sustainable sanitation alliance

Case study of sustainable sanitation projects

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

Fig. 1: Project location

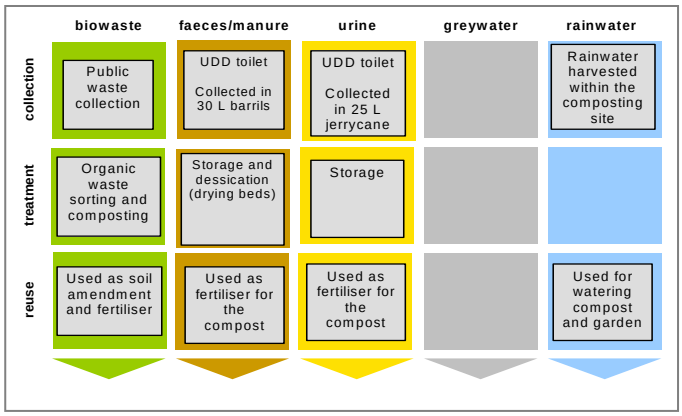

Fig. 2: Applied sanitation components in this project

1 General data

Type of project:

Small scale, semi-urban pilot project

Project period:

Start of construction: June 2013

End of construction: March 2014

Start of operation: January 2014

Project end: August 2014 (GIZ field coordination)

Project scale:

Number of people covered: a group of 8 gardeners, 28 pilot households and the city council – approx. 320 people (10 persons per household toilet and 50 people at the city council are assumed)

Number of toilets built: 28 domestic and 2 public Ecosan latrines

Size of treatment plant: 3.5 ha

Total investment: EUR 220,000

Address of project location:

Mairie de Lokossa BP 138, Région Mono, République du Bénin

Planning institution:

GIZ Advisory project „Concepts for Sustainable Waste Management“

Dag-Hammarskjöld-Weg 1-5, 65760 Eschborn, Germany

Executing institution:

GIZ (sector project and PEP: local water and sanitation project), City council of Lokossa, GI-Mono Inter-municipality Group, Protos NGO and DCAM Bethesda NGO

Supporting agency:

The German Federal Ministry for Economic Cooperation and Development (BMZ)

2 Objective and motivation of the project

- Contribute to an improvement of solid waste management and introduce ecological sanitation solutions in the city of Lokossa.
- Develop income-generating activities and stimulate the local agricultural sector by creating in the long term a sustainable and profitable compost market offering an ecological alternative to chemical fertilisers.

3 Location and conditions

Lokossa is the capital city of Mono Department, located in the Western part of Benin. The municipality covers an area of 260 square kilometres and counts approximately 108,000 inhabitants as of 2012.

Fig. 3: *The group of gardeners working in the co-composting plant of Lokossa (source: A. Dubois, 2014)*

According to the Hygiene and Sanitation City Plan (2011), Lokossa faces some serious problems in terms of solid waste management and sanitation, which are the results of a non-functional waste management system and a very small percentage of the population that has access to latrines.

Agriculture is one of the main sources of income in the region. Excessive use of chemical fertiliser and non-renewal of soils lead to crop lands exhaustion and sanitary and environmental impacts such as polluted groundwater.

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

4 Project history

The GIZ advisory project "Concepts for Sustainable Waste Management" in cooperation with GIZ Water and Sanitation Programme of Benin (PEP), implemented a pilot project on "solid waste management and basic sanitation" in Lokossa in October 2012. The pilot project, funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), combines the management of solid waste with the reprocessing of excreta in order to revalue both categories of waste for agricultural purposes.

To ensure its sustainability, the project has formed partnerships and formal agreements with the City Council of Lokossa, the regional Inter-municipality group (GI-Mono) and NGO's that are well-established in the region: Protos and DCAM Bethesda.

A year later (October 2013), after an evaluation of the implemented activities and the potential of the project, BMZ has assigned an additional budget to scale up the project, which has led to a reinforcement of activities.

5 Technologies applied

The project includes the construction of 30 double vault UDDTs (EcoSan latrines): 28 at household level and 2 for public/demonstration purposes. Additionally, a 3.5 ha composting site has been rehabilitated to accommodate the activities of solid waste and excreta treatment and reprocessing.

The public solid waste of the city is collected by municipal workers with a garbage truck provided by the project. The waste is transported to the composting site located nearby in the main district. A group of gardeners who received the appropriate trainings and equipment (material and protective clothing) is in charge of sorting and composting waste in the composting plant.

Regarding the sanitation aspect, all EcoSan latrines are built in the main district, in the vicinity of the composting site. Each beneficiary has been selected according to a list of criteria chosen by the project team (GIZ and partners) and has received a specific training on the general EcoSan concept and on how to use and maintain their latrine. Each latrine includes a range of containers to receive separately both kinds of excreta. The urine diversion system leads urine to a 25L yellow jerrycan stored outside the latrine whereas faeces are collected in a 30 L blue barrel located in each vault.

Fig. 4: *Public waste collection (left) and excreta collection (right) (source: A. Dubois, 2014)*

The group of gardeners working in the composting site is responsible for the collection of the containers from the beneficiaries (households and the city council) who must pay a monthly subscription to the gardeners for this service. A motor tricycle provided by the project to the city council is assigned for exclusive use of the gardeners who are in return, responsible of its maintenance. The collection fees are mainly used for this purpose.

The containers are stored, emptied and treated in the composting site following strict guidelines. Urine and faeces containers are stored in the sun for at least one month. Urine is then ready for use, whereas faecal matter requires further treatment. Faeces containers are emptied in drying beds where the matter needs approx. two months to dry out completely. Once it is dry and odourless, the faeces are ready for use. Both hygienised excreta can be handled together with the sorted organic waste to produce enriched compost through a properly monitored co-composting treatment. The building of windrows involves alternated layers of each matter (waste, faeces and fresh vegetation) and adequate watering. The co-compost reaches its mature state after four months of appropriate watering and turning (according to moisture level and temperature).

Fig. 5: *Excreta hygienisation treatment (left) and co-compost windrow making process (right) (source: A. Dubois, 2014)*

For all these activities, the group of gardeners has received suitable training (from DCAM Bethesda and Protos NGO) and the associated composting plant manual. The training included safe handling, treatment and use of EcoSan products as well as waste sorting and co-composting processes.

6 Design information

EcoSan latrines

In order to facilitate the construction and the replication of the 28 domestic latrines, a model that our partner Protos had developed in the region (masons trained in EcoSan design) was chosen. This latrine is composed of double vaults and a single cabin with two squatting pans (one for each vault). The upper- and sub-structure, the pits and the ventilation system are made of concrete, whereas the roof and the door are built using metal sheets. Even though removable containers are used for faeces collection, it has been decided to build a double vault UDDT model, to enable the beneficiaries to easily switch to the traditional use of alternated vaults in the case of an abandonment of the collection services. The volume of each vault is around 0.55 m^3 (1 m x 0.8 m x 0.7 m) which can safely store the faeces of households of around 10 members during 6 to 8 months.

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

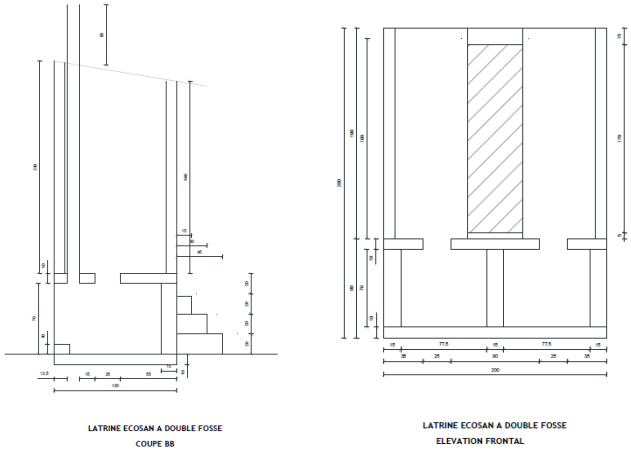

Fig. 6*: Cross-section and front view of a Domestic EcoSan latrine (source: GIZ, 2013)*

Each household was given seven 25 L yellow jerrycans for urine collection and three blue 30 L blue barrels for faeces collection. On an average basis, it takes 2-3 weeks to a household (around 10 members) to fill one container of each (faeces and urine). During the collection provided by the gardeners, all full containers are replaced by empty ones that have been previously emptied, cleaned and stored within the composting plant.

Fig. 7: *Domestic EcoSan latrine (source: E. Albert, 2014)*

For aesthetics and practical reasons, the chosen design for the **2 public latrines** is very different from the domestic one. The module of latrines is displayed in the city council premises as a demonstration model to familiarise people with EcoSan technology, therefore the general design has been redefined to offer a more attractive and elaborated model that enables separated gender use and disabled people's access (ramps, large doors, space). The module is also equipped with 2 sinks and a men urinal where urine is flushed with the used water from the sink towards the sump outside the latrines. Earlier case studies have shown that it is very difficult to operate alternated vaults in the case of public use, therefore each latrine is equipped with a single squatting pan cabin and a 1.5 m^3 single vault (1.5 m x 1.3 m x 0.7 m) with the same container system as for the domestic latrines.

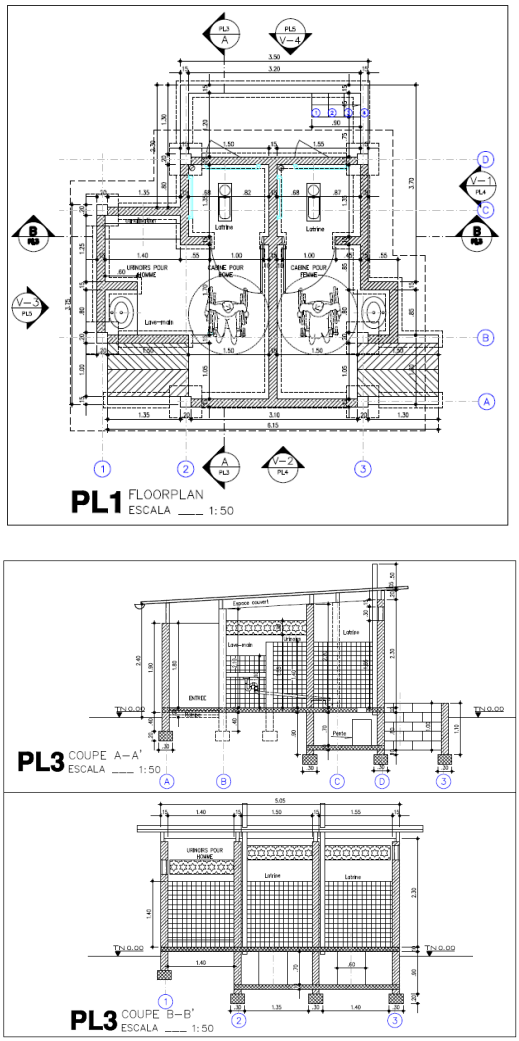

Fig. 8*: Plan view cross section and back view of the module of public EcoSan latrine (source: GIZ, 2014)*

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

Fig. 9: *Public EcoSan latrines in the city council of Lokossa (source: A. Dubois, 2014)*

Composting plant

Lokossa has been chosen partly because it accommodated in its main district a fenced composting site with some infrastructure (a waste sorting shed, several concrete composting compartments, a storage and a tool shed, a well and three latrines). The existing site was not functional at the time the project team arrived. In order to improve and facilitate the activities of waste treatment and compost making, a rehabilitation of the composting plant was decided. The rehabilitation work included the construction of:

- a 200 m^2 composting shed for composting and co-composting activities
- a 75 m^2 storage shed to store the mature compost
- a 25 m^2 EcoSan container storage platform for urine and faeces containers
- ten (10) drying beds for drying faecal matter with a volume of 0.4 m^3 each
- a 25 m^2 sieving platform to sieve and store the mature compost in bags
- a 2.25 m^2 shower cabin for the gardeners group
- a 6.25 m^2 cleansing platform to clean the tools and the empty EcoSan containers
- three (03) rainwater harvesting systems located under the roof of the three main sheds: 2 m^3 each for the sorting, and the storage shed and 5 m^3 for the composting shed
- two (02) drain wells with a volume of 5.5 m^3 each, intended to collect the leached water of the composting shed and the wastewater from the shower and the cleansing platform

The design and construction parameters of the composting facility were studied and decided according to guidance and recommendations from literature (*User's manual: Decentralised Composting for Cities of Low- and Middle Income Countries*, Eawag/Sandec and Waste Concern, 2006) adapted to local context with advice from local engineers. The composting scheme was scaled based on a maximum capacity of processing (manual work) 10 tons of (mixed) waste and 0.5 tons of faeces per week

Fig. 10: *Sheds, drying beds and rain water harvesting system of the composting plant of Lokossa (source: E. Albert, 2014)*

7 Type and level of reuse

The enriched compost produced from sorted waste and hygienised excreta through co-composting treatment is used by the group of gardeners as soil conditioner and fertiliser for demonstration purpose in the 1.5 ha field located in the composting site. The group has received training for agricultural use of co-compost and EcoSan products. However, the enriched compost is mainly intended for sale; therefore it is necessary to inform the targeted group (gardeners and farmers of the region) on the correct use of this product. A compost user's guide leaflet has been developed through literature and expert advice (Protos, DCAM) to acquaint the compost user with the dosage and frequency of application. The leaflet is distributed free of charge and thoroughly explained by the group of gardeners to each client who buys compost.

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

Fig. 11: *Demonstration field in the composting site (source: E. Albert, 2014)*

Samples of the mature compost have been sent to a specialised laboratory in France in order to analyse the conformity of the product according to international standards. The sale of the product and the associated marketing strategy will start, once the official results declare the compost a safe product. To increase acceptance among the public, the marketing campaign will include an important awareness raising component. The strategy includes communication through radio media, distribution of promoting leaflets, organisation of a workshop inviting key actors of the domain and potential clients, service of a commercial representative to canvass and retain customers, etc.

At this stage of the project, the effects and changes in yield can only be witnessed at the demonstration plot located in the composting plant. An average of 2 kg / m^2 between different crops of vegetables (spinach, cabbage, salad, carrots, etc.) and fruit trees (papaya and banana trees) has been applied in one year and the direct effects observed by the gardeners are:

- less watering
- better growth of plants
- no need for additional chemical fertilisers
- no need for insecticide and fungicide (except for cabbages)
- no erosion issues

8 Further project components

The first milestone of the project was to find local partners to support the project financially and/or technically. Therefore, a strategy of close cooperation through the creation of a steering committee composed of all project partners was adopted. In order to reinforce the role of the city council as main partner, it was decided that the mayor of Lokossa chairs the steering committee and that local coordination is ensured by the head of the environment department. The partners GI-Mono, Protos and DCAM are called on regularly to support the project by participating and sharing their expertise in the definition, organisation and implementation of activities. This strategy of close cooperation aims at increasing the involvement of all partners which will ensure the monitoring and pursuit of ongoing work when the GIZ team leaves.

Throughout the project, awareness raising and communication measures were conducted for both project components: solid waste management and sanitation. On the one hand, the local population was encouraged to subscribe to waste collection organisations by raising awareness on health problems related to illegal waste dumps. A radio show with all key actors was broadcasted and several campaigns of waste dumps destruction were coordinated by DCAM, GI-Mono and the City Council. On the other hand, the example of the constructed EcoSan latrines and related communication tools (radio show, organised visits, etc.) serves as promotion of this approach as a solution to sanitation issues.

Activities in the composting plant have officially started in January 2014 and were monitored over a period of eleven weeks to allow for a mid-term assessment and a closing report whose purpose was:

- to assess the environmental and sanitary safety of the excreta reuse system;
- to analyse the project's achievements and potential risks related to its sustainability;
- to give general recommendations to ensure sustainability and potential development and/or duplication of the project.

Following the recommendations on capacity building, a three day training session on management and entrepreneurship was offered to the group of gardeners.

Search for future partners is another component of the project to guarantee the project sustainability and development as well as to increase the expected impacts and encourage the replication of such activities. Result dissemination and field visits are being organised among the key actors and targeted structures in the field of waste management, sanitation and agriculture to encourage partnerships of all kind (research activities, financial support to up-scale activities, etc.). At this stage of the project no further partnerships have yet been settled.

9 Costs and economics

The capital cost of the project includes the construction of the EcoSan latrines, the rehabilitation of the composting plant and the purchase of equipment.

Table 1: Capital costs

Item	Qty	Unit Price (EUR)	Total Cost (EUR)
I. EcoSan latrines			
Domestic latrine	28	534	14.962
Module of 2 public latrines	1	5.956	5.956
		I. Sub-total	**20.918**
II. Composting plant			
Small rainwater harvesting system (2 m³)	2	714	1.428
Big rainwater harvesting system (5 m³)	1	1.775	1.775
Composting shed	1	12.200	12.200
Storage shed	1	4.247	4.247
Drain well	2	568	1.135
Module of 10 drying bed	1	1.040	1.040
Small platform (5 m²)	1	420	420
Big platform (25 m²)	2	812	1.625
Shower cabin	1	580	580
		II. Sub-total	**24.450**
III. Equipment			
Garbage truck	1	29.710	29.710
Motorised tricycle	1	2.369	2.369
Public bin	6	254	1.525
Public waste container	3	527	1.580
Gardening and composting equipment		3.420	3.420
		III. Sub-total	**38.605**
TOTAL			**83.973**

The domestic latrines were specifically designed to require very low capital cost in order to enhance replicability by other households. This was not the case for the capital cost of the public latrines module. Its display function for the EcoSan approach and its position inside the municipal compound required an attractive and elaborated design that automatically raised the price.

The capital invested in the composting plant rehabilitation and equipment is comparatively high if the municipality were required to finance it. In the long run such expenses could be partly compensated by savings made in terms of avoided waste management costs, and hygiene & sanitation improvements.

Operation and maintenance costs apply to all beneficiaries of each investment: household, group of gardeners and city council.

Table 2: Maintenance and operation costs

Item	Beneficiary	Costs source	Estimated cost (EUR/year)
I. EcoSan latrines			
Domestic latrine	Household	excreta collection and containers replacement	31 per latrine
Module of 2 public latrines	City council	excreta collection, container replacement and general maintenance	247
II. Composting plant			
Motorised tricycle	Gardeners	repairs, maintenance and gas	458
Gardening and composting equipement	Gardeners	replacement and gas (motor-pump)	128
Composting plant infrastructures	Gardeners	various repairs	46
III. Equipment			
Garbage truck	City council	repairs, maintenance and gas	5.000

The operation and maintenance cost for each household is very low and concerns mainly the excreta collection and the replacement of impaired excreta containers. Those costs apply also for the city council which is responsible for the operation and maintenance of its public latrines. In addition the costs of cleaning and maintenance services, toilet paper and ash supply must be taken into account, which all in all multiplies the cost per latrine by 4 compared to its domestic counterpart. The city council is also in charge of the garbage truck, which is the investment that requires the highest maintenance and operation costs. The gardeners are responsible of the composting site operation, which includes maintenance of its infrastructure and equipment (low costs) as well as operation and maintenance of the motorised tricycle used for the collection of excreta containers (higher costs).

10 Operation and maintenance

The project success is based on a management model that enables each actor to benefit in one way or another from the newly established waste management and sanitation system.

The first actors are the beneficiaries of the latrines, for whom the system gave access to sanitation services. Each household attended a two days training session and received a user's manual on how to use and maintain their latrine properly, which includes keeping the toilet clean, ensuring the proper use of the latrine, covering the faeces with ash after defecation and monitoring the urine and faeces levels in the containers. Those tasks are done by the households themselves, who only need to pay for the collection of the excreta containers (EUR 1.5 per month) and the replacement of damaged containers. The fee for the replacement is collected at the end of the year. The cost per household is determined on the total cost of the missing containers divided by the number of beneficiaries.

The second actor is the municipality of Lokossa, which profits from the system in two ways. First, the public latrines in the city council offer sanitation access to the municipal staff (mainly guards and cleaning staff) and visitors. Second, the co-compost activities improve the waste management system and the sanitation situation in the city. In return for these benefits in terms of improved public services, the city council participates financially and logistically. Like the households, the municipality must pay for the collection of the excreta containers (EUR 38 per month). The higher cost of that fee is justified by the fact that it covers also the benefits from the general improvement of the waste management and sanitation situation of the city. In terms of logistics, the municipality is required to supply the gardeners with mixed waste and to collect the sorted ultimate waste and transport it to a place of end disposal. For this, the city council makes its waste collection services (garbage truck and municipal employees) available at request.

The third group of actors benefiting from the system is the group of gardeners who developed from it a range of activities generating income. The group offers the excreta collection services to the 28 households and the city council. The services include collection and transport of the containers, processing of the excreta and redistribution of empty containers. To keep the project running, the operation and maintenance costs (gas, vehicle repairs and labour) resulting from that service must be quickly retrieved, which is done by the recovery of collection fees (households and city council) and by the sale of products at the site: vegetables and compost.

At this stage of the project, the system implementation remains a challenge due to the difficulty to recover the collection fees and the still doubtful cooperation of the municipality.

11 Practical experience and lessons learnt

Difficult collaboration with local authorities

The collaboration and participation of the local authorities in the project implementation was the first objective and condition of the project team. A Memorandum of Understanding stating the tasks and responsibilities of each partner, including the City Council and GIZ, was signed in February 2013. As a result of the additional funds and the reinforcement of the activities, an amendment was signed in December 2013 between the City Council and GIZ only. Throughout the whole project the commitment of the municipality was always below expectations. Financial support commitment is respected but with excessive delays. At this stage of the project the public latrines have been

operational for 4 months, but the City Council hasn't paid any collection fees yet. Logistical support is at a minimum: the services of mixed waste supply from public places and ultimate waste collection from the composting plant is not efficient, moreover ill will and jealousy are observed. The expected ownership of the project by the municipality is also very low. The municipality justifies its low commitment concerning monitoring and coordination by the fact that the municipal staff (including the designated local coordinator) is too busy to take over these activities as thoroughly as the GIZ team.

Multistakeholder partnership
Due to the synergistic approach of the project combining waste management and sanitation, the formation of a multistakeholder partnership was necessary. At the launch of the project, GI-Mono, Protos and DCAM signed the aforementioned MoU (together with the City Council and GIZ), which defined them as technical partners in their field of expertise. Basically GI-Mono is in charge of the results dissemination, DCAM is responsible of the waste management component and Protos of the sanitation component. Globally, the project gained from that partnership; however it increased greatly the demands of management and coordination. Steering committee meetings were rarely held on the scheduled monthly basis and the project suffered from conflicts between the partners.

Lack of water on site
The rehabilitation of the composting plant included the drilling of a deeper well to ensure water supply at all time (the existing well runs dry during dry season). But because of an unexpected thick stone layer found at depths, the intended hand operated drilling failed and the available budget did not allow for a more elaborated drilling. As a result, the activities of the composting plant (compost making and gardening) suffer from the lack of water during dry season.

Pilot households low involvement
At first, the sanitation activities were planned to focus on public sanitation solutions, but experiences in the region have shown that public latrines projects always fail because of operation and maintenance problems. It was then decided to build EcoSan latrines at household level mainly (only 2 public latrines in the city council). Beneficiary households were chosen according to a criteria list through a survey done in the project target area. Because of time restrictions, the selected households were not requested to contribute financially to the construction of latrines. The only condition required was to attend the 2 days training session and to subscribe to the solid waste collection (NGO) and the excreta collection services (group of gardeners). The absence of participation in the financing of the latrine can partly explain the lack of commitment observed within many households. Despite the training, some households are not operating and maintaining their latrine properly. Moreover, the fee collection rate is low. A close and continuous follow-up must be done by the gardeners with the help of the municipality, who is the only one in a position to be able to apply sanctions.

Short monitoring period
Because of the accumulated delay in the project's implementation and the limited timeframe available, the monitoring of the activities covered a period of eleven weeks only. Moreover, this short period of time corresponded with the start of the activities. Consequently, the results of the assessment are of limited value and cannot account for what the project would look like once it has reached its cruising speed, i.e. once excreta and waste collection services take place on a regular basis and the gardeners are empowered to run their compost-making start-up autonomously.

Early withdrawal of the GIZ coordination team
The GIZ field coordination is due to be over in mid-August 2014, which is only 7 months after the launch of the composting plant activities. Even though the departure of the GIZ team has been postponed as much as possible (because of the delays accumulated during the project implementation) the withdrawal will come at an early stage. This may impact the effective operation of the activities and therefore jeopardize the sustainability of the project. The project's partners (especially the city council) are meant to take over the GIZ coordination and monitoring activities, however it has been observed during the temporary absence of the GIZ coordination team in April and June 2014 that their involvement was below expectations and that the group of gardeners was more or less left on its own. Therefore a focus is currently given on finding new partners who could in one way or another support the project activities.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 3) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

Table 3: Qualitative indication of sustainability of the system: A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

	collection and transport			treatment			transport and reuse		
Sustainability criteria:	+	o	-	+	o	-	+	o	-
• health and hygiene	X				X		X		
• environmental and natural resources	X			X			X		
• technology and operation		X		X			X		
• finance and economics		X			X			X	
• socio-cultural and institutional		X			X			X	

Combined solid waste management and basic sanitation Lokossa, Mono region, Benin

Sustainability criteria 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 practiced 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 fertiliser 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.

For details on these criteria, please see www.susana.org: the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

With regards to long-term impacts of the project, a stimulation of the agricultural sector in the region is expected as well as an improvement of the hygiene and sanitation situation of the city. The valorisation of biodegradable waste and excreta, replacing chemical fertilizers with alternative products and reducing the practice of open-air defecation will contribute to environmental protection and preservation of public health. In parallel, communication and awareness-raising about the EcoSan approach will increase acceptance among a larger public.

The project contributes directly to reinforce the waste collection system of the city by reducing the amount of waste ending up in the disposal site (unregulated tip). It also clearly improves the hygiene and sanitation situation of the beneficiary households and influences the socio-economic situation of the group of gardeners by creating a new market generating additional source of income.

13 Available documents and references

- Rothenberger, S, Zurbrugg, C., Enayetullah, I., and Sinha, A.H.M.M. (2006), *Decentralised composting for cities of low- and middle- income countries : a user's manual* *http://www.ircwash.org/resources/decentralised-composting-cities-low-and-middle-income-countries-users-manual*
- Hygiene and Sanitation City Plan of Lokossa *http://www.mairiedelokossa.com/demo/wp-content/uploads/PHAC-DEFINITIVE-LOKOSSA2.pdf*

14 Institutions, organisations and contact persons

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Case study of SuSanA projects

Combined solid waste management and basic sanitation in Lokossa, Bénin

SuSanA 2014

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