The Emerging Market of Treated Human Excreta in Ouagadougou

Linus Dagerskog
Chiaca Coulibaly
Ida Ouandaogo

Since March 2009, there has been a "human fertiliser" market in Ouagadougou, the capital of Burkina Faso. Human urine and dried faeces are collected and taken to eco-stations, where they are sold to farmers after adequate storage. In this way they increase sanitation coverage, create jobs in the private sector and provide urban farmers with complete and efficient indigenous fertilisers.

The technical, social and institutional problems around an excreta-recycling system at scale may seem daunting, especially for rapidly growing cities in the developing world. Bracken (2008) describes the massive amount of nutrients brought into cities with the food (also see the article on page 8). In a sustainable society these nutrients are recycled back to productive land. Today they often accumulate in deep-pit latrines and septic tanks with the risk of leaching to groundwater together with pathogens. No explicit price can be calculated for wasting nutrients and spreading pathogens through poor excreta management, but this approach does have dire effects in terms of soil fertility loss, increased disease burden and eutrophication. In the absence of political pressure, the market could be an important driving force for the recycling of human excreta. Especially within the context of unpredictable chemical fertiliser prices, exemplified by the price hike in 2008, treated human excreta can provide a reliable nutrient source for agriculture in and around cities.

Urban households want a toilet that is comfortable and reliable, but they have in general no interest in using the excreta as a fertiliser. This is why a collection service is needed, providing the link between households and the urban farmers. Such an integrated ecological sanitation (Ecosan) system has been set up in four sectors of the city of Ouagadougou, through the project ECOSAN_UE.

Transport of urine to the fields, Storage of urine and Urine application in Ouagadougou
Photo-: Linus Dagerskog, CREPA

The European Union financed the ECOSAN_UE project, which operated from 2006-2009 and was implemented by CREPA (Regional Center for low cost Water and Sanitation), GTZ (German Technical Cooperation) and ONEA (National Water and Sanitation Authority). The project is active in four out of Ouagadougou's thirty urban sectors, where many urban agriculture activities take place.

Three main components of the eco-sanitation chain in Ouagadougou will be discussed here, starting at the end: the **use** of treated human excreta. It will then look at the **collection and treatment**, and lastly at the **production** of human fertilisers.

Figure: The urine circuit in Ouagadougou.

Use

Even before construction of the toilets began in 2006, efforts were being made to sensitise urban farmers with respect to the value of urine as a fertiliser. This was necessary because if there was no interest in the end product, the whole chain would surely fail. The promotion was based on participative experimentation using urine as a fertiliser in each of the four sectors. The urine had been collected with mobile urinals during a film festival. In a first wave, 70 urban farmers applied urine and compared it to urea on test plots with NPK as base fertiliser (see Bonzi, 2008, for results). Yields of the plots using NPK and urine were higher. Urine was dosed based on its nitrogen content, which was around 5 g/l in Ouagadougou.

Since then, 600 urban farmers have been trained on the use of urine as a fast-acting nitrogen fertiliser, and to a certain extent also on the use of sanitised dry faeces as base fertiliser. The training is based on practical knowledge concerning soil preparation, application period, application method and

dose for different plants, and also on safety measures for the plants, farmers and consumers.

In March 2009 an evaluation workshop was held with urban farmers from the four sectors to decide on the transition from "free" human fertilisers to a fertiliser market. The price of liquid and solid fertilisers was based on the NPK content compared to the cost of an equivalent amount of nutrients as chemical fertiliser. Based on earlier calculations by Dagerskog (2007), the work of Jönsson et al. (2004), and considerations that human fertilisers contain organic material and trace elements but also demand more work both in transport and application compared to chemical fertilisers, a reasonable price was set at USD 0.20 per jerry can of hygienised urine and USD 0.10 per kg of hygienised faeces (sold in 25 and 50 kg bags).

The interest in buying Ecosan fertiliser depends largely on the price of the chemical fertilisers, but there are also convinced adopters like Mr. Dera Mouni (see Box).

Dera Mouni, urban farmer for the past 25 years

In the beginning I was a bit sceptical, but after the training first at CREPA and then here in our own fields I was convinced. The liquid fertiliser gives very good yields.

For the last crop cycle I bought the liquid fertiliser for my cabbage, but this cycle I will grow peppers as well. Peppers respond very well to liquid fertiliser. It is true that I have to invest some more when using the liquid fertiliser. For one plot of 40 m2, I usually apply manure and then 2 kg of urea. The urea costs me around USD 1. With the urine I use around 10 jerry cans, which costs me USD 2 and is also heavier to apply. In return I have fewer problems with insect attacks, and the yields have been great. What I harvest from one plot I can usually sell for USD 50.

Of the 16 farmers who participated in the fertiliser tests on this site I am the only one as far as I know who now buys the liquid fertilisers. Many farmers don't see tomorrow. In order to get them to buy liquid fertiliser, the cost has to come down a little bit more. Once they have gotten used to it, the price can be increased again! I think this system has a future, because the chemical fertilisers kill the soil in the long term, and we know that. The liquid fertiliser is new for us. Regarding the solid fertiliser (sanitised faeces) it will be easy to sell. The treated faeces looks like the manure we are used to.

Collection and treatment

In each sector a collection system managed by a local association was set up. The association collects and transports urine and dried faeces from households to eco-stations, where it is stored for further sanitation. The urine is collected in yellow containers, and stored in tanks for sanitisation. After storage it is tapped into green jerry cans, with the label "Liquid Fertiliser". The sanitised faeces are put in bags labelled "Solid Fertiliser". The associations managing the collection and treatment would ideally cover their own running costs by selling the fertilisers to farmers, as the theoretical cost/benefit analysis shows (see Box).

Cost/benefit

The income depends on the amount of urine and faeces that enters the system and is then sold to farmers. The following calculation was based on the estimation that 40 per cent of the urine and 75 per cent of the faeces produced by a household actually enters the system.

The cost for transport and treatment is about USD 2.30/household/month. A benefit could be obtained of USD 2/household/month from selling the excreta and USD 0.3/household/month from a household collection fee (the fee is USD 0.6/household/month, but the cost for collecting it is USD 0.3/household/month). The costs referred to are only operating costs for the collection and treatment. They do not include investment and depreciation costs for equipment, especially urine storage tanks. These costs need external funding.

Thus, theoretically the associations involved in collection/treatment could cover their operating costs, but this requires that the following operating criteria be fulfilled. In the actual situation, after a year of functioning, none of these criteria were completely fulfilled as of yet.

1. *Excreta volume*: At least the above estimated amount of urine and faeces per household has to enter the system. However, it takes time before the faeces from double vault toilets can enter the system, simply because the first vault is emptied after one year, at the earliest. Also, in practice, less urine from the households enters the system than was predicted. Not all the households with toilets actually use them – some toilets have been built on new lots, which are not yet inhabited; other households stopped using the toilets in anger over the collection fee. In addition, when urinating, many people find it more convenient to use the traditional shower than the toilet.
2. *Fee*: The households have to pay the collection fee. However, about 50 per cent of the households do not pay the fee.
3. *Scale*: The collection system has to operate at full capacity. However, it did not do so in all sectors of the city.
4. *Storage*: There has to be sufficient storage capacity at the eco-stations to handle the volume generated per household in the system. The present storage capacity would not be enough for the "estimated volumes" of urine at the eco-stations. Based on the estimated production of urine and

Double vault toilet with adobe brick superstructure (~340 $)
Photo: Linus Dagerskog, CREPA

A Yellow Revolution in Aguié, Niger

Linus Dagerskog (CREPA), Laurent Stravato (IFAD) and Elisabeth Kvarnström (SEI)

Human urine is collected and used as a liquid fertiliser by more than 700 households in the Aguié province in southern Niger. The "yellow revolution" was triggered in 2009 through participative tests in eight villages, demonstrating the effects of using urine as a fertiliser on cereals and vegetables.

PPILDA [1] is a USD 17.6 million rural development project in Aguié supported by IFAD [2]. One of the main activities is identifying and supporting local innovations in farming communities, often via farmer field schools. In 2007, PPILDA constructed wells around several villages to enable vegetable farming during the dry season. Organic fertilisers were used, but not enough was available to cover the needs, while the chemical fertilisers available in Aguié, mainly urea and NPK 15:15:15, are costly and of poor quality. Looking for alternatives, PPILDA contacted CREPA[3] to see how productive sanitation could improve local nutrient management. It was estimated that the annual quantity of plant nutrients in human urine and faeces produced by an average family in Aguié (9 persons) is roughly equivalent to one bag of urea (50kg) and one bag of NPK (50kg). Two such bags cost around USD 80 on the local market, which is more than most families can afford. It is also known that urine contains the majority of the nutrients leaving the human body, while rarely containing pathogens.

On this basis IFAD granted a pilot project for CREPA, PPILDA and SEI [4] to test the use of urine as a fertiliser and develop sensitisation tools, low-cost appropriate technologies and strategic documents in order to facilitate an upscaling of productive sanitation. The Aguié project promotes productive sanitation via participative agriculture experimentation, sensitisation to the dangers and resources in urine and faeces and the promotion of low-cost reuse-oriented urinals and latrines, adapted to the cultural context. For fertiliser collection, the "no-cost" Eco-lilly urinal [5], a 25-litre plastic jerry can and a funnel, is promoted together with low-cost versions of urine-diverting dehydration and composting toilets (which are subsidised with USD 45). The central message is that proper use of these urinals and latrines helps eliminate the dangers and capture the resources in urine and faeces. Thanks to good yields and good-looking vegetables, the demand has been high for urinals and toilets that make the collection of the "new fertiliser" possible.

In the future it is probable that this kind of close collaboration between sanitation and agriculture professionals will increase, since maintaining or increasing yields will demand the optimal use of all available nutrient sources. And the demand for fertilisers could in turn be the motor for sanitation in periurban and rural areas.

The Aguié project results and tools are available on www.ecosanres.org/aguie.

Notes
1) Projet de Promotion des Initiatives Locales pour le Développement à Aguié
2) International Fund for Agriculture Development
3) Centre Régional de l'Eau Potable et de l'Assainissement à faible coût
4) Stockholm Environment Institute
5) In Aguié this urinal costs USD 2-3. While urine collection is easy, the storage of large volumes is a challenge. Enriching composts and incorporating urine in the field during the dry season can be alternatives to storage.

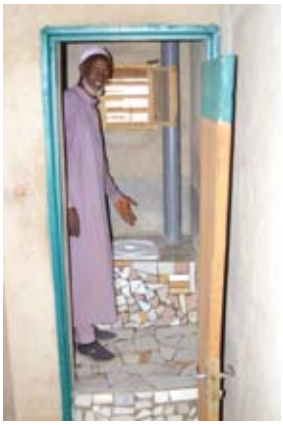
faeces, the eco-stations must be able to store 200 l of urine (45 days storage + some buffer volume) and 40 kg of faeces (three months extra storage on site + some buffer volume) per household. This could become a major obstacle in the future, as it is not clear yet who will take on the cost for increased storage volumes. The local cost of a high-quality storage tank of 1 m³ is around USD 300, corresponding to USD 60 per household.

5. *Reuse demand*: There must be a demand for all the excreta entering the system. But so far, the demand for urine has not been very high. Some farmers have bought large quantities, but the urban farmers' willingness to pay has not been up to expectations, partly because of the transporting cost from the eco-stations to the farm-site (around USD 0.05/jerry can).

Production

In Ouagadougou only 19 per cent of the population has access to improved sanitation, like connection to sewers, septic tanks or improved pit latrines. The common pit-latrines in Ouagadougou have several problems. In addition to the risks of groundwater pollution and nutrient losses from infiltration, there are also flies, odours, risk of collapse and difficulties in emptying the pits. There is not yet a system for sludge treatment in Ouagadougou, which means the sludge is informally dumped in and around the city.

To provide an alternative, the project promoted the Urine Diverting Dry Toilet (UDDT). When urine and faeces are kept separate, there are generally fewer problems with odours and flies, the treatment is relatively easy and nutrient losses are prevented. The toilets are built off ground to protect the groundwater and enhance the dehydration of the faecal matter. A range of models with single or double vaults in different materials was available for the households to choose from. In the course of the project several lessons were learned and adaptations made.



Single vault integrated into the house (variable cost)
Photo: Linus Dagerskog, CREPA

Discussion

The project has succeeded in raising awareness on urban excreta and nutrient management in Ouagadougou, and ONEA is planning to continue the toilet constructions in the four pilot sectors. If the collection system continues to grow, it will be necessary to know how much excreta urban farmers potentially can use. Sawadogo (2008) therefore made an inventory of urban farming within Ouagadougou city limits and found in total 201 hectares, 93 per cent of which is dedicated to vegetable farming and 7 percent to horticulture. However, he also found that more than 75 per cent of the urban farmers do not have rights to the land they farm. These urban farmers would only have use for a small part of all the excreta produced in Ouagadougou (less than 5 per cent). The rest would need to be transported to agricultural land outside the city.

This means that, if the authorities decide to adopt ECOSAN on a large scale, agricultural production using sanitised excreta needs to be made a priority in and around the city to avoid high transportation costs. In the case of Ouagadougou, the scarcity of water during the dry period will limit the expansion of urban vegetable farming in the city. Water saving technologies, such as drip irrigation, and the potential of greywater recycling can be explored. It is, however, clear that a large part needs to be applied in rain-fed cereal production.

A related problem is the storage of large volumes of urine until the time of application in the rainy period. All together the population of Ouagadougou generates around 525,000 m3 of urine per year, amounting to 1.2 l of urine per person per day! Simple methods of reducing the volume of urine without losing nitrogen would be of great value. The alternative to storage could be to apply the urine to the land during the dry period, or use it as a nitrogen source for composting.

As it stands now, external funding is necessary to support part of the operating costs of the associations. From 2010, the municipality will take over the coordination and financial support of the system. Instead of paying the associations directly, the subsidy might be more efficient if targeted to the end of the chain, linking it to each jerry can or bag of fertiliser sold and applied in farming. The incentive to sell the fertilisers would then become even greater, and the associations would be stimulated to improve their marketing. It will also be important to have a municipal strategy for what to do when demand does not meet supply, and how to use the excreta elsewhere.

The EcoSan circuit painted on the entry door to the ecostation
Photo: Linus Dagerskog, CREPA

A woman from Saja Manja applying the liquid fertilizer
Photo's: Linus Dagerskog, CREPA

The new Ecosan system in Ouagadougou is by no means ideal, but it has taken some innovative steps in urban nutrient management. The experiences show that the operating costs of collection and treatment can almost be recovered by the sale of treated excreta, if the distances to be covered are relatively short. Public funding is needed for investments in and control of the system, and to a certain extent for running costs, at least in the short term. It is always difficult to mobilise scarce public funds, but if the gain in health and environmental protection could be evaluated in addition to the mentioned agricultural benefits, it would probably prove to be an economically sound public investment.

Linus Dagerskog
Linus Dagerskog, Stockholm Environmental Institute (SEI).
E-mail: linusdagerskog@yahoo.fr
Chiaca Coulibaly and Ida Ouandaogo
CREPA, Burkina Faso.

References

Bonzi, Moussa, 2008, "Experiences and opportunities for human excreta fertilisers in improving small scale agriculture", presentation during side event of the World Water Week, Stockholm, Sweden, www.ecosanres.org/pdf_files/www2008/Dr_Bonzi_14.pdf

Bracken, Patrick; Panesar, Arne, 2008, "Ecosan in poor urban areas, sustaining sanitation and food security", IRC conference: Sanitation for the urban poor: Partnerships and Governance", 19-21 Nov, 2008, Delft, the Netherlands http://www.irc.nl/redir/content/download/140068/433182/file/GTZ-bracken-panesar-IRC-final-version%2028.doc

Dagerskog, Linus, 2007, "ECOSAN et la valeur des fertilisants humains - le cas du Burkina Faso", ITN conference paper, Ouagadougou, Burkina Faso, 26-28 Nov 2007

Jönsson, Håkan et al. 2004, "Guidelines on the use of Urine and Faeces in Crop Production", EcoSanRes publication series, report 2004-2, http://www.ecosanres.org/pdf_files/ESR_Publications_2004/ESR2web.pdf

Sawadogo, Sawadogo Hamadé, 2008, "Approche GIRE et expansion de l'agriculture urbaine à Ouagadougou", Master's Thesis, 2iE, Ouagadougou

WSP, 2009, "Study for financial and economic Analysis of Ecological Sanitation in Sub Saharan Africa", www.wsp.org/UserFiles/file/Ecosan_Report.pdf