Journal of Cleaner Production xxx (2014) 1–9

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Turning waste into value: using human urine to enrich soils for sustainable food production in Uganda☆

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ARTICLE INFO

Article history:
Received 27 September 2013
Received in revised form
16 January 2014
Accepted 24 January 2014
Available online xxx

Keywords:
Action research
Collective action
Natural resource management
Smallholder agriculture
Sustainability science

ABSTRACT

This article builds on an action research process involving Ugandan smallholder farmers in collaborative experimentation on the use of human urine as a crop fertilizer. The aim is to explore farmers' perceptions and evaluation of the practice as a potential and partial solution to soil productivity problems. Findings show that urine fertilization is valued as a low-cost and low-risk practice contributing to significant yield increases, suggesting important contributions to food security and income, especially for those who have few options in soil nutrient management. Weaknesses identified by farmers relate mainly to limitations in collection and storage capacity rather than to inherent traits of the practice. In conclusion, urine fertilization should be acknowledged as a valuable strategy for supporting sustainable agricultural intensification. Furthermore, the importance of social norms and cultural perceptions should be recognized but not treated as absolute barriers to diffusion of the practice. Collective action, where groups of farmers jointly develop new procedures and adapt practices, serves as an important arena for social change and negotiation of norms and taboos, which can otherwise limit the acceptance and diffusion of alternative soil management practices. The research finally illustrates that transdisciplinary research can guide pathways towards sustainability through locally anchored and solutions-oriented knowledge generation.

1. Introduction

Smallholder farmers in sub-Saharan Africa largely depend on, and continuously struggle to maintain, the productive capacity of their land (Sanchez, 2002). In order to improve land management, food security and rural livelihoods, it is important for agricultural research to collaborate with farmers – in all stages of development – in the search for affordable, locally anchored and sustainable practices. Only then is technology adoption expected to take root (Röling, 2009).

The promotion of inorganic fertilizer is a dominant strategy among governments and international development organizations to tackle low soil fertility. However, for the large majority of farmers in sub-Saharan Africa such initiatives have had limited effects due to high costs and limited access. At roughly 2 kg per hectare of farmland, the average fertilizer consumption[1] in Uganda is among the lowest in the world (World Bank, 2013). Among women, who are likely to be more asset-poor and subsistence oriented compared to men, fertilizer use is even lower (Peterman et al., 2010). Soil fertility practices benefitting those who need it most are therefore called for.

Human urine is a valuable, yet underestimated and underutilized, resource for plant fertilization that has been used in agriculture since ancient times, not least in intensive farming systems in various parts of Asia (Goldstein, 2012; Netting, 1993). Nevertheless, in much of sub-Saharan Africa, including Uganda, its use in agricultural production is not a common practice (Winblad and Simpson-Hérbert, 2004). Until recently, the demand for additional fertilizer sources was low since agricultural land was generally fertile and farmers practiced shifting cultivation. Moreover, the handling of human waste is often surrounded by cultural norms and taboos, which restrict its use in agriculture (Dellström Rosenquist, 2005). Finally, the one-sided focus on conventional 'end-of-pipe' sanitation systems has not only created a techno-institutional lock-in (cf.Unruh, 2000), discouraging nutrient reuse in wealthier parts of the world, but this philosophy has also spread to the Global South (Bracken et al., 2007).

There is an increasing research interest in the fertilizer value of human waste. Studies have focused mainly on its yield enhancing potential (e.g., Mnkeni et al., 2008; Semalulu et al., 2011), possible

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[1] Refers to total consumption of nitrogenous, phosphate and potash fertilizers in kilograms per hectare of arable land.

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http://dx.doi.org/10.1016/j.jclepro.2014.01.070

health hazards (e.g., Höglund, 2001; Jönsson et al., 1997), and technical aspects of collection and storage systems (e.g., Maurer et al., 2006; Wohlsager et al., 2010). While most of these studies are based on off-farm research, participatory approaches that involve farmers remain marginal. Furthermore, although often identified as key barriers to the use of human waste in food production, related norms, attitudes and cultural perceptions have so far been insufficiently explored (Karak and Bhattacharyya, 2011).

In order to successfully promote nutrient reuse, we need to better understand not only if and how such systems can be introduced in specific contexts but also how farmers perceive the use of human waste in food production, and how they evaluate and adopt such practices. In this article, I draw on a collaborative process of experimenting with urine fertilizer in maize production in an Ugandan smallholder farmer community to explore these issues, and to evaluate urine fertilizer as a potential and partial solution to soil productivity problems, including both yield impact and farmers' perceptions.

The article is organized as follows. First I introduce the agrarian setting and outline the ideas of participatory action research. Then I discuss the process of identifying urine fertilizer as a partial and potential solution to soil productivity problems, followed by an account of the actual implementation of the experiments. After that, I discuss the evaluation of the practice, both from a yield perspective and by the expressed views of farmers. In the concluding section, I summarize the research findings and discuss them in the wider context of agricultural development and a solutions-oriented sustainability science agenda.

2. Setting the scene

My research with smallholder farmers of the Jopadhola ethnic group is set in the Tororo District in eastern Uganda (Fig. 1), which is a region suffering from particularly severe land degradation (Pender et al., 2006). Soils are varied but dominated by sandy clay and loam soil types with low organic matter content and soil fertility (NEMA, 1997).

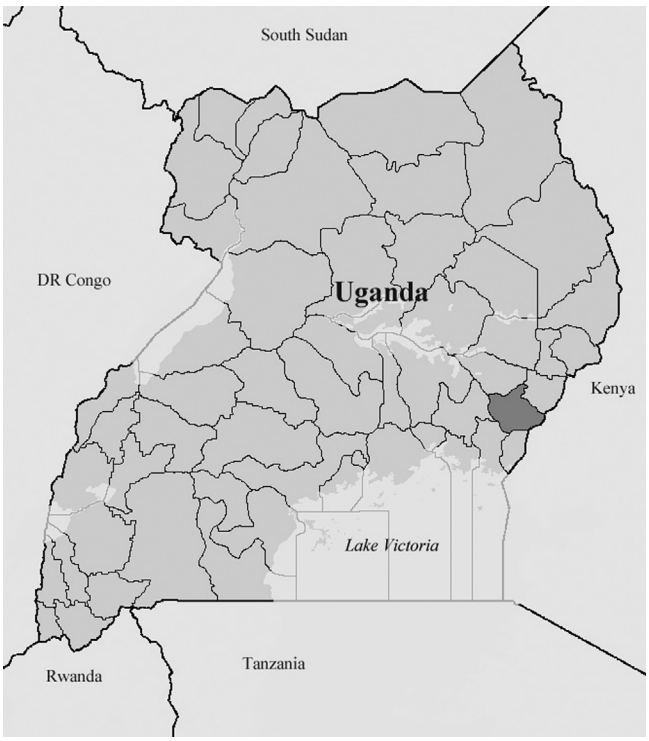

Fig. 1. Location of the Tororo district in Uganda. Source: Wikimedia Commons.

The situation in the region reflects the generally dire conditions experienced in many parts of rural sub-Saharan Africa where the majority of the population depends on rain-fed smallholder agriculture as a principal source of income. Poverty in the region is widespread and purchased inputs are few (c.f. Pender et al., 2006). Farmers operate in the unfavourable environment of poor infrastructure, weak social security systems, fluctuating food prices and few credit services. At roughly 1 ha per household, land holdings are generally small and intensively cultivated. As pressure on land is growing (Hundsbæk Pedersen et al., 2012), it is urgent to find strategies to sustainably produce more on existing farmland. Farmers grow mainly cassava, millet, maize and plantain. Due to land pressure and disease, livestock numbers have decreased considerably over time (Field data 2010–2012). Gender inequalities, in terms of access to land and other productive resources, are significant. While responsible for much of the agricultural labour, women are often discriminated against in land disputes (c.f. Pedersen et al., 2012).

Many farmers experience a dwindling capacity to sustain the household through agriculture; yields are typically well below potential yields, found at research stations, and have gradually declined over time (cf. Pender et al., 2006). Farmers identify low and declining soil fertility as one of the main reasons for the poor agricultural performance. A range of soil fertility management methods are practised, including crop rotation, intercropping with nitrogen-fixing crops, composting and crop residue management, in combination with various soil conservation measures. A key limitation is that organic resources are generally low in nutrient content and have numerous competing uses (Field data 2010–2012).

In response to these harsh livelihood conditions, farmers in the area have increasingly begun to organize themselves in local farmer groups. Compared to previous forms of collective action, which were short-term and centred around specific agricultural activities, these new groups can be described as continuous and well-organized 'communities of practice'. Women in particular engage in such groups for the purpose of making better use of their limited assets and supporting each other in daily livelihood provision (Andersson and Gabrielsson, 2012).

3. Doing participatory action research

This research is guided by a participatory action research approach, which distinguishes itself from conventional research approaches in two important ways: 1) it aims to contribute practical solutions to 'issues of pressing concern to people' (Reason and Bradbury, 2008), and 2) it directly involves people affected by such problems, not merely as 'research participants' but more as 'co-researchers'. Collaborative learning and action thereby become essential elements of the research process, implying a shift from the traditional divide between the 'researcher' and the 'researched' towards a greater sense of shared ownership of the research process and its results (Herr and Anderson, 2005).

In the context of agricultural development, action oriented research approaches represent an alternative to the conventional 'transfer-of-technology' model, which espouses the idea that knowledge be generated by research institutions and then diffused among farmers via extension services (Röling, 2009). Proponents of participatory approaches have emphasized that farmers are neither just passive victims of changing realities, nor merely recipients of agricultural innovations, but 'agents of change' (Chambers et al., 1989; Gabrielsson and Ramasar, 2013; Olsson and Jerneck, 2010). Close interaction with farmers is therefore seen as imperative for

Please cite this article in press as: Andersson, E., Turning waste into value: using human urine to enrich soils for sustainable food production in Uganda, Journal of Cleaner Production (2014), http://dx.doi.org/10.1016/j.jclepro.2014.01.070