Title: **Operation and maintenance challenges to promote dry toilet: A case of ENPHO EcoSan implementing area in Nepal**

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Abstract:
Environment and Public Health Organization (ENPHO) has been working in the sector of Water, Sanitation and Hygiene (WASH) since two decades and implementing Ecological Sanitation (EcoSan) program since 2002. EcoSan is a technological option where urine and faeces are collected separately. EcoSan system provides sustainable solution of sanitation problems and prevent from disease outbreak due to fecal contamination. The major advantage of EcoSan lies in the recovery of nutrients by converting human excreta into rich agriculture fertilizer. However, it requires more awareness and technical knowledge for its proper use and operation & maintenance. If toilet is not used properly or the excreta are not composted safely, it leads to health threat, environmental pollution and complex maintenance problems. Hence, problems related to operation and maintenance must be addressed appropriately and users are to be made aware on every aspect of this new sanitation system.

KEYWORDS: *Environmental sustainability, Cultural adaption, New horizon.*

Background and Introduction

Nepal is facing several problems related to water and sanitation. Water scarcity and water pollution is the major problems. Water scarcity is prevailing in big cities like Kathmandu and is mostly due to water pollution. But also hillside settlements face water problems. It is more a problem of dispersion than of quantity as most water runs off unused (Von Benda-Beckman et al. 1997). The problem of polluted water is caused by black water, which is often directly discharged into natural water bodies (Wateraid 2008a: 13).

Knowledge of using urine and faeces as agriculture fertilizer is not new for Newar community in Nepal. However, their practice is not safe as they use raw faeces in their farm that pose a health threat. Scientifically, The concept of EcoSan first stroke in the minds of policy makers of Nepal after one of the authors, Mr. Nawal Kishor Mishra, of the paper entitled "A way forward to promote EcoSan in Nepal" participated in the first International Conference on ECOSAN in 2000 in Germany and brought a Dry EcoSan pan in Nepal. He also started applying urine as agriculture fertilize on the roof of his three story building (Figure-1).

Figure 1 First EcoSan pan brought in Nepal from Germany (left) and urine applied qualiflower grown on the top of the roof of Mr. Mishra's house, Kathmandu.

Eventually, the Department of Water Supply and Sewerage (DWSS) strived for appropriate local technology, funding and recipient community to initiate EcoSan program in Nepal. The past decade has seen a new beginning for EcoSan implementation in Nepal, and initial acceptance and growth of the technology suggests a promising future to expand and develop EcoSan across the country, in turn improving public health, the environment and food production. (Jems, 2012)

ENPHO has been implementing sanitation promotion programs through EcoSan in order to ensure sustainable solution in respect of prevention of disease due to fecal contamination, improvement in environmental degradation problem and recovery of nutrients for agricultural purpose. Four types of EcoSan toilet are used in working area, like (i) Double Vault Urine Diversion (DVUD), (ii) Single Vault Moveable Container Type (SVMCT) (iii) Two Vault Solar Model (TVSM) and (iv) Urine Diversion Pour Flush (UDPF). ENPHO has installed 1500 dry toilets so far.

It is a felt need that organizations and stakeholders, those vesting effort to improve sanitation and hygiene practices in Nepal, should adopt an integrated approach for implementation of sustainable sanitation through dry toilet concept. However, different complexities related to operation and maintenance of EcoSan is being hindrance for the sanitation promoters as well as the users. So, it is worthwhile to address the operation and maintenance challenges in order to promote EcoSan in large extent.

Methods

ENPHO keeps updated records of the area of program intervention. Organization collects information on need identification in the community, construction activities, awareness raising, operation and maintenance and other similar aspect of effective program implementation process. It develops a community based participatory mechanism where the users identify their problems and seek support from the organization on technical, social as well as behavioral aspect. Monitoring and supervision unit of the organization categorize the problems and make recommendation for support. Generally skillful person from the community are selected and trained on construction and operation & maintenance aspect. Technical team (engineers, technical experts, masons and community motivator) takes responsibility of seeking appropriate solution of the problems surfaced in the intervention area in order to ensure sustainability of the project in long run.

Results and discussion:

Operation and Maintenance Challenges of Dry EcoSan Toilet

For Nepal, EcoSan is still a new sanitation technology. People are gradually being aware of this system. In some regions a whim of building EcoSan is prevailing and people are applying the product of EcoSan (decomposed faeces and urine) in their agricultural farm. Meanwhile, operation and maintenance problems are also surfacing in the area of program intervention. As this is a system quite different from the conventional one, it requires more awareness and technical knowledge for its proper use and operation & maintenance. If toilet is not used properly or the excreta are not decomposed safely, it leads to health threat, environmental pollution and complex maintenance problems. Hence, problems related to operation and maintenance must be addressed appropriately and users are to be made aware on every aspect of this new sanitation system.

The major operation and maintenance challenges are as follows;

Urine pipe blocked problem

Figure 2 Urine pipe blocked at intervention area, Surkhet.

Blocking of urine pipe (Figure-2) is a major problem both in cases of dry and wet EcoSan in program areas. Generally, urine solidifies when its flow in the pipe is blocked. In several cases the urine diverting pipes are bent at 90 degree in order to join it down to the collection chamber which causes the urine blocked. Hence, the pipes are to be bent at 45 to 60 degree in order to ensure appropriate flow of urine in the pipe. Also, bigger size of pipe should be used in order to escape such problems. Mouth of the pipe should be covered with sieving plate so that dust, pebbles or other things can not drop at the hole.

Putrefaction of Iron taps

Some of the users complained of degrading problems in iron pipes in intervention area. Though not proved, it has been found in some cases that urine decay the iron taps in course of time. Also, the iron pipes too starts licking due to the same. Practically, it has been found that the use of plastic pipes is durable.

Missing or unfit cover lid on drop hole

In absence of the cover lid or out of shape cover lid of the dry EcoSan toilet pan, drop hole is left open or not covered appropriately that cause foul smell emission problem and attract fillies and other insects. Hence, the drop hole must be covered with a lid with proper shape and size.

Seepage from the bottom slab

In some of the cases the surface of the excreta collection chamber is sloppy towards the window made for the purpose of emptying the decomposed excreta comfortably. This causes leakage from excreta chamber and pollutes the environment. Hence, bottom surface of the excreta chamber should be equally plain. Such sort of seepage problems are prevailing in many places of program intervention. In order to prevent such problems windows of the excreta chamber should be fixed appropriately.

Urine sealed pipe system

In most of the program areas the urine diverting pipes are not sealed. If urine diverting pipe is not urine sealed in the collection chamber or collection tank then the hard smell of urine emit out from the urinal system causing air pollution around the toilet. Therefore, urine sealed system should be adopted in urine diverting pipe at the chamber end.

Figure 3 Anal cleansing wash water left open, Bardia.

Disposal of anal cleansing wash water:

The anal cleansing wash water must not be either mixed with urine or disposed off openly (Figure-3). This may cause fecal contamination and attracts flies and other insects. A separate pipe should take it to a filter bed constructed for this purpose and few small plants should be grown upon the surface of filter bed.

Addition of extra matters in excreta chamber

Ash, Lime, Sand or sow-dust must be dropped in excreta chamber every time after the defecation. They observe the water in the excreta and help enhancing the decomposing process.

Uncovered vent pipe

In some of the cases vent pipes are found left uncapped. This can cause rainwater to enter into the excreta chamber and paralyze the process of safe decomposition of the faeces. Hence, vent pipe should be caped from above.

Cultural Misconception and Social acceptance

Religious and cultural belief comprises a concept of clean and unclean. “A traditional upper class Hindu would have nothing to do with human faeces, not even his own”, because it is considered as unclean or impure (Winblad and Simpson-Hebert 2004: 100). In order to deal with the cultural misconception and enhance social acceptance, effective training, orientation and capacity development on technical aspect of this system should be imparted.

Handling of faeces

The dry EcoSan concept is not fully accepted by the rural population (Wateraid 2008a and 2008b). The majority of the Nepalese population has traditionally always practiced open defecation. Many people have an attitude, which can be called *faecophobic*, the fear of human excrement. However, still, there are some of Nepal’s communities traditionally used to systems for recycling their waste, including human excreta.

These were mainly the Newar in urban and peri-urban areas of the Kathmandu valley, but also the Sherpas living in high mountain areas (Wateraid 2008a and 2008b). In order to cope this problem, appropriate tools should be developed to handle faeces and urine fertilizer. Also, the system should be promoted first in the area or community where people are relatively less faecophobic.

Dosing problem in urine application

There has not been sufficient research in order to fix the doses of urine for various vegetable and fruits in deferent geographical locations and atmosphere. Hence, the users are still not confident in respect of frequency of times and amount of urine to be applied to their crops. In order to solve this problem systematic research is to be conducted in order to study the urine application impact on various crops in different conditions.

Limitations of low cost EcoSan toilet promotion

EcoSan toilet is comparatively expensive than the conventional one. As per the master plan for sanitation promotion, being implemented by the government, optimal local resources are to be used for toilet construction and no subsidy has been provisioned for such purpose. In one hand poor are not in the position to install an EcoSan for them due to heavy cost and in other hand building EcoSan using local resources raise questions on its sustainability. Therefore, in order to promote this system in rural areas considerable subsidy provision should be made.

Construction and Maintenance

Very limited effort has been vested for local human resource development in context of promoting professional skills of local people for construction and maintenance of EcoSan toilet. Thus, in absence of skilled manpower construction as well as repair and maintenance works stand paralyzed. Hence, locals should be trained and oriented for the construction as well as operation and maintenance.

Cost Recovery

Studies have shown that urine contain about 85% manure value whereas, human faeces contains only about 15 %. An estimate shows that 10 million tons of urine and 0.6 to 1.1 million tons of faeces are produced in a year in Nepal. The financial value of the nutrients of the urine and faeces based on existing prices of chemical fertilizers is about NRs 7.11 billion which is equivalent to 50% of the total fertilizers imported every year and the equivalent value of the fertilizer produced by a family of an average size of 6 is estimated about NRs 2,000, which is about 50% of the cost of the latrine structure up to the plinth level (Mishra, 2001). Nepal imported chemical fertilizer worth of 9,24,00,000 NC in 2001/02 which had increased up to 2,95,11,00,000 NC in 2009/10 (NRB, 2010).

In such background EcoSan fertilizer can contribute for saving on cost of fertilizer. Thus, It is important to make the people realize the monetary value of the fertilizer produced by EcoSan in order to motivate people to invest for construction and operation & maintenance of EcoSan.

Conclusion:

The EcoSan toilet places a high responsibility on the user as they require more attention than pour-flush or pit toilets and are more complex to maintain. Therefore thorough user understanding and commitment is vital. To help in the maintenance of EcoSan toilets, regular monitoring is also vital. The main challenges associated with EcoSan toilets can be overcome with effective training, user understanding and maintenance. (Jems, 2012). The closed loop approach to sanitation that EcoSan provides ensures the nutrients in excreta are returned to the soil, instead of polluting the environment. Though, ecosan toilet provide sustainable solution for the multifaceted problems related to water, sanitation, health, hygiene, malnutrition, quality of agriculture production, environment and atmosphere, construction, operation and maintenance of the same is an important aspect to deal with.

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