Sustainable Sanitation System for the Future: Ecological Sanitation the Best Sanitation Option in Nepal

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ABSTRACT

In Nepal there are estimates that, by the end of the year 2005, around 74.0 percent of the population access to drinking water whereas only 39.0 percent of the population has access to sanitation facilities [1 DWSS documents]. The access to water in Nepal does not mean that the water supplied is safe and meets WHO standard. Similarly, sanitation coverage is calculated taking toilet construction as an indicator which again does not mean that toilets are safe to use. Most urban centres of Nepal are facing the problem of inadequate supply of drinking water and compromised sanitation. The unplanned and unscientific use of natural resources in Nepal has created severe environmental degradation posing great threat to healthy living. The state of environment (SOE) Nepal identifies water pollution and land degradation among most important environmental issues of Nepal. Shallow groundwater (shallow tubewells) is the main source of drinking water in Terai (the lowland region of Nepal). A study conducted by Department of Water Supply and Sewerage (DWSS) showed that almost 55% of Terai tubewells are microbiologically contaminated [2 Neku and T]. It seems possible that Nepal can meet the Millennium Development Goal (MDG) target of halving the proportion of population without access to water and sanitation facilities. But sufficient attention has to be given to make the supplied water safe and potable and the toilets are safe to use which at the same time help conserve water and recycle nutrients that are wasted as toilet waste. Ecological sanitation (ecosan) seems to be a potential alternative to conventional sanitation systems, which replenishes part of organic matters, and nutrients that are removed from the soil. This leads to food security by conserving soil fertility and helps alleviate poverty, prevents surfaces and sub surface water sources from pollution. An elevated double box urine diverting toilet [KM Lamichhane paper, Fig 1] is proposed which can serve the purpose of conserving water and recycle nutrients.

INTRODUCTION

Nepal is broadly divided into three physiographic regions: Hills, Mountains and Terai. Unfertile mountains and rugged hills constitute about 77% of the area. Terai, a narrow fertile strip of land in the south, shares 23% of the land area but harbours 47% of the country's population [KML, GTZ].

Table 1. Share of land and population by physiographic regions.

Physiographic Region	Share of				Access of people to physical facilities		Population growth rate (% per annum)
	Land		Population				
	%	Area (10^3 km^2)	%	Millions	Piped water (%)	Sanitation (%)	
Mountains	15	22.10	7	1.61	75	15	~0
Hills	62	91.20	46	10.58	70	44	~2
Terai (low land)	23	33.90	47	11.00	78	42	>3
Total	100	147.18	100	23.19	74	39	~2.17

The Terai is in heavy pressure due to over exploitation of natural resources and high population growth rate. Production in mountains is decreasing at a rate of 40 Kg/ha.Yr [4 Ghimire and Upreti]. Agricultural productions contribute about 38% of country's GDP [CIA fact book, 2005]. It is estimated that Nepal is loosing 240 million tons of top fertile soil annually. Another estimate indicates that about 1.8 million tons of plants nutrients are removed away from soil of crop harvest and soil erosion of which only 16% are replenished by organic and mineral fertilizer sources [Ghimire and Upreti].

WATER AND SANITATION FACILITIES

It is estimated that 74% of the people in Nepal have access to drinking water facilities and only 39% of the people have access to sanitation facilities. The supplied water in most of the places is not adequate in qualities and quantities. The water supply coverage in Nepal does not mean that drinking water is immediately available in taps. Most of the houses even in urban centres with household connections do not receive a regular supply in dry seasons (UNICEF 2005). The water supply system of Kathmandu, the capital of Nepal, meets only about 80% of the demand during the wet season whereas it meets only about 40% of the demand during the dry season. There are many projects (completed) in Nepal which are partially operational and some are completely non-functioning [NPC 10th] due to lack of proper repair and maintenance mechanism. The population benefited by the completion of these projects is not unaccounted when they stopped serving the communities. The coverage rate should therefore be carefully analyzed in case of developing countries like Nepal. Similar pragmatic approach of analysis has to be adopted to calculate the sanitation coverage.

Low quality drinking water supply in the system, poor sanitation practices of the people and unplanned, unsystematic and unsafe disposal of human wastes are causing very

serious environmental problems in Nepal. Safe disposal of human excreta alone can save hundreds of lives in these countries. In Nepal, Water Borne Diseases claim 15,000 under five children deaths each year (UNICEF 2004) and it is believed that human waste (due to ignorance of individual and community hygiene) is the main cause of water contamination.

ECONOMIC OVERVIEW

Nepal is one among the poorest and least developed countries in the world. Agriculture is the mainstay of the economy, providing a livelihood for three-fourths of the population and accounting for 38% of GDP. It has high unemployment rate of about 42%. Nepal has total labour force (mostly unskilled) of about 10.4 million and agricultural sector is the one which uses the major part of it (table 2). Technological backwardness, its susceptibility to natural disasters, its remoteness and its landlocked geographic location are hindering the economic development of the country. Almost 31% of the people of Nepal live below the poverty line. Industrial activities are growing these days which mainly involves the processing of agricultural produce including jute, sugarcane, tobacco, and grain [CIA fact book 2005].

Table 2. Sector wise GDP contribution and occupation

Particulars	Agriculture	Industry	Services
GDP composition by sector (%)	38	21	41
Labour force by occupation (%)	76	6	18

MILLENNIUM DEVELOPMENT GOAL (MDG)

In Nepal it seems that the MDG target on water and sanitation (watsan) sector is met if this rate of flow of budget in the sector is continued in the years to come. The government is also committed to meet the MDG target in watsan target [5, 9th, 10th plan, NPC]. The progress in watsan sector is illustrated in Table 3 [6,DWSS document].

Table 3. Water and Sanitation coverage in Nepal♠

Indicator	1990	1995	2002	2005	2015
Proportion of population with sustainable access to water	45.9		71.6	74	73
Proportion of population with sustainable access to	6	21.6	34	39	53

♠ Department of Water Supply and Sewerage (DWSS) document, 2005

From the table 1 above it is clear that MDG target on water sector is already met as the target to be met by the end of 2015 is 73% coverage whereas the coverage by the end of 2005 is already 74%. But considerable attention has to be paid to the sanitation sector

so that MDG target is met. A lot of money and effort is therefore needed to provide sanitation facilities to the remaining portion of the population.

NEW CHALLENGES IN WATER AND SANITATION SECTOR

The quality of supplied water has been assessed on the basis of national clean drinking water indicators (table 4) which include safety and sustainability [8 Goal 7, August 2005, dwss Kathmandu]. According to these standards, 4 percent of the population currently has access to a high-quality water supply, 20 percent to a good-quality water supply, and 74 percent of the population has the access to basic-quality water. The target of the Ninth plan (1997-2002) was to provide basic drinking water to all people by the end of the plan period [NPC]. But the coverage in water sector achieved was just 71.6 % by the end of that period. It seems that it is not possible to achieve 100% coverage in water sector even at the end of the 10th plan period (2002-2007) though the MDG target is already met. MDG on sanitation sector is likely to be met but a lot of attention has to be given to provide sanitation facilities in such a way that water supply system and water sources do not get contaminated because of unplanned sanitation activities (cross contamination, surface and ground water contamination etc.).

Table 4. Clean drinking water indicators in Nepal♣

Service level	Quantity (per person per day)	Quality	Accessibility	Reliability (hours per day)	Sustainability (months per years)
Best	According to WHO standard	According to WHO standard	According to WHO standard	24	12
Good	According to WHO/national standard	According to WHO/national standard	Installed inside the house compound	24	12
Basic	20-45 litres	Processed, generally not injurious to health	Available up to a distance of 20 minutes	4	12

♣ Ministry of Physical Planning and Works (MPPW), Rural Water Supply and Sanitation (RWSS) National Policy, 2004.

A study conducted by the Department of Water Supply and Sewerage (DWSS) showed that more than 55% of the tubewells in Terai are microbiologically contaminated [7 Neku & Tandukar, DWSS 2002]. There might be many reasons for this contamination but it is expected that poor sanitation system (pit latrines) share the most [3 KM Lamichhane].

SANITATION (TOILET) SYSTEM IN NEPAL

Open defecation is still widely practiced in most of the rural areas in Nepal. Part of the urban population (around 10 %), mostly slum dwellers, also practice open defecation. The sanitation system in major urban centres including Kathmandu, the capital, is water borne toilet system. Septic tanks are quite popular in urban centres which when become full are emptied by the vendors by means of honey suckers. A few urban centres also have central sewage collection system and carried to wastewater treatment plants (WWTP). Most of the WWTPs are not functioning to the extent desired. In many towns sewage is centrally collected and conveyed and which ultimately feed to nearby rivers and streams as a result rivers and streams have turned in to open big sewers. Ecological Sanitation (source separation of urine) is introduced in recent years and Government organizations as well as NGOs are involved in this endeavour.

SANITATION AND MDG

To meet the MDG in sanitation sector in Nepal more than 3 million additional toilets have to be constructed. Huge amount of money is necessary for the toilet construction alone. Additional toilet construction implies that additional amount of water has to be provided for the smooth functioning of toilets. Investment, therefore, should also be made for providing water. As people are ignorant about importance of watsan facilities, implications of poor hygiene and sanitation, community awareness and training programmes have to be launched. Such training and awareness programmes on hygiene education and sanitation will be launched as an integral component of the drinking water supply projects and communities will be motivated for the construction and use of family toilets [10th plan].

HISTORY OF ECOSAN IN NEPAL

Collection of urine and faeces to use it later in agriculture fields had been practiced in Nepal since ancient time. This practice of collecting faeces in a bucket to use it in vegetable farms still exist in Jyapu community in some places of Kathmandu, the capital of Nepal. The main aim of introducing ecosan in these places is to make them aware of the possible risks in collecting and handling the toilet contents.

“Mala” is the name to a pit used as community toilet. It is a narrow and long drain like structure, 30 cm wide and 40-60 cm deep, without any partition which can accommodate 10-15 people at a time. People of Kathmandu used to live in dense clusters in ancient times and Mala are made in places appropriate for the whole community. There exist separate Mala for male and separate for female. People say that the sole purpose of constructing Mala was to use it as toilet but later when the fertilizer value of the human waste was known they started to use it as fertilizer. They used to empty when they are full.

"Nauga" is a name given to a pit situated below the staircase (exists almost in every old house in Bhaktapur) used to collect night time urine and mixed with ash. People used to think that ash has a good fertilizer value. The mixing of Ash with urine was solely for aesthetic purposes. Ash production at that time used to be very high as fuel wood was the only source of energy such that they need place to store. Nauga is emptied either when it is full or when there is necessity of fertilizer.

NECESSITY OF ECOSAN CONCEPT IN NEPAL

As explained earlier, Nepal is one among the poorest countries in the world and around 31 % of the people live below poverty line. Agriculture is the mainstay of economy which absorbs about 76 % of the total labour force. There are very few WWTPs in Nepal, mostly in urban centres, but most of them are not performing well. Country can not afford building new WWTPs because of its economy. Conventional Sanitation system has been considered to be based on a principal error in its use of large volume of clean water to dilute and transport small volume of human waste (Niem Czyno Wicz 1994, Swedish EPA 1995, Esrey 2000) which also makes it unviable to the economy of Nepal.

An agricultural production in mountains is decreasing at the rate of 40 Kg/ha.yr because of lack of fertilizers. There is therefore an urgent need to plan and design such a toilet system that is cheap alternative to conventional sanitation system and at the same time helps recycle nutrients and organic matters to crops. Ecotoilet is proposed to serve the purpose of conserving water and recycle nutrients [KM Lamichhane].

ADVANCEMENT OF ECOSAN IN NEPAL

Activities on ecosan have started in Nepal since 2001. current practice and development trend of sanitation in Nepal and social acceptance of ecotoilet in Nepalese communities will be dealt with. Based on the social interaction and learning from the villages an elevated double box urine diverting toilet (ecotoilet) is proposed (figures 1, 2). Ecotoilet seems especially useful for regions prone to ground water contamination by simple pit latrines [KM Lamichhane].

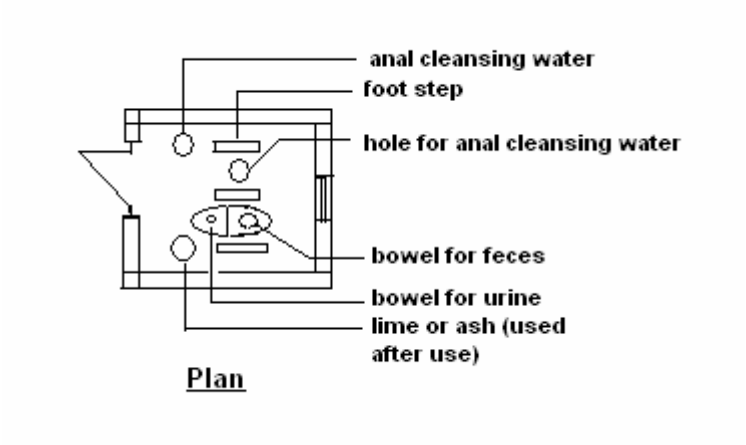

Figure 1. Proposed ecotoilet (elevated, double box, urine diverting)

There are people who are "washers", use water to clean their bottoms after defecation. The toilet will highly benefit from the users who are wipers as toilet papers absorb moisture and helps accelerate microbial die off. The toilet has provision for diversion for anal cleansing water to go to an onsite treatment system like soak pit or constructed wetland. The sectional elevation of ecotoilet can be depicted from figure 2.

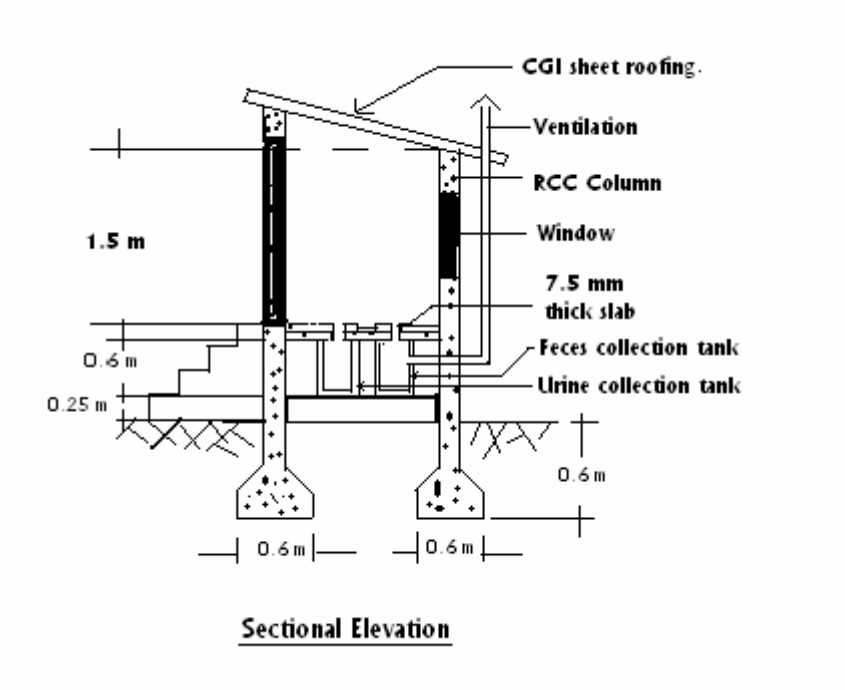

Figure 2. Ecotoilet (Sectional elevation)

The toilet is elevated to ensure that water does not enter in to collection tanks even during flooding. Provision is also made for the anal cleansing water to go, because most people in the Indian subcontinent use water to clean the bottom, the collection tank separately to ensure drying of faeces. The collection tanks are replaced with new ones when they get full. Urine mixed with water can be applied directly to crops whereas faeces are properly composted for about six months before applying in the farms. In Nepal people are collecting urine in small tanks and apply frequently to the crop when necessary. The average cost of an ecotoilet in Nepal is Nepali Rupees (NRs.) 18000

(≈US$ 250.0) and average maintenance cost involved is less than NRs. 1000.0 (≈US$ 15.0) in a year (Lamichhane, K.M.).

FUNCTIONING OF ECOTOILET

Ecotoilet is, principally, a dry toilet. The aim is to keep the faeces as dry as possible so as to accelerate bacterial die off and composting. It is therefore designed in such a way that flushing by water is kept at minimum. The development of toilet system is mainly centered on comfort and minimizing water necessary for flushing. The development process of toilet system from pit latrines to comfortable toilet seats took several years which encouraged use of large quantity of water for flushing. As the population is growing very fast, the per capita water available is decreasing. Demand of water is increasing in such a way that the pace of increased demand is much faster than the pace of population growth. It is thus imperative to conserve water wherever possible.

BENEFITS OF ECOTOILET

There are few pilot projects on ecosan in Nepal. The benefits of ecotoilet are elaborated on the basis of experiences gained in Nepal and on the basis of available literatures. Majority of people in Nepal who are using ecotoilet seem happy. They are also applying contents of ecotoilet (urine and composted faeces) in the crop. The comparison of crop production in plots of land with urine application over chemical fertilizer is also made. The study (Thapa, G; 2003) showed that production in the piece of land with urine application was comparable with the production in the land with chemical fertilizer application. People feel that they are saving money which they had to use for buying chemical fertilizers.

CONCLUSIONS

Ecotoilet conserves appreciable quantities of water. By replacing conventional toilet (flushing) system with ecosan system (urine diverting, two button types) can save even higher quantity of water. Ecosan system can be a potential alternative to conventional sanitation system which conserves the scarce resource, the water, both in quantity and quality and at the same time helps recover nutrients. People in ecosan sites are convinced on the fact that ecotoilets are best suited for nutrient recovery and recycling and water conservation. It is therefore urgent to integrate sanitation system with agricultural practices to recycle and reuse nutrients which helps conserve soil fertility.

Introduction of ecotoilet concept by introducing it in policy documents can help meet millennium development goals on sanitation. Application of toilet content to farm fields with proper treatment can substitute nutrient requirement of crops so that production in mountain areas can be increased. This increased production also helps retain rural population from migrating into city centres. This system also helps reduce the demand

of potable water which subsequently reduces the volume of sewage and nutrient load to the wastewater treatment plant (WWTP).

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