

PRACTICE OF USING HUMAN EXCRETA AS FERTILIZER AND IMPLICATIONS FOR HEALTH IN NGHEAN PROVINCE, VIETNAM

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Abstract. The ancient practice of applying latrine wastes to agricultural land has maintained soil fertility in Vietnam for several centuries but may be associated with health risks if the wastes are inadequately treated before usage. This study aimed at investigating the perceptions and handling practices using latrine wastes as fertilizers in a community in central Vietnam. Information was collected through structured questionnaire interviews administered to 75 farming households, focus group discussions, and key informant interviews. The majority (64%) of households had a single vault latrine, a possession that was associated with low income ($\chi^2 = 12.45$; $p < 0.05$). Most households (85%) used latrine waste in agriculture that was composted before usage (98%). Households often mixed the composted excreta with kitchen ashes and powdered lime likely to increase pH and pathogen die-off. About 28% of households that were applying latrine waste as fertilizer composted three to six months, and only 11 (18%) households composted human excreta for more than the recommended six months. Households with double vault latrines were 7.8 ($\chi^2 = 9.4$; $p < 0.05$) times more likely to compost human excreta more than six months as compared with households having single vault latrine. Most farmers distributed the latrine wastes with bare hands (66%) because of convenience during application. Respondents with a high educational level used protective gloves more often when distributing latrine wastes in the fields compared to respondents with a low educational level ($\chi^2 = 7.6$; $p < 0.05$). If any negative health impacts of latrine waste use in agriculture are to be reduced, then it is suggested that sustainable interventions should take into consideration farmers current excreta-use practices.

INTRODUCTION

The people in Vietnam, particularly in the northern and central provinces, have traditionally used human excreta and urine as fertilizer in both household gardens and agriculture to increase yields and to save on expensive inorganic fertilizer. A study in three different provinces in northern Vietnam found that agriculturally dependent communities would often insist that promoted sanitation technologies should allow access to excreta to be used as fertilizer (Water

and Sanitation Program, 2002). This use of inadequately treated human excreta has been identified as a major health problem for rural communities. In areas where untreated human feces is used as fertilizer for vegetable and other crops eaten raw, the consumers risk diseases caused mainly by parasites such as *Ascaris* spp and *Trichuris* spp as well as other food-borne pathogens. In addition, farmers could face the occupational risk of hookworm infection if they work barefoot in the fields (van der Hoek *et al*, 2003). Often untreated human feces are used in vegetable cultivation. Consequently, hookworm infection is found to be higher in vegetable cultivation areas than in areas where mainly rice or other crops are grown (De, 1995; Thanh and Nga, 1996; Van *et al*, 1996; Trong, 1997). Overall, the Ministry of Health estimated in 1997 that

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90% of the rural population was infected with one or more intestinal parasites: nearly 100% in the northern region, 60-70% in the central region, and 40% in the southern region being infected (Cong, 1998).

The type and time of treatment required for human excreta before it can be safely used as fertilizer is dependent on the health status of the users and the intended use of the end product (Winblad, 1996). The key factors affecting the survival of excreted pathogens in composted material are the duration of the composting process and the temperature during composting (Feachem *et al*, 1983). It has been suggested that primary treatment, either by dehydration or decomposition, is usually sufficient to destroy most pathogens, but secondary treatment (*eg*, high-temperature composting) may be required where intestinal parasites are common and found in high numbers (Winblad, 1996). Therefore, in households in Vietnam where dry sanitation is installed, primary treatment by dehydration or decomposition may be insufficient to ensure pathogen die-off.

Since 1960, the government has encouraged people to use the double vault latrine for composting human excreta before use in agriculture. However, the installment of such latrines and hygienic composting practices of collected fecal material are not common, and rural farmers still seem to use fresh excreta collected from latrines as fertilizer (Ministry of Health, 2003). According to the Vietnamese Ministry of Health, it is recommended to compost human excreta inside the double vault latrine with the addition of kitchen ash, vegetable wastes, rice husks, or powder lime. During subsequent storage, the vault must be covered for at least 6 months before excreta should be used in agriculture (Ministry of Health, 2003). Despite the apparent common use of human excreta in agriculture in Vietnam, only limited information is available about the farmers' practices, the hygienic quality of the excreta that is used, and the possible human health risks from such usage. The aim of this study was to assess the practices of rural farmers during collection, treatment, and use of human excreta in agriculture in a village in Nghe An Province in northern Vietnam and to high-

light potential health risks associated with such practices.

MATERIALS AND METHODS

Study site

The study was conducted in a village in the Phuc Son commune, Anh Son District, Nghe An Province, in central Viet Nam, in April and May 2003. The village selected for the study had 85 households. About 80% of the households had agricultural activities as the main income generating activity, and 20% had off-farm activities as the main income source. The most common agricultural practice was wet-rice cultivation. According to the government statistics for 2002, the average annual income was 2,500,000 VND per capita (1 US\$ = 15,000 VND) (General Statistics Office, 2002). Almost all adults in the study area could read and write.

Every year in the study area, government departments undertook a week-long campaign on the need for clean drinking water and hygienic sanitation using poster, drama, television, and local radio communication that promoted the consumption of cooked food and boiled drinking water, and the cleaning of the environment around homesteads (Directive 200 QD-TTg, 1994).

Data collection and analysis

The respondents were household heads or adult members of the household who provided interview-based information on the following topics:

- Existing latrine systems used in the study area.
- Storage conditions and treatment procedures (*eg*, composting and time periods before reuse as fertilizer in agriculture).
- Means of collecting, storing, transporting, and applying latrine wastes as fertilizers in agricultural production.
- Main crops fertilized with latrine wastes.
- The perceptions and handling practices of households and workers engaged in the reuse of latrine wastes, with a focus on the health aspects.

- Information about personal hygiene (eg, hands washing).

Trained local assistants used structured questionnaires to interview 85 household members. However, of the 85 targeted households, five households were omitted from the survey because the family had left the village in search of jobs; in two households, a person with a mental illness lived alone, and it was found difficult to conduct interviews; and in three households, members declined to participate in the study. Therefore, the actual number surveyed was 75 households. The questionnaire was initially written in English and later translated into Vietnamese. A pre-test of the questionnaire was undertaken at a community similar to the study area, and changes were made to the original questionnaire.

Two focus group discussions (FGD) were conducted that involved one group of twelve adult women, and another group that involved twelve adult men. The participants were randomly selected from the households in the village. However, among the selected participants, there happened to be representatives of the local Farmers' Union, the Women's Union, and a staff member of the commune health center. Each focus group discussion lasted approximately 90 minutes. A FGD guide was developed and included questions on farmers' perceptions of the use of human excreta as fertilizer in agriculture; why and how people composted human excreta before usage; and knowledge and perceptions of the diseases associated with human excreta storage, handling, treatment, and use.

The principal investigator moderated the discussions, and a research assistant took notes. Following standard procedures in Vietnam, people who were to be interviewed were informed about their rights (eg for example) to withdraw, and how information would be used. With the full consent of the participants, the discussions were tape-recorded. Key-informant interviews were conducted among representatives of local authorities that covered similar topics and the types of questions as used in the FGDs. Ethical approval of the study was obtained through the local authorities in Phuc Son Commune and from the Center of Rural Water Supply and Sani-

tation in Nghe An Province, under the Department of Agriculture and Rural Development.

The data obtained from the questionnaires were entered and analyzed using Epi-Info 2000 software, and the results were presented with chi-square values and uncorrected p-values, where relevant.

RESULTS

Characteristics of the study population

A total of 75 people were interviewed, with one respondent from each household. The age of the respondents ranged from 24 to 69 years, with a mean age of 47 years. Thirty-eight interviewees (51%) were women, and 37 interviewees (49%) were men. Regarding educational level, 26 respondents (35%) had completed secondary school education, 23 respondents (31%) had completed tertiary school education and only four respondents (5%) had never attended school. All respondents were married and of Kinh ethnicity (lowland Vietnamese). The mean family size was four persons with a range of one to eight family members. The majority of the respondents were farmers (79%); eight respondents (11%) were officers in public service, such as teachers, police, and health workers; and seven respondents (9%) were retired and worked at home.

When using the classification derived by the Vietnamese General Statistics Office (GSO, 2002) to relate annual household income with poverty status, only 9 (12%) among the studied households were categorized as "very poor" (Table 1).

Types of latrines in the study area

Seventy of the 75 surveyed households (93%) used latrines. Single vault latrines were the most common type (64%), followed by double vault latrines (26%). About 9% of the households used temporary pit latrines.

Among the households with a very low, low, or average income, 75% (34) used single vault latrines, and only 28% (5) used double vault latrines. However, among the households with a moderate or high income, only 25% (11) used single vault latrines, and 72% (13) used double vault latrines. The number of households with

Table 1
Classification of income levels of the 75 households in the study commune.

Household Income	Number (%)	Category ^a
Very poor	9 (12)	< 80,000 VND/month/capita
Poor	21 (29)	80,000 – 100,000 VND/month/capita
Average	20 (27)	101,000 – 150,000 VND/month/capita
Moderate class	16 (21)	151,000 – 200,000 VND/month/capita
High income	9 (12)	> 200,000 VND/month/capita

^a1US\$ = 15,000 VND

moderate or high income that used double vault latrines was significantly higher than those households with a lower income ($\chi^2 = 12.45$; $p < 0.05$).

Practices and reasons for storage of human excreta

Sixty out of 70 households (85%) that had a latrine used latrine wastes in agriculture, and most of them (98%) reported that they composted human excreta before use in the fields. A large group of farmers (57%) composted human excreta in the garden together with kitchen ashes and/or powdered lime in a depression in the soil. Others (43%) composted human excreta inside the latrine vaults with the addition of ash and/or powdered lime.

In the FGDs, most of the household members stated that kitchen ash and powdered lime were added to composting human excreta because it reduced the odor and it prevented environmental pollution and insects or animals from spreading the excreta. Also, the respondents felt that the application of ash and lime, and the subsequent composting, made it easier to distribute the excreta in the fields. In the FGDs, only two household members mentioned that the addition of kitchen ash and powdered lime before composting may protect people from disease during the application of excreta on the fields. The information from FGDs was in agreement with the findings from the questionnaire, where the majority of the respondents (48%)

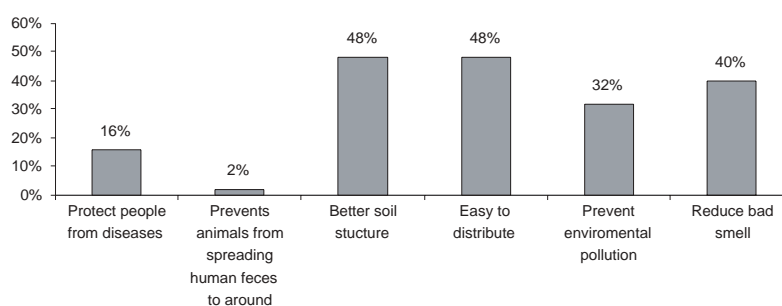


Fig 1—Reasons stated for composting human excreta before use in agriculture.

stated that when human excreta was composted it changed consistency from a wet clay-like mass to a dry humus-like mass, which made it easier to distribute. Also, composting of excreta before use as fertilizer was said by 48% of the respondents to increase agricultural production. Only 16% of the respondents said that composting human excreta protected people from diseases. The reasons for composting human excreta before use in agriculture that were stated by the farmers in the interviews are presented in Fig 1.

A key informant from the local People's Committee stated that most of the households in this study area composted human excreta outside the latrine because they had single vault latrine. However, he also said that in the past the farmers composted human excreta with addition of kitchen ashes or powdered lime as this would reduce environment pollution and reduce bad smell.

Regarding the composting time of excreta before use in agriculture, among the 60 households surveyed, the respondents variously re-

ported that they did so for less than one month (15%), from one-to-three months (38%), from three-to-six months (28%), or for more than six months (18%). However, when the same question was brought up in the FGDs, it became clear that the respondents had difficulties giving precise information on the time period that excreta was normally composted. In the FGDs, it was mentioned that composting was normally done until the composted human excreta no longer had an odor, while others mentioned that composting lasted until they needed the fertilizer in the fields. Most of the households (89%) using latrine waste used this as an input to rice production, with three-to-four applications per year. The majority of the respondents (97%) who applied human waste to the fields did so before crop cultivation, with around half of these households (53%) also did so during crop cultivation. Information obtained from the FGDs confirmed that the main reason for farmers to compost human excreta was to obtain good fertilizer, with reduced odor, making it easier to apply, and improving soil structure. During the FGDs, the members did not mention the aim of composting of human excreta to achieve a hygienically safe fertilizer.

In agreement with the FGDs, the Heads of Women's Union and Farmer's Union stated that people stored human excreta inside or outside the latrine vaults until it was dry and had no bad smell, with little attention being paid to the actual duration of storage or composting of the excreta before usage in the fields. The statistical analysis of the household questionnaire data showed that households with a double vault latrine were significantly more likely to compost human excreta when compared with households having only a single vault latrine ($\chi^2 = 9.4$; $p < 0.05$). The analysis further indicated that respondents with a secondary school education or below were less aware that composting human excreta could protect people from disease than respondents with a high school or college education ($\chi^2 = 6.3$; $p < 0.05$).

Occupational health hazards

Out of the 60 responding household using latrine waste in agriculture, it was apparent that different means of transport were being used to

take latrine waste to the fields, with 20 (34%) using bamboo baskets, 16 (26%) using push wagons and 20 (34%) using both bamboo baskets and push wagons. Forty-eight of the 60 respondents (80%) who used equipment for collection and transport of excreta did so because it was more convenient. Only 12 respondents (20%) who applied human waste to the fields mentioned that the use of such equipment could protect them from diseases.

Of the 60 responding households 40 (66%) handled excreta with their bare hands, 15 (26%) used a shovel with bare hands, and only five (8%) used protective plastic gloves. In the FGDs, most of the participants mentioned that it was easier to distribute latrine wastes in the fields using bare hands. In the statistical data analysis, no significant differences were found between women and men in the way that they handled latrine wastes for use in agriculture.

The heads of the health station and the village said that people did perceive human excreta as very dirty and containing pathogens. However, when the excreta was composted until the bad smells were eliminated and the product was easy to distribute, then the farmers thought the excreta could be safely handled and distributed without any protective measures.

A significant difference was found between educational level of respondents and use of protective gloves when distributing latrine wastes in the fields. None of the 35 respondents who had never attended school used protective gloves, while five of the 25 respondents who had completed high school used protective gloves ($\chi^2 = 7.64$; $p < 0.05$).

DISCUSSION

The vast majority of households in this study had some form of latrine, but only 26% of the survey households changed to a double vault latrine. This agrees with other surveys conducted in the north-central region of Vietnam where it has been estimated that among the households with a latrine the large majority (71%) use single vault latrines (Ministry of Health, 1999). This study indicates that increased household income is likely to facilitate the change to double vault

latrines, although this will have to be assessed further in future studies where a larger sample allows for the control of confounding variables.

The large majority of the farming households used latrine waste as an input to agricultural production, particularly for rice cultivation. This is consistent with surveys that were conducted in the north-central region of Vietnam where 78% of the households were found to use latrine waste in rice production (Ministry of Health, 1999). The previous study found that almost all households composted and processed human excreta before using it in the fields, but only a small minority did so for the recommended six or more months (Ministry of Health, 2003). The most important reasons given for composting and processing human excreta were to improve on the agricultural productivity, ease of field application, smell reduction; much less of a reason was to reduce the human health risk involved. Similar reasons for composting have been found in other studies, and it is likely that the demand from poor farmers for the use of latrine waste as a source of plant nutrients will grow as the cost of industrially produced fertilizers rises (FAO, 1975). The agricultural benefits from composting human excreta have been documented from several Asian countries where outputs increased by 10-25% when composted material was used as compared with the use of raw human feces (Winblad and Kilama, 1985 cited in Jenkins, 2001).

Households with double vault latrines composted human excreta for longer time periods than households with single vault latrines. Also, household members with a high educational level were more aware that composting human excreta could protect people from diseases than household members with a low educational level. Possible explanations for this are that people who have a high educational level received information about water, sanitation, and health at school, or they are better at assimilating the messages from the annual health and hygiene education campaigns. However, it is also likely that educational level is an indicator for income and socio-economic status in general, and this group of households had the means to construct more appropriate sanitary facilities and

had the capacity to respond to health promotion. If the goal would be to promote composting for an increased period of time, it would seem that the national programs should increasingly highlight the actual and perceived agricultural benefits of composting. Also, the promotion of doubled vault latrines should continue to receive high priority, as this would be likely to facilitate an increased period of composting before application. An important barrier to the appropriate method of composting, as explained by the farmers, was that, when nutrients are needed in field, this would be given priority over other concerns, including the composting period. The real problem in northern Vietnam, however, was found to be that some farmers tended to empty the processing chambers whenever they need fertilizer, regardless of what would be the appropriate retention time. This means that partly processed and even fresh feces are spread on the fields. It would take a long time to break age-old habits, and in Vietnam there is definitely a need to improve, intensify, and continue hygiene education until the practice of using fresh feces as fertilizer can be halted (Esrey *et al*, 1998). Therefore, there is a need to promote appropriate sanitation systems and the piloting of innovative approaches to ensure that farmers can get the composted latrine waste when needed, and at the same time, safe from a health point of view.

Most households composted human excreta by mixing it with kitchen ash or powdered lime inside the latrine or in the garden. Lime and ash was primarily applied to reduce bad smell, to make application in the field easier, to control for insect breeding, and, for some households, to prevent environmental pollution. Very few people directly suggested that it could protect humans from disease. Also, the use of ash and lime was not reported by the farmers to be related to pH, and temperature increases or decreased moisture content during composting. Approaching the composting process through community education and experimentation might improve on the safety of the end product. A study from Vietnam has indicated that, if human feces is mixed with appropriate amounts of kitchen ashes or paper ashes and placed in a pit and

covered with leaves and dirt for approximately four months, then this significantly increases the safety of the product (Humphries *et al*, 1997). However, as pointed out by Franceys *et al* (1992), the generation of household wastes, such as vegetable waste, ash, and sawdust, by a single family may not be sufficient to support a sufficiently large increase in temperature during composting. Therefore, the process cannot be relied upon to destroy pathogenic organisms, particularly parasitic eggs and cysts. Overcoming the problem of having sufficient household waste to add, and building on the perceived benefits of adding ash and lime could also be used to reduce the composting time needed to achieve a safer end product.

Most of farmers in this study (66%) applied latrine wastes on the fields with bare hands. This was perceived to be more practical and less uncomfortable than using gloves. The farmers were either not aware or not concerned about the health hazards of being in direct contact with fecal material. Furthermore, farmers who had completed a high school education were more likely to use gloves than farmers with no education ($p < 0.05$). These findings make it even more important that pathogens in human excreta fertilizer are eliminated and underline the importance of education in reducing health risks. In future studies, it would be important to systematically observe the handling and application practices to better assess the potential risks and to formulate health educational messages. Similar studies need to be repeated in other parts of the north central region of Vietnam to adjust for possible differences in ethnicity, agricultural practices, and the possible influence of local promotional activities. In the current study few references were made to the health promotional activities undertaken in the area.

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