

Farmers and Wastewater Management - A Case Study of Integrated Urban Wastewater Management and Agriculture in Hanoi, Vietnam

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ABSTRACT:

Owing to the improper management of wastewater in many cities in Vietnam, a large number of urban and peri-urban farmers are engaged in the practice of wastewater for irrigation and aquaculture. Especially in Hanoi, total area irrigated with wastewater is 43,778 ha and involved 658,300 farmers (L Raschid-Sally & Jayakody, 2008). Despite the amount of wastewater utilized by urban farmers are expected to increase due to the larger amount of wastewater generated from urban population, and the contribution of urban farmers to generate vast quantity of urban waste including solids and wastewater through agriculture practices (Brody Lee, 2010), these activities are very little recognized by municipal's management authorities (Do et al., 2006) nor looked down by the community. Therefore, wastewater utilization by urban farmers remains as informal, unplanned and spontaneous practices.

The purpose of this study was to investigate into farmers' managerial capacity wastewater irrigation. Individual aspect of farmers' wastewater irrigation management capacities are personal characteristics and skills (including drives and motivations, abilities and capabilities and biography). Farmers perform their tasks in the environment that is influenced by various factors. Boehlje and Eidman (1984) distinguish four major dimensions: (1) the institutional environment; (2) the social environment; (3) the physical environment; and (4) the economic environment .

By applying sustainability science and system dynamic approach, this research sought answers for following questions: (1) How farmers practice wastewater irrigation? (2) How they perceived of risks /benefits of wastewater irrigation? (3) Are they willing to adopt measurements to reduce risks while engaging in wastewater irrigation? (4) What are factors affecting farmers' managerial capacity toward wastewater irrigation management?

This research selected 2 communities: Thanh Liet, Dong Ba in peri-urban area of Hanoi according to its typical practices of wastewater irrigation in Vietnam. GIS device was used to map the study area, irrigation systems, water sampling points and cropping

pattern. Quality of irrigation water was analyzed both on site and in laboratory by using simple test kits and portable water quality meter. General information of the communities and agriculture activities of the farmers were obtained from key informants. Combined informal interviews and participatory observation were applied for farmers either at the field when working or at their homes

Total 29 farmers were interviewed in both areas. The number of female participated were outnumbered men (18 female /11 male farmers). All farmers interviewed were literate with primary and upper education and most of them were involved in rice cultivation. Farmers in Thanh Liet were exposed more to wastewater than Dong Ba farmers in terms of exposure time and concentration of wastewater. Most farmer households have access to hygienic latrines with septic tank while fewer farmer households could access to tap water. Data from water sampling showed that many water quality parameters in both areas do not meet the standards, especially very high number of detected E.coli and Total Coli forms. However, when distributing into the plots, the quality of water is improved by flowing through long distance of channels and undergone natural treatment.

From preliminary assessment of water quality, it can be seen that wastewater irrigation has some potential to be reused for farmers in terms of nutrient recovery and income generation as well as bring s high risk for human health relating to pathogens (i.e., the risk of diarrheal disease associated with consuming salad crop irrigated with wastewater in Thanh Liet was 2×10^{-5} . This is 2 times higher than WHO's tolerable risk of infection of 10^{-3} per person per year, but lower than the estimated incidents of diarrheal disease in Western Pacific region, i.e., 0.72 pppy (WHO, 2009)).

Farmers in Thanh Liet have more experiences in wastewater agriculture compare to farmers in Dong Ba. They have more knowledge about the contaminants and risk posed by wastewater, mainly by physical appearances and experience of diseases. Dong Ba farmers on the other hand are more concerned about invisible risks since they were informed by various channels such as the media or relatives or neighbors , but they insisted that the irrigation water in Dong Ba is from Red river, therefore it is clean.

Many farmers in Thanh Liet are observed to wear protective clothes especially gloves and boots to protect the skin from contacting with the wastewater. This practice is either seen on women or men. In contrast, very few farmers in Dong Ba answered that they wear gloves and many of them said it is not necessary and uncomfortable.

The quality of water seems to affect the crop pattern. Thanh Liet farmers shows more adaptation than Dong Ba farmers, they shift from rice to other aquatic vegetables

Regarding to willingness of farmers to adopt measures in 2 study areas, 59% farmers agreed that wearing protective cloth; 76% keep hygienic of food and drinks are effective to protect their physical health.

This research found that wastewater irrigation in Hanoi peri-urban agriculture and urban wastewater management was integrated system. Despite of being linked in urban wastewater and urban food chain, wastewater farmers behaved independent and self

interested among peers and others which results in some short terms measures such as generate income from wastewater fed fish ponds, aquatic plants or non-food crops, reduce occupational health risks or keep cleanliness of food and drinks to improve health.

The study found out that the factors influenced farmer's capacities of wastewater irrigation governance are:

- Internal factors are: (1) age of farmers, (2) experience in wastewater irrigation, (3) knowledge and skill in wastewater irrigation, (4) motivation in wastewater agriculture.
- External factors are: (1) institutional environment includes regulation on wastewater use in agriculture, decentralised/centralised wastewater management, spatial separation on governance responsibilities of different department, state of participatory in local cooperatives; (2) physical environment such as climate change, diseases outbreak, constituent in wastewater; (3) social environment consists of social linkage and norms; (4) economic environment: consumer buying behaviour and income from wastewater agriculture.

Farmers' behavior where more driven by economical and physical factors, while institutional and social factors appeared to discourage farmers to have high performance of farming.

This research proposes two mechanisms for strengthening farmers' managerial capacity on wastewater governance via wastewater irrigation, i.e. strengthening social participation and institutional involvement of farmers.