



Reuse of human and animal wastes in Bangladesh

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THE INDISCRIMINATE DISPOSAL of human and animal wastes into living environment causes diseases and squanders valuable nutrients which could otherwise augment the production of food. Hanumanulu (1978) pointed out that in India the gap between food production and need could be reduced considerably by properly treating and recycling nutrients in human excreta. According to Rao (1977) it is ecologically expedient to recycle nutrients from renewable sources rather than to rely on nonrenewable sources to produce chemical fertilizer. The conventional sewerage system, which is also not common in developing world, do not remove nutrient efficiently (Tortell, 1979 and Mara and Pearson, 1986) and thus the disposal wastes from this systems into living environment creates serious health hazards for the population who use open water sources for their household and other purposes including eutrophication of water bodies. Thus alternative waste treatment methods are needed to recycle nutrients from human and animal wastes into useful foods and to safeguard overall environmental degradation. Reuse of human and animal wastes in aquaculture can produce significant benefit by providing valuable nutrients. The cultivation of duckweed, as practiced in few places of Bangladesh, appears to be a very appropriate form of reuse of human waste. Again, the use of anaerobic digestive method for the treatment of human and animal wastes generates biogas (a mixture of methane and carbon dioxide), and preserves the nutrients which are recycled back to the agricultural land in the form of slurry. Therefore, this action research evaluate the cost-effectiveness and performance of the proposed technological option as practiced in Bangladesh. An attempt is also made to highlight the potential of the excreta reuse technologies in the Bangladesh context, and to identify the problems and research needs in this prospective field.

Human wastes

About 33 per cent of rural households in Bangladesh have access to the low-cost sanitation system in mid 1993 as revealed by a rapid assessment survey by UNICEF and DPHE (1994a). It is estimated that about 2×10^4 metric tons of fecal matter is deposited in the public domain every day (UNICEF and DPHE, 1994b). Only 15 per cent of Dhaka (the capital) city's population is served by conventional waterborne sewerage system. All other cities in Bangladesh mainly have septic tank system and with some coverage by pour flush pit latrines or bucket latrines. About 30 per cent of Dhaka city's population, 49 per cent of Chittagong city's population and 36 per cent of Divisional/ District town's

population are served by an unsanitary system consisting of kutchra latrines or open defecation directly into the living environment. Therefore, the present sanitation practice for human waste management require special attention to improve the situation.

Animal wastes

Traditionally, animal dung is generated in rural and semi urban areas in Bangladesh and are used as fuel and/ or soil conditioner. Excess animal dung, which is not being used as fuel is dumped on selected sites and after long time these decomposed wastes are used by farmers for soil manuring (or conditioning) purpose. The combustion of animal dung causes severe ecological imbalance due to loss of nutrients and serious indoor air pollution.

General discussion

The reuse of human waste in aquaculture is an age-old practice, particularly in Asia, and there are also commercially operational system in Europe. At present, there is an unintentional reuse of excreta in aquaculture in Bangladesh. During monsoon period, the unsanitary latrines constructed in ditches behind houses, or pour flush pit latrines are flooded with water and the wastewater remain either in these ditches, or in low-lying areas. The fish entered these ditches or low-lying areas are benefited from this wastewater. Although the consumers are generally reluctant to accept these fish from such ditches, but they would be unaware of the origin of such fish if these fishes are sold on markets. The use of such fresh sewage is not recommended for aquaculture by WHO because of potential danger to public health. However, the scheme, presented in Fig. 1 for the reuse of human and animal wastes in aquaculture and agriculture, can improve the situation, and minimizes the risk to public health. These treatment options require minimum operational and maintenance skills and energy. And thus appears to be the appropriate low-cost sanitation technologies for those who can not afford expensive and conventional waterborne sewerage system, and wastewater treatment plants. Edward (1992) pointed out that the wastewater reuse should be promoted as a well-defined system with recognizable boundary so that it can be managed and controlled, from both production and public health point of view, without harming the environment. The cultivation of duckweed, as presently being practiced in few places of Bangladesh, appears to be an appropriate form of reuse of human wastes. The basic mechanism employed in duckweed based wastewater treat-

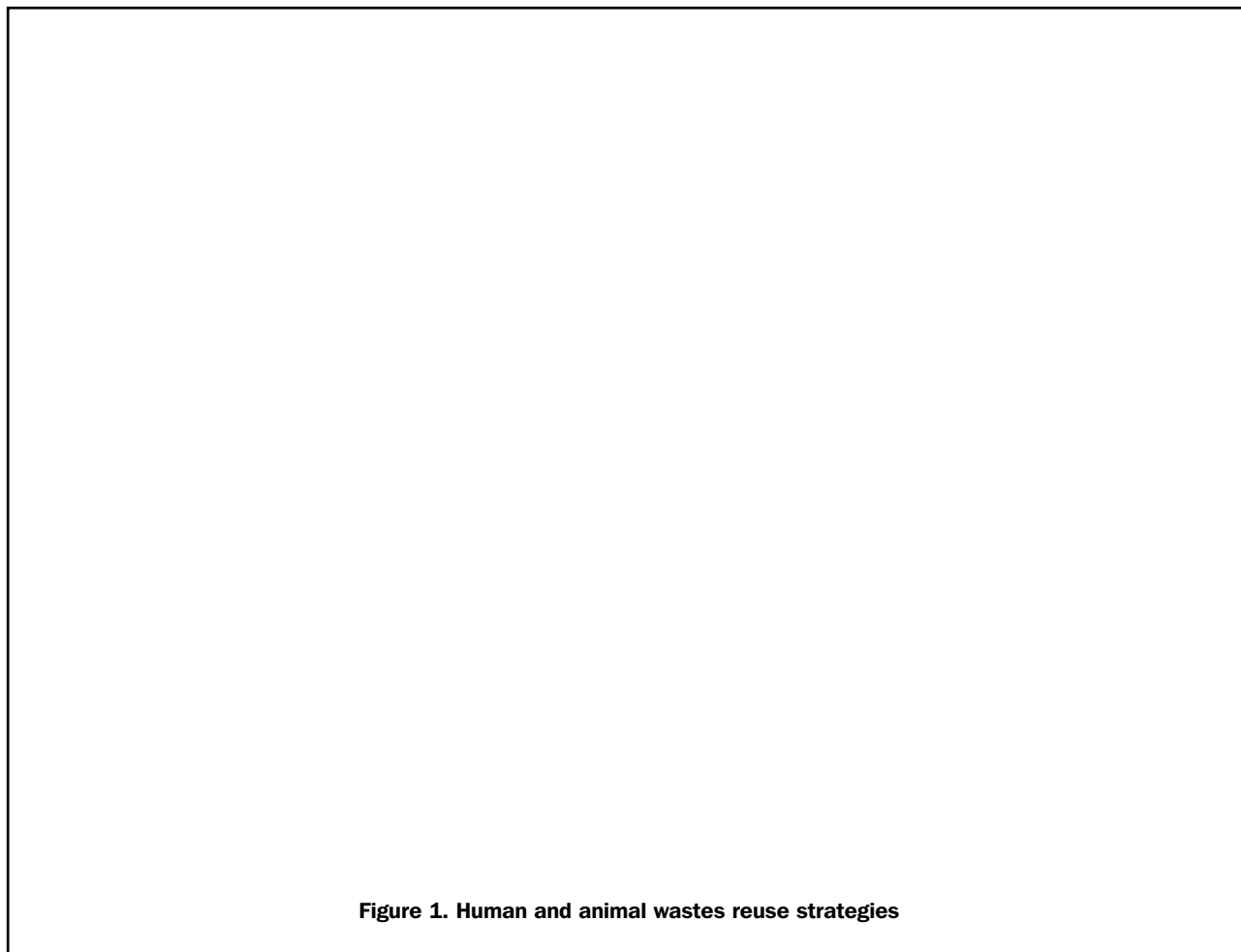


Figure 1. Human and animal wastes reuse strategies

ment system is to farm various duckweed (lemna, spirodela, and wolffia). These are rapidly growing plants with high protein content and used for fish feed, or animal feed (Fig. 1). This will also be an attractive option for societies in which direct reuse of excreta is socially unacceptable. Again, the implementation of biogas technology would be one of the best methods of sanitary practices and will improve fuel efficiency in rural and semi urban areas. This minimizes the traditional use of animal dung as fuel which is not only hazardous to health but is also a most inefficient way of using them as energy. At present about 150 fixed dome Chines-type, and about 80 floating dome Indian-type biogas plants are operating in Bangladesh. The raw materials used in those biogas plants are human and animal excreta. The estimated potential for generation of biogas in Bangladesh as shown in Table 1 indicates that the best possible utilization of human and animal wastes through biogas generation can supply clean energy to cook three meals for a population of about 7.3×10^7 , which is about 63 per cent of the total population of Bangladesh. The daily fertilizer contribution would be equivalent to 2,665 tonnes of urea, 6,725 tonnes of superphosphate and 1,225 tonnes of muriate of potash. In the anaerobic fermentation process, various kind of nutrient contents basically remain in residue except that such elements as

carbon, hydrogen, and oxygen decompose stepwise and finally transform into methane and carbon dioxide. Some water soluble remain in digested slurry while some insoluble organic or inorganic solids in digested residue, whose surface adsorb a great amount of effective nutrients. As a result, the nutrient of biogas fertilizer are higher than those of the compost and the manure as produced from animal dung in open dump. Most of the water related disease-causing microorganisms come from animal or human excreta, basically faeces, and occasionally urine. During digestion inside a digester, majority of the harmful microbes present in the feed stocks (excreta/ urine) are inactivated, and killed and at the same time the waste is stabilized to a significant extent (Rahman, 1996). It has been reported that the principal organisms killed in biogas plants are typhoid, paratyphoid, cholera and dysentery (in one or two weeks), hookworm and bilharzia (in three weeks) (Sasse, 1988). Feachem (1979) reported that average virus removal was about 90 per cent at a digestion temper of 35°C at twenty days' retention time. It can be concluded that a great reduction of pathogens occurs in the biogas generation process but in the case of high concentrations of pathogens in the excreta of infected persons or animals, this reduction does not lead to a pathogens-free effluent (Rahman, 1996). However, complete removal of pathogen is possible with

further treatment of digested slurry. The most common treatment methods are:

- drying,
- composting
- composting with additional chemicals.

Thus the biogas technology has a great potential of supplying nutrients, mitigating several problems related to ecological imbalance, minimize crucial fuel demand, improve hygiene and health conditions. The relevance of biogas technology, in relation to sewage treatment as an alternative to the septic tank system, as initiated to practice in Bangladesh, lies in the fact that it makes the best possible utilization of human waste (which have no economic value at the present moment) as a renewable source of clean energy and supply nutrients. It is evident from the cost-benefit analysis of about 25 properly maintained biogas plants that the payback period of these biogas plants ranges between 1 to 5 years (Rahman, 1998). The study of the performance of operating biogas plants indicates that different implementing authorities in Bangladesh are mainly active in promoting waste reuse technologies, without proper attention to research and development to renovate and optimize the design by suiting them to the local condition. The different implementing authorities in Bangladesh have limited research and development capabilities and there is a limited coordination among the researchers and implementing authorities. There is also a very limited follow-up action program. Therefore, coordinated effort should be given to research on nutrient recycling by the scheme proposed in Fig. 1 to provide improve design guideline for their effective use, and to disseminate resource recovery information.

Conclusion

Planned use of human and animal wastes (i.e. cultivation of duckweed, or the introduction of biogas technologies prior to agriculture or fish culture for human consumption), as presented in Fig. 1 appears to be an environmentally sound protective measure for proper management of these wastes in developing countries in general, and Bangladesh in particular. However, present experience to implementing human and animal wastes reuse technologies in Bangladesh indicates that there is an urgent need to develop an indigenous technical expertise, together with strong national coordination among different implementing authorities, and research institutions to provide improved design guideline for their effective use, and to disseminate resource recovery information in a meaningful way.

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Table 1. Potential of biogas generation in Bangladesh

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