SFD Lite Report

Buon Ma Thuot
Vietnam

This SFD Lite Report was prepared by GFA Consulting Group GmbH.

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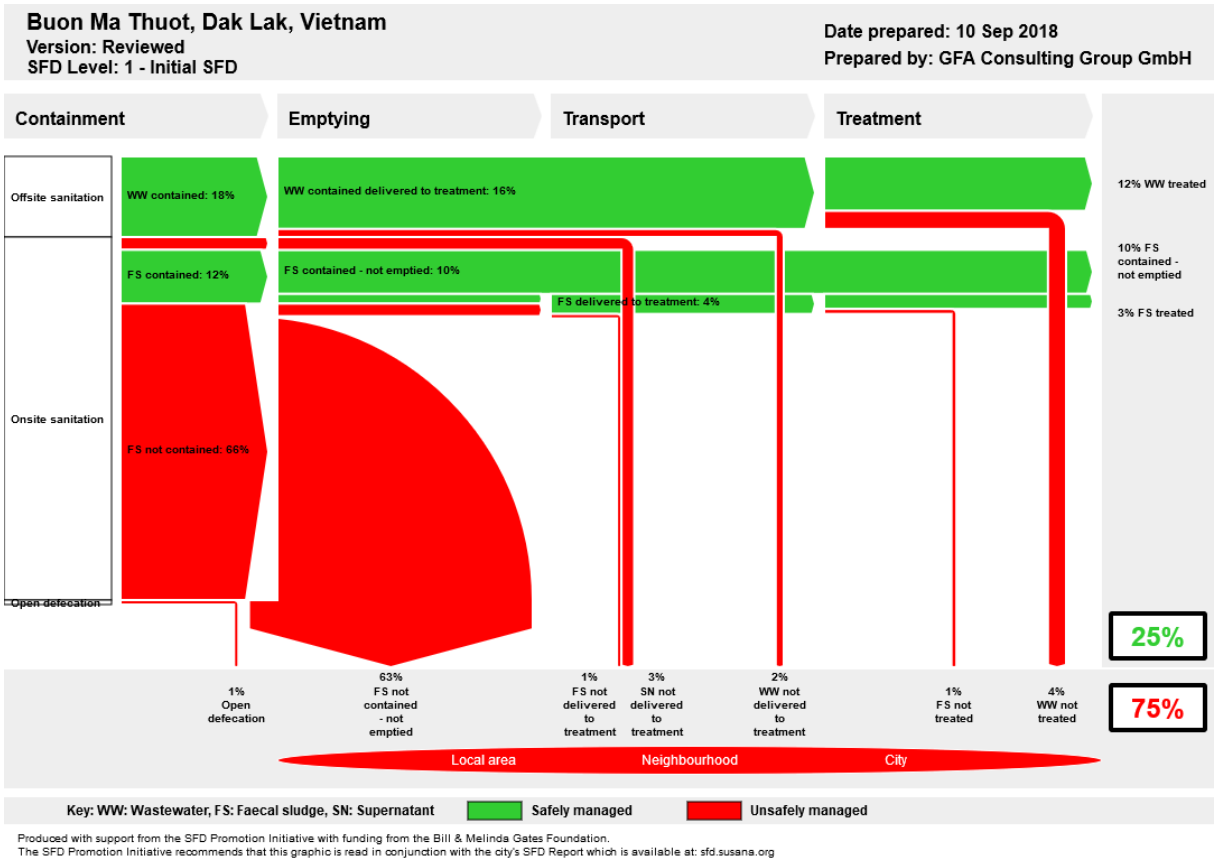
1 The SFD Graphic



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 Pia Fischer, Lena Westhof and Thuylinh Dang.

Date of production: 27/09/2018

3 General city information

Buon Ma Thuot is the capital city of Dak Lak province. The urban center is located in the southwest of Dak Lak and lies on fairly flat highland at an average height of 536 m above sea level. Buon Ma Thuot borders Dak Nong province in the west, and four districts of Dak Lak province in the other directions. Its population of about 457,000 (Statistic Office of Vietnam, 2016) is distributed over 13 wards and 8 communes with a general growth rate of 1.12% per year. The average number of persons in a household is estimated to be at six (KII 1, 2018). Due to its strong coffee industry, Buon Ma Thuot is known as regional “capital of coffee”. Furthermore, the city´s economy is mainly based on tourism, which is an attractive destination with its waterfalls and villages of ethnic minority groups. Buon Ma Thuot is also famous for its agricultural products like durian and avocado (Dak Lak Portal, 2018).

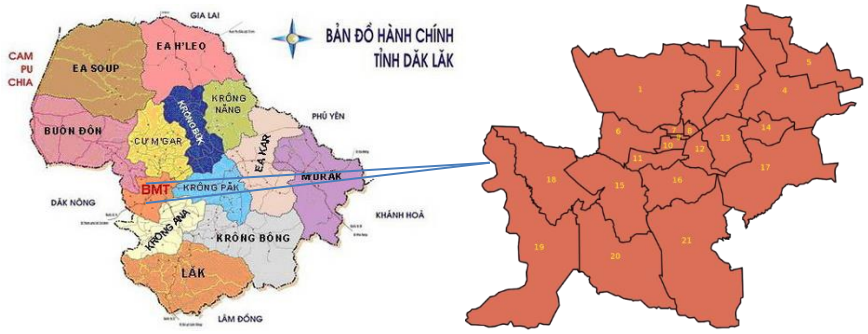


Figure 1 Map of Dak Lak Province and Buon Ma Thuot
(Source: Electronical Portal of Daklak Province, 2018); (Source: Government of the Social Republic of Vietnam, 2018)

The weather is dominated by two seasons throughout the year, with a rainy season that usually starts in May and ends in October and a dry season that lasts from November to April respectively. The average annual precipitation is about 1,796mm, 90% of which occurs during the rainy season. The average relative humidity is about 81.4 (Dak Lak Portal, 2018). Buon Ma Thuot is a large highland city with total area of 377 km^2, the distance between its northern and southern border is about 90km and between the eastern and western border about 70km. The northern area has an altitude of 800m, while the western and southern areas lies at 300m – 400m. Due to the gentle to moderate slope ranging from 3 to 8° (Buon Ma Thuot City, 2018), water, wastewater and stormwater flow smoothly and cleaning of storm sewers is considered to be uncomplicated (KII 2, 2018).

Buon Ma Thuot has a network of traditional storm sewers with a total length of 20.659km, which not only collects storm water, but is also used informally as combined sewer for wastewater (Feasibility Report, 2008). In principal, all households should have functioning septic tanks to pretreat the human waste, with their effluents filtrating into the ground through properly build soak pits. However, in many cases the soak pits do not function properly, which causes overflows and blockages. (WHO et al., 2012 and Nguyen et al., 2011).

4 Service outcomes

4.1 Onsite sanitation

Containment

Septic tanks are the most common technology used for the collection of human waste in Buon Ma Thuot. Septic tanks in Vietnam are often made from bricks, for individual houses, or reinforced concrete, for individual houses and public buildings. They are sealed by concrete base and cement mortar. Many households place the tank in the basement, surrounded by the foundation. Total volume of the

household septic tank, depending on available space and financial availability, often ranges from 1.5 to 5m^3 (Nguyen et al., 2011).

In Buon Ma Thuot, septic tanks have often two to three chambers and vary in how the effluent is discharged. The available data did only classify various septic tanks into the number of chambers. Our informant (KII 2, 2018) indicated that large parts of the septic tanks are not fully functional due to failed soak pits. He indicated that many septic tanks are therefore connected to streams, rainwater sewers, or are being emptied mechanically. However, the only figure available, was the percentage of two chamber septic tanks connected to a stream. As there were no other figures available, we agreed with the informant to assume that half of each septic tank type has a non-functional soak pit. The informant has then, based on the amount of sludge received at the treatment facility, estimated the proportion of these types of system from which faecal sludge is emptied.

Although a World Bank study from 2003 found that groundwater table levels under the provincial capital Buon Ma Thuot is at –33.5 meters (ADB, 2013), it is assumed that the overall risk for groundwater pollution is high. This is due to the estimation that approximately 25% of the sanitation facilities are not build according to Ministry of Health standards, not fulfilling the requirement of minimum 10 m distance to ground water sources. This is particularly the case in the outskirts of BMT. Furthermore, due to the topography of BMT, it is assumed that more that 25% of the facilities are located uphill from water sources. Despite the availability of piped water, it is assumed that more that 25 % of the households rely on unprotected water sources, such as wells and boreholes (KII 3, 2018).

This resulted in the following classification and distribution of figures, as visualized in Table 1.

Table 1 Calculation of percentages according to SFD classification

Data provided		Assumption that half of the septic tanks do not have a functional soak pit and are connected to rainwater drainage or emptied.			
Type of tank	Households %	Effluent discharge:	Households %	Classified according to SFD:	Estimated proportion of this type of system from which faecal sludge is emptied %
2 Chambers, connected to stream	10%	Stream	10%	T1A2C7 (Septic Tank connected to open water body)	3%
2 chambers with a soak pit (possibly connected to rainwater drainage)	17%	Functional soak pit	8.5%	T2A2C5 (Septic Tank connected to soak pit, high risk of groundwater pollution)	2%
		Connected to rainwater drainage	8.5%	T1A2C6 (Septic Tank connected to open drain or storm sewer)	3%
3 chambers with a soak pit (possibly no outlet)	25%	Functional soak pit	12.5 %	T2A2C5 (Septic Tank connected to soak pit, high risk of groundwater pollution)	2%
		Emptying	12.5%	T1A3C10 (Fully lined tank (sealed), no outlet or overflow)	18%
3 chambers with a soak pit (possibly connected to rainwater drainage)	20%	Functional soak pit	10%	T2A2C5 (Septic Tank connected to soak pit, high risk of groundwater pollution)	2%
		Connected to rainwater drainage	10%	T1A2C6 (Septic Tank connected to open drain or storm sewer)	3%
"Digged hole, (3-4m)"	9%	-	9 %	T2B7C10 (Pit (all types) never emptied, no outlet or overflow, high risk of groundwater pollution)	-
No Toilet / Open defecation	1%	-	1%	T1B11C7TOC9 (Open Defecation)	-

As a result, it is estimated that about 31 % of the households have a septic tank that is connected to a functioning soak pit (T2A2C5). A further 18.5% (rounded up to 19% in the matrix) are connected to the drainage and storm water sewers (T1A2C6), which are not transporting the supernatant to any treatment

facility (S4e). Moreover, it is estimated that about 10% of the households connected their septic tank to an open water body (T1A2C7), such as streams. In about 12.5% (rounded off to 12 in the matrix) of the households, septic tanks have failed soak pits, which ultimately classifies them as fully lined tanks with no outlet or overflow (T1A3C10) (KII 2, 2018).

The proportion of the contents of the septic tanks is assumed to be 85 %, which is made up of 19 % connected to the rainwater sewers (50 % default) and the 41 % that are connected to a functioning soak pit or open water body (100% default).

Another 9% of the households discharge directly into a “digged hole of about 3-4 meters depth” (classified as pit), which will not be emptied. This can be categorized as a pit with high risk of groundwater pollution (T2B7C10). Lastly, about 1% of the population practice open defecation (T1B11C7TOC9) (KII 2, 2018). A detailed overview can be found in the SFD Matrix Table 3.

Emptying

At the moment, households only contact the urban environment company or a private enterprise (either state-owned, limited liability or private companies) for emptying when problems, such as clogging or overflowing occur (WEPA, 2013). Therefore, emptying rates are low, as displayed in Table 1 above. In Buon Ma Thuot, there are both public and private service providers, who are responsible for removing of septage from the tanks. (Nguyen et al., 2011; WEPA, 2013; WHO et al., 2012).

Transport

After years of unregulated transport (Nguyen et al., 2011; WEPA, 2013; WHO et al., 2012), transporters of human waste are nowadays obligated to transport all emptied waste to the wastewater treatment plant. According to directive No. 02/2011/CT-UBND, breaking this regulation will be punished by the provincial environmental police. KII 2 (2018) confirmed the enforcement of this regulation, which is consistent with our observations.

According to KII 2 (2018), about 22.860m^3 of septage per year is removed and transported to wastewater treatment plant. Based on our informant’s estimation and his insight knowledge of the emptying business in Buon Ma Thuot, it is estimated that between 3 to 6% of the septic tanks with an outlet or overflow and 18% of the systems without outlet or overflow are being emptied. Due to the strict enforcement and the proximity of the treatment facility, we assume that 90% of the emptied faecal Sludge is delivered to the treatment plant. This is reflected in the SFD Matrix Table 3.

Treatment

Buon Ma Thout´s centralized WWTP has been designed to receive and treat sludge from septic tanks. The sludge is discharged into the plant through a sludge receiving chamber. The wastewater and faecal sludge are then mixed together at the treatment plant. The treatment efficiency is elaborated under 4.2.

4.2 Offsite Sanitation

Transport

Parts of the city are connected to a separate sewerage system (SSS) which specifically excludes rainwater. In total, 13,700 households have been connected, amounting to a SSS coverage of 18% of the city’s population (T1A1C2) (KII 1, 2018). The wastewater from the separate sewer is transported to and treated in a centralized wastewater treatment plant (WWTP). In the connected households, septic tanks were eliminated or bypassed to connect the sanitation facilities to the SSS (WB, 2013). Eliminating the septic tanks and the limited dilution by rainwater (as it is characteristic for SSS), led to increased levels of contaminant loads in the sewer. The average concentration of BOD5 in the wastewater that reaches the treatment plant is about 358mg/l. Furthermore, the quantity of sewage collected in a SSS is far less than in a combined sewerage system. The household construction type in the project areas

is primarily common walled blocks, featuring kitchen/toilets in the rear and SSS in the front. The household connects the discharge piping directly to the junction box, which is the access point for maintenance. The Buon Ma Thuot City sewerage piping network was conceived on the basis of the use of primary, secondary and tertiary sewerage pipelines to collect and transport sewage flow from the households to the WWTP.

Despite the efforts to ensure a high standard of quality and minimum leakage at the household connections, it was discovered that various household roof drains had been connected to the system, causing high inflows during rain events, which, due to the steep slopes, quickly diminished when the rained stopped (WB, 2013). According to KII 1 (2018), this issue persists up until today. As a result, it remains challenging that wastewater sewers and manholes overflow in rainy season, and the mixed waste and storm water discharges to the roads (KII 1, 2018). Despite the challenges with seasonal overflow, the system is relatively young, properly managed, and has recently been extended. Therefore, we assume that it is a well-maintained SSS with 90% of the wastewater being delivered to the treatment plant (W4a).

Treatment

The WWTP treatment capacity has recently been increased from 8.125m^3/d (Corning, 2004) to 12,200m^3/d. Additionally to the three-stage stabilization pond system consisting of anaerobic, facultative and maturation flow trains (World Bank, 2013), the new construction consists of two lines of tanks using moving bed biofilm reactor and disc-filters. (KII 1, 2018). As the augmented WWTP´s treatment efficiency was being tested during the period of preparation of this report, the below described data refers to the original WWTP efficiency prior to augmentation.

Due to the less complex treatment technology and the concentrated SSS wastewater flows, the WWTP is capable of meeting the majority of the required effluent standards for BOD, Chemical Oxygen Demand (COD), TSS and TN, but has specific performance limitations for ammonia, as noted in Table 2.

Table 2 Treatment Performance of Buon Ma Thuot WWTP (Source: WB, 2013)

No.	WWTPs	City	Treatment process	Sewage system	BOD (mg/L)		COD (mg/L)		TSS (mg/L)		NH_4-N (mgN/L)		T-N (mg/L)		T-P (mg/L)		Coli-form (MPN/ 100mL)	Applicable Effluent Standard
					Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Eff.	
14	Buon MaThuat	BMT	SBR (AS)	SSS	336	45	564	98	286	76	36.4	32	93.7	23	11.2	4.3	15000	QCVN24-2009, B
QCVN 40:2011/BTNMT, A class						30		75		50		5		20		4	3000	
QCVN 40:2011/BTNMT, B class						50		150		100		10		40		6	5000	

Because the WWTP receives an already high influent concentration of ammonia from the SSS, the stabilization pond systems cannot reliably achieve nitrification (ammonia removal) (WB, 2013). Hence, the quality of treated wastewater discharged from the plant meets Class B of Vietnamese standard QCVN 14:2008/BTNMT, which is the National technical regulation on domestic wastewater applied for water bodies that are not to be used for drinking water supply treatment facilities (KII 1, 2018). The recent augmentation of the WWTP aims to ensure that the effluent of the last pond of the original treatment plant flows into a new construction and be treated there in order to meet the class A of the standard (KII 1, 2018).

Due to the described treatment limitations, and the impact of heavy rain events that are observed to negatively affect the treatment efficiency due to illegal storm water connections to the SSS, we estimate the proportion of wastewater and faecal sludge, which is treated at the treatment plant (W5a and F5) to be 75%.

End use / Disposal

Effluent of the WWTP is being re-used for coffee irrigation (WB, 2013).

SFD Matrix:

A summary of the collected and assumed data is given in the following SFD matrix (Table 3). The combination of 18% of the population being connected to the SSS, low emptying rates for septic tanks, and the average proportion of feacal sludge in septic tanks (85%) contribute positively to the 25 % safely disposed sludge displayed in the SFD graphic. However, there are still a large number of households that rely on unsafe containment technologies in an area that is at a high risk for ground water pollution, which is ultimately reflected in the 75 % of unsafe disposal of feacal sludge.

Table 3 SFD Matrix for Buon Ma Thuot

Buon Ma Thuot, Dak Lak, Vietnam, 10 Sep 2018. SFD Level: 1 - Initial SFD
Population: 457000
Proportion of tanks: septic tanks: 85%, fully lined tanks: 100%, lined, open bottom tanks: 100%

System label	Pop	W4a	W5a	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 centralised treatment plants	Proportion of wastewater delivered to centralised 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
T1A1C2 User interface discharges directly to a centralised foul/separate sewer	18.0	90.0	75.0					
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	31.0			6.0	90.0	75.0		
T1A2C6 Septic tank connected to open drain or storm sewer	19.0			6.0	90.0	75.0	0.0	0.0
T1A2C7 Septic tank connected to open water body	10.0			3.0	90.0	75.0		
T1A3C10 Fully lined tank (sealed), no outlet or overflow	12.0			18.0	90.0	75.0		
T2B7C10 Pit (all types) emptied but abandoned when full and covered with soil, no outlet or overflow, where there is a 'significant	9.0							
T1B11 C7 TO C9 Open defecation	1.0							

5 Data and assumptions

To produce this present SFD Lite for Buon Ma Thuot, Vietnam; a wide desk-based literature review was carried out. The literature review included publications and reports from universities, donor agencies, consultancies and official information published by local/national institutions.

The literature gives an overview about different aspects of the sanitation situation in Vietnam, but only limited information was found specifically for the city of Buon Ma Thuot. Due to the large DANIDA-funded wastewater project, some information about this project and the new technology and infrastructure was found, but especially regarding the remaining area, well-validated data is missing. Due to the age of the published reports (5-7 years) they only referred to Phase 1 of the DANIDA-funded project. The latest development during Phase 2, which commenced in 2015, have not been covered by any publication. Hence, many of the assumptions taken during the preparation of this SFD are based on detailed interviews with our key informant Ms. Pham T.T.S, who is the Vice Director of Dak Lak Urban and Environment Limited Company. She has access to internal utility records, as well as in-depth and up to date knowledge of the sector. Assumptions on the areas that are not being served by the SSS have been based on in-depth interviews with our second key expert Mr. Hoang M.D, the Head of Planning

and Material Chamber at the Urban and Environment Limited Company. Assumptions for the risk of groundwater pollution have been based on the estimations of our third key informant, who wishes to stay anonymous. The informant is considered to be a reliable source due to his/her long standing experience on this matter.

The literature was consistent when the sources have been cross-validated. Furthermore, the literature data was confirmed by the interviewees, which were able to give an up-to-date picture of the most recent developments. Unfortunately, it was not possible to validate every single assumed figure during the interviews.

6 List of data sources

Reports and Literature

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Interviews:

KII 1, 2018. Interview with Ms. Pham T.T.S, Vice director of Dak Lak Urban and Environment Limited Company, August, 2018.

KII 2, 2018. Interview with Mr. Hoang M.D, Head of Planning and material chamber, Urban and Environment Limited Company, August 2018.

KII 2, 2018. Interview with anonymous interviewee. October, 2018.