

Study on the Reuse of Human Excreta in Bangladesh



By
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Reviewed and supported by Jo Smet (IRC) and Laurent Stravato (IRC)

February 2006



Abstract

In order to have a better knowledge about the reuse of human excreta in Bangladesh this particular study has been carried out in Bagerhat, Faridpur, and Rajshahi districts.

Initially, available literature was reviewed and later, empirical observations in the given areas have been carried out in February and August 2005. Basic techniques of observation were in-depth interview, key informant interview, group discussion, transect walk, direct observation of the ways, systems and purposes of reuse of human excreta.

The study has revealed that human excreta is used (a) as fertilizer for production of plants particularly by (a.1.) sowing of plants on 'saturated' latrine pit, (a.2.) by mixing human excreta with poultry, animal and other organic solid waste, including sludge of Bio-gas, (a.3.) by using wastewater for agriculture and aquaculture, and (b) for the reproduction of alternative energy through bio-gas plant.

A reasonable number of cases of reuse of human excreta in agricultural product appeared to be informal and are based on individual initiatives, while biogas plants are the outcome of planned intervention of the government and NGOs under specific projects. The bio-gas plant technology is costly and so is beyond the affordability of the poor.

The study has also found that in reusing human excreta both in agriculture and production of bio-gas some fundamental questions need to be addressed in the context of Bangladesh such as sludge disposal, aspects of environmental pollution, health risks, and agricultural products

It was found that people re-using excreta are Muslim, Hindu and Christian by religious affiliation, though literatures suggests that the Islam discourages contact with human excreta. Reasons for reusing excreta are reported and found to be tradition, indigenous knowledge and financial benefits.

In the background of these findings, it is expected that the reuse of human excreta is implemented from the perspective of environmental sanitation. In this process of re-use the key focus should be on 'adoption of scientific procedures' in preparing compost and its safe utilization. Such safe and hygienic behaviour and handling would promote health and well-being of the population. Institutions engaged in promoting hygiene and sanitation should incorporate reuse of human excreta into their programme.

Given the development situation in Bangladesh, it is expected that the Government, Non-Government Organizations including private institutions be intensively involved in reuse of human excreta in agriculture (through composting processes) and for biogas production. The government should adopt a policy for reuse of human excreta, allocate budgets to develop affordable and appropriate technologies, provide subsidies to the poorest, while the NGOs may raise awareness for safe and effective utilization of excreta, provide training to users, caretakers, and private producers, conduct advocacy at national and local level, monitor and facilitate field level operations, and carry out action research to ensure the effectiveness of technologies and approaches in accordance with socio-economic and environmental context.

When simple and affordable designs in EcoSan toilets, composting systems and biogas plants are developed and the community may be willing to be involved in the reuse of human excreta, the private sector could be engaged in ensuring the availability of hardware materials and the building skills in the localities.

1. Introduction

Bangladesh has made a significant increase in latrine coverage during last ten years¹ but this progress has not addressed the concern of the total management of environmental sanitation. The management of disposal, treatment, and reuse of human excreta, solid waste, and wastewater have not received adequate attention.

Bangladesh produces annually 17 million metric tons of human faeces and 57 million metric tons of urine². Major portion of these excreta are deposited in the water bodies and in open places, so polluting the water sources, ground water and the environment in general. As a result, a large number of inhabitants of Bangladesh suffer from sanitation-related and water-borne diseases and other health problem caused by poor sanitation practices. *Progotir Pathay report* (2003) indicates that 25% children of the age below five suffer from diarrhoea³ and in 1996 about 110,000 children died of diseases caused by poor sanitation and contaminated water use⁴.

In this context, the proper management and reuse of human excreta (human faeces and urine) could ensure not only the improvement of the environmental conditions in human settlements but also promote the economic and social well-being and health of the population if reuse is safely practised.

Human excreta can be used for generating energy and as fertiliser for agriculture and aquaculture. Therefore, reuse of human excreta would make significant contribution in safeguarding environmental degradation, eradicating poverty and developing rural areas of Bangladesh.

As there is a lack of access to conventional fuels (gas, oil and coal) people of rural areas in Bangladesh are using biomass as a resource for fuel beyond the acceptable limit to meet their household energy need.

In Bangladesh, about 62% of the total national energy requirement is met by biomass fuels. Annually, 40 million tons of biomass fuel, particularly, firewood, agricultural residues, leaves, cattle dung, straw, rice husk are being used as source of energy.⁵

Biomass fuel is mainly used in the rural areas. About 83% of rural households depend on biomass fuel for cooking.⁶ As half of the household income of nearly 50% of the rural households would have to be spent on fuel, women are involved for a long period of time in gathering lower grade biomass fuels from agricultural and animal residues to reduce fuel-related expenditure.

The use of given biomass as fuel is creating environmental degradation in an alarming magnitude. For example, the process of organic recycling of the soil is affected severely by the decrease of microbial

Benefit of reuse of excreta

Excreta fertilizing potential of a family of 5 adults

Excreta are to be valued both because of their nutrient content and soil-conditioning and humus-building potential. Based on a daily excreta production of 110g/person a family of 5 adults produces enough excreta equivalents theoretically produce adequate nitrogen and phosphorus to cultivate a rice plot ranging between 40X40 m and 40X50 m in size. (Strauss, 2002, p-22)

Benefit in use of excreta for aquaculture:

Fish cultured in excreta reuse systems are of high quality and are equal or even superior in taste and odour to fish cultivated in other ways. Fish cultured in ponds manured on high-protein natural food and were much leaner, only 6 percent fat compared to fish raised on high-protein feed pellets and gain with 15 percent and 20 percent fat respectively. (Peter Edwards, 1992, p-272)

Potential of biogas from human waste in Bangladesh:

| Feed materials | Total population (x10 ⁷ nos) | Waste disposal rate (kg/head/day) | Gas production rate (m ³ /kg) | Amount of Gas (x10 ⁶ , m ³ /day) |
|----------------|---|-----------------------------------|--|--|
| Human excreta | 11.50 | 0.40 | 0.07 | 3.22 |
| Cattle dung | 2.42 | 11.50 | 0.03 | 8.35 |
| Poultry manure | 13.79 | 0.18 | 0.06 | 1.49 |

Source: MH Rahman, MA Mottalin and MH Bhuiyan, "A study on Biogas technology in Bangladesh, 22 WEDC Conference, 1996, New Delhi, p-340

population and the fertility of the soil. Therefore to improve the efficiency of their agricultural production, farmers are using increased doses of chemical fertiliser. To develop productive harvest, soil must contain at least 3% of organic compound which has come down to less than 1% presently due to gathering of lower grade biomass. This situation is not sustainable for agriculture. Cutting trees to meet the fuel requirement is leading to further environmental degradation as forest areas have been reduced to less than 9% in Bangladesh. The use of lower grade biomass fuel by the rural poor is exposing women to smoke that can cause acute respiratory infections, chronic obstructive lung diseases, low birth weight, lung cancers, and eyes problems.⁷ Given this background, reuse of human and animal excreta can be an alternative source of energy and fertiliser could greatly contribute to the solutions of these problems.

Therefore, reuse of human excreta using safe environmental sanitation approaches would not only improve the health of the people, but also to reduce the problem of accessibility of safe drinking water and sanitation, alleviate poverty, improve rural economy, relief women from physical hazards and safeguard environment in general.

Nevertheless, for reusing of human excreta, it is imperative to follow scientific procedures as it contains pathogens particularly bacteria, viruses, protozoa, and the helminths, which may cause serious health problems if human excreta are not properly treated.

Health Risk related to reuse of Human excreta:

Agriculture:

The main health risks of workers who use excreta related waste for fertilisation or irrigation are faecal-oral infections and soil-transmitted helminths. Where workers come in contact with contaminated surface water, schistosomiasis could also be a problem. Consumers of the crops are at risk of faecal-oral infections and ingested soil-transmitted helminths. (Eric Rottier & Margaret Ince, 2003 p-85)

The health risks of using untreated excreta-related wastes for fertiliser should be reduced by minimising the contact between crops and pollution as much as possible (e.g. through subsurface irrigation). Excreta-related wastes should only be applied before the crops are planted or up to one month before the crops are harvested.

Aquaculture:

Non-bacterial faecal-oral infections, bacterial faecal-oral infections, water-based helminths, and excreta-related insect vectors categories need to be considered as potential sources of infection in excreta-fed aquaculture systems. The intestinal bacteria and viruses of warm-blooded animals do not cause diseases in fish but they may be passively transferred to humans by fish raised in excreta-fed systems. Water-based helminths parasitic to humans may be transmitted by fish which act as worm intermediate hosts, for instance liver flukes. Schistosomiasis, a disease caused by the water-based helminth *Schistosoma* has a snail intermediate host, and may also be spreading through excreta-fed ponds. There does not appear to be much risk from the breeding of insect vectors in well-managed excreta-fed ponds. (Peter Edwards, 1992, p-268)

Avoidance of using fresh excreta for aquaculture, eating well-cooked fish, snail control, depuration (Fish kept in clean water for a period, prior to harvest) of fish reduces these health risks.

Biogas:

Handling excreta and removing regularly the sludge from a biogas plant which could be a health risk. The sludge could be heavily contaminated with pathogens and should be handled and disposed with the same care as fresh excreta. (Eric Rottier & Margaret Ince, 2003 p-86)

2. Literature Review

In order to have an understanding about the practices related to reuse of human excreta in Bangladesh, a study has been carried out in February and August 2005. Before conduction of empirical observation, a search of literature has been carried out and relevant literature been reviewed. The review of the literature has found that documentation about the reuse of human excreta in Bangladesh is scanty. Only a few

documents are available which are basically about the initiatives taken by agencies in developing bio-gas plants under specific projects.

Current practices

A survey in the late 1980s had opined about unintentional excreta reuse in Bangladesh. Latrines constructed in ditches behind houses remained almost dry in the summer but filled with flood water during the monsoon. Fish that entered the ditches with floodwater benefited from the eutrophic water, and night soil from the latrines continued to feed fish that grew in the ditches. Fish was harvested towards the end of the monsoon season when the water level had dropped. Consumers were generally reluctant to accept fish harvested in such ditches, however they were unaware of the origin of such fish when the product was bought in the market. (UNDP, 1992).⁸ ' In the last few years, national newspapers of Bangladesh reported about intentional fish farming by using sewage water. Newspapers reported that people are practising large-scale fish cultivation in the lagoon of the sewage treatment plant in Dhaka.⁹ A recent city survey on wastewater irrigation also reported about this practice (Dr Avizit Reaz Quazi, 2005) ¹⁰

Religious issues

Some literature highlighted difficulties related to the reuse of excreta in Muslim society. They argued that the Islamic culture professes the avoidance of all contact with human excreta. Excreta and urine, along with semen, corpses and other specified substances are regarded as spiritual pollutants. Quranic edict and Islamic custom demands that Muslims minimise contact with these substances (Martin Strauss, 2002)¹¹. It was also reported that people of Bangladesh, who are predominately Muslims, are reluctant to accept fish harvested in ditches fertilized with excreta. However, it was also quoted that the reuse of treated sewage effluent seems to be perfectly legitimate from the Islamic points of view. The Eminent Scholars of Saudi Arabia expressed unanimous approval of reuse of treated wastewater effluents for all purposes including religious washing (UNDP, 1992)¹².

The reluctant attitude of the people of Bangladesh in reusing human excreta was also mentioned in a study conducted in 2002. According to the document, people kept silent when the possibility of reuse of human excreta was discussed, they evinced discomfort with the whole idea through their gesture. Many respondents strongly opposed the whole idea. Even those who have a two-pit latrine showed reservation and argued that they are not using two-pits latrine for composting purposes but to increase the longevity of the latrine. Only a small number of respondents said with some hesitation that human excreta can be used as manure if full composting is ensured (Avizit Reaz Quazi, 2003).¹³

However, this hesitation is not general. An earlier-conducted study provides a different picture; the majority of the respondents replied affirmatively in favour of using human excreta as manure (DPHE UNICEF, 1995).¹⁴ However, the practice of reuse of human excreta for agriculture was not found in the literature but use of wastewater for irrigation was clearly mentioned.

Wastewater in agriculture

The recent city surveys (Dr. Avizit Reaz Quazi, 2005)¹⁵ in Rajshahi and Dhaka cities revealed the use of drainage water in peri-urban areas for irrigation purposes. The survey indicated that approximately 145 and 550 hectares of land are irrigated by untreated waste water in the peri-urban areas of Dhaka and *Rajshahi* cited respectively. The common agricultural products grown on waste water are: cauliflower, *Lao* (bottle gourd), sweet pumpkin, *Pauishak* (Indian spinach), *Palongshak* (spinach), *Dantashak* (amaranths) potato, tomato, pulse, oil seeds, wheat, paddy, and sugarcane. The survey also found that for several years diluted wastewater was used in nine lagoon/ponds in Pagla sewerage treatment plant (each pond size

1000 feet x 1000 feet) for aquaculture. Yearly production was 562.5 tons of fish. But since early 2003, the Government of Bangladesh have imposed a ban on aquaculture in such lagoons. However, still some aquaculture is illegally being done there on a very limited scale. The production is now only 18.75 tons per year, some 3% of the past production. The survey also revealed that general customers are not comfortable with the idea of wastewater irrigated products. But it was observed that they are purchasing the products from the market as they were not aware about the origin and the methods of cultivation. However, the same survey indicated that farmers who are practising wastewater irrigation are consuming these products (Dr. Avizit Reaz Quazi, 2005)¹⁶. The use of wastewater is also undertaken by NGOs, e.g. the NGO *Prisam* is involved in the cultivation of duckweed to feed fish.¹⁷

Low cost technology

The practices related to the reuse of human and animal excreta for biogas production as a renewable energy source are reported in several documents available from the web pages on the project initiatives taken by the Local Government Engineering department, Bangladesh Council for Science and Industrial Research.¹⁸

In Bangladesh, the first biogas plant was built in 1972 by the Bangladesh Agriculture University (BAU). However, the bio-gas plant based on night soil was only constructed at *Faridpur Muslim Mission* in early 1990s by Local Government Engineering Department (LGED).

Since the first introduction in mid 1990s, more initiatives were taken by various organisations particularly by LGED and Bangladesh Council for Scientific and Industrial Research (BCSIR). It has been reported that LGED and BCSIR have already installed more than 20,000 biogas plants in the country but most of the biogas plant are based on cow dung and only a few are on human excreta.

It is noteworthy that LGED has successfully constructed human excreta based biogas plants in number of religious institutions that involved *Madrasahs*, Islamic missions, orphanages and mosques. One of the aims to install a biogas plant based on human waste is to test the general assumption that reusing human excreta in the Islamic culture is not feasible. Literature review also indicated that a considerable percentage of bio-gas plants are not functioning due to design, construction and maintenance problems.¹⁹

Basic Design of the Bio-gas technology promoted by Government Agencies

The introduction of Biogas plants in Bangladesh was started with the floating dome Indian type plants. Later it was replaced by fixed dome Chinese-type plants and at present, the majority of the plants are fixed dome household based biogas plant.

The present fixed biogas plants have an underground cylindrical shaped biogas digester constructed with brick walls and concrete. Based on the nature of raw materials inlet connections/tanks with digester varies. The digester is also connected with the outlet tank, which include hydraulic chamber, and bio-fertiliser pit. The size of the plant depends on the availability of raw materials and demand of gas. It works according to the principle, constant volume, changing pressure. When the rate of gas production is higher than that of gas consumption pressure inside the digester rises and expels some digester contents into the outlet compartment. When the consumption is higher than production, pressure inside the digester falls and the expelled materials in the outlet compartment run back to the digester.

The biogas technology employs the technology of anaerobic digestion. It is based on the natural breakdown of organic materials under bacteriological attack in the absence of oxygen, producing a combustible mixture of gas with up to 70% of methane.



BCSIR Design

Source: BCSIR, Biogas technology (Brochure in Bangla). Biogas Pilot Plant-2nd phase, Dhaka

3. Objectives of this study

Based on the literature review, a study based on field work was undertaken:

- To have an understanding about the reuse of human excreta including other organic waste in Bangladesh
- To determine ways, processes and purposes of reuse of human excreta in the rural areas in Bangladesh
- To assess the extent to which the reuse of human excreta meet the requirement of environmental sanitation.

Methodology for collection of data at field level

Structured interviews have been made by telephone with (i) the 14 Regional Managers of NGO Forum who cover almost entire country, (ii) staff members of national and international agencies engaged in water and sanitation activities, and (iii) consultants who are directly involved in water and sanitation program. Outcomes of the interviews were recorded.

These interviews did not provide adequate information about the use of 'saturated'²⁰ latrine pits and human waste for agriculture. The study had incorporated a few group discussions with local NGOs who are partners of NGO Forum. They had provided information about the reuse of human excreta in agriculture as well as the use of saturated pit to grow plants and had identified few places where such practices take place.

Based on these interviews and group discussions, the following three study districts were chosen,: *Bagerhat, Rajshahi and Faridpur*. In total, 18 cases of reuse of human excreta have been studied:

- 6 cases of users of saturated latrine pit used for growing plants; this is practised in *Doiboyga Kathi, Joka, Nurullahpur* villages of *Morrelganj Upazila* (sub-district) and *Paschim Khada* village of *Sharankholan Upazila* under *Bagerhat* district
- 4 cases of users of compost containing human excreta for producing vegetables, fruits, nuts, tree; this is practised in *Haldhibunia* and *Malgazi* villages of *Mongla Upazila* under *Bagerhat* district and in *Bil Mahmudpur* village of *Sadar upazila* in *Faridpur* district;
- 8 cases of users of bio-gas plants; this is practised in *Dhopagata* village of *Mohanpur Upazila* and *Rakkhitpara* village of *Bagmara Upazila* in *Rajshahi* district

The field study area was restricted given the time and financial constraints.

Empirical observations in the selected sample areas have been carried out in February and August 2005. The basic techniques of observations have been: in-depth interview, key informant interview, transect-walk and direct observation of the reuse system, ways and outcome.

Key research instruments were: interview schedule, check list, audio and visual documentations.

Categories of informants were: Users of reuse of human excreta, senior staff members of institutions working with water and sanitation, social elites, engineers who have constructed the reuse system and are responsible for its monitoring, maintenance; and caretakers.

Field Findings

Direct observation revealed that out of 6 villages (in 4 *Upazilas*) 4 villages have 'saturated pits' used for the production of plants. These villages are Doibogya Kathi, Joka, and Nurullahpur under Doibogya Kathi union of Morrellganj upazila and Paschim Khada village of Randha union of Sharankhola Upazila. Six households in these villages have been found using saturated pits for the production of plants in a planned way.

Cases of used latrine pits for production of plant



In Paschim Khada, Sayeedur Rahman Akkon, a Muslim by religious affiliation and a teacher of a primary school had constructed a pit latrine in mid 1980 which was saturated in early 1990. Mr Akkon had covered the saturated pit with soil and kept it for a year and in 1992 sowed two bamboo saplings of a special type 'Molibansh' which is thin and short. After a few years, out of these saplings, a bamboo bush had developed while the size of a bamboo appeared to be 10 to 15 feet high and its dia is about 2 inches. From this bush he had collected at least one hundred bamboos, each cost taka 30. He further expressed that he had cultivated similar type of bamboo on a plain land without using any type of fertilizer and had found that the bamboos grown on the latrine pit are relatively thicker in size and the growth of the bush is better than that of the bamboo bush cultivated at the plain land. With this experience he had arrived to the conclusion that plants grown on the saturated pits have better results.

In the village Joka of Doibogya Kathi union of Morrellganj upazila, Asken Sheikh, a Muslim by religious affiliation and a shrimp cultivator, had constructed a latrine in 1999 that was saturated in 2003 and sealed with soil. He had constructed another latrine in close proximity. After a year he sowed a coconut sapling on the saturated pit as he heard that if a coconut tree planted on saturated pit than it produces more coconuts than the coconut trees planted on the plain land.



In the village Joka, Yunus Ali, a Muslim by religious affiliation, a peasant and also engaged in small business with Golpata (one type of mangrove) and bamboo, had constructed a latrine in 2000 which was saturated in 2003, sealed with soil and kept it for six months. After that he sowed a sapling of betel leaf in mid 2004 and in mid 2005 he just disposed seeds of mango on the sealed pit for the purpose of plantation. It was observed that the betel leaf tree is growing and three mango saplings are visible on the saturated pit surface. He used this saturated pit for growing plants as he has understood by hearing from people that plants that are grown on such pit are developed better. He also practises disposal of organic household waste on a dug hole and later use the compost as fertilizer.



Another case in the village Joka is Shujid Kumar Biwas, a Hindu by religious affiliation, is basically agricultural labourer and in season he prepares betel nut tree by removing the bark by layers in order to collect the juice that drives from the tree. His family had constructed a ring pit latrine in 1998 which was saturated in 2002 and it was sealed with soil, after few months he sowed a coconut sapling. Another pit latrine that was constructed during the same period was saturated in 2000 and been sealed with soil. After nearly one year, their family members sowed betel nut sapling and a sapling of a tree, Chambaal. These saplings are growing for last four years. He and his family member did this practice as to their indigenous knowledge, that latrine pit are good for growing plants, transmitted to them by his maternal grand father, Mahendro Nath pal.



In Nurullahpur village, under Doibogya Kathi union of Morrellganj upazila, Abdul Salam Sheikh, a Muslim by religious affiliation and a peasant. He had constructed a pit latrine in 2000, which was saturated in 2004. He sealed it with soil and kept for four months and then sowed roots locally known as Mitya Alo or Gouz Alo, a very special kind of vegetable where the bulky root grows in the soil, on the top thin and long creepers are raised and on the creepers small roots appear. The life of these root plants is about three years. Roots grown in the soil and small roots grown on the creepers are cooked and consumed. He used the saturated pit for planting this particular root as he had learned by watching a television program on cultivation of vegetable, 'Mati O Manus', that means land and human, that the use of saturated pit is good for production of vegetable. Having implemented this, the root has grown for six months and were raised on the surface and became matured to produce small roots on its creepers. However, his family members had expressed their strong resentment to use plant products grown on pit content and have warned him that they will not consume it. So, Mr Salam, had decided to sell the entire product in the market and he is expecting that it will provide him with a profit of taka 500 each year.

In Doibogya Kathi village, Kalam Sheikh, a Muslim by religious affiliation and an agriculture laborer. He sealed their pit latrine in 2003 after the pit had got saturated. After a few months, he sowed sapling of bamboos on the saturated pit. It is growing for the last one and a half year. He did so because he heard that saturated pits are very effective for the growth of any plants. His father's brother, Hatyem Sheikh, an agricultural labourer, had constructed a latrine in 1997 that was saturated in early 2000 and was sealed with soil which was kept for a few months and a coconut sapling had been showed which has been growing for the last five years.



Basic reasons expressed for using saturated pits are: (1) based on empirical experience—it was reported that the saturated pits are better fertilizers than chemical fertilizers as the efficacy of the latrine pits fertilizer sustain for a longer period of time. This they measured by the produce of the plant both in terms of quality and quantity; (2) information from neighbours, acquaintances that saturated pits are better fertilizer as it produces healthier plants and more yield; (3) information from television programs about the effectiveness of latrine pit fertilizer; and (4) indigenous knowledge— ancestors believed that latrine pits are better fertilizer and this believe is transferred from one generation to the other.

The plants that were sowed on the saturated pit are: coconut tree, betel nut, bamboo, mango tree, *Chambal* (tree), *Mitha Alo* or *Guz Alo* (a special kind of vegetable with the bulky root growing in the soil, on the top thin and long creepers grow and on the creeper small roots appear).

Along with utilization of saturated pit it was found that human excreta are also used in cultivation. In two villages, Haldhi bunia of Chila union and Malgazi of Chandpai union under Mongla Upazila cases are found of using human excreta as fertilizer.

Cases on the use of human excreta in cultivation

Mr. Mohammad Abu Siddique, a Muslim by religious affiliation and a laborer of Mongla Harbor. He owns some land within his homestead which he uses for cultivating different types of vegetables,- Brinjal, Green Chillies, 'Dantashak' (Amaranths), lemon: fruits- papaya, Guava, Banana, Pomegranate, Mango, Jackfruit, 'Safeda' (Sapota)-, Jam-A fruit like black berry; nuts- date, peanuts, coconuts, betel nuts; and different types of trees-Kaorah, and Shundari.

In cultivating the given agricultural products, he uses compost as fertilizer which is contains human waste (10%), organic solid waste and poultry manure. He collects human faeces from his latrine that is used by his family member for 12 months and mixes it with other organic waste to produce the compost. Initially, he dug a hole of 2 feet depth, and 3 to 4 feet width. At the same time, after one year of use of the latrine, he stop using it for one to one and a half month. After this period he collects all the faecal material with the help of a sweeper and carries this material to the hole that is dug to produce the compost. He preserves the faecal material in the hole for a month and then adds to it other organic waste consisting of manure of poultry, kitchen and garden waste and leaves. All this is mixed and kept in the hole for another one and a half months to be decomposed. He used to cover the hole with wood, banana leaves and palm leaves. As of his estimation, each hole provides him with a compost of some 40 to 50 kilogram. After collecting the compost from the hole he processes the soil by digging and mixing the compost with soil then he puts seeds of vegetable and sapling of fruits and wood plants on it. In August 2005, he used compost for cultivating Brinjals, green chillies and Danta in a 3 decimal area and to sow 20 saplings of Guava. In handling compost he uses plastic boots and gloves which he has as he is a laborer in a harbor.

He learned about the benefit of such compost from the Agriculture Office at Mongla in 1987 and for last three years means since 2003 he is using compost in cultivation on the given land. He further mentioned that the cultivation of these vegetables is particularly during October-February. The period is extended for another tree months for certain vegetables. He gets a satisfactory amount of products from his field. It is note worthy that in August, some plants - particularly brinjal - was found that was not of that quality and size which he usually finds during the appropriate season. One of his brinjal weighed even 800 gram. He earned in a year taka 10 to 12 thousand by selling vegetables that were cultivated in his land. Only bringal has brought him a profit of taka 4,500. He sowed 32 guava sapling, of them 12 trees had given him 200 kilograms of guava which he did not sell, instead he and his family members had consumed or he had offered this to his neighbours and visitors. He has sixteen coconut trees which provide him nearly 10,000 taka per year by selling the coconuts. His thirteen papaya trees give around 20 kg's of papaya which he sells. He had further observed that the production of the Banana and papaya had been significantly reduced in the year of field work as to fresh flood which caused water logging for a long period of time that had affected the production of fruits. As of his opinion, the use of compost in the production of agricultural outputs provides 60 percents higher profits than the products grown on chemical fertilizer. He has expressed his feeling about his main occupation which is wage labourering at the mongla harbor. He had mentioned that the work in the harbor is becoming difficult as number of ships entering the harbour is consistently reducing, as a result, he gets only one duty shift in a month which wage him only 450 taka. This trend is not healthy for his livelihood so he is giving more time to agriculture.

Further, Mr. Siddique indicated that in Satgaria, Malgazi and Haldibunia villages many households used compost consist of organic waste of any source and of them nearly hundred households used human waste but about a year ago a miking (spreading of information by mobile speakers) had informed people that use of human faeces in agriculture food produce is hazardous for health. This miking had resulted in reducing the use of human waste in cultivation.

Continuation of Cases on the use of human excreta in cultivation

The use of human excreta and other organic compost is also practised in Malgazi of Chaddpai union. Three more cases were observed particularly Kuldeep Mondol, Biprotip Mondol both of them are Hindu by religious affiliation and Maneendra Halder is a Christian. It was found that all three individuals produce the compost by using a hole in which an adequate amount of human excreta is transferred to from used latrines. The human excreta is kept for three months and then some other organic waste is added like poultry manure, cow dung, household and kitchen waste, leaves. It is kept for decomposition to produce a compost which is later used in agricultural fields for production of vegetables, fruits, nuts and trees. In these cases some different kinds of vegetables were found particularly, *barbiti* (a kind of beans), tomato, potatoes, cauliflower, cabbage, 'puin-sak'-green leaves, ladies finger, Lou-bottle-gourd. All of farmers have the opinion that the compost is capable of producing more outputs of the agricultural product than the chemical fertilizer and the products appeared more healthier and have better look. The experience of Kuldeep Mondol is noteworthy, as he shared: "Gato bachhar Kritim Shar babohar korey jay fashal payeshilam, A bachhar tar thake adhik fashal payechi jaiboshar babohar kore, A bacchar barboty abong Danta hoyeche goto bochhar rer diguin", or "Last year I used chemical fertilizer but this year I got more yield by using compost. This year I have got beans and fibrous vegetables double in quantity than last year."



Mr Abu Siddique



Mr Kuldeep Mondal



Mr Biprotip Mondol



Mr Maneendra halder



Pit that is used by Siddique for decomposition



Pit that is used by Biprotip for decomposition



Pit that is used by Maneendra for decomposition

Human excreta and other organic compost is being used to produce compost. This is done by digging a hole in which an adequate amount of human excreta is collected from used latrines. The human excreta is kept there for some months and then other organic waste such as poultry manure, cow dung, household and kitchen waste and leaves. The composting process takes a few months. The produced compost is used in the agricultural field for the production of vegetables, fruits, nuts and trees. They produce vegetables particularly *brinjils*, *danta*, *barbiti*-one kind of beans, tomato, potatoes, cauliflower, cabbage, *puishak*, ladies finger, gourd. All farmers have the opinion that such compost is capable of producing more agricultural outputs than when using chemical fertilizer. And the products appeared healthier and have better look.

The reuse of human excreta is found to be not limited to agriculture but it is used for the production of alternative energy, bio-gas in particular. Eight cases that had been studied have provided some understanding about its use and its purpose.

Biogas plants using human and animal excreta were found under specific projects undertaken by government institutions. In the *Mahmudpur* village of *Sadar upazila* in *Faridpur* district, and *Dhopagata* village of *Mohanpur Upazila* and *Rakkhitpara* village of *Baghmara Upazila* in *Rajshahi* district a total of 8 biogas plants were investigated. Two plants linked to the community latrines use its excreta for biogas production. The energy generated is used for cooking in a single household.

One community latrine linked to biogas plant is installed in an Islamic religious institution to reuse the energy for cooking meals to orphans while the remaining five biogas plants are constructed for individual use in these five households.

1.1.1 Household based bio-gas plants: A few instances of reuse of human and animal excreta

Gulam Mustafa is a resident of Dhopagata village, Baghshimaile union of Mohanpur Upazila in Rajshahi district. As he is serving at the Agriculture Extension Directorate, as block supervisor, he had some ideas about the biogas technology. However, it was his nephew who was involved with the Biogas pilot plant-second phase project of BCSIR as a Deputy Assistant Engineer. He encouraged him to install the Biogas plant instead of a septic tank for his building which was under construction. Subsequently, in 2003 he installed a household based biogas plant for cooking purposes in front of his house taking the advantage of BCSIR project. The total cost of the plant is Taka 14,000, however, he spent only taka 6,500 as taka 7,500 was provided to him under the project of BCSIR. The plant occupies one decimal of land that has value of Taka 4,000. The design of the biogas plant is similar to the design promotes by BCSIR.

The digester of the plant is attached to his family latrine through an inlet pipe. The raw materials of the plant are cow dung (90%) and human excreta (10%) supplied, which is generally used by 6 persons. Each week he adds 2 bags of cow dung (100kg) to the plant through the inlet tank. As the family does not have any cows they have to purchase cow dung from others and spending taka 15 for 100kg of cow dung. Earlier, the family had to spend TK 400 to 450 per month on kerosene for cooking. Having the biogas plant the household is spending TK 60 to 80 only on kerosene.

Ms Jharna, housewife of the family, informed that earlier she used to cook with kerosene and she was not comfortable with it as the operation and maintenance of the kerosene oven is difficult. Now she is enjoying cooking with biogas and she finds it as good as natural gas. She informed that the plant produces enough gas for daily cooking of three meals for her family that has 6 adult members. When guests visit, she has to add some additional cow dung in the digester. Furthermore, to ensure cost effective utilization biogas, they use pressure cookers for cooking.

The family is Muslim by their religious affiliation, educated and members are not feeling hesitation in using biogas for cooking which is produced by human and animal excreta. Until the plant started functioning, Ms. Jharna was not very comfortable with the idea of using biogas for cooking. However, after the operation of plant gradually her perceptions started to change as she found no difference between natural gas and the gas available from the plant and no smell was felt. Further, the use of biogas stove relatively easier than the stove work on kerosene. However, they expressed that an auto firing of the oven would help them avoid experiencing the release of biogas during lighting the oven. This may be considered as an indicator of their 'unconscious' discomfort about the raw materials used.

Other members of the family also expressed similar views. Until now, they haven't encountered any problem with the plant except some minor problems with the stove for which they have to wait for the project engineers for repairing. They are not given any caretaker training.

During observations, it was found that plant area was mostly clean but the sludge tank was found covered with bamboo mat and sludge is disposed in very unhygienic way to the open space attached to the river. When the issue was brought to the attention of Mr Mustafa, he informed that the problem would no longer be there as he planned to use this sludge as compost for agriculture land owned by his family. At present a small part of the sludge is used for roof gardening.

In the entire Dhopagata village, this was the only Biogas plant based on reuse of cow dung as well as human waste. However, in Rakkithpara village, of Bagmara upazila 4 more similar type of plants were found. Like the Mustafa's plant, all four plants are found to be disposing sludge in an unhygienic manner and pollution the surrounding environment plants and the plants were installed under the BCSIR project having similar design.

In Rakkithpara, of four households, only one is using a small portion of the sludge to cultivate Patol (a kind of vegetable). It is to be noted that in the given plants, no test whatsoever, was done to have any understand about the quality of sludge of the plants as a result of which no health risk could be assessed.

It is important to note that all the biogas users are found to be resourceful. Each have a well-structured house made of bricks and concrete and household income ranges between US \$1300 to 1400 annually. Further, all the families are Muslim and no complain was reported about the plants and use of human and animal excreta as raw materials. It is noteworthy that one of the users was a teacher of religious institution, Abdul Waheed, who finds no reason why he should not use a biogas plant. Moreover, he has constructed a community toilet for his poor neighbour families and their excreta is collected in the digester of his biogas plant as raw materials besides cow dung. He also informed that as other users, he is also using pressure cooker for cooking. In both the villages, reuse of excreta other than biogas plant not been observed.



A biogas plant (human and animal Excreta based)



Disposal of sludge (unhygienic Mode)



Use of Biogas sludge in roof gardening

The study revealed that the cow dung is the main raw material in biogas plants. For all the 5 household-based biogas plants, although linked to the household latrines, human excreta contribute only 10% of the total raw materials, while cow dung provides 90% of the raw materials. Use of cow dung increases with the increased demand for biogas for cooking.

However, all three community-based plants (different than household-based plants) are using only human excreta for the production of biogas. The raw materials of these plants are supplied through an inlet pipe from community latrines to the digesters. An extra inlet tank for adding cow dung was constructed during the installation of the plant but they later were closed which indicate that the plants are currently able to supply desired amount of biogas for cooking.

The use of biogas has the great advantage to reduce the cost of household fuel requirement significantly. The fuel cost for those households (using cow dung) has come down to less than half of the cost incurred earlier, while households using human excreta are paying only an insignificant amount of energy for cooking.

The biogas plant installed at the religious institution is providing energy for cooking to one fourth of the total number of consumers, therefore, fuel cost has reducing to one fourth of the total cost involved.

Use of Community latrine for biogas production:

Mr Abul Kalam, whose relative was involved with biogas pilot project, through his initiative in 2004, has constructed two community latrines for his neighbouring 9 poorest families. The total members of these families are 31 and they used to practice open defecation on the bank of the river. Now the majority of the members are using these toilets.

Mr Kalam also constructed a bio-gas plant based on BCSIR design there. The inlet tank that was there to have the facility to add cow dung is sealed and human excreta is the only raw material used in this plant. The produced biogas from the plant is supplied to his house through 150 feet gas pipe. His family is using a two-burner stove to cook three meals for his family having five members. The total cost of the plant is taka 15,000 (US\$250), half of which had been shared by the BCSIR project. The annual income of the family during the construction of the plant was approximately US\$ 1,400.

Now he is saving nearly 300-400 taka per month as he no longer purchases any biomass as fuel. However, he informed that when guests visit or more items then they use their traditional oven made of mud fuelled by biomass. His family is using a pressure cooker and they are strictly maintaining this practice as it was observed during demonstration of the using of the gas for cooking. The family members are very strict on using a pressure cooker and not the traditional uncovered pot.

This family also have no problem in using the biogas plant but like others they also informed that they would prefer an auto-firing oven over the present one. Users of the plant haven't received any orientation and training on taking care of the plant and on the use of the plant in a hygienic way.

During observation it was found that the sludge of the plant is disposed in the open place through outlet pipe in a very unhygienic manner and the community latrines were not clean. The owner of the plant informed that in each year, 640 kg of sludge of the plant is used on their agricultural land to improve the soil condition and during this study a farm of betel leaf on 2 decimal land was observed where the sludge of the plant was used. However, no testing whatsoever was carried out to have any understanding about the quality of the sludge. In the Dhopaghata one more such type of plant was observed and the condition related to sludge disposal was found to be similar. In Rakkhitpara no biogas plant based on exclusive human excreta was found.



A community Biogas plant (human excreta based)



Disposal of Sludge (unhygienic mode)



cultivation of betel leaf using sludge as fertilizer

It has been revealed that the residues of the biogas plants are generally managed in an unhygienic way: it is disposed into the water bodies and open places. An exception has been found in the religious institution. The Arambag Islamic Trust is initially decomposing the residues with soil and organic solid wastes. After 10 to 15 days this resulting product is used as fertilizer in cultivations. A few users of household-based biogas plants are also using a small part of the residue for roof gardening and in other cultivations.

It was observed that the households using biogas energy are relatively resourceful in term of money. The construction of a biogas plant requires taka 12,000 to 14,000 and one decimal land (100 decimal=1 acre) is needed for the installation of the plant.

Therefore, household biogas plants are feasible for the poor for reasons of high construction costs and the availability of adequate biodegradable material (human waste; cow dung; chicken manure). Biogas is not the sole environmental sanitation solution contributing poverty alleviation.

Muslim religious institution is reusing Human Excreta for Generating Biogas for cooking and agricultural purposes.

In the entire village of bil Mahmudpur of Aliabad Union in Faridpur Sadar Upazila, no practice of reuse of human excreta was found except a biogas plant constructed by Arambag Atim Khana. Arambag Atim Khana was established under Arambag Islami Trusts in 1986. Nearly, 200 children, overwhelmingly orphans live there. Cooking for this large number of children is a difficult task. For cooking, they used 'bushtech'- a processed material made of wooden dust - and had to spend Taka 20 to 22,000 per month for fuel.

However, in 1999 LGED encouraged the trust to construct a bio-gas plant for cooking by taking the advantage of huge amount of human excreta generated in the community latrines of the orphanage. In response to the proposal the LGED a plant was constructed. LGED had shared a part of the installation cost.

The plant has a 10-inch diameter fixed dome digester. It is connected with the two units of toilets including 6 urinals and 5 lavatories that are regularly used by nearly 200 people, most of them being children. The design of the plant is nearly the same as that of BCSIR. The cow dung inlet tank is sealed as only human excreta are used as raw material for the plant. The produced bio-gas is used for the cooking purposes but it is not enough to meet the cooking need of entire orphanage population. With the produced biogas cooking is possible for only 20 to 25 persons which save nearly TK. 3,500 per month. Further, the trust has ensured proper management of human excreta.

Users as well as the cook did not have any complain about the reuse of human excreta as source of energy for cooking. As to the question whether the child-users feel uncomfortable for having food cooked by the energy generated from the reuse of human excreta, they simply responded 'no'. The caretaker of the plant, Mr Tariquzzaman and cooks had informed that since the installation of the plant they have not experienced any difficulties in operation and also no major repair was needed. During observation it was found that the plant area was very clean and sludge disposal is done in a very hygienic manner and the sludge point is covered. A female staff is paid for collecting the sludge of the plant and disposed into a hole with all other solid organic waste such as leaf and kitchen waste. After 10 to 15 days this compost along with TSP (JS: WHAT IS THAT??) are used for cultivating groundnuts and vegetables in an area of 2.5 acre of land. Sludge is not used in aquaculture, though the institution has aquaculture. It is to be noted that no preventive hygienic measures are taken in handling the sludge.



The biogas plant with inlets



The desenter of Biogas plant



Sealed inlets facility to add cow dung



Flame of the oven resourced from biogas



Covered disposal point of sludge



Cultivation of vegetable use compost of sludge as fertilizer

On the other hand, the study also found that a biogas plant based on reuse of human excreta inevitably requires a certain amount of excreta that one or two households cannot supply. Therefore, a good number of households have to be gathered to generate enough raw biodegradable materials to have a proper functioning of the biogas plant and so meet the demand of energy of a single household. It was observed that two community latrines had been built to collect the excreta of the poor families for the operation of one biogas plant; the produced biogas is being used by the household of the owner of the latrines and plant. In this manner, affluent households can support the sanitation coverage of the poorest in a community.

The designs of the biogas plants studied are basically fixed dome designs, which are promoted by government institutions; only the number of inlets for the supply of raw materials is varied. No complaints were recorded on the design and the functioning of the plant. However, owners expressed to prefer an auto-firing of the oven to avoid experiencing the release of biogas during its lighting. This may be considered as an indicator of their 'unconscious' discomfort about the raw materials. Furthermore, the use of a pressure cooker by almost all of the users may have a similar meaning though it has not been explicitly expressed. At the sometime, all users appreciated the fire generated by the gas that eased their cooking.

The study found that the users were not given the necessary orientation on sanitation and hygiene related to biogas plants. The caretakers of the plants were found to have not enough capacities to manage even a small technical problem, which may be the result of lack of training.

Conclusion

The study of 6 cases of users of saturated latrine pits who are growing plants, 4 cases of users of compost consist of human excreta, producing vegetables, fruits, nuts, tree and 8 cases of users of bio-gas plan in 9 villages under three districts²¹ have given an understanding about the way human waste are reused, purpose of reuse and its outcome.

The findings has helped to arrive to the conclusion that the reuse of human excreta and the compost containing human and animal excreta and other organic waste are used in cultivating plants that include various kinds of vegetables, fruits, nuts and trees. Overwhelmingly the users expressed their satisfaction about the reuse of excreta given their experience as to the fact that the products grown on the saturated pit and organic compost are healthier, larger in quantity and size, and have a better look. And this produce provides them with some financial benefits.

Reuse of human excreta has often been encouraged by their ancestors who had practised it and transmitted their indigenous knowledge about the reuse of human excreta to their next generation. The present re-users learned about the benefits of human excreta as fertilizer from mass media, NGOs, government organization and neighbours.

However, the way human excreta is reused, sludge of bio-gas plants is disposed, latrines are used, waste collected and mixed for preparing compost are not convincingly safe. Individual initiatives are exclusive in case of reuse of human waste for cultivation while for the bio-gas plant construction support from the project or government was provided.

The reuse of human excreta is discouraged by Islam as it was found in some literature. However, during the study it was observed that a Madrassa (Islamic religious academic institution), and a teacher of

Madrasa and many Muslim families are actually reusing human excreta. This conclusion based on a limited study sample can not be extrapolated to the entire country. The practice of reusing human excreta for cultivating agricultural products for human consumption exists not only among Muslims but also among Hindus and Christians.

Therefore, given the limitations of the study, it is concluded that the reuse of human excreta as well as excreta of animal and other organic waste is a reality in Bangladesh but the way it is used may be 'improper' and 'dangerous' for the health and environment of poor communities. The issue of reuse of human excreta should be addressed by the government, non-government organization and international agencies.

Recommendations

As this particular study has been carried out in a very limited area which was selected purposively, it does not provide an understanding about the reuse of human excreta for the entire country of Bangladesh. Therefore, the magnitude of reuse of human excreta in the entire country has to be assessed through an extensive research. This proposed study should also look at the purposes of reuse of human excreta.

As the study revealed that safe and hygienic utilization of human excreta was not practised, serious health risks exist for the people managing the re-using processes and for the consumers of the agricultural produces. The same applies to the general environment likely to get heavily contaminated with improperly treated sludge from biogas plants. It is recommended to government and support agencies to consider activities to support capacities building and information sharing related to safe and hygienic waste utilisation. Furthermore, it is recommended to study the extent of health risks to human beings from all aspects around the reuse of human excreta.

It is also recommended to the Government, non-government organisations and private entrepreneurs who are engaged sanitation, to incorporate reuse of human excreta into their programme and undertake initiatives and activities for safe reuse of excreta.

Given the development situation in Bangladesh, it is expected that the Government, Non-government Organizations including private institutions will be intensively involved in reuse of human excreta. The government should adopt a policy for the reuse of human excreta, allocate budget to develop affordable and appropriate technologies, provide subsidies to the poorest. NGOs may raise awareness for safe and effective utilization of excreta, provide training to users, caretakers, and private producers, conduct advocacy at national and local level, and carry out action research to ensure the effectiveness of technologies and approaches in accordance with socio-economic and environmental context and monitor and facilitate field level operations.

Once simple and affordable designs are developed and communities are willing to be involved in the reuse of human excreta, the private sector could be engaged in ensuring the availability of hardware materials, the provision of technical building skills, and the marketing and promotion of the re-use options in the localities.

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Acknowledgement: We like to thank Dr Shah Jalal, professor, Department of Anthropology Jahangir nagar University for providing editorial support. I also like to acknowledge, the support provided by Mr. Mizanur Rahman, and Mr Qamruzzaman of NGO Forum and Rifatul Islam of NGO Forum and Md. Motasheen Bilah of Mohanpur during field survey. I also want to acknowledge the support I received from Quamrun Nahar of UNICEF, WS of Bangladesh. The initiative was supported by Jo Smet (IRC) who did the reviews together with Laurent Stravato (IRC).

¹ In 1990 the coverage was 21%, in 1995 it was 48% and in 2003 it was 53.2- (UNICEF & BBS, "Progotir Pathey 2003," December 2004, Dhaka, see p-21.) and in 2005 the coverage is 67% (Speech of Chief guest, Mr. Abdul Mannan , Minister, Ministry of Local Government, Rural development and Cooperatives, Government of Bangladesh; International Symposium on Environmental Sustainability, BUET, 7 February 2006.)

² The Bangladesh Observer 15.05.04

³ UNICEF& BBS, "Progotir Pathey 2003," December 2004, Dhaka,

⁴ UNICEF& BBS, "Progotir Pathey 2000," December 2000, Dhaka,

⁵ Kazi Aktarujjaman, "The Urgency of Application of Biogas Technology: Bangladesh Perspective," Bangladesh Renewable Energy Newsletter, vol.1 No-2. Bols 2 & 3 July 200 December, 2002

⁶ Wahidul K Biswas, 'Bangladesh's Energy sector: The past, present, and future of renewable energy technologies, p-2

⁷ ibid

⁸ Peter Edwards, "Reuse of Human Wastes in Aquaculture: A technical Report," UNDP-WB-ASP, USA, 1992, p-7

⁹ Prothom Alo, 09.02.2002 & Editorial on 29.09.2003

¹⁰ Dr Avizit Reaz Quazi, "Wastewater Irrigation in Dhaka," Unpublished, 2005

¹¹ Martin Strauss, opcit, p-11

¹² Peter Edwards, opcit, p-274

¹³ Quazi Avizit reaz, "Impediments Towards sanitary Latrine Coverage: The case of Rural Bangladesh, NGO Forum for DWSS, Dhaka, 2003

¹⁴ DPHE-UNICEF and VHSS, "Women in the context of Sanitation, Water Supply and Hygiene: A village based study," Dhaka (unpublished), 1995, p-60

¹⁵ Dr Avizit Reaz Quazi, "Wastewater Irrigation in Rajshahi," Unpublished, 2005

¹⁶ Dr Avizit Reaz Quazi, "Wastewater Irrigation in Rajshahi," Unpublished, 2005

¹⁷ Paul Skillicorn, William Spira and William Journey, "Duckweed Aquaculture; A New Aquatic Farming System For Developing Countries," The World Bank Emen Technical Department, Agriculture Division , <http://www.p2pays.org/ref/09/08875.htm>

¹⁸ Bio Energy Development, <http://www.lged.org/sre/bio-energy.htm> ; BCSIR, opcit also see, M. Halibut Rahman, Reuse of human and animal wastes in Bangladesh, 24th WEDC conference, Islamabad, 1998

¹⁹ M. H. rahman, M. A Mottalib & M. H. Bhuiyan, "A Study on Biogas Technology in Bangladesh," 22 WEDC Conference, New delhi, 1996, p-340.

²⁰ The word saturated is used in the article to refer a state of utilization limited of a system is completely exhausted

²¹ details of the place are given in the methodology