Health Risks from Excreta and Wastewater to Vietnamese Farmers

Diarrhoeal infection risks caused by exposure to human excreta and wastewater were studied in Hanam province, North Vietnam. Untreated wastewater, discharged into watercourses by households and urban settlements further upstream, is highly contaminated with pathogens. Overall excreta handling and use of untreated wastewater for rice cultivation lead to high risks of infection of the exposed population. Nguyen Cong Khuong[1,2,5], Pham Duc Phuc[3,4], Tran Huu Bich[1], Hung Nguyen-Viet[1,2,4]

Wastewater and excreta use in Hoang Tay and Nhat Tan

The Kim Bang district in the province of Hanam, situated 60 km downstream of Hanoi, lies at the bank of the Nhue river receiving untreated wastewater from different sources upstream (households, industry, hospitals etc.) from the city of Hanoi. In the communities of Hoang Tay and Nhat Tan in the Kim Bang district, residents use this polluted river water and wastewater to irrigate crops and for aquaculture. The study presented here assessed microbial infection risks related to excreta and wastewater use.

Microbiological analyses and exposure assessment

The quantitative microbial risk assessment (QMRA) method was used to determine the risk of infection from wastewater and excreta use in agriculture and aquaculture [1]. 137 wastewater samples were collected in eight sampling rounds once every fortnight from the Nhue river (54 samples), from wastewater at household level (24), fishponds (32), fields (22), excreta composts and raw-eaten vegetables (5). Three pathogens were analysed quantitatively: *Escherichia coli* by MPN (most probable number) method and the protozoan parasites *Giardia lamblia* and *Cryptosporium parvum* by staining with fluorescent monoclonal antibodies and microscopic observation. A survey was conducted with 235 households to assess people's exposure to wastewater and excreta use in agriculture, i. e. working in the fields, swimming and fishing in the river, contact with wastewater in the household, handling of excreta etc. Finally, the risk of diarrhoea from all these different exposure categories was calculated using estimated probability density functions randomly sampled by Monte Carlo simulation.

Microbiological contamination

E. coli concentration was highest in household wastewater (2.107 MPN per 100 mL^{-1}) and lowest in Nhue river water (14.105 MPN per 100 mL^{-1}). Also *G. lamblia* and *C. parvum* had the highest load in household wastewater with 178 and 238 cysts per 100 mL^{-1}, respectively. All *E. coli*, *G. lamblia* and *C. parvum* concentrations in household wastewater were significantly higher than in any other sample ($P < 0.05$). *G. lamblia* in composted excreta numbered 120 cysts per g^{-1}, whereas *C. parvum* was not observed in any sample. The exposure survey revealed that people were exposed when handling excreta (emptying latrines, composting excreta and field application of excreta) (34 %). Furthermore, exposure was high during rice cultivation when using excreta and wastewater (90 %) for irrigation and during individual contact with pond and lake water (19 %) (Fig. 1). It should be noted that fieldwork, such as ploughing, rice seeding and transplanting, are the most common critical activities associated with high exposure to wastewater and excreta.

Infection risks

We calculated infection risks for both single and multiple exposures (annual risk). *G. lamblia* caused higher infection risks than *E. coli* and *C. parvum*, particularly when exposed during transplanting of rice seedlings (4.10^{-2}). Infection risk is far greater when handling excreta. People exposed to Nhue river water during vegetable cultivation, show annual infection risk by *E. coli, G. lamblia* and *C. parvum* in the range of 2.9×10^{-4}, 3.9×10^{-2} and 2.7×10^{-2}. The study revealed that wastewater and composted excreta in the Hoang Tay and Nhat Tan communities of Hanam province contain high pathogen loads compared to specifications in the WHO guidelines on wastewater and excreta reuse (33–690 times in the case of *E. coli* for instance) [2]. Protective measures during wastewater and excreta handling, adhering to the national composting guidelines and raising awareness of the population with regard to risks, are considered the most effective intervention measures to reduce infection risks.

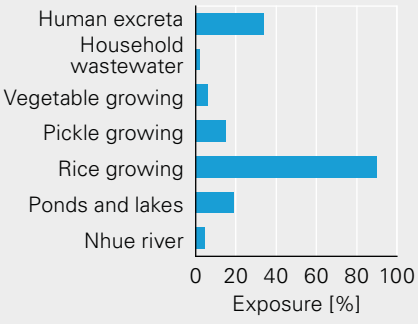

Figure 1: Exposure to excreta and wastewater (%) through agricultural activities.

[1] Haas, C.N., Rose, J.B. and Gerba, C.P. (1999): Quantitative Microbial Risk Assessment. New York: John Wiley & Sons, INC. 449.

[2] World Health Organisation (2006): WHO guidelines for the safe use of wastewater, excreta and greywater. Volume 2: wastewater use in agriculture. Geneva, World Health Organisation. 191 p.

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