Human urine can be reused also in cultures with habits to wash after defecation

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ABSTRACT

Most South-Asian people have learned that the anal cleaning after defecation should be done by washing - not by wiping with paper. Therefore they would like to have at least 1-2 litres water for washing and a true dry toilet are not easily accepted in this culture. Most ideally human excreta and washing water should be flushed through a goose neck tube and a y-joint to one of two pits. When the first pit is full, the y-joint is turned to the second pit. This liquid-formic pit content is supposed to disappear during aging, since traditionally (and officially) human excreta are not utilized for plant production. In practice a part of pit content is evaporated and absorbed to earth or lead to surface water especially if there is only one pit, which may be more common in reality. Sometimes pit content is used for irrigation or fertigation, since during dry season vegetation needs fresh water besides other human needs.

Anyhow, often the availability of water is so limited that even the getting and carrying drinking water is a great effort and thus the getting water into latrine would be an overwhelming task. In this case people must use the latrine without any flush. Due to this difficulty a separating toilet has sometimes been accepted.

Plant production in home plots is important for many South-Asian people due to poverty. In addition many people would like to get extra income from their garden as well as many people would like to make their garden more attractive with flowers or to get more protection against sun and wind and privacy by trees and bushes. For these people the use of fresh urine is an alternative to get a nitrogen fertiliser free of charge and without transportation.

There are few examples how human excreta - usually urine - is used for plant production.

Still many more examples would be needed. The hygiene should be known as well as the true fertilisation value of pure human urine produced at hot climate with more vegetarian diet. Still there should be studies about the cultivation of different plants with

urine taking special care about the plant yields, their hygiene and the possible symptoms on herbivorous insects, which might benefit from high nitrogen fertilisation.

INTRODUCTION

In tropics the own gardens are economically important, but they could be economical still more important if the yields would be better. The home plots are important especially for women who are often working "only" at home and who have difficulties to find a paid work, since home garden could possible give them raw material for handicraft or it could give food stuff, so that women need not buy products which they can self produce.

The better productivity of home plots would be possible if there would be more fertilisers and irrigation water in spite that the home plot sites are often small. In tropics the cultivation is possible during all the year and the rich sunshine can guarantee an abundant growth if water or nutrients are not limiting. The easiest way to get a new fertiliser and irrigation water would be if human urine could be accepted as fertiliser and washing waters as irrigation water both free of charge and without any transportation costs.

On the coastal area strong wind, poor soil structure having low capacity to bind water and nutrients, permanent water logging and salinity can force to select plant species being resistant to these factors. These factors may be often exaggerated since there can be in the same coastal village home plots with very poor vegetation (said to be due to wind and salinity) but then there can be other home plots with rich versatile vegetation from small herbs to trees and climbing plants sometimes utilising efficiently photosynthesis surface of roofs, roads or ponds often a net spread so that the plants can grow on it. Similarly tourist beached may have some vegetation, but the home plots can be practically empty of vegetation.

The coverage of any latrine types is not perfect in poor South Asian communities, while especially women should have an own latrine in order to be able to use toilet when they need without need to think about what and when to drink and eat. A private latrine pit would be smaller, cheaper and safer for the environment if the pit would be filled only by dry faeces and possible by some harmful plant residues as those suspected to contain pests. The plain urine and washing waters would be utilised as fertigation (= combined irrigation and fertilisation) resource.

The results presented here are whose met in Women, Work, Wellbeing, Water and Sanitation Project (The European Union contract ICA 4 -CT-2002-10013). The work has been made in India and Sri Lanka in fisher village towards the Arabian Sea and in a Bangladesh village near to Bengal Bay in the Ganges delta area. In addition I will discuss about other plants what could be still cultivated with the "free" fertiliser in order to improve the environment.

SOME BACKGROUND FACTS

We can assume that most agricultural fields situating near villages, roads or harbours must have met human urine passed, because it is not uncommon to see from a car men squatting in field in order to urinate and to be partly protected by vegetation. Women are urinated often only in the darkness so they can not be seen is this activity. In spite of urine contacts there still is vegetation near the roads without any unusual symptoms. Many people must have seen in practice that human urine has not caused any harm for vegetation - at least if the amounts of urine are not very high. Thus in practice the fact that human urine is lead on the vegetation may not be so unfamiliar.

Traditionally major South Asian cultures accept that animal faeces and urine can be utilised as fertiliser but the human excreta has not been considered as a valuable resource. During our project I had an opportunity to tell in India and Bangladesh to local people and co-workers about the studies where we had compared the cucumber cultivation fertilising using either human urine or industrial mineral fertilisers and we did not find any meaningful differences in cucumbers (Heinonen-Tanski et al. 200x) as you could also expect since industrial mineral fertilisers are either nitrate or ammonium salts or urea (each approximately 1/3 of total volume) and this industrially produced urea is exactly the some molecule as is present in urine and usual industrial fertilisers are not known to cause serious problems for plant yields. In addition soil micro-organisms are known to make ureolysis, ammonification, nitrification and denitrification according the soil conditions and according to the nitrogen uptake of plants or the leaching of nitrate.

In Sri Lanka the possibility to use urine in horticulture was spoken with the Sri Lankan partner, who gradually also accepted this idea and they had a field worker who knew horticulture. This person could help the inhabitants to improve horticulture in their home plots and to protect the plants against saline winds.

Among our study areas the acceptance may have been most likely in India, where garden work seems to be a usual hobby and the people, especially the young ones, have rather good education and they get modern ideas even by radio, TV or Internet. Also the home plot gardens are economically very important in Bangladesh, due to its poverty. On the contrary only quite few people in Sri Lanka had garden, since fishing is much more important and many people (but not all) have so good income that they can buy food from shops.

NEW PRACTICES HAVE BEEN REACHED

Private yards: At the end of the project many Indian and Bangladesh home plots had more versatile and new plant species but since the vegetation was very rich already at the beginning, there were not so clear increase of vegetation - just a higher versatility in plant species. However, in Sri Lanka there was a rather high increase of vegetation in some home plots, which was not met so often at the start phase. This may be

economically rather important for these families (some of them lead by the old single women), who are not working in fishing so they might not get benefit from fishing. It has also made their environment more attractive, too.

Thus some families in India started to use urine and washing waters as a new fertigation resource for some vegetables, spices, bushes and trees. These families did not change their latrine structure but plain urine is directly passed to a bucket and then this urine is diluted with some washing water and applied already in the same day **to garden soil** (not on the plant) as split fertilization, which is usually the best way to increase yields. Thus there are no urine tanks and urine is not stored for months as recommended in many European countries. In very small plots there could be high difficulties to have and to place two expensive urine tanks and in hot climate the ammonia evaporation could be a problem and during rainy seasons there could be high possibility for the penetration of rain water to underground urine tanks. In those conditions I see that a good solution.

The families have thus got higher plant yields and this may be for them the main benefit. They have also got other benefits by the fact that the filling of latrine pit will still take a long time so the emptying work can be transferred to the future. The smaller volume of wastewater will still reduce the survival time of enteric microorganisms in soil and thus protect the well waters, which used for washings of faces, cloths, or vegetables and maybe sometimes for drinking.

In Sri Lanka a few families have build a separating latrine, because they could build only a small pit on the area where groundwater level is very close to soil surface and the sand soil structure is too weak so that sand will run down. The lining is then done from old car rollers. These families were not yet very sure which plants they would like to cultivate or which plants would grow well. The idea to get own yield was still too far for them.

School urinals: During the project urinals connected to garden banks were built in Sri Lanka and in Bangladesh. The Sri Lankan urinal was paid by Finnish project overhead money from University of Kuopio and in the Bangladesh the money came from the Netherlands from IRC.

In Sri Lanka the school with urinal tried originally to cultivate banana, papaya and coconut, which all should benefit from high fertilization level. The banana and papaya, anyhow, died and the death was said to be caused by too hot sunshine. At least papaya is known to be sensitive against water logging and the site was very close to lagoon surface. The site is now used for a new building so new plants can no more be cultivated. Coconuts have survived and after some years they are assumed to produce fruits.

In Bangladesh the school urinal feeds now many different tree species aimed for timber - one of those being neem-tree. In Bangladesh this urinal area is used as science teaching, since the local teachers are worrying about the frequent cyclones in Bangladesh and the disappearance of coastal mangrove forests (the Sundarbans

mangrove forests, which is the largest in world). The teachers know very well that the more frequent tree cultivation is one way to protect the Bengal Bay against cyclones and high tides as they told me already before the tsunami Dec, 26th, 2004. Since neem tree can be sensitive against to high calcium content of soil, it is essential that lime or ash is not used for hand washing detergent or at least it is not lead to the urinal. Thus urine can be one tool against climatic disasters.

WHAT ELSE COULD BE CULTIVATED USING HUMAN URINE AS FERTILIZATION

Personally I would be ready to use human urine for any edible plant if the edible parts develop at such height that they are not in the contact to soil, or if the edible plant is peeled or frequently boiled and if the fertilisation is done for months before harvesting which is the usual practice. The hygiene risks can be studied as well as the possible too high nitrate concentrations in edible part, if the amounts of urine would be very high. There should also be no obstacles to use urine for male plant in any species, since the male plants usually do not produce edible parts.

The other category would be the non-edible plants. This list could contain many fibre plants, construction plants or firewood trees or timber trees, from which some can be simultaneously also useful fruit trees or plants used for animal feeding or for industrial raw materials. Firewood is here locally very important since poor people can pay almost half of their income for firewood and seeking of firewood is a heavy and time-consuming work for women.

The fibre plants: cotton, ramie, jute, fibre hemp or textile hemp (the last one being a banana plant, not a true hemp) give already plenty of selection. There are also larger fibre plants such as kapok tree (called also as white cotton tree) and its botanical relative, silk cotton tree (red cotton tree) and mulberry trees. These plants are known to need high fertilisation so they could be fertilised with urine and all these trees have decorative value, too.

Light construction material plants would be f. i. rattans (canes), bamboos and oil palm, which leaves are very often used for roofing, walls or fences. On the other hand oil palm is used for animal feed and it is an industrial plant since its oils used for soaps, bio fuel or even for food industry.

The list of timber trees is so long that it cannot be here perfect. There could be many well-known tree species such as teak tree, neem tree, Indian almond, red sandalwood (rosewood), moluccean ironwood (sold in furniture industry as merbau), true mahogany or small-leafing mahogany and many others.

As presented there are many different plants that could be cultivated using human urine. The difficulty is just to select the suitable plants considering the size and situation (altitude, climate, salinity, water-saturation of soil etc.) of plot site. Still it would be important to consider the growth time needed for each plant species. The cultivation

time can be from less than one year for cotton or bamboos but it can be also many decades for mahoganies. The availability of seeds or seedlings can be the other factor that must be considered as well as the own possibilities to utilise the product as handicraft or other purposes.

LITERATURE

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