

## Integrated faecal sludge management scheme for the cities of Burkina Faso

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### ABSTRACT

The National Utility for Water and Sanitation in Burkina Faso (ONEA) has recognized the difficulty in providing sewerage sanitation to the entire urban population and has opted for a strategy involving onsite sanitation. Most of the country's population is served by onsite systems that generate large amounts of faecal sludge, and are responsible for a high prevalence of water-borne diseases. ONEA and the Department of Water and Sanitation in Developing Countries (Sandec) at the Swiss Federal Institute of Aquatic Science and Technology (Eawag) have a collaborative project that aims to establish an enabling environment for the development of the faecal sludge sector at the institutional and technical level. The project's participatory process has allowed the design of a treatment plant adapted to local conditions, and the elaboration of the first institutional framework for faecal sludge management including several new official documents. Several technical studies filled knowledge gaps of faecal sludge characterization, and the feasibility of implementing planted drying beds. Lessons learned are transferable nationally and internationally.

**Key words** | Burkina Faso, faecal sludge, institutional setup, treatment plant

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### INTRODUCTION

Centralized, sewer-based wastewater systems have not been adequate in meeting sanitation needs in urban areas of developing countries; and 2.5 billion people worldwide still lack access to 'improved' sanitation (UNICEF & WHO 2012). In West Africa, the majority of the urban population with access to sanitation are served by onsite facilities (e.g. pit latrines, septic tanks) that produce large amounts of faecal sludge, and require a management plan (Mbéguéré *et al.* 2010). Faecal sludge is defined here as the 'raw or partially digested slurry or solid that results from the storage of blackwater or excreta' in onsite sanitation systems (Tilley *et al.* 2009). Urban sanitation systems based on faecal sludge management have been shown to be adequate and much more affordable than sewer-based systems (Dodane *et al.* 2012). At this time, there is no management or treatment of the faecal sludge from onsite systems in Burkina Faso, and the legal framework only weakly addresses these aspects. A lack of regulation is well known to be a major stumbling block in achieving adequate sanitation (Strauss

and Montangero 2003; Koanda 2006; AECOM & Eawag 2010).

To address the sanitation and public health challenge, the National Utility for Water and Sanitation of Burkina Faso (ONEA) has adopted Strategic Plans for the two biggest cities (Ouagadougou and Bobo-Dioulasso) that include wastewater and faecal sludge management (Vezina 2002). After the completion of a sewer based system, ONEA launched a parallel program for faecal sludge management in these cities.

ONEA signed an agreement with the French Development Agency to build two faecal sludge treatment plants (FSTPs) in Ouagadougou that were designed by a consultant. Following this agreement, a 3-year collaborative project between ONEA and the Department of Water and Sanitation in Developing Countries (Sandec) at the Swiss Federal Institute of Aquatic Science and Technology (Eawag) was launched. Two main objectives of this project are: (1) to ensure the successful operation of the future FSTPs, and (2) to develop a sustainable institutional

framework for faecal sludge management, which can also be implemented in other cities in Burkina Faso. This paper presents the activities carried out to meet these objectives during the period of January 2010 to June 2012.

## Context

Ouagadougou, the capital city of Burkina Faso, has an estimated population of 1,475,233 (INSD 2008). It is located in the sahelo-soudanese region of Africa that is characterized by a dry season from October to May, and an intense rainy season from June to September, with a mean annual rainfall of 773 mm (Sou 2009). The faecal sludge production of Ouagadougou is greater than 500 m<sup>3</sup>/day (Koanda 2006), and 88% of its population is served by onsite sanitation (Somda 2006).

The Environment Code of Burkina Faso includes excreta under the definition of 'urban waste' (Assemblée des députés du peuple du Burkina Faso 1997). A decree sets the basic conditions for the collection of faecal sludge from onsite systems, and its end use or disposal. The Code of Public Hygiene prohibits the spreading of faecal sludge in agricultural fields, and defines municipalities to be responsible for the provision of sanitation services (Koanda *et al.* 2010). No official documents define the stakeholders in charge of the collection, transport, treatment, and end use or disposal of faecal sludge.

Several stakeholders are already providing collection and transport services, although a FSTP is not yet in place. These businesses and their working standards are not regulated. They are typically considered not to be legitimate by the authorities, and face harassment from citizens. This project only addressed mechanical collection and transport.

## METHODS

Three main activities were carried out, along with frequent interviews and workshops, to address problems and fill knowledge gaps: (1) Technical advice on FSTP technologies; (2) Research studies in Ouagadougou; and (3) Development of institutional framework and documents.

Financial aspects for the construction of the FSTPs are managed by ONEA. Other financial issues were included under institutional setup.

## Technical advice on the FSTP technologies

The decision to use unplanted drying beds was made by the consultant based on the following important criteria: financial sustainability (e.g. salaries, cost of consumables, amortization), land characteristics (e.g. availability, cost of land), local context (e.g. legal framework, existing stakeholders, hydrogeology, geography), and operational and reuse potential of liquid and solid end products (Strauss & Montangero 2003). A literature review on appropriate technologies for faecal sludge treatment was presented in a report to strengthen the capacity of local stakeholders (Bassan *et al.* 2010). Information workshops on the selected technical options were organized with all the important stakeholders, whose activities are crucial for the sector (e.g. municipality, technical professionals and police, and collection and transport companies) (DFID 1995). Influential stakeholders that have decision powers (e.g. the Ministries of Environment and Health) were also included, as were local non governmental organizations (NGOs) and universities active in faecal sludge management. The completion of the FSTPs is scheduled for mid-2013. At this time a technical assessment of the design and performance will be conducted.

## Research studies conducted in Ouagadougou

In order to meet the project objectives, two research studies were conducted.

1. Feasibility of faecal sludge treatment with planted drying beds:

Fodder and cattle markets were evaluated, and interviews conducted to determine the willingness to use fodder plant from drying beds. The availability of local plants that can be used in faecal sludge drying beds was assessed.

2. Characterization of faecal sludge in Ouagadougou:

Studies were conducted from December to February 2010 (dry season) and from June to September 2011 (rainy season) to analyse faecal sludge from collection and transport trucks in four frequently used discharge sites. Analyses of biological oxygen demand (BOD<sub>5</sub>), chemical oxygen demand (COD), Sludge Index (SVI), total solids (TS), total volatile solids (TVS), total

suspended solids (TSS), suspended volatile solids (VSS), Zn, Cu and NH<sub>3</sub>-N were completed.

### Development of institutional framework and documents

A stakeholder analysis was conducted based on (Koanda 2006) to build an enabling environment for faecal sludge management and ensure success of the participatory approach. The roles, responsibilities, and activities of stakeholders were assessed. Information workshops were then organized to bring stakeholders to a common understanding of the challenges (Lüthi *et al.* 2011).

Focus groups with the collection and transport companies and with the municipality were organized to elaborate the institutional and legal documents necessary to regulate faecal sludge management in Ouagadougou. These documents were validated in a workshop with representatives of all local stakeholders.

## RESULTS AND DISCUSSION

### Technical advice on the FSTP technologies

Unplanted drying beds were selected by the consultant for faecal sludge treatment based on the above-mentioned criteria. This choice was confirmed with previous operational experience. Field experiments with drying beds have demonstrated good treatment performance, straightforward operation and maintenance (O&M) procedures, resistance to shock loads, and adaptation to hot and dry climates (Koottatep *et al.* 2005; Mbéguéré *et al.* 2011). Based on 6 years of operational experience in Dakar, Senegal, the presence of flies and other vectors has been insignificant. The O&M does not require specialized equipment and consumables, and there is a potential for using treated faecal sludge in agriculture in the outskirts of Ouagadougou. The O&M is less demanding than settling/thickening tanks or stabilization ponds, which require intensive dredging, and the logistics are simpler than co-composting, which requires transport of solid wastes to the treatment plant.

The FSTPs were designed to treat 125 m<sup>3</sup>/day with a TS load of 21,000 mg l<sup>-1</sup>, and will have 48 drying beds with a

surface area of 128 m<sup>2</sup>. Faecal sludge will be discharged to a channel with one 1 cm grid bar screen prior to the drying beds. Once the beds are fully loaded (nominative load 150 kg TS m<sup>-2</sup>/year), they will be left to dry for up to 3 weeks (Pöyry 2010). The liquid fraction that percolates through the beds will be further treated in nearby waste stabilization ponds designed with anaerobic, facultative and maturation basins. The dried solids will be stored in a drying area built in two sections: one open area (3,337 m<sup>2</sup>) for solar drying, and one covered area for storage during the rainy season (1,000 m<sup>2</sup>). The storage time is estimated to be 6 months, based on a 90% reduction of helminth eggs (Kengne *et al.* 2009). Considering the helminth egg concentrations observed in other locations (30 eggs g<sup>-1</sup> TS), this would allow acceptable end product quality for agricultural reuse, and will be verified during operation (Koné *et al.* 2007; Navarro *et al.* 2008). The technical design was determined to be robust, and to have a minimal energy demand based on gravitational circulation.

Still in progress is an assessment of management needs to develop guidelines for safety, O&M, and monitoring procedures. These documents are crucial for ongoing sustainability of the FSTPs, and need to be completed prior to FSTPs' operation.

### Research studies conducted in Ouagadougou

It is planned to assess the possibility to adapt the unplanted drying beds into planted drying beds to ensure adequate treatment during the rainy season. This could enhance treatment performance and lower maintenance fees (Koottatep *et al.* 2001). Important parameters to assess for this adaptation include plant acclimatization and demand for end products. The market demand study revealed a strong acceptance of fodder from faecal sludge drying beds among sellers and buyers of fodder. They showed acceptance of 90 and 86%, respectively (Somé Dagba Gbessin 2010). Benefits include that 'fresh' plants can be available even during the dry season when other vegetation is desiccated. Two local fodder species were selected that have a good agronomic potential and reproduce readily by cuttings in wet environments: *Sporobolus pyramidalis* and *Echinochloa pyramidalis*. These species will be tested in experimental planted drying beds to assess the feasibility of full scale operation.

Faecal sludge characterization studies conducted in Ouagadougou during the dry and rainy seasons revealed that the BOD<sub>5</sub> and TS design values for the FSTPs are overestimated by a factor of 2 (Mahamane 2011; Zöllig 2011). These characteristics were estimated based on literature values prior to the start of the ONEA-Sandec project. Estimating faecal sludge characteristics in different contexts is very difficult due to the high spatial variability, which depends on the type and usage of onsite systems, the collection and transport technologies, the climate and the hydrogeology. This study illustrates the importance of conducting local characterization studies prior to design. The FSTPs' capacities are overdesigned, but fortunately the operation can be adapted, and the load increased. In the end, this will allow for an increased volume of 250 m<sup>3</sup>/day, a treatment capacity that was planned for 2020.

### Development of institutional framework and documents

Due to a lack of regulation, a large number of stakeholders are currently engaged in faecal sludge management without coordination (Koanda *et al.* 2010). The institutional analysis revealed that faecal sludge management is the overlapping responsibility of several government departments, and that previously no contact has existed between the collection and transport companies and other stakeholders.

To ensure stakeholder engagement, an information workshop was organized in June 2010 with representatives from all types of stakeholders, where the institutional analysis report was presented. At this stage it was realized that the association of collection and transport companies was inefficient and reluctant to collaborate in the project. Several meetings were held with this association to discuss their professional risks, development, and the benefits of being actively involved in the new faecal sludge management system. The association was hence reorganized, strengthened, and willing to participate.

Focus group discussions were time demanding, but were the only way to ensure agreement was reached among the stakeholders. Challenges and difficulties faced by the collection and transport companies were acknowledged by all key stakeholders. The need for professional development of private and public stakeholders was assessed, which resulted in

the identification of weaknesses in the system. A manual for collection and transport companies was then developed to address their needs. It includes technical information on existing onsite sanitation systems, health risks and protection measures for the handling of faecal sludge, and best management practices.

Two focus groups were organized to develop contractual and legal documents for the faecal sludge sector with the collection and transport companies and the municipal authorities (i.e. the five municipal districts, the police, the direction for property and the legal service). The obligations, rights and official relationships of collection and transport companies, ONEA (FSTP operator), and the technical services of the municipality (in charge of the regulation enforcement) were established:

1. The decree on provision of mechanical collection and transport services for onsite sanitation systems in Ouagadougou defines the required quality of service regarding the hygiene and the protection of employees and the environment. Conditions for service provision are also included (i.e. availability of a physical address, registration of the number of onsite systems emptied and discharge trips to the FSTP, and obligation to have a municipal licence);
2. The licence for service provision of collection and transport is an official authorization issued by the municipality, and based on the conditions outlined in the decree;
3. The partnership agreement between ONEA and the municipality defines each of their responsibilities to ensure the effective coordination of faecal sludge management.

The final management scheme is presented in Figure 1, where blocks represent stakeholders and their roles, and arrows indicate their relationships.

### CONCLUSIONS

The project led by ONEA and Sandec succeeded in developing the first official documents and clear institutional framework in West Africa for faecal sludge management. This will help ensure a future enabling environment for this sector. The collection and transport companies were successfully included in the collaborative development of

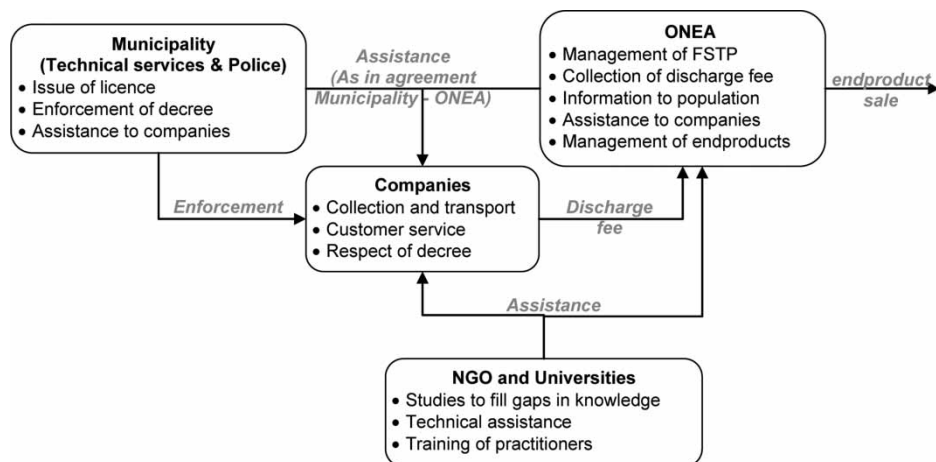


Figure 1 | Faecal sludge management scheme adopted for Ouagadougou.

faecal sludge management, and could review institutional documents prior to implementation. This will help guarantee that the businesses will be successful, faecal sludge will be delivered to the FSTPs, and that the FSTPs will function as designed. The developed project approach and solutions can be readily expanded for the implementation of faecal sludge management in other countries. Lessons learned from this project include:

- Detailed technical and institutional studies at the local level are necessary to accurately design FSTPs;
- Faecal sludge management involves multiple private and public stakeholders whose activities need to be coordinated for the system to work effectively, and can be more complicated than sewer-based systems. To ensure success, multiple stakeholder assessment and participative workshops must be conducted;
- The enforcement of a new institutional framework for faecal sludge management involves capacity strengthening for the stakeholders in the field of technical, financial, and human resource management together with public outreach campaigns for proper maintenance of onsite systems, and ongoing support of collection and transport companies.

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