Waterlines, 39:1, 61–72
<http://dx.doi.org/10.3362/1756-3488.19-00008>

Return to learn: recommendations from revisited rural ecosan projects in Burkina Faso

Linus Dagerskog, Sarah Dickin, and Karim Savadogo

Abstract: *Burkina Faso has extensive experience with urine-diverting dry toilets (UDDTs) and the reuse of human excreta in agriculture in line with the ecological sanitation (ecosan) principles of containment, treatment, and reuse. Around 30 such ecosan projects have been implemented over the past 15 years, including installation of approximately 13,500 household UDDTs, accompanied by awareness-building and training on toilet use, emptying, and reuse. Recently, efforts have been made to revisit former and current project sites in the spirit of 'return to learn'. We identified four such learning initiatives (studies/events), from which we draw recommendations to improve the sustainability of future implementation of ecosan in Burkina Faso and similar contexts. Key recommendations include increased attention to different user needs, handwashing and training on emptying/reuse as well as research and innovation on toilet design, urine collection/handling, menstrual management, and cost reduction/financing. Burkina Faso has set up the ambitious goal of 100 per cent toilet coverage and optimal reuse in the national sanitation programme by 2030, with UDDTs projected to make up 15 per cent of the 2 million toilets needed in rural areas. It is therefore timely to take stock and learn from past interventions. In addition, to enable resource recovery and reuse at scale, it will be important to develop a supportive policy and legal framework with collaboration between the WASH, agriculture, health, and environmental sectors.*

Keywords: sustainability, ecosan projects, policy framework, Burkina Faso

ECOLOGICAL SANITATION (ECOSAN) PROJECTS are ambitious, given the focus on safe resource recovery and reuse of human excreta in addition to access to sanitation. Reuse of human excreta in agriculture has productive benefits but also requires more effort from implementers and households compared with conventional sanitation interventions. Urine-diverting dry toilets (UDDTs) have a high resource recovery potential and is a common technology used to 'close the loop' in line with the ecosan principles of containment, treatment, and reuse (Winblad and Simpson-Hébert, 2004). In Burkina Faso, around 30 such UDDT ecosan projects, with a total of approximately 13,500 household toilets and 40 public toilets, have been implemented over the past 15 years, mainly in rural areas (Figure 1).

Despite extensive experience in Burkina Faso, relatively little is known on the sustainability of ecosan project outcomes. This knowledge gap has also been

Linus Dagerskog (linus.dagerskog@sei.org) and Sarah Dickin (sarah.dickin@sei.org) research fellows at Stockholm Environment Institute; Karim Savadogo (ksvadogo@yahoo.fr) director of Cabinet d'Études de Formation de d'Aménagement Écologique (CEFAME), Ouagadougou, Burkina Faso

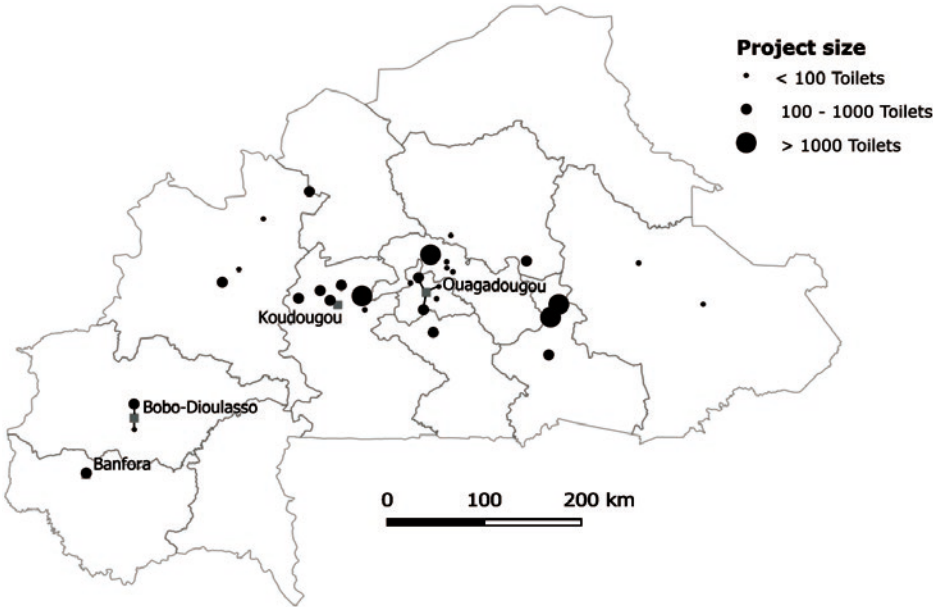

Figure 1 Location of identified ecosan projects in Burkina Faso
Source: compiled from Dagerskog et al., 2015 and Tourlonnias, 2018 (for further details on these projects see https://kvisit.com/Ow/sqkB)

identified as an obstacle for further uptake in policy and practice (Dagerskog et al., 2015). However in recent years, several efforts have been undertaken to visit former as well as current project sites in the spirit of 'return to learn'. We have identified three such field studies (here called S1–S3) and one workshop (S4) covering experiences from different rural ecosan projects in Burkina Faso (Table 1).

The learning initiatives in Table 1 contain findings that need to be synthesized into actionable recommendations for practitioners to improve sustainability of future ecosan interventions. In this paper we draw such recommendations and present them under the headings of the five sustainability dimensions of sanitation proposed by the Sustainable Sanitation Alliance (SuSanA) (Box 1). In addition, we analyse the current policy environment in Burkina Faso and propose potential changes to enable safe resource recovery at scale.

The UDDT ecosan systems in Burkina Faso

Projects in S1, S2, and S4 used UDDTs of a similar design with twin vaults above ground, known in Burkina Faso as the 'Ecosan toilet' (Photo 1).

The Ameli-EAUR project (S3) developed a urine-diverting single vault composting toilet in collaboration with Japanese partners, where faeces and carbon-rich organic matter was collected and composted in a rotating drum below the toilet. This toilet was provided to eight households.

Table 1 Overview of learning initiatives from ecosan projects in Burkina Faso

Study/ event	*Overview*	*Projects in study/event*	*Toilets visited*	*Years post project*	*Toilet age (years)*
S1	Study from 2016 by the authors of this paper, revisiting 522 households from three former ecosan projects, referred to as Ecosan-EU2, Ecosan-EU3, and EU-LVIA with a total of 8,000 urine-diverting dry toilets (UDDTs). Methods and results have been published in Dickin et al. (2018) and in Jonsson and Land (2017). The Ecosan_EU2 project approach with reuse focus is also described in Dagerskog and Bonzi (2010) and the EU_LVIA project experience in LVIA (2014).	EU-LVIA	295	2	3
		Ecosan_EU2	131	6	7
		Ecosan_EU3	96	5	6
S2	Carrasco et al. (2014) at IRC evaluated the hygienic use of ecosan toilets and fertilizers through a survey of households in the large ecosan project coordinated by the NGO LVIA (this project was also part of S1).	EU-LVIA	318	Before end of project	40% < 1 60% > 2
S3	Dakouré et al. (2017) and Traoré et al. (2017) from 2iE report from a follow up study of two of the eight households participating in the R&D project Ameli-EAUR.	Ameli-EAUR	2	1	?
S4	A two-day workshop was organized by the knowledge network ACTEA to discuss experiences from ecosan projects with support from French decentralized development cooperation to identify possible improvements (ACTEA, 2018). Three projects were presented followed by discussions on social, technical, and economic aspects of ecosan.	French financed ecosan projects	–	–	–

Box 1 Sustainability dimensions for sanitation

- *Health and hygiene* include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.
- *Environment and natural resources* involve the resources needed in the project as well as the degree of recycling and reuse practised and the effects of these.
- *Technology and operation* relate to the functionality and ease of constructing, operating, and monitoring the entire system as well as its robustness and adaptability to existing systems.
- *Financial and economic issues* include the capacity of households and communities to cover the costs for sanitation as well as the benefit, such as from fertilizer and the external impact on the economy.
- *Socio-cultural and institutional aspects* refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues, and compliance with legal and institutional frameworks.

Source: SuSanA, 2008

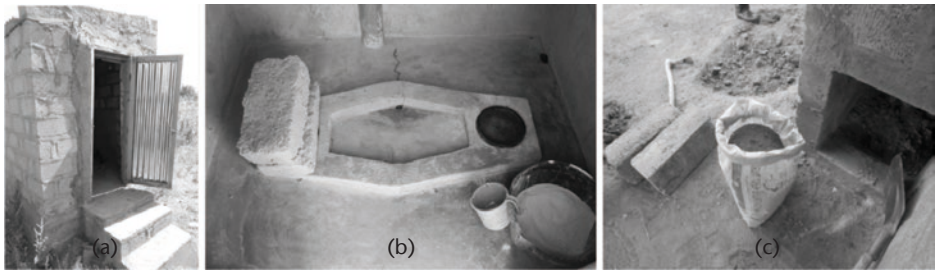

Photo 1 The common double vault UDDT in Burkina Faso. The urine diverter is often cast in cement on the slab, and there is an outlet for anal wash water in the corner of the cabin (b). The vaults can be emptied, removing the cover bricks (c).
Source: (a) ACTEA, 2018; (b) Clair le Bas/Bamouni Oumarou; (c) ACTEA, 2018

Considering the significant volume of urine generated over time with UDDTs, storage can be a challenge. Urine storage in 20-litre jerry cans at the household level has been common practice, but some projects have organized common storage in larger tanks at the community level. The reuse component has been emphasized to different degrees depending on project. Demonstration fields are common, and more ambitious projects have thorough training with all households (Photo 2).

Photo 2 Examples of reuse training by Association Koassanga (a) and maize demonstration fields (b) in the project by PSo05 comparing ecosan and conventional fertilizer
Source: (a) Association Koassanga; (b) PSo05

Recommendations to strengthen sustainability

This section presents recommendations to enhance the different dimensions of sustainability in future ecosan initiatives on the ground. The recommendations are based on findings from S1–S4, where S1 (carried out by the authors) was the most extensive study, providing most of the findings.

Health and hygiene

Cater for all users' needs. For health protection, it is important that all household members use the toilet at all times. S1 showed that 70–89 per cent of toilets,

depending on project, were observed to be in use after several years. However, within the household, groups such as women during menstruation, children, and the elderly were less likely to use the toilets:

- *Women during menstruation*. Most women respondents (67 per cent) in S1 were reluctant to use the latrine during menstruation. Reasons included shame, fear of leaving traces on the slab, and fear of contaminating the fertilizers. Future implementation will need to address menstrual management and raise awareness among both women and men to ensure that women are comfortable to use the toilet also during menstruation. Research on the underlying socio-cultural aspects and ways to address them would be helpful, as well as adapting the toilet design to better cater for women's needs. A proper wash-area in the toilet is likely essential, and the message should be clear that the ecosan fertilizers are not negatively impacted by menstrual blood.
- *Child faeces management*. 25 per cent of households with small children in S1 emptied potties outside the compound or left the children's faeces on the ground. Households need to be aware of the risk of child faeces in the local environment and encouraged to empty potties in the faeces compartment of the toilet. Additional ash or soil can be added to the toilet to make up for urine in the potty.
- *Elderly*. The stairs of the double vault UDDT can pose a problem for the elderly and people living with disability. A ramp or handrail in the wall can support access.

Highlight key practices to reduce pathogens and exposure. There was low presence of water and soap by the toilets (12–16 per cent of households in S1; 25 per cent in S2), indicating the need for more emphasis on handwashing. The safe management of the sanitation products also needs more attention:

- *Emptying and storage of faeces*. Storage of emptied faecal compost in open piles was practised by 10 per cent of households in S1, indicating the need to emphasize the importance of storage of emptied faeces in bags or direct incorporation in the field.
- *Urine*. A higher proportion of households in S1 had health concerns regarding reuse of urine (25 per cent) compared with the reuse of faeces (8 per cent). However, WHO (2006) considers recycling of a household's urine to their own agricultural fields as a very low risk for household members and requires no particular treatment (not even storage). Avoiding urine application the last month before harvest is considered enough for consumer protection.
- *Additives*. Access to ash as an additive seems to be an issue for many households, with ash present in only 43 per cent of revisited toilets in S1. Emphasize that covering faeces with dry material is important to avoid flies and odours and to help desiccation. In the absence of ash, dry soil can be used but WHO (2006) then proposes a storage period of at least 12 months in the toilet. If this is the case, adequate size of toilet vaults needs to be considered.

Environment and natural resources

The findings on vault emptying and the frequency of changing the urine jerry in S1 indicate that most households recover far less than the potential quantity of urine and faeces. Recovery is of course directly related to toilet use. Ecosan_EU2 was the most successful project in S1 with a high emptying frequency, which also implies a good toilet use. This was also the project with the most thorough training and emphasis on reuse among the three projects in S1. The recommendations in this section aim to enhance resource recovery and reuse.

Emphasize training and guidelines

- *Agricultural training*. Practical reuse training and participative field experiments build reuse skills and create demand for toilets and motivation to use them. A successful model has been applied in Association Koassanga's projects (from S4), where households are required to participate in a season of reuse experimentation on a part of their field before they can apply for toilet support.
- *More use → more fertilizers*. Emphasize that the more the households use the toilets and urinals, the more fertilizers they will recover, and the more agricultural production can be expected.
- *Guidelines*. Some households express a lack of knowledge of the dose and mode of fertilizer application. Manuals that can be adapted for farmers have been developed in Burkina Faso (CREPA, 2008), Niger (Barage, 2010) and in a general guideline by Richert et al. (2010).

Recover more urine and simplify handling. When it comes to urinating, 49 per cent of the respondents in S1 claimed to use the shower area or urinate outside the compound. To recover more fertilizers, urine collection and management would need to be improved:

- *Use of complementary urinals*. The use of simple urinals (e.g. jerry can and a funnel) in the shower area and elsewhere in the compound can increase collection.
- *Alternative urine handling*. Storing, transporting, and applying large volumes of urine is challenging both at household and community level, with several cases of failed community storage centres in the Ecosan_EU3 project. One alternative practised by some households is adding urine to the traditional composting pit or pile, providing much needed humidity and nutrients to the composting process in the dry season. A study from Niger showed good results from using such compost (Bouzou, 2009), while additional research would be useful for recommendations on urine dose, impact on compost process and quality, and how nitrogen losses could be minimized. Direct application of urine to agricultural fields during the dry season in furrows, preferably covered with soil, is another alternative (Illiassou, 2009). Promising research on urine drying, reducing volume by 90 per cent, can eventually enable the development of a drying technology also applicable in low income settings (Senecal et al., 2018).

Importance of vault emptying demonstration and support. Vault emptying has proven to be a problem; some households abandon their toilet instead of emptying it when

full. As toilet vaults take time to fill up there is often a lag time of 1–3 years before the first vault needs to be emptied. Ideally households are accompanied throughout a full cycle of toilet vault filling, emptying, and reuse. If that is not possible, a strategy can be to organize demonstration events around the first toilets to be emptied and also to raise the emptying issue at community level to identify potential individuals who could offer an emptying service in case of demand.

Technology and operation

Most households find the common double vault UDDT in Burkina Faso easy enough to use. However, there is room for technical improvements:

- *Doors*. Wooden door frames eaten by termites and poor-quality hinges were the main reasons for door problems (21 per cent of S1 households). Consider metal door frames and better hinges, or alternative entrances that don't need a door.
- *Design of the anal washing area*. Several households mentioned the problem of moving over to the washing area and limited space for washing. Anal washing needs to be easy and comfortable in the dry toilets if they are to be used by all people at all times. Innovation is called for.
- *Urine diversion design*. Most projects used the same mould to cast the urine diverter in cement directly on the slab. However, urine splashing can be an issue with this model and innovation is encouraged. For example, Sanergy in Kenya has used industrial designers to come up with a 'splash free' urine diversion pan (see photos in SuSanA, 2014). CREPA (2007) also displays different urine diversion options from around West Africa.
- *Urine pipes*. Blocked urine pipes and deteriorating flexible pipes have been a problem for 34 per cent of respondents in S1. To minimize blockage problems, a minimum of 25 mm pipes from the urine diverter with a good angle to the urine container is recommended (Kvarnström et al., 2006). If the flexible hose used to connect the exit pipe to the container deteriorates, a funnel (or cut-off bottle) could be placed on the jerry can to collect the urine.
- *Avoid overly complex designs*. The composting toilets with rotating drums (S3) were too advanced for the rural setting. Parts that cannot be repaired or replaced locally are risk factors for sustainability.

In Burkina Faso there has been a strong focus on double vault UDDTs, with less attention on other types of toilets that also could enable resource recovery, likely at a lower cost. This is discussed in the next section.

Financial and economic issues

The basic variant of the double vault latrine with a superstructure of mudbricks had a cost of approximately €180, to which the household contributed roughly 20 per cent in the projects studied in S1 and S2. The reported cost of the double vault latrines in two projects of S4 was approximately €400 (superstructure in cement). The high upfront cost makes scaling up difficult. In search for viable alternatives

there are now two projects trying a new financing model, providing the toilet on credit using a revolving fund (ACTEA, 2018). The credit is to be repaid with the ecosan fertilizers to a local association that in turn grow crops, with some of the revenue refilling the revolving fund.

To reduce the need for credit and subsidies it is important to encourage innovation and experimentation with lower cost toilet models, also beyond the conventional double vault UDDTs. A very basic solution with decent resource recovery potential could be to alternate between two pit latrines and collect urine with urinals separately. Other variants to explore include pit composting toilets without urine diversion (Morgan, 2007), with urine diversion (Dagerskog and Bonzi, 2010), or container-based toilets with external composting (Morgan, 2007; Jenkins, 2019). With more options, households can choose the model that best suits their needs.

Socio-cultural and institutional aspects

Recommendations to cater for socio-cultural and institutional aspects include:

- *Use different messages for demand creation*. Access to fertilizer came out as the main reason to acquire the toilet for households visited in S1, while privacy was given as the main advantage in S2. Hence it is important to use different messages to create demand, including the advantages for crop production, health, and dignity/privacy/convenience. The link to agriculture is a good entry point to engage the rural population and participative field experiments are an efficient way to create demand for toilets while building the reuse capacity. This also requires the involvement of agriculture competence.
- *Access and discretion*. Emphasize easy toilet access by encouraging placement of the toilet within the compound. Also make sure the entrance is oriented in a way that enables discreet entry/exit, which is important for many users (S4).
- *Visual information for visitors*. Some households worry about how to inform visitors and give instructions on toilet use. Simple visual instruction to put in the toilets could help.
- *Religious aspects*. In Muslim communities it has been important to emphasize the cleanliness aspects of sanitation and ensure adequate protection when manipulating the sanitation fertilizers as touching human waste is taboo (Dagerskog and Bonzi, 2010). It is also useful to distinguish between raw and treated faeces and urine, giving local names such as 'liquid and solid fertilizer'.
- *Local customs*. Local customs and beliefs could hinder or encourage toilet use and reuse. For example, in some ethnic groups in Burkina Faso a woman and her father-in-law should not use the same toilet. These types of taboos need to be identified and solutions found in a participative process.
- *Involving local institutions*. Long-term results require involvement and capacity building of the local institutions that remain post-project, including local political and technical authorities, traditional and religious leaders, and masons and community leaders.

Policies for sanitation and resource recovery in Burkina Faso

Burkina Faso's National Sanitation Programme (PN-AEUE) aims for 100 per cent sanitation coverage by 2030, but also includes a goal on optimizing reuse (MEA, 2016). The ambitions in sanitation coverage will require the construction of 2 million rural toilets and 1 million urban toilets. Of these toilets, the PN-AEUE projects that 15 per cent and 5 per cent of rural and urban toilets, respectively, will be UDDTs, while the rest would be different versions of improved pit-latrines and pour-flush latrines (MEA, 2016). To operationalize the PN-AEUE vision of both toilet provision and resource recovery there is a need for an enabling policy framework that goes beyond the WASH sector to include aspects related to the agriculture, health, and environment sectors. Table 2 summarizes how resource recovery from sanitation systems links to priorities of these four key sectors along with some steps these sectors could take to enable safe recycling in Burkina Faso.

Table 2 Key sectors with links to resource recovery and reuse from sanitation systems, possible policy measures, and current status in Burkina Faso

Sector	*Sector priorities with potential links to reuse*	*Possible policy/ regulatory interventions to enhance reuse*	*Current status in Burkina Faso*
WASH	UDDTs included in the national programme	Emphasize a systems approach to sanitation, including treatment and reuse	The PN-AEUE includes a specific objective on treatment and reuse of wastewater and faecal sludge
	Increased attention to faecal sludge management	Recommendations should preferably be technology-neutral, focusing on the function of the system to avoid stifling innovation	A national faecal sludge management strategy is in preparation
Agriculture	Conserving nutrients in agricultural systems	Include sanitation-derived resources in soil fertility strategies and fertilizer regulations	No specific mention of human excreta in policies and programmes
		Provide guidelines on how, when, and where to apply different types of sanitation-derived resources in agricultural production	Research has been carried out on crop-response from urine fertilization by the National Agricultural Research Institute (INERA), but no official guides have been published
Health	Minimizing risks to human health	Promote national research and advice on treatment options and protection measures along the sanitation chain from toilet to field to consumption	WHO reuse guidelines have not yet been adapted for the national context
		Adapt the WHO (2006) guidelines on reuse of excreta and wastewater to the national context	

(Continued)

Table 2 (Continued)

Sector	*Sector priorities with potential links to reuse*	*Possible policy/ regulatory interventions to enhance reuse*	*Current status in Burkina Faso*
Environment	Protection of water bodies Reducing the need for non-renewable resources	Regulations to avoid negative environmental impact from sanitation systems Regulations that encourage resource recovery and minimized use of non-renewable resources	Decree 2001/185 includes waste water discharge norms The National Adaptation Plan recognizes the collection and recycling of wastewater and excreta as one of the means to 'protect water resources from the adverse effects of climate change'

Source: updated from Dagerskog et al., 2015

Conclusion

Implementation of UDDTs in rural areas forms part of Burkina Faso's strategy to meet the sanitation target in Sustainable Development Goal (SDG) 6.2 and can also contribute to SDG 2 on zero hunger. However, what matters for impact is not the toilet itself, but the sustained use of toilets and sanitation-derived fertilizers over time. The studies analysed in this paper show that a majority of toilets in past projects are still in use, but not by everyone and at all times, which can undermine both health protection and potential resource recovery. The hands-on recommendations presented address some of the identified weaknesses. We also call for research and innovation related to toilet design, menstrual management, alternative urine handling, and cost reduction/financing.

In addition, to achieve the ambitious goal of 'optimal reuse' in Burkina Faso's national sanitation programme, a supportive policy and legal framework needs to be further developed with collaboration between the WASH, agriculture, health, and environment sectors.

References

ACTEA (2018) *L'assainissement écologique au Burkina Faso: quelles expériences, quelles conditions de réussite et quelles pistes d'amélioration?* [pdf] <www.actea.org/wp-content/uploads/2018/04/CR_atelier-ECOSAN_VF.pdf> [accessed 12 November 2019].

Barage, M. (2010) *Fiche technique d'application des urines hygiénisées (Takin Ruwa) dans les conditions agricoles du Niger* [pdf] <www.ecosanres.org/aguie/documents/FicheTechniqueApplicationUrine-BARAGE.pdf> [accessed 12 November 2019].

Bouzou, I. (2009) *Evaluation de l'effet du compost enrichi avec des urines hygiénisées sur la culture du mil* [pdf], MSc thesis, Université Abdou Moumouni, Niamey, Niger <www.ecosanres.org/aguie/documents/Memoire-Compost-BOUZOU.pdf> [accessed 12 November 2019].

Carrasco, M., Dubé, A. and Bassono, R. (2014) *Efficacité des interventions en matière d'hygiène et d'assainissement: Etude de cas des latrines EcoSan dans le cadre du projet d'appui à l'assainissement familial dans 12 communes rurales des régions du Plateau Central et du Centre-Ouest au Burkina Faso de 2011 à 2014* [pdf], IRC <www.ircwash.org/sites/default/files/2014_10_29_irc_lvia_rapport_ecosan.pdf> [accessed 12 November 2019].

CREPA (2007) 'Atelier regional ECOSAN des architects, ingénieurs et techniciens', *ECOSAN Info* 09 [pdf] <www.susana.org/_resources/documents/default/2-1517-ecosan-info-no09-june-2007.pdf> [accessed 12 November 2019].

CREPA (2008) 'ECOSAN convainc les agronomes d'Afrique', *EcoSan Info* 14 [pdf] <www.susana.org/_resources/documents/default/2-1518-ecosan-info-no14-septembre-2008.pdf> [accessed 12 November 2019].

Dagerskog, L. and Bonzi, M. (2010) 'Opening minds and closing loops: productive sanitation initiatives in Burkina Faso and Niger', *Sustainable Sanitation Practice* 3: 4–11 [online] <www.ecosan.at/ssp/issue-03-use-of-urine/issue-03> [accessed 12 November 2019].

Dagerskog, L., Savadogo, K., Hamadou, K. and Vodounhessi, A. (2015) 'Productive sanitation in Burkina Faso and Niger: going beyond projects?' *5th International Dry Toilet Conference, Tampere, Finland, 19–22 August 2015* [pdf] <www.huussi.net/wp-content/uploads/2015/06/Dagerskog_Full-paper_DT20151.pdf> [accessed 12 November 2019].

Dakouré, M.S., Traoré, M.B., Sossou, S.K. and Maïga, A.H. (2017) 'Development of sanitation technologies in African context: how could we make it more sustainable?' *IOP Conference Series: Earth and Environmental Science* 60(1): 012032 <https://doi.org/10.1088/1755-1315/60/1/012032>.

Dickin, S., Dagerskog, L., Jiménez, A., Andersson, K. and Savadogo, K. (2018) 'Understanding sustained use of ecological sanitation in rural Burkina Faso', *Science of the Total Environment* 613: 140–8 <https://doi.org/10.1016/j.scitotenv.2017.08.251>.

Illiassou, Y. (2009) *Evaluation de l'effet de l'application periodique de l'urine hygienisé sur la culture de mil* [pdf], MSc thesis, Université Abdou Moumouni, Niamey, Niger <www.ecosanres.org/aguie/documents/Memoire-Saisonseche-ILLIASSOU.pdf> [accessed 12 November 2019].

Jenkins, J. (2019) *The Humanure Handbook: Shit in a Nutshell* [online], 4th edn, Grove City, PA: Joseph Jenkins, Inc. <http://humanurehandbook.com/contents.html#> [accessed 12 November 2019].

Jonsson, A. and Land, A. (2017) *An Evaluation of the Long-Term Functionality of Ecological Sanitation (EcoSan) Projects in Rural Burkina Faso: Reuse of Sanitized Human Excreta as Fertilizer in Local Agriculture* [pdf], MSc thesis, Royal Institute of Technology, Stockholm, Sweden <www.diva-portal.org/smash/get/diva2:1128388/FULLTEXT01.pdf> [accessed 12 November 2019].

Kvarnström, E., Emilsson, K., Richert Stintzing, A., Johansson, M., Jönsson, H., af Petersens, E., Schönning, C., Christensen, J., Hellström, D., Qvarnström, L., Ridderstolpe, P. and Drangert, J.O. (2006) *Urine Diversion: One Step Towards Sustainable Sanitation*, SEI EcoSanRes series: 2006-1 [pdf] <www.sei.org/mediamanager/documents/Publications/SEI-Report-Kvarnstrom-UrineDiversion-2006-1.pdf> [accessed 12 November 2019].

LVIA (2014) *A Chaque Famille sa Latrine: Une expérience d'Assainissement Ecologique au Burkina Faso* [pdf], Project report <http://lvia.it/wp-content/uploads/2018/11/Publication_Assainissement_Burkina.pdf> [accessed 12 November 2019].

MEA (2016) *Programme National d'Assainissement des Eaux Usées et Excreta (PN–AEUE) 2016–2030* [pdf], Ministère de l'Eau et de l'Assainissement, Burkina Faso <https://www.actea.org/wp-content/uploads/2016/12/Programme-PN-AEUE-2016-2030-VF-final_CNEau-14-06-2016.pdf> [accessed 12 November 2019].

Morgan, P. (2007) *Toilets That Make Compost: Low-Cost, Sanitary Toilets that Produce Valuable Compost for Crops in an African Context* [pdf], Stockholm: SEI EcoSanRes Programme <www.ecosanres.org/pdf_files/ToiletsThatMakeCompost.pdf> [accessed 12 November 2019].

Richert, A., Gensch, R., Jönsson, H., Stenström, T.A. and Dagerskog, L. (2010) *Practical Guidance on the Use of Urine in Crop Production* [pdf], Stockholm: SEI, EcoSanRes series: 2010-1 <www.

sei.org/publications/practical-guidance-use-urine-crop-production/> [accessed 12 November 2019].

Senecal, J., Nordin, A., Simha, P. and Vinnerås, B. (2018) 'Hygiene aspect of treating human urine by alkaline dehydration', *Water Research* 144: 474–81 <https://doi.org/10.1016/j.watres.2018.07.030>.

SuSanA (2008) *Towards More Sustainable Sanitation Solutions: SuSanA Vision Document* [online], Sustainable Sanitation Alliance <www.susana.org/en/knowledge-hub/resources-and-publications/library/details/267> [accessed 12 November 2019].

SuSanA (2014) 'Photos of Sanergy's urine diversion pan' [online] <https://www.flickr.com/photos/gtzecosan/sets/72157644699243384/> [accessed 12 November 2019].

Tourlonnias, B. (2018) 'Panorama des projets EcoSan au Burkina Faso' [PowerPoint presentation], 28 February 2018, ACTEA Ecosan workshop, Koudougou <http://www.actea.org/wp-content/uploads/2018/03/Panoramas-projets-Ecosan-BF.pptx> [accessed 16 December 2019].

Traoré, M.B., Dakouré, M.S. and Maïga, A.H. (2017) 'Ameli-EAUR project: which lessons for the promotion of agricultural value chains?' *IOP Conference Series: Earth and Environmental Science* 60(1): 012033 <https://doi.org/10.1088/1755-1315/60/1/012033>.

WHO (2006) *Guidelines for the Safe Use of Wastewater, Excreta and Greywater: Volume 4 – Excreta and Greywater Use in Agriculture* [pdf], Geneva: WHO <https://www.who.int/water_sanitation_health/publications/gsuweg4/en/> [accessed 12 November 2019].

Winblad, U. and Simpson-Hébert, M. (eds) (2004) *Ecological Sanitation*, revised and enlarged edn [pdf], Stockholm: SEI EcoSanRes Programme <www.ecosanres.org/pdf_files/Ecological_Sanitation_2004.pdf> [accessed 12 November 2019].