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Factors Affecting Optimal Use of Urine Diverting Pit Latrines from a User Perspective; a Case Study from Darechowk VDC, Nepal

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Preface

This thesis is my final work of the Master of Science in Environment and Natural Resources with specialization in Sustainable Water and Sanitation, Health and Development at Norwegian University of Life Sciences. My motivation for the topic of this thesis was my interest in water and sanitation in developing countries and the possibility to experience a new country and culture from the inside. I got the chance to live together with a family in a rural village in Nepal, which has given me memories and experiences of a lifetime.

I really want to thank Shreerendra Pokharel for being my good friend and guide for my thesis in Darechowk, as well as his family who took such good care of me during my stay. I would also like to thank Nam Raj Khatri for excellent supervisory and insight in ecological sanitation in Nepal. At last I would like to thank my supervisors Petter D. Jenssen, and Manoj Kumar Pandey who made this thesis possible to carry out.

Ås, 13.05.15

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Abstract

Almost half of the world's population lack access to improved sanitation facilities. Thus, appropriate sanitation technologies are urgently needed. Nepal inhabits a large population without access to any sanitation facility, and continuously strives to ensure 100% sanitation coverage nationwide through different strategies, policies and approaches. Urine diverting pit latrines, introduced as ecological sanitation, is one approach to achieve the goal of eliminating open defecation in Nepal. However, a successful implementation of ecological sanitation technologies and optimal use of the technology depends on user adaption and preference in order to achieve this. The village of Darechowk in Nepal has a goal of becoming "Eco-san Model Village" and is acknowledged as an example of successful implementation of ecological sanitation. If Darechowk is to become a standard model for implementation of eco-san toilets and will be replicated in other parts of the country, a performance evaluation is needed from a user perspective to identify if this technology is used properly and how it can be improved. This thesis investigates factors affecting optimal use and adaption of the implemented eco-san toilets in Darechowk. It takes on a user perspective with emphasis on extent of user friendliness, social acceptance and economic and health benefits for the surveyed population. 36 semi-structured interviews and six focus group discussions were conducted during a fieldwork in Darechowk from December 2013 to March 2014. The findings show that the users have many challenges regarding operation and maintenance such as blockage in the urine pipe and inconvenience with urine collection due to lack of proper equipment. This in turn leads to discontinuance in urine collection and limits the economic benefits since the collection is not maximized and use of chemical fertilizer is still a practice. Social acceptance of the technology has proven to rely heavily on local initiatives and voluntary work with promotion and sanitation related activities. This has generated a sense of responsibility among the population towards keeping the village open defecation free. However, further knowledge and continual training regarding spread of disease and proper handling of urine is needed for the population to fully accept the sanitation system. The surveyed population expressed openness towards using human faeces as fertilizer. This gives the opportunity to modify the existing system towards urine diverting dry toilet with the goal of also reusing faeces as fertilizer. The overall recommendation is to provide more comprehensive training in operation and maintenance and handling of urine in order to achieve optimal use and adaption of the sanitation system in Darechowk.

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Acronyms

CLTS	Community-led Total Sanitation
DWSS	Department of Water Supply and Sewerage
DDC	District Development Committee
DVUD	Double Vault Urine Diverting toilet
Eco-san	Ecological sanitation
ENPHO	The Environment an Public Health Organization in Nepal
GoN	Government of Nepal
MDG	UN Millennium Development Goal
OD	Open Defecation
ODF	Open Defecation Free
SLTS	School-led Total Sanitation
UDDT	Urine Diverting Dry Toilets
UDWT	Urine Diverting Wet Toilets
UD	Urine Diverting
VDC	Village Development Committee
WHO	World Health Organization

1. INTRODUCTION

1.1 General introduction

The UN General Assembly recognizes the access to and the use of basic sanitation facilities to ensure increase in life quality and health, as a human right (UN 2011). Unfortunately, 1 billion of the world's population still practices open defecation, where the majority of this population lives in rural areas in developing countries (WHO&UNICEF 2010). To reduce the population without access to any sanitation facility many approaches and technologies have been introduced and implemented with a target of rural areas. Basic and low cost sanitation technologies is desirable for poor communities in developing countries (Moe & Rheingans 2006). Hence, the pit latrine is one of the most implemented sanitation technologies in rural areas in developing countries to reduce the proportion of open defecation and provide access to improved sanitation facilities (Stauffer & Spuhler 2008). However, to what extent a pit latrine is an improvement to open defecation depends on many considerations. Thus, new and more holistic approaches to sanitation are emerging with a focus on environment and sustainability with positive health impact for rural communities.

Nepal is one of the countries where a large part of the population is suffering from lack of improved sanitation facilities. The government policy on water and sanitation is to achieve the UN Millennium Goal to half the population without sustainable access to safe drinking water and basic sanitation by 2015 in addition to a national goal of 100% sanitation coverage by 2017. (Adhikari 2012b). So far, Nepal has urban sanitation coverage of 78% compared to only 37% coverage in rural areas and still a population of 52% is practicing open defecation (DWSS/NMIP 2011). Thus, a proper solution to rural sanitation is crucial for Nepal to achieve the goal of 100% sanitation coverage. A simple pit latrine is the most promoted sanitation technology and is used to achieve the approach of declaring areas in Nepal with an open defecation free (ODF) status (Adhikari 2012b; DWSS 2013). The ODF-status has become a measure of sanitation coverage in the country, without concerning if the technologies used are sociocultural acceptable or sustainable approaches to protect health and environment. However, a focus on environment and benefits from sanitations has emerged with the introduction of the concept of ecological sanitation. Ecological sanitation is a sustainable approach to sanitation technologies with principle of nutrient recycling and reuse of human excreta in order to close the nutrient-loop and to prevent pollution to the

environment (Schonning & Stenström 2004). Darechowk VDC situated in Chitwan district has been recognized as an example of a successful implementation and use of ecological sanitation with the goal of becoming of "Eco-san Model Village" (Adhikari 2012b; SACOSANV 2013). The status came with implementing urine-diverting pit latrines, known as eco-san toilets to users, with reuse of urine as fertilizer in agriculture as a main focus.

1.2 Rational of the study

For an optimal use and implementation of ecological sanitation (eco-san) there are many measures that need to be achieved, considering acceptability and benefits. Eco-san is a lot more than just technical infrastructure and acceptance from users is anchored within the local cultural context and affected by individual attitudes and behaviours (ADC 2004). Collaboration with users is important when developing sanitation technologies so they can be adjusted to the current socio-cultural setting (Nawab et al. 2006). Thus, the planning and decision-making process has to include users and provide them with appropriate education and awareness. Increased awareness and knowledge among users is known to give better results and give optimal benefits from eco-san (ADC 2004).

Darechowk VDC's goal of being a model village for implementing ecological sanitation as a sustainable approach to rural sanitation in Nepal is the background for the rational of this study. Darechowk VDC has been acknowledged as an example of a sustainable approach to rural sanitation nationwide in Nepal, but should it become a standard model? A standard model should reflect upon optimal use of the technology in order to optimize the benefits for a rural population. Whether Darechowk VDC really has optimized the technology or not is important to address if it were to be replicated. An evaluation of the technology needs to be conducted through a users perspective in order to identify the extent of optimal use. Based on such a performance evaluation from a user perspective one can recommend improvements.

1.3 Main objective and research questions

The main objective for this thesis is to identify how the eco-san toilets implemented in Darechowk VDC is being used an adapted by the villagers and to what extent this system is used in an optimal way.

The main research question for this thesis is defined as:

- What are the factors affecting optimal use and adaption of the implemented technology in Darechowk?

With additional research questions to support the main research question:

- What are the technological and operational factors that determine user friendliness? To what extent is the technology used in Darechowk community being user friendly?

- What are the economic and health related benefits from the technology? To what extent is Darechowk community realizing these benefits?

- What are the factors affecting social acceptance? To what extent is the community of Darechowk socially accepting the technology?

1.3 Limitations for the study

An obvious limitation for the researcher, as well as for the research, was that the fieldwork was conducted in Nepal. The adjustment to a new cultural setting and new norms for behaviour affected the progression of the fieldwork. The period of time for the fieldwork was also limited due to the extent of the thesis and obligations in Norway. In retrospect the field study in Nepal should have lasted longer so as to enable further revision and adjustment in both sample size and questionnaire.

Language is also a limitation for this study since the researcher did not speak Nepali and the key informants were not fluent in English. This did lead to some misunderstandings during the process of planning the execution of interviews and focus group discussions (FGD), which are the main data collection tools for this thesis. Thus, the process of planning

exceeded the initial time frame. Language also became a limitation since the performance of the interviews and FGD demanded a translator. Due to time and convenience, the translator was local and not familiar with much of the terminology used and was neither perfectly fluent in English. This could have affected how the answers were dictated back to the researcher during interview sessions and FGD. Furthermore, subjectivity could be another factor of limitation. In qualitative research the researcher's opinion and experiences in the field or other settings could give bias to data collection and analysis (Creswell 2007). In this study, the researcher developed the interview guide and also carried out the data collection and the data analysis. Even though supervisors and key informants helped in developing the interview guide, the data analysis was completely conducted by the researcher. To avoid bias, it is recommended for another researcher to be involved in the coding process of the collected data (Berg & Lune 2012). This has not been done in this study and can affect the results, even though the researcher tried to stay as neutral and objective as possible throughout the research process. When it comes to the selection of sample size, this research used the "snowball method" for selecting participants. Even though some criteria for selection was decided from the objectives, some bias to weather the sample size was representative or not for the study area can be present.

2. CONTEXTUAL BACKGROUND

2.1 Introduction to Nepal

Nepal is located land-locked between India in south, east and west and with the Tibetan Plateau and China in north. The land area is 147,181 square meters and divided to five physiographic regions from the Terai (14% of total area) in the south, the Siwaliks (13%), the Midhills (30%), the High Mountains (20%) and the High Himalayas (23%) far north. The country is also divided from a government structure into five development regions (Eastern, Central, Western, Mid-Western and Far-Western). All development regions are divided into different District Development Committees (DDC), with a total of 75 DDCs. Every DDC is again divided into many Village Development Committees, with a total of 3915 DDCs throughout the country (DWSS 2013). The population is estimated to 30 million in 2013 and the current population growth rate is about 1.7 per cent (IndexMundi 2013). Nepal's population is amongst the poorest in the world, listed as number 157 out of 187 countries on the Human Development Index (The World Bank 2014).

Nepal has been defined by political instability over the last two decades, with 20 governments since the introduction of democracy in 1990. This instability and conflict has contributed to ineffectiveness in many of the state institutions and has also allowed for ethnic identity to grow. A strong growth of diverse ethnic identities has arisen and raised awareness that the Nepali state has acted with exclusionary politics and not supported the county's diverse population (The World Bank 2014). The population of Nepal is very diverse with many different ethnic groups originated from other Asian countries. Different ethnic groups give also Nepal a complex and diverse religious composition with 80.6 % Hindus, 10.7% Buddhists, 4.2% Muslims, 3.6% Kirant and 0.9% other religions such as Christians (IndexMundi 2013). Due to the large percentage of Hindus, the India influenced caste system is still functioning in some extent in Nepal and remains fundamental to people's understanding of society, even though it was officially abolished in 1963 (Jodhka 2008).

2.2 Global sanitation background

On a global scale, 2.6 billion people lack access to improved sanitation facilities and 80 % of all disease in developing countries is due to water born diseased related to poor water and sanitation facilities (WHO&UNICEF 2010). To control the impact of poor sanitation as one goal, the UN-Summit came together in September 2000 and agreed to set up and to fulfil the Millennium Development Goals. One of the main goals (goal 7) was to "halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation" (UN 2010). Unfortunately, the MDG goal for sanitation will probably not be met, however great progress is made with 63% of the world's population using improved sanitation facilities (WHO 2012). Furthermore, the cost for installation per toilet needed to achieve further progress is estimated to $100 USD, hence the most basic level and low cost technologies of sanitation is desirable for poor communities in developing countries (Moe & Rheingans 2006). Still, the basic sanitation technologies implemented have to be sustainable and appropriate approaches to protect health and environment and be sociocultural acceptable (Mara 2003). To protect both health and environment and still provide the basic requirement, on-site low cost sanitation technologies are good options, especially for rural areas (Langergraber & Muellegger 2005). In poor rural areas there are often more factors to consider during implementation of sanitation technologies for sanitation projects to succeed. For the technology to be accepted and used in an optimal way, community participation of both men and women, design, training and cultural and religious practices are factors that need to be part of the implementation planning (Mara 2003). Rural sanitation technologies have to be simple in design and affordable so the user population will accept it and use it optimally (Mara 2003).

2.2.1 Sanitation technologies

UNICEF and WHO defines improved sanitation facilities as: "facilities that ensure hygienic separation of human excreta from human contact" (WHO&UNICEF 2010). Pit latrines are part of the improved sanitation option after this definition and is a low-tech option often constructed in rural areas. This section describes two of the most widely used pit latrines for improving sanitation facilities.

Simple pit latrine

The simple pit latrine is one of the most used sanitation technologies for improved sanitation facilities (Stauffer & Spuhler 2008) because it is easy available low-cost and basic form of improved sanitation (WHO 1996a).

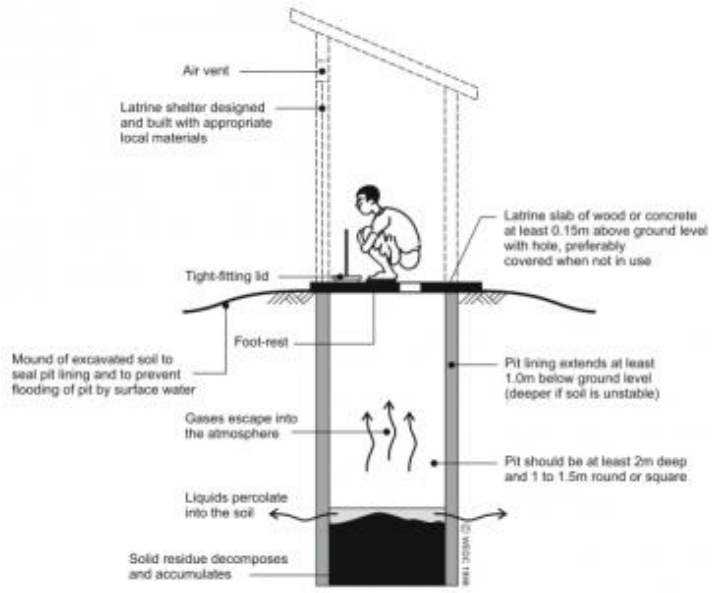

Figure 1: schematic design of a constructed pit latrine (Harvey et al. 2002).

The pit latrine is designed with a pit dig into the ground, which is covered by a cover slab or floor, as seen from fig. 1 (WHO 1996a). The floor has a hole where excreta and or anal cleansing material (water/solids) are disposed (Stauffer & Spuhler 2008). Taken into account user preferences, a seat or squat hole with footrests can be added. In addition, a lid to cover the hole should be installed to prevent people from falling into the pit and to reduce odour (WHO 1996a). On average, a volume of 0.06 m^3 per person per year is needed for anticipated lifetime for the latrine. This does not include the top 0.5 metres, which is to be filled up with soil when the pit is full. To eliminate groundwater pollution from faecal pathogens, the location of the pit should be examined and groundwater table located before installing the pit 2 meters above the groundwater level (WHO 1996a). A minimum distance of 30 meter from any water source is also required to limit the exposure to microbial contamination (WHO 1996a). The simple pit latrine is most appropriate when anal cleansing water is not needed and where water is scarce because it is not need for any flushing water

Pour flush latrine

The pour-flush (or water-seal) latrine is very similar to the simple pit latrine. The main difference is that the pour flush latrine does not have a squatting hole in the cover slab, but a squatting pan (or sitting toilet seat) with a water seal (WHO 1996b).

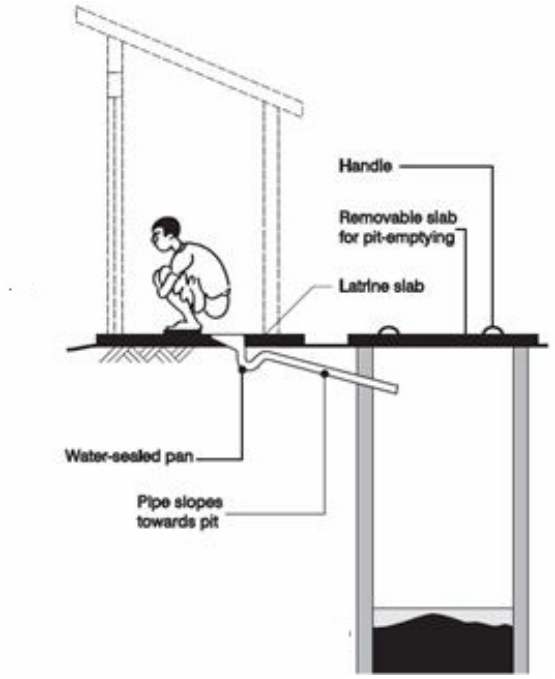

Figure 2: schematic design of a constructed pour-flush latrine (Harvey et al. 2002).

Fig. 2 describes the main design for the pour flush latrine. The pan is cast in the floor with a connected water seal of 20-30 millimetres to minimize the water used for flushing (Wafler & Spuhler 2008). The water requirements for a pour flush latrine are estimated to be between one and three litres for flushing each time used. Excreta are flushed into the pit and the liquids will filter down to the ground. Some of the solids will remain in the pit while some will decompose and as well be filtered into the ground (WHO 1996b).

Advantages and disadvantages

Both the simple pit latrine and the pour flush latrine have many advantages. The simple pit latrine does not require water (unless anal cleansing with water is a custom), which makes it appropriate where water is scarce. It is a low cost technology, which can be constructed and maintained with local materials (WHO 1996a). The pour flush latrine has a water seal, which effectively will prevent odours due to excreta being flushed away and prevents flies from

coming back up the pipe. In addition, it is a suitable technology for different local factors because it can be adjusted to the user's preferences if they desire a sitting toilet, squatting toilet or if they use water or paper for anal cleansing (Wafler & Spuhler 2008).

Nevertheless, both of these latrines have some disadvantages. The pit latrine is mostly used as improved sanitation facilities, thus pose most risks if not installed properly. In theory, the pathogens in liquid leaching from the pit will sorb to soil particles in the unsaturated zone; hence they will be removed prior to contact with groundwater. However, many environmental factors are affecting the degree of removal, such as different soil types and moisture content and distance travelled (Stauffer & Spuhler 2008). These factors are in many cases not taken into account and it is difficult to estimate proper distance to water sources or groundwater table if no investigations are preformed (WHO 1996a). In areas that are densely populated and many latrines are constructed, the safe distance between the pit and groundwater and water sources is often not upheld. In these areas the risk of groundwater pollution and health risks related to water bourn diseases are very high, thus another sanitation option should be considered (Stauffer & Spuhler 2008). With water-flushed toilets as the pour flush latrine, higher quantities of contaminated wastewater are produced. Thus, more attention to downstream infrastructure is required as it pose even higher environmental and health related risks due to pollution. Another concern with pit latrines is flies as they can carry faecal pathogens from excreta to food (WHO 1996a). The fly leys eggs and breed in the latrine where excreta is available as flies are attracted to light and odour, thus diarrhoeal diseased may easily be spread from human excreta to food (WHO 1996a). With proper maintenance and elimination of exposed excreta by keeping all openings, including the seat or squat-hole, clean and closed this could be avoided. However, this is not always the case (WHO 1996a). Accordingly, to what extent a pit latrine is an improvement to open defecation depends on many considerations taken by those who implement and use the latrine.

2.2.2 Ecological sanitation

The urine-diverting latrine can be a good option for improvement of the simple pit latrine and the pour flush latrine. There are many different designs and versions of the technology behind the urine-diverting toilets due to different local conditions and factors. The most relevant designs for this research will be presented in chapter 2.3.3.

The principle of urine-diverting latrines is based on the expression ‘sanitize-and-reuse’ (Nawab et al. 2006). The ‘sanitize-and-reuse’ model is again referred to as ‘ecological sanitation’ where this approach has the principle of separating and reusing human excreta, control pollutants, reduce water consumption and recycle nutrients (Benetto et al. 2009; Nawab et al. 2006). Ecological sanitation (eco-san) decreases the need of resources by lower the water consumption and recycle nutrients through reuse of human excreta as fertilizer in soil. Eco-san also promotes the use of local resources and makes it cost efficient and very applicable to developing countries whit lack of financial resources (Jenssen et al. 2004). Eco-san can be acknowledged as an approach towards an ecological and environmental safe sanitation technology that ranges from natural wastewater treatment, composting toilets, simple household systems to larger and complex decentralised systems. Thus, the concept of eco-san is not just for the poor population of the world, but gives opportunities for appropriate solutions to different locations (Langergraber & Muellegger 2005). However, to ensure successful implementation and retrieve the optimal benefits from the eco-san concept, a holistic understanding of all components of the sanitation system is required (Langergraber & Muellegger 2005). Material used, operation and maintenance and user friendliness are important for optimal use of the technology. Since the concept of eco-san looks at the entire system, the technologies used have to be appropriate for the user and the local circumstances; it should be flexible, manageable and adaptable (ADC 2004).

Furthermore, the principle of eco-san is to close the nutrient loop by exploiting the co-benefits from the nutrient recovery of human excreta. Human excreta has the potential to be used as an agricultural fertilizer resource and to improve soil fertility and food security (Haq & Cambridge 2012). Agricultural benefits such as nutrient input from both urine and faeces, increase of organic mater and moisture-retaining capacity in soil can be obtained from eco-san technologies and can decrease or eliminate the use of chemical fertilizer. To gain optimal benefits, the use of both faeces and urine is recommended to obtain all nutrients and to close the loop (Moe & Rheingans 2006). However, to use human excreta in a safe way in agriculture some safety measures must be held to ensure pollution control and health. Faeces can contain higher concentrations of pathogens than urine, thus appropriate treatment is crucial to reduce levels of human pathogens to a safe level of use (WHO 2006). The total amount of nutrients in faeces is lower than in urine, but faeces holds a high concentration of phosphorous and potassium. Phosphorous and potassium are two elements that can significantly increase crop yields (Morgan 2003). Pathogens from urine entering the urine

collection container must also be considered when handling and using urine even though fresh urine is mostly considered safe. To ensure safe use, anaerobic storage with ambient temperature, elevated pH in combination with ammonia have been concluded to affect the inactivation of microorganisms (Schonning & Stenström 2004). At household level, the urine can be used directly in crops, but in large-scale systems it should be stored for one month at 20° C before use (Schonning & Stenström 2004).

2.3 Sanitation in Nepal

According to Department of Water Supply and Sewerage of Nepal, the nationwide sanitation coverage in 2010 was 43% (DWSS/NMIP 2011), where the sanitation coverage in urban areas was 78% against the coverage of only 37% in rural areas (Adhikari 2012b; DWSS/NMIP 2011). An estimate of 52% of the total population is still practicing open defecation (WHO&UNICEF 2010) and lack of hygiene and sanitation has resulted in outbreaks of both cholera and diarrheal epidemics especially prominent in the Western and Far Western Development Regions (DWSS/NMIP 2011). Annual total deaths due to diarrhoea related diseases among children under five, is around 10,500 in Nepal (DWSS/NMIP 2011) and the drop-out rate of girls from school has increased because of inadequate sanitation (Adhikari 2012b). The most affected by lack of proper sanitation is the poor urban population and especially women and children amongst them (Adhikari 2012b). To be able to change this trend and increase the national sanitation coverage, the Government of Nepal has declared an ambitious goal of aiming to achieve 100% sanitation coverage by 2017 (Pretus et al. 2008). In addition, Nepal has committed to the MDG and needs to reach national sanitation coverage of 53% by 2015 to meet this goal. The annual increment of sanitation coverage in Nepal is found to be 1.9% by Ministry of Physical Planning and Works (MPPW), which is not sufficient enough to meet the national target of 100% coverage by 2017 (Adhikari 2012a).

2.3.1 Sanitation technologies in Nepal

In urban areas of Nepal, sewer systems are present with 30% of the population with toilets connected to sewer systems and 47.5% have toilets connected to septic tanks with poor treatment of sludge (DWSS 2013). There are five municipal wastewater treatment plants where only one is operating when power is available.

The lack of treatment and direct discharge of wastewater into rivers and streams are causing high levels of contamination and poses high health risks for the population (Rajbhandari 2008). In addition, 17.3% of the urban population was found to be practicing open defecation in 2006 (GSFN 2010). This has probably decreased, but no current percentage has been found. The GoN has initiated some policies such as: Urban Water Supply and Sanitation Policy, 2009; Bagmati river Action Plan, 2010, and Solid Waste Management Act, 2012, in order to address the issues of urban sanitation. Urban sanitation also includes solid waste and some initiates as encourage waste recycling and building six sanitary landfills have been done, but there is still a lot of work left to ensure safe sanitation in the urban areas of Nepal (DWSS 2013). The urban population has a growth rate of 3.38% per year compared to the national growth rate of 1.35% (DWSS 2013). This urbanisation trend needs to be considered despite the greater sanitation coverage in urban areas compared to rural Nepal. Urban sanitation facilities are not always considered improved sanitation. Thus, new holistic sanitation approaches that takes into account Nepalese context, environment, hygiene and sustainability is needed to solve the sanitation issues in urban areas (Rajbhandari 2008).

In rural areas of Nepal, the most promoted sanitation technologies are simple pit latrines, and pour flush latrines (Adhikari 2012b). As explained, these technologies are rather simple with no water sealed septic tanks to limit groundwater pollution or any focus on reuse of nutrients. These latrines are promoted with a main goal to increase ODF-status and not with the thought of environmental-friendly and sustainable excreta disposal (Adhikari 2012b). However, a focus on environment and benefits from sanitations has emerged. The urine-diverting toilet was introduced in Nepal in 2002 and piloted by DWSS and World Health Organization based on the ecological approach in sanitation also referred to ecological sanitation as previously explained (Adhikari 2012b; DWSS 2009). The Environment and Public Health Organization (ENPHO) Nepal, defines ecological sanitation as: *"Eco-San is a technological option where urine and faeces are collected separately. Eco-San system provides sustainable solution of sanitation problems and prevent from disease outbreak due to faecal contamination"* (Upadhyay Adhikari et al. 2012). And there are two types of urine-diverting toilets introduced in Nepal as eco-san toilets. These are Urine-Diverting Dry Toilets (UDDT) and Urine-Diverting Wet Toilets (UDWT).

Urine-Diverting Dry Toilets (UDDT)

The principle of UDDT is to collect faeces and urine separately through a squatting pan with separate holes for urine, faeces and water for anal cleansing. Most people in Nepal has the habit of anal cleansing with water (WaterAid 2011). No water is used for flushing and faeces is composted in vaults with addition of ash or sawdust used as cover to increase pH (Adhikari 2012b). The Double Vault Urine Diverting toilet (DVUD) is the first UDDT introduced in Nepal. The DVUD has two separate watertight chambers of mason or concrete for storage of faeces, both with connected ventilation pipes. In addition, there is a urine collection vessel connected and a system for collecting anal cleansing water (WaterAid 2008).

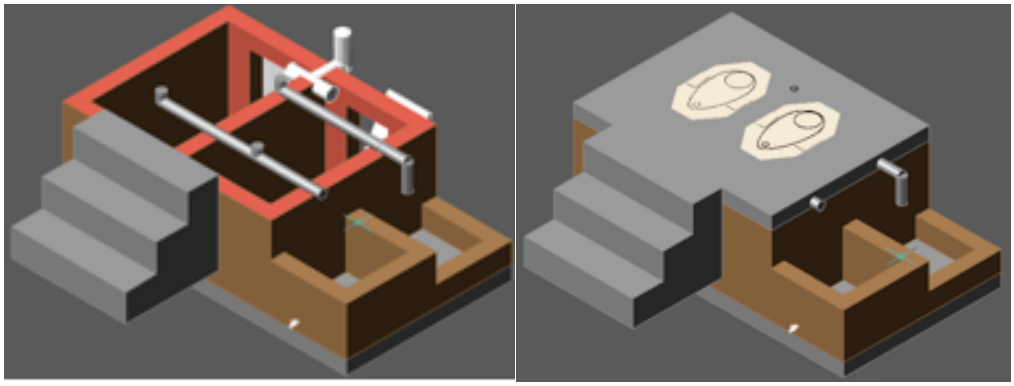

Figure 3: design layout for Double Vault Urine Diverting toilet (DVUD) (ENPHO 2007).

As seen from fig. 3, the two chambers are constructed above ground to eliminate any ground water contamination, even though the chambers aught to be watertight. The size of each chamber is ca. 0.35 cubic meters where the inner wall is plastered with cement or mortar (ENPHO 2006). The vault doors, seen to the left in fig. 3, is about 6'x6', which is a necessary size to allow easy removal of dry excreta after composting (WaterAid 2008). A polythene pipe with 50 millimetres in diameter is connected to the pan and diverts the urine to a urine collection tank (ENPHO 2007), as seen from fig. 3. The urine collection vessel varies in material from brick masonry to plastic barrels or jerry cans. The most used urine collection tanks are plastic barrels where the capacity varies from 50 – 100 litres. In the DVUD, a separate hole for anal cleansing water is provided where the wastewater from anal cleansing is diverted into a soak pit (WaterAid 2008).

Urine-Diverting Wet Toilets (UDWT)

Urine diverting pour flush toilets are the most common UD-toilet in Nepal. It is introduced as a wet eco-san toilet and similar to the DVUD, it separates urine and faeces. This type of eco-san toilet is a modification of the pour flush latrine with an added mechanism of urine diversion and two pits for collection of faeces.

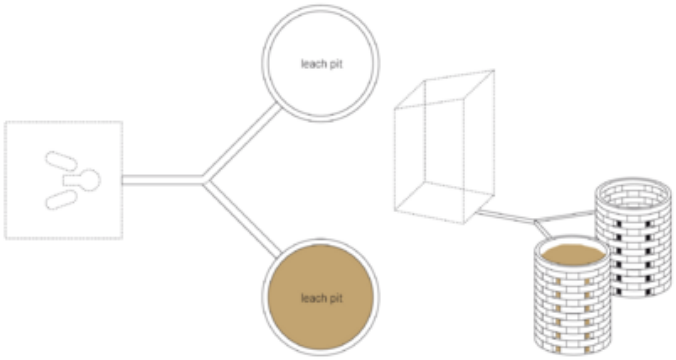

Figure 4: simple design of a twin pit pour flush toilet. The system in Nepal has in addition a urine-diverting pan for urine collection.

The urine-diverting squatting pan is used for collecting urine in a separate container based on the same technology as for the DVUD. Faeces and wastewater from flushing and anal cleansing are collected in a pit lined with precast concrete rings, as shown from fig.4. The pit is not water sealed and constructed below ground with liquid infiltrating the ground (Adhikari 2012b; WaterAid 2011). After one of the pits is filled up, the other one is used while the content of the first pit is composted. The recommended time for composting of faeces before it can be used as fertilizer is six months in Nepal (WaterAid 2008). One of the disadvantages with the UDWT is that only urine is collected and stored for use as fertilizer and that the amount of water used makes it difficult to utilize faeces after six months of composting (WaterAid 2011). Thus, optimal benefits from the concept of eco-san are not obtained.

Darechowk version of UD-toilet

The implemented technology in Darechowk is based on the wet urine diverting pit latrine explained in the previous section, but the twin pit is only installed in a couple of households. Thus, this section will be explaining the wet urine-diverting toilet with a single pit, as this is most common and relevant for this research.

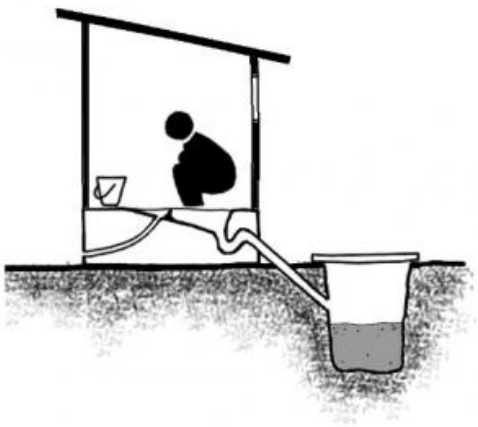

Figure 5: simple design of a urine diverting pour flush latrine. The system in Darechowk has in addition masonry brick walls with concrete lining.

As seen from fig. 5, the 750 eco-san toilets constructed in Darechowk has a urine-diverting squatting pan with one hole for urine and one hole for faeces. Faeces together with anal cleansing water are flushed through a pipe into a pit. The pit is constructed as a square pit in the ground, separate from the toilet and with four brick masonry sidewalls with cement mortar and a concrete slab on top. The average size of the pits installed in Darechowk is usually 4 feet deep with a length of 4 feet and a width of 3.5 feet. Same as the principle for pour flush latrines, the faeces are not reused and liquid together with decomposed solids are infiltrating the ground. The superstructure of the toilet is made from brick walls with the toilet floor elevated to fit the urine-diverting pour flush pan. The pan is made out of fibreglass and is constructed into the toilet floor. A urine collection pipe, with 50 millimetres in diameter, made from rubber is connected to the pan and collects urine by gravity to a collection tank. The size of collection tanks varies from small jerry cans (10 L) to barrels of 30 litres capacity.

Figure 6: (photo: Kaia Bing) photos illustrating the eco-san toilets in Darechowk VDC.

Fig. 6 shows photos taken of the wet eco-san toilet used in Darechowk. The photo to the left in fig. 6 shows the urine collection tank connected to the pan via a black plastic pipe, which collects the urine by gravity. The photo to the right in fig. 6 shows the urine-diverting pan with one hole for urine in front of the pan and the hole for faeces, anal cleansing water and flushing water in the back. The bucket in the same photo is filled with water for both anal cleansing and flushing.

2.3.2 Socio-cultural factors affecting ecological sanitation

The concept of ecological sanitation is implemented in Nepal as a response to the achievement of UN MDGs and the 2017-goal. However, the achievement of implementing sanitation technologies that will be successful depends upon in which degree it will be accepted among users (Mosler 2012). Eco-san is a lot more than just technical infrastructure and acceptance from users is anchored within the local cultural context and affected by individual attitudes and behaviours (ADC 2004). Collaboration with users is important when developing sanitation technologies so they can be adjusted to the current socio-cultural setting (Nawab et al. 2006). Thus, the planning and decision-making process has to include users and provide them with appropriate education and awareness. Increased awareness and knowledge among users is known to give better results and give optimal benefits from eco-san (ADC 2004). For eco-san to be accepted a change in how people think about and act upon human excreta is essential (DWSS 2009).

Communities in Nepal can be attributed as faeco-friendly (who easily accept excreta as fertilizer) or faeco-phobic (often reluctant to use of excreta). Many old farmer communities have since ancient times used human excreta to grow crops and collected human faeces from the whole community in big pits called "Saaga" (DWSS 2009). Some farmers in Nepal are still using the practice of fresh human excreta as fertilizer, but due to rapid urbanization and western-inspired sanitation technologies the practice has declined (DWSS 2009). Accordingly, both wet and dry eco-san toilets have been promoted to adjust to the different cultural practices when it comes to human excreta. Furthermore, the majority of Nepalese population has traditionally always practiced open defecation (WaterAid 2008). Studies show that most people are not willing to change this practice unless they see advantages that benefit them and can increase their quality of life (Adhikari 2012b).

The religious setting of Nepal is highly complex due to a multi-ethnic and culturally diverse society with 60 officially recognized ethnic groups and castes (Cole & Tamang 1998). There is however a limited set of ethnic contrasts that can describe the unlimited ethnic diversity in Nepal: Hindu versus Buddhist, tribe versus caste and mountain versus middle hills versus lowland Terai. From this, the creation of Nepal's first legal code, the Muluki Ain of 1854 was established during the era of Rana rule. The Muluki Ain ranked all people in the state territory after purity according to the principles of Hindu caste hierarchy (Hangen 2007). It is argued that the government created the caste system to legitimate Nepal's separate political identity and to be able to unify the country based on a cohesive legal system (Levine 1987). Furthermore, this caste system placed high Hindu castes, such as Brhamins and Chettri in high-ranking positions, non-Hindu middle hills and mountain groups, such as Gurung and Magar, in middle-ranking positions and lower Hindu castes, such as Dalits (untouchable) and other groups, in the lower ranking positions (Levine 1987). Even though the caste system was abolished in 1963 (Jodhka 2008), the Nepalese society is highly affected by this division of people over many years. This division has also affected sanitation coverage due to less attention to some groups in the society that has become neglected when promoting sanitation. Level of education, which is highly important for acceptance, has also been in favour for higher castes and groups such as Brhamin and Chhetri. Higher Hindu castes are often not to be handling human waste, not even their own, as this is associated with something unclean or impure (Winbald & Simpson-Hébert 2004).

Impurity is also linked with the menstruation period for women among Bragmins and Chhetris. Depending on the community's local norms, the period up to the 4th or 5th day of menstruation is considered 'impure' or 'unholy'. During this time, women are not allowed to touch water, cook food or participate in religious practices and in some communities not even to use the toilet (Adhikari 2012b). The Hindu culture comprises a concept of clean and unclean and can explain some of the cultural factors affecting sanitation in Nepal. Accordingly, religious practices and norms has to be considered when introducing and implementing sanitation technologies, in order to achieve behavioural change.

2.3.3 Government policies and strategies on sanitation

The history of sanitation policies and strategies from the Government of Nepal started when the Ministry of Health recognized the correlation between diseases and poor sanitation and initiated the first safe water supply project in 1950 (Adhikari 2012b). Department of Irrigation and Water Supply was later established and continued the work with sanitation mainly focusing on constructions of simple latrines and soak pits. Even though the Department of Water Supply and Sewerage (DWSS) was established in 1972, construction of latrines and focus on safe sanitation was very low and subject to most urban areas up to 1984. In 1984 the Community Water Supply and Sanitation Project was initiated from DWSS with the goal of improving rural sanitation (Adhikari 2012b). Initiatives for rural sanitation came with the "community management approach" and Users Committees (UCs) to ensure local sanitation projects. The aim was for local government to provide sanitation services for their ruling area. However, inadequate funding from national government resulted in lack of funds to sustain long-term operation and the "community management approach" was considered a failure and did not succeed to increase the sanitation coverage in any degree (Koestler et al. 2010). During the 1990's, the concept of decentralization was introduced in the sanitation sector with the Nepal National Sanitation Policy and Guidelines for Planning and Implementation of Sanitation Program in 1994 (DWSS 2013). These policies and guidelines focused on sanitation not just as constructing latrines but an emphasis on community led approaches including promotion activities on household level in rural as well as urban areas (GSFN 2010). From 1994 to 2004, many policies and strategies was launched but not carried out because of different implementation methods, lack of communication between different departments and institutions and low and insufficient resources.

Despite the lack of resources for sanitation, the government declared in 1997 a goal of achieving 100% sanitation coverage by 2017. This was followed up in 2004 by a new policy called "the Rural Water Supply and Sanitation National Policy", which also included (for the first time) expenditure commitments for sanitation and hygiene promotion (Pretus et al. 2008). The 2004 policy was not a success and the last attempt from the Government of Nepal to increase sanitation coverage and meet both the MDG and the 2017 target is "the Sanitation and Hygiene Master Plan 2011" (Adhikari 2012b). The master plan aims to improve the sanitation sector by streamlining promotion activities, strengthening local bodies' leadership, resolve cultural and socio-economic barriers through controlled planning, monitoring and follow-up processes.

Another aim is to strengthen the collaboration between government, NGOs and other stakeholders (Adhikari 2012a). Further, the master plan has recognized the importance of local leadership and decentralization due to Nepal's diverse geographical, ecological, cultural and socio-economic setting. Even though the master plan seems to emphasise and give strategies to all sides of sanitation promotion and implementation, there are many challenges with the strategy. Among others, the lack of financial resources to monitor and follow-up by local government and the fact that the government relies on local initiatives with no funding are the most severe backsides. Other challenges with sanitation policies and strategies is the lack of financial support for rural sanitation technologies to be more environmental friendly (Adhikari 2012a). With these backsides there is a strong concern to which Nepal manage to meet the target of 100% sanitation coverage by 2017 and be able to sustain it with respect to both health and environment.

2.3.4 Promotion approaches on sanitation

Many different approaches to increase knowledge and awareness about sanitation have been introduced in both rural and urban areas in Nepal. School-led total Sanitation (SLTS) and Community-led Total Sanitation (CLTS) are two approaches adapted and used for sanitation promotion. These approaches was introduced after representatives from the government of Nepal (GoN) attended the first South Asian Conference on Sanitation held in Bangladesh in 2003 (Adhikari 2010). The CLTS approach recognizes the household's or the individual right to live in an open defecation free environment with safe sanitation.

To ensure safe sanitation, the community is appointed main decision-maker and will analyse and assess the impact of open defecation in order to completely eliminate the practice (Sah & Negussie 2009).

CLTS has the aim of behavioural and social change of the community and a "community mobilization" over a focus on the sanitation technologies (Sah & Negussie 2009). Further, the GoN has developed different variations of CLTS, such as Community Led Basic Sanitation for All (CLBSA), Community Led Total Behavioural Changes in Hygiene and Sanitation (CLTBCHS) and Local-body Led Total Sanitation (LLTS), which all build upon the same principles (Adhikari 2012b). The implementation of SLTS started in Nepal with The School Sanitation and Hygiene Education (SSHE) program based on the principles of CLTS. With the recognition of children as change makers and promoting a child-friendly aspect of sanitation, some schools have now implemented "life skill based hygiene education" (UNICEF 2006). The approach of SLTS has contributed to communication between local bodies such as teachers, women groups and community-based organization. As a result, an increased focus on sanitary conditions of school and hygiene behaviour of children has been improved. The overall aim of SLTS in Nepal is to eliminate all open defecation in school catchment areas and has three main objectives: *Raaj Hath* (state level determination), *Baal Hath* (children level determination) and *Stri Hath* (women level determination).

Another sanitation promotion approach, which emerged from both the CLTS and the SLTS approach, is the declaration of ODF-status on a district or village level. The focus on community participation and mobilization has given the sanitation sector a new way of promoting toilets through promotion of ODF-status (DWSS 2013). The ODF-status are given by the GoN to any VDC or DDC that has achieved 80% improved sanitation facilities and eliminated open defecation in the community. It has been introduced with an emphasis on collective community action with the aim at strengthening the community's awareness of negative impact from OD. The ODF-status has also become a social status among the population of VDC's and DDC's that have achieved this goal. Representatives of the GoN often give the deceleration of ODF during a ceremony held in the receiving DDC or VDC. The ODF ceremony has become an important local event and is often followed by reward and national recognition through mass media (Adhikari 2012b). Accordingly, other VDC's and DDC's are encouraged and inspired to set ODF as a goal for their community and raise

awareness on sanitation in all authorities and institutions. Several district authorities have also begun to run sanitation campaigns on their own initiative in order to achieve ODF status in school areas as well as the whole district.

Due to the ODF declarations and campaigns, the current nation-wide movement in sanitation is not based on sanitation interventions or any technology implemented but is rather measured in terms of ODF areas (Adhikari 2012b; DWSS 2013). There are now many ODF areas in Nepal, and as of March 2013, 748 VDCs and five DDCs have achieved 100% sanitation coverage (DWSS 2013). 100% sanitation coverage is not defined by one toilet for every household but by access to safe defecation for all community members. Safe defecation can be possible through use of neighbour's toilet or a shared toilet in the community (Adhikari 2012b). Thus, communities can declare their own ODF-status if they know that all members have access to safe defecation. Even though the term "safe defecation" includes the use of toilets and that ODF campaigns have increased toilet coverage, there is still a concern regarding the sustainability and optimal use of the toilets built. Toilets are often built in a hurry to achieve the ODF-status because this gives more acknowledgements to the community than the actual toilet construction. Consequently, the quality and sustainability of the toilets are often low and communities rarely consider different factors such as environment or reuse of nutrients during construction (Adhikari 2010; Adhikari 2012b). Thus, the actual sustainability of ODF-status as the most pertinent approach to sanitation in Nepali is not of direct certainty.

Emerged from the ODF approach is also the sanitation initiative "Sanitation Model District" (SMD), which was introduced in 2006 (DWSS 2013). SMD is originated from Nepal and has the purpose of further stimulate sanitation promotion on a local level. (Adhikari 2012b) The first and only district to receive the title of SMD was Chitwan district in Central Development Region. Chitwan received the title due to the district's ODF-status in 2011 and the many sanitation campaigns and promotion approaches initiated on village and district level. Chitwan DDC is promoted as a sanitation-model for how all other districts in Nepal should practice and has been recognized as a success nation-wide. The success is also based on the efforts regarding promotion and implementation of urine-diverting pit latrines and the reuse of nutrients as an optimal technology for rural areas (Adhikari 2012b).

3. RESEARCH METHODS AND FIELD WORK

One essential part of empirical research is collecting, analysing and interoperating data. In any science, data are not error free (J. & Fowler 2009), thus strict requirements for any proof obtained to be able to draw a conclusion. Consequently, the researcher has to choose a method that makes it possible to argue his or her assumptions to be correct (Johannessen et al. 2011). Based on this, the researcher must deselect methods and further argue his or her final choice of method based on literature (Ryen 2002). Literature also argues when and whether to use qualitative or quantitative method, but in the end it must be up to the researcher to evaluate what will fit best with the research questions and objectives for the study.

3.1 Choice of research design

This research focuses on the different factors affecting the adoption and optimal use of urine-diverting eco-san toilets in Darechowk. The study aims at evaluating the use of the technology from a user perspective. It also aims at providing a deeper understanding of a technology to go into the actual causes and effects of optimal use. Thus, qualitative method for data collection and analysis was concluded as appropriate for this study. Berg & Lune (2012) describes quality as something that refers to *"what, how, when, where, and why of a thing – its essence and ambience"* (Berg & Lune 2012). Thus, qualitative research refers to meanings, concepts, feelings and descriptions in contrast to quantitative, which refers to numbers and counts of things (Berg & Lune 2012).

The goal of this study is to describe a current situation based on people's feelings and perceptions. This will involve a description and interpretation of a phenomenon within a cultural context, since user friendliness, social acceptance and economic benefits all relates to a human perspective. Hence, utilizing an ethnographic view or "analytic ethnography" as the strategy for fieldwork is appropriate (Lofland 1996). Lofland (1996) describes "analytic ethnography" as follows:

"I use the term "analytic ethnography" to refer to research processes and products in which, to a greater or lesser degree, an investigator (a) attempts to provide generic propositional answers to questions about social life and organization; (b) strives to pursue such an attempt in a spirit of unfettered or naturalistic inquiry; (c) utilizes data based on deep familiarity with a social setting or situation that is gained by personal participation or an approximation of it; (d) develops the generic propositional analysis over the course of doing research; (e) strives to present data and analyses that are true; (f) seeks to provide data and/or analysis that are new; and (g) presents an analysis that is developed in the sense of being conceptually elaborated, descriptively detailed, and concept-data interpenetrated"

Loftland's above mentioned definition provided the context for an empirical approach. This approach was based on the surveyed population's experiences and understanding of their own context in order to get a valid understanding of their actions and feelings. To be able to gather data based on familiarity of a social setting or situation, the research took place on-site at the chosen geographical area; Darechowk VDC in Chitwan DDC in Nepal. Site of fieldwork has also been site of residence for the researcher, in order to obtain as much knowledge and understanding of the surveyed population. Accordingly, this research is based on qualitative method with semi-structured interviews, focus group discussion and observations as data collecting tools.

3.2 Study area

The reason for the fieldwork to be carried out in Darechowk VDC in Nepal was in large part due to the contextual background of this study. The execution of the study was planned out in dialogue between the researcher, her supervisor and key persons in Nepal. The first key person is an environmental engineering consultant working with ecological sanitation in Nepal. The second key person is Shreerendra Pokharel, the chairperson of THE SEWA Nepal, who lives and works with promotion of ecological sanitation in Darechowk. Because of these persons, the researcher was able to conduct the fieldwork in Nepal from December 2013 – March 2014. The researcher also stayed with Shreerendra Pohkarel's family during this time. Thus, the study area was defined in cooperation with the two key persons who became guides and key informants for this study.

3.2.1 General description of Darechowk VDC

The empirical part of this thesis was situated to Darechowk VDC, which is one of the 40 village development committees of Chitwan DDC. Darechowk is located in the mountainous region of Chitwan with altitudes reaching more than 1100 m above sea level. As of other mountainous regions in Nepal, Darechowk has characteristics such as steepness, isolation and marginality. Nevertheless, Darechowk VDC was declared open defecation free in 2010 and is committed to upheld this status through implementation and promotion of urine-diverting eco-san toilets for every household in the community (DWSS 2009). South Asian Conference (SACOSAN) recognized Darechowk VDC as 'Ecosan Model Village' after the fifth conference was held in 2013 in Kathmandu (SACOSANV 2013).

Figure 7: (map retrieved from Google maps), the map section shows the study area, Darechowk VDC, situated North in Chitwan DDC. The map is also showing Nepal's capital, Kathmandu, East for Darechowk and the second largest city, Pokhara to the West.

Fig. 7 shows Darechowk VDC, which is situated in Chitwan DDC and belongs to Nepal's Central Region and geographically to the midlands. Darechowk VDC is situated in the north of Chitwan district and the VDC is divided into nine wards. According to Shreerendra Pokharel, there are approximately 1665 households in Darechowk grouped in 45 clusters of about 20 – 100 households. The Prithvi Highway marks the north boarder of Darechowk VDC, which is one of Nepal's main highways following the Trishuli River.

The highway stretches from Kathmandu to Pokhara, which are Nepal's biggest cities. Due to the good transportation connection between these two cities, VDC administration, health post and many shops are located in clusters near the highway. The highway is not in a very good condition, even though it is reckoned as the busiest highway in Nepal, and causes regularly traffic jams (AnaTravels 2014). However, traffic jams is considered an important source of income, hence the large number of small shops in Darechowk. In Darechowk's rural areas of higher altitude the main occupation is farming with both vegetables and orange production. Orange production is primarily produced for the market and yields an income, but vegetable production is more a case of subsistence farming due to low soil fertility Subsistence farming is a self-sufficient farming in which farmers focus on growing enough food for personal consumption without any significant surplus for sale (Kostov & Lindgard 2002). Thus, the use of chemical fertilizer is very common among farmers in Darechowk.

Further socio-economic facts and statistics about Darechowk were hard to retrieve because the VDC administration mainly records date and birth. However, some information was retrieved through verbal communication. The VDC administration stated that capita per income is 75 Nepalese Rupees (NPR) per person per day, which is almost equal to the standard poverty line from The World Bank of 1 USD per person per day. It was further stated that about 60% of all household in Darechowk are below the poverty line. Furthermore, the population of Darechowk has 14 different ethnic groups with the majority represented of Gurung (28%) and Magar (21%) mainly located in the upper hilly part of the VDC. In the mid-hills is mostly inhabited by Chepang ethnic groups (15%), who are considered as lower caste. Higher caste such as Brahmin (14%) and Chhetri (5.7%) lives mixed in clusters situated on the foot of Darechowk's many mountains by the highway (DWSS 2009) (verbal communication with VDC administration and the researcher).

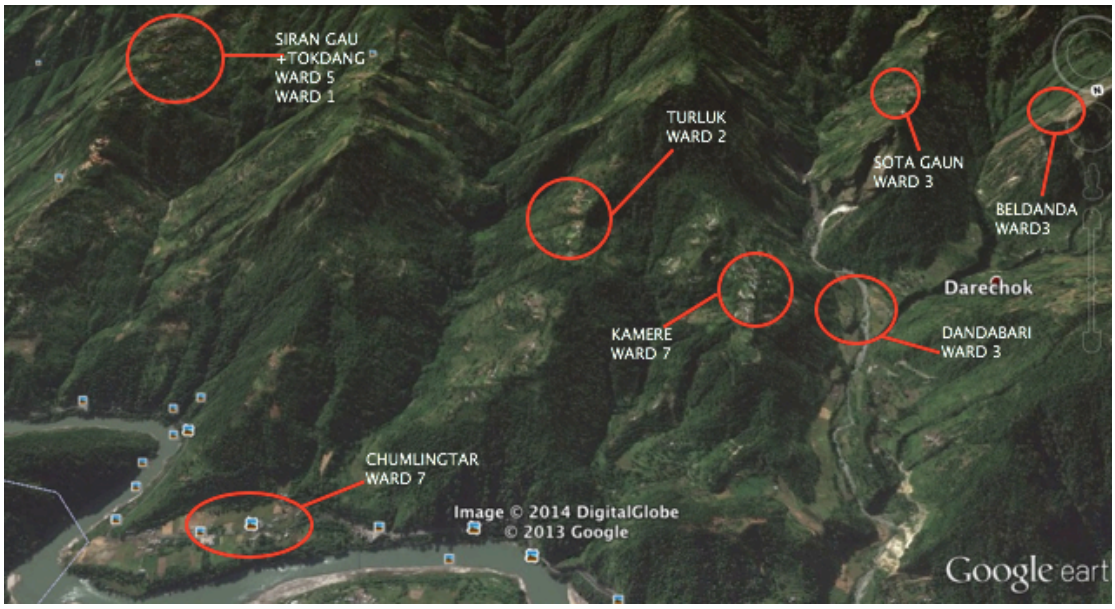

Figure 8: (retrived from Google Earth) overview of study area with visited custers in Darechowk VDC marked with a red circle.

As seen from fig. 8, the data collection for this research took place in five of the nine wards in Darechowk VDC and within eight clusters. The reason for the selection of these specific wards and clusters was due to recommendations from the two key informants and accessibility; many clusters in Darechowk are situated at very high altitudes in quite remote areas. Footpaths works as the main form of infrastructure for transportation, going up and down from clusters in mountain areas. From the mountainous areas, there are only a couple of car-roads from the highway. Due to accessibility of the clusters and the recommendation from key informant, a decision to define the study area as close to the highway as possible was made. The second reason for selection of study area was on the basis of the research question and the purpose of the study. All participants had to be selected on the basis of weather they had constructed the urine-diverting pit latrine and collected urine for use as fertilizer. As earlier explained, 750 households in Darechowk have constructed the urine-diverting wet eco-san toilets, so the study area had to include a fraction of these households for surveying. For every cluster visited, six semi-structured interviews and one focus group discussion was conducted.

Figure 9: (photo: Kaia Bing) Shows the first and second cluster visited, Chumlingtar (ward 7) to the left and Dandabari (ward 3) to the right.

The first cluster to be surveyed was Chumlingtar, as shown in fig. 9 to the left. Chumlingtar was also the site of residence for the researcher during the fieldwork. The village is in ward 7 and located by the highway, 100 km from Kathmandu and 100 km from Pokhara, about 300 meters above sea level. The village extends along both sides of the Prithvi highway, a couple of kilometers between Kuringtar in west and Phisling in east. The second cluster surveyed was Dandabari in ward 3 (right picture, fig. 9). The village is located about one hour driving up a mountain road up from Nayabasti in Kuringtar. Six interviews and one FGD were conducted for each of these clusters.

Figure 10: (photo: Kaia Bing) Shows the third area visited, Sota Gaun (ward 3) to the left and Belenda (ward 3) to the right.

The third area visited contained two different clusters, both located in ward 3. Fig. 10 shows Sota Gaun to the left and Beldanda to the right, which together made the boundaries of area three. Both clusters are located about two hours walk from Dandabari.

Since both Sota Gaun and Beldanda were two small clusters, where only a few households had urine-diverting toilets, it was decided that three interviews were to be conducted in each cluster in addition to a FGD with participants from both clusters.

Figure 11: (photo: Kaia Bing) Shows the fourth and fifith cluster visited, Kamere (ward 7) to the right and Turluk (ward 2) to the left.

The fourth cluster visited was Kamere in ward 7, shown to the left in fig. 11. Kamere is situated about two hours walk from Chumlingtar, in a steep slope of a hill ca. 800 m above sea level. The fifth cluster visited was Turluk in ward 2, located about two and half hours walk up northeast from Prithvi highway ca. 1000 m above sea level.

Figure 12: (photo: Kaia Bing) Shows the sicth area visited, Siran Gaun (ward 5) to the left and Tokdang (ward 1) to the right.

The sixth area visited were two clusters, Siran Gau in ward 5 and Tokdang in ward 1. Fig. 12 shows Siran Gau to the left and Tokdang to the right, which together made the boundaries of area six. Siran Gau and Tokdang is located about one hour drive from Chumlingtar.

3.2.2 Background on eco-san in Darechowk VDC

The recognition of Darechowk VDC as an eco-san village has emerged through the construction of 750 urine-diverting wet eco-san toilets throughout the 9 wards of the VDC. Ecosan toilets have been implemented and promoted mainly due to local initiative. The local teacher, Shreerendra Pokharel, started his work of promoting eco-san after he attended a SLTS program in 2006 organized by DWSS and WHO and wanted to implement the concept in his school. He founded eco-san clubs for school children and awareness raising campaigns with children taking pictures of the sanitation conditions in their clusters. These initiatives achieved attention from district and national sanitation departments as well as non-governmental organisations and WHO in Nepal, which led to financial support. To receive the financial support, Shreerendra Pokharel funded the NGO named THE SEWA Nepal in 2009 and continued his work with implementation and promotion of eco-san toilets. With the financial support from ENPHO Nepal and WHO Nepal, THE SEWA Nepal organized different training programs and financial support to construction of toilets. A resource centre was established in Chumlingtar, which is Shreerendra Pokharel's home cluster, where eco-san training and activities were conducted. Even though Shreerendra Pokharel himself is from Brhamin caste, he included all ethnic groups and castes from Darechowk in these training programs and activities.

Shreerendra quit his job as a teacher to dedicate all his work and effort in promotion and implementation of eco-san with the aim of becoming 'Eco-san Model Village'. To reach this aim in addition with an ODF-status in, ENPHO Nepal and WHO Nepal provided THE SEWA Nepal with funding. Through this funding, Shreerendra was able to distribute free urine-diverting pans, urine-collecting pipes and cement in order for the concinced population to construct toilets. By July 2010 Darechowk reached the aim of ODF-status with coverage of more than 50% eco-san toilets. However, lack of financial funding forced Shreerendra to start working as a teacher again later in the year of 2010. Now THE SEWA Nepal faces many challenges in continue the work on sustaining the implemented technology.

3.3 Data collecting tools

As previously mentioned, qualitative interviews were selected as the primary tool for collecting data in this research. Kvale & Brinkmann (2009) describes a qualitative interview as a structured conversation where the purpose is to understand and later describe the outcomes of the conversation. Further, they explain that interviews can be more or less structured within three different forms (Kvale & Brinkmann 2009). An unstructured interview has no order in which the questions are asked and the questions are adjusted to the different interviewees and settings (Berg & Lune 2012). In a semi-structured interview, a set interview guide with questions related to the research questions are used, but the interviewer is allowed to adjust language or re-phrase questions depending on the interviewee. The interviewer may as well add further questions or delete questions from the interview guide (Berg & Lune 2012). In a structured interview, the researcher has decided both topics and questions beforehand and uses given answers that is ticked off as the respondents are answering (Johannessen et al. 2011). In this research a semi-structured interview form was identified as appropriate since three main objectives were already selected, which would form the questions. At the same time, the flexibility of rearranging, adding or deleting questions gives the opportunity to explore new topics introduced by the participants.

Furthermore, a FGD was also selected as a data-collecting tool for this research. Focus group research is explained as a way of collecting data that involves the engagement of a small group of people to perform an informal group discussion focused on a particular topic or set of issues (Wilkinson 1997). The focus group setting is often less threatening for participants and they can more easily and openly discuss different topics (Onwuegbuzie et al. 2009). Furthermore, the method has multiple benefits as it is cost effective and an efficient way of obtaining data from many participants during a relatively short period of time (Berg & Lune 2012). FGD was also selected in this research because data obtained can be interoperated as a community feeling and give an overall answer to the research questions asked. The method was also considered important because topics discussed could indicate reliability of the answers from the interviews.

In qualitative research, collecting data from every member of a community or population is not seen as a necessity in order to get valid information and results. It is seen sufficient to collect data from a sample of the selected population. The sample size and whom to sample

are selected on the basis of research questions of the study and the characteristics of the study population (Mack et al. 2005). Based on these criteria, there are different methods for sampling. Purposive sampling selects the participants on the basis of preselected criteria related to particular research questions. Another type of purposive sampling, called "snowballing", described as a method where a key informant or guide for the researcher in the selected study area, use their contact network to help the researcher select participants (Mack et al. 2005). A combination of purposive- and snowball sampling are used as methods for sampling in this research. The sample had initially one main criterion; that all participants had constructed a urine-diverting toilet and used the collected urine as fertilizer. As the study progressed the local teacher in Darechowk, Shreerendra Pokharel, became the key informant and guide for the researcher. He used his network to help the researcher to select the participants. Pokharel also appointed one coordinator for each surveyed cluster, who would assist in selection of participants for both interviews and FGD. The coordinator also asked all potential participants if they wanted to participate and organized time and place for the FGD. All together, this was a very effective way for the researcher to get a good sample size, and secured a good form of communication.

Furthermore, for the researcher to go through with the selected methods, a translator was used for both the interviews and FGD. The translator was a local poultry farmer from the VDC bordering Darechowk and was selected because of his fluency in English, and because of his local knowledge on socio-cultural views and the area itself. His knowledge was valuable both because it helped build up trust with the participants and for practical reasons such as locating the various clusters.

3.3.1 Semi-structured interviews

The initial thought was to make a more structured interview guide that combined both "yes and no type" of questions with open-ended questions aimed at capturing more detailed perspectives and feelings. The first questionnaire made had about 50 questions and was quite comprehensive and wide-ranging. Limitations were found after two test interviews were carried out, so a modification towards a semi-structured interview guide with an open-ended approach, was decided. This aimed at more intense individual interviews with a decrease in number of questions and respondents, and more complex and open-ended questions. The

questions in the interview guide were structured in a sequence based on the main objectives. The interview guide can be found in Annex 2.

Before the interviews were carried out, the translator together with Shreerendra Pokhrel, went through every question so the translator understood and became familiar with technical words, expressions and the intention of all questions. In cooperation with the translator, some of the questions were modified and made easier to understand. A test interview was also carried out in order for the translator to practice and be more confident with the content. The timeframe for each interview varied between 45 min – 1,5 hours. Taken into account ethical considerations, it was important that the interview session did not exceed a time limit that was not comfortable for the participants. Due to this consideration it was decided that only the introductory part, where the purpose of the research, introduction of the researcher together with rights for the participants were explained, would be translated directly from English. During the rest of the interview session, the translator would ask questions and translate the answers, which the researcher would write down. From the answers given to the questions in the interview guide, the researcher would ask follow-up questions if appropriate. Naturally, these questions would be translated and again noted by the researcher.

A total of 36 households were visited in six different clusters in Darechowk VDC, with a distribution of six households for each cluster. The age of the participants ranged between 18 to 75 years with men and women almost equally distributed with 56% and 44%, respectively. In Annex 1, a more detailed overview of the participant's demographics can be found.

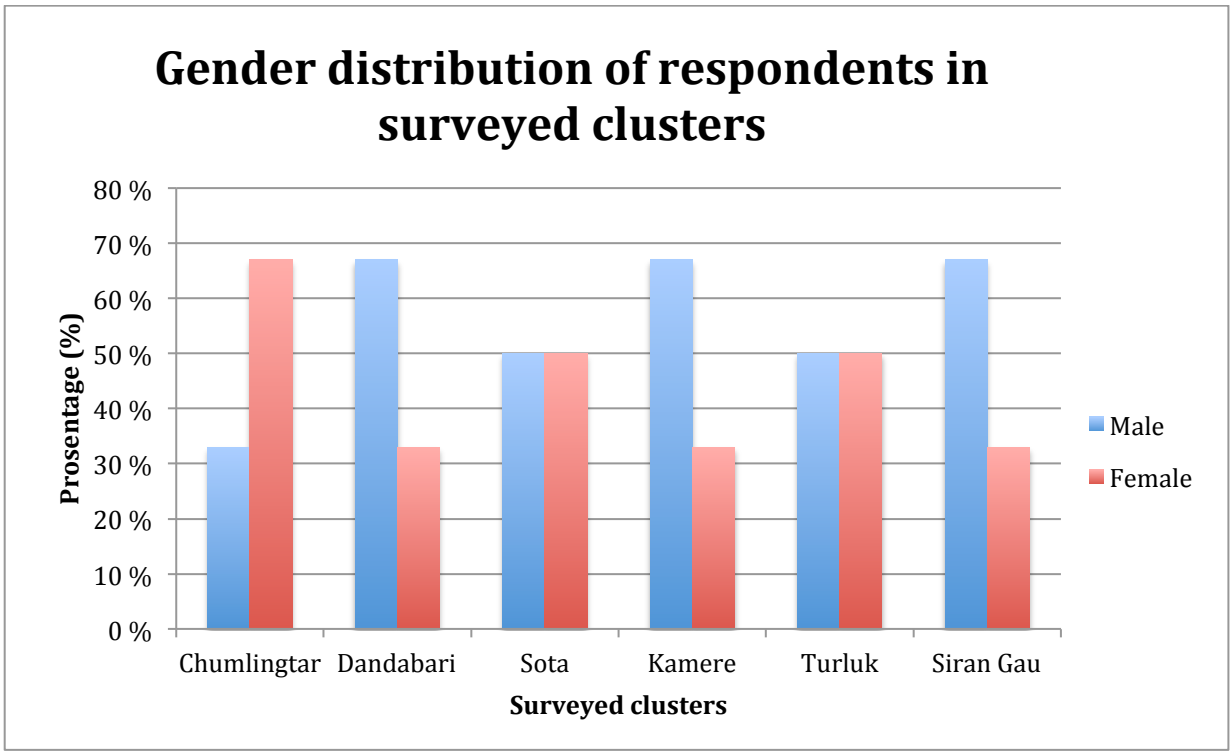

Figure 13: Gender distribution of respondents in the different surveyed clusters.

Initially, an equal selection of men and women from all six clusters were to be interviewed, but due to unforeseen reasons more men were interviewed in this research, as shown in fig. 13. For each cluster, the number of male and female participants varied depending on whether the head of the household (mostly males) were present or not. The coordinator for each cluster selected the households for the interviews, but they could not foresee each time-schedule for each household member. If both husband and wife were present during a planned interview with the wife, the husband would interrupt and answer the questions, which often the wife approved of. In these situations, the translator would ask in a polite manner if we were allowed only to interview the wife, but in most cases the husband stayed and continued answering for her. In many cases where the wife in the household was interviewed, the husband was out working in the field or occupied with other daily activities. The interviews were conducted during daytime mostly between 10 AM – 2 PM, depending on the household's daily routine to assure that someone was present. Since the coordinator planned and organized every interview conducted, all participants were asked in advance weather they would like to participate or not, and time and place for the interview was set according to the participant's desire.

3.3.2 Focus group discussion

The aim of the FGD for this research was to ensure a greater validity on some of the topics from the 36 in-depth interviews. From every cluster, randomly selected members and key persons in the community were invited. Key persons were invited on the basis of their position in the cluster, such as teachers, health post workers or respected community leaders. The purpose of inviting these persons was to get another point of view or new insight to the given topics. A new and more openly themed interview guide was made for the FGD. Main topics raised and questions asked for the FGD was made and adjusted from the interview guide for the in-depth interviews. Topics selected for FGD are to be found in Annex 3.

The FGD was conducted on the last day of every cluster visit. The coordinator for every cluster was responsible for the organizing of the FGD and to invite key persons in the community, as well as all interviewees from the cluster. Key persons were invited based on certain criteria previously explained, which were selected before the field survey was initiated. The coordinator for each cluster functioned as a moderator with the responsibility to facilitate the discussion, prompting participants to speak but also control overly talkative participants and encouraging more withdrawn participants to come forward. Due to language barrier for the researcher, only the introductory part, including introduction of the researcher and the purpose for the FGD together with ethical considerations, were translated directly. During the FGD, the translator took notes that later on were explained to the researcher in order to avoid interruptions. The translator would also participate as an assistant moderator to keep the discussion focused.

Table 1 shows the main demographics for the focus group discussions conducted throughout the field survey. As mentioned, the coordinators for every cluster had the responsibility of organizing and inviting key persons they saw fit. This was the main reason for why locations and the representation of key persons for the FGD vary. The desired number of attendants was initially set to about 20, but due to various unforeseen reasons this was not always achieved. The FGD was mostly held after lunch (most times from 1 PM – 3 PM), which for many farmers was the time they went back to the field working, thus listed variations in number of attending participants described in table 1. Naturally, the most desired gender distribution would be equal, but due to certain limitations in the field described in chapter

3.3.1 it was not set as a criteria to whether the attendants were a satisfactory selection or not. As described in the introduction, most of the interviewed population were farmers or teachers, which also was the case for the participants in the FGD. All teachers who attended are listed in table 1, identified as key persons. The remaining participants were either farmers or members of families with agriculture as main source of income.

Table 1: overview of attendents and location for focus group discussions.

Cluster	Location of FGD	Key persons attending FGD	Total persons attending FGD
Chumlingtar	Ecosan Resource Centre	6 members of local women group 2 teachers	7 women 6 men
Dandabari	In the home of the coordinator for Dandabari	1 teacher from the local school	12 women 6 men
Sota Gaun	At local elementary school	1 teacher from the local school	7 women 5 men
Kamere	At local elementary school	2 teachers from local school 1 teacher from the nearby school	5 women 20 men
Turluk	In the home of the coordinator for Turluk	-	8 women 7 men
Tokdang	In local community centre	7 members of local women group	9 women 8 men

The engagement in the discussions and the participation of both women and men varied a lot from cluster to cluster. This was also considered before the field study started as a limitation of the method, as well as a validity issue for the results conducted from the FGD. In some cases both men and women were equally engaged in the discussion, while in other occasions only the male participants could discuss without including the female participants. If the last situation described occurred over some period of time, either the translator or the coordinator interfered in the discussion for the purpose to include the women. Because of this, all main points have been evaluated as valid to represent a community perspective and feelings towards the given topics discussed.

3.2.3 Observations

Data through observation obtained by the researcher can also provide a more comprehensive understanding of data collected from other methods (Mack et al. 2005). Observation by the researcher was also used as a method to support the findings in this study, and to better understand the community context and the household standards. When every household had been interviewed, the researcher asked if the participant would allow the researcher to observe the toilet-, drinking water- and washing facilities. While observing the researcher took photographs and noted down certain observations found. The researcher also made observations during the FGDs so as to understand the interaction between the various participants and also their level of engagement during the discussion. These observations carried out as a guideline, and were used to give validity to the results.

3.4 Research ethics

For every research that involves and delve into human beings and their lives, the researcher must take into account ethical questions and the ethical manner of how the research is carried out. The researcher must ensure that non of the selected participants are to experience any negative consequence and uphold the rights of privacy and anonymity during and after the survey (Berg & Lune 2012; J. & Fowler 2009). The respondents have to be informed and assured their rights and explained what they are volunteering for before they attend the survey. Respondents should be informed about the researchers name and institution, a description and purpose of the study, confidentiality aspects including the right to not answer questions and where the results are being used and an assurance that cooperation is voluntary and that there will be no negative consequences if they decide to participate (J. & Fowler 2009). For this research, all the points above were taken into account and conducted through an introductory part both for the interviews and the FGD. The researcher also learned some pleasantries from the interviewer to get in contact with the participants. A small token for their cooperation was also given in the form of soap to the participants in the interviews, and in the form of a small lunch including tea and snacks after the FGD.
The researcher did not get the impression that any participants felt uncomfortable or suppressed in any situation during interviews or FGD.

3.5 Data analysis

All data gathered from any method given requires interpretation and analysis. This is required to bring order to the data and for the researcher to understand and be able to discuss and draw conclusions (Berg & Lune 2012). The data collected also needs to be organized depending in part on how the data is obtained in the field. If the researcher has not planned in any way how data are to be organized before collecting starts, the process of analysing will be challenging (Berg & Lune 2012). In this study, primary data was mainly collected through interviews and FGD. For the interviews, the interview guide followed the main objectives and made the structure for the answers easy to follow. For the FDG, topics raised were made from the interview guide so that the researcher easily could compare and follow the discussion from the FGD to the answers from the interviews.

3.5.1 Codes and categories

As Vivi Nilssen explains in her book *"Analyse i kvalitative studer"*, the researcher starts the process of analyzing the collected data with an open coding. Further she explains, that the concept of an open coding is to look at the collected data with an open mind and attitude towards what the content tells you (Nilssen 2012). This method of coding is based on the method of "grounded theory". The main idea behind grounded theory is to be able to develop and identify new theoretical ideas through the collected data material (Glaser & Strauss 1967, 1999). This is also known as an inductive approach in contrast to a deductive approach where the aim is to test different theories (Nilssen 2012). The challenges with an inductive approach are to simplify, reduce and to make sense out of the complex and huge amount of the collected data. The collected data, (including field notes, transcribed data material from interviews and FGD in this research), are recognized by Patton (2002) as the complex reality (Patton 2002). The reality is thereby described by analyzing collected data material. This methodology of grounded theory and open coding was used for the data analysis process for this research.

The first stage of this analysis included 'open coding' and is referred to as the part of the analysis where the researcher develops codes or identifies labels on different phenomenon and utterances found after a careful review of the collected data (Nilssen 2012). The researcher focused at this stage on how individuals or groups responded to each question or topic and developed codes as a result from this focus. Further, all codes were put together in

the respective questions to be able to show structure and clarification. After this process all codes were grouped after similarities in order to link and establish relationship between codes, so as to be able to identify different categories. This second stage is referred to as 'axial coding' and is also a process that requires some initial main categories for the categorized codes to be linked up to (Nilssen 2012). Hence, the main topics for the interview guide were based on the main objectives for this research, which again were used as main categories for the analysis. The last stage of analysis is referred to as 'selective coding' and is the stage were the 'core-categories' are defined from the already identified categories from the second stage (Nilssen 2012).

Table 2: shows a section from the analysis of the answers from interviews based on "open coding", "axial coding" and "selective coding".

Question from interview guide	Codes	Sub-category	Main-category
1. What kind of eco-san training have you got?	• (men/women) • Level of training • Different training given • No follow-up	**Training and understanding**	**Technology**
2. Are there any differences between your old toilet and the eco-san toilet? Explain	• Pollution control • Better hygiene • Safer construction • Cleanliness • Security (W) • Walking distance (W) • Privacy (W) • Urine collection • Easiness (no need to empty)	**Motivation**	
3. Do you find any difficulties with the eco-san toilet? Explain	• Blockages • Cleanliness • Broken pan • Guests mixing • Availability of equipment • Public toilet issue • Insects • Faeces collection technology • Hard to keep clean	**Operation and maintenance**	

Accordingly, three core-categories were identified for this research underlying each main category representing the main objectives for this research as seen from the table 2. Furthermore, some questions used in the interview guide give occasionally quantifiable data that again allows one to find patterns and similar answers of association. This association can be illustrated in a manner of quantitative data, as for this study through pie chart. The pie charts used in this research illustrate the distribution of repeated codes or categories to assure quality.

3.5.2 Reliability in qualitative research

The term “reliability” is a more common concept for testing quantitative research, but it is also used in qualitative research as testing its quality (Golafshani 2003). The quality concept in qualitative study aims at generating understanding, where in a quantitative study the concept of quality has the purpose of explaining and evaluating the quality (Golafshani 2003). This difference in purpose gives another meaning to quality in the qualitative research. Lincoln and Guba (1985) use the term “dependability”, which they describe as being more correspondent to the notion of “reliability” for qualitative research (Lincoln & Guba 1985). Furthermore, Bulmer and Warwick explain that reliability in qualitative research reflects to what extent the results from the research are to be consistent and if the results can give an accurate representation of the surveyed population (Bulmer & Warwick 1993). This also reflects the reliability of a study if it was to be conducted by another researcher at the same time, whether the results would be similar or not.

This study describes a current situation through factors affecting the use and adaption of a sustainable sanitation technology among users in a certain area in Nepal. The sample derived from this certain area aims at being as representative as possible by selecting participants based on general demographics from this area and knowledge from key informant. Nevertheless, working environments are dynamic and change in behaviour and people’s conception and attitude among the surveyed population can pose a risk to the reliability of the research. Among the participants, it was also evident that the level of knowledge and understanding towards the technology and terminology used in the questions varied, even though it was translated into the participant’s first language. In some cases this may have meant that the respondents did not sufficiently understand the questions and gave answers at random, or provided the answers that they thought to be ‘correct’. By utilizing the methodology described above, the researcher sought to minimize such sources of error. However, the complete elimination of such errors can not be guaranteed.

4. RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents observations and interpretation of the data collected from the 36 household interviews using the described method of qualitative data analysis. The results are divided in three main sections or categories viz. 'Technical aspects', 'Economic benefits and health aspects related to the technology' and 'Social acceptance of the technology', which represent the three main objectives, and have all sub-categories formed by the answers from the interview guide. The results will be presented and discussed within each category presented. The sanitation technology used in Darechowk is described in chapter 3.2.2 and is understood as eco-san for the participants in this survey. Thus, referred to as eco-san throughout this chapter.

4.2 Technical aspects

In order to answer the main research question about which factors are affecting the optimal use and the development and optimization of the technology in Darechowk, user friendliness of the technology is an important indicator to investigate. This section will address the first objective, which asks what technological and operational factors are determining user-friendliness for the community of Darechowk and to what extent the technology is user friendly. Three sub-categories identified from analysing the answers from both interviews and FGD will be presented and discussed.

4.2.1 Operation and maintenance

One important sub-category identified from the questionnaire is "operation and maintenance". This sub-category describes the experiences for the users with operational and maintenance issues, which reflects the user friendliness and the adaption of the technology. The participants had many similar thoughts and experiences related to operation and maintenance as for this category become very strong and one of the important factors for user-friendliness.

The experience of blockage in the urine pipe is a frequent mentioned issue that, and explained by many participants, something that has occurred many times during the lifetime of the toilet. A total of 14% of the surveyed population (5 households) have discontinued collecting urine due to blockage of urine pipe. The reason for discontinuance is that the respondents do not have the capacity and technical knowledge to repair occurring blockage. From the remaining percentage of the participants, 57% have experienced pipe blockage. The frequency of the blockages depends on various reasons. Most mentioned reasons are debris inside the toilet going into the urine collection hole or insects gathering in the opening. When (mostly children) people are using the toilet they sometimes keep their shoes on and bring organic material from outside in to the toilet. The practice of flushing water over the pan to clean the pan area is usual, which allows the organic matter to flush into the urine pipe and again eventually create blockage. The same problem with insects often originates from this practice as well. Flies, ants or mosquitos gather in the urine-collecting hole and with flushing these will accumulate in the pipe and cause blockage. When blockages occur they are not able to collect urine and express that it is hard to keep continuance to the collection and to keep the toilet in good condition. As a result of blockage, maintenance will not be at a sufficient level, which affects the operation of the toilet and this is a factor to whether participants are collecting urine or not.

Another concern that also inflicts with blockage is cleanliness of the toilet in general. Most participants expressed that during blockage, smell and visual appearance are factors influencing both their overall attitude when using the toilet and to keep it in a good and inviting condition. Cleanliness is important for the maintenance, and another factor influencing this is the pan material. The pan materials in the visited households were either fibreglass or plastic. Participants using either of these materials complained about the quality and that the pan was easily scratched up or severely damaged from use.

Figure 14: (photo: Kaia Bing) example of scrashed up pan and broken pan from one of the interviewd households.

As we can see from fig. 14, poor quality of pan and problems related to smell were observed by the researcher as well as explained by a male participant; *"I am not satisfied with my pan, it is a fibreglass pan but it is very hard to clean. Both faeces and urine get stuck in the cracks and it smells. I would like to have a pan in plastic so it would be easier to clean"*. For the operation and maintenance of the toilet the urine collection, factors such as blockage in urine pipe, problems related to pan material and cleanliness were affecting user friendliness for the participants.

ENPHO Nepal states that operation and maintenance issues are often experienced in areas in Nepal where eco-san has been introduced (Upadhyay Adhikari et al. 2012). Pipe blockages and problems related to quality of pan are also identified challenges by ENPHO. Another study carried out in Darechowk in 2010 by a German master student from University of Basel, discovered that the most frequent technical problems were blocked pipes and flooded or broken pans (Messmer 2011). Both of these studies identify some of the same O&M issues as seen from this research. Why authorities have not acknowledged these problems or monitored use of the technology could be lack of commitment or financial capacity from responsible institutions. One of these institutions responsible is DWSS that provided most of the urine-diverting pans for the toilets constructed in Darechowk between 2008 - 2010 (Department of Water Supply and Sewerage (DWSS) 2010). Messmer (2011) also suggests that a solution to some of the O&M problems identified in Darechowk could be monitoring and regular visits from experts, so that the problems easily can be solved and to increase technical knowledge among the users (Messmer 2011). For users to understand and carry out the operation and maintenance the interventions introduced must reflect their capacity (Montgomery & Elimelech 2007). The technical capacity among the participants varies and reflects how they deal with O&M issues occurring.

If they were able to solve the occurring O&M issues, the extent of user friendliness would also be increased for the technology. Hence, a more optimized system could be an outcome of improving technical capacity among the users in Darechowk.

4.2.2 Handling of urine and field application

In addition to direct technical O&M problems with the toilet system, concerns towards handling urine and how to apply it in the field were noticed among the surveyed population. Different challenges among the participants were identified through questions related to the urine collection and application system. Some respondents had more than one concern, which affected their easiness with handling and applying urine.

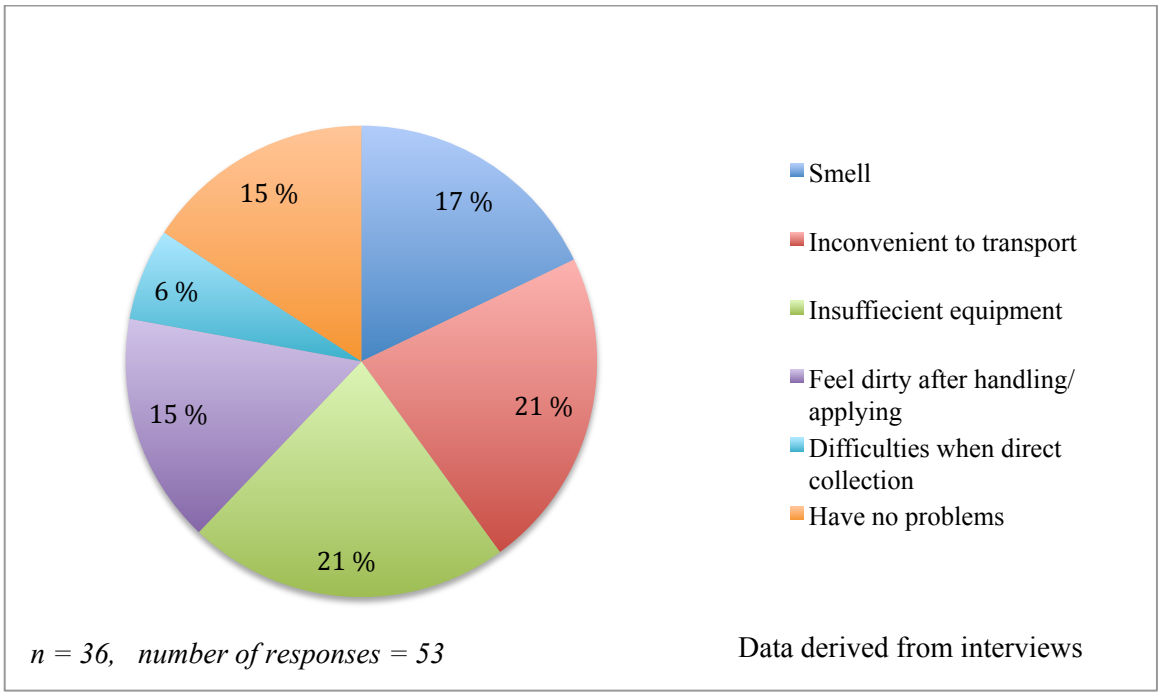

Figure 15: Distribution of respondent's challanges and innconviniences with handling of urine and urine application to the field.

For questions related to inconvenience and challenges with handling and applying urine, more than one issue came up as issues affecting the participants, as seen from fig. 15. 21% of the respondents explained that the transport of urine from the toilet to the field was inconvenient. The buckets and jerry cans used for collecting are heavy and the fields are far away. A desire for a mechanized distribution system was visible through the answers.

The answers also showed that equipment insufficiency was a concern and a challenge for the participants when handling and applying urine. 21% of the respondents mentioned insufficient equipment in form of not enough collection containers, low quality in collection containers so easily broken and lack of masks and gloves for application. Lack of masks and gloves also influenced to what extent the respondents experienced odour as a problem. 17% related smell to one of the major challenges they had towards handle and apply urine. Some of these participants expressed strongly their feelings; *"I am disgusted when handling and applying the urine because of the smell. The smell is very strong and I feel dirty after I have done it. I don't have the right tools for applying only one jerry can and often spill on my clothes"* (female respondent).

In contrast, one male participant claimed that he had no problems; *"I always wear mask and gloves when handling or applying urine, so I have no problems with it. My field is not so far away so it is easy to carry the urine t the field. Afterwards I am always taking a shower"*. This statement also reflects the group of people who did not have any problems, which represent 15% of the participants. Those participants had both advantages with the location of their fields and with availability of the right gear, which made handling and application more comfortable for them. Still, taking a shower was also common among those with no problems as well for many participants with identified challenges. 15% said that they felt dirty after handling or applying urine and many participants from this group added that taking a shower afterwards was a necessity for them. Reasons for taking a shower were explained by a male participant; *"we don't have the right equipment to handle or apply it. It is nasty and we always wash our whole body after we have been in contact with urine. We have to carry it so far in open buckets and it is very easy to spill on out clothes"*. Another issue raised by some female participants was related the collection of urine directly into jerry cans or bottles; *"now we don't collect urine from the toilet because of blockage, but we collect directly in jerry cans. This is not easy for me as a woman, and I know my children feel the same. This is the reason why we don't collect as much as we would like to, right now"*. 6% of the female participants said they had challenges with direct urine collection.

A study carried out by Water Aid Nepal in 2008 states that insufficient equipment and problems with transportation of urine are hindering factors for optimal use of urine and the user friendliness with urine-diverting toilets (WaterAid 2008). Further the same study states; *"this study has clearly indicated that many of the Eco-San toilet users are not effectively utilising the urine. Therefore, a good urine collection system, with 100 litre plastic tanks, and proper training on urine utilisation, should be mandatory" (WaterAid 2008).* This suggestion has clearly not been carried out, since most of the participants in Darechowk VDC explained how the urine collection is being compromised by the lack of urine containers. Lack of proper urine collection tanks also affects user friendliness for women who collect directly during blockage of urine pipe. Obviously, blocked urine pipes contributes to as a negative factor for the optimal use of the system, but considering this factor urine containers should still be fit for direct collection so the villagers can be able to continue collecting. Thus, design of collecting tanks should be thought of so it is comfortable for women to use when direct collection is needed. A mobile urinal for women that could be designed in cooperation with users could be a recommendation to make direct collection more comfortable and easy for women.

Handle and apply urine are clearly factors affecting user friendliness in a negative way for many participants. Many participants state that problems related to handle and application inflicts with the effectiveness of the collection and that hesitation influence the extent of collection. Again, this affects the optimal use of the technology where a development of the distribution system needs to be taken into account.

4.2.3 Training and understanding

From the time the villagers of Darechowk were introduced to the practice of using toilet and the collection and application of urine, not many training- programs or possibilities have been offered. The introduction to urine-diverting pit latrines and sustainable sanitation was given to specific head masters from different schools in the VDC. This training program took place in Nagarkot, Bakhtapur and was initiated by the Government of Nepal with DWSS as responsible actor. DWSS has not initiated any other training program for the villagers of Darechowk. THE SEWA Nepal and Shreerendra Pokharel have organized the only training

given to other users than head masters. Training is an important aspect to adoption of any sanitation related technology (Langergraber & Muellegger 2005).
User participation and appropriate education is seen as very important especially for adoption of eco-san technologies (ADC 2004).

The importance of training and the basis of understanding emerged as a factor clearly affecting the participant's reactions towards challenges with the technology. Many are regularly facing these problems and their attitude and response varied a lot. Some of the participants have only had toilets for a short period of time (3 – 5 years) and are not familiar with the operation and maintenance of a toilet or urine collection from before. The type of training and to what extent they have been instructed on how to use the toilet before installation, varies among the participants.

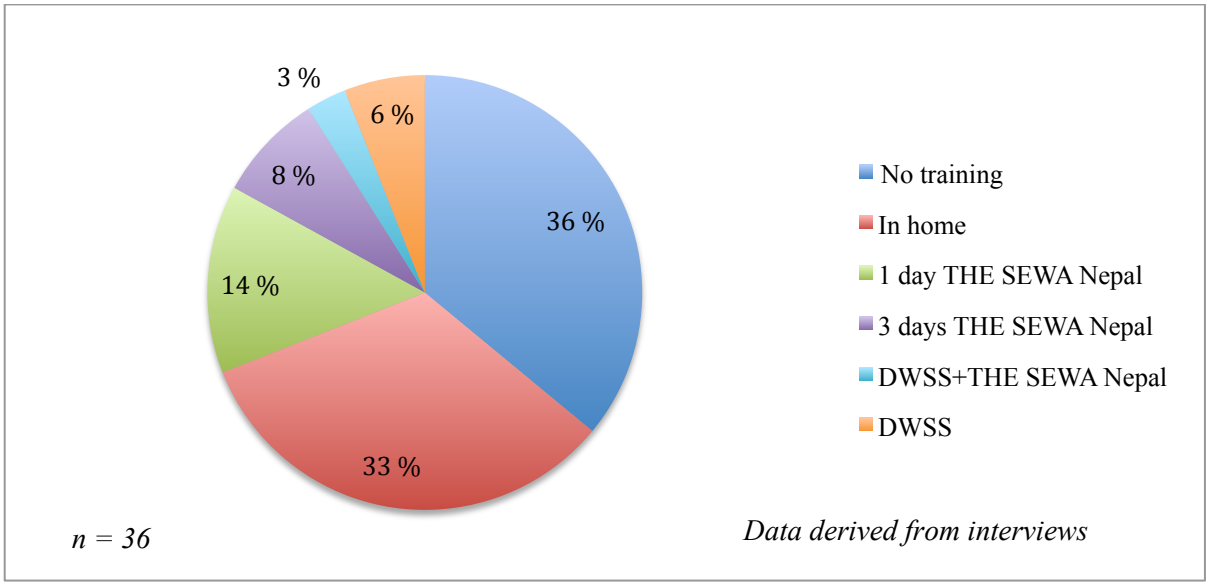

Figure 16: distribution of different sanitation related training the respondents received before or during installation of eco-san toilet. The different types of training are described regarding to who or which institution initiated and organized the training.

Fig. 16 shows the distribution of what kind of training the participants did receive before or during installation of toilet or when they started collecting urine. 36% of the participants did not receive any training in how to maintain or operate the toilet nor the urine collection system. For the other 33% given training in home, this was done by Shreerendra Pokharel who told the how to use the pan or how to collect urine. During Shreerendra's three years leave, he started the NGO called THE SEWA Nepal, from where he had his first training program in 2009 over a three days timeframe. 11% of the respondents were participating in

this program. The second training programs initiated by THE SEWA Nepal the same year, had a timeframe of only one day, where 14% of the respondents had attended. These three groups represent the largest part and show a lack of continuance in training and support. 9% of the respondent had attended a 6 days long training program supported and managed by DWSS in Nagarkot, Bakhtapur. This training program was more comprehensive and detailed that the ones organized by THE SEWA Nepal, which clearly is visible from the respondent's answers. Two male respondents explain: *"I know how to keep the pipe in a good condition and how important it is to maintain the toilet so this don't happen. I know this because of my training in Nagarkot", "I understand the process of sanitizing the urine and that it takes away the diseases and protects us from diseases. I know this because I got good training".* Understanding and involvement to the point of responsibility are factors seen as very important for user friendliness. Especially in these two cases were feelings towards responsibility are observed. Often community leaders or important persons in the community who understands and appreciates the technology are initiating training and support for other community members.

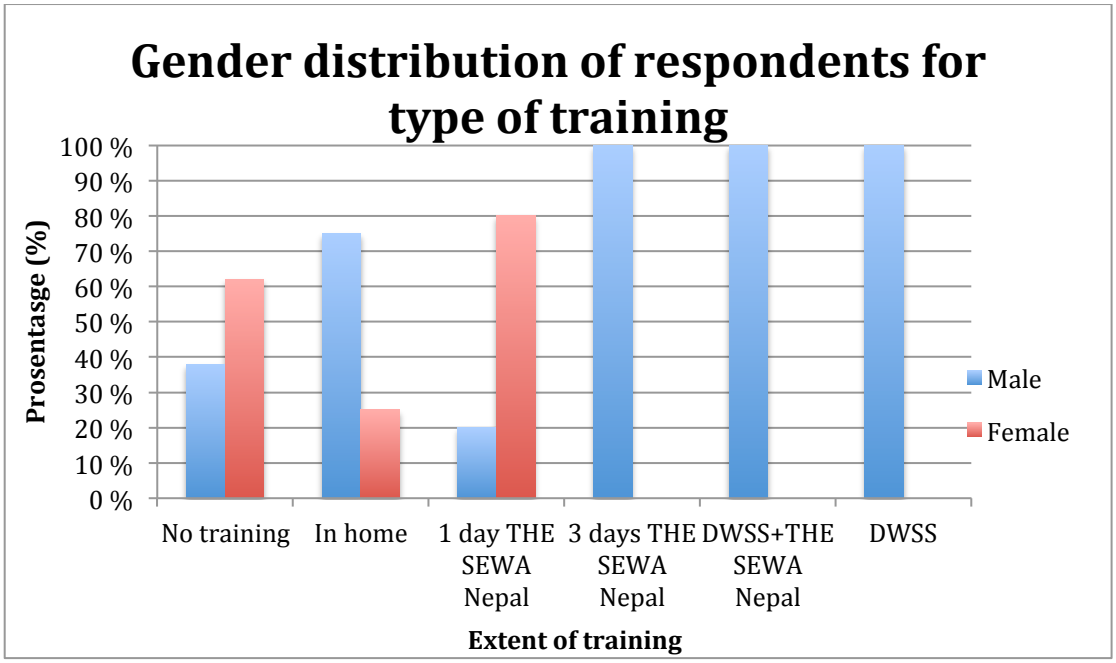

Figure 17: Gender distribution of respondents in relation with what type of training they have received.

As fig. 17 describes, the gender distribution is significantly not equal and shows a majority of male respondents with more comprehensive training. Development of sanitation related technologies are often dependent on women because these technologies often includes

maintenance activities performed by women (Murphy et al. 2009). More women than men said they were unsecure in how to meet challenges with the technology and be able to solve occurring problems. Involvement of women, who in may cases in Darechowk more frequently operates the toilet, could increase their overall capacity. Furthermore, Hossain et al. (2004) states that *"women can be empowered by giving them equal access as men in training and extension programs"* (Hossain et al. 2004). Capacity building and more enhanced training for women can be important factors for the overall operation and maintenance, hence a continuation in urine collection. From the FGD, some women expressed that they were frustrated because they had never received proper training for them to understand how to encounter technical problems with the toilet.

Although many participants clearly have or have had challenges with the technology in the past, many showed great enthusiasm and involvement towards improvements of the system. When asked if there were anything they would like to change with the toilet system or suggestions for improvements, many direct suggestions for upgrade was given. Some participants claimed that the main reason for blockage was because the urine pipe was too narrow. Blockage could be prevented if the existing urine pipe would be exchanged with a wider one, was a common respond. As well as the urine pipe, upgrade of the pan was a frequent suggestion. The suggestion was aimed at the grate, which according to some had too small holes in it. If the holes were made larger, blockage could also be prevented. Prevention of problems was also related to knowledge from some of the participant's point of view. Many claimed that they experienced problems with the system from lack of knowledge and training. Hence, a desire of more instructions and training came through as important for people to understand how the existing system could be improved and for them to be able to encounter on-going problems with confidence.

The link between training and understanding how to operate and maintained the system is shown from the level of knowledge among the participants. Lack of proper training also decrease the user friendliness of the system because technical problems are not being solved, resulting in insufficient use, which again affects the optimal use of the system.

Other head masters together with Shreerendra Pokharel were participants in the SLTS training in 2006. It was easy for Shreerendra to team up with them and start his work on promotion and to convince people. It made it easier when more respected head masters and

community leaders already were accepting the technology and wanted to promote it. We can see this from motivation as an important factor for social acceptance.

Thus, it is clearly one of the strongest factors influencing acceptance and something that should be taken seriously from a government point of view if they would want this technology to be optimized and to achieve the goal of 100% coverage in 2017 (Adhikari 2012b). The investment in local teachers and schools will not only make this more accepted, but also give more options for training and capacity building among the villagers. When it comes to women, they are clearly less equipped to meet challenges with the technology and by this will not be able to evolve a total acceptance because of lack of knowledge (Davies-Colley & Smith 2012). Another example from Davies-Colley & Smith (2012) is how education and training for a technology implemented in a community are structured and planned specifically after this community's needs. These needs are including the community's existing education level and technical knowledge identified by local people who also are a part of shaping the training. This way people will become experts in the technology as well as operation and maintenance to again optimize the use and resources among the users (Davies-Colley & Smith 2012).

4.3 Economic benefits and health aspects related to the technology

This section will address the second objective concerning economic and health related benefits from the technology among the surveyed population. The section will further discuss to what extent the community of Darechowk is realizing these benefits and how the system can be optimized to increase the economic benefits from the system.

The majority of the surveyed population from this research are farmers with limited financial resources. Many of the farmers experience bad soil quality and poor conditions to obtain a good production, much due to the mountainous area of residence. In many cases the production is just enough to cover the families daily consumption, beyond this they sell to the market if possible. Most common crops produced among the participants are oranges, corn, wheat and millet together with vegetables as root vegetables, cauliflower, saag[1],

[1] Saag is a generic term used for a variety of greens like spinach, mustard leaves, amaranth etc. The type of saag grown in Darechowk was a bigger variety of spinach with a bitter taste.

cucumber, tomatoes and cabbage. Due to the altitude of the surveyed clusters, most participants do not produce rice and have to buy this at the market.

4.3.1 Urine as fertilizer

When the FGD participants were asked what advantages and benefits from eco-san they saw as most important for the community, the most frequent discussed topics were related to economic benefits. The opportunity to save money from reducing procurements of chemical fertilizer and pesticides was mentioned in many occasions as a positive change after they started using urine. One male respondent from interviews was financially motivated to continue using urine as fertilizer; *"It is hard to transport the urine so far to my field, but now I don't mind because I know I save money from using urine"*. The practice of using urine was also associated with better soil quality among attending farmers in FGD. Poor soil quality and availability of irrigation water all year round are challenges many farmers in Darechowk face regularly. Some farmers mentioned that using urine had helped them to keep a good level of soil moisture content during dry season and that this was an important factor for them to continue collecting urine and to keep the toilet in good condition. Another reason for collecting urine among participants in FGD was increase in quality and quantity of vegetables. A difference in quantity of crop production was also noticed among the participants from interviews. The majority of participants mentioned that green vegetables such as saag (explonation) and leafs of cauliflower grew bigger after using urine and that their overall production had increased in yield. One participant shares his experience; *"I have noticed some differences in vegetables, especially for the beans, which are longer and bigger than before"*. To visually see the change in vegetables after the use of urine was identified as an important factor for the participants to see the economic benefits from urine.

Furthermore, an important benefit for the participants was clearly the use of urine as a substitute for chemical fertilizer. Reduction in chemical fertilizer was found among the majority of respondents and many are now mostly substituting to some extent with urine. Substituting with animal manure and urine is also a practice among the participants and has been a practice from before eco-san was introduced.

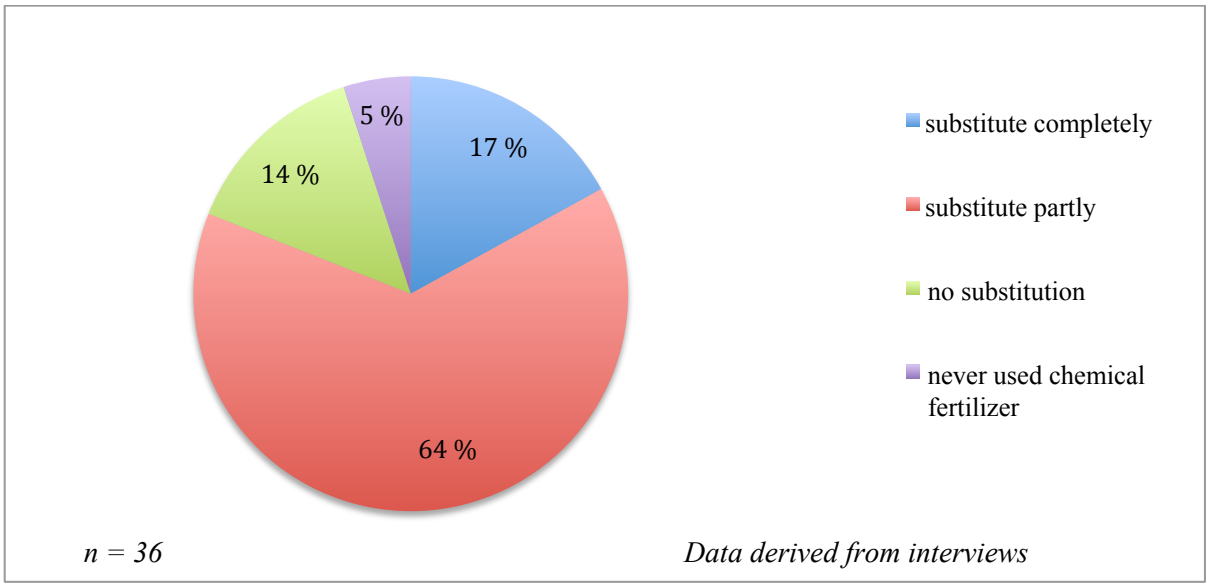

Figure 18: distribution of the different levels urine is used as a substitute for chemical fertilizer among the participants.

As seen from fig. 18, most of the participants (64%) substitutes partly with urine. Participants in this group explain that they only use urine for vegetables and use chemical fertilizer for other crop. For the other crop they are not sure of how to use urine. One male participant described this situation: *"I only use urine on vegetables because I don't now how much or when to apply urine to other crops. I have never learned how to do this"*. A female participant explains her reason for using urine for vegetables: *"I will not use urine on other than vegetables because vegetables can I wash with water before I eat it, I cannot wash crops like wheat or corn"*. Accordingly, due to lack of knowledge, many participants do not use urine for all their crops.

Another reason for partly substituting is because most of the participants are not able to collect enough urine for all productive land. Production is also dependent on season and some participants explained that they only collect and use urine for vegetable season and do not care to collect during other seasons if they have other crops. This also reflects the extent of realizing the benefits from urine among the participants. Many participants do obviously benefit from reduction in chemical fertilizer and increase in vegetable production. However, if they realise to the full extent of what they can save by collecting urine all year round and use urine for all crops to eliminate the expense of chemical fertilizer, is questionable. Nevertheless, 17% of the surveyed population has managed to eliminate all costs from procurements of chemical fertilizer.

Chemical fertilizer is notably eliminated due to use of both urine and animal manure, as pointed out by a male respondent: *"This is the first year I don't need to use chemical fertilizer because I managed to collect so much urine that together with animal dung, this was enough fertilizer for my production"*. Naturally, the area of agricultural land owned by these 17% also affects why they have eliminated the use of chemical fertilizer. A total elimination of chemical fertilizer-use was only registered among 5% of the population. One male participant from this group stated that he used about 100 kg of chemical fertilizer before he started using urine. He further explains: *"I used to first apply animal dung and than chemical fertilizer to my crops, now I first apply animal dung and than urine. The production has increased this way"*. This participant has fully embraced the use of urine and is motivated based on economic benefits.

The participants are clearly realizing the benefits from eco-san relating to improvement of soil quality and increase in agricultural production. These advantages are also identified as main advantages of eco-san from the collaborative council for water supply & sanitation (WSSCC 2010). They visually see the change in crop, but this is clearly not a superior motivation for them to scale up the urine collection to be able to cover all use of chemical fertilizer. They are able to see some economic benefits from a household level, which also can be seen from FGD. Even though participants from FGD mentioned economic benefits as a positive outcome from eco-san, they rarely discussed them in a broader perception to scale up the collection and be able to maximize the benefits. To maximize the benefits would be if they collected continuously regarding season even if they do not want to use it for other than vegetables. Use of urine only for vegetables is clearly related to knowledge and training among the participants. For Darechowk community to extend their economic benefits and generate more economic value from the system, a more comprehensive training aimed at agricultural use of urine should be conducted.

4.3.2 A goal of using faeces as fertilizer

Another aspect of gaining economic benefits from the technology is the reuse of faeces. As of now, reuse of faeces is not yet possible with most of the eco-san toilets in Darechowk. However, this is one of the goals for THE SEWA Nepal, to be able to close the cycle of nutrients and reuse both urine and faeces as fertilizer.

For this reason, questions regarding reuse of faeces are an important element to this research to identify factors affecting the development of the technology.

From a couple of these questions it was found that over 80% of the respondents did not reuse faeces as fertilizer. From the remaining 20%, two households used faeces for biogas together with animal dung, and two households had the dry eco-san collection system referred to as DVUD and is explained in chapter 2.3.2. These two households were not using the compost at the time of surveying, since they just constructed them and have not filled up the containers. When all participants were asked if they thought they would benefit from reuse of faeces, the majority explained that they wanted more training and knowledge about how to use faeces as fertilizer to see the benefits. However, some participants had seen the faeces collection system and wanted to construct the same, but did not have the financial means. Participants from the two households with collection systems had a very open mind towards using faeces as fertilizer and saw the economic benefit from completely stopping using chemical fertilizer.

For Darechowk to optimize the use of the system they have today, including faeces would be an effective way to achieve this. Mishra and Shrestha (2006) states that the value of fertilizer produced by human excreta from an average size family in Nepal every year is estimated to ca. 2000 NPR[2]. Further they state that "*the equivalent financial value of nutrients of the urine and faeces is about 7.1 billion NPR which is equivalent to 50% of the total fertilizer being imported every year*" (Mishra & Shrestha 2006). The economic value of the system in Darechowk will increase drastically if they start using faeces together with urine as fertilizer. Urine as a total substitution for chemical fertilizer was only found from a couple of participants (5% of the total surveyed population). One of these participants estimated that he saved about 7000 NPR every year from not buying chemical fertilizer. If this would be the case for every inhabitant of Darechowk, the overall household wealth could increase drastically. The VDC administration in Darechowk stated that the average family income in Darechowk is estimated to ca. 55 000 NPR/year. This reflects how important it could be for the household economy to save from using both urine and faeces as fertilizer.

[2] NPR = Nepalese rupees, where 1.00 NPR = 0.06 NOK. 2000 NPR = 122.5 NOK

4.3.3 Health aspects

Reduction and elimination in use of chemical fertilizer have according to the population increased their overall health. Health aspects as better quality in food and better taste in vegetables are mentioned both in interviews and FGD. Many participants in FGD mentioned that they had more energy and better digestion when eating vegetables without chemical fertilizer. Even though these advantages were mentioned, again these are obviously not strong enough for the community to extend the collection of urine to a greater economic level.

Another aspect is the use of urine, as a substitute for pesticides it is not only considered an economic benefit among the participants, but a positive driver in terms of health. Practice of using pesticides can often give health problems in different variations (Damalas & Eleftherohorinos 2011). Among the participants and in FGD, headache as a result for using pesticides was a repeated concern. A decrease in headaches was stated among many participants and was expressed as a positive outcome of using urine for plant disease control. Another positive outcome related to health, was increase in use of soap among many participants. When they were asked if they had noticed any difference in overall health, some respondents mentioned that they now use more soap on a regular basis. Only a couple of respondents stated that the increase in use of soap could be a reason for a decrease in disease among family members, but they were not sure of this outcome.

To what extent the surveyed population is realizing the health benefits from the use of urine as fertilizer can be discussed. Even though many advantages regarding health was mentioned, the majority of respondents had not noticed any difference in health after eco-san was introduced. The practice of use of toilet and urine as fertilizer is fairly new, as most participants have only used a toilet and collected urine for 3 – 5 years. Through these few years it could be difficult for the participants to identify any health advantages related to reduction in chemical fertilizer. Another health advantage from the ODF status and the adaption of the sanitation system in Darechowk is the disease control. Inadequate sanitation is related to poor health (Kasi et al. 2004) and pose a high risk of water-related diseases such as diarrhoea, intestinal helminth infections and dracunculiasi (Bartram et al. 2005). Reduction in disease-rate after starting the practice of using a safe toilet was not registered according to the participants. Many of the participants explained that level of infections and

disease in the family was the same as before and some had not even thought of reduction in diseases as a positive outcome of eco-san. One probable cause for this could be that the majority of participants only have had toilets for 3 – 5 years, so the time for noticing any change in disease pattern is too short. One speculative reason could be that the rate of disease not really has gone down so much as expected with the ODF-status, due to the fact that people are still practicing open defecation on a regular basis. Open defection happens daily when farmers are working in the field or cutting grass for livestock far away from the house. This is also something to consider when discussing how to optimize the use of the technology and if Darechowk is using it the most optimal way. From a health aspect, the most optimal situation would be for the population of Darechowk to have unlimited access to toilets so risks related to water bourn disease would be limited.

Some participants mentioned the increase in use of soap as a positive outcome after promotion and implementation of urine diverting pit latrines. Curtis & Cairncross (2003) states that hand washing with soap can reduce the risk of diarrhoea related diseases with 47% and that promoting hand washing can save lives (Curtis & Cairncross 2003). Promotion of hand washing has been done to a certain extent in Darechowk, but again due to low resources when it comes to promoters and training this has not been carried out in the best possible way. Soap is also too expensive to purchase for many of the villagers and they are often dependent on financial support for this. Hence, accessibility of soap can contribute to optimal health effects, and should be a prioritizing when promoting sanitation.

4.4 Social acceptance of the technology

The third objective of this research is to understand and identify which factors are affecting social acceptance and to what extent the community of Darechowk socially accept the technology. This section will focus on the analysis of different perspectives from the participants from questions in the interview guide related to social acceptance. With these perspectives this section will further discuss the extent of social acceptance of the technology in Darechowk.

4.4.1 Motivation

The motivation to adapt and to use the technology introduced was identified as one of the important positive factors for social acceptance among the participants. How they were motivated and for different reasons came up in many questions not particularly aimed at this, but came through as important for further practice.

DWSS currently recons Darechowk VDC as one of the most accepting VDC in Chitwan district towards the technology of urine-diverting pit latrine. This statement is mostly based on what impression they get through the work of THE SEWA Nepal, which previously explained, is the work of one man; Shreerendra Pokharel. His promotion and motivational work has played an important part in the extent of acceptance in Darechowk. This is clearly visible through the respondent's answers to what motivated them to construct ecosan toilet and start the practice of urine collection.

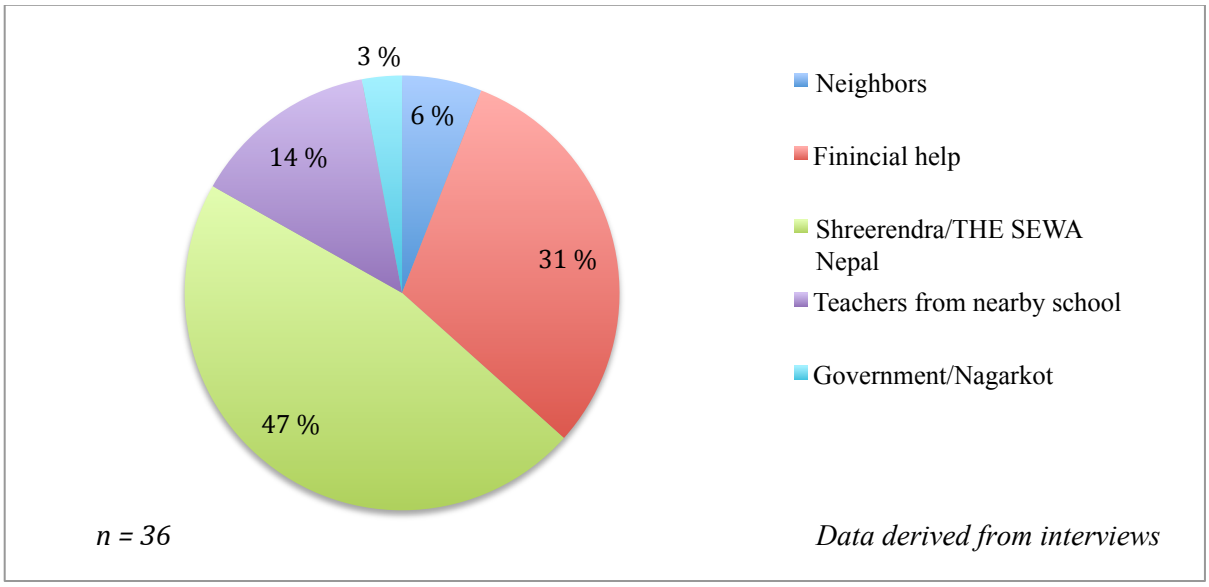

Figure 19: Distribution of respondent's main motivation for construction of urine-diverting toilet and collection of urine.

Fig. 19 shows 47% of the respondents explained that Shreerendra Pokharel and his work through THE SEWA Nepal was the main reason for them why they were motivated enough to construct toilet and/or start collecting urine to be used as fertilizer.

One female respondent explains: *" Shreerendra motivated me and convinced me that this was a good thing. My whole family knows him and we trust him. He is a respected man".* Shreerendra himself explains that his vision is to make a sanitation movement including all social strata. He wants to include all casts in his work and focus on the benefits from ODF-status and the reuse of human excreta and not on cultural or religious views. *"I have talked to different casts all over Darechowk, explaining them how to do it and convincing them that this is very beneficial and good a good thing"* (Shreerendra Pohkarel, founder of THE SEWA Nepal). Trust and respect are clearly feelings important for acceptance and are easily triggered through the work of not only THE SEWA Nepal but also other respected community leaders and teachers, who often are the most respected people of the community. Teachers from nearby schools were also clearly a motivation for many of the participants. 14% of the participants claimed that motivation from teachers was the main reason for them to start collecting urine.

31% of the participants saw financial help as the main reason for why they were motivated to construct the urine-diverting pit latrine and to collect urine. For this group of participants, the main impression was that they already had accepted the use of toilet and urine collection as something positive and was only dependent on financial help. The financial support came from THE SEWA Nepal in form of free urine-diverting pan, urine collection pipe and cement. In addition to financial help, 6% of the respondents had their neighbours thoughts and action as their motivation, which again reflects upon community acceptance as important. As long as the neighbour does it, it is not an embarrassment for you to practice the same ting.

Another perspective of motivation is old practices being reintroduced. For some of the respondents, an old practice of using urine and faeces as fertilizer in agriculture was remembered. They did not only remember the practice as accepted but also the value from urine as fertilizer. One male respondent from Dandabari could not explain why they stopped collecting urine, but did clearly see it as something positive and as motivation to accept it. He explains: *"when I first heard Shreerendra talk about using urine as fertilizer and that it is easy to collect it from the toilet, I remembered that my father used to do this 30 years ago! Why did we stop it? I don't know, but that made me think about it and now I am using it".* A point from the FGD was that a good taste in vegetables could also be linked to quality of life and positive personal experiences with the use of urine. Hence, a positive driver for social

acceptance is identified. Being convinced and motivated through personal experience to continue using urine. Many mentioned that from chemical fertilizer they experienced a bitter taste in green leafed vegetables and are now much happier using urine due to change in taste. Furthermore, some respondents found motivation to trust the use of urine and to continue collecting through their own experiments. One male respondent explains his reaction when he first heard about "eco-san": *" after I heard about eco-san from Shreerendra I wanted to test it on my own, so first I tried fresh urine in my saag production and I noticed a very bad smell and became very unsure. Than I stored the urine and mixed it with water, as Shreerendra said I should do. Than it did not smell as much and I felt much more certain that this urine was better for the plants".* From his body language and enthusiasm this was clearly something he was proud of and he also said he had showed it to other villagers to pass on his discovery. Feelings of ownership and pride also came through when the participants were asked if they recommended eco-san to other than their closest family and friends. Many participants explained that they try to talk about eco-san when they meet new people in their village or when they are traveling to other places. One male participant responded: *" When I go to other places and meet new people I talk about the benefits with urine and explain how I am doing it in my home".*

On the other hand, some participants felt they did not have knowledge and confidence enough to explain the technology to other people. Feelings of embarrassment from lack of knowledge can also be connected to answers from question 4 in Annex 2, where participants were asked if they contact anyone for help if they experience any difficulties. Even though this question originally was aimed at technical issues, many answers reveals that lack of knowledge also interferes with social acceptance among the participants. Many did not ask for help when technical problems occurred because they were afraid to be judged by persons with higher social status in the community. Again this reflects upon the importance of involvement and motivation from community leaders or teachers.
In general, it is visible from the respondent's answers that common community feelings of pride and ownership towards the technology are gained through motivation and promotion from community leaders and schoolteachers in the area. Generation of local community leaders, social marketing and institution building are essential elements to scale-up and optimize the use of eco-san toilets in Nepal (Adhikari & Thapa 2009). Social acceptance has increased in Darechowk with the work of local promoters and schoolteachers. This capacity

is a very important factor for acceptance and the optimization of the technology. The technology will not be fully optimized without a total acceptance from the users.

Another perspective affecting the extent of acceptance is the reintroduction of old practices. Mia O'Neill, the chairperson of the Global Dry Toilet Association states in her paper from the 4th International Dry Toilet Conference in 2012; *"As ecological sanitation is very close to the ancient practices, where human excreta was used together with animal manure as fertiliser (eco-san simply includes the hygiene aspect), it is not as much a question of new technology being brought to people but rather about an old practice made new - and getting the people to realise this"* (O'Neill 2012). This could also be an important aspect for Darechowk, by using old agricultural practices as example to increase the level of social acceptance. Adhikari (2012b), also explains this in a Nepalese context: *"Indigenous practices of using urine and faeces for various purposes could be credited as the major driving factors for promoting ecological approach in the field of sanitation. Communities in Nepal have wisely conceived the reciprocal interaction between human excreta and crops that is justified by their saying: Pet Dekhi Khetma and Khet Dekhi Petma (stomach to farm and farm to stomach) and Najane Phodor Jane Mohar (waste if you don't know, wealth if you know)"* (Adhikari 2012b) (p.61).

4.4.2 Open defecation free-status

As mentioned, Darechowk VDC was given the status as "open defecation free" in 2010. The ODF-status was frequently mentioned and interoperated by the researcher as a positive driver for accepting the changes in the community after eco-san was introduced. Many respondents explained how the environment in the community had visually changed in a positive direction over the past few years. From a daily concern of stepping in faeces on every path in the cluster's surrounding jungle and feel the distinct smell of excreta near their household, many participants explained that these were no longer concerns. As they saw these changes and experienced an increase in life quality, positive feelings towards the practice of using toilets and safe control of human excreta emerged. One example of this is also how some participants explained their negative feelings targeting people in the community with no toilet. One male respondent elaborate his reason for feeling negative: *"I don't like that some people don't want to construct a toilet, they contribute to pollution"*. Hence, pollution

control is a positive outcome affecting the overall community acceptance. Moreover, the visual change in the community after installation of more toilets was also a frequent mentioned topic in FGD. This topic clearly enhanced feelings of appreciation and pride among the participants. Feelings of responsibility towards the environment in the community were identified as a positive driver for acceptance based on this.

Furthermore, another sign of social acceptance from the participants were their reactions when asked if they still practiced open defecation. OD was clearly connected to embarrassment among the participants and was a topic many wanted to avoid. This could be a sign of a turn in the community towards no longer accepting OD, as OD clearly is associated to something negative among the surveyed population. Although many did not want to admit that this was something they still did, it was found that defecating in the open is usual while working in the field or cutting grass for livestock, activities often done far away from their house. A female respondent elaborates: *"I do not practice open defecation no more, because we have toilet close to our house and we always use the toilet. The only time I have to defecate in the open is when I am too far away from my house to go back"*. The tendency of first ensuring the researcher that they did no longer practice OD before they admit to the practice in some occasions, was common among the participants. Still, this shows a higher acceptance for using a toilet than the practice of OD.

4.4.3 Level of knowledge

Naturally, the extent of knowledge and awareness about the use of urine as fertilizer and the technology in general, varies among the surveyed population. Education level, social strata and training could be factors affecting this. But again, knowledge and awareness are important for social acceptance of such a technology introduced in Darechowk, because it includes reuse of human excreta. Acceptance of reuse of human excreta are often linked to cultural and religious behaviour (Drangert & Nawab 2011), thus a high level of knowledge is even more important for acceptance. This is reflected among the participants from several questions in the interview guide as well as topic raised in FGD, where the level of knowledge clearly affected their answers and discussion.

When the participants were asked if they accepted to use urine as fertilizer from other than close family, the majority responded that they would not accept it. Many respondents stated that they were afraid of diseases from other persons and would rather protect their family than take the risk of using urine from other people. This resistance of not accepting urine from other people can be a reason for lack of urine for all crops, as discussed in chapter 4.3.1. By this, social acceptance is affecting the extent of realizing the economic benefits among the participants. Even though they do not have enough urine to cover the need of fertilizer, the risk of contamination is a grater driver for them not to receive more urine, than reduction in use of chemical fertilizer. This negative driver of not wanting to receive urine from other persons is also related to the level of knowledge and trust in the sanitizing process of urine. When asked if they trusted this process, many of the same respondents that did not want to accept unknown urine neither trusted the sanitizing process. This correlation can also be connected to the extent of training received, which shows that lack of training affects the level of understanding and again the knowledge and acceptance. Acceptance was also a factor identified when the question about consumption of vegetables grown with urine as fertilizer, was raised. Many of the participants did not have any qualms against consuming the produce in their home nor sell it to the market, which reflects social acceptance as well as a awareness when it comes to safety. To others, safety was an issue and some thought that it was not safe to eat their own vegetable production. A mother explains why they no longer use urine as fertilizer for vegetables consumed in home; *"one day my oldest son saw me pouring urine on our cucumber production and he was very angry with me, since he did not want to eat anything grown with urine. He told me it was unsafe and that we could get diseases from it. From that day I did not use it anymore"*. Even though this was not a common reaction for the respondents, it still affects the extent of social acceptance of using urine as fertilizer in Darechowk. Level of knowledge and acceptance also came up in a couple of FGD, where it was uttered a need for more training to fully accept the use of urine. Acceptance was also related to the sanitizing process in some FGD. Some participants in the FDG discussed that if they would understand more of how the urine became safe through sanitizing, they would trust it more. One male respondent from interviews also commented on the sanitizing process; *"if we only could test the urine after it has been sanitized to see that it will be safe, I think that would be very good for many in the community and we could trust it when they say it is perfectly safe to use"*.

In addition to the use of urine as fertilizer, THE SEWA Nepal and Shreerendra Pohkarel have a desire of introducing composting toilets and use faeces as fertilizer in Darechowk VDC (Shreerendra Pokharel, 2013). When asked if the participants would consider using human faeces as fertilizer, the majority of respondents from both the interviews and the FGD linked knowledge as their main concern; *"I don't know anything about it and how to use it, now I would never consider it but maybe if we got more training and more knowledge about it I could try it"*. Even though many respondents would not use faeces as fertilizer today, many did admit that they were open for it but needed more comprehensive training and knowledge to be sure how to use it properly.

Lack of awareness and low levels of knowledge when it comes to a new technology are acknowledged as significant barriers for acceptance. If any technology are to be promoted, awareness will be one of the main preconditions for implementation and adaption to the technology (Davies-Colley & Smith 2012). The technology promoted in Darechowk has to a certain extent been socially accepted since the majority of participants use urine as fertilizer and would not go back to OD. However, if the villagers of Darechowk are initially are open to gain more knowledge, acceptance could easily increase in the community and be a contribution to optimize the use of the technology. The use of the technology includes collecting urine and the amount of urine collected by the participants is clearly an indicator of how the system could be optimized.

5. RECOMMENDATIONS AND CONCLUSIONS

5.1 Summary of findings and recommendations

This chapter summarize the main findings and present the main weaknesses and strengths with the sanitation system in Darechowk together with opportunities and recommendations to optimize the system. The findings are presented as the different identified factors affecting the optimal use and adaption of the sanitation system in Darechowk. Furthermore, the factors will be evaluated based on their degree in strength viz. minus as a negative factor and a weakness with need for improvement and plus as a positive factor and strength for the use and adaption of the technology.

Summary of findings

Table 3 shows the main factors affecting user friendliness with the sanitation system in Darechowk. From the participants answers it was identified many factors related to the system, which contributes to a negative impact on the user friendliness.

Table 3: Evaluation of factors affecting user friendliness of the sanitation system in Darechowk.

Factors affecting user friendliness	Evaluation
Operation and maintenance	
• Blockage in urine pipe	-
• Pan material	-
• Breeding of flies	-
Handling of urine and field application	
• Smell from urine	-
• Transport of urine to the field	-
• Direct collection	-
• Design of urine collection tanks	-
• Lack of proper urine collection tanks	-
• Urine distribution equipment	-
Training and understanding	
• Extent and continuance of training	-
• Monitoring of users	-
• Community leaders and volunteer work	+
• Gender distribution and training	-
• Suggestions for improvements from participants	+

Table 4 shows the main factors affecting economic benefits and health aspect with the sanitation system in Darechowk. Economic benefits such as reduction in use of chemical fertilizer, increase in yield and improved soil fertility are the main positive drivers for the participants to realize the economic benefits from the collection of urine and using urine as fertilizer. However, reduction in chemical fertilizer was identified as an average strength for the system due to the extent of reduction. Furthermore, some negative factors are interfering with the extent of economic benefits gained from the system.

Table 4: Evaluation of factors affecting economic benefits and health aspect with the sanitation system in Darechowk.

Factors affecting economic benefits and health aspects	Evaluation
Urine as fertilizer	
• Extent of collection	-
• Reduction in chemical fertilizer use	+
• Urine as pesticide	+
• Soil quality and moisture holding capacity	+
• Yield	+
Faeces as fertilizer	
• Current practice in using faeces as fertilizer	-
• Training in how to use faeces as fertilizer	-
• Level of understanding the benefits from faeces as fertilizer	-
Health aspects	
• Food quality	+
• Decrease in headaches from not using pesticides	+
• Hygienic awareness (use of soap)	+
• Infiltration of liquids from pit	-
• Lack of knowledge regarding spread of disease	-

Table 5 shows the factors affecting social acceptance of the sanitation system in Darechowk. The extent of social acceptance towards the existing system in Darechowk is fairly high much due to the involvement of community leaders and volunteer work with promotion and motivation. Financial support for construction of toilets is identified as an average strength for motivation because it was never mentioned as the major motivation for the participants. Furthermore, some factors related to awareness and level of knowledge regarding safe use of urine is affecting the social acceptance in a negative direction.

Table 5: Evaluation of factors affecting social acceptance of the sanitation system in Darechowk.

Factors affecting social acceptance	Evaluation
Motivation	
• The work of THE SEWA Nepal	+
• Trust gained from community leaders	+
• Financial support for construction of toilet	+
• Government involvement	-
• Old practices reintroduced	+
• Visual change in crop	+
• Availability of contact persons	-
Open defecation free-status	
• Visual change in community	+
• Pollution control	+
• Responsibility towards community environment	+
• Current practice of open defecation	-
Level of knowledge	
• Acceptance of urine from other than close family	-
• Knowledge regarding sanitizing process of urine	-
• Resistance to consume own production	-
• Sell production to market	+
• Lack of knowledge regarding human faeces as fertilizer	-
• Openness regarding human faeces as fertilizer	+

Overall recommendations

Based on the different factors above and to what extent they are affecting the optimal use and adaption of the sanitation system in Darechowk, some specific recommendations can be given.

From the technical factors affecting user friendliness, the need of an upgrade and modification of the system is clear. The urine collection pipe is frequently mentioned as an issue because it is too narrow and blockages occur consistently. Blockage depends on cleanliness of the pan to avoid debris but also in a hygienic perspective to avoid breeding of flies and mosquitoes, thus a more comprehensive training regarding operation and maintenance and the importance of cleanliness, should be given. Another factor conflicting with cleanliness and overall use is the pan material. The current pan is made from fibreglass, nevertheless broken and scratched up pans were a frequent observation and complain from participants. Thus, an abrasion test of the pan in order to identify the most appropriate pan material should be conducted.

Regarding urine collection and application of urine in the field, the current situation in Darechowk is dominated by lack of proper equipment and inconvenience for the users. A solution could be a mechanized system that collects urine from each household and transports it to a location for storage before it distributes urine to nearby fields. This is a very comprehensive operation, which needs further investigation from engineers and involvement of stakeholders. However, some adjustments to the current situation can be made as provision of bigger collection tanks and proper equipment for application such as masks and gloves. A more easy way of distributing urine to the field could be the use of a watering can to make the distribution more precise and to avoid spill of urine on users. As a result, the collection of urine could increase together with the economic benefits for the population.

The extent of economic benefits from the current system in Darechowk is reduced due to the level of urine collection. Level of urine collection is also dependent on social acceptance, since reluctance in receiving urine if one household was not able to collect enough was an issue. Thus, it is recommended to conduct a urine test to convince users that urine is safe. Moreover, training regarding proper storage and sanitizing of urine should be conducted to increase responsibility and knowledge among users. In general, more continual training should be provided and a focus on monitoring users in order to identify important gaps and

threats to the optimal use of the system. A recommendation based on this research is to organize regular meetings where suggestions for improvements of the system are to be discussed. Inputs from users should be recognized as high value for optimizing the system and should be brought forward to the authorities and support organizations.

Even though Darechowk has been identified as a faeco-fobic community, openness towards gaining more knowledge about reusing human faeces as fertilizer is strong among the participants. This should be explored and a goal of reusing faeces should be a main goal for this system, hence a modification in direction of the urine-diverting dry toilet presented in chapter 2.3.1 is recommended. This system provides a possibility to eliminate groundwater pollution as well as a more controlled urine and faeces collection and storage. Hence, improved health benefits for the population. The UDDT provides a user-friendly collection of compost for use as fertilizer, and an optimal use regarding economic benefits from using both faeces and urine as fertilizer. Accordingly, the population of Darechowk could benefit from less dependence upon chemical fertilizer and a safe environment in the community.

However, all the above mentioned recommendations are dependent on financial support and the involvement of stakeholders, local governance and contributors. In the case of Darechowk, THE SEWA Nepal is the major if not the only contributor to the ODF-status and sanitation promotion. Thus, the work of THE SEWA Nepal is the most important influence to whether the sanitation system in Darechowk can be optimized to the maximum level of benefits for the environment and the inhabitants of the VDC. THE SEWA Nepal should be financially supported and recognized for its importance by stakeholders and government so the organisation can provide Darechowk's inhabitants with an optimal sanitation system for the future.

5.2 Conclusion

For Nepal to achieve a sanitation coverage of 100% the need of a sustainable sanitation approach is crucial due to lack of improved sanitation in the country. Darechowk VDC in Nepal has been recognized as an 'Eco-San Model Village' with the implementation of urine diverting pit latrine based on the concept of ecological sanitation with the reuse of urine as fertilizer. The literature on ecological sanitation states that many measures, such as socio-cultural factors, user participation and education, knowledge and awareness, design and planning strategies needs to be addressed properly to achieve sustainability and optimal benefits for users and environment. If Darechowk VDC is to be considered the model of successful implementation of sustainable sanitation in Nepal, it is necessary to investigate if this technology is used in an optimal way. This study was set out to explore factors affecting optimal use and adaption of the ecological sanitation technology implemented in Darechowk VDC from a user perspective in terms of user-friendliness, social acceptance and economic benefits.

The sanitation system in Darechowk has many challenges when it comes to user friendliness identified through users problems with continuance in urine collection. More comprehensive training and monitoring of users are needed to optimize the system. To optimize economic and health related benefits, the system is in need of a holistic approach which includes a more mechanized system for urine collection and distribution. A modification of the system in direction of a dry system for the faeces where both urine and faeces are collected and treated separately is recommended. From this system, the population in Darechowk would benefit in terms of maximized economic benefits in addition to a safe environment.

Furthermore, the overall social acceptance of the technology used in Darechowk is very high, but the level of knowledge among users needs to be increased in order to achieve a complete acceptance. Acceptance is dependent on community involvement and awareness in Darechowk, and the work of local teachers and community leaders is identified as the most important factor for social acceptance in Darechowk. Thus, this work needs to be further encouraged and appreciated by national institutions working with rural sanitation as well as local governance. Local governance should also be involved in the organisation and provision of sanitation related training and monitoring in order to identify and close gaps in the existing system.

This research has mainly identified factors affecting optimal use and adaption of the sanitation system in Darechowk from a user perspective. Hence, a further investigation is needed to suggest technical modifications for the system to be used in an optimal way in terms of ecological sanitation. Even though this thesis gives some recommendations, a proper evaluation on a technical level should be conducted. Furthermore, the existing system is originally designed based on the pour-flush latrine, which allows for groundwater contamination. Investigations including soil conditions, locating level of groundwater table and the extent of pollution of drinking water sources in Darechowk in conjunction with modification of the existing system should be obtained. Consequently, the community of Darechowk can modify the existing system to decrease negative health impacts and impacts on the surrounding environment.

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ANNEXES

ANNEX I – Overview of respondent's demographics

Respondent nr.	Female/Male	Age group (years)	Level of education	Occupation	Home cluster
1	F	26 - 35	Higher Secondary (12 years)	Shop owner	Chumlingtar
2	F	36 - 45	Secondary (10 years)	Farmer	Chumlingtar
3	F	36 - 45	Secondary (10 years)	Farmer	Chumlingtar
4	F	26 - 35	Lower Secondary (8 years)	Farmer	Chumlingtar
5	M	76 - 85	Primary Education (5 years)	Farmer	Chumlingtar
6	M	66 - 75	Primary Education (5 years)	Farmer	Chumlingtar
7	M	66 - 75	Higher Secondary (12 years)	Former teacher, now farmer	Dandabari
8	M	18 - 25	Higher Secondary (12 years)	Farmer	Dandabari
9	M	36 - 45	Higher Secondary (12 years)	Farmer	Dandabari
10	F	26 - 35	No education	Farmer	Dandabari
11	F	26 - 35	No education	Farmer	Dandabari
12	M	56 - 65	No education	Farmer	Dandabari
13	F	26 - 35	No education	Farmer	Sota Gaun
14	M	46 - 55	Primary education (only 3 years)	Farmer	Sota Gaun
15	F	36 - 45	No education	Farmer	Sota Gaun
16	M	46 - 55	No education	Farmer	Sota Gaun
17	M	36 - 45	No education	Farmer	Beldanda
18	F	26 - 35	No education	Farmer	Beldanda

19	M	36 - 45	No education	Farmer	Siran Gaun
20	M	46 - 55	Primary Education (5 years)	Farmer	Siran Gaun
21	M	18 - 25	Lower Secondary (8 years)	Assistant at the local primary school	Siran Gaun
22	F	26 - 35	No education	Farmer	Siran Gaun
23	F	56 - 60	No education	Farmer	Tokdang
24	M	36 - 45	Lower Secondary (8 years)	Shop owner	Tokdang
25	M	36 - 45	Lower Secondary (only 6 years)	Farmer	Kamere
26	M	26 - 35	Higher Secondary (12 years)	Farmer	Kamere
27	F	26 - 35	Secondary (10 years)	Husband is a teacher	Kamere
28	M	66 - 75	No education	Farmer	Kamere
29	M	36 - 45	Higher Secondary (12 years)	Teacher	Kamere
30	F	46 - 55	Higher Secondary (12 years)	Husband is teacher	Kamere
31	F	36 - 45	None provided	Husband is teacher	Turluk
32	F	36 - 45	Secondary (10 years)	Farmer	Turluk
33	M	36 - 45	Primary Education (5 years)	Farmer	Turluk
34	M	36 - 45	Higher Secondary (12 years)	Farmer	Turluk
35	F	46 - 55	No education	Farmer	Turluk
36	M	56 - 65	No education	Farmer	Turluk

ANNEX II – Interview guide for semi-structured interviews

1. House nr:…….
2. Date……..
3. Ward nr:…….....
4. Name of cluster…….

A. GENERAL INFORMATION

1. Name of interviewee:
2. Name of head of the HH:
3. How many family members are living in this HH:
4. Main occupation in the HH:
5. Level of education for respondent:
6. Farmland owned by the HH:
7. Farmland leased by the HH:
8. Livestock owned by the HH:
9. When was eco-san toilet introduced in the HH:
10. Did you have any toilet before the eco-san toilet?

TECHNOLOGY

1. What kind of eco-san training have you got?
2. Are there any differences between your old toilet and the eco-san toilet? Explain
3. Do you find any difficulties with the eco-san toilet? Explain
4. If you experience any difficulty, do you contact anyone for help?

5. Do women face any difficulty using the toilet during their menstrual period?
6. Are all members of the HH able to use the eco-san toilet? If not, explain?
7. Do you face any difficulties in keeping the toilet clean?
8. Do you face any difficulties in maintaining the toilet and keep it in good condition?
9. Is there anything you would like to change with your eco-san toilet? Explain
10. Do you find any difficulties with the eco-san system? Explain
11. Do you face any problems when handling urine or applying urine to the field?
12. Do you understand the sanitizing process of urine and its purpose?
13. Do you have any doubts about the sanitizing process of urine?

SOCIAL ACCEPTANCE

14. Do you still practice open defecation?
15. How did you find out about eco-san and the usage of urine as fertilizer?
16. What or who motivated you to construct the eco-san toilet/urine-collecting system?
17. What do you do with the crop grown by using urine as fertilizer?
18. Do you ever get urine from another place?
19. Do you reuse human faeces?
20. Would you consider using human feces as fertilizer?
21. Do you recommend the use of eco-san to other than your closest family and friends?
22. How do your neighbours feel about eco-san?
23. Do you think the village has changed in any way after implementation of eco-san toilet? Explain

ECONOMIC AND HEALTH BEGENFITS

24. How much urine do you collect per day, and is this enough for the fields you want to apply urine to?

25. What are the differences in amount used of chemical fertilizer after you started using urine?

26. What were your practices of using chemical fertilizer before you started using urine?

27. Are there any changes in quality (size, taste, color) and quantity (volume) of your production when using urine as fertilizer? Explain

28. Do you benefit from the reuse of urine? If so, how?

29. Do you use faeces for biogas?

30. Do you think you would benefit from the reuse of human feces? If so, how?

31. Have you or your family noticed any difference in your or in your family's health after installation of the eco-san toilet/system?

ANNEX III – Focus group discussion: topic guide

1. Advantages with eco-san

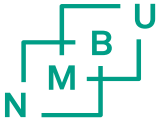
2. Disadvantages with eco-san

3. Advantages and disadvantages with dry eco-san

4. Economic benefits from eco-san

5. Health related benefits from eco-san

6. Does the system need to be upgraded? How can it be upgraded?



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