

ECOLOGICAL SANITATION PRACTICE AND TECHNOLOGY DEVELOPMENT IN SOUTHERN AFRICA AND ZIMBABWEAN CASE STUDY

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Abstract

Mvuramanzi Trust is a Zimbabwean NGO that has been making ecological sanitation trials since 1998. About four different technologies have been developed to date and are being used in a number of community trial projects. Before introducing ecological sanitation practice among communities the Trust carried out a basic base line knowledge attitude and practice survey. The survey showed that people in Zimbabwe and the region in general were using urine and faeces as fertiliser or for medicinal purposes. Trials on crops showed that urine and sanitised faecal matter are useful ingredients to plant growth and improved harvest.

After some 24 months of trials the Trust carries out a Knowledge attitudes and practice study whose objective was to establish family, knowledge, attitudes and practice on ecological sanitation toilets and management of ecological sanitation toilets in the densely populated informal settlements near Harare. Interesting findings coverings gender roles, user friendliness of the toilets, hygiene and toilet use.

Introduction

Mvuramanzi Trust has been carrying out trial on ecological sanitation from 1998. A number of technologies have been designed in collaboration with Peter Morgan to address challenging community situations. Some of the situations where ecological sanitation technologies have been found to be useful include high water table areas, rocky areas, temporal camping site and densely populated informal peri-urban situation. The Trust has also been working with communities to introduce the use of sanitised human excreta in agriculture.

The baseline KAP surveys carried out by the Trust showed that urine has been used for medicinal purpose in the treatment of ear aches, athlete feet, bed wetting. It has also been used as an important ingredient in the preparation of love portions.

During the experimental trials Mvuramanzi Trust came up with the following ecological sanitation technology designs which are being used in rural and peri-urban situations.

Compost latrine

The compost latrine consists of two vaults 1m x 1.2m x 3m long these vaults are separated by a dividing wall. The vault is fitted with an access opening through which the digested excreta can be empty. A compost toilet normally has two non- urine diverting squat or and pedestal leading to each vault. One such squat and vault is used at a time whilst the other one is closed. Organic materials such as leaves, ash, soil, saw dust and grass is added into the toilet as the people uses the toilet. Earthworms may also be added to the mix, these together with fly- maggots help to digest the matter. The contents are left for six months to mature before being used as manure.

Abhor-loo “Tree toilet”

The Abhor-loo consists of a movable bottom slab and a portable upper structure; the movable components are placed on a 70cm shallow pit lined with bricks to prevent the pit from collapsing. Users are encouraged to add ash, leaves and other organic material as they use the toilet. The mixture of soil, ash, urine and faecal matter forms a rich mix of compost. When the pit becomes $\frac{3}{4}$ full a layer of top-soil is added and a choice fruit tree is planted. The toilet is used to furnish orchards and have been used extensively to address sanitation and deforestation problems in some peri-urban informal settlements. Communities are planting bananas, guava, marlberry and mango trees.

Fossa Alterna

This operates like an Abhor-loo, it consists of movable upper structure and slab which is placed on top of 70cm pit, in the case of the Fossa Alterna twin pits are used. The materials used to make the upper structure ranges from plastic sheets, hessian and wood. The family is encouraged to add organic matter, ash and soil to the human excreta as they use the toilet. When the first pit is $\frac{3}{4}$ full it is covered top soil is added, short term plants like maize and flowers may be planted into the pit the plant roots helps in breaking down the faecal matter facilitating decomposition. The matter can be left for six months or so to allow for composting to take place, after the 6months the rich organic manure is recovered and used in agriculture.

Sky-loo Urine Diverting toilet

Sky-loo refers to a step up toilet built with a vault above the ground to minimise the possibility of ground water contamination especially in areas where the water table is very high. A wooden or brick super structure is placed on top of the vault. The faecal matter drops directly into the vault or into the plastic dish place in the vault.

The Sky-loo urine diverting toilet is fitted with a urine-separating pedestal that diverts urine and ensures that urine and faeces do not mix. The separation of urine from faeces reduces the production of odours it is said that the bad odours in a toilet are cause by the metabolic process of some bacteria in urine “bacterium urea” that feeds on organic matter and produce bad smells. The separation of urine and the addition of soil and ash accelerate drying of faeces and create an environment that hinders multiplication of pathogenic bacteria. The diverted urine go through a network of pipes into a small soak away where a tree is planted to absorb all the nitrates from the urine to prevent contamination of underground water.

Two phases of experiments were done to introduce the use of sanitised human excreta in crop production the first phase was focussing on the effects of urine concentration, application distance on growth and production. The second phase of the experiment was focussing on the use of both treated urine and faeces on production, the methodology of both experiments are detailed below:

Methodology

Phase 1

In the first phase of the experiments three farmers with urine separating toilets who were practising ecological sanitation were identified and were advised to carry out experiments in partnership with the Trust.

The three farmers were assisted to plant Maize seed, onion seedlings, tomato seedlings and giant rape-seed, were planted in three beds measuring 3m x 1m. Farmer A was advised to use a concentration of 1:2 urine: water. Farmer B was advised to apply a concentration of 1:5 and Farmer C was advised to apply a concentration of 1:10. In two of the seed beds 300ml of urine was applied to each crop the distance of application was varied from about 1cm to 90cm and this was done by drawing a diagonal across the seed which gave us more than 18 variables. The weight of the onion to which urine was used was taken and compared with an equal number of onions to which no urine was added to determine the impact of adding urine as fertiliser. At ripening the onions were sample and tested to determine the levels of residual nitrates content in the crops fertilised with urine and compared with the control crop to which no urine was used.

In the second phase land tillage was done using ox drawn ploughs to a depth of 0.15m. Twelve trench lines were made to a depth of 0.15m. visual observation showed that the soil within the experimental acreage looked similar and of the same consistence. Decomposed faecal matter mixed with ash and cleansing materials was applied to about 15m of all the six 30m length lines. Maize seed sc5001 short season type was planted on three of the six lines on which human excreta was applied to a distance of 15m and the remaining 15m was treated with compound D commercial fertiliser. Sunflowers short season type was planted on the three trenches, half of which was treated with human derived nutrients. The remaining 15m were treated with compound D fertiliser for both maize and sunflowers. Maize and sunflowers seeds from the same pecks and of similar varieties were planted in the six control lines. Water was evenly supplied by rain. 340ml of 0.3% nitrate were applied to each crop. Urine was applied to the crops when they were about six weeks old. Growth pattern and crop colour, height, plant stem thickness was used as some of the growth monitoring parameters during the crop progression period.

Methodology (Phase2) KAP studies

The evaluation methodology included the following

- Literature reviews of project documents
- Questionnaires were administered to selected households,
- Four focused group discussions were conducted
- Pocket charts and community mapping was also used.

A purposeful cluster random sampling procedure was used for the evaluation to capture attitudes of family members already using the toilet and those not using the toilet. A questionnaire was administered to households with ecological sanitation toilets and a different questionnaire was administered to households without ecological sanitation toilets (see attached annex 1). The same households were invited to attend focused group discussions. The use of questionnaires, pocket chart voting, maps and focused group discussions helped to validate findings.

Discussion, results

Effects of distance on growth

It seems maize and onions has a greater affinity for nitrates and the plants to which urine was applied at 2.5cm-10cm grew much more faster than crops at the range of 10-40 and even faster than the ones at 40cm-60cm and almost twice the growth rate of the control.

Tomatoes fertilisation at various concentration by the three farmers showed very

interesting reaction those to which urine was applied 2.5cm-15cm were grossly retarded

Whilst those at 15cm-30cm grew faster greener and healthier compared with those where urine was added at 5cm –15cm. Tomatoes are negatively sensitive to urine at 1:2, 1:5, and 1:10 concentration, application especially when they are less than 6 weeks old after six weeks they tend to be positively sensitive but those to which urine is applied at 20cm-40cm seemed to do better than at 2. 5cm-10cm. The tomatoes in the control bed however suffered poor growth than any of the plants in all the beds to which urine was being added at different concentration.

Rape is highly sensitive to the urine applied at 2.5cm-15cm distance and at a concentration of 1:2 and 1:5

Most of the plants died at the application of the second urine dose at the age of 3 weeks. The rape to which urine at 1: 10 concentration was used showed good growth. An important observation was the curving of the vegetable roots upwards where the urine was applied on to the surface, this result in a number of plants dying off within about six weeks of germination despite the water which was being added.

Effects on production

Mount-pleasant village

Crop	Tonnes		
	per Acre		
	Control	Excreta	Fertiliser
Sunflower	0	0.63	0
Maize	0	1.32	1.13

- ◆ An important point to note is that human excreta use seems to minimise nutrients loss through leaching in the event of heavy rains.
- ◆ It has been observed that crops to which commercial fertilisers were used the harvest was not as good as where human excreta was used.

Muzika primary school

Crop	Kgs per		
	Acre		
	Control	Excreta	Fertiliser
Maize	1.68	1.62	1.69

- ◆ The trials have shown that an average Zimbabwean family saves \$5000/acre by using human excreta in agriculture. The money saved would be invested in productive family economic venture with multiple opportunity benefits.

What people like/dislike about the toilets

What they like (by %)	Hatcliffe Extension	Dzivarasekwa Extension	Total for two settlements
Privacy / Convenience	80.3	60	76.5
Little labour	13.3	1.5	6.7
Ease to construct /	7.6	0	6.2

maintain			
Health	4.5	13.3	6.2
Household asset	0	6.7	1.2
Source of manure	0	6.7	1.2

76.5% of the respondents said they like the ecological sanitation toilets because they are convenient and private to the household. It is easy to supervise the use of the toilet by household members and ensure it is clean at all times. 6.7% of the people felt that there is little work involved in the maintenance of the ecological sanitation toilets. 6.7% of the people in Dzivarasekwa Extension said the toilet provided manure, and was a household asset.

In Hatcliffe extension 83.3% of the households said the toilet was all right and 60% in Dzivarasekwa Extension said the toilet was all right. However the community did not like the following on the ecological sanitation toilets:

In Hatcliffe Extension

- 7.6% said the pit was too shallow,
- 3% said rain comes in
- 3% said the toilet smells
- 1.5% said the squat hole was too big (because it was not fitted with a pedestal seat)

In Dzivarasekwa Extension

- 20% did not like carrying the faecal bucket,
- 13.3% did not like blockages of the urinary pipe,
- 6.7% said the toilets smell.

20% of people in Dzivarasekwa Extension said they did not like carrying the faecal bucket for fear of ridicule by neighbours. They said the perforations on the bucket had grown big so faecal matter drops through the perforations onto their heads and shoulders. Because they have no protective clothing, they feel it's a dirty job. Communities suggested that the faecal bucket should have a lid so that contents do not spill during transportation. Emptying faecal buckets is done at night to avoid other people noticing.

The communities in Dzivarasekwa Extension said they allow neighbours and lodgers to use the toilets. In Hatcliffe Extension 84.6% of the households said they allow lodgers to use the toilet while only 12.5% of the households in Dzivarasekwa Extension allow lodgers to use the toilet. The situation is different for neighbours. In Hatcliffe Extension 50% of the households said they allow neighbours to use the toilet while in Dzivarasekwa Extension only 13.3% said they allow neighbours to use the toilet. The table below summarises attitudes towards the use of toilets by neighbours:

Attitudes towards Sharing Ecological Sanitation Toilets

Attitude	Hatcliffe Extension	Dzivarasekwa Extension	Total sample
They mess the toilet	21.2	60.0	28.4
Good neighbourliness	0	18.5	18.5
Only when passing through	16.7	0	13.6
Should get one from the project	7.6	20	9.9
They will contaminate the environment	12.1	0	9.9
Do not want to handle other people's faeces	3	13.3	4.9

The study sought to find what the community members know about ecological sanitation toilets. The following were the findings:

- 90% of people with ecological sanitation toilets have received instructions on their care and maintenance.
- 54.3% knew how to use soil, ash or sawdust.
- 25.9% said they knew about human manure.
- 9.1% knew about alternating the pit.
- 3.7% said the pit should always be dry.
- 1.2 said deep pit toilets contaminate ground water.

The communities in Dzivarasekwa Extension felt that every household member could easily use the toilet. 92.8% of the people felt that men, women and boys could use the toilet with ease while 85.6% felt girls could use the toilet with ease and 71.4% felt the disabled could easily use the toilet. They however felt that the chamber needed modification to avoid the mixing of urine and faeces when girls are using the toilet.

Management of the toilet

The management of the toilet weighs heavily on women as the following table shows:

Gender Roles in Toilet Management

Management activity	Mother	Father	Boy	Girl	Other (employee or both)
Refills ash/ soil/ saw dust container	92.9	7.1	0	7.1	0
Cleans toilet	84	4.9	1.2	0	2.5
Puts faecal bucket in place	78.6	7.1	7.1	0	7.1
Cleans faecal bucket	78.6	7.1	7.1	0	0
Empties faecal bucket	71.5	14.3	7.1	0	7.1
Responsible for the plot / garden	64.2	18.5	1.2	3.7	3.7
Attends meetings	59.3	27.2	1.2	0	0
Contributes labour during construction	51.5	21	27	27	0
Pays for construction	42	50	3.8	0	3.8

The community said mothers are generally responsible for the family hygiene hence they do most of the maintenance work on the toilet. The health and hygiene programme should target women more than men because they handle excreta more frequently than any other member of the family do. Interestingly is the fact that mothers are responsible for cleaning and when they are away the duty falls on girl children and the fathers with boy child having the least responsibility.

Management of Excreta generated from toilets and options for re- use

While there is knowledge on the different uses of excreta, there was limited evidence of the actual use in Dzivarasekwa Extension. Some members indicated that they prefer to buy vegetables from other people but would not eat their own vegetables in which they have re-used excreta. In Hatcliffe Extension, the toilets are still new and have not yet filled up so communities have not really experienced re- using their excreta.

In Dzivarasekwa Extension, the community said they would use excreta for the following:

- Planting flowers, maize and fruit trees
- Urine is used as fertiliser

However most said they cannot use for growing vegetables as they are uncomfortable eating vegetables knowing that they were fertilised from human manure. At the moment options for disposing have been limited to throwing the faecal matter on open ground or rubbish pits. Isolated cases were reported of faecal disposal on the road or in neighbour's yard. The community noted that they have limited space for gardening so in the long run the supply would be greater than demand. Presently no one is buying the manure.

In Hatcliffe Extension there was no experience in handling (through excavating of old pits) and using through planting crops, as most pits have not yet filled up. During a voting session, women indicated that they would plant "things" or place the manure in the gardens. The feeling was that there is nothing embarrassing about handling of the faecal matter (23 women saw no problem). However two women in the group said they would not handle pit manure as it was dirty.

Some community members said they ate sweet potatoes planted where people used to dispose of their faecal matter and these did not test as good as those planted with ordinary manure. This finding is not conclusive since other factors may influence the taste. However 66.3% of the households interviewed said they put the faecal manure in their fields or gardens, 13.8% said they use it for tree planting and only 8.8 % said they throw away the manure. They throw away the manure because they either do not want to use it or they had no plot in which to apply the manure. 24 households (out of 80) were not using faecal manure for the following reasons:

- 11 said the manure was not treated.
- 6 because they had no knowledge on safe use.
- 4 said they did not want to handle faeces.
- 2 said they had no garden.
- 1 felt the manure might cause disease.

61.3% of the households said they would not use urine as a fertiliser because they said it would burn crops, 17.5% said it had a bad smell while 55% said they did not know that it could be used. 11.3% said urine is a good fertiliser and 12.5% said they would use urine because fertiliser was expensive.

The buying and selling of faecal manure is not taking place in the two settlements. Nurseries have bought manure from households. When asked if they could use manure from neighbours the response indicated that communities are uncomfortable doing that. (17 voted that they could not, 3 said they did not know while 2 said yes). However during the household interviews, 67.5% said they would sale their faecal manure. 35 households said they would sale to generate income, 24 households said they would sale if they have no need for it while 5 households said they would sale because they do not want to use it.

7.5% of the households felt it was a health hazard to buy faecal manure and 32.5% would not buy because they did not want to handle other people's faeces. However, 56.3% of the households said they would buy faecal manure from other people because:

- 23 said they would buy if they did not have enough.

- 22 households said it was good manure
- 3 households felt it was cheaper than fertiliser.

Mobilisation Strategies used in marketing ecological sanitation

The first reaction to ecological sanitation ideas was scepticism. In Hatcliffe Extension, households indicated that their initial reaction was that there would be too many holes, too many flies and high incidence of cholera. Demonstration toilets, peer education and pressure brought about attitude change. Communities indicated that demonstration creates awareness and improved understanding. Visual aids enhanced understanding. Another motivating factor was that communal toilets were unbearable to use. During the rainy season, the toilets flooded and faecal matter started flowing out of toilets. This and the education given promoted some members to try the Fossa Alterna toilet. Women in Hatcliffe Extension indicated that hygiene education is best given during weekdays.

In Dzivarasekwa Extension, the initial reaction was one of discomfort at the thought of carrying faecal matter in buckets for disposal.

The motivation for change of attitude was demonstration toilets at the school supported by booklets. The community felt that demonstration works best. 55.6% of the respondents said Mvuramanzi Trust did the mobilisation, 23.5% got the idea from other people while 6.2% got the idea from Ministry of Health staff. Community meetings provided information to 14.8% of the respondents.

In 59.3% of the cases the mothers attended meetings on ecological sanitation which explains why mothers were the first to know about ecological sanitation in 60.5% of the cases. The father attended meetings in 27.2% of the cases and male children attended in 1.2% of the cases. The girls did not attend meetings and have therefore limited knowledge on ecological sanitation.

One woman had this to say" Well I thought they were giving us these toilets because we stay in Dzivarasekwa Extension and are a forgotten community"

What was evident in both communities is that there has been sufficient marketing of the toilets to an Extension where demand has outstripped supply.

Hygiene Awareness

Priority areas for hygiene awareness were:

- Hand - washing after changing baby napkin, before handling food, after using the toilet and after greeting people.
- Personal hygiene (including washing private parts when waking up)
- Cleaning the toilet.

During the focussed group discussion, women said generally people do not practice good hygiene behaviours even when these are known. The Fossa Alterna toilet does not have hand- washing facilities making it difficult to wash after using the toilet. There was also an emphasis on body- washing.

Decision- making powers for investing in ecological sanitation

In both communities the decision to construct the toilet is usually made by women. Children who request for improved sanitary facilities also influence this decision. It is logical that women make the decisions about the toilets as they attend meetings, are inconvenienced by lack of privacy. They also manage the disposal of faeces of the

young children. However the investment into the toilet is shared among men and women depending on the breadwinner.

Lessons learnt

The ecological sanitation toilets have been well received and clearly the communities prefer them to communal toilets. However there are problems in the use of the toilets. Some households in Dzivarasekwa Extension were not using the toilet during the time of the study. They said they did not have ash or dry soil to use in the toilet. The study was undertaken during the rainy season. The following table summarises the findings:

Condition of Toilet

Observation (%)	Dzivarasekwa Extension
Clean pedestal	93.3
Back slab in position	85.7
Faecal bucket in place	64.3
Faecal bucket in use	64.3
Tight back slab	50
Solids in the chamber	21.4
Blocked pipe	14.3

To validate findings from oral discussions we administered a checklist on a sample household toilets and the following were our the results:

- In 82.5% of the toilets there was evidence of soil /ash / sawdust
- 73.8% of the toilets had soil / ash/ or sawdust containers.
- 71.3% of the containers had soil / ash / sawdust.
- 12.5% of the toilets had a bad smell.
- 12.3% of the toilets had evidence of fly breeding.

Community attitudes have been influenced by practical demonstrations at schools. Attitudes towards excreta use need to be reinforced with practical demonstrations on the safe use of human manure. Production of human manure should be matched with safe use of the manure. Currently the project has not adequately demonstrated the advantages of using human excreta. There is therefore no concerted effort to harvest and use the manure. The manure is harvested to clean the bucket or to empty the pit not for its value.

Excreta management: the project assumed that every household had a plot/ garden in which to use the manure. 10% of the households in the sample interviews did not have gardens or plots in which to apply the manure. Households with no gardens did not have alternatives but to throw the faecal manure away in the bush. The households should be encouraged to donate or sell their manure to the school or interested persons.

The project should build upon the ecological sanitation project to improve solid waste management in the two settlements. At present there is no refuse collection system. Households dump their refuse in rubbish heaps. The dumping site promoted the breeding of rodents. The abundance of rodents led to increase in snakes and fleas feeding on the rodents. People should be encouraged to separate waste and use the degradable matter in composites. This effectively reduces the amount of waste in the environment. If waste is properly managed, the rodents will be reduced because they have no food.

Contrary to popular belief the health and hygiene education encourages toilet use, in the two settlements the main reason was convenience. The health and hygiene benefits became incidental. The project has demonstrated that social reasons can promote the use of toilets. The project should now focus at other issues and not stick to health and hygiene education to promote the safe use of toilets.

User friendliness of the Urine Diversion toilet and the Fossa Alterna on gender groups.

As indicated above, the toilets offer safety and improved hygiene in particular to the vulnerable groups, the children. At the same time girls and women have benefited from privacy while the family has an enhanced social standing. However there is still need to improve the technical design of the toilet to make them women and child friendly. The urine diversion toilet is not women friendly but is men friendly. Women have problems disposing of their pads and when they visit the toilet they would like to perform all the functions there including changing pads. At the moment, they have to come out of the toilet carrying this small bundle that they dispose of elsewhere.

92.9% of the respondents felt the toilets could be easily used by boys, 85.7% by girls, 92.9% by disabled and 71.4% by disabled. The disabled and girls have a problem in using the toilet to separate urine from faeces.

The following are some of the recommendations for improvements;

- That the toilet superstructure is made bigger as it was difficult to manoeuvre one way when changing pads etc.
- That the urine pipe is made bigger as there were cases of blockages from the clotting blood.
- That there are two pits one being used for bathing where pads will be washed but still retains one superstructure.
- The urinary needs to be raised, as it is too low for women and in most cases some urine ends up in the bucket.
- Children (under five) cannot sit on the chamber as it is too big and needs to be reduced in size.

The Fossa Alterna also presents problems for women, as there are no pad disposal facilities. Communities are uncomfortable planting edible food knowing that there are sanitary pads underneath. Women were not comfortable with the idea of digging their pads from ecological toilets when the excreta is now being reused.

Some suggestions for change are:

- That the chamber be made smaller so that children may comfortably use the toilet.
- There is promotion of two pits under one superstructure so that the other pit may be used for disposing of sanitary pads.

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Introducing the author

Edward Guzha was born in Zimbabwean rural district of Marondera. He has worked with communities for more than 15 years starting with the Ministry of health and child welfare, then with World vision international and is currently working with Mvuramanzi Trust. Because of his experience with communities Edward was instrumental in introducing ecological sanitation at grass roots in Zimbabwe through cutting edge experiments, trials and pilot projects.