SFD Promotion Initiative

Bignona
Senegal

Final Report

This SFD Report was created through desk-based research by Sandec (the Department of Sanitation, Water and Solid Waste for Development) at Eawag (the Swiss Federal Institute of Aquatic Science and Technology) as part of the SFD Promotion Initiative.

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On behalf of Federal Ministry for Economic Cooperation and Development

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Sandec Sanitation, Water and Solid Waste for Development

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SFD Report Bignona, Senegal, 2016

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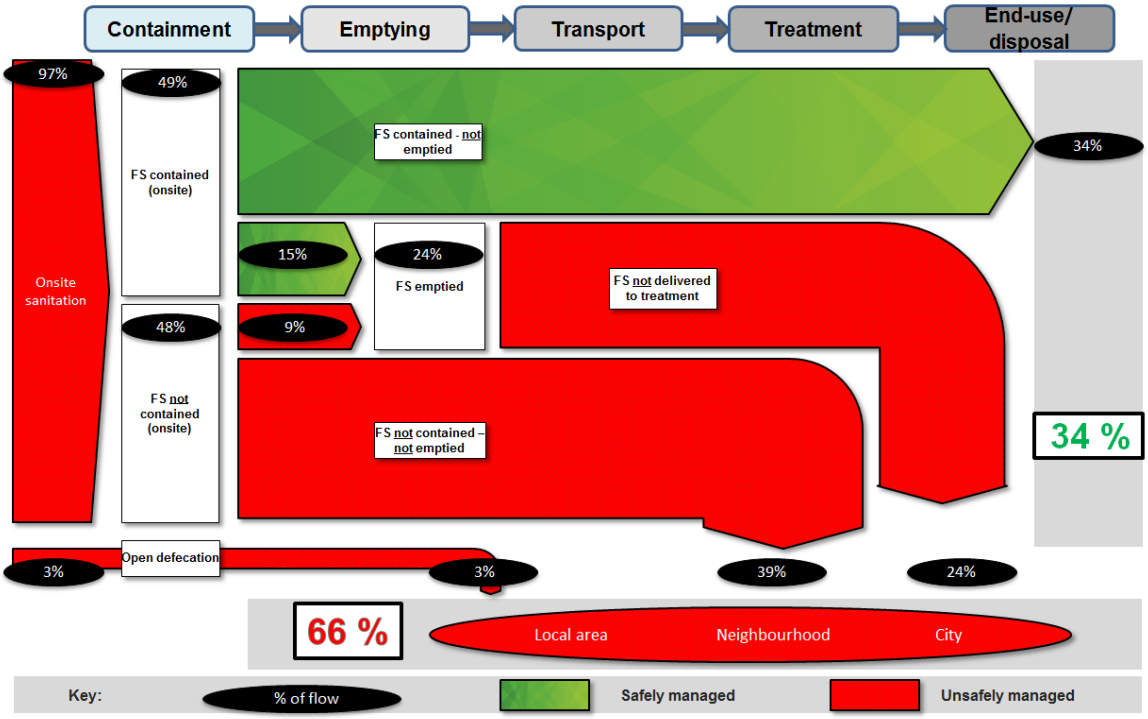
1. The Diagram

Bignona, Senegal, 08.12.2015
Desk based assessment



2. Diagram information

The Shit Flow Diagram (SFD) was created through desk-based research by Sandec (Sanitation, Water and Solid Waste for Development) of Eawag (the Swiss Federal Institute of Aquatic Science and Technology)

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3. General city information

Bignona and Tenghory Trans-Gambian are in the region of Casamance, Senegal. The study area is comprised of seven districts, of which the following six are in Bignona: Badionkoto, Bassène, Manguiline North, Manguiline South, Château d'eau, and Kadiamor, and the seventh is the neighboring district of Tenghory Trans-Gambian in the municipality of Tenghory. These seven districts have a total area 10.5 km^2, with 6.9 km^2 for the municipality of Bignona and 3.6 km^2 for Tenghory Trans-Gambian. Administratively, the Tenghory Trans-Gambian district is part of the municipality of Tenghory, but it is generally associated with Bignona, as it is immediately adjacent to Bignona. Throughout this report, the term Bignona is used to refer to the combined municipality of Bignona and Tenghory Tran-Gambian. Based on a census conducted in 2014, Bignona has a population of 44,783 with an annual population growth rate of 2.7%. The average population density is 4,300 people per km^2, ranging between 16,000 (Bassène) and 2,000 (South Manguiline) people per km^2 (H2O and I&D, 2014).

Bignona's climate is characterized by a dry season of about seven months, followed by a distinct rainy season of five months with around 80% of the annual rainfall being between July and September (Climate-data, 2015).

4. Service delivery context

Policy

The provision of sanitation in Senegal is the responsibility of the Ministry of Sanitation and its regional and communal delegations. The standards for faecal sludge management in Senegal are in Chapter 3 of the Sanitation Code, which is part of the law No. 2009-24 of July 8, 2009. The Sanitation Code was also updated by the presidential decree of 11 February, 2011. The Senegal Sanitation Code includes several aspects that are relevant for faecal sludge management such as definitions for onsite sanitation, individual sanitation, unloading site and faecal sludge.

Institutional roles

On a national level, the following five ministries are responsible for implementing national policies related to sanitation:

1. Ministry of Hydraulic and Sanitation

This Ministry is responsible for the preparation and implementation of policies adopted by the Government of Senegal in the field of hydraulics and sanitation. This ministry supervises the Directorate of Water Resources, the Directorate of Sanitation and the Senegalese National Sanitation Utility (Office National de l'Assainssement du Sénégal: ONAS).

2. Ministry of the Environment and Sustainable Development

This ministry assists and supports industries in their compliance with discharge standards for wastewater and informs them about existing funding opportunities.

3. The Ministry of Health and Social Action

This ministry is responsible for the control of diseases such as cholera and malaria. It operates through the National Hygiene Service. The mandate of the National Hygiene Service is to ensure the implementation of the hygiene code.

4. Ministry of Planning and Local Government

This ministry is responsible for the preparation and implementation of Senegal's policy in decentralization, local development, support and control of local authorities, implementation of policies for training of local elected officials, management of local development policies.

5. Ministry of Urban Renewal, Housing and Living Environment

This ministry is responsible for urban planning. It ensures the preservation of the environment is responsible for the implementation of the housing policy and as such, ensures the quality of construction through the compliance with building standards.

Service provision

Faecal sludge emptying and transport service provider are based in Ziguinchor, which is located 30 kilometers from Bignona. These providers are private entrepreneurs and the Bignona municipality ensures the coordination at the public level (KII1, 2015, KII3, 2015, MHA, 2011). In total, five trucks are operating in Bignona and the surrounding areas. Senegalese regulations for onsite sanitation services require the emptying and transport service provider to pay taxes at local and national level. The taxes are comprised of village taxes (35,000 FCFA/month or 56 USD/month) and communal taxes (5,000 FCFA/truck/day or 8 USD/truck/day) (KII3, 2015, KII4, 2015):.

Service standards

The Senegalese Standards Association (ASN) is related to the Ministry of Industry and Mines, which works in close collaboration with the Ministry of Sanitation and the Ministry of Environment. The mandate of the ASN is to implement national standards, disseminate information and raise awareness (ASN, 2015, MHA, 2011).

Policies and regulations monitored by the ASN are listed in chapter 3 of the Senegal Sanitation Code and cover the whole sanitation service chain from containment to end-use and disposal.

5. Service outcomes

In Bignona there are no existing sewer systems. The city relies fully on onsite sanitation technologies with the majority of the population (49%) utilizing so-called traditional pit latrines (unlined pits), 31.6% using septic tanks, 10.2% using improved pit latrines and 5.7% manual flush toilets (pour flush toilets). 3.5% of the total population do not have a sanitation facility at all.

As part of this assessment, three public toilets were identified. One at the Bignona bus station, one at the “old” market and another one at the “new” market constructed in 2009.

Septic tanks installed at a private estate, at a hospital and at a high school are emptied on a monthly basis and contribute considerably to the total amount of faecal sludge collected in Bignona. The total amount from these technologies is 132 m^3/month. However, this figure was not included in the SFD, as there was a lack of available data for quantities collected from households only.

Risk of groundwater pollution

The soil types in Bignona are primarily clay and sand and the hydrogeological structure of Bignona is characterized by three main aquifer layers (1) groundwater levels between 300 and 500 m, (2) groundwater levels between 100 and 150 m, and (3) groundwater levels between 0 and 50 m. Within the study area, groundwater levels are considered high for the neighborhoods of Bassène, Badionkoto and part of Tenghory Trans-Gambian (river side). Containment technologies in these areas are affected by periodic flooding, which results in groundwater intrusion and rapid filling during the rainy season.

39% of the households in Bignona receive their drinking water from the national water distribution network, while 57% use wells as their main source of drinking water. Another 3% receive drinking water from public water points and 1% uses boreholes (H2O and I&D, 2014).

These two factors contribute to the risk of groundwater pollution and therefore whether or not faecal sludge is considered contained / not contained.

Containment (contained / not contained)

48% of the total population use systems that do not safely contain faecal sludge. This comprises facilities that are in areas where the infiltration of liquid (effluent or infiltrate) from containment technologies into the soil results in a significant risk of groundwater pollution, due to the existing high groundwater table. On the other hand, 49% of the of the population use systems that safely contain faecal sludge. This comprises facilities in areas of low risk of groundwater pollution:

Emptying

To assess the potential for emptying of facilities systems, it is assumed that 100% of the population could have access to emptying services. However it is also assumed that unlined pits even if located in high risk areas are not emptied when full, but covered with soil and abandoned. In total, the population equivalent for 34% of faecal sludge is considered contained and not emptied, which is the total amount of excreta “safely managed”. 15% of the population equivalent from systems containing faecal sludge is emptied. In areas where faecal sludge is not contained, the population equivalent for 9% of faecal sludge is emptied and 39% not emptied. These 39% contribute significantly to the total amount of excreta “unsafely managed”.

Transport and treatment

Faecal sludge is transported by the same service providers that offer emptying services. Information on transport

destination of faecal sludge was unavailable and it was assumed that none of the collected faecal sludge is transported to any official discharge location since none exist in the area of Bignona. In total, this amounts to 24% of the excreta of the total population which can be characterized as "*FS not delivered to treatment*" and therefore contributes to the flow of "unsafely managed" excreta.

End-use and disposal

No end-use practices could be identified in Bignona. However, during interviews with local stakeholders it was mentioned that faecal sludge discharged at informal discharge locations gets collected once it is dry and used as a soil conditioner by farmers. It was not possible to quantify these amounts.

6. Overview of stakeholders

Key stakeholders were involved at several stages throughout the writing process of this report. They were selected based on their expertise and knowledge about the local context in Bignona. Interviews were conducted remotely by phone and also in person in the field.

7. Credibility of data

Data used for the SFD development was mainly taken from H2O and I&D (2014), which is regarded as a reliable source of information. During key informant interviews, the data was triangulated and furthermore verified by local stakeholders. The final SFD was presented at a workshop in Bignona on the 15th of December 2015. The purpose of the workshop was to share results obtained from studies undertaken by Eawag/Sandec as part of a project implemented together with ACRA-CSS. Workshop participants comprised of stakeholders from the Bignona municipality, representatives from ONAS (the local utility for sanitation), the directorate of sanitation, hygiene services, and directorate of environment and neighborhood councils. The presented SFD was verified by all participating stakeholders.

8. Process of SFD development

A desk-based literature review was performed to collect the required data. The involvement of several local stakeholders ensures the reliability of the collected data and the final SFD was verified by several local stakeholders.

9. List of data sources

ASN 2015. Senegalese Standards Institute /Association Senegalaise de Normalisation. *http://www.asn.sn/index.php/component/content/article/2-uncategorised/112-test1*.

CLIMATE-DATA 2015. Climat Bignona: Diagramme Climatique. *http://fr.climate-data.org/location/762108/*.

H2O & I&D 2014. Analyse Situationnelle du Secteur de l 'Assainissement dans la commune de Bignona et Transgambienne (Sénégal). Senegal: ACRACCS.

KII1 2015. Regional Service of Sanitation. *Head of service*.

KII3 2015. Emptiying Collectif. *Head of the Emptying collectif at Ziguinchor*.

KII4 2015. Emptiying Collectif. *Driver and Manager Bignona Vacuum Truck*.

MHA 2011. Decret d'application de la loi portant code de l'assainissement. 2011-245. Senegal. *Ministère de l'Hydraulique et de l'Assainissement*.

Bignona, Senegal, 2016

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Abbreviations

ACRA	Association de Coopération Rurale en Afrique et Amérique Latine
ASN	Senegalese Standards Association
DEEC	Directorate of Environment and Classified Establishment
DREEC	Regional Department of Environment and Classified Establishment
FS	Faecal sludge
KII	Key informant interview
NGOs	non-governmental organizations
ONAS	Office National de l'Assainssement du Sénégal
PEPAM	Programme d'eau potable et d'assainissement du Millénaire
SFD	Shit Flow Diagram
SNH	National Hygiene Service
SRA	Regional Service of Sanitation

1 City context

This Shit Flow Diagram (SFD) report presents results from desk-based research done for the town of Bignona and Tenghory Trans-Gambian, which lie in the region of Ziguinchor/Casamance, Senegal. The study area is comprised of seven districts. The following six are in Bignona: Badionkoto, Bassene, Manguiline North, Manguiline South, Château d'eau, and Kadiamor, and the seventh is the neighboring district of Tenghory Trans-Gambian in the municipality of Tenghory (see Figure 1). These seven districts have a total area 10.5 km^2, with 6.9 km^2 for the municipality of Bignona and 3.6 km^2 for Tenghory Trans-Gambian. Administratively, the Tenghory Trans-Gambian district is part of the municipality of Tenghory, but it is generally associated with Bignona, as it is immediately adjacent to Bignona. Throughout this report, the term Bignona will be used to refer to both municipality of Bignona and Tenghory Tran-Gambian (H2O and I&D, 2014).

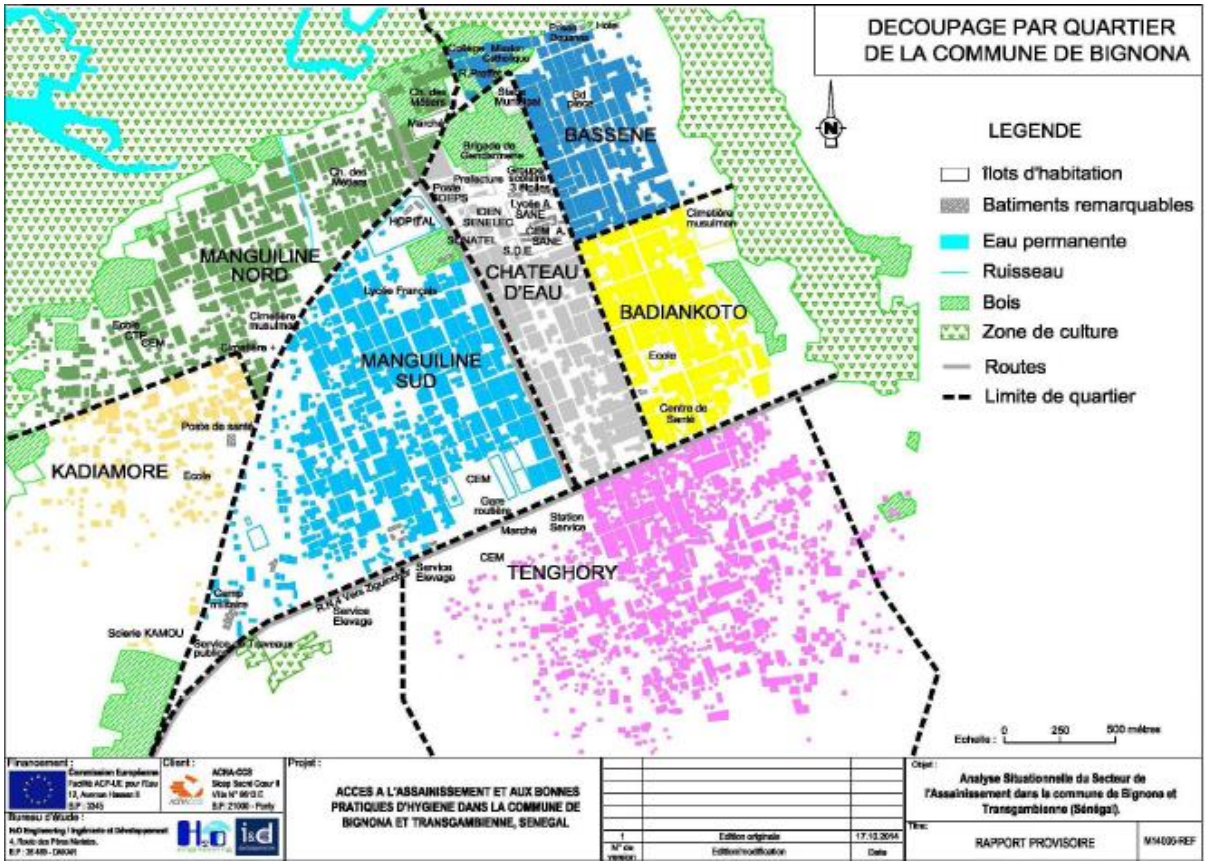

Figure 1: District boundaries of Bignona and Tenghory Trans-Gambian (H2O and I&D, 2014)

Based on a census conducted in 2014, Bignona has a population of 44,783 with an annual population growth rate of 2.7%. The most populated areas are Bassene and Tenghory Trans-Gambian with 10,678 and 11,000 inhabitants, respectively (H2O and I&D, 2014).

The average population density of Bignona is 4,300 people per km^2 with areas of high and low population density (compare Figure 2):

- Bassène, >16,000 people per km^2;
- Manguiline North, Château d'eau and Badionkoto, 4,000 to 6,000 people per km^2
- Kadiamor and Tenghory, 2000 to 4,000 people per km^2
- South Manguiline, <2,000 inhabitants per km^2

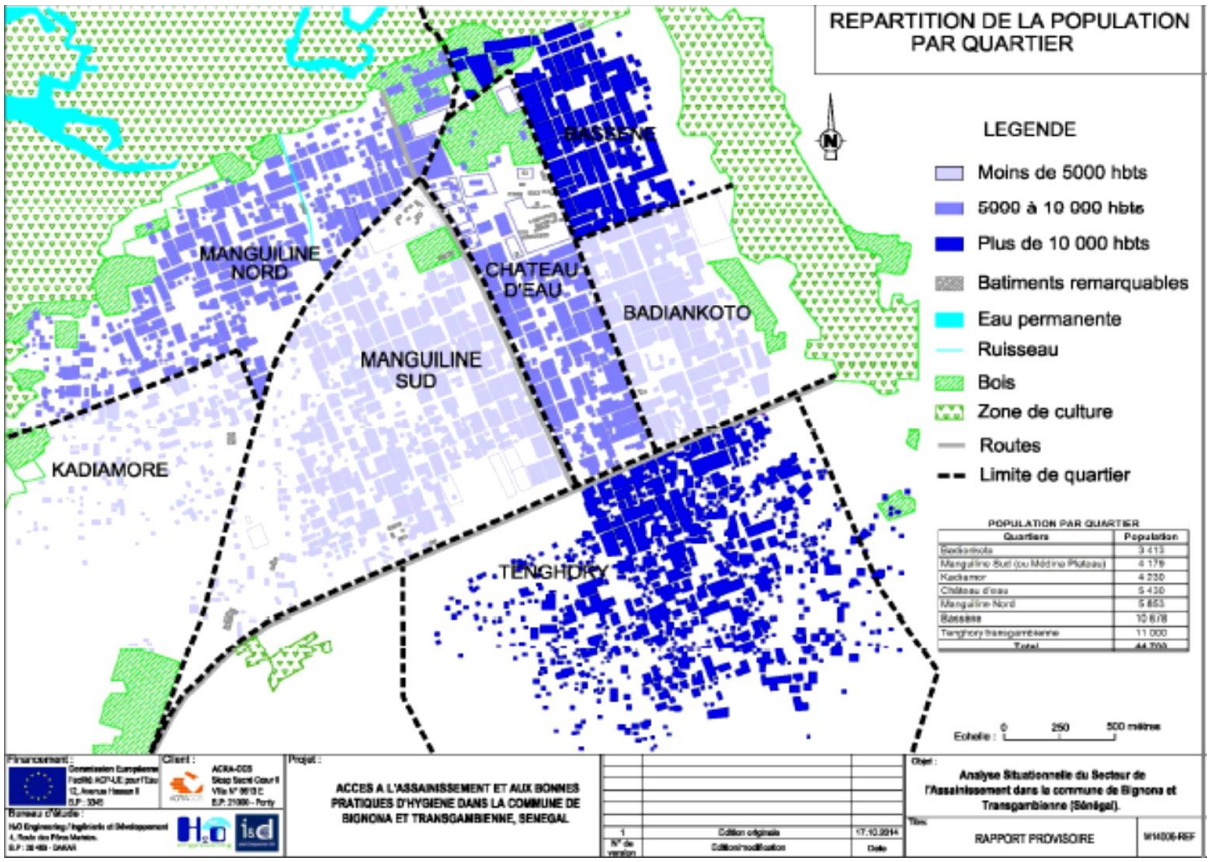

Figure 2: Population density of Bignona and Tenghory Trans-Gambian (H2O and I&D, 2014)

Bignona's climate is characterized by a dry season of about seven months, followed by a distinct rainy season of five months (compare Figure 3), with around 80% of the annual rainfall being between July and September. Runoff water and flooding occur regularly during this period, frequently resulting in destruction of houses and onsite sanitation technologies as shown in Figure 4 and Figure 5 (H2O and I&D, 2014).

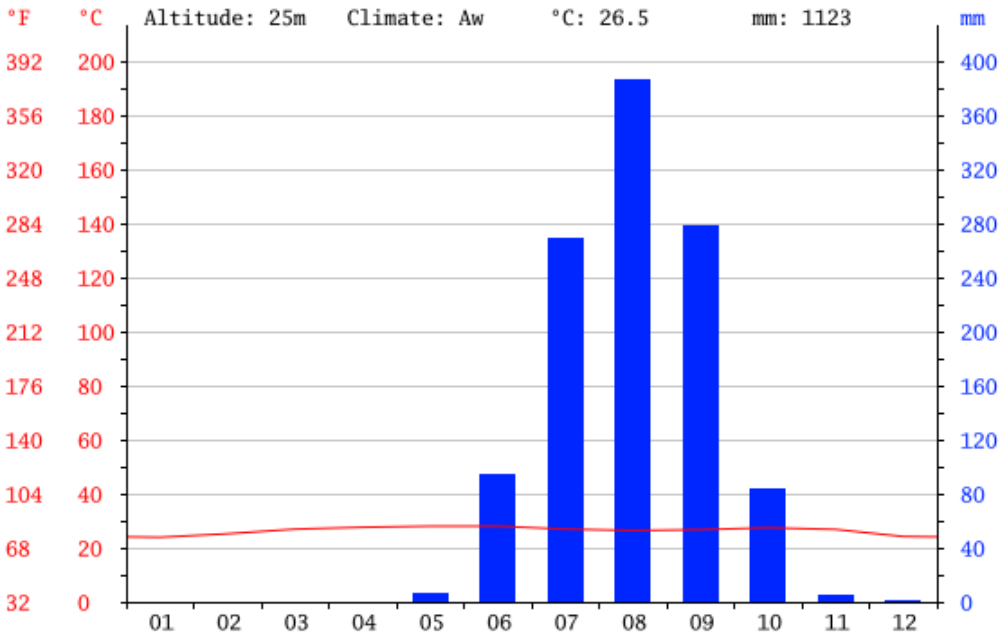

Figure 3: Climate diagram of Bignona, Senegal (Climate-data, 2015).

Figure 4: Housing structure damaged by run-off water after heavy rain event (H2O and I&D, 2014).

Figure 5: Sanitation system damaged after flooding in Bignona, Senegal (H2O and I&D, 2014).

2 Service delivery context description/analysis

2.1 Policy, legislation and regulation

2.1.1 Policy

The provision of sanitation in Senegal is the responsibility of the Ministry of Sanitation and its regional and communal delegations. The standards for faecal sludge management in Senegal are in Chapter 3 of the Sanitation Code, which is part of the law No. 2009-24 of July 8, 2009. The Sanitation Code was also updated by the presidential decree of 11 February, 2011. The Senegal Sanitation Code includes several aspects that are relevant for faecal sludge management, including the following definitions (MHA, 2009, MHA, 2011):

- Onsite sanitation includes individual (household level) sanitation and shared sanitation technologies not connected to public sewerage
- Individual sanitation is the household level management of domestic water, excreta and faecal sludge by the user within the concession
- An unloading site is a location that is properly set up to receive faecal sludge, including drying and leachate treatment, without nuisance for the neighborhood
- Faecal sludge is defined as materials extracted from individual sanitation technologies including septic tanks, lined pits and infiltration wells
- It is illegal to discharge any domestic or industrial liquid waste prior to adequate treatment for decontamination.

2.1.2 Institutional roles

On a national level, five ministries are responsible for implementing national directorates. Most of these ministries have regional representatives. The following sections summarize the roles and responsibilities of each ministry.

Ministry of Hydraulic and Sanitation

This Ministry is responsible for the preparation and implementation of policies adopted by the Government of Senegal in the field of hydraulics and sanitation. This ministry supervises the Directorate of Water Resources (Direction de l'Hydraulique), Directorate of Sanitation (Direction de l'Assainssement) and the Senegalese National Sanitation Utility (Office National de l'Assainssement du Sénégal: ONAS). This ministry has the responsibility of sanitation policies, and implementation and maintenance of sanitation facilities. Moreover, this ministry, with the help of the Ministry of Health and Social Actions, has to prescribe mandatory rules of hygiene and ensure their compliance. It shall ensure in particular through preventive actions that individual and collective behaviors are favorable to the development of public hygiene. In this context it works in connection with the Ministry of Environment to ensure the adequate disposal of solid liquid waste, quality of water, air and soil.

Sanitation Directorate (Direction de l'Assainssement): The Directorate of Sanitation was established by Decree 2 of September 2003. This directorate is responsible for:

- Defining sanitation strategies, policies and pricing in urban and rural areas
- Identifying and executing rural sanitation programs
- Conducting and controlling of rural sanitation programs
- Ensuring the technical supervision of ONAS
- Following with ONAS the planning, construction design and implementation of urban sanitation programs
- Monitoring the activities of companies and other autonomous administrations involved in the sanitation sector
- Following the programs related international organizations

The Sanitation Directorate has regional departments. The Regional Sanitation Directorate of Ziguinchor is responsible for monitoring sanitation projects and implementation in Bignona and Tenghory Trans-Gambian

The Senegalese National Sanitation Utility (ONAS): ONAS was established by Law No. 96-02 of February 22, 1996 as a public industrial and commercial institution. ONAS is responsible for the collection, treatment, recovery and disposal of wastewater and stormwater in urban and peri-urban areas. In the context of wastewater, the responsibilities are:

- Planning, design and implementation of infrastructure for wastewater, faecal sludge and stormwater treatment
- The promotion of appropriate on-site sanitation technologies for implementation
- Appropriate disposal/enduse of treatment endproducts;

Concerning stormwater management, ONAS responsibilities are combined with other ministries:

- Investments into stormwater networks (open or buried/covered) are under the Ministry of Equipment and Terrestrial Transport, and the Ministry of Hydraulic and Sanitation
- The operation and maintenance of open stormwater networks is a municipal responsibility
- The operation and maintenance of the covered stormwater networks returns to ONAS, without financial compensation from the municipalities

ONAS has a regional department in Ziguinchor. This regional department would normally be the owner of any treatment facilities constructed in the Ziguinchor region, unless ONAS specifically gives permission to a third party.

The Regional Service of Sanitation (SRA): The SRA in charge of Bignona is based in Ziguinchor and works in close collaboration with the municipality of Bignona and the National Hygiene Service (SNH) to ensure regularity of sanitation provision.

PEPAM: (Programme d'eau potable et d'assainissement du Millénaire /Potable Water Program and the Millennium sanitation) is the unified framework of interventions implemented by the Government of Senegal for the realization of the Millennium

Development Goals in the drinking water sector and sanitation in urban areas and in rural areas (PEPAM, 2015).

Ministry of the Environment and Sustainable Development

This ministry is responsible for all other departments and agencies involved in the field of environment and sanitation. Through the Directorate of Environment and Classified Establishment (DEEC), the department assists and supports industries in their compliance with discharge standards for wastewater and informs them about existing funding opportunities. DEEC has a Regional Department of Environment and Classified Establishment (DREEC) in Ziguinchor. That means for sanitation projects in Bignona, the DREEC of Ziguinchor is responsible for validating the environmental impact assessment studies required for the establishment of any sanitation facilities or faecal sludge treatment plants.

Ministry of Health and Social Action

This ministry is responsible for the control of diseases such as cholera and malaria. It operates through the National Service of Hygiene.

The National Hygiene Service (SNH)

The main mission of the SNH is to ensure the implementation of the hygiene code, but also works in other contexts including:

- Training of operators for the construction of private sanitation infrastructure
- The definition and implementation of awareness programs and health education for the Senegalese population and operators

The National Hygiene Service is the most decentralized institution in the field of sanitation. It has departments in all regions of Senegal. Thus, in Ziguinchor there is a Regional Hygiene Service, which has the Departmental Hygiene Service of Bignona under its authority.

Ministry of Planning and Local Government

This ministry is responsible for the preparation and implementation of Senegal's policy in:

- Decentralization
- Local development
- Support and control of local authorities
- Implementation of policies for training of local elected officials
- Management of local development policies.

Local communities/municipalities and Bignona Tenghory

The municipalities of Bignona and Tenghory have several sanitation-related functions. Local communities/municipalities of Senegal have the jurisdiction to:

- Ground and surface water resources management except international and national water courses
- The development of municipal action plans for the environment
- Waste, unhealthiness, pollution and nuisances' management

The involvement of local communities/municipalities in the sanitation sector is implemented through projects and cooperation with non-governmental organizations (NGOs) or government departments. The Italian NGO ACRA-CSS (Association de Coopération Rurale en Afrique et Amérique Latine) is active in this context and currently implements the project "Access to sanitation and good hygiene practices in the town of Bignona and Trans-Gambian".

Ministry of Urban Renewal, Housing and Living Environment

This ministry is responsible for urban planning. It ensures the preservation of the environment is responsible for the implementation of the housing policy and as such, ensures the quality of construction through the compliance with building standards.

2.1.3 Service provision

Service providers for faecal sludge emptying and transport are based in Ziguinchor. Therefore, the municipality of Bignona ensures the coordination of these services at public and private level (KII1, 2015, KII3, 2015, MHA, 2011). In total, there are five operating trucks, which also operate in Bignona and the surrounding area. Based on Senegalese regulations for onsite sanitation services, the emptying and transport service provider is obliged to pay taxes at national and local level, which is comprised of (KII3, 2015, KII4, 2015):

- Village taxes: 35,000 FCFA/month (56 USD/month)
- Communal taxes: 5,000 FCFA /Truck/day (8 USD)/day)

Additional costs for the emptying service provider are travel expenses at 30,000 FCFA (30 USD), due to the long distance of 30 km from Ziguinchor. Emptying service providers will only travel to Bignona if at least 4 to 5 households require emptying services at the same time. The revenue for the emptying service providers must be at least 100,000 FCFA (165 USD) in order to be able to cover the expenses (KII3, 2015).

2.1.4 Service standards

The Senegalese Standards Association (ASN) is related to the Ministry of Industry and Mines, which works in close collaboration with the Ministry of Sanitation and the Ministry of Environment. The mandate of the ASN is to implement national standards, disseminate information, raise awareness (ASN, 2015, MHA, 2011).

Policies and regulations monitored by the ASN are listed in chapter 3 of the Senegal Sanitation Code and presented below.

1. Containment and Emptying

Emptying and uncontrolled disposal of material from drains and septic tanks are prohibited unless they are performed under the following conditions:

- Temporarily stored in watertight tanks
- Discharged at treatment plants designed for this purpose
- At areas designed for disposal
- Discharged at wastewater treatment plants either directly or through the sewer network, if capable of receiving

2. Transport

Transport of faecal sludge is provided by trucks approved by the minister of sanitation or its delegates (MHA, 2011, MHA, 2009).

3. Treatment

Faecal sludge discharge for soil improvement may be authorized by the minister of sanitation on the advice of the minister of the environment. The application process requires the inspection and authorization of the ground where faecal sludge is supposed to be discharged. An environmental impact assessment is carried out to define the terms of application, taking into account:

- The ability of the soil to receive the material
- Material and storage facilities for temporary storage between application periods
- The potential nuisance to the neighborhood.

Faecal sludge must be evenly spread on the ground and furthermore buried by plowing the soil during the first days of application (MHA, 2009, MHA, 2011).

4. End-use/disposal

The disposal of faecal sludge on the surface or arable land can be approved if the following provisions are implemented:

- A minimum distance of 200 m from any dwelling
- A minimum distance of 1,000 m from shellfish beds
- A minimum distance of 15 m from streams, wells, swimming areas, beaches, roads and paths
- Out of immediate protected areas, reconciled catchment sources and channels carrying water for drinking purposes

All measures must be taken so that runoff water cannot reach the protected areas or environments (MHA, 2011, MHA, 2009).

3 Service Outcomes

3.1 Overview

This section presents the range of infrastructure/technologies, methods and services designed to support the management of faecal sludge and/or WW through the sanitation service chain in Bignona. For details on quantitative estimations, refer to section 3.2 SFD Matrix.

3.1.1 Range of sanitation infrastructure

In Bignona there are no existing sewer systems. The city relies fully on onsite sanitation technologies with the a majority of the population (49%) utilizing so-called traditional pit latrines (unlined pits) (see Figure 6), 31.6% using septic tanks, 10.2% using improved pit latrines and 5.7% manual flush toilets (pour flush toilets). 3.5% of the total population do not have a sanitation facility at all.

Figure 6: User interface (left) and wall of unlined pit in Bignona, Senegal (H2O and I&D, 2014)

3.1.2 Emptying and transport services

Emptying and transport serviced in the study area are provided by private service providers, based in Ziguinchor, which is about 30 km from Bignona. These service providers operate a total of five trucks and provide services on a periodic basis. Manual emptying services could not be identified in Bignona, however, during interviews with local stakeholders it became apparent that households often empty their own containment technology when full (KII1, 2015, KII2, 2015, KII3, 2015, KII4, 2015). When mechanical service providers empty systems, the sludge is transported offsite by the same service providers. Information on the destination of faecal sludge was unavailable. Recently an informal discharge location, shown in Figure 7, was closed following complaints of the nearby population.

Figure 7: Informal discharge location on Niamone road at the entrance of Bignona. Photos: Juliette Ndounla

3.1.3 Shared and communal toilets

The private estate “Maison Blanche Bignona” provides toilets connected to two septic tanks to its tenants. These tanks are emptied on a bi-monthly basis by one 7 to 8 m^3 truck, which has to return six to seven times until the system is fully emptied. The average monthly quantity of faecal sludge collected from these households is 28 m^3 (KII4, 2015).

3.1.4 Public toilets

As part of this assessment, one public toilet could be identified at the Bignona Bus Station. The user interfaces are connected to two septic tanks, which are emptied once a year. One 8 m^3 vacuum truck removes three truck volumes when emptying, which does not fully empty the containment technology (Stekeholder6, 2015, Stakeholder5, 2015). One public toilet was identified at the “old” market. The toilet is connected to a septic tank, which has never been emptied. Another public toilet was identified at the newly constructed market and has been emptied once since the construction in 2009. One 8 m^3 vacuum truck required eight trips to fully empty the system (Stakeholder 8).

3.1.5 Institutional, commercial and industrial areas

Two institutions regularly require emptying and transport services. These are:

- Bignona Hospital which has two septic tanks. One 8 m^3 truck performs eight trips once a month, which results in a total of 64 m^3 collected faecal sludge.
- Bignona high schools, which has one septic tank. One 8 m^3 truck performs five trips once a month, which results in a total of 40 m^3 collected faecal sludge.

The total volume of faecal sludge collected from these two institutions is 104 m^3 per month (KII4, 2015).

3.1.6 Restaurants and hotels

Overall, ten restaurants, bars and hotels were identified as part of this assessment, which perform the following emptying practices:

- Hotel Le Palmier has three septic tanks, which have not been emptied since it's opening in 2009
- Hotel Auberge Kayokoulo has one septic tank, which was emptied the last time in 2013
- Hotel Auberge Le Jardin has one septic tank, which has not been emptied since it's opening in 2013
- Bar-Restaurant Kamongone has one septic tank, which has never been emptied
- Hotel Auberge Kayagnor has one septic tank, which has not been emptied since it's opening in 2005
- Bar-Restaurant Auberge BBC has two septic tanks, which are emptied once every three months. Three trips are performed during each emptying operation.
- Bar-Restaurant Kelumack has nine septic systems, which are emptied manually once a year. The management of the hotel prefers manual emptying over mechanical services, because the vacuum trucks would only empty the liquid part of the tanks, while the solids remain on the bottom. The emptied faecal sludge is discharged to a hole that is dug within the perimeter of the hotel facility.
- Bar-Restaurant Erobon has one septic tank, which has never been emptied.
- Bar-Restaurant Chez Omar has one septic tank, which is emptied twice a year.
- The Coconut Bar has one septic tank, which has not been emptied since it's opening in May 2015

3.2 SFD Matrix

For Bignona in total, 34% of the excreta of the total population are considered “safely managed”, while 66% of the excreta are considered “unsafely managed” (Figure 8). Table 1 summarizes onsite sanitation technologies used in Bignona together with definitions used in the SFD assessment and the respective percentage of population using these systems. The following sections provide more detail about the respective percentages for each step of the sanitation service chain.

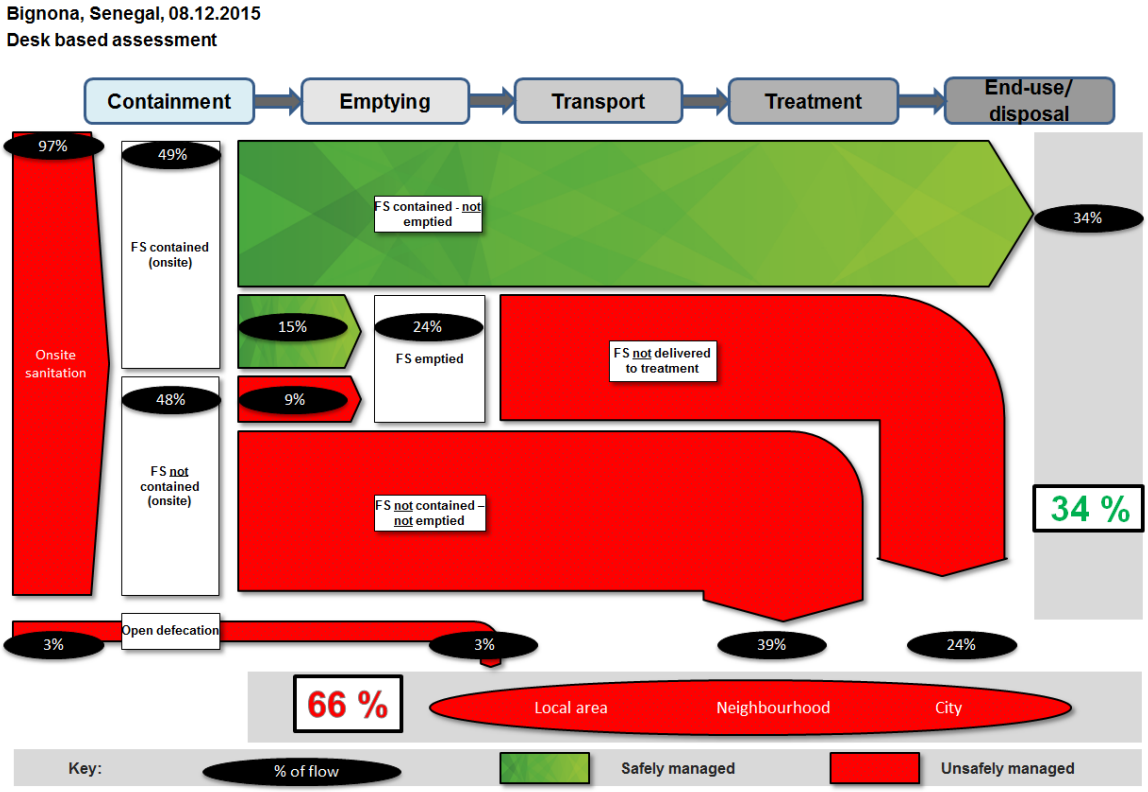

Figure 8: SFD for Bignona, Senegal.

Table 1: Terminology used for sanitation facilities in Bignona compared to SFD definitions.

Terminology used in Bignona		SFD definition	%age of population
Septic Tank	1	Septic tank connected to soak pit	17
	2	Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	15
Pour flush toilet	3	Lined tank with impermeable walls and open bottom, connected to a soak pit	6
Improved pit latrine	4	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	7
	5	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	3
Traditional pit latrine	6	Unlined pit, no outlet or overflow	19
	7	Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	30
Open defecation	8	Open defecation	3

3.3 Household sanitation facilities

Bignona does not have any offsite sanitation (sewer) facilities, and therefore this sanitation type is listed in neither the diagram nor the table.

Of the total population, 3% do not have any sanitation facility. It is probable that people use sanitation facilities of their neighbors, however, that could not be confirmed and so for this report it was assumed that people without access to sanitation facilities practice open defecation.

3.4 Risk of groundwater pollution

Vulnerability of the aquifer (e.g. geology, soil type, depth of groundwater table)

The soil types in Bignona are primarily clay and sand and the hydrogeological structure of Bignona is characterized by three main aquifer layers. (1) The deep aquifer with groundwater levels between 300 m and 500 m, (2) the semi-deep aquifer with groundwater levels between 100 m and 150 m, and (3) the superficial layer with groundwater levels between 0 m and 50 m, which is usually captured by the wells for drinking water provision. Within the study area groundwater levels are considered high for the neighborhoods of Bassène, Badionkoto and part of Tenghory Trans-Gambian (river side). Containment systems in these areas are affected by periodic flooding, which results in groundwater intrusion and rapid filling during the rainy season. Groundwater levels are low in the neighborhoods of Kadiamor and Château d'eau, Manguiline South and North, which are located in the upper parts of Bignona (H2O and I&D, 2014).

Lateral separation between groundwater sources and sanitation facilities

No quantitative information on lateral separation between sanitation facilities and groundwater sources was available. However, most of the wells in Bignona are located in the most densely populated area. Population density is highest in the old quarters of the city (H2O and I&D, 2014):

- Bassène with over 160 inhabitants per hectare
- Manguiline North, Château d'eau and Badionkoto with 40 to 60 people per hectare
- Kadiamor and Tenghory with 20 and 40 people per hectare
- South Manguiline with less than 20 people per hectare

Water supply / Water production

Figure 9 illustrates the percentage of drinking water provided by different technologies. 39% of the households in Bignona receive their drinking water from the national water distribution network, while 57% use wells as their main source of drinking water. Another 3% receive drinking water from public water points and 1% uses boreholes (H2O and I&D, 2014).

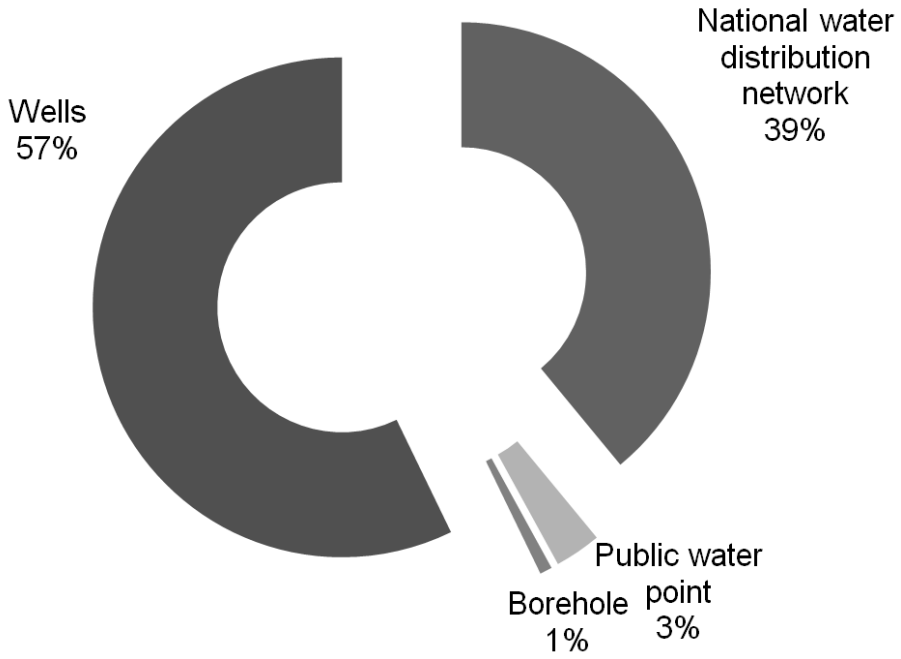

Figure 9: Water supply sources in the study area (adapted from H2O and I&D, 2014)

3.5 Containment

For each type of sanitation facility, the SFD methodology distinguishes if the sludge and effluent at that facility can be safely contained or not safely contained on-site. The distinction between “on-site safely contained” and “on-site not safely contained” depends on the location of these facilities. If the on-site facilities: a) discharge any wastewater effluent (or infiltrate from sludge) to the environment, for instance by infiltration into soil through unlined pit walls, open bottom, or soak pits) and, b) are located in areas of high groundwater level where 'significant risk' of groundwater pollution can be expected by the effluent; then the containment is considered “unsafe”.

3.5.1 Not safely contained

With this definition, in Bignona, 48% of the total population use systems that do not safely contain faecal sludge. This comprises facilities that are in areas of significant risk of groundwater pollution (see Table 1):

- Septic tanks connected to soak pits (15%)
- Lined pit with semipermeable walls and open bottom (3%)
- Unlined pits (30%)

In these areas the infiltration of liquid (effluent or infiltrate) from these facilities into the soil results in a significant risk of groundwater pollution, due to the existing high groundwater table. These areas include: Kadiamor, remaining parts of Tenghory Trans-Gambian, Manguiline Sud, Manguiline Nord and Chateau d’eau.

3.5.2 Safely contained

On the other hand, 49% of the of the population use systems that safely contain faecal sludge. This comprises facilities in areas of low risk of groundwater pollution:

- Septic tanks connected to soak pit (17%)
- Lined tanks with impermeable, walls and open bottom (6%)
- Lined pits with semi-permeable walls and open bottom (7%)
- Unlined pits that are covered with soil and abandoned when full (19%)

These areas include: Bassène, Badionkoto and parts of Tenghory Trans-Gambian.

3.6 Emptying

To assess the potential for emptying of facilities systems, it is assumed that 100% of the population could have access to emptying services. However it is also assumed that unlined pits even if located in high risk areas (30%) are not emptied when full, but covered with soil and abandoned.

One further consideration is that when emptying sludge from a facility they are typically only partially emptied, with a portion of faecal sludge remaining on-site with a risk of groundwater pollution. The SFD assessment method sets the proportion removed by emptying to 50% of the facility content, by default. Respectively, even with an emptying activity, 50% of the excreta still remain on-site.

For the facilities in low-risk areas, this amounts to a total of 15% of faecal sludge removed. This comprises:

- 8.5% of septic tanks connected to soak pit (50% of 17%),
- 3% of lined tanks with impermeable walls and open bottom connected to soak pit (50% of 6%)
- 3.5 % of lined pits with semi-permeable walls and open bottom (50% of 7%)

The remaining 15% (the other 50% of the excreta) from these facilities and the 19% of unlined pits in areas of low risk to groundwater, result in a total of 34% of faecal sludge safely contained and not emptied (top green arrow in Figure 8).

For the facilities in high-risk areas, the faecal sludge removed amounts to a total of 9%. This comprises:

- 7.5% of septic tanks connected to soak pit (50% of 15%),
- 1.5 % of lined pits with semi-permeable walls and open bottom (50% of 3%)

Therefore a total of 24% (= 15% + 9%) of faecal sludge is emptied and removed. However, as there is no faecal sludge treatment facility, this sludge is considered "*FS not delivered to treatment*" (Figure 8) and is part of the unsafely managed flow.

Subtracting this 9% of removed sludge from all facilities where sludge is not safely contained from the 48% (see chapter 3.5.1) amounts to 39% of "*FS not emptied and not safely contained*".

Emptying services are performed by five mechanical emptying and transport service providers using trucks equipped with vacuum pumps. These trucks are based in Ziguinchor, which is located 30 km from Bignona. Also manual emptying of faecal sludge is carried out by the households themselves. Given that it is an individual and informal activity it is not listed as a "service".

3.7 Transport

Sludge is transported by the same service providers that offer emptying services. Information on transport destination of faecal sludge was unavailable and it was assumed that none of the collected faecal sludge is transported to any official discharge location. As stated in the previous chapter, therefore all the emptied sludge does not reach any treatment facility. In total, this amounts to 24% of the excreta of the total population which can be characterized as "*FS not delivered to treatment*" and therefore contributes to the flow of unsafely managed faecal sludge.

3.8 Treatment

Currently, there is no faecal sludge treatment in Bignona.

3.9 End-use/disposal

No end-use practices could be identified in Bignona. However, during interviews with local stakeholders it was mentioned that faecal sludge discharged at informal discharge locations gets collected once it is dry and used as a soil conditioner by farmers. It was not possible to quantify these amounts.

4 Stakeholder Engagement

4.1 Key Informant Interviews

Key stakeholders were involved at several stages throughout the writing process of this report. They were selected based on their expertise and knowledge about the local context in Bignona and included:

- Head of the RSA based in Ziguinchor,
- Counselor of the Tenghory Trans-Gambian Municipality,
- Head of the emptying and transport service provider in Ziguinchor
- Vacuum truck driver in charge of emptying and transporting faecal sludge in Bignona and its surrounding area
- Counselor of the Bignona Municipality

Interviews were conducted remotely by phone and also in person in the field. Furthermore the final SFD was presented at a workshop in Bignona on the 15th of December 2015. The purpose of the workshop was to share results obtained from studies undertaken by Eawag/Sandec as part of a project implemented together with ACRA-CSS. Workshop participants comprised of stakeholders from the Bignona municipality, representatives from ONAS (the local utility for sanitation), the directorate of sanitation, hygiene services, and directorate of environment and neighborhood councils. The presented SFD was verified by all participating stakeholders.

5 Acknowledgements

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7 Appendix

7.1 Stakeholder identification (Tab 2: Stakeholder Tracking Tool)

	Stakeholder Group	**Name of organization**
Stakeholder 1	Ministry in charge of urban sanitation and sewerage	SRA
Stakeholder 2	City council	Tenghory transgambien township
Stakeholder 3	Service provider for emptying and transport of faecal sludge	Emptiying Collectif
Stakeholder 4	Service provider for emptying and transport of faecal sludge	Emptiying Collectif
Stakeholder 5	External agencies associated with FSM services	ACRASS
Stakeholder 6	Ministry in charge of urban sanitation and sewerage	ONAS
Stakeholder 7	Ministries in charge of urban planning, environmental protection	DREEC
Stakeholder 8	Ministries in charge of urban planning, environmental protection	SH
Stakeholder 9	External agencies associated with FSM services	ENDA RUP
Stakeholder 10	External agencies associated with FSM services	PEPAM
Stakeholder 11	External agencies associated with FSM services	Groupement H2O Engineering
Stakeholder 12	External agencies associated with FSM services	Ingénierie et Développement
Stakeholder 13	External agencies associated with FSM services	Commission Européenne

7.2 Stakeholder tracking

	Date of Engagement	Purpose of Engagement
Key informant 1	30.05.2015	Interview on FSM practices in Bignona (phone interview)
Key informant 2	30.05.2015	Interview on FSM in Bignona (phone interview)
Key informant 3	16.06.2015	Interview on faecal sludge emptying and transport services in Bignona (phone interview)
Key informant 4	16.06.2015	Interview on faecal sludge emptying and transport services in Bignona (phone interview)
Local consultant	15.09.2015	Verification of data (phone interview)
Group of stakeholders	12/2015	Verification of data (workshop)
Local consultant	15.02.2016	Verification of data (phone interview)