Guidelines on the Use of Urine and Faeces in Crop Production *

Ecological sanitation

Ecological sanitation [ecosan] is aimed at safely closing the nutrient and water cycles. Nutrients from human excreta should be returned to the soil to fertilize crops. Safe processing of the urine and faeces into fertilizer is described in EcoSanRes Fact Sheet 5. Keeping urine and faeces separated at the source simplifies safe processing and handling of excreta.

Ecosanitation and agriculture

In order to ensure sustained soil fertility and ample harvests, the soil in the cultivation fields needs to be replenished with nutrients and soil-improving material. There are several ways to add nutrients to the soil and to increase its water-holding and buffering capacities. In large-scale commercial agriculture this is mainly achieved by the application of commercial fertilizers. Alternative approaches include crop rotation, slash and burn techniques and the reuse of nutrients and soil-improving products from decomposed plants, animal manure and human excreta.

Human food contains considerable amounts of nutrients originating from plants. Only minute amounts of the plant nutrients are absorbed by and retained in the growing human body – the remainder leaving the body as excreta.

The products of ecological sanitation, urine and faeces, are in many ways well suited for use as fertilizers. They contain all nutrients essential for crops. The fertilizing effect of urine, just as that of chemical fertilizers, is greater if the soil contains at least some organic matter. Urine is nutrient-rich and faeces are high in organic matter content. They should be used in combination with each other, though preferably not at the same time.

Sanitizing human excreta

Human faeces contain bacteria, viruses and other pathogens and can be harmful to humans and the environment. However, by handling them according to the hygiene guidelines, the risks associated with reuse of excreta are minimized.

Maize trials using urine as a fertilizer. Urine treatments of 750 ml and 1750 ml. Growth period 3.25 months. Zimbabwe. (Source: Aquamor)

Urine. The urine fraction is normally free from pathogens when leaving the body. However, urine can be contaminated by faeces. Hygiene recommendations state that urine collected from different households should be stored for between one and six months, depending on the crop to be fertilized and the storage temperature, before application. When single households use their own urine as a fertilizer, there is no need for storage prior to application. In both cases, the last application should be made at least one month prior to harvesting.

Faeces. The faecal fraction of excreta must always be sanitized before use as a fertilizer, to prevent transmission of disease. Guidelines on how to sanitize faecal matter are found in Schönning and Stenström (2004), or EcoSanRes Fact Sheet 5.

Household application of urine

Fertilizing with urine

Urine is a high quality, low-cost alternative to commercial fertilizers. It is especially rich in nitrogen and also contains substantial amounts of phosphorus and potassium. The fertilizing effect is rapid and the nutrients are best utilized if the urine is applied prior to sowing and up until two-thirds of the period between sowing and harvest. It can be applied pure or diluted. To avoid odour, foliar burns and the loss of ammonia, the urine should be applied close to the soil and incorporated into the soil as soon as possible.

Application rates for urine

Urine is a by-product from the body's function of balancing liquid and salts, and the amount of urine therefore varies with time, person and circumstances. The average person produces about 500 litres of urine per year. However, urine volume is not a good indication of nutrient content. It is better to calculate the application rates based on the amount of urine produced per person per day.

If available, local recommendations for commercial mineral fertilizers, urea or ammonium, can be translated to the use of

** Based on Jönsson, H. et al. 2004. Guidelines on the Use of Urine and Faeces in Crop Production. EcoSanRes Publication Series. Report 2004-2. Stockholm Environment Institute; Stockholm, Sweden. Available from ecosanres.org*

Urine application before sowing on a large scale (SLU, Sweden)

urine. The nitrogen (N) concentration of urine should be analysed. Otherwise it can be estimated at 3-7 g N per litre. If no local recommendations can be obtained, a general rule of thumb is to apply the urine produced by one person during one day (24 hours) to one square metre of land per growing season (crop). The urine from one person will thus be enough to fertilize 300-400 m^2 of crop per year and even up to 600 m^2, if dosed to replace the phosphorus removed by the crop.

For most crops, the maximum application rate before risking toxic effects is at least four times the dose above.

Fertilizing with faeces

The total amount of nutrients excreted with faeces is lower than with urine, and the nutrients are not as easily accessible for plants. However, faeces are concentrated and rich in phosphorous, potassium and organic matter.

Sanitized faeces should be applied prior to planting or sowing as the high phosphorus content is beneficial for root formation of young plants. The faecal matter should be within reach of the plant roots but it should not be the only growing medium. The faeces should be thoroughly mixed in and covered by soil before cultivation starts. If there is a limited amount of faeces fertilizer, it can be applied in holes or furrows close to the planned plants to capitalize on this valuable asset.

Application rates for faeces

The application rate of faeces can be based on local recommendations for the use of phosphorus-based fertilizers and analysis of the phosphorus content of the faecal product. This gives a rather low application rate, and the improvement of the crop due to the added organic matter is hard to distinguish. However, faeces are often applied at much higher rates, at which the structure and water-holding capacity of the soil are also visibly improved. Organic matter and ash are often added to the faeces during collection and processing. These additions will improve the buffering capacity and the pH of the soil, which is especially important on soils with low pH.

The average person produces around 50 litres of faeces each year. This amount of faeces will fertilize 1.5 – 3.0 m^2 of crop if the application is made according to organic content. If application is instead based on phosphorus content, it will be enough to fertilize 200-300 m^2.

Local adaptations and knowledge gaps

These guidelines should be adapted to local conditions. Agricultural systems vary, as does human behaviour in different cultures.

There is a lack of documented research in the area of using urine and faeces as fertilizer. However, these products have been used in agriculture since ancient times, and there is considerable undocumented knowledge based upon practise.

Estimated excretion of nutrients per capita in different countries (from Jönsson & Vinnerås, 2004)

Country		Nitrogen kg/cap, yr	Phosphorus kg/cap, yr
China	total	4.0	0.6
	urine	3.5	0.4
	faeces	0.5	0.2
Haiti	total	2.1	0.3
	urine	1.9	0.2
	faeces	0.3	0.1
India	total	2.7	0.4
	urine	2.3	0.3
	faeces	0.3	0.1
South Africa	total	3.4	0.5
	urine	3.0	0.3
	faeces	0.4	0.2
Uganda	total	2.5	0.4
	urine	2.2	0.3
	faeces	0.3	0.1

More information would be useful, especially in the following areas:

- nutrient effects of excreta on crops and soil
- application techniques
- efficiency of storage of urine in soil
- simple and resource-efficient sanitation techniques for faeces.

References

Jönsson, H., Richert Stintzing, A., Vinnerås, B. and Salomon, E. 2004. Guidelines on the Use of Urine and Faeces in Crop Production. EcoSanRes Publication Series. Report 2004-2. Stockholm Environment Institute: Stockholm, Sweden. Available from www.ecosanres.org

Jönsson, H. and Vinnerås, B. 2004. Adapting the nutrient content of urine and faeces in different countries using FAO and Swedish data. In: Ecosan – Closing the loop. Proc. 2nd Intern. Symp. Ecological Sanitation, April 2003, Lübeck, Germany. p 623-626. (www2.gtz.de/ecosan/ download/ecosan-Symposium-Luebeck-session-f.pdf)

Schönning, C. and Stenström, T.A. 2004. Guidelines for the Safe Use of Urine and Faeces in Ecological Sanitation Systems. EcoSanRes Publication Series. Report 2004-1. Stockholm Environment Institute: Stockholm, Sweden

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