SFD Lite Report

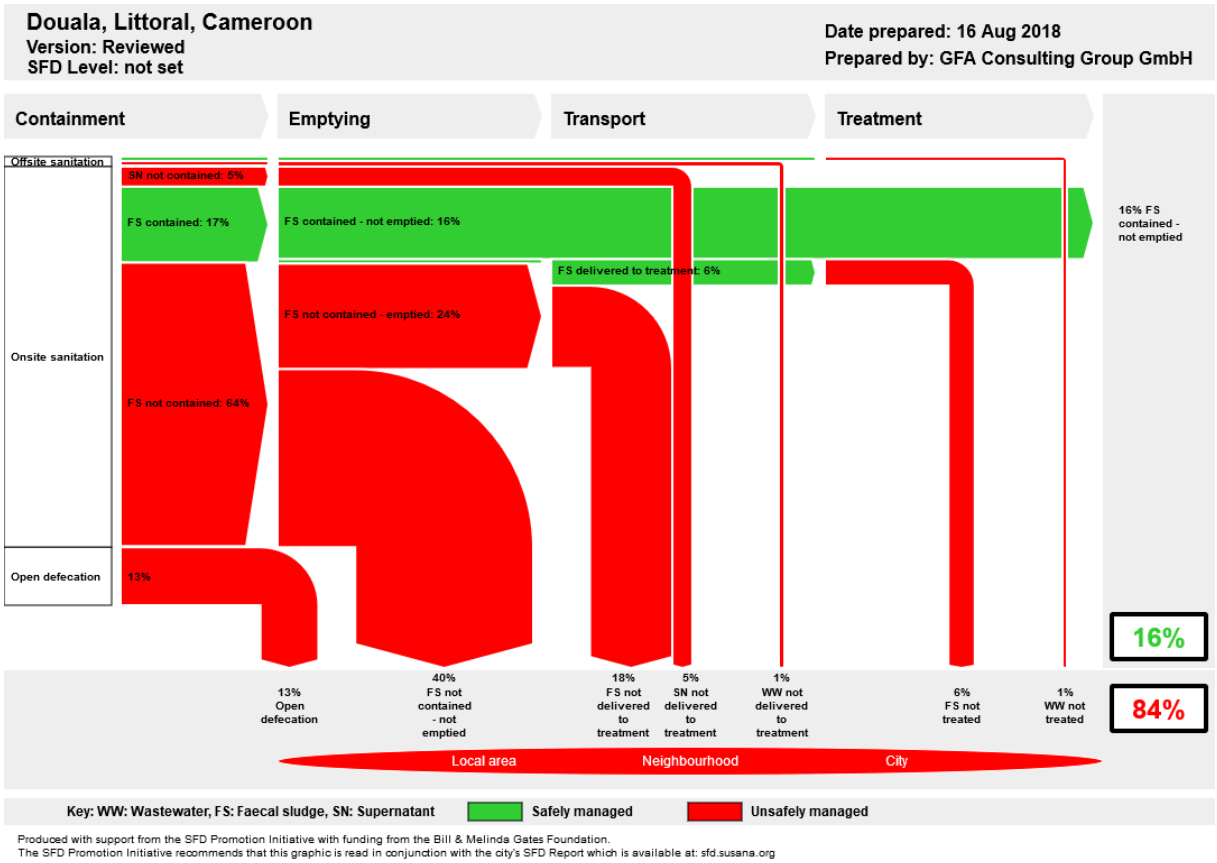
Douala
Cameroon

Final report

This SFD Lite Report was prepared by GFA Consulting Group GmbH

Date of production: 05/09/2018

1 The SFD Graphic



Produced with support from the SFD Promotion Initiative with funding from the Bill & Melinda Gates Foundation.
The SFD Promotion Initiative recommends that this graphic is read in conjunction with the city's SFD Report which is available at: sfd.susana.org

2 SFD Lite information

Produced by:

- GFA Consulting Group GmbH
- This SFD Lite was produced by Dr. Roger Feumba (main author) with inputs from Alejandra Burchard and Leonie Kappauf (all GFA Consulting Group GmbH).

Collaborating partners:

- Many collaborating partners were involved in the data collection during the elaboration of this SFD Lite for Douala. Key informants included Heukoua Willy and Djomo Céline[1] from DEPIDD[2] of the Municipality of the Douala.
- A stakeholder validation workshop was held during the Training for Sanitation Stakeholders in Cameroun within the RASOP-Africa[3] programme (23.08.2018, Yaoundé). Representatives from the Douala 5 city council were present and validated the data.

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[1] *Head of the Unit of Social and Environmental Management*
[2] *Division of Studies, Town planning, Investments and Sustainable Developement*
[3] *Reinforcing Capacity of African Sanitation Operators on Non-Sewer and FSM systems through peer-to-peer learning Partnerships*

3 General city information

Douala is the economic capital of Cameroon. It is located between 04°01' and 04°06' North and 09°40 'and 09°45' East, and has six city councils, with four on the Western bank and two in the eastern bank of Wouri River connected by a bridge (Figure 1).

In 2005, Douala had 1,907,479 inhabitants (RGPH, 2010). With a growth rate of 4.7%, the population of this city is estimated to be 3,309,939 inhabitants in 2017. There are no important diurnal and seasonal variations of population in Douala. This SFD was elaborated beyond the administrative boundaries. The total area of the city (excluding Douala VI and Wouri River) is about 41,000ha. According to ENSP/L3E (2014), 30 to 40% of the area is occupied by slums. Only 50% of housing in Douala can be considered as accessible by a paved road and emptying trucks (Toukap, 2012).

The Douala sedimentary basin (sand, gravel, clay and loams) consists of two aquifer systems divided into four aquifer formations. Average groundwater level fluctuation ranges between 0.3m and 1.60m during dry and wet seasons, respectively, in the unconfined aquifer. The aquifer records water levels of approximately 1 – 20m and is mainly exploited by hand-dug wells. 60% of the Douala sedimentary basin area is prone to floods, which affects the risk to groundwater pollution depending on the type of sanitation facilities and corresponding maintenance conditions (Feumba and Ngounou Ngatcha, 2014).

The city is subject to an equatorial coastal climate, with two annual seasons: the dry season from mid-November to end of February and the wet season from March to mid-November. The average temperature varies only slightly throughout the year with the maximum in February (27.6°C) and minimum in July (24.8°C). There is an average of 3,600mm of annual rainfall, with about 180 days of rain per year mostly during the rainy season (Feumba et al., 2011).

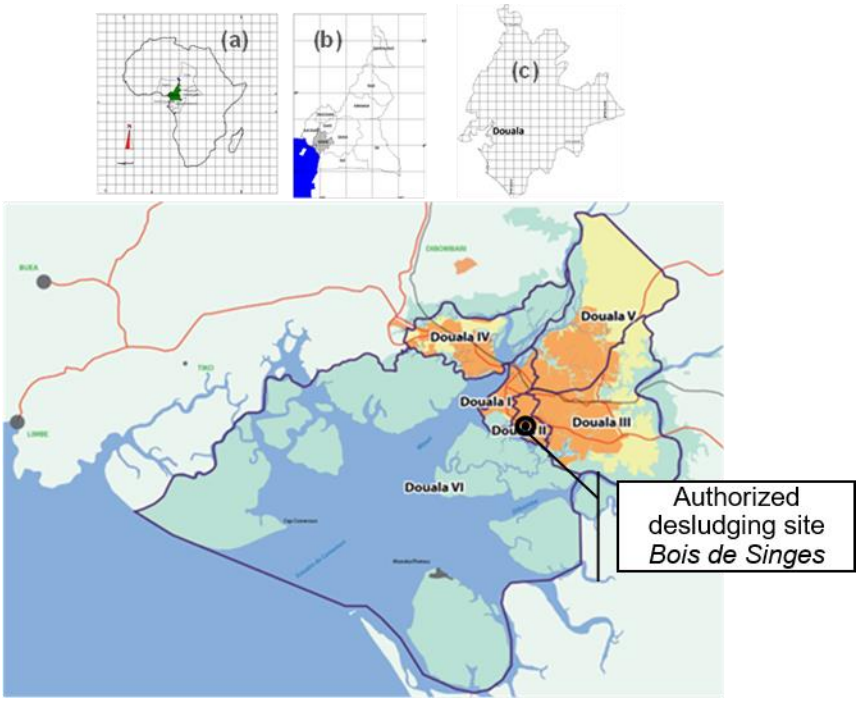

Figure 1: Geographic location of Douala (CUD-Groupe Huit-AS consultants, 2012)

4 Service outcomes

It is estimated that only 16% of faecal sludge and wastewater is treated and safely managed in Douala. Part of the remaining 84% is discharged either directly into a water body or to the soil or is disposed in the authorized sludge disposal site known as “Bois des Singes”. According to Mougoué et al. (2013), 84% of the faecal sludge discharged in “Bois des singes” comes from households. From

"Bois des Singes", the faecal sludge joins the Wouri River without any treatment. According to the National Strategy on Liquid Sanitation, the city of Douala will have four faecal sludge treatment plant stations and, the access to good sanitation facilities by the population will be improved from 34% in 2010 to 57% in 2020 (BM and MINEE, 2011). This will require the construction of about 1,100 000 additional improved individual sanitation facilities, roughly half of which should be constructed in rural areas.

The following table shows the SFD matrix and the sanitation systems used in Douala.

Table 1: SFD Matrix for Douala

Douala, Littoral, Cameroon, 16 Aug 2018. SFD Level: not set
Population: 3309939
Proportion of tanks: septic tanks: 100%, fully lined tanks: 50%, lined, open bottom tanks: 100%

System label	Pop	W4b	W5b	W4c	W5c	F3	F4	F5	S4e	S5e
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to decentralised treatment plants	Proportion of wastewater delivered to decentralised treatment plants, which is treated	Proportion of wastewater in open sewer or storm drain system, which is delivered to treatment plants	Proportion of wastewater delivered to treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C4 Toilet discharges directly to a decentralised foul/separate sewer	1.0	75.0	0.0							
T1A1C6 Toilet discharges directly to open drain or storm sewer	1.0			0.0	0.0					
T1A3C10 Fully lined tank (sealed), no outlet or overflow	1.0					77.0	75.0	0.0		
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	9.0					77.0	0.0	0.0	0.0	0.0
T1A3C7 Fully lined tank (sealed) connected to a water body	6.0					100.0	0.0	0.0		
T1A4C7 Lined tank with impermeable walls and open bottom, connected to a water body	13.0					77.0	0.0	0.0		
T1B11 C7 TO C9 Open defecation	13.0									
T1B7C10 Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow	16.0									
T1B8C10 Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil, no outlet or overflow	15.0									
T2A1C5 Toilet discharges directly to soak pit, where there is a 'significant risk' of groundwater pollution	1.0									
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	3.0					77.0	75.0	0.0		
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	13.0					23.0	75.0	0.0		
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	8.0					23.0	75.0	0.0		

4.1 Groundwater contamination

Approximately 60% of Douala's residents rely on groundwater wells/boreholes for drinking water (Feumba et al., 2011). More so, according to ENSP/L3E (2014), 30 to 40% of the area is not suitable for traditional sanitation facilities due to high levels of groundwater (water table is less than 2m from the topographic ground). Data on the relative elevation of groundwater sources to on-site sanitation facilities are available, data on septic tank proximity, water table depth and protection of groundwater sources were collected (section 5). Due to the high groundwater level (Table 4), most on-site sanitation facilities are elevated but frequently the construction quality is poor.

The municipality of Douala is the only authorized entity to issue septic tanks or latrine licenses to households or any third party to ensure that there is no risk of groundwater from onsite sewage facilities. However, due to rapid slum expansion, the execution of these regulations is weak. Due to the soil conditions (mainly sandy, sandy silty, loamy or clayed), unsealed sanitation facilities add to the risk of groundwater pollution in Douala. High population density added to spontaneous arrangement of drinking water wells cause additional public health risk because two pit latrines exist around a well within a distance less than 30m (Bilogue, 2011; ENSP/L3E, 2014). 75% of wells are highly vulnerable in this regard (Feumba, 2015). A detailed explanation on use of the SFD Groundwater Pollution Risk Assessment tool is given in Table 4.

4.2 Containment

Data presented in this section are related to percentages found in documents and not readjusted percentages used to generate the SFD. When adding up percentages from the literature, the total surpasses 100% due to different researchers and different population pools. Please refer to Table 2, for final consolidated numbers used to generate the SFD. The total percentages from the literature were combined and readjusted to a total of 100% for the SFD.

According to SOGREAH and ECTA BTP (2004), in Douala, on-site sanitation facilities such as septic tanks and latrines are mostly financed by households, while public sanitation is marginal or absent. Most [95% (19% of septic tank, 60% of latrines and 16% of fully lined tanks)] (SOGREAH and ECTA BTP, 2004, p.123), of the residents of Douala use on-site sanitation facilities (pit latrines and septic tanks). Septic tanks are used by more than 20% of the population (Nguedjo, 2011; Mougoué et al., 2013). According to ENSP/L3E (2014), the proportion of population, using septic tanks is 22.5% where those with soak pits represent 6%, but most (16.5%) discharged to open drain or storm sewers. From CUD (2009), approximately 12% used pour flush latrines and 17% used dry latrines. The 16% safely managed sanitation is coming from these dry latrines (never emptied).

According to ENSP/L3E (2014), latrines without containment *(latrine sans fosse),* which directly discharge the excreta into a water body represent 7.7% and, are mainly found around the edges of the Wouri River or the flooded-area. Other technologies are latrines directly discharging into a water body or open drain/storm sewer (10.1%), and latrines with an elevated tank (29.1%) which are mainly found in flood prone areas and latrines with non-elevated tanks (30.7%).

According to CUD (2009), VIP latrines, which represent 55%, are mainly found in New Bell and Bonaberi. Meanwhile, according to Ngeudjo (2011), latrines with fully lined tanks represent 1%, which are mainly found in New Bell and Bonaberi.

Public or communal sanitation facilities are found in the few planned areas and are mostly non-functional due to poor operation and maintenance (O&M) which is partly due to inadequate and unsustainable O&M concepts and mechanisms. Open discharge (25%) is a major form of faecal sludge disposal (CUD, 2009).

According to Ngeudjo (2011), approximately 4% of the population is connected to decentralized foul/separated sewer facilities. The network of these off-site sanitation systems exists in Bonanjo, Plateau Joss, Bonamoussadi, Makepe and Cité des Palmiers but the treatment facilities for wastewater and feacal sludge are all dysfunctional. Open defecation represents 15% (CUD, 2009; Ngeudjo, 2011).

For the elaboration of the SFD, these percentages were aggregated to not surpass 100% (see data on the fourth column in table 2).

4.3 Emptying

77% of septic tanks are regularly emptied, meanwhile 23% of pit latrines of all types are regularly emptied (Mougoué et al., 2012). Nevertheless, it is assumed that the sanitation technology T1A3C7 is emptying at the rate of 100% during rainy season.

Illustration of a lined tank with hole towards water body (the content of this type is emptied to the water body)

Type of latrine without tank used in Douala and considered as a form of open defecation

Type of latrine with elevated tank

Figure 2: Illustration of examples of on-site sanitation technologies found in Douala

According to Toukap (2012), three types of emptying exist in Douala:

- **Mechanical emptying:** Offered by 22 private companies and nine (9) individuals. A household pays US$ 50 for this purpose (ENSP/L3E, 2012).
- **Manual emptying:** Households, which are not accessible by trucks, pay to manual emptiers between US$ 60 and US$ 90 for this service (ENSP/L3E, 2012).
- **Discharge into nature:** Finally, 'emptying' (meaning either direct discharge or draining) into water bodies is practiced by households along the rivers.

4.4 Transport

According to Mougoué et al. (2013), 75% of feacal sludge collected reaches the 'authorized' desludging site known as "Bois des singes", which is located in the southern part of the city (Douala 2 City Council), close to the international airport of Douala at 6km from Akwa (centre of the town). The site has an area of 25ha and is mainly used by formal providers. Each of the 49 trucks that exist in the city pays US$ 3 per round trip to get access to the dumping site of "Bois des Singes" (ENSP/L3E, 2012). Their volume is ranging between 4m^3 to 12m^3. Many of these trucks are very old and thus leakage can be assumed.

4.5 Treatment

Currently, there is no operational treatment plant for faecal sludge or wastewater in the city of Douala. The treatment facilities have been dysfunctional since 1985. However, there are plans to restore some of the old facilities within the coming months with financial support from the World Bank, AfrDB and AFD. The municipality intends to construct two treatment facilities for faecal sludge by 2020 in the site "Bois des singes" and in Ngombè (Douala 5 City Council, in the Eastern part of Douala) (CUD, 2012).

4.6 Reuse and disposal

Non- applicable for Douala.

5 Data and assumptions

5.1 Availability and accessibility of data

All data used to elaborate the Douala SFD Lite are available and easily accessible. Most of them come from different research reports such as MAFADY[4] project, which took place in Douala and Yaoundé from April 2011 to June 2014, Ph. D and master thesis, National strategy on liquid Sanitation and Solid waste, and from the close collaboration with members of the Douala Municipality.

[4] *Mastery the Sanitation chain in the coastal zone of Douala and slums of Yaoundé (SPLASH Programme)*

5.2 Quality of data and used

Data collected to elaborate the SFD Lite was shared and validated with water and sanitation stakeholders such as the Municipality and Cities Councils of Douala, different ministries in charge of water, environment, health, sanitation and sustainable development in Cameroon, NGO, emptiers, practitioners, other municipalities of Cameroon during MAFADY's project from April 2011 to June 2014 and during the elaboration of the National Strategy on Liquid Sanitation of Cameroon (2011). The data collected and related to decentralised separate sewer was derived from the Sanitation Master Plan of Douala (Horizon, 2025). These were updated with statistical assumptions such as population figures.

5.3 Identified data gaps

The data related to the decentralised/separated sewer of Douala was derived from literature. During data collection, it was not possible to find proportions of on-site technology where containment of the sanitation system was damaged, collapsed, failed or flooded and still used by populations or households.

5.4 Major assumptions

Based on the last general census of population in Cameroon, the initial population was considered as 1,907,479 inhabitants with a growth rate of 4.7%. The statistic formula of geometric growth was then applied to obtain the population by the city council in 2017. Pt = Po*(1+r)^t where Po=population in 2005; r=growth rate; t=difference between 2017 and 2005 and Pt=population in 2017.

For off-site sanitation systems, it was assumed that according to Mougoué et al. (2013), 75% of all faecal sludge and wastewater is delivered to the treatment plant even if it is dysfunctional. It is also assumed that the latrine without containment (*latrine sans fosse*) is a type of "open defecation" because it is a latrine built with four tires and a platform near a water body where feacal sludge is discharged directly to water body or open ground. This percentage was added to T1B11C7T0C9. Percentages of the different types of sanitation systems were retrieved from ENSP/L3E (2014), Nguedio (2011) and CUD (2012). When adding together all the percentages of each different type of sanitation system from different sources the total surpasses 100%. This is due to different researchers carrying out studies with different population pools, which can lead to differences. These percentages were then adjusted to obtain 100% as can be observed in the table below.

Table 2: Total population served by sanitation system (ENSP/L3E, 2014; Nguedio, 2011; CUD, 2009 and 2012)

Type (local term)	References	% directly from the literature	% to be used for SFD generator*	Type of sanitation system[5]			Technology	Population served	% of total type
Fosse septique à puisard "septic tank with soakpit"	ENSP/L3E (2014)	6,0	3	**T2A2C5**			On-site	85	3
Fosse septique sans puisard "septic without soakpit"	ENSP/L3E (2014)	16,5	9	**T1A3C6**					9
Latrine à fosse étanche "sealed tank"	NGUEDJO (2011)	1,0	1	**T1A3C10**					1
Latrine à fosse sèche "dry latrines"	CUD (2009)	55,0	31	**T1B7C10**	**T1B8C10**				31
Latrine à fosse non surélevée ''non-elevated containment or tank''	ENSP/L3E (2014)	30,7	18	**T2A4C10**	**T2A5C10**				18
Latrine à fosse surélevée ''elevated tank or containment''	ENSP/L3E (2014)	29,1	17	**T2A4C10**	**T1A4C7**				17
Latrine à canon ''sealed tank with a pipe"	ENSP/L3E (2014)	10,1	6	**T1A3C7**					6
Latrine sans fosse ''latrine without containment/tank"	ENSP/L3E (2014)	7,7	4	**This is not a technology. We add this to "rejet dans le milieu naturel"**					
Assainissement collectif ''off-site sanitation system"	NGUEDJO (2011)	4,0	2	**T1A1C4**	**T2A1C5**	**T1A1C6**	**Off-site**	**2**	2
Rejet dans le milieu naturel ''open defecation''	CUD (2009) ; NGUEDJO (2011)	15,0	9	**T1B11C7T0C9**			**Open defecation**	**13**	13
Total		**175.1**	**100,0**					**100**	**100**

***Formula for adjustment = percentage from references (column 3) x100 and divided by the total sum of percentages**

[5] *Based on SFD Manual classification*

Table 3: On-site sanitation systems

On-site sanitation indicators	Percentage (%)	Correspondence with the matrix
Proportion of septic tanks from which faecal sludge is emptied regularly (Mougoué and al., 2012)	77	F3
Proportion of faecal sludge delivered to treatment plants which is treated	0	F5
Proportion of latrines (all types) from which faecal sludge is emptied regularly (Mougoué and al., 2012)	23	F3
Proportion of wastewater delivered to treatment plant (Mougoué and al., 2013)	75	W4b

Table 4: Groundwater pollution risk assessment

Question	Response	Calculation and assumptions
What is the rock type in the unsaturated zone?	Fine to coarse clayed sandy or gravelly (non-flooded areas) and clayed loamy to flooded-areas	(1) The unsaturated zone is the portion of the subsurface above the groundwater table. The soil and rock in this zone contains air as well as water in its pores. (2) Soil data are available for Douala. > 80 % of the area is covered by sandy gravelly loams (Feumba, 2015). Choice between fine clayed sandy and coarsed sands / gravel; however, picked fine clayed sandy / gravel because the typical soil profile is predominantly clayed sandy / loamy with particle size described as 50-60 % rock fragments (Feumba, 2015).
What is the depth to the groundwater table?	<5m 5<GWT<10m	We used piezometric map of vulnerability to appreciate the depth of groundwater in Douala (Feumba, 2015)
What is the percentage of sanitation facilities that are located <10 m from groundwater sources?	<25%	We need a distance of about 15 m between a well and a pit latrine or on-site sanitation facility and, around 50 m from a source of water and pollutant (Feumba, 2015)
What is the percentage of sanitation facilities, if any, that are located uphill of groundwater source?	<25%	Douala is a flat city. However, hills with 60 m of elevation exist in two council, Douala 3 and 5 and we can assume according to morphology of these two districts that this percentage is 20.92 % (Feumba, 2015)
What is the percentage of drinking water produced from groundwater sources?	>25%	An estimated 60% of Douala population relies on groundwater wells/boreholes for drinking water. That is 1,985,963 people (Feumba et al., 2011).
What is the water production technology used?	Protected boreholes/wells, Mungo River	Households are not used to test the quality of their water but the company in charge of distributing water to population (approximately 4% are connected, Ngeudjo, 2011) usually make bacteriological test and physic-chemical test by a certified laboratory (Centre Pasteur du Cameroun) according to public health rules.
Level of risk of groundwater predicted		Significant risk if GWT<5m (>75%) Low risk if 5<GWT<10m (<25%)

5.5 Stakeholder validation

A stakeholder validation workshop was held during the Training for Sanitation Stakeholders in Cameroun within the RASOP-Africa [6] programme (23.08.2018, Yaoundé). Representatives from the Douala 5 city council were present and validated this SFD Lite for Douala. Figure 3 shows Dr. Feumba presenting the SFD for Douala.

Figure 3: Stakeholder Validation Workshop 23.08.2018, Yaoundé (FGD 1, 2018)

6 List of data sources

Banque Mondiale and MINEE (2011). Stratégie Nationale d'Assainissement liquide au Cameroun. 48 p.

Bilogué, B. (2011). Diagnostic technique de l'assainissement dans les quartiers précaires de Douala. Mémoire de fin d'étude d'ingénieur de génie civil et de conception, Ecole Nationale Supérieure Polytechnique de Yaoundé, Dept. GCU ; 117 p.

BUCREP (RGPH) (2010). Résultats globaux du recensement des populations et de l'habitat de 2005. Mars 2010. Bureau Central de Recensement des populations, Yaoundé. 68 p.

CUD et Groupe huit-AS consultants (2012). Plan Directeur d'Urbanisme de Douala horizon 2025. 241 p.

ENSP/L3E (2012). Rapport scientifique du projet MAFADY, année 1. Rapport de l'activité 2.1 « diagnostic technique de l'assainissement dans le bassin de Besseke à Douala et la zone de Nkolbikok à Yaoundé ». Yaoundé, 126 p.

ENSP/L3E (2014). Fiches techniques de capitalisation des résultats du projet MAFADY. Yaoundé, juillet 2014. 50 p.

Feumba R. (2015). Hydrogéologie et évaluation de la vulnérabilité des nappes dans le bassin versant de Besseke (Douala, Cameroun); thèse de Doctorat Ph.D; Univ. Ydé I; Fac. Sci., DSTU; 254 p.

Feumba, R. and Ngounou Ngatcha, B. (2014). Maps of vulnerability to pollution: a useful tool for sustainable groundwater in Douala (Cameroon). Construction Publishing of the National University of Civil Engineering of Hanoi; ISBN: 978-604-82-1337-4; Pp. 249-254.

Feumba, R., Ngounou Ngatcha, B., Tabué Youmbi, J.G. and Ekodeck, G.E. (2011). Relationship between Climate and Groundwater Recharge in the Besseke Watershed (Douala-Cameroon). Journal of Water Resource and Protection, 3, Pp. 607-619.

[6] *Reinforcing Capacity of African Sanitation Operators on Non-Sewer and FSM system through peer-to-peer learning Partnerships*

Feumba, R. (2005). Hydrogéologie en zone de socle cristallin : cas du bassin versant de l'Ekozoa, zone nord de Yaoundé. Mémoire de DEA ; Univ. Ydé 1 ; Fac. Sci. Dept. Sci. De la Terre ; 101 p.

Mougoue, B., Ngnikam, E., Wanko, A., and Noumba, I. (2013). Le devenir des boues de vidange dans la ville de Douala: un exemple de dysfonctionnement des systèmes d'assainissement d'une grande ville africaine ; article ; International journal of advanced studies and research in Africa ; 4 ((1)):: 23—35 ; IISSN:: 1920 -- 860X ((online)) ; ISSN:: 1920 -- 8693 ((print) ; 13 p.

Mougoue, B., Ngnikam, E., Wanko, A., Feumba, R. and Noumba, I. (2012). Analysis of faecal sludge management in the cities of Douala and Yaoundé in Cameroon. Sustainable sanitation practice. Article published by / Medieninhaber, Herausgeber und Verleger, EcoSan Club, Schopenhauerstr. 15/8, A-1180 Vienna, Austria ; www.ecosan.at. Pp 11-21.

Nguedjo, P.A. (2011). Géomatique et analyse de l'assainissement et des risques sanitaires en milieu urbain: cas du bassin versant de Mbanya dans la ville de Douala (Cameroun) ; Master II Géomatique; Univ. Ngaoundéré, aménagement et gestion des ressources; abstract online.

SOGREAH and ECTA BTP (2004). Etude du schéma directeur d'assainissement de la ville de Douala et maîtrise d'œuvre d'une tranche prioritaire des travaux, phase 1. Rapport d'étude; 159 p.

Toukap S.C. (2013). Organisation de la filière boues de vidange dans la ville de Douala. Master Professionnel en Urbanisme, aménagement et développement urbains, Dept. Géographie, UYI, projet MAFADY. 142 p.

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KII 1, 2018. Telephone interviews with Head of the Unit Social and Environmental Management of the Division of Studies, Town planning, Investments and Sustainable Development of the Municipality of Douala (27th and 30th of July 2018)

FGD 1, 2018. Stakeholder validation workshop during the Training for Sanitation Stakeholders in Cameroun within the RASOP-Africa [7] programme (23.08.2018, Yaoundé).

[7] *Reinforcing Capacity of African Sanitation Operators on Non-Sewer and FSM systems through peer-to-peer learning Partnerships*