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Knowledge identification and creation among local stakeholders in CDM waste composting projects: A case study from Uganda

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ABSTRACT

Municipal solid waste composting is seen as a promising technology in Sub-Saharan Africa to offset greenhouse gas emissions under the Clean Development Mechanism (CDM) program. The main reasons given therefore are the large organic fraction in municipal solid waste in this world region and the low complexity of the technology. The investigation results of case studies from other world regions suggest that the knowledge of local stakeholders involved in CDM composting projects is another crucial factor for their success and sustainability. The existing knowledge and knowledge demand of these stakeholders, however, is rarely considered in CDM composting project design documents from Sub-Saharan Africa. The study presented in the article at hand aimed to investigate both the existing knowledge and knowledge gaps of local stakeholders in a CDM waste composting project implemented in 17 cities in the Sub-Saharan African country of Uganda. This was done by selecting one of these cities (Busia) as a case study. After identifying the most important local stakeholders, methods of data collection and analysis (i.e. interviews, focus group discussions, compost field tests, material flow analysis, and full cost accounting) were embedded in an action research framework and applied to the case study of Busia prior to implementation of the CDM project. Furthermore, ways of closing the knowledge gaps identified were elaborated. Results showed that city authorities implementing and operating the CDM composting project, as well as farmers as potential users of the compost, were the two most relevant stakeholder groups. For city authorities, a knowledge gap regarding the net costs and benefits associated with the CDM project was identified, due to the underestimation of operation costs for composting and the overestimation of revenues from compost sales in the CDM project design document. The overestimation of compost sales revenues was due to the non-existence of a compost market, explained by the lack of experience and knowledge of farmers with respect to compost use and its value. While this knowledge among farmers can be acquired, for instance by means of agricultural extension services, key factors for marketing the compost, such as appropriate compost prices and compost quality, must also be addressed as part of a comprehensive solution. Investigations like the one presented in the article at hand are important not only for future CDM composting projects in Sub-Saharan African countries, but also for designing greenhouse gas mitigation programs under the green climate fund in the post-CDM period, as stipulated in the Paris Convention of Parties 21 Agreement.

1. Introduction

The clean development mechanism (CDM) program finances measures of greenhouse gas (GHG) reduction in lower income countries. One of the sectors considered in CDM is waste handling and disposal, a sector that also includes solid waste management (Bufoni et al., 2015; Plöchl et al., 2008; Rahman and Kirkman, 2015; Siebel et al., 2013; Unnikrishnan and Singh, 2010). Among the GHG reduction technologies and related methodologies for calculating GHG reductions in solid waste management (UNFCCC, 2016a), landfill gas management is the most important, followed by composting, waste to energy, and other technologies. Table 1 illustrates the distribution of solid waste treatment technologies in registered CDM projects considered in the sector "waste handling and disposal (13)" (UNFCCC, 2017; see also Table S1 in the supplementary material).

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Table 1
Percentage distribution of registered CDM solid waste management projects.

	Landfill gas	Composting	Waste to Energy	Biogas	Miscellaneous
SSA countries	72%	18%	5%	5%	0%
Other countries	66%	18%	14%	1%	1%
Total	67%	18%	13%	1%	1%

For the world region of Sub-Saharan Africa (SSA), several general studies suggest that composting is the most promising technology of GHG emission reduction in solid waste management due to the comparatively large organic fraction in waste in SSA countries, and the low complexity of composting (Couth and Trois, 2012; Friedrich and Trois, 2016; Galgani et al., 2014; Rogger et al., 2011). Experiences from detailed case study investigations of CDM composting projects from non-SSA countries like Bangladesh and Indonesia, however, suggest that beyond waste composition and composting technology, knowledge among local stakeholders of waste management (e.g. city authorities and politicians, locally operating NGOs, waste collectors and pickers or waste producers), ideally existing before the project implementation, plays a crucial role in the success of CDM waste composting projects. Zurbrügg et al. (2012), for instance, highlight the role of local leaders in mediating between the composting plant operator and the neighboring community by transferring knowledge between both stakeholder groups in the Gianyar waste recovery project in Indonesia, while Ayers and Huq (2009) point out the lack of experience and thus knowledge of local NGOs to comply with the administrative burdens of CDM projects in Bangladesh.

Even though these findings from Asia exist, hitherto no such CDM composting project case study investigation considering existing knowledge and knowledge requirements of local stakeholders involved in the project has been published for the region of SSA. The article at hand aims to partially fill this gap by presenting the investigation of a CDM composting project from SSA as a case study, focusing on existing knowledge, knowledge gaps and knowledge requirements of local stakeholders as well as on ways to bridge existing knowledge gaps before the implementation of the CDM project. To fulfil this aim, the *Uganda Municipal Waste Compost Programme*, implemented in 17 cities in Uganda was taken as a case study. The CDM project city investigated in detail was Busia Municipality in Eastern Uganda, and the specific research questions that guided the investigation were:

1) What knowledge exists among local stakeholders on the CDM composting project prior to its implementation?
2) What further knowledge on the CDM composting project is required prior to its implementation?
3) If knowledge gaps on the CDM composting project exist prior to its implementation, how can they be overcome?
4) What can future CDM composting projects learn from this case study?

Thus, the specific research objectives of the study were i) to identify relevant local stakeholders, their knowledge and knowledge gaps with respect to the CDM project prior its implementation, ii) to present approaches how to overcome these knowledge gaps (if existing), and iii) to discuss what can be learned from this case study in an international context. To meet these objectives, a set of methods of knowledge generation, exchange, and dissemination were embedded in an action research framework. After giving some background information on the case study, the application of this framework, which was also presented in another article on waste collection in Busia (see Lederer et al., 2015), is shown in Section 2, including the therein embedded methods of data collection and processing. The results of the research are presented in Section 3, while the discussion in Section 4 wraps-up the research questions in detail. After giving an update on the recent development of the CDM composting project in Uganda (Section 4), the conclusion is presented in Section 5.

2. Materials, methods and methodology

2.1. Background information

2.1.1. The CDM composting project in Uganda and Busia

The *Uganda Municipal Waste Compost Programme* is a two-phase small-scale CDM project under the Program of Activities (PoA) number 2956 (UNFCCC, 2016b). The duration is 21 years (2007–2028), and the project is implemented by the World Bank, the Ugandan National Environment Management Authority (NEMA), the Government of Uganda (GoU) and the participating cities. In total, 17 medium-size cities of 50,000–200,000 inhabitants, amounting to 25% of Uganda's urban population, participate in the project (UBoS, 2011; see Fig. S1, supplementary material, for the location of the cities). Using a loan from the World Bank, the GoU finances waste collection equipment and one composting plant in each of the participating cities. By registering as a CDM project, certified emission reductions (CER) of GHGs can be generated by composting instead of landfilling of the cities' organic wastes. These CERs can be sold to generate income for the cities and to pay back the World Bank loan (see Fig. 1).

According to NEMA (2011), the nine cities of the first phase of this project (Fort Portal, Jinja, Kabale, Kasese, Lira, Mbale, Mbarara, Mukono, Soroti) started to operate the delivered composting equipment in the year 2010. The second phase, which started in 2012, is currently being implemented in eight other cities (Arua, Busia, Entebbe, Gulu, Hoima, Masindi, Mityana, Tororo). The investiga-

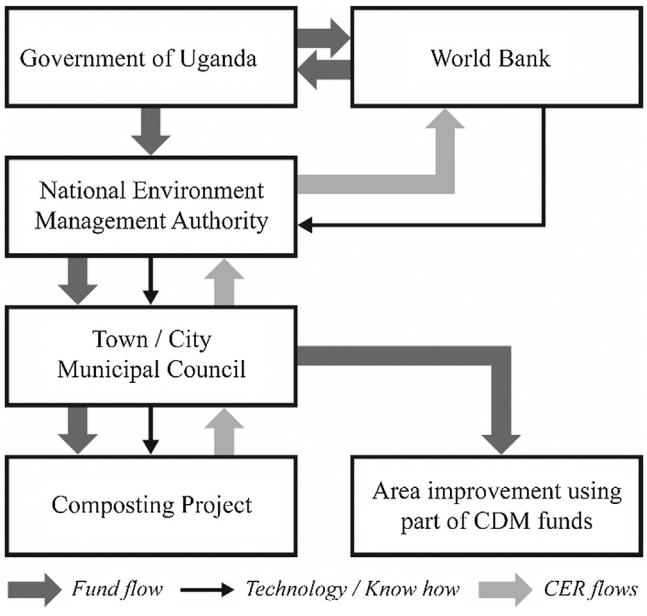

Fig. 1. Implementation framework in the *Uganda Municipal Waste Compost Programme* after Kumar (2008).