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Understanding to Ecological Sanitation (EcoSan): Research and implementation - A review

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Introduction

Ecological Sanitation(EcoSan) is an approach that focuses on closing the loop safely between sanitation and agriculture. This approach is widely being used in parts of East and South-East Asia.

In Nepal, there are still traditional practices of recover and reuse of excreta. They are termed as Nauga and Saga system, where the urine mixed with ashes are used for farming. In 2002, ENPHO introduced EcoSan which has been gaining its popularity in different parts of Nepal.

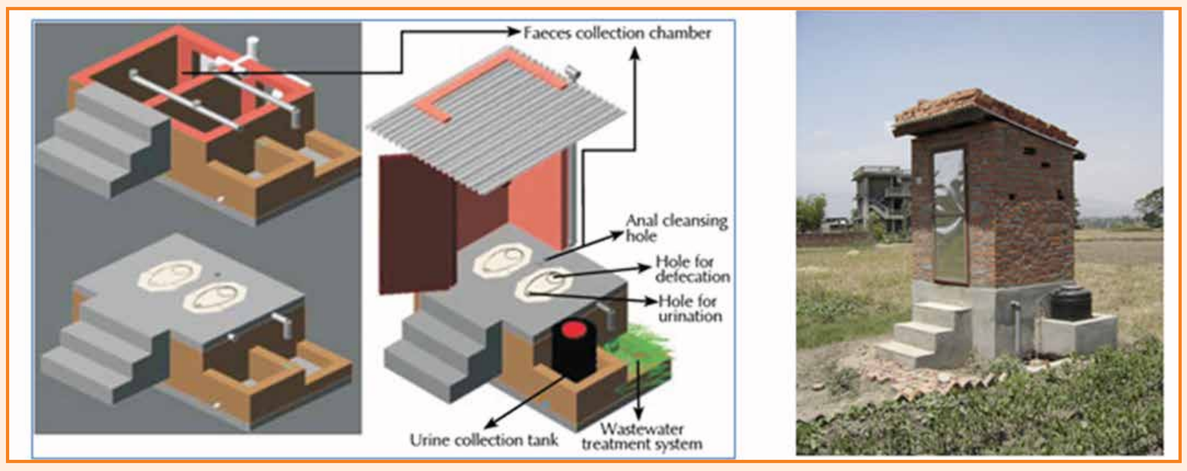

Figure 1 EcoSan toilets
Source: ENPHO

Methodology

Available Journal articles, conference reports, books and reports on EcoSan latrines were collected and searched for the relative theme to collect information, also relevant websites were scrutinized for the required information.

Results

A. Summary of major research findings on EcoSan from scientific perspectives in the world

Survival of pathogens

- The survival days of pathogens depends upon their habitat and their treatment types.

Table 1 Survival times of pathogens in days by different disposal/ treatment conditions (Source : Jones et al., 1998)

Condition	Bacteria	Viruses	Protozoa *	Helminths **
Soil	400	175	10	Many months
Crops	50	60	-	-
Night soil,Faeces,Sludge (20°C-30°C)	90	100	30	Many months
Composting (Anaerobic at ambient temperature)	60	60	30	Many months
Thermophillic composting 50°C-60°C maintained for days	7	7	7	7
Waste stabalizing ponds(Retention time>20 days)	20	20	20	20
* excuding Cryptosporidium parvum				
** mainly Ascaris, other parasitc eggs tend to die quicker				

Nutrient contents in urine and faeces

- For the average person, a year's worth of urine contains about 3.5 kg of nitrogen and nearly 0.5kg of phosphorus – that's enough to grow about one year's worth of food.
- Although faeces compost contains fewer nutrients than Urine, they are good soil conditioner.

Table 2 Nutrient content in Urine and Faeces

Nutrients	Nutrient content in Urine (Source:Dubey et al.,2016)		Nutrient content in (Source:ENPHO)	
	Per liter	Person/ year	Person/year (In urine)	Person/year (In Faeces)
Nitrogen	7g	3.5 kg	4 kg	130 g
Phosphorus	1g	0.5 kg	400 g	398 g
Potassium	2g	1.0 kg	1 kg	407 g
Sulphur	1g	0.5 kg	-	-
Magnessium	80 mg	40 g	-	-
Calcium	200 mg	100 g	-	-

Pathogens and recommended crops

- Should allow sufficient time for application of urine in an agricultural land.

Table 3 Possible pathogens in different time interval and recommended crops

Storage temperature (° C)	Storage time	Possible pathogens in the urine mixture after storage	Recommended crops
4	1 months	Viruses, protozoa	Food and fodder crops that are to be processed
4	6 months	Viruses	Food crops that are to be processed, fodder crops (but not grassland for the production of fodder)
20	1 months	Viruses	Food crops that are to be processed, fodder crops (but not grassland for the production of fodder)
20	6 months	Viruses	All crops (if the crops are to be consumed raw, there must be prevented at least one month before harvesting

Merits and demerits of urine as fertilizers

Table 4 Merits and demerits of using urine as fertilizer

S.N.	Merits of using urine as fertilizer	Demerits of using urine as fertilizer
1	This high nutrient, low pathogen combination means that urine can be used very easily and safely to increase the yields of food crops.	In undiluted fresh human urine, the following elements were found, nitrogen 7-9 g/L, phosphorus 0.20-0.21 g/L, potassium 0.9-1.1g/L, sulphur 0.17-0.22g/L, Calcium 13-16 mg/L and Magnesium 1.5-1.6mg/L.. Some plant micronutrients, i.e. copper, zinc, iron and boron were also found in fresh urine at levels of micrograms per liters (Source:Dubey et al.,2016).
2	May encourage income generation (improved yield and productivity of plants).	Urine is heavy and difficult to transport.
3	Reduces dependence on costly chemical fertilizers.	Smell may be offensive.
4	Low risk of pathogen transmission.	Risk of soil salinization if the soil is prone to the accumulation of salts.
5	Low costs.	Social acceptance may be low in some areas.

Major consideration

Table 5 Major Operation and maintenance consideration

S.N.	Management consideration(O & M)	Technical consideration (O & M)
1	Explain users about using the toilet.	The ash should be mixed with soil at 1:3 ratio so as to stabilize the ash.
2	Each family should collect all the ash that they produce throughout the week and sieve it to remove all the charcoal, charcoal is the main culprit in causing pipe blockages.	Anal cleansing material should be put into the faecal channel to prevent the blockages.
3	Aware visitors on its operation and maintenance.	Enough ash should sprinkled on top of the faecal matter after each visit to the toilet, care must be taken to make sure that ash does not sprinkle into the urine channel.

B. Summary of Perception, willingness and common experience in Nepal

Perception and willingness

- Research reveals positive perception and willingness towards EcoSan in respondent.

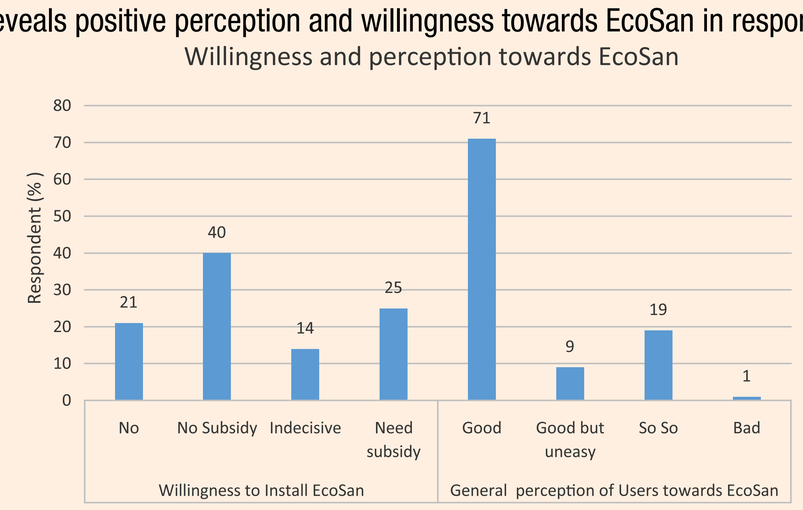

Figure 2 Willingness and perception towards EcoSan in Nepal
Source: ENPHO

Commons experience and steps

Table 6 some experiences and further needs in Nepal

Some common experience in Nepal	Further steps seemed to be taken
• Pan is not easily available on local markets. • Expensive than the ordinary type of toilets i.e. pit latrines. • Difficult to use for new users. • Problem of social acceptance in some areas.	• Awareness increment to public. • Active participation of stakeholders in construction activity. • Subsidies/ Incentives as per need. • Local technician growth. • Availability of resources in local markets.

Conclusion

EcoSan is a good option in rural areas where there is high possibility of reuse in agriculture. So innovative design for easy use, education/awareness, and promotional activities should be conducted in national and local level. Future perspectives of the ecological sanitation seemed good if and only if, the technology could be adapted/modified concerning with local scenario; for its sustainability multiple options of benefits, easy O and M should be linked with the system.