Pathogen Destruction and Aerobic Decomposition in Composting Latrines

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"The United Nations estimates that 2.5 billion people worldwide lack access to basic sanitation (United Nations, 2008). Inadequate sanitation causes diseases and deaths—about 2 million people die every year from diarrheal diseases (WHO, 2008). In Panama, while 90% of the population has some form of sanitation, only 25% of those living in the indigenous reservation, Comarca Ngöbe -Buglé, has access to sanitation (ANAM, 2006).

Composting latrines are a common sanitation solution in rural Panama. These latrines are assumed to effectively destroy pathogens in human excrement through aerobic decomposition at high temperature—the composting process. However, according to several studies (summarized in Hurtado, 2005; Kaiser, 2006), the majority of composting latrines in developing countries never reach high enough temperatures for pathogen removal. Instead, studies (summarized in Kaiser, 2006) suggest that desiccation at high pH may be the responsible means of pathogen removal; yet, the breakdown of organic matter is hindered at high pH and low moisture levels.

To assess the relationship between temperature, high pH, desiccation, decomposition, and pathogen destruction, a survey to observe the use of desiccant and obtain temperature and pH measurements was conducted on 63 composting latrines in five indigenous communities. Furthermore, compost samples were taken to a laboratory for chemical and microbiological analysis to test for pH, % moisture, carbon-to-nitrogen (C/N) ratio, and presence of pathogens.

The temperature results support previous findings that compost latrines do not get hot enough to kill pathogens; rather, the latrines remained close to ambient temperatures. The pH results show that many latrines were operating within the range for ideal decomposition, pH of 7.5-8.5 (Jenkins, 1994), but only 17% of latrines measured pH 9 or above, the recommended pH for pathogen destruction (WHO, 2006). Most composting latrine users added desiccant materials, sawdust and wood ash, to lower the moisture level and provide the necessary carbon for decomposition. However, it seems not enough desiccant materials were added because moisture levels remained above the suggested maximum of 25% for pathogen destruction (WHO, 2006) and C/N ratios were in the range of the ratio of raw human feces. More importantly, the results of the microbiological analysis show various pathogens, mainly helminthes, still present in the compost samples that had been stored for the recommended 6-month storage time.

From these results, it follows that pathogens are not being removed in composting latrines nor is aerobic decomposition taking place. As a means of sanitation, composting latrines must be operated to destroy pathogens. Storage time should be increased to a minimum of 1-year, and users should be instructed to add more desiccant materials of both the high pH type (e.g., wood ash) and bulky type (e.g., sawdust). The current composting latrine design used in Panama will need to be adjusted for the longer storage time.