a fast rate (Statista 2018). Agriculture is Nepal's main source of contribution to the economy, sustaining the livelihood of 70% of the population, which accounts for more than one third of Nepal's GDP. (WaterAid 2015). Nepal has quite recently become a democracy and is one of the youngest federal democratic republics in the world. The political transition in the country has lasted over a decade, and has severely stunted its development. It is now among the 48 least developed countries of the world with per capita income of about US$ 850 in 2017 (Government of Nepal 2017), where 25% of the population lives below the poverty line (WaterAid 2015). Recovery from the decade long violent armed conflict is still ongoing, and is currently at a stage of peace building, social reconciliation and economic revival. Despite the internal dispute, Nepal has been able to reduce poverty and made progress with human development during the last two decades, where absolute poverty declined by one percentage point each year and the human development index improved by one basis point per year. Poverty is still a big problem, with an absolute poverty of 21.6 percent, which is among the highest in South Asia. This is also at the bottom of the countries with middle human development status (Government of Nepal 2017).

2.1 Water, Sanitation and Hygiene (WASH) in Nepal

Nepal has made huge progress the last 20 years in improving water and sanitation (*Fig 1*). It is found that 87 percent of households have access to improved drinking water sources. However, the supply system and water quality still see substantial challenges. In urban areas, coverage of water supply is even at 96 percent, but a lot of these urban areas have a semi-rural nature with poorly developed water supply and sanitation systems. 7 percent of households without piped water supply, spend 30 minutes or longer to fetch water, where certain hilly and mountainous areas have up to 30 % of their population 30 minutes or longer from a safe water source. Only 25 percent of drinking water supply systems have good water quality and functionality. For schools and health facilities, around 80 percent have toilets and water supply. However, there are no numbers of how many that are out of operation, as this data has not yet been collected. Water quality remains a priority concern given the vulnerability of existing systems to contamination and poor water treatment practices. 71 percent of households are at risk from *E. coli* contamination at the source of water, and 82 percent are at risk from re-contamination by *E.coli* at the household level. This is a major cause of diarrhoea. While contamination of water with *E. coli* is one of the major reasons for poor water quality, there are also localized issues of chemical contamination such as arsenic, requiring continuous trend monitoring (UNICEF 2016).

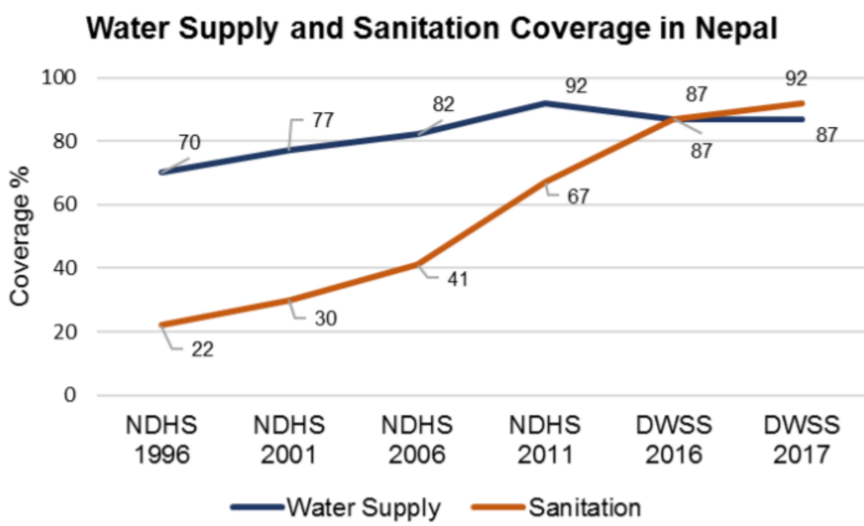

Figure 1. Illustration of the increasing water supply and sanitation coverage in Nepal. Data for 1996-2011 is collected by Nepal Demographic and Health Survey (NDHS), data for 2016 and 2017 is collected by The Department of Water Supply and Sewerage (DWSS) (Joshi 2017).

2.1.1 General situation

The political tension and stunted development Nepal recently went through is partly to blame for the poor sanitation conditions, lack of water with appropriate drinking quality and inappropriate hygiene awareness for the Nepali people living in both cities and on the countryside (UNICEF 2012). Back in 2011, the government started the “Open Defecation Free” movement (ODF), which has seen great results so far. At the time when it was formed back in 2011, 62 percent of the people lived in an ODF area (UNICEF

2016), today 95 percent do. It is also estimated that open defecation will end within 2018 (Khatri 2018). There are just some areas remaining before open defecation ends, where mountainous and hilly areas are 95-100 % free of open defecation, the Terai only has 81 percent ODF-zones. Even though every household and school soon is found to have an available toilet, it continues to be challenges related to the operation, maintenance and use of toilets in schools. Moreover, when there are toilets, social norms still affect people's ability to access them. Daughters-in-law, for example, are not allowed to use the same toilets as fathers-inlaw, a practice which is prevalent in many central Terai communities adding to the burden of building additional toilets (UNICEF 2016). Poor availability and maintenance of toilets particularly affects infants and children under five with potentially lethal outcome, and are a major cause of their current mortality rate. Bad sanitation conditions are also heavily affecting the health of school-aged children who spend their entire days at school. Improved sanitation conditions would significantly improve the health of both teachers and pupils because diseases quickly spread in badly ventilated and small rooms, especially when soap, handwashing facilities and handwashing habits are poor or unavailable (UNICEF 2012). The government with non-government partners did a WASH in schools training programme in 2016. They had three levels of grading for the schools sanitary facilities, where one star grading included daily supervision of handwashing, daily supervised toilet cleaning, soap availability, access to water and catchment area of the school being declared ODF free. To achieve the second star, it is needed to fulfil requirements of the first star, as well as to have improved water treatment, separate toilets for boys and girls, menstrual hygiene dustbin or incinerator, handwashing stands and a drinking water supply system. For three stars, it was also needed to have a ramp up to the toilet, hand railing inside the toilet, at least one toilet per 50 students and a WASH plan within their school improvement plan. In total, 20 schools achieved three stars, 158 schools got two stars and 362 schools were given one star out of more than 29000 schools. (UNICEF 2016).

Basic water supply has currently reached 87 percent, but only half of this (49.5 percent) is water supply through pipelines. Access to a pipeline system as water supply is connected to personal wealth of the household. 99 percent of the people connected to a pipeline system live within 30 minutes of the water source, where access is constant through the rainy and dry season. However, problems with *E. coli* is still very common. 82.2 percent of households connected to pipelines were found to have contaminated water with *E. coli*. For sanitation, 70 % of the households have their own system, where 67.6 percent of the population use latrines. In urban areas, only 30 percent of the latrines treat their wastewater. Most people use nearby rivers or streams as recipients of their untreated wastewater, or send it to a soak pit (Government of Nepal 2017).

2.1.2 Institutional Framework, relevant Policies of Government of Nepal and Strategies

In general, the culture of raising funds for operation and maintenance of water and wastewater handling has been bad in Nepal. Only 4.5 per cent of the water supply distributors generate funding on a regular basis. This poor management may be caused by Nepal's major focus over the last years of eliminating open defecation (UNICEF 2016). However, with help from UNICEF, the government have made a WASH Sector Development Plan (SDP) for 2016 – 2030. The plan is based on the sustainable development goals, with an estimation of about US$10 billion over 15 years to cover the goals. UNICEF supported the finalization of the plan, including review by a mission from UNICEF Headquarters concluding that the SDP and its investment plan were focused towards attainment of the SDGs. In order to meet the target of universal access to water and sanitation for all by 2017, the government increased funding for water and sanitation by 65 percent for the calendar year 2016-2017 (UNICEF 2016). However, the specific targets of the sustainable development goals for year 2030 include basic water supply coverage to 99 percent of the households and piped water supply and improved sanitation to 90 percent of all households. They also wish to eliminate open defecation by 99 percent in all communities, have a personal improved sanitation system for 95 percent of all households, and that 98 percent of the population have access to a latrine (Government of Nepal 2017).

The national organ in charge of water and sanitation is under the ministry of Urban development and called The Department of Water Supply and Sewerage. It has presence in all 75 districts with division and sub-division offices. They have regional offices in five development regions established to monitor. In addition, The Ministry of Federal Affairs and Local Development also works on Water and Sanitation in all the 75 districts through its Technical Department named Department of Local Infrastructure. For strategy and sanitation promotion at a district level, the District Water Supply, Sanitation and hygiene coordination committee is in charge (SACOSAN 2013).

2.1.3 Achievement and Challenges

In total there are 17 SDGs that handle national problems Nepal face, including the sixth SDG for water and sanitation issues. Sustainable development goal 1 for 2030 is to reduce extreme poverty to less than five percent and reduce the gap of people in poverty to be within 2.8 percent, raise average income to US$ 2,500 and raise social protection budget to 15 percent of total budget (Government of Nepal 2017).

For SDG 2, Nepal wants to reduce prevalence of undernourishment to 3 percent and prevalence of underweight children under five years of age to 5 percent by 2030. The more general targets are to (1) end hunger by 2030 and ensure access for everyone to safe, nutritious and sufficient food all year round. (2) End all forms of malnutrition. (3) Double agricultural productivity and incomes of small-scale food producers. (4) Ensure sustainable food production systems and implement resilient agricultural practices. Currently, anaemia remains a major child health problem for almost 22.6 percent of the children. Anaemia amongst women of reproductive age also remains high at 35.6 percent. It is observed that two-thirds (61 percent) of the child population aged 0-59 months has suffered from undernourishment, while close to one-third (32.3 percent) of the children do not consume food adequately (Government of Nepal 2017).

The third SDG is addressing a reduction of maternal maternity rate to less than 70 per 100 000 births. The goal for children's health is to reduce all preventable deaths of new-born and young children to less than one percent. In reality this means to lower current rates of 23 for new-born and 38 for children under five per thousand, to 10 and 22 respectively (Government of Nepal 2017). These SDGs are somewhat related and connected to the state of the current water and sanitation situation. Despite being close to achieving the target related to universal access to drinking water for everyone, several concerns such as quality of water, sufficient availability of water, equality in access to water sources and sustainability of water resources are still to be addressed. Though a policy of integrated water resources management has been formulated, its implementation has been very weak. Only half of all water supply schemes are fully functional at any time. Rapid urbanization is putting more pressure to it, as sanitation issues is mostly linked to creating an ODF society. The challenge will be to keep up the work on sanitation and generate a post-ODF movement to better the current state of household sanitation (Government of Nepal 2017).

In general, the goal of Nepal is to become a middle-income country by 2030 with the spirit of a welfare state. The country aims at sustainable poverty reduction and promotion of human development with low vulnerability and higher human security. The state is realizing its people's increased aspirations for peace, development and prosperity along with their claim to a greater stake in the government and society, notably by exercising a greater voice in determining state policies along with ensuring human security. The state transformation process is now envisioning an inclusive society and economy, and a prosperous welfare state (Government of Nepal 2017).

2.2 Water and sanitation situation in Nepalese schools – review

Water and sanitation facilities in the average Nepalese school is poor. It is not uncommon for schools to have three or four generations of poorly constructed toilets or latrines where maintenance have been non-existent, resulting in the toilets going out of operation. When WaterAid went on random visits by to different schools, they got the impression that the poor state of sanitation and hygiene is understood, but national governments – and civil society in general – often fail to take action. A few simple actions is all that would be needed to better the sanitation standard to an acceptable level in many cases (WaterAid 2015).

Figure 2. State of the boy's toilet on Jana Jeevan School. Photo Ø.M.

2.3 Nutritional issues in Nepal

In recent years, Nepal has been experiencing a stable decline in food security. The World Health Organization found malnutrition to be at a crisis level (Hobbs 2009). A study done by Nepal Demographic Health Survey found protein energy malnutrition in Nepal to be 43 percent and that 48 percent of people suffer from anaemia. Another study by Nepal Micronutrient Status Surveys revealed that 32 percent of children U5 have vitamin A deficiency. Only 47 percent of children between 6-23 months consumed foods rich in vitamin A daily. It was also found that 27 percent of the population in Nepal are in risk of developing iodine deficiency disorders because iodized salt is not accessible in certain areas of Nepal (Chandra et al. 2015). Iodine deficiency is found to be associated with lowered cognitive function, making students affected by this do worse in school. This is also the case for iron-deficiency anaemia, which in addition can lead to reduced muscle function and work capacity. Vitamin A deficiency increases susceptibility to infection and subsequently the risk of severe infection and mortality. Using vitamin A supplementation was found to reduce mortality by 23% to 34% in children below 5 years of age in areas of endemic vitamin A deficiency. A specific consequence of vitamin A deficiency is xerophthalmia, a severe eye disorder and a primary cause of childhood blindness, which is responsible for 350,000 cases of blinding in children worldwide every year. In addition to causing reduced immune competence and eye disease, vitamin A deficiency is likely to negatively influence iron status. Intervention studies showed that vitamin A supplementation or fortification can contribute to anaemia control efforts by increasing haemoglobin levels in preschool and school-aged children (Best et al. 2010).

For children under five years of age in Nepal, protein energy malnutrition is a common problem. 41 percent of children under five years of age are stunted and 29 percent are underweight. For women, 18 percent are malnourished in the sense that they have a lower body mass index (BMI) than 18.5, 46 percent of children age 6-59 months and 35 percent of women age 15-49 are anaemic. The main cause of nutritional deficiency is lacking food intake in terms of quality and quantity. Most Nepalese people's diet consists mainly of carbohydrates with insufficient protein and other micronutrients. This is due to limited access to foods like meat, eggs, milk, legumes, fruits and vegetables. Even if they do have this available, their culture and eating habits does not include in particular animal products on regular basis (Chandra et al. 2015)

Education through school gardens

Constructing and maintaining a school garden has shown several benefits among the students. Skelly & Bradley observed a higher sense of responsibility among the students and increased positive attitude towards science. The garden may not be the direct cause of higher sense of responsibility, but the teachers themselves observed that gardening played a role in fostering it. (Skelly & Bradley 2007). School gardens also exposed students to nutrition education lessons, which significantly improved their nutrition knowledge. The increased exposure of vegetables also improved students' vegetable preferences. In the study done by Morris et al., the interest for carrots and broccoli were in particular increased. They also found increased interest among students in certain vegetables that was not even grown in the garden. This suggests that the intervention even improved students' preferences for vegetables to which they were not directly exposed. (Morris et al. 2009) This was probably due to a higher willingness to taste new vegetables after participating in the gardening. With good availability of fresh vegetables for school cafeterias, healthier school lunches is one measure to deal with the obesity epidemic. There is already a campaign program to implement more fruit and vegetables in school meals. (Ratcliffe et al. 2011)

Wastewater handling for nutrient recovery

A school kitchen garden needs fertilizers for vegetables to grow. They are expensive to get by and not affordable for most public schools in Nepal. Nepali people today view wastewater as dirty and something that needs to be disposed of. However, the traditional practice has been to mix cattle dung with urine and remains of grasses and hay, then use this as manure after composting it in a manure pit. Human excreta was also recognized as the most valuable manure, and in many cases fed directly to pigs (Poudel & Adhikar 2015). They also made pits with ash from kitchen waste along with urine and some agricultural residue. This was to balance out the high the nitrogen content in urine with the high carbon content in ash and straw and produce a good quality compost to use in the field after six months of composting. These days, most houses have implemented a pour-flush toilet that is connected to sewer lines or septic tanks. Garbage is usually thrown on the streets and collected by municipal sweepers. The poor management of excreta and waste has led extreme pollution of rivers and streams and farmers no longer benefit from the use of human excreta (WaterAid 2008a).

Ecological sanitation recognizes the value and reuse of excreta and wastewater. The goal of EcoSan is to protect the environment. Using urine as a fertilizer rather than releasing it directly into water bodies prevents issues like eutrophication. Secondly, the environment benefits from the conservation of fresh water by reducing water used for flushing, as many places in Nepal have scarce water supply. Thirdly, the decreased need for chemical fertilizers with urine as replacement is beneficial to the environment and the soil quality. Minerals used for chemical fertilizer are also typically mined and processed by using large amounts of energy, water, explosives and harmful chemicals. Once produced, these fertilizers leak from fields into ground and surface water, especially when applied in excess, and cause the same problems with excess nutrients as urine does in water (WaterAid 2008a)

To solve and change the negative sanitation pattern Nepal is currently suffering from, ecological sanitation is a sustainable option well suited for the social and economic conditions of the Nepalese people and schools. However, it is important that health-related conditions are safeguarded, with treatment systems that properly hygienize the human waste for the people who are using it for plant production.

2.4 Overview of EcoSan technologies for school water and sanitation

The most common sanitation systems in Nepal today are either pit latrines or squat pans connected to a septic tank (ENPHO 2006). They are easy to operate and maintain and is considered as an improved sanitation system. The wastewater is either transported to a septic tank first, or directly to a dug hole. If the wastewater goes through a septic tank first, a lot of the suspended solid will have time to settle inside the tank before it is sent to the hole, which usually is one to three meters deep and covered by a slab to avoid flooding of surface water, odor and access for insects. Without a septic tank, all toilet waste is disposed of into the pit where the solids accumulate and the liquid infiltrates into the walls and bottom of the pit. The pit latrine does not require water and is a good option for areas with limited access to water. The only issue is the level of treatment with this system. There is risk of groundwater contamination from the leachate and the bottom of the pit should be at least 2 meters above the groundwater table and 30 meters from the nearest source of water. After the pit is full the contents can be dug out and used for agricultural purposes if it is properly stored and dried to limit the number of pathogens (Rørå 2017).

However, to recover nutrients in schools with limited resources, these systems are not very sustainable. A new sanitation system should have better treatment values than what a septic tank can provide for protection of the ground water, unless there is certainty of good treatment during infiltration.

2.4.1 Urine diversion

The main thing for ecological sanitation systems is to separate urine from the faeces. Urine contains little to no pathogens and the main portion of nutrients in wastewater is in urine, which is roughly 88 percent of nitrogen, 74 percent of potassium and 61 percent of the phosphorus humans excrete (Tilley et al. 2014). Consequently, if it is mixed with faeces it will require treatment before it can be used as a fertilizer. Separating urine is therefore bringing a number of benefits, including simple waste management, reduction of odors from the wastewater and a reduced volume of waste. In a rural situation the best means of re-using urine is through direct application to land (Khatri 2013). Before applying to the field, it should be stored for at least two months after collection. After storage, the urine is hygienized and fast acting as an easily plant available N-fertilizer. Before application, the urine should also be diluted with a ratio from 1:3, up to 1:5 parts urine to water, in order to avoid over-application and to reduce odour (Krause & Rotter 2018). In an experiment with urine collection done at a school in Nepal with the support from UNICEF, urine from more than 200 students filled a tank with the capacity of 1000 litres in four to five months. They used two tanks with a capacity of 1000 litres each to collect urine and sold it as an extra income for the school (Poudel & Adhikari 2015).

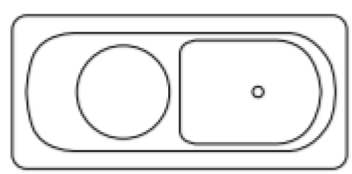

Figure 3. Urine diverting slab (Tilley et al. 2014)

There are several different types of urine diverting toilets, but squatting pans are the most common toilet types in Nepal (Water Aid 2008b). The slab with urine diversion will have a urine collection part in the front area of the toilet, while faeces fall through a large chute (hole) in the back (Tilley et al. 2014). It functions very similarly to a pit latrine, where faeces together with wash and flush water is transported to a pit. The water will percolate through the soil in the pit and once the pit is full, the contents can be dug out and used elsewhere as fertilizer. The only difference is the urine diversion to a separate container (Poudel & Adhikari 2015).

2.4.2 Urine diverting dry toilets

A dry toilet with urine diversion, referred to as Double Vault Urine Diversion toilets (DVUD) is very similar to the urine diverting slab. Instead of using a pit, faeces is stored in vaults with ventilation pipes. In addition to the urine diversion container, the slab has a separate compartment for anal cleansing water. Usually, there are two separate vaults for faeces storage constructed above ground level to avoid contact with ground water. The vaults for faeces storage need doors that are big enough to allow easy removal of its content and the wastewater from anal cleansing is transported through pipelines into a soak pit. If there is danger of contaminating the groundwater, the anal cleansing water can be led through a small wetland for better treatment values (WaterAid 2008a).

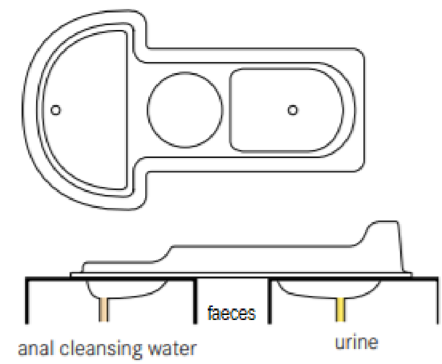

Figure 4. A dry toilet with separate compartments for urine diversion and anal cleansing (Tilley et al. 2014).

2.4.3 Constructed wetland

Horizontal flow wetlands

There are two main types of constructed wetlands. The difference between them is what direction the water flows through the system. A horizontal subsurface flow constructed wetland is a dug basin filled with gravel and sand. The wastewater inlet is at the top of the wetland in one end, with the outlet on the bottom of the basin in the other end. This makes the wastewater flow horizontally through the filter material to let sand and gravel filter out particles, while microorganisms remove the biological oxygen demand (BOD) and chemical oxygen demand (COD). Pathogens are removed by natural decay, predation by other organisms and filtration. The filter media has a fixed surface where bacteria can grow, as well as being a base for the vegetation. The plants themselves don't play an important role in directly removing organic pollutants. However, the vegetation transfers small amounts of oxygen to the root zone so that aerobic bacteria can grow and degrade organic pollutants as well, which is very important. The roots are also important for the permeability of the filter (Tiller et al. 2014).

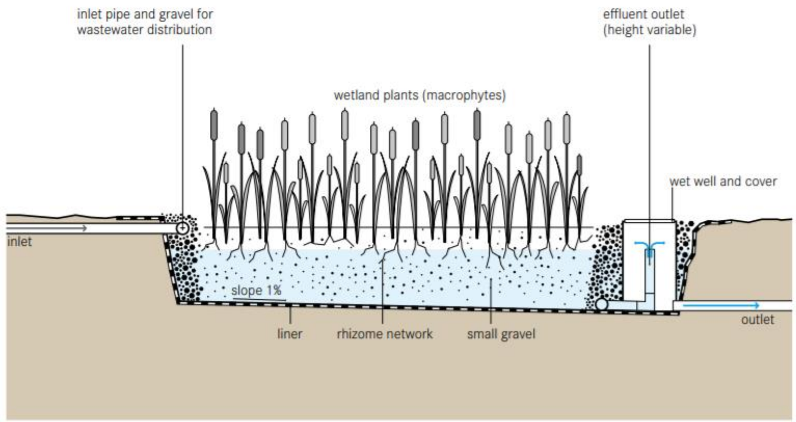

Figure 5. A cross-sectional scheme of a horizontal flow constructed wetland (Tiller et al. 2014).

Vertical flow constructed wetland

A vertical flow constructed wetland is different to the horizontal flow wetland by dosing wastewater onto the surface from the top of the media. The water infiltrates vertically down through the filter media to the bottom of the basin where it is collected in a drainage pipe. The important difference between a vertical and horizontal wetland is not simply the direction of the flow path, but the aerobic conditions necessary for nitrification. This is because pores in the filter media are reaerated a between every dose of wastewater, which would not happen with a constant flow. Vertical flow constructed wetlands generally need less space than horizontal flow and efficiently removes BOD, COD and pathogens as well (Tiller et al. 2014).

2.4.4 Options for sludge handling

Current management of sludge generated in decentralized wastewater treatment systems in Nepal is not sustainable. Septic tanks, the most common storage container for sludge does not treat it, and with a lack of sludge treatment facilities most of the sludge is disposed of untreated. Some people use accumulated sludge for agriculture, if they don’t, sludge is often taken away and dumped in nearby water bodies or open spaces (Pandey & Jenssen 2015). Sludge treatment facilities are sophisticated and expensive to build and operate, which in particular makes developing countries at a disadvantage in handling this problem (Brix 2017).

For places with a lack of funding for an advanced conventional sludge treatment plant, sludge drying reed beds (SDRBs) is a good option. The reed beds are built similarly to a constructed wetland with vertical filters and a drainage system in the bottom in order to reduce the water content of the sludge. The bed is sealed by a plastic sheet in the ground or with vertical concrete sidewalls on top of the soil. The walls need to be approximately 1.5m above the ground so it is possible to store the sludge for a longer period. Drainage pipes are placed in a layer of coarse gravel at the bottom with ventilation to transfer oxygen from the atmosphere to the drainage layer. On top of the drainage layer is one to three finer-textured layers of gravel, sand or soil to filter the water from the sludge. The upper so-called 'growth layer' is planted with the wetland grass Common Reed (Brix 2017). A well designed SRDB is effective in increasing the dry matter content of the sludge, which also reduces total sludge volume (Pandey & Jenssen 2015). Processes during drying also hygienize the sludge by up to log 5 for *enterococci* and log 6-7 for *E. coli*. A study proved three to four months after the final loading of sludge was enough to reduce the number of pathogens for the sludge to be safe for agricultural uses. The final product can therefore safely be disposed of or used as fertilizer (Brix 2017). A properly constructed sludge dewatering reed bed system requires little maintenance, uses little to no electricity and can be loaded for up to 8 - 10 years before the sludge must be removed (Pandey & Jenssen 2015).

2.5.5 Biogas reactor

A biogas reactor collects, stores and treats excreta in addition to producing biogas which can be burned for cooking, lighting or electricity generation. For biogas production, the reactor can use urine, faeces, flushwater, cleansing water, dry cleansing materials, organic material and animal waste if available. It can be connected either a standard pour flush toilet or a urine diverting flush toilet. Depending on the loading and design of the biogas reactor, a thin or thick digestate is continuously discharged. Because of the high volume and weight of the material generated, the sludge should be used onsite. The sludge produced is nutrient-rich and a good fertilizer that can be applied in agriculture after drying. (Tilley et al. 2014). The anaerobic digestion for biogas production depends on several different parameters for optimal performance. Different groups of microorganisms are involved in the methane production, and suitable conditions have to be established to keep all the microorganisms in balance. Some of these parameters are: pH, temperature, mixing, substrate, carbon/nitrogen ratio, and hydraulic retention time. Digestion is a slow process and it takes at a minimum of three weeks for the microorganisms to adapt to a new condition when there is a change in substrate or temperature. Furthermore, a neutral pH is favorable for biogas production, since most of the methanogens grow at the pH range of 6.7–7.5. Mixing is also an essential parameter for biogas production. Too much mixing stresses the microorganisms and without mixing foaming occurs (Rajendran et al. 2012).

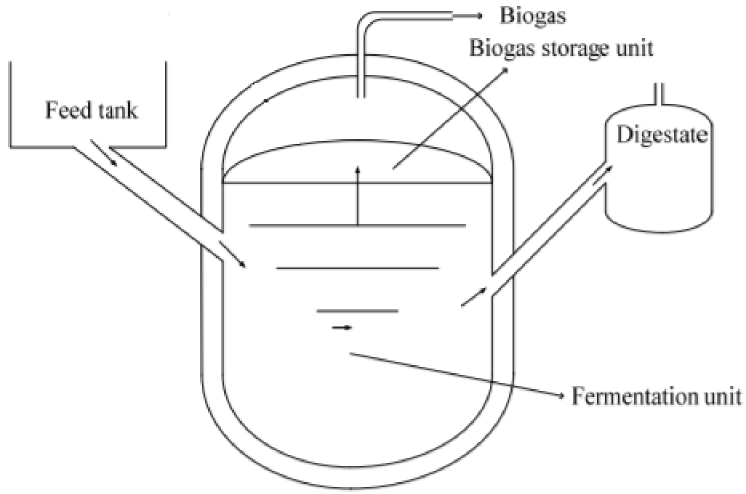

Figure 6. A dome biogas reactor (Rajendran et al. 2012)

2.5.6 Rainwater harvesting

Most commonly, drinking water is generally obtained from two sources: ground water (wells, boreholes, etc.) and surface water (rivers, lakes, etc.). However, these water sources only represent 40 percent of total precipitation. Areas suffering from water scarcity lack sufficient water supply from ground water and surface waters and need an additional supplier for their demand to be met. A simple solution to this is collecting rainwater, and prevent the water to run off into rivers, streams or infiltrate to the ground and become contaminated.

To maintain the quality of harvested rain water, a simple and convenient discharge system is very important. It is essential that the first rainwater can be discharged outside the storage tank easily through a flushing system. The cover of the tank should be tightly fitted to prevent evaporation and mosquito breeding and to keep spiders, lizards, and other insects from entering the tank (Kumar 2014).

3 Methodology and materials

The thesis is based on a PhD research proposal by the NORHED fellowship called EcoSan in schools: A Participatory Action Research on integrating water and sanitation to farming in schools of Nepal through school garden projects.

3.1 Study areas

Chitwan

The district of Chitwan is located in the southern parts of central Nepal. The district is very flat with a lot of cultivated land and a fairly developed community. Most of the people are farmers, where rice, corn, wheat and various vegetables are the most common agricultural products. The Jana Jeevan school is located around 50 meters above sea level

Figure 7 Map of all districts in Nepal with Chitwan marked in red (Wikipedia n.d.).

Figure 8. Pictures of typical landscape and home in the area around the Jana Jeevan school. Photos Ø.M.

Kavre

The district of Kavre is located in the mid-eastern parts of Nepal with a population of 381.937 in 2011 and an area if 1396 km^2, only a two-hour drive from Kathmandu. The area is very mountainous with deep valleys separating the villages. Altitude varies from 1007-3018m (Ofenmacher 2018), The Jana Hit school is approximately 1600 meters above sea level. It has about 350 students from grade 1-15 and 15 teachers. Houses

Figure 9. Map of all districts in Nepal, where the district of Kavre is marked in green (Ofenmacher 2018).

are mainly made from stones and clay.The geology has made parts of the district very rural despite being close to Kathmandu. Most people living in the mountains are more or less self-sufficient and have farming as their main source of income.

Figure 10. Pictures of households and the environment in the area around the Jana Hit school.

3.2 School selection – How the schools were selected

The schools were selected by being two among a few schools that expressed their interest in nutrient recycling of school wastes. The areas around the schools are relatively spacious and they had a wish to start their own kitchen garden for teaching purposes. The NORHED project then visited the schools with a form (below) to see if this was a place they saw potential in working with.

S.No.	Indicators	Yes	No
1.	The schools owns land for school garden/kitchen garden (at least 0.5 hectare)		
2.	The school comprises dalit/Janjati /Madhesi children		
3.	The school has female teachers(at least 2-3)		
4.	Teachers are motivated to collaborate in the project		
5.	School management committee is active/functional (meetings are organized regularly)		

6.	SMC members and head-teacher are motivated to implement the program		
7.	There is a need/feasibility of installing ecosan toilet		
8.	There is space/room for installing/developing a science/computer lab		
9.	There is a functional/active child club		
10.	There is electricity facility in school		
11.	There is drinking water facility in school		

3.3 Data collection.

3.3.1 Review of literature

Nepal have been going through massive changes recent years. After the earthquake in 2015, progress has been made to cover water and sanitation issues faster than ever. To get a representative picture of Nepal's current state, sources for information released as recent as possible have been used to be as accurate as possible. I have been given access to some articles that have yet to be published, and I have also used information from presentations during my stay in Nepal. This was to describe the current state for some topics in this thesis because no article published recently enough do.

3.3.2 Social survey study: Structured questionnaire survey

A questionnaire survey to map baseline knowledge and attitude for specific topics, also called a Knowledge, Attitude and Practices survey with predefined questions in standardized questionnaires is a quantitative method that provides access to quantitative and qualitative information. KAP surveys reveal misconceptions or misunderstandings in potential obstacles and barriers for behavior change when implementing new activities to an area. Essentially, a KAP survey reveals the opinion of a specific topic based on statements by the interviewed. Ultimately, the KAP survey reveals what was said, but there may be considerable gaps between what is said and what is done. With information found through a KAP study, suggestions for an intervention strategy that reflects specific local circumstances and the cultural factors that influence them is easier to make. In other words, the KAP study simplifies the making of a plan for activities that are suited to the respective population involved. (Monde 2011).

For this thesis, data were collected with the help of mPhil and PhD students from Tribhuvan and Kathmandu University. They acted as interpreters for a questionnaire survey about water, sanitation, nutrition and health. It was given to local people of the community, teachers and students and was based off tools made for similar studies conducted before.

In Chitwan, the number of peopled interviewed was of 15 people from the community, 13 students and five teachers, while in Kavre, only eight community people and five students were interviewed.

3.3.3 Focal group discussion, site visit and verification

A focal group discussion with the head teacher and the chair-person of management committee was done so they could express what they were expecting of this system, and to find what solutions they did not find suitable. Focal group discussions are used as a qualitative approach to gain an in-depth understanding of social issues with a purpose to find data from a select group of people e.g. the people in charge, instead of the average opinion in the area (Nyumba et al. 2018)

Examinations done during the site visit include access to available area, basic geology interpretations, soil type, groundwater depth, infiltration capacity and some other field investigations.

3.3.4 Analysis and interpretation of the data

Structured questionnaires were used to conduct KAP studies. Since the information collected were qualitative in nature, simple graphs were used to interpret the aggregated information.

4 Results - Primary research findings

4.1. WASH situation in the school – Jana Jeevan – Water supply, Sanitation systems, Greywater situation, Blackwater Disposal

Figure 12. Second floor of the current toilet facility for grade 5-15 used by the girls and the teachers. Photo Ø.M.

Figure 11. Inside the girls and teachers toilet. Photo Ø.M.

Their water supply system is sufficient to cover their needs and they have several hand washing and drinking water stations. They do currently not provide soap for hand wash, because most students don't have habits of using it. However, they have plans of collecting a small fee from the students to provide soap, to make them feel an ownership of the soap and use it more frequently. The state of the toilets are varying. They renovated the kid's toilet a few years back to a decent standard. Girls and teachers share toilets at the first floor, while boys have their own separate toilet on the ground floor at the back of the school. The state of the girls and teachers toilet is also quite good, with a relatively clean environment given the situation. The boy's toilet however, is stinking of urine and old books and papers are clogging the squat pans. The waste from these toilets are sent to a soak pit where water infiltrates through the ground and walls. The pits are about 2 meters deep. Waste from the children's toilet is sent to a septic tank before infiltration in a soak pit. The septic tank was built seven years ago, and has not yet been emptied.

All things considered, current WASH situation in Jana Jeevan is fair for the most part, with a few exceptions like the boys toilet.

4.2 WASH situation in the school – Kavre- Water supply, Sanitation systems, Greywater situation, Blackwater Disposal

The WASH situation in Kavre had recently been improved. The old toilets were stinking of urine and had paper sheets clogging some of the latrines, but a new sanitation facility had just been built. It was going to open in the near future, and had septic tanks before soak pits to handle black water, while grey water was just infiltrating to the ground wherever tapped. There were no proper stations for handwashing, but they had a basic water tap in the middle of the school yard used for both hand washing and drinking water. The school was on top of a mountain, so there was no groundwater present. All the water came from the bottom of the valley by pumping. Available water was decreased after the earthquake in 2015, and the whole community had insufficient water supply during the dry season.

Figure 13. Genderless toilet facility in the middle of the schoolyard on Jana Hit secondary school. Photo Ø.M

4.3 Natural conditions around the school

Jana Jeevan

The area of Chitwan is very flat. There is a lot of agricultural land surrounding the school and a few masonries taking advantage of the clayey soil to make bricks.

Figure 14. The schoolyard of the Jana Jeevan secondary school. Photo Ø.M.

The soil was red with high clay content and very typical for the area. It has low nutrient values and needs additions of nitrogen, phosphorus and potassium to become fertile. The water supplier of the school had been checked for arsenic content in the water five years ago by the government. They did not find any alarming levels of arsenic or other metals back then.

By consulting with local people in the area and the chair-person of the management committee, I found groundwater level to be 13.5-15m during the dry season, and 6-7.5m during the rainy season. With an infiltrometer I found a water infiltration rate of 0.76m/d. Daily water use in the school varied depending on the season. During the dry season, they use around 8000 L daily, in the rainy season and the winter time they use around 4000 L. Flooding during the rainy season was not of worry, as the ground would be soaked, but they do not experience any running streams.

Jana Hit

Figure 15. The schoolyard of Jana Hit, currently under a lot of construction work at the time the picture was taken. Photo Ø.M.

The school is located on the top of a hill on a mountain ridge. The school is next to agricultural land organized in ledges all the way down the mountain. The land is very barren during the dry season because of the lack of water, only allowing pine trees for the most part to grow. The dry soil is also creating a lot of dust in the air.

The soil in this area was light brown. It mainly consists of clay and loam and is very dense and difficult to penetrate with spades. Infiltration rate was 0.5 m/d. Groundwater is not present, and has to be pumped from the bottom of the valley to supply the people. There are also no problems with flooding events.

4.6 Meteorological data

The weather of the area in Chitwan is split up in three seasons called the rainy season, the dry season and the winter season. During the rainy season, flood events are common and it lasts mainly from June/July to September like we see in figure x. Temperatures vary from 30-40 ^{0}C during this period, before winter starts around December and lasts until February. During this time temperatures varying from 10-20^{o}C.

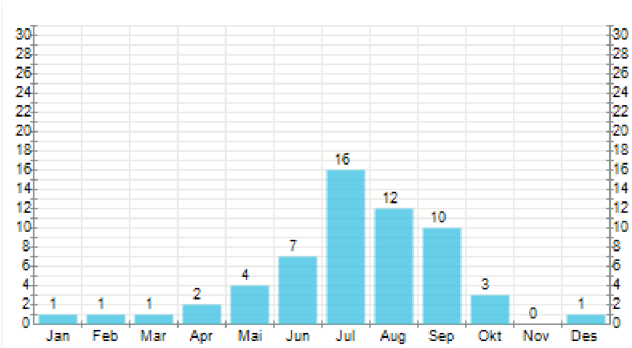

Figure 16 Days during the month with at least 1mm of precipitation (www.yr.no)

Meteorological data for the Kavre area was unfortunately not accessible online

4.7 Agriculture in the area

Chitwan

Agriculture in the area is very diverse. Most farmers have either rice pads or corn fields as their main production. Wheat production was also common and at the time I was there tomatoes were the most common vegetable grown. There were also numerous banana plantations at the outskirts of the area. Livestock for most of the farmers were goats, chicken and buffalos. Dairy cows were also common.

Figure 17. Local farmer next to tomato plants with his corn field in the background. Photo Ø.M.

Kavre

The agricultural activity is mainly during the rainy season. The most common plant grown by far is corn, the only other type of fields observed were for wheat and grass. Most households have goats and chicken for livestock.

4.8 Result of questionnaire survey and focus group discussion

4.8.1 Chitwan

Sanitation

12 of the people from the community were farmers and regularly used animal manure and DAP for fertilizing their fields. Nine people said they also use potassium. Three of the teachers were also part time farmers and used animal manure, DAP and potassium in their fields.

Toilet types in their homes were either a standard squat pan or water seal single pit with pour-flush. Only one house had a toilet that did not use water to flush. The most common way of handling the toilet waste was through a septic tank. Of people asked, 50 % were using a septic tank, while other people used pit, biogas reactor, left it out in the open or did not know here it went *(fig 18).*

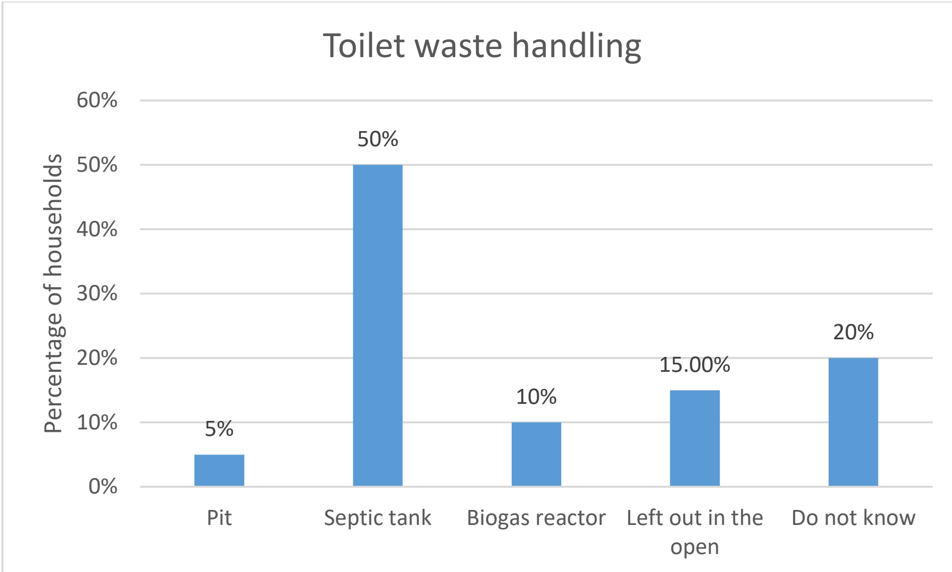

Figure 18. Percentage of different methods for toilet waste handling.

Reusing the sludge as fertilizer was only done by 50 percent of the people asked *(fig 19).* As mentioned, 75 percent were using chemical fertilizers in their fields, indicating a substantial gap in knowledge about the value of human excreta in this area. 15 percent did not know what they did with the sludge, while the remaining people dug the sludge down somewhere else, transported it away or stopped using the toilet.

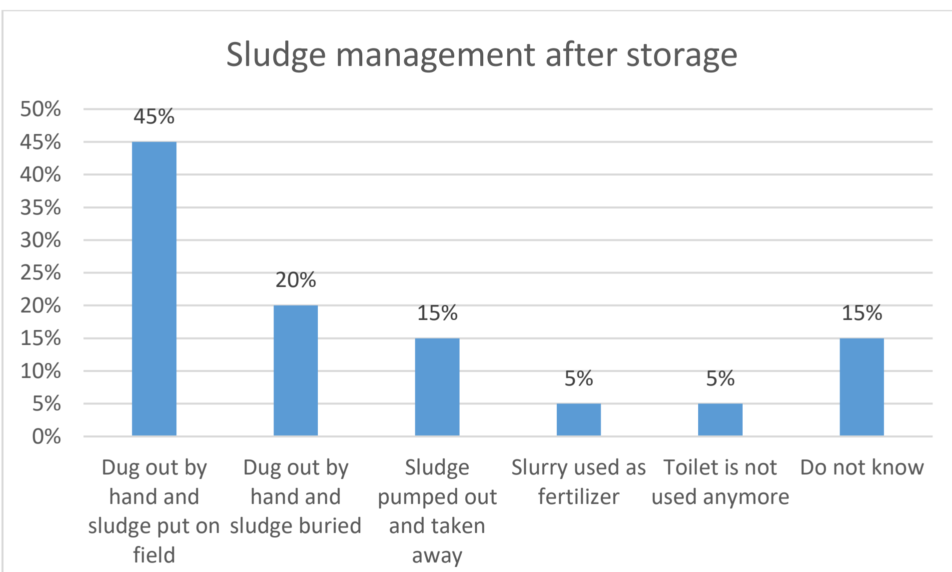

Figure 19. Management of sludge once their sanitation system was full.

Eight out of 20 stated they had issues with their toilet, leaving it unavailable for use yearly.

When asked if they had heard about urine diversion before, eight out of 20 said they had. However, five of these were teachers who had all heard about it, meaning three out of 15 community people were aware of this solution.

The new sanitation system of the school will produce more organic fertilizer than they need themselves. They will therefore be able to sell some to neighbours of the school. When asked if they would be interested in buying composted excreta for a reasonable price, nine out of 20 said they would. Three teachers and three community people said maybe, while one farmer was self-sufficient with organic fertilizers leaving five people uninterested in buying this product. When asked about buying urine, the response among the community people was the same, while three teachers answered yes and two were unsure. When asked about buying slurry from a biogas reactor, four community people and four teachers said they would. Seven community people did not want this, while four farmers and one teacher said they might or were unsure.

When asked if it was okay for their children to eat vegetables from a school kitchen garden nourished by human excreta, this was their response *(fig 20).*

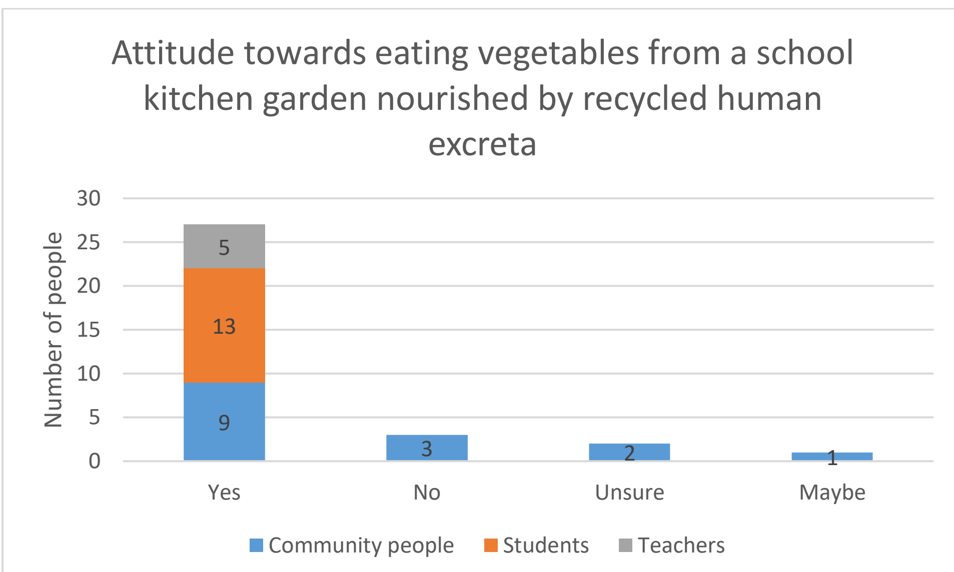

Figure 20. Attitude towards eating vegetables grown using human excreta.

All teachers and students said they were ok with it, while six community people expressed their concern by answering no, unsure or maybe.

If the new sanitation system for the school implements a biogas reactor, most of the gas would be sold to others, as the school does not require a lot. 12 out 20 of the people asked, expressed their interest for this, while three did not need biogas. Five people were unsure or said they might buy.

Water

Water supply in Chitwan changes for some people depending on the season. When asked about water supplier during the dry season, 66 percent got their water from a private pipeline. Most people had pipeline systems directly to a sink inside their home, but 15 percent or five of the students had to collect water at a public tap stand.

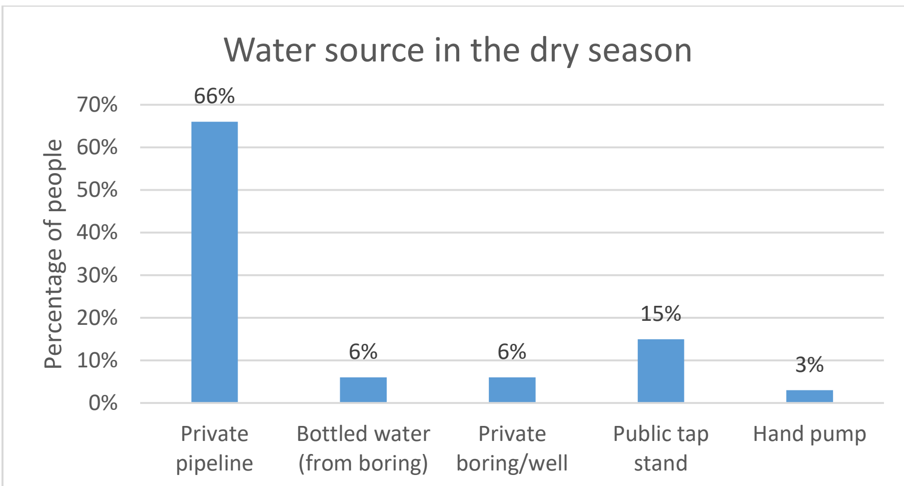

Figure 21. Different types of water suppliers during the dry season.

The source of water during the rainy season was not very different from the dry season. The only difference was for the people who needed bottled water during the dry season. They had private boring or hand pumps with sufficient water supply this period.

Half of the people asked did not treat their water in any way, while seven people bleached or added chlorine occasionally, five people had installed a water filter and three people boiled their water before intake.

For water quality, 23 out 33 expressed satisfaction for the standard of their water supply in the dry season. In total, 9 people expressed a concern saying it was either poor with a clear red colour, or not fit for use.

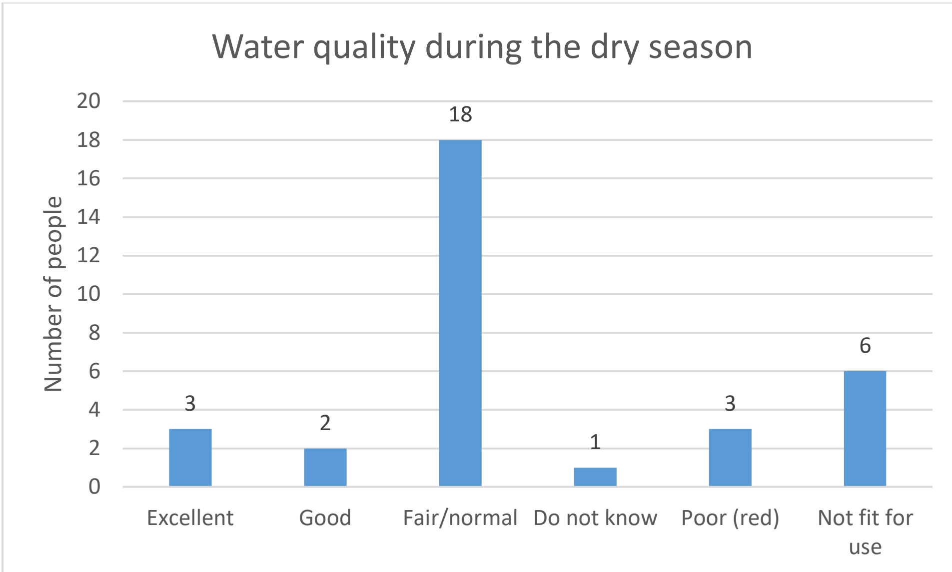

Figure 22. Perception of their water quality during the dry season.

Water quality during the rainy season, got worse for five of the people asked. In total five people now found their water poor with a red colour and nine did not find their water source fit for use. For the remaining people, they did not see any substantial change. When asked how often they think members of their community have diarrhoea, 17 answered yearly while 15 answered never and one didn't know. However, all five teachers and nine of the students answered yearly. Among the community people only three households answered yearly while 11 said never along with four of the students.

One solution to solve this change and lack of water would be to implement a rainwater harvesting system. The community people and teachers were therefore asked if they would like to build such a system if they had the financial means. The response was positive and 14 households said they would like one, while four households were satisfied with their current system and had no need and two households were unsure. Although they were satisfied with their current water supply system, some of them thought rainwater harvesting would be nice to irrigate their plants.

Nutrition and health

When asked about nutritional habits, everyone said they eat vegetables on a daily basis. As snack, seven of the community people and two students occasionally eat processed or fast food. 13 of the community people usually ate homemade food as snack, while all students and teachers ate food from the school cafeteria. Animal products like milk was a part of all community people and teachers daily intake. Only three students had milk on a daily basis. Meat intake among the community people was weekly or rarely for 11 of the households asked. 10 of the students rarely ate meat while all of the teachers did on a regular basis.

When asked about health today, 28 answered they had good health. It was only four households of the community people who stated they suffered from poor health, where two of them recently had gone through operation. When asked if they had been sick the last 30 days, common cold with fever and running nose was the most common. However, only 3 of the community people and two of the teachers had been sick. For the students on the other hand, 10 out of 13 had gone through a common cold, stomach pains or vomiting the last 30 days. In total out of all 33 people questioned, there were only two cases of diarrhoea.

Even though everyone said they washed hands before and after eating and after going to the toilet, personal hygiene among students is probably worse than for adults due to their high sickness rate. This may also be related to the sanitation state of the school.

Focus group discussion

They expressed their concern of the school uniforms student need to wear. Working with decomposed faeces and urine would most likely make their uniforms dirty, so they wanted a system with a minimum of maintenance and direct contact with dirt. A separate sink for anal cleansing was not a solution they liked and would rather only have urine separation with a septic tank, over implementing a dry toilet. They have very limited resources and capability to hire personnel that can maintain a system that needs continuous supervision and because the students will do most of the work with the kitchen garden, excreta reused should be at a state that makes little mess.

When asked about biogas, they were not sure if neighbours would buy. It would also have very limited use at the school premises, because the cafeteria is the only place it would be used. For optimal production of biogas, the reactor needs a source of organic waste. The cafeteria produced about 3 kg of organic waste every day, which should be sufficient for optimal production.

Their current water supply was sufficient, and a rainwater harvesting system was not something they were interested in at this time.

4.8.2 Kavre

With a very limited time frame, and arrival in the middle of the exam period, interviewing students and teachers proved to be a little difficult. The area was very poor with scattered houses, and the time of year made most of the younger adults leave for seasonal work elsewhere. That meant a lot of the houses were vacant during our visit. In total, eight households with community people, five students and no teachers were given the survey. All community people interviewed were farmers and used animal manure and urea for fertilizing the soil. However, they were only able to grow crops in the rainy season due to lack of water supply. The researcher and his team I went with for interpreting had spent a lot of time to become good friends with teachers in the area, and did not want to stress them more than necessary to keep the good relation, which is why no teachers were interviewed.

Sanitation

The most common toilet facility in Kavre was also the standard squat pan or water seal single pit. However, three of the people asked had a hole, one household used buckets and one of the students had a urine-diverting toilet. Only two of the households had ventilation chimneys and many of the people expressed their concern about smell putting the toilet out of operation for a while. Two thirds had their toilet lead to a pit, while the remaining one third had septic tanks. Only three of the eight households used their sludge in the fields. The remaining five covered the pit and dug a new one once it was full. Five out of the eight community people did not have practice of separating decomposable and non-decomposable waste, and deposited their garbage out in the open field. The remaining three had compost pits. For animal waste, six of the households had a traditional manure pit, while the remaining two put it in a compost pit. No one, but the student with a urine diverting toilet had heard of urine diversion before.

However, their attitude and understanding towards reuse of human excreta was very positive when asked if they would like to buy it for a reasonable price *(fig 23).*

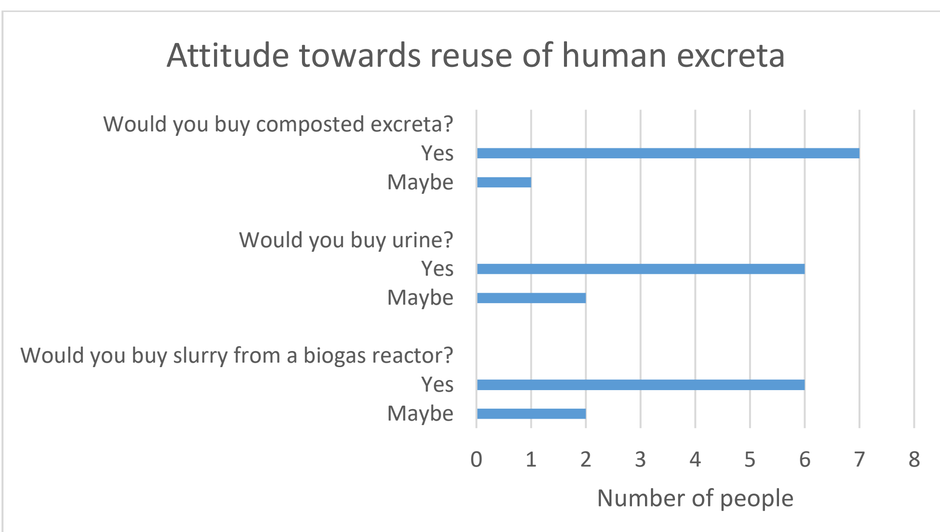

Figure 23. Response from the community people towards reuse of human excreta.

They also responded equally positive towards buying biogas and to implementation of a rainwater harvesting system, where six answered yes and two answered maybe for both questions. In addition, all eight community people and five students said they had no problems concerning vegetables grown in a school kitchen garden nourished by recycled excreta.

Water

Like in Chitwan, most people have private pipelines to their household. Two of the households had to get their water from a public water tap or well nearby and there was no change in water supplier depending on season. One household stated that their water supply goes dry weekly without saying why. For the other households, water supply only stopped during electricity cuts because pumps went out of operation.

All but one of the households were satisfied with the colour of the water during the dry season. In the rainy season, three households perceived the water colour as poor, while the remaining eight were satisfied. Four out of the eight community households never purified their water. One household had a water filter, one household boiled their water occasionally and two households always boiled for purification. When asked how often they think members of the community have diarrhoea, the replies were quite varying *(fig 24)*.

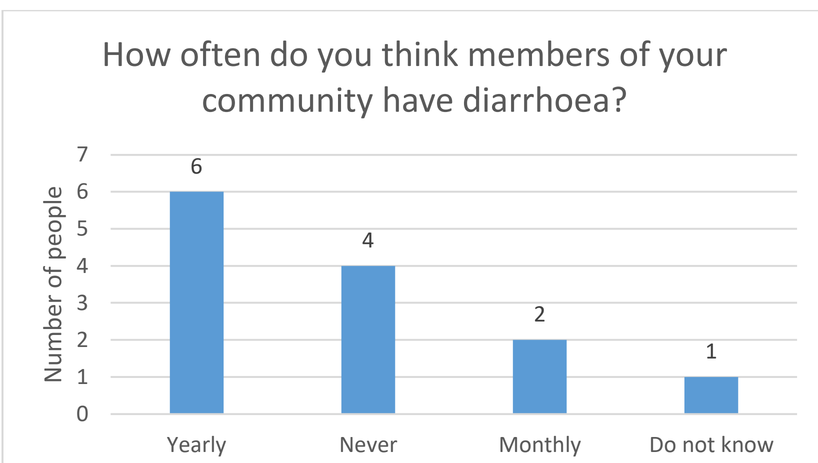

Figure 24. Guesstimate of how often people in the community suffer from diarrhoea.

Four out of five students thought yearly incidents of diarrhoea was common. Only one student and three community people said never, while two community people thought diarrhoea incidents happen on a monthly basis.

Nutrition and health

All students and three of the community people eat vegetables on a daily basis and the remaining five community households rarely eat vegetables. When asked how often they eat animal products like meat, egg and milk, all students and seven of the community people answered rarely. The last household said never.

The majority of the people interviewed described their current health as very good *(fig 25)*.

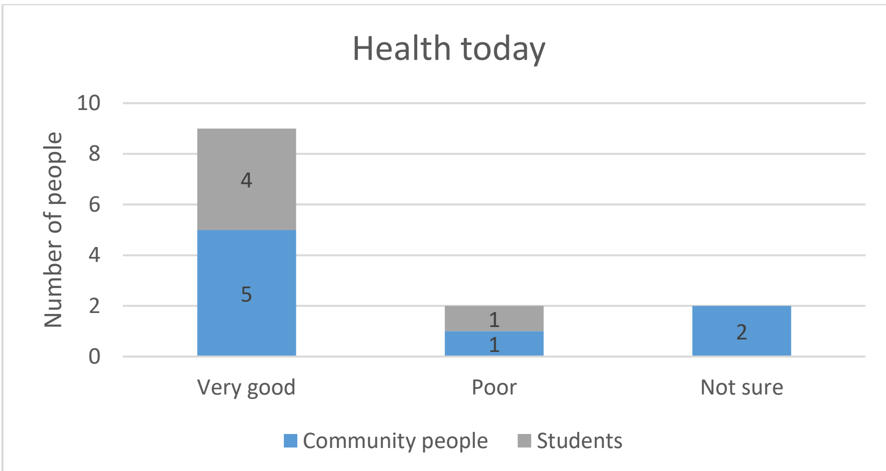

Figure 25. Description of current personal health.

Only one student always washed hands after using the toilet. It was also not common to wash hands before eating.

Focus group discussion

Head teacher of the school was not available and with a limited time frame of the trip, the vice principal had to step in his place. When asked about handling of urine diversion, he said the school helper team could help distribute to the school garden and community. He was open to the idea of a dry toilet and thought students would adjust to the changes. When tanks were full, they were able to hire someone to clear and clean them.

When asked about biogas reactor, he said the community were aware of the uses for biogas and would most likely buy from them. They did not have any source of organic matter to add to the reactor and would have to depend on surrounding community to supply them this.

He said they would like to implement rainwater harvesting. They had just recently built a big water storage tank in the middle of the schoolyard, and with proper instructions on how to make rainwater harvested safe to use, it would be a great supplementation to their current water supply. The water supply they currently use is pumped from the bottom of the valley and would be enough for the kitchen garden, but using rainwater harvesting for this purpose would be good.

Greywater from the school is just infiltrating wherever tapped. Blackwater is led to a soak pit.

5 Discussion

5.1 Suggested improvement options

5.1.1 Sanitation system proposal for Jana Jeevan

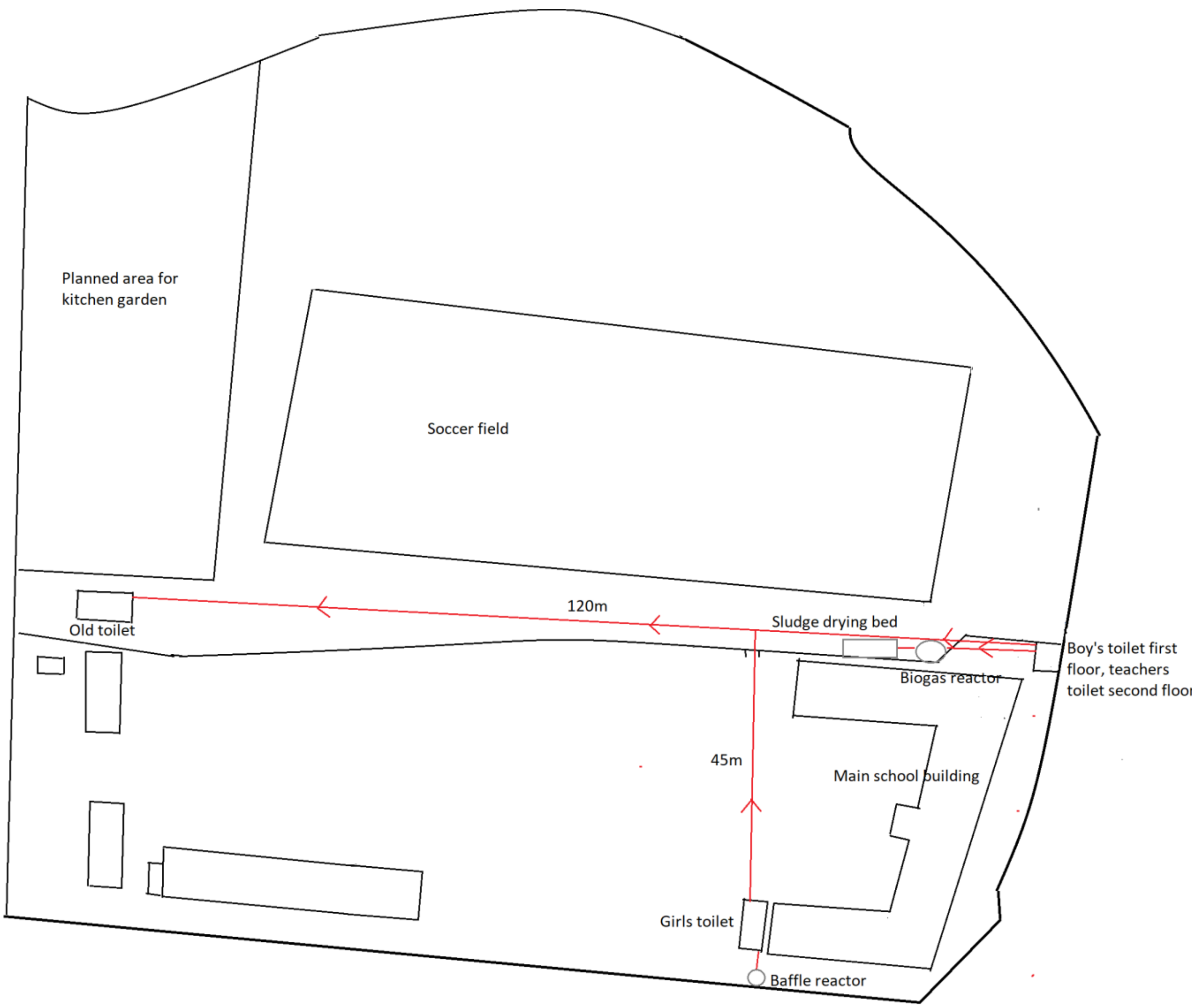

Figure 26. Schoolyard of the Jana Jeevan school with proposed solution sketch.

The toilet currently in use by boys, girls and teachers is located behind the main school building and will have to be torn down for reconstruction (called boys toilet first floor, teachers toilet second floor in on the far right hand in *fig 26*). This makes renovation of an old toilet for temporary use necessary during the construction period.

Figure 27 The designated area for the new sanitation system. The soccer field is on the right and the old toilet is at the back of the picture. Photo Ø.M.

Next to the planned area for the kitchen garden is an old toilet out of use, perfect for this purpose. While renovating, it should also be possible to add a room for urine collection tanks in the old toilet. Because the EcoSan system and nutrient reuse is dependent on student participation to work, having a collection tank close to the reconstructed toilet was not found feasible, as students would have to carry urine for a long distance. Therefore, pipeline systems from the eastern toilet to the western toilet is necessary.

Figure 28 The old toilet referred to as "the western toilet" in the text. Jana Jeevan school in the background. Photo Ø.M.

There are also plans for a new separate girls toilet located next to the southern wing of the main building. This makes the pipeline system with a urine collection tank next to the kitchen garden the most viable option, as pipelines from the girls toilet can connect to the pipelines from the boys and teachers toilet. The only concern with this solution is the water velocity in the pipelines. The eastern toilet is located about one meter above the soccer field area. The wall that separates the school yard from the soccer field area has a small a small hill of about one meter on its northern side. As the pipelines need to be buried beneath the ground, they need at least a velocity of 0.009, which is the minimum for water to run, through a flat area of about 110m that has no head difference. Because the water flow from urine separation will be very low, a velocity of at least 0.0125 should be used for safety measures. To calculate the depth of the pipeline by the old toilet, this is the equation:

Fall = Gradient X Distance

Fall = 0.0125 X 110m = 1.375m

We can add at least another 30cm to this depth, as the pipes will be dug at a certain depth in the beginning for protection. This means we need a urine collection chamber dug down at about 1.5m depth next to the old toilet house, with a pump that goes to a collection tank inside the toilet house whenever it fills up. This is to make the urine more accessible and easier to transport for the children, as they simply tap urine from the tank inside on to smaller cans before preparing the urine for application in the kitchen garden.

The girls toilet also needs a certain velocity for urine to flow down to the main pipeline. With the height difference of about one meter between the schoolyard and football field, depth of the main pipeline it connects to needs to be calculated. The pipeline should be dug through the gate that connects the schoolyard to the football field to avoid tearing down the wall. The gate is 30 meter from the start of the main pipeline, making the gradient between the girls toilet and main pipeline to be 0.37 to begin with. Raising the height of the girls toilet to gain additional head is therefore unnecessary in terms of water velocity.

For sludge handling, biogas reactor is a well-suited option. Students don't excrete very often during school hours, making a standardized sized biogas reactor of at least $4m^3$ sufficient with a pump to the sludge drying bed. The girls toilet is also too far from the area given for sludge handling, halving the potential sludge collection for biogas production. To calculate how much excreta/day that is produced, number of users of the toilet needs to be estimated. In total there are 600 students and 20 teachers. About 300 of the students are boys, but grade 1-4 have their own children's toilet. This leaves about 250 potential users. Most students seldom excrete at school, so an assumption where 25 percent of the students excrete daily is reasonable, which makes total production to be nine litres/day. Amount of water present in the reactor should be the same as amount of excreta. In addition, organic matter is necessary for optimal biogas production, where the school had about 3 kg of vegetable peel from the cafeteria available a day. In total, this adds up to about 20 litres added to the reactor/day, which means it can take up to 200 days until it's full from the boy and teachers toilet facility. Total amount of flushing water is naturally a lot more than this, making a soak pit for the overflow of water necessary. However, sludge has to continuously be pumped out of the reactor. This requires sludge drying beds. The sludge drying bed can treat 250 kg total solids/m^2/year. Approximate sludge accumulation for Jana Jeevan is 0.15 L/pe/d. If we exclude the elemtary school children from using the toilet, 500 people is a fair assumption to use to dimension the bed. This makes:

0.15 L/pe/d x 500 pe x 365 d = 27300 kg/year

Assuming 3 percent is of the wastewater is solid.

Total solid = 3/100 x 27300 = 819 kg TS/year.

819 kg TS/year / 250 kg/m^2/year = 3.5 m^2

Total area of the sludge drying bed should be at least 4 m^2 to handle the load from the school.

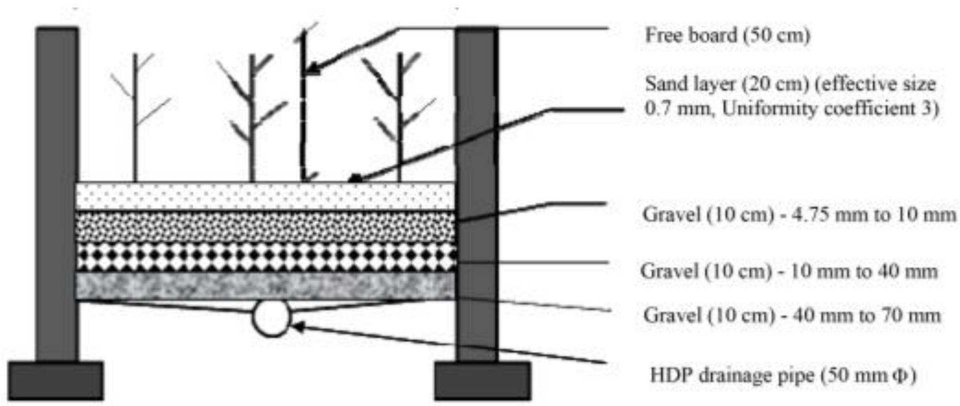

Figure 29. Illustration of a sludge drying bed. The suggested thickness of layers and grain sizes can also be used in this system (Pandey & Jenssen 2015).

The sludge drying bed consists of different levels of sand and gravel, with elevated walls at the top where dried sludge will accumulate. One extra bed should be made – while one of them is resting, the second bed is used. They should be 2x2m^2 and separated by a concrete wall or something similar. As the sludge needs to dry for 13-37 days before it can be applied to the field, a second chamber for the continuous flow of sludge from the biogas reactor is needed. This can be prevented by only emptying sludge at set intervals a few times a year, but maintenance will be easier with at least two beds. The bottom is sealed with a plastic membrane and the collection pipe will lead water to a soak pit. Reeds should be planted for enhanced conditioning of the media, but this could prove difficult for this particular case (Pandey & Jenssen 2015). That is because of the location of the SDB's. It will be constructed right next to a soccer field that is in use all day. This means the bed has to be covered by some kind of a structure and a ventilation pipe approximately 2.5 meters above the building. With reed plants being anything from 2-4m tall, the structure would have to be quite massive which the budget of the system may not allow. This is to avoid children interfering with the process and to minimize issues with smell. Aerating the chamber sufficiently for reeds to grow could prove difficult, because they don't have anyone to handle harvesting of the plants once they are fully grown unless a teacher volunteers for it. The structure should also be sturdy because of the football field, a transparent greenhouse-like building may face problems due to the structure being too fragile. The school is also located right next to the proposed area for wastewater treatment. Even with a tall ventilation pipe, some classrooms will be located higher and right next to the ventilation pipe. This may cause issues with smell during some periods of the year.

Lastly, excreta from the girls toilet needs to be handled. For this purpose, a baffle reactor provides sufficient treatment with low operation maintenance. Ultimately, it acts as a septic tank, but with extra chambers for enhanced removal and digestion of organic matter. BOD may be reduced by up to 90% (Online compendium 2014).

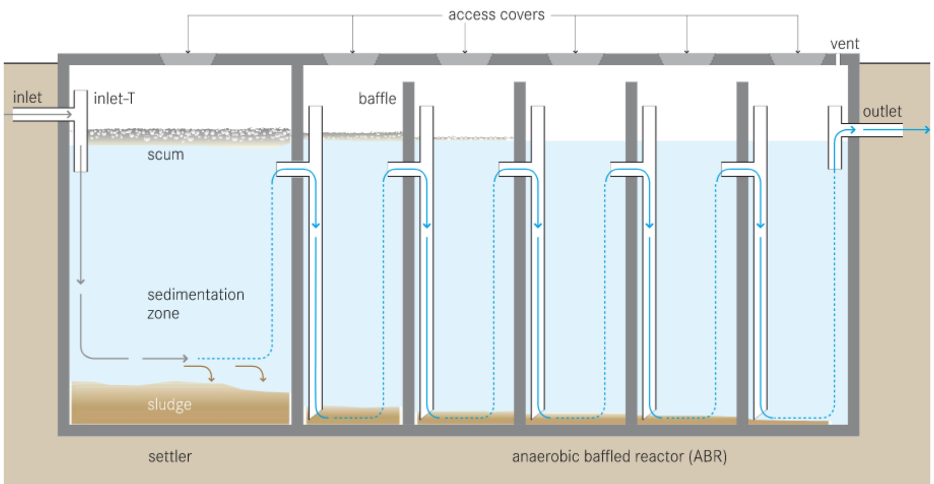

Figure 30. Anaerobic baffled reactor (Online compendium 2014).

With several chambers or baffles that forces wastewater to flow through them *(see fig 30),* contact time with microbial activity increases, which improves the treatment. Because the baffled reactor treats the sludge to some extent, it is possible to hire someone to transfer sludge from the baffle reactor to the sludge drying bed once it is full. This allows for exploitation of the dried sludge from the girls toilet as well to be used in the kitchen garden or sold.

A simple sketch of the full system will look something like this.

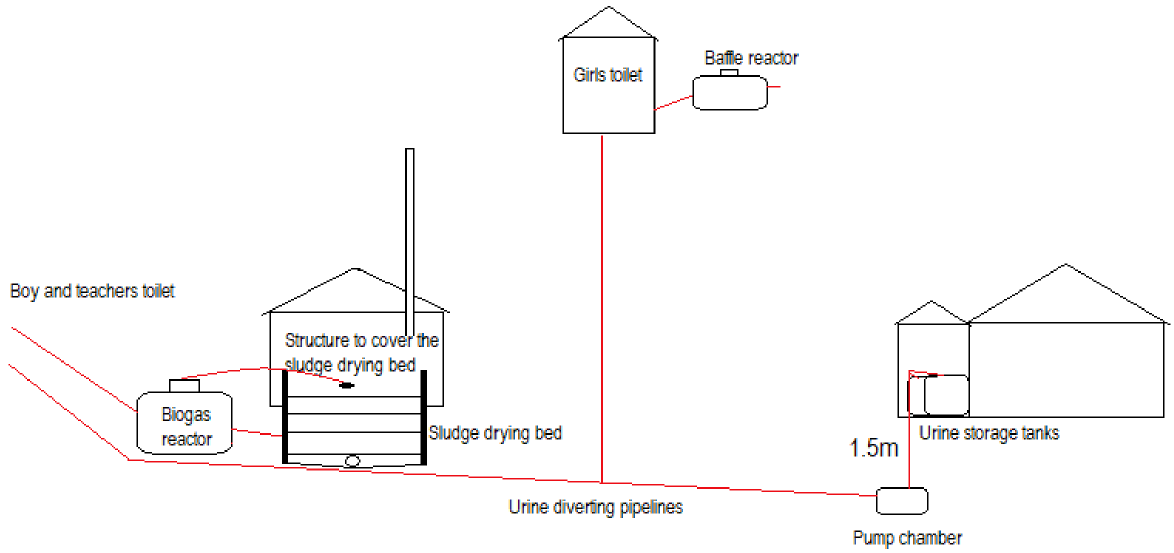

Figure 31. Sketch of the proposed sanitation system for Jana Jeevan secondary school.

In this sketch, overflow from the biogas reactor goes directly into the bottom of the sludge drying bed. Instead of doing that, the overflow can also be led directly to the soak pit at the end of drainage pipe from the sludge drying bed. By leading the overflow through the bed, some, but limited treatment will happen. However, it increases chance of clogging the filter media.

5.1.2 Sanitation system proposal for Jana Hit

With the recent construction of a new toilet facility and septic tank, implementing a new system like a biogas reactor is not feasible. The area below the toilet *(fig 33)* is also a private owned farmland. This makes space for a treatment system very limited, where something like a sludge drying bed would require more space then what they have available. However, because they wish to rent this land to use as the school kitchen garden, a structure for urine diversion tanks should be possible. The toilets are located at the edge of a hill *(fig 32),* if the urine separation tanks are built below, the urine can easily be transported to the tanks by velocity. If they don't find room for a sludge drying bed, sludge from the septic tank would have to be pumped and brought to a nearby farmer.

Figure 32. The newly constructed toilet facility in Jana Hit. The building was locked, so no pictures were taken inside. Photo Ø.M.

What they also can do is to implement rainwater harvesting. There is already a newly built water storage tank next to the school buildings *(fig 34)* where the closest buildings have sloping metal roofs covering an area of about 365 m^2.

Figure 33. The farmland below the toilets with infiltrometer test ongoing. Photo Ø.M.

Figure 34. The newly built water storage tank, with a nearby building that easily can exploit the potential for rainwater harvesting. Photo Ø.M.

Figure 35. Roof tops next to the water collection tank with good potential for rainwater harvesting. Photo Ø.M.

5.1.3 - Sanitation management systems and implementation barriers

The main problem for these schools is the physical maintenance, as well as the cost of operation. Someone has to be taught routines to keep the system run fluently. If no one working at the school are interested in this, the school would need to hire someone with the already limited funds they have. They also need a network of farmers who are interested in paying for the fertilizer and possibly biogas produced, otherwise electricity bills can become higher than what the school can afford.

All students wear uniforms to school, and because they are the ones who will handle the finished fertilizer product, it should be as hygienic and easy to handle as possible to avoid dirtying their clothing. Alternatively, the school can have working clothes for the students working in the kitchen garden, but the head teacher did not appear positive towards this.

5.2 Assessment of research project

This research project has been a very exciting study to be a part of. The Nepali people have been very kind and helpful when approached and with help from skilled candidates from Kathmandu and Tribhuvan University I got all the help I needed. The idea of this potentially becoming a pilot study for similar sanitation solutions in schools all over Nepal in the future is intriguing.

5.3 Challenges and shortcomings

An issue with the questionnaire surveys, particularly in Chitwan, was that neighbours and friends gathered to listen to the people being interviewed. This may have affected some answers, resulting in every answer not being fully honest. Number of participants in the KAP-study may also be little too few to give a completely accurate picture of social and financial conditions. This was particularly the case for Kavre, but the time frame in terms of days spent and time of year I was there. Due to lack of equipment and knowledge among the local people, some data were rough estimates or qualified guesses, which might have given a little inaccurate end result.

5.4 Lessons learned and recommendation

When working in developing countries, time is not something they worry a lot about. The term “Nepali hour” got awfully familiar within a short period of time spent there. Work plans and goals for individual days were often proven difficult to follow because of time limitations. However, as mentioned, everyone are very helpful so it did not cause any problems.

5.5 Further research needs

It could be beneficial to do an even more extensive survey to get a more accurate picture of opinions and the state of the areas. Coverage of Kavre in particular was not as extensive as what was hoped. How students actually handle direct contact with urine and dried sludge that will have some smell in Nepal needs more research. The way sludge is handled in this solution may not be optimal for this issue.

6 Conclusion

The current sanitation and agricultural issues Nepal is facing like eutrophication of rivers and lakes, overuse of increasingly expensive chemical fertilizers and nutritional issues, a paradigm shift in behavioural customs towards a more sustainable society is long overdue.

According to the findings, the average opinion among the surrounding people of the study areas showed a positive attitude towards nutrient recycling and most people reported fairly good WASH habits Even though the KAP-study could have been more extensive, the findings should be representative for similar areas as well in regards to implementation of EcoSan solutions in schools.

EcoSan in schools is a great arena for students to train future-oriented environmental technology/bioeconomics by combining circuitry solutions with school gardens. This can be a good way of spreading information and experience to reduce contamination of water, reduce spreading of disease and increase food production based on recycled waste-fertilizer.

REFERENCES

Rørå, A. 2017 Wetland treatment of hospital wastewater in Far Western Nepal including a Knowledge Attitude and Practice (KAP) study on sanitation. Faculty of Environmental Sciences and Natural Resource Management NMBU.

Best, C., Neufingerl, N., Van Geel, L., van den Briel, T., Osendarp, S. 2010 The nutritional status of school-aged children: why should we care? Food Nutr Bull. 31:400–417

Biswas, K. B., Biswas & Bablu Hira Mandal B. B. 2014 Construction and Evaluation of Rainwater Harvesting System for Domestic Use in a Remote and Rural Area of Khulna, Bangladesh, International Scholarly Research Notices, vol. 2014.

Brix, H. 2017 Sludge Dewatering and Mineralization in Sludge Treatment Reed Beds. Water, 9 (3): 160.

Devkota, S. C, De, A., Sathian, B. 2015 Nutritional Deficiencies: Major Public Health Problem in Nepal American Journal of Public Health Research Vol. 3, No. 4A, pp 1-5and Communication, 6:1, 97-104

ENPHO 2006 Final report assessment of ecosan toilets in Nepal.

Erismann, S., Shrestha A., Diagbouga S., Knoblauch A., Gerold J., Herz R., Sharma, S., Schindler, C., Odermatt, P., Drescher, A., Yang, R., Utzinger, J., Cissè G. 2016 Complementary school garden, nutrition, water, sanitation and hygiene interventions to improve children's nutrition and health status in Burkina Faso and Nepal: a study protocol. BMC Public Health **16**(1): 244.)

Government of Nepal, National Planning Commission 2017 Nepal's Sustainable Development Goals Baseline Report.

Hobbs, C., 2009. The cost of coping: A collision of crises and the impact of sustained food security deterioration in Nepal. World Food Programme Nepal Food Security Monitoring System. Kathmandu: World Food Programme.

Joshi, B. G. 2017 Member, National Planning Commission, and Coordinator, National Nutrition and Food Security Coordination Committee presentation.

Khatri, N. R. 2013 Sustainability and Climate Change aspects of Ecosan Toilet: Nepal prospective, Environemntal Engineer, Thecho lalitpur Nepal

Khatri, N. 2018 Water and sanitation – Sustainable development goals presentation. Retrieved 09.04.2018.

Krause, A., Rotter, V. S. 2018 Recycling Improves Soil Fertility Management in Smallholdings in Tanzania. *Agriculture* , *8*, 31.

Monde M. 2011 The KAP survey model (Knowledge, Attitude & practices)

Morris, J. L. & Zidenberg-Cherr S. Sheri 2009 Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables American Dietetic Association. Journal of the American Dietetic Association Chicago Vol. 102, Iss. 1

Norad 2016 Innovations in teaching and learning through contextualized approaches to increase the quality, relevance and sustainability of education in Nepal.

Nyumba, T. O., Wilson, K., J. Derrick, C. J., Mukherjee, N. 2018 The use of focus group discussion methodology: Insights from two decades of application in conservation.

Online Compendium of Sanitation Systems and Technologies 2014 Anaerobic baffled reactor (ABR) Retrieved 30.04.2018

Ofenmacher 2018 Kavre-Palanchok District. Retrieved 13.05.2018 Available on: https://ofenmacher.org/welcome/projects/nepal/district-kavrepalanchok/

Pandey, M. K. & Jenssen, P. D. 2015 Reed Beds for Sludge Dewatering and Stabilization. Journal of Environmental Protection, 6: 341-350.

Poudel, B., Adhikar, K. 2015 Ecological Sanitation: Solution for the public places and mass events, experiences from Nepal Ministry of Science, Technology and Environment.

Rajendran, K., Aslanzadeh, S., Taherzadeh M. J. 2012 Household Biogas Digesters—A Review. School of Engineering, University of Borås. Energies 5, 2911-2942.

Ratcliffe, M. M., Merrigan, K. A., Rogers B. L., Jeanne P. Goldberg J. P. 2011 The Effects of School Garden Experiences on Middle School–Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption Health Promotion Practice Vol. 12, No. 1, 36-43

SACOSAN 2013. Nepal - Country Paper on Sanitation - Sanitation for All: All for Sanitation SACOSAN-V.

Skelly, S. M, & Bradley, J. C. 2007 The Growing Phenomenon of School Gardens: Measuring Their Variation and Their Affect on Students' Sense of Responsibility and Attitudes Toward Science and the Environment, Applied Environmental Education

Statista 2018 Nepal: Degree of urbanization from 2006 to 2016. Retrieved 25.04.2018 Available on: https://www.statista.com/statistics/422620/urbanization-in-nepal/

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., Schertenleib, R. & Zurbrügg, C. 2014 Compendium of Sanitation Systems and Technologies. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).

UNICEF 2012 Water, Sanitation and Hygiene (WASH) in Schools, A companion to the Child Friendly Schools Manual

UNICEF 2016 ANNUAL REPORT WASH Section, Nepal Country Office Chap. 1

UNWater 2015 *Water in the 2030 Agenda for Sustainable Development*.

WaterAid 2008a Assessment of urine-diverting EcoSan toilets in Nepal.

WaterAid 2008b Ecological sanitation latrines: The experience of Nepal.

WaterAid 2015 School WASH research: Nepal country report

Wikipedia Category:Populated places in Chitwan District. Retrieved 10.05.2018. Available on: https://en.wikipedia.org/wiki/Category:Populated_places_in_Chitwan_District

Appendices

Appendix 1. Community people questionnaire

Directions: Please, specify the most appropriate answer. Some questions may have more than one answer that applies.

General

1. How many people live in your household?
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6
   - ☐ 7
   - ☐ More than 10

2. How old are you?
   - ☐ 18 and under
   - ☐ 19-25
   - ☐ 26-34
   - ☐ 35-44
   - ☐ 45-54
   - ☐ 55-64
   - ☐ 65 and over

3. What is your occupation?
   - ☐ Homemaker
   - ☐ Farmer
   - ☐ Laborer
   - ☐ Carpenter
   - ☐ Technician
   - ☐ Teacher
   - ☐ Student
   - ☐ Other

Water

4. What is your water source in the dry season?
   - ☐ Private connection to pipeline
   - ☐ Private/household well
   - ☐ Public tap stand
   - ☐ Public well
   - ☐ Springs
   - ☐ River/stream/lake
   - ☐ Rainwater
   - ☐ Bottled water
   - ☐ Other (please specify)

5. What is your water source in the rainy season?
   - ☐ Private connection to pipeline
   - ☐ Private/household well

☐ Public tap stand
☐ Springs
☐ Rainwater
☐ Bottled water
☐ Public well
☐ River/stream/lake
☐ Other (please specify)

6. Which of the following activities do you use this water source for?
☐ Drinking
☐ Cooking
☐ Bathing
☐ Washing
☐ Livestock
☐ Garden
☐ Other (please specify)

7. How do you treat/purify your drinking water?
☐ Boil
☐ Add bleach/chlorine
☐ Strain through a cloth
☐ Water filter
☐ Solar disinfection
☐ Let stand and settle
☐ Do not treat/purify my drinking water
☐ Other (please specify)

8. How often do you treat water in your household?
☐ Always
☐ Sometimes
☐ Never

9. How often do you think members of your community have diarrhea?
☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ Do not know

10. In the dry season, how would you judge the color of your water source?
☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

11. In the rainy season, how would you judge the color of your water source?
☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

12. How much time does it take to walk one-way to your water collection point?
☐ <5 minutes
☐ 5 minutes
☐ 10 minutes
☐ 15 minutes
☐ 20 minutes
☐ 30 minutes
☐ >30 minutes (please specify)
☐ Do not know

13. How much time do you spend queuing at your water collection point?

☐ <5 minutes
☐ 5 minutes
☐ 10 minutes
☐ 15 minutes
☐ 20 minutes
☐ 30 minutes
☐ >30 minutes (please specify)
☐ Do not know

14. Each day, how many gagri do you use for drinking? Cooking? Bathing? Washing clothes and dishes? Livestock? Garden? Other?
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ 8
☐ >10 (please specify)

15. How often does your water source go dry?
☐ Daily
☐ Weekly
☐ Monthly
☐ Every six months
☐ Yearly
☐ Never
☐ Do not know

16. In which of the following ways has your water supply changed over your lifetime?
☐ Less flow (spring is drying up)
☐ More flow
☐ It is a new spring due to earthquakes or landslides
☐ It is a new type of source due to government or NGO projects
☐ I do not know
☐ Other (please specify)

17. Who is responsible for the operation and maintenance of your water source?
☐ Government authority of Nepal
☐ Rural municipality/municipality
☐ Water user committee
☐ NGO
☐ Other (please specify)

18. Do you think unpurified/untreated drinking water causes harm or diseases?
☐ Yes
☐ No

19. What disease/harm occurs if untreated water is consumed?
☐ Diarrhea
☐ Cholera
☐ Pneumonia
☐ Abdominal pain
☐ Do not know
☐ Intestinal worm
☐ Typhoid
☐ Hepatitis A/Jaundice
☐ Others (please specify)

20. What are the benefits of hand washing with soap?

☐ Kills germs
☐ Keeps clean
☐ Prevents form disease
☐ Do not know
☐ Other (please specify)

21. When should you wash your hands with soap?

☐ Before eating
☐ After using toilet
☐ After playing on the ground
☐ After cleaning the toilet
☐ After touching dirt/dust
☐ Anytime when hands are dirty
☐ Do not know
☐ Other (please specify)

22. When do you usually wash your hands with soap? (*Multiple responses are possible)*

Options	Always	Some times	Never	code
Before eating				
After using toilet				
After playing				
After touching dirt/dust				
Anytime when hands are dirty				
After cleaning the toilet				

Sanitation

23. If you have access to toilet facilities in your community, what features do the toilets have?
  a. What is the flushing method?
     ☐ Pour-flush
     ☐ Button-flush
     ☐ No flush (separate hole for cleansing water)
  b. What is the toilet pan like?
     ☐ Standard squat pan
     ☐ Urine-diverting squat pan
     ☐ Hole (no squat pan)
     ☐ Bucket (no squat pan)
     ☐ Water seal single pit
     ☐ Water seal double pit
     ☐ Other (please specify)
  c. What other features does the toilet have?
     ☐ Windows in the building
     ☐ Ventilation chimney
     ☐ Bin for disposal of menstrual rags

☐ Connected to biogas reactor
☐ Other (please specify

24. Where does the sewage from your toilet go?
☐ Community wastewater treatment plant
☐ Pit
☐ Septic tank
☐ Biogas reactor
☐ River
☐ Left out in the open
☐ Other (please specify)
☐ Do not know

25. What happens when the septic tanks or pits are full?
☐ Dug out by hand and sludge put on fields *(ask for more details if yes)*
☐ Dug out by hand and sludge buried
☐ Sludge pumped out and taken away
☐ Pit covered and new pit dug
☐ Toilet is not used any more
☐ Do not know
☐ Other (please specify)

26. How often are these toilets unavailable for use?
☐ Hourly
☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ I do not use these toilet facilities

27. Why do you think your toilet often fail?
☐ High operational costs
☐ Poor maintenance
☐ They smell
☐ They are dirty
☐ They are difficult to use
☐ The toilet facilities never fail
☐ Do not know
☐ Other (please specify)

28. Who is responsible for the operation and maintenance of your toilet?
☐ NGO
☐ Rural municipality/municipality
☐ Oneself
☐ Other (please specify)

29. Have you ever heard about feces and urine diverted/separated toilets?
☐ Yes
☐ No

30. Who cleans the toilet?
☐ Sweeper/helper
☐ Students
☐ Students and teachers
☐ Other (please specify)

31. How often do you want toilet cleaned?
☐ Two times in a day
☐ Twice a week
☐ Never
☐ Once a day/daily
☐ Weekly
☐ Other (please specify)

32. Do you have practice of separating decomposable and non-decomposable wastes before disposing in your household?

☐ Yes
☐ No

33. Where do you deposit garbage (kitchen waste, peel of fruits and vegetables, leaves etc.) at your house?

☐ Open field
☐ Anywhere around the house
☐ Other (specify)
☐ Compost pit
☐ Not sure

Agriculture

34. How many *ropani* does your household own?

a. Irrigated	b. Non-irrigated

35. How many animals does your household own?

a. Cows	b. Buffalo	c. Goats	d. Other

36. What fertilizer do you use on your agricultural land?

☐ Animal manure
☐ Urea
☐ DAP
☐ Potassium
☐ Other (please specify)
☐ Do not use fertilizer

37. Where do you dispose animal waste/decomposable waste at your home?

☐ Open field
☐ Cowshed
☐ Anywhere around home
☐ Compost pit
☐ Traditional manure heap
☐ Other (please specify)

Opinionated Responses

38. Toilets *can be designed so that the contents in the hole under the toilet become a fertile soil after storage for a long time and can be used as a fertilizer on fields.*

If composted excreta were available for sale for a reasonable price, would you buy the soil to fertilize your fields?

☐ Yes
☐ No
☐ Maybe
☐ Unsure

38. *At the Institute of Engineering at Tribhuvan University, they have researched using human urine as a fertilizer on vegetables. Their research has shown that its use increases the size of vegetables and as long as it is used correctly, they are safe to eat. Toilets can be easily designed to collect urine in a removable container. Using urine as a free source of fertilizer for your crops would mean that you could spend less money purchasing chemical fertilizer.*

If urine were available for sale for a reasonable price, would you buy and use this urine to fertilize your fields?

☐ Yes	☐ Maybe
☐ No	☐ Unsure

38. Biogas means using waste from animal manure, crop waste, garden waste and kitchen waste to produce energy used for cooking. Toilets can be connected to a biogas reactor to increase biogas production to produce energy used for cooking. During biogas production, pathogens are reduced and a sludge is produced that can be used as a fertilizer.

If sludge from a biogas reactor were available for sale for a reasonable price, would you use the sludge to fertilize your fields?

☐ Yes	☐ Maybe
☐ No	☐ Unsure

39. If biogas were available for sale for a reasonable price, would you buy and cook with the gas?

☐ Yes	☐ Maybe
☐ No	☐ Unsure

40. Rainwater tanks can be installed to collect water from your roofs during the rainy season, which can be used as additional water in the rainy season for agriculture and bathing, and to provide a source of water in the dry season.

If you had the financial means, would you like to build one of these systems?

☐ Yes	☐ Maybe
☐ No	☐ Unsure

38. *If a school garden was built and nourished by recycled excreta, would you be ok with letting your children eat vegetables grown there?*

☐ Yes	☐ Maybe
☐ No	☐ Unsure

Food and Nutrition

39. How often do you eat vegetables?

☐ Daily

☐ Rarely

☐ Not sure

40. How often do you eat meat/egg/milk?

☐ Daily

☐ Rarely

☐ Not sure

41. What do you usually eat as tiffin/snack in your household?

☐ Homemade food items ☐ Fruits

☐ Junk (Noodles, biscuits etc.) ☐ Other (please specify)

☐ Food from the cafeteria

Health problems	
Questions	Response
How is your health today?	a) Very good b) Poor c) Not sure
During past 30 days, did you become sick or suffer from any health problem?	a) Yes
	b) No
If yes, what happened to you?	a) Common cold and cough
	b) Cold, running nose and fever
	c) Only fever
	d) Diarrhea
	e) Vomiting
	f) Stomach
	g) Dysentery
	h) Typhoid fever
	i) Skin diseases
	j) Eye infection
	k) Toothache
	l) Jaundice
	m) Cut and wound
	n) Sprain ankle or wrist
	o) Other specify.......
What treatment did you receive? (Do not answer this question if you were not sick in last 30 days)	a) No treatment
	b) Home remedy
	c) Medicine bought from drug retailers
	d) Visited health post

Appendix 2. Teacher questionnaire

Directions: Please, specify the most appropriate answer. Some questions may have more than one answer that applies.

General

1. How many people live in your household?

☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ More than 10

2. How old are you?

☐ 18 and under
☐ 19-25
☐ 26-34
☐ 35-44
☐ 45-54
☐ 55-64
☐ 65 and over

Water

3. What is your water source in the dry season?

☐ Private connection to pipeline
☐ Private/household well
☐ Public tap stand
☐ Public well
☐ Springs
☐ River/stream/lake
☐ Bottled water
☐ Other (please specify)

4. What is your water source in the rainy season?

☐ Private connection to pipeline
☐ Public tap stand
☐ Springs
☐ Rainwater
☐ Bottled water
☐ Private/household well
☐ Public well
☐ River/stream/lake
☐ Other (please specify

5. Which of the following activities do you use this water source for?

☐ Drinking
☐ Cooking
☐ Bathing
☐ Washing
☐ Livestock
☐ Garden
☐ Other (please specify)

6. How do you treat/purify your drinking water?

☐ Boil
☐ Add bleach/chlorine
☐ Strain through a cloth
☐ Water filter
☐ Solar disinfection
☐ Let stand and settle
☐ Do not treat/purify my drinking water
☐ Other (please specify)

7. How often do you treat water in your household?
☐ Always
☐ Sometimes

8. How often do you think members of your community have diarrhea?
☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ Do not know

9. In the dry season, how would you judge the color of your water source?
☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

10. In the rainy season, how would you judge the color of your water source?
☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

11. How much time does it take to walk one-way to your water collection point?
☐ <5 minutes
☐ 5 minutes
☐ 10 minutes
☐ 15 minutes
☐ 20 minutes
☐ 30 minutes
☐ >30 minutes (please specify)
☐ Do not know

12. How much time do you spend queuing at your water collection point?
☐ <5 minutes
☐ 5 minutes
☐ 10 minutes
☐ 15 minutes
☐ 20 minutes
☐ 30 minutes
☐ >30 minutes (please specify)
☐ Do not know

13. Each day, how many buckets do you use for drinking? Cooking? Bathing? Washing clothes and dishes? Livestock? Garden? Other?
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6

☐ 7
☐ 8
☐ >10 (please specify)

14. How often does your water source go dry?

☐ Daily
☐ Weekly
☐ Monthly
☐ Every six months
☐ Yearly
☐ Never
☐ Do not know

14. In which of the following ways has your water supply changed over your lifetime?

☐ Less flow (spring is drying up)
☐ More flow
☐ It is a new spring due to earthquakes or landslides
☐ It is a new type of source due to government or NGO projects
☐ I do not know
☐ Other (please specify)

15. Who is responsible for the operation and maintenance of your water source?

☐ Government authority of Nepal
☐ Rural municipality/municipality
☐ Water user committee
☐ NGO
☐ Other (please specify)

16. Where do you drink water at your school?

☐ Water tap in school
☐ Water tap near school
☐ Hand pump/tube well in school
☐ Water brought from home
☐ Water stored in jar
☐ Water from filter
☐ Other (please specify)

17. How often do you drink water from the water source at school?

☐ Daily/Always
☐ Rarely
☐ Sometimes/Occasionally
☐ Other (please specify)

18. Do you think unpurified/untreated drinking water causes harm or diseases?

☐ Yes
☐ No

19. What disease/harm occurs if untreated water is consumed?

☐ Diarrhea
☐ Cholera
☐ Pneumonia
☐ Abdominal pain
☐ Do not know
☐ Intestinal worm
☐ Typhoid
☐ Hepatitis A/Jaundice
☐ Others (please specify)

20. How often do you carry drinking water with you from home?
☐ Daily/always ☐ Sometimes/occasionally
☐ Never ☐ Other (please specify)

21. What are the benefits of hand washing with soap?
☐ Kills germs ☐ Do not know
☐ Keeps clean ☐ Other (please specify)
☐ Prevents form disease

22. When should you wash your hands with soap?
☐ Before eating ☐ After touching dirt/dust
☐ After using toilet ☐ Anytime when hands are dirty
☐ After playing on the ground ☐ Do not know
☐ After cleaning the toilet ☐ Other (please specify)

23. When do you usually wash your hands with soap? (*Multiple responses are possible)*

Options	Always	Some times	Never	code
Before eating				
After using toilet				
After playing				
After touching dirt/dust				
Anytime when hands are dirty				
After cleaning the toilet				

24. Where do you wash hands at your school?
☐ At hand washing station (basin or improvised station)
☐ Open space outside of school
☐ Other (please specify)

25. Do you have enough water to wash hands at your school?
☐ Yes
☐ No

26. How often do you carry drinking water with you from home?
☐ Daily/always ☐ Never
☐ Sometimes/Occasionally ☐ Other (please specify)

Sanitation

27. If you have access to toilet facilities in your community, what features do the toilets have?
    a. What is the flushing method?
       ☐ Pour-flush
       ☐ Button-flush
       ☐ No flush (separate hole for cleansing water)
    b. What is the toilet pan like?
       ☐ Standard squat pan
       ☐ Urine-diverting squat pan
       ☐ Hole (no squat pan)
       ☐ Bucket (no squat pan)
       ☐ Water seal single pit
       ☐ Water seal double pit
       ☐ Other (please specify)
    c. What other features does the toilet have?
       ☐ Windows in the building
       ☐ Ventilation chimney
       ☐ Bin for disposal of menstrual rags
       ☐ Connected to biogas reactor
       ☐ Other (please specify

28. Where does the sewage from your toilet go?

☐ Community wastewater treatment plant
☐ Pit
☐ Septic tank
☐ Biogas reactor
☐ River
☐ Left out in the open
☐ Other (please specify)
☐ Do not know

29. What happens when the septic tanks or pits are full?

☐ Dug out by hand and sludge put on fields *(ask for more details if yes)*
☐ Dug out by hand and sludge buried
☐ Sludge pumped out and taken away
☐ Pit covered and new pit dug
☐ Toilet is not used any more
☐ Do not know
☐ Other (please specify)

30. How often are these toilets unavailable for use?

☐ Hourly
☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ I do not use these toilet facilities

31. Why do you think your toilet often fail?

☐ High operational costs
☐ Poor maintenance

☐ They smell
☐ They are dirty
☐ They are difficult to use
☐ The toilet facilities never fail
☐ Do not know
☐ Other (please specify)

32. Who is responsible for the operation and maintenance of your toilet?
☐ NGO
☐ Rural municipality/municipality
☐ Oneself
☐ Other (please specify)

33. Have you ever heard about feces and urine diverted/separated toilets?
☐ Yes
☐ No

34. Do you need to wait in queue while going to the toilet?
☐ Yes
☐ No

35. If yes, how long?
Note time in minutes ………….

36. Who cleans the toilet?
☐ Sweeper/helper
☐ Students
☐ Students and teachers
☐ Other (please specify)

37. Would you like to be involved in cleaning your school toilet?
☐ Yes
☐ No

38. How often would you want the school toilet cleaned?
☐ Two times in a day
☐ Once a day/daily
☐ Twice a week
☐ Weekly
☐ Never
☐ Other (please specify)

39. Do you have practice of separating decomposable and non-decomposable wastes before disposing in schools?
☐ Yes
☐ No

40. Where do you deposit garbage (kitchen waste, peel of fruits and vegetables, leaves etc.) at school?
☐ Open field
☐ Compost pit
☐ Anywhere around the school
☐ Not sure
☐ Other (specify)

Agriculture

41. How many *ropani* does your household own?

a. Irrigated	b. Non-irrigated

42. How many animals does your household own?

a. Cows	b. Buffalo	c. Goats	d. Other

43. What fertilizer do you use on your agricultural land?

☐ Animal manure
☐ Urea
☐ DAP
☐ Potassium
☐ Other (please specify)
☐ Do not use fertilizer

44. Where do you dispose animal waste/decomposable waste at your home?

☐ Open field
☐ Cowshed
☐ Anywhere around home
☐ Compost pit
☐ Traditional manure heap
☐ Other (please specify)

Opinionated Responses

38. Toilets *can be designed so that the contents in the hole under the toilet become a fertile soil after storage for a long time and can be used as a fertilizer on fields.*

If composted excreta were available for sale for a reasonable price, would you buy the soil to fertilize your fields?

☐ Yes
☐ No
☐ Maybe
☐ Unsure

39. *At the Institute of Engineering at Tribhuvan University, they have researched using human urine as a fertilizer on vegetables. Their research has shown that its use increases the size of vegetables and as long as it is used correctly, they are safe to eat. Toilets can be easily designed to collect urine in a removable container. Using urine as a free source of fertilizer for your crops would mean that you could spend less money purchasing chemical fertilizer.*

If urine were available for sale for a reasonable price, would you buy and use this urine to fertilize your fields?

☐ Yes
☐ No
☐ Maybe
☐ Unsure

38. *Biogas means using waste from animal manure, crop waste, garden waste and kitchen waste to produce energy used for cooking. Toilets can be connected to a biogas reactor to increase biogas production to produce energy used for cooking. During biogas production, pathogens are reduced and a sludge is produced that can be used as a fertilizer.*

If sludge from a biogas reactor were available for sale for a reasonable price, would you use the sludge to fertilize your fields?

38. ☐ Yes ☐ Maybe If biogas were available for sale for a reasonable price, would you buy and cook with the gas?

☐ Yes ☐ Maybe

☐ No ☐ Unsure

39. *Rainwater tanks can be installed to collect water from your roofs during the rainy season, which can be used as additional water in the rainy season for agriculture and bathing, and to provide a source of water in the dry season.*

If you had the financial means, would you like to build one of these systems?

☐ Yes ☐ Maybe

☐ No ☐ Unsure

☐ No ☐ Unsure

38. *If a school garden was built and nourished by recycled excreta, would you be ok with letting your children eat vegetables grown there?*

☐ Yes ☐ Maybe

☐ No ☐ Unsure

Food and Nutrition

39. How often do you eat vegetables?

☐ Daily

☐ Rarely

☐ Not sure

40. How often do you eat meat/egg/milk?

☐ Daily

☐ Rarely

☐ Not sure

41. What do you usually eat as tiffin/snack in your school?

☐ Homemade food items ☐ Fruits

☐ Junk (Noodles, biscuits etc.) ☐ Other (please specify)

☐ Food from the cafeteria

Health problems	
Questions	Response
How is your health today?	d) Very good e) Poor f) Not sure
During past 30 days, did you become sick or suffer from any health problem?	c) Yes
	d) No
If yes, what happened to you?	p) Common cold and cough
	q) Cold, running nose and fever
	r) Only fever
	s) Diarrhea
	t) Vomiting
	u) Stomach
	v) Dysentery
	w) Typhoid fever
	x) Skin diseases
	y) Eye infection
	z) Toothache
	aa) Jaundice
	bb) Cut and wound
	cc) Sprain ankle or wrist
	dd) Other specify.......
What treatment did you receive? (Do not answer this question if you were not sick in last 30 days)	e) No treatment
	f) Home remedy
	g) Medicine bought from drug retailers
	h) Visited health post

Appendix 3. Students questionnaire

Directions: Please, specify the most appropriate answer. Some questions may have more than one answer that applies.

General

1. How many people live in your household?

☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ More than 10

2. How old are you?

☐ 6-9
☐ 10-12
☐ 13-1

Water

3. How often do you think members of your community have diarrhea?

☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ Do not know

4. In the dry season, how would you judge the color of your water source?

☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

5. In the rainy season, how would you judge the color of your water source?

☐ Excellent
☐ Good
☐ Fair/normal
☐ Poor
☐ Not fit for use
☐ Do not know

6. Where do you drink water at your school?

☐ Water tap in school
☐ Water tap near school
☐ Hand pump/tube well in school
☐ Water brought from home
☐ Water stored in jar
☐ Water from filter
☐ Other (please specify)

7. How often do you drink water from the water source at school?

☐ Daily/Always ☐ Sometimes/Occasionally
☐ Rarely ☐ Other (please specify)

8. Do you think unpurified/untreated drinking water causes harm or diseases?

☐ Yes
☐ No

9. What disease/harm occurs if untreated water is consumed?

☐ Diarrhea ☐ Intestinal worm
☐ Cholera ☐ Typhoid
☐ Pneumonia ☐ Hepatitis A/Jaundice
☐ Abdominal pain ☐ Others (please specify)
☐ Do not know

10. How often do you carry drinking water with you from home?

☐ Daily/always ☐ Sometimes/occasionally
☐ Never ☐ Other (please specify)

11. What are the benefits of hand washing with soap?

☐ Kills germs ☐ Do not know
☐ Keeps clean ☐ Other (please specify)
☐ Prevents form disease

12. When should you wash your hands with soap?

☐ Before eating ☐ After touching dirt/dust
☐ After using toilet ☐ Anytime when hands are dirty
☐ After playing on the ground ☐ Do not know
☐ After cleaning the toilet ☐ Other (please specify)

13. When do you usually wash your hands with soap? (*Multiple responses are possible)*

Options	Always	Some times	Never	code
Before eating				
After using toilet				
After playing				
After touching dirt/dust				
Anytime when hands are dirty				
After cleaning the toilet				

14. Where do you wash hands at your school?

☐ At hand washing station (basin or improvised station)

☐ Open space outside of school

☐ Other (please specify)

15. Do you have enough water to wash hands at your school?

☐ Yes

☐ No

16. How often do you carry drinking water with you from home?

☐ Daily/always ☐ Never

☐ Sometimes/Occasionally ☐ Other (please specify)

Sanitation

17. If you have access to toilet facilities in your community, what features do the toilets have?

a. What is the flushing method?

☐ Pour-flush

☐ Button-flush

☐ No flush (separate hole for cleansing water)

b. What is the toilet pan like?

☐ Standard squat pan

☐ Urine-diverting squat pan

☐ Hole (no squat pan)

☐ Bucket (no squat pan)

☐ Water seal single pit

☐ Water seal double pit

☐ Other (please specify)

c. What other features does the toilet have?
- ☐ Windows in the building
- ☐ Ventilation chimney
- ☐ Bin for disposal of menstrual rags
- ☐ Connected to biogas reactor
- ☐ Other (please specify

18. How often is your household toilet unavailable for use?

☐ Hourly
☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Never
☐ I do not use these toilet facilities

19. Do you feel privacy in your school toilet?

☐ Yes
☐ No

20. Do you need to wait in queue while going to the toilet?

☐ Yes
☐ No

21. If yes, how long?

Note time in minutes ………….

22. Are school toilets easy to use for you (child friendly)?

☐ Yes
☐ No

23. If no, why?

☐ I could not open the toilet door
☐ Difficult to open water tap in toilet
☐ The height of the toilet (commode) is not appropriate for me
☐ Other (please specify)

24. Who cleans the toilet?

☐ Sweeper/helper
☐ Students
☐ Students and teachers
☐ Other (please specify)

25. Would you like to be involved in cleaning your school toilet?

☐ Yes
☐ No

26. How often would you want the school toilet cleaned?

☐ Two times in a day ☐ Once a day/daily

☐ Twice a week ☐ Weekly

☐ Never ☐ Other (please specify)

27. Do you have practice of separating decomposable and non-decomposable wastes before disposing in schools?

☐ Yes

☐ No

28. Where do you deposit garbage (kitchen waste, peel of fruits and vegetables, leaves etc.) at school?

☐ Open field ☐ Compost pit

☐ Anywhere around the school ☐ Not sure

☐ Other (specify)

Agriculture

29. How many animals does your household own?

a. Cows	b. Buffalo	c. Goats	d. Other

Where do you dispose animal waste/decomposable waste at your home?

☐ Open field ☐ Compost pit

☐ Cowshed ☐ Traditional manure heap

☐ Anywhere around home ☐ Other (please specify)

Food and Nutrition

30. How often do you eat vegetables?

☐ Daily

☐ Rarely

☐ Not sure

31. How often do you eat meat/egg/milk?

☐ Daily

☐ Rarely

☐ Not sure

32. What do you usually eat as tiffin/snack in your school?

☐ Homemade food items ☐ Fruits

☐ Junk (Noodles, biscuits etc.) ☐ Other (please specify)

☐ Food from the cafeteria

33. *If a school garden was built and nourished by recycled excreta, would you be ok with eating vegetables grown there?*

☐ Yes ☐ Maybe

☐ No ☐ Unsure

Attitude on Nutrition			
How much do you agree with these statements?	 **Strongly Agree**	 **Neutral/ Not sure**	 **Strongly Disagree**
I am interested to eat healthy diets/food.			
I would like to learn about how to prepare healthy diets and snack.			
I would like to eat vegetables every day.			
I would like to drink a glass of cow/buffalo milk every day is good for my health.			
I would like to eat fruits daily.			
It is good to eat fruits or vegetables for snack.			
It is good to learn what I eat.			
I like to know how to grow vegetable in the home/school garden.			
We do not eat different kinds of foods every day.			
Eating healthy tiffin/snack in school is important for me.			
School does not regulate school tiffin system			

Health problems	
Questions	Response
How is your health today?	g) Very good h) Poor i) Not sure
During past 30 days, did you become sick or suffer from any health problem?	1. Yes
	2. No
If yes, what happened to you?	ee) Common cold and cough
	ff) Cold, running nose and fever
	gg) Only fever
	hh) Diarrhea
	ii) Vomiting
	jj) Stomach
	kk) Dysentery
	ll) Typhoid fever
	mm) Skin diseases
	nn) Eye infection
	oo) Toothache
	pp) Jaundice
	qq) Cut and wound
	rr) Sprain ankle or wrist
	ss) Other specify.......
What treatment did you receive? (Do not answer this question if you were not sick in last 30 days)	i) No treatment
	j) Home remedy
	k) Medicine bought from drug retailers
	l) Visited health post

Appendix 4. Points for focus group discussion

Points for focal group discussion with head teacher and chair-person of management committee, Jan Jeevan

Urine diversion

How do you foresee the handling of urine from urine diversion?

Pipeline/directly apply through use of a bucket

Dry toilets

How do you foresee the handling of excreta and maintenance of a dry toilet?

You are aware you will need two separate holes for urine and excreta, and a separate sink for anal cleansing?

How do you think the pupils will manage this?

Is there cleaning personnel to keep the toilet clean?

Biogas reactor

If you receive funding for building a biogas reactor, would this be an option you could consider?

You will need to add organic matter to the reactor (like plant residues), do you have a source to get this?

You will also need to raise pH to 9.5 for optimal function, do you have personnel and availability to add lime to the reactor?

Some of the biogas can be used at the school for cooking etc, but do you think neighboring households will be willing to buy this product?

Rain water harvesting

Do you think rainwater harvesting can positively work as an additional supply for your current water situation, and is something you would want for the school?

Groundwater (Dug well/Tube well)

GW level, flooding level; Do you have any current sanitary issues in school or the community related to this?

WASH situation in the school –Jan Jeevan

What is your water supply?

What is your current sanitation system?

What do you do with the greywater?

Where do you dispose of the blackwater?

Do you know if anyone has had problems with arsenic in their groundwater in this area?

Name

Position

Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway