



# Awareness and Practices on Domestic Wastewater Sanitation of Select Coastal Barangays in Surigao City, Philippines

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## ABSTRACT

Some pollution point sources causing health concerns in coastal and freshwater are from domestic sewage discharge, which include septic tanks that function in the primary sewage treatment process. Septic tanks are important in wastewater sanitation and should work effectively if properly installed and maintained. This study aims to determine the level of awareness on wastewater and sanitation practices of the communities in the prime coastal tourism area in Surigao City. A face-to-face interview with 425 respondents and a key informant interview with a government office representative is employed. Indicators for the level of awareness were assessed using the Likert scale. Participants rated from 1 (not aware) to 4 (highly aware) to the indicators presented and asked to describe their conditions and practices related to sanitation. The overall mean of the respondent's level of awareness is 2.98, interpreted as high. The strongest level of awareness is the improper septage management can cause water-related diseases, and the lowest level of awareness is that septic tanks should be regularly desludged. Respondents know that it is the LGUs' obligation to manage or improve water quality (76.9%), and it is their obligation to support wastewater sanitation programs (80.9%). Almost all (99.1%) have private toilets with a pour-flushing type. Chlorine is commonly used for cleaning, and 98.1% of the respondents installed septic tanks as their household disposal facility. Respondents encountered no issues relating to waterborne illnesses, pollution of their drinking water, and beach waters in their locality. LGUs design strategies and undertake activities to improve sanitation practices by enacting a sewage treatment and septage management ordinance. The LGU can pass an ordinance requiring residents with septic tanks that have been in use for at least five years to desludge them using private service providers in the city. Effective social and educational efforts and policy interventions must be developed for the long-term protection of water resources and the strengthening of strong local governance in the coastal tourism area.

Keywords: *Septage, Coastal Tourism Area, Surigao City*

## 1 Introduction

Clean and accessible water for all and improved sanitation are taken as Goal Six (6) of the seventeen global Sustainable Development Goals (SDGs). However, water quality degradation is a global concern as it is highly recognized to interfere with the vital and legitimate uses of water. A major

fraction of water quality degradation has been attributed to anthropogenic influences. One of the pressing environmental issues in the Philippines is water pollution because of inappropriate sanitation practices, especially with disposal of wastewater. The conventional septic tank system has been known as the prevailing method for wastewater treatment and disposal in the country (Walag et al. 2018). Septic tanks contain septage which refers to liquids, solids (sludge), as well as the fats, oils, and grease (scum) that build up in the septic tanks over time (Robbins 2007). Unfortunately, based on the Environmental Management Bureau, the general conditions of septic tanks in the Philippines are undersized, many are single-chambered, the bottom is commonly unlined, and are not regularly desludged (Walag et al. 2018).

Commonly, the discharge of wastewater from the septic tanks is directed to the drainage canals. Most of the septic tanks are known to be constant sources of groundwater pollution since the water overflowing into its drainage system is only partially treated. Hence, it contains most fecal bacteria and nutrients, causing oxygen consumption and eutrophication in water bodies. Further, in the event of floods, the contents of septic tanks can be flushed into the roads, and the houses, which cause the transmission of diseases (IGB 2014). Indeed, septic tanks cannot be the final solution for wastewater treatment and disposal. Thus, there is a need to hasten the implementation of septage management programs to guarantee that septic tanks function efficiently and dispose of the septage appropriately.

Over the years, several policies have already been in place to protect our water resources by ensuring proper sanitation. The Philippine Clean Water Act of 2004, otherwise known as Republic Act No. 9275, mandates the local government units (LGUs) to share the responsibility in the management and improvement of water quality within their territorial jurisdictions. The National Sewerage and Septage Management Program (NSSMP) in 2010 has already provided targets for sewerage and septage management provision in urban areas outside Metro Manila. One of the targets in the NSSMP is, by 2020, all LGUs should develop septage management systems (World Bank 2013). The Provincial Water Utilities Act of 1973 or PD 198 further provides the formation of the Water Districts to operate water supply

and distribution systems, wastewater collection, treatment, and disposal facilities, and conduct the function and operations related to water resource development, utilization, and disposal. Yet, only a few Water Districts have extended their services to cover sewerage and septage management (Metin and Sahagun 2010). This problem also becomes more of a concern in coastal areas because wastewater can affect the quality of nearby water bodies when discharged without treatment. This poses threats to public health, tourism, and others. A good intervention to address this threat of water contamination or pollution is establishing of a septage management system. However, implementing such is expensive for local government units, which have a clear responsibility for providing sanitation facilities within their jurisdiction, as mandated by the Local Government Code in 1991.

In the Philippines, wastewater disposal has become an enormous challenge as only 10% of wastewater in the country is treated, while 58% of the groundwater has been identified to be contaminated. Further, only 5% of the entire population is connected to sewers (Claudio 2015). The main sources of water pollution are the inadequately treated domestic wastewater or sewage, industrial wastewater, agricultural wastewater, as well as the non-point sources, including the rain and groundwater runoff (Walag et al. 2018). However, there are still key issues, problems, and concerns that need to be addressed in wastewater management, treatment, and disposal. One of which is the absence of a sewerage system. According to the study performance of community water supply management towards designing water safety plan, only a few households, about less than 5% estimate, are connected to a sewerage network. The majority of them have toilets connected to septic tanks that are somehow inadequately designed or maintained; hence, most of its effluents are likely discharged without appropriate treatment (Ganiron 2017).

Surigao City is known for its long stretch of pebble beach, specifically in Barangay Mabua and Barangay Ipil, which play a vital role in the city's tourism industry. The multitude of smooth white pebbles that make up the shoreline in the barangays, its clear waters, rock formations, and mountain trail on-site, have made its beach very appealing to the locals and foreign tourists. Over time, local residents and tourism-related establishments have grown in number. With the rising economic activities in the

tourism area, there is a need to check the wastewater sanitation practices and conditions in the coastal tourism area and assess the level of awareness of the communities in terms of their obligations to support wastewater sanitation initiatives which are crucial in protecting the health and safety of the people and the surrounding environment. This study aims to determine the wastewater sanitation practices and level of awareness of the residents and cottage beach owners in the coastal tourism area of Surigao City. The local government of Surigao City continues to face enormous challenges when it comes to the implementation of some policies related to wastewater sanitation. It is a prime consideration in ensuring public health and avoidance of the degradation of water bodies. Establishing baseline data on demographic characteristics, the residents' wastewater sanitation practices and conditions, and level of awareness on sanitation and their obligations would help the LGU estimate the risks associated with water body contamination. The data will also provide guidance on the extent of social promotion they have to undertake to inform the stakeholders of the importance of having a public septage management system in the area. The results of this study contributes to the need for a public septage management system, and develop a better understanding of its importance, leading to the protection of public health, the environment's integrity, and the services it provides, and help sustain the tourism industry.

## 2 Materials and Methods

### *Locale of the Study*

The study was conducted in Barangay Mabua and Barangay Ipil, Surigao City, Philippines. It is located along the northernmost portion of Surigao del Norte. The area is the coastal tourism site situated in the western part of the City, where the long stretch of pebble beach known as prime beach tourism area can be found. The area is located at approximately 9048'31.17" N 125026'27.33"E with an elevation at around 10.0 m or 32.8 ft above mean sea level.

### *Research Design*

The study employed the quantitative research design, specifically the descriptive research wherein the data on the socio-economic profile of the respondents, their sanitation conditions and practices, level of awareness are collected. The primary data was gathered from the residents of barangay LGUs of Mabua and Ipil. Secondary data was taken from the Surigao Metropolitan Water District, local offices of the Department of Environment and Natural Resources, Department of Public Works and Highways, and the City Engineering Office, City Health Office, City Environment and Natural Resource Office. Key informants interview was conducted in the offices mentioned. A total of 425 respondents was selected from Barangay Ipil ( $n_1=255$ ) and Barangay Mabua

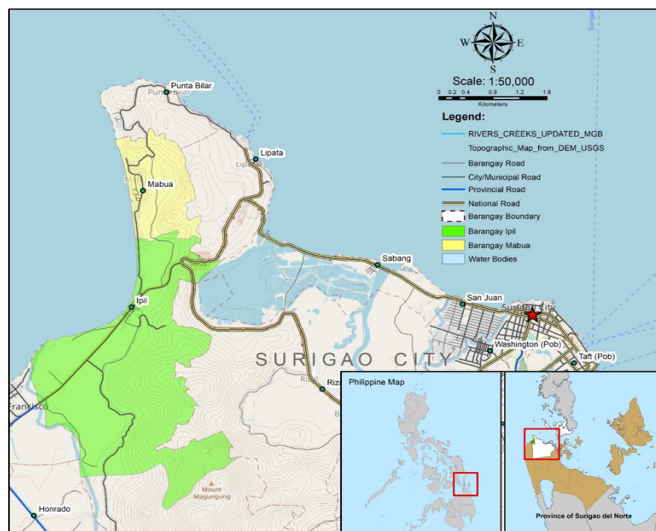


Figure 1. Map showing the study site in Surigao City, Philippines.

( $n_2=170$ ) using the two-stage cluster sampling. The sample size was computed using a 99% confidence level and an 8% standard error based on the Cochran formula. Where  $n_0$  is the sample size,  $Z^2$  is the abscissa of the normal curve,  $(1-\alpha)$  equals the desired confidence level,  $e$  is the desired level of precision,  $p$  is the estimated proportion of an attribute that is present in the population, and  $q$  is  $1-p$ .

$$n_0 = \frac{Z^2 pq}{e^2}$$

The survey instrument is composed of the following parts: (1) Socio-economic profile such as the age, sex, educational attainment, and number of years stayed in the area; (2) Wastewater sanitation practices and conditions of the respondents like the presence of toilet, cleaning solution used, disposal facility, presence of septic tanks, presence of concrete flooring, manhole and discharge outlet; and (3) Awareness of wastewater sanitation and obligations of the respondents on septage management. The data were processed and analyzed through Microsoft excel. Indicators for the level of awareness were assessed using the Likert scale by giving rates from 1 (lowest score: Very low awareness) to 4 (highest score: Very high awareness). A Likert scale is an extensively used scaling method. This refers to the use of an ordinal 4-or 5-point rating scale with corresponding interpretation. The calculated mean for the indicators of the residents' level of awareness towards septage management is measured and interpreted as Very Low: 1.00-1.44, Low: 1.45-2.44, High: 2.45-3.44, Very High: 3.45-4.00 (Altman and Bland 1995).

A pre-test was undertaken to check if there were items that still need refinement. After the survey material was finalized, it was translated into the local dialect. The contents and administering process of the interview instrument were discussed during the orientation of the enumerators.

### 3 Results and Discussion

#### I. Socio-Economic Profile of the Respondents

Table 1 presents the socio-economic profile of the respondents. The majority of the respondents are aged 31-40 at 26.6%, females at 61.4%, and married at 73.9%. The educational attainment, 24.7% of the respondents reached high school level, while at least 1.9% do not have formal education. The average number of years the respondents resided in

the area is 30.4 years. The average household size is 5 members, of which mainly 71% of the households are composed of five members and below. The result shows two family members are earning with an average income of Php 13, 664.00 (USD 285.57) monthly. However, almost half (47.53%) of the respondents earn less than Php 10,000 (USD 209.00) monthly. The numbers are not far from the projected average family income of Php15, 193.22 (USD 317.53) based on the socio-economic profile of Surigao city (PSA 2019). Interestingly, the respondent's income is higher than the average poverty threshold amounting to Php 10, 481.00 (USD 219.05). According to Philippine Statistics Authority, the income is enough to meet both the basic food and non-food needs of a family of five monthly (PSA 2019). Similar with set range of the Philippine Statistics Office of Caraga Region, the poverty threshold per family per month in Surigao del Norte is Php11,451.00 (USD 239.32), higher than the national average. Based on the survey, 304 or 72% of the households in the coastal tourism area meet the average food threshold, which is the minimum income required to meet the basic food needs. On the other hand, only 233 or 55% meets the poverty threshold, which is the minimum income required to meet the basic food and non-food needs of a family. The results show that the income of the participants is only enough for the basic needs of the family, such as food, education, shelter, and clothing. Other kind of expenditures is already a great challenge for the residents.

#### II. Level of Awareness

Table 2 presents the level of awareness of the residents on wastewater sanitation and their responsibilities. The results shows that 45.4 % are highly aware of the regular desludging of septic tanks, 30% are not aware, 23.8% moderately aware, and the remaining percent low level of awareness.

It has been identified that key sources of pollutants affecting coastal recreational waters are riverine inputs of domestic, agricultural and industrial effluents, and direct sewage discharges from the local populace. The point sources of pollution that cause most health concerns in coastal and freshwaters are domestic sewage discharges. Discharged sewage to coastal waters is known to cause pollution impacts that depend on the composition and quantity of the effluent and the capacity of the receiving waters to handle that

Table 1. Socio-economic profile of the respondents

	Variables	Frequency (n=425)	Percentage (%)
<b>Age</b>	30 and below	83	19.5
	31 to 40	113	26.6
	41 to 50	85	20
	51 to 60	82	19.3
	61 to 70	41	9.6
	71 to 80	18	4.2
	81 and above	3	0.7
<b>Gender</b>	Male	164	38.6
	Female	261	61.4
<b>Civil Status</b>	Not married	65	15.3
	Married	314	73.9
	Widow/ Widower	<b>46</b>	10.8
<b>Education</b>	No formal Education	8	1.9
	Elementary level	47	11.1
	Elementary graduate	30	7.1
	High school level	<b>105</b>	24.7
	High school graduate	98	23.1
	College level	67	15.8
	College graduate	68	16.0
	Post graduate	2	.5
<b>No. of Years in the Area</b>	10 and below	<b>81</b>	19.06
	11-20	68	16
	21-30	91	21.41
	31-40	64	15.06
	41-50	59	13.89
	51 and above	<b>62</b>	14.59
<b>No. of Members in the Household</b>	5 and below	302	71.06
	6-10	116	27.29
	11 and above	7	1.65
<b>No. of Members with Income</b>	2 and below	390	91.76
	3-4	31	7.29
	5 and above	<b>4</b>	0.94
<b>Average Monthly Income</b>	10,000 and below	202	47.53
	10,100-20,000	134	31.53
	20,100-30,000	50	11.77
	30,100-40,000	21	4.94
	40,100-50,000	7	1.65
	50,100-60,000	9	2.12
	60,100-70,000	1	0.24
70,100 and above	1	0.24	

Table 2. Level of awareness of the residents to wastewater sanitation and their obligations

Awareness		Percentage (%)
Awareness that ST should be regularly desludged	Not aware	30.8
	Low	5.9
	Moderate	17.9
	High	45.4
Awareness that improper septage management can contaminate nearby water bodies	Not aware	24.5
	Low	6.6
	Moderate	13.9
	High	55.1
Awareness that improper septage management can cause drinking water contamination	Not aware	21.6
	Low	7.5
	Moderate	17.4
	High	53.4
Awareness that improper septage management can cause water-related diseases	Not aware	21.9
	Low	5.9
	Moderate	15.8
	High	56.5
Awareness that improper septage management can destroy the tourism industry	Not aware	22.4
	Low	6.8
	Moderate	15.1
	High	55.8
Awareness of LGU's obligation to manage or improve water quality	Yes	76.9
	No	23.1
Awareness of the obligation to support the LGU's sanitation-related programs	Yes	80.9
	No	19.1

effluent (Bartram and Gates 2000). In the coastal tourism area of Surigao City, only more than half of the respondents are highly aware that improper septage management can contaminate nearby water bodies, can cause drinking water contamination and water-related diseases and can destroy the tourism industry.

The result also shows that more than two-thirds (76.9%) are aware of the LGU's obligation to manage or improve water quality, but around one-third (23.1%) are unaware of this. LGUs under RA 7160 have been mandated to effectively provide basic services and facilities to their constituents, including drainage and sewerage (Metin and Sahagun 2010). Increasing awareness and action of the people in compelling action from the government can lead to positive interventions towards wastewater sanitation. Further, 80.9% are aware of the importance of support to LGUs wastewater sanitation-related programs. Participating actively in the community contributes to the successful implementation of the activities. However, 19.1% are not aware of this obligation.

In general, the calculated average score of 2.98 for the respondents' level of awareness is high. The residents' most substantial level of awareness is that improper septage management can cause water-related diseases, and their weakest level of awareness is that septic tanks should be regularly desludged. Notably, the level of awareness is

interesting since more than half of the participants are aware of the adverse effects of inappropriate wastewater discharge. Perhaps because the Clean Water Act stipulates payment, and the LGU lacks enforcement. Despite no regular desludging activity, respondents did not encounter issues relating to waterborne illnesses, pollution of their drinking water, and beach waters in their locality. During the key informant interview, the claim affirmed that there had been no outbreak of waterborne diseases in the coastal tourism area. However, 30.8% of the households are not aware that septic tanks need to be desludged. Bao et al. (2020) suggested increasing public demand for septage services, and every city should require households on desludging activity to empty the septic tanks every 3-5 years. Lack of knowledge has a significant impact on the respondent's understanding and appreciation of the wastewater sanitation programs and initiatives related to water supply conservation and appropriate septage management measures.

Increased environmental protection awareness have an immense contribution to the achievement of an adequate supply of potable water and improved sanitation facilities in some developed countries globally, together with the strict implementation of environmental laws and monitoring and good waste management technologies. This has consequently led to fewer reported waterborne diseases compared to developing countries (Edokpayi et al. 2017).

The World Bank and Australian Aid have also stated that citizens' demands will ultimately lead to better sanitation services. Accordingly, in many countries in East Asia and the Pacific Region, the concern for the quality of drinking water that caused citizen demand further led to lasting changes. For example, in Korea, public awareness has been identified to have created the increased demand for cleaner rivers, leading to public actions and the preparation of projects and making finances available for wastewater investments and operations. The key ingredients for triggering sanitation improvements included strong citizen awareness caused by the appreciation of the health and environmental results of poor services; access and free flow of information relating to environmental and utility execution by the public authorities and civil society; and public sector and organized civil society leadership (World Bank 2013).

It was noted that 19.1% are not aware of their obligation to support the LGU's sanitation-related programs, being members of the community. This could be because of the lack of activities that will foster the engagement of the community in the developmental plans in the localities. Information dissemination of programs and projects, and the involvement of the public will help raise public participation and support.

Various studies indicate that desludging is not a common practice in the Philippines. According to a rapid assessment on septage management conducted by AECOM International Development (2010), shows little awareness of septage management among local governments and utilities. Improvement of sanitation practices is challenging since national institutions have no adequate septage management expertise and have not even completed the national sewerage and septage management plan. Besides, there are insufficient funds to implement the Clean Water Act as well as septage management related projects. Enforcement of environmental regulations

for non-industrial sources is also challenging.

Results of this study could somehow support the key drivers and barriers to providing effective sanitation in the Philippines, as identified by The World Bank and Australian Aid. The drivers include the citizen's interest in reducing pollution of water bodies, legislation requiring agencies to take action, contractual requirements between the local government and service provider to improve services, presence of technical assistance to prepare viable interventions, presence of local 'champions' for sanitation, and viable business opportunities in providing sanitation services. The barriers, on the other hand, include the lack of community awareness of the impact of inadequate sewerage and septage management systems, lack of regulation and enforcement of the prescribed penalties, limited human resource capacity and skills in sanitation, lack of institutional arrangements for providing finance to the sector, and fragmentation of the institutional arrangements for the sector (World Bank and Australian Aid 2013).

### *III. Residents Sanitation Conditions and Practices*

The sanitation conditions and practices within the households were assessed. It reveals that 99.1% of the respondents have private toilets. The majority (90.6%) of the households have the pour-flushing type of toilet while a small number have aqua privy (0.2%) and VIP latrine (0.5%) types (Table 4). Pour-flush types of toilets are more common in the area since it is less expensive than the mechanized flush type toilets. Minor repair and maintenance are also needed for the pour flush compare to mechanized ones. Households with private toilets were able to provide cleaning solutions. Chlorine is predominantly used by the households with 39.5%, followed by hypochlorite with 22.6%. These cleaning solutions are readily available in the market wherein the households easily accessed them. Residents with cottages or beach huts

Table 3. Average level of awareness towards septage management

Indicators	Mean $\pm$ SD	Remarks
Awareness that ST should be regularly desludged	2.78 $\pm$ 1.3	High
Awareness that improper septage management can contaminate nearby water bodies	3.00 $\pm$ 1.27	High
Awareness that improper septage management can cause drinking water contamination	3.03 $\pm$ 1.22	High
Awareness that improper septage management can cause water-related diseases	3.07 $\pm$ 1.22	High
Awareness that improper septage management can destroy the tourism industry	3.04 $\pm$ 1.23	High
<b>Average</b>	<b>2.98 <math>\pm</math> 0.89</b>	<b>High</b>

provided toilets for their customers and these are commonly pour-in flush (87.5%). The widely used cleaning solution (66.7%) for the toilets along the beachside is hypochlorite.

Since majority of the respondents use chemical solutions in cleaning their toilets, the chemicals will end up mixed in the septage in the tanks over time. It can have adverse impacts on the treatment capabilities of the septic tanks as high concentrations of household disinfectants in wastewater can produce toxic effects on the microbes doing septage treatment in the tanks (Ip and Jowett 2004). This further supports the need to regularly desludging the septage in the tanks to ensure the tank's efficiency.

Almost 100% (417) of the respondents installed the septic tank with the size of 1.5 m in length, 1.8 m in width, and 0.8 m in height based on the preferred size set by the City Engineering Office. The size is adhered to the Philippine National Plumbing Code which is 1.8 m in length, 0.9 m in width and 1.2 m depth. This is a good indicator that the barangays and residents are already conscious as to the need of having septic tanks and are being compliant with Presidential Decree No. 856, otherwise known as the Code on Sanitation of the Philippines that mandates the construction of septic tanks in areas where a public sewerage system is not available.

Though the majority has been compliant in establishing septic tanks, 50.4% of the established disposal facilities are only single-chambered, and about 25.4% have two to three chambers. Septic tanks should have at least two chambers, with the first chamber providing a venue for the settling of solids and the bacterial action to take place in breaking down the sludge and wastewater, and the second chamber to provide further bacterial

action in the treatment of the wastewater (Wilson 2011). Further, 25.4% do not know the number of chambers that their septic tanks have. Septic tanks are frequently used in remote areas and low-income urban settings as primary treatment. They are made of series of communicating chambers and must be water sealed to avoid underground infiltration (Cisneros 2011).

The majority (96.5%) of the households, disclose that their septic tanks have concrete flooring. Still, only a lesser percentage (84.5%), say that their disposal facility has a manhole, 79.5% is accessible for sanitary inspections, and 59.5% say their septic tanks have discharge outlets. Septic tanks must have concrete flooring because sealing the bottoms of the facility can help avoid contaminations from human wastes being absorbed by the soil. Over time, waste materials will accumulate at the bottom of the tanks and there will be too much sludge in the tanks, thus there is a need to pump it out for proper disposal. It is important for septic tanks to have manholes and should be easily accessible, not to be constructed with its access ports buried under concrete floors of the buildings or houses. This would allow the authorized personnel to undertake proper desludging and checking of the condition of the facilities. Moreover, the septic tank discharge outlet is necessary for wastewater released into the drainage systems.

The resident's septic tank profile and conditions is shown in Table 5. Nearly half of the respondents (46.8%) stated that their septic tank has not yet been deslugged. This essential information will the local government units to efficiently track and identify those septic tanks that need priority attention. Old facilities are most likely in need

Table 4. Sanitation Practices of the Residents in the Coastal Tourism Area

Indicators		Frequency (n=425)	Percentage (%)
Presence of toilet	Yes	421	99.1
	No	4	.9
Type of toilet	Flush	37	8.7
	Pour Flush	385	90.6
	Aqua Privy	1	.2
	VIP Latrine	2	.5
Cleaning solution	Muriatic Acid	82	19.3
	Chlorine	168	39.5
	Detergent (bar/ powder)	66	15.5
	Aerosol (lysol,etc.)	7	1.6
	Hypochlorite (zonrox)	96	22.6
	None	2	.5
	Others	4	.9
Disposal facility	Septic Tank (ST)	417	98.1
	Cesspool/Aqua Privy	4	.9
	Line Pit	3	.7
	Others	1	.2



of urgent repair and maintenance activities than the new ones. Some claimed that their septic was desludged but were unable to determine when it was last desludged. Generally, septic tanks should be desludged before the solids exceed 50% of the tank volume, or every three to five years, whichever comes first (Phil. Department of Health and USAID 2008). This is to ensure that the septic tanks will still function efficiently. The usual thinking of the people that they will only empty the septic tank once it is fully loaded. This kind of practice also happened in nearby countries such as Bangladesh, Cambodia, Vietnam, and India (Bao et al. 2020).

The majority (73.2%) of the respondents said that they have not yet experienced problems with their septic tanks, but 7.5 % identifies that blockage is the most common problem, followed by reeking-off (3.5%) and overflowing (2.8%). The blockage and overflowing can cause the transmission of disease-causing organisms and materials to the environment. Residents who were able to experience septic tank problems allowed their tanks to be inspected or desludged.

According to the sanitation code of the Philippines, septic tanks shall be located not less than 25 m away from any spring, cistern, well, or other sources of drinking water supply, should not be less

than 1.5 m. (5 ft.) away from any water service line, and should not be less than 3.0 m. (10 ft.) away from the water main (Magtibay 2006). However, some septic tanks in the coastal area of Surigao City are located less than 25 m from deep wells, water pumps, and reservoirs. Edokpayi et al. (2017) stated that septic tank effluent contains various pollutants, including pathogens, fecal bacteria, phosphorus, nitrogen, organic matter, suspended solids, pharmaceutical compounds, and household detergents and chemicals that pose threats to any water resources. In addition, the discharge of these pollutants would negatively impact loads of concentration of the wastewater contaminants, volume, and wastewater effluents.

Poorly treated wastewater would potentially affect the water source of the both barangays. In Brgy. Ipil, six water pumps are in use for household chores and bathing, and one water pump facility is utilized for drinking water. There is also one deep well in barangay which its water is utilized for household chores. In Brgy. Mabua, there are four water reservoirs, two of which are no longer in use. There are 11 water pumps, but only seven are functional which provides water for cooking, drinking, bathing, washing clothes and other household chores. However, despite of no reported

Table 5. Residents' Septic Tanks (ST) Profile and Conditions

	Indicators	Frequency (n=425)	Percentage (%)
ST no. of chambers	One	214	50.4
	Two	89	20.9
	Three	14	3.3
	No idea	108	25.4
Presence of concrete flooring	Yes	410	96.5
	No	11	2.6
	No idea	4	.9
Presence of Manhole	Yes	359	84.5
	No	62	14.6
	No idea	4	.9
ST accessibility	Yes	338	79.5
	No	78	18.4
	No idea	9	2.1
Presence of discharge outlet	Yes	253	59.5
	No	152	35.8
	No idea	20	4.7
No. of years House ST is used	5 and below	110	25.88
	6-10	89	20.94
	11-15	17	4.00
	16-20	35	8.24
	21-above	49	11.53
ST desludged	Yes	38	8.9
	No	199	46.8
	No idea	188	44.2
Problems with the ST	Emits Odor	15	3.5
	Overflow	12	2.8
	Blockage	32	7.5
	Full	1	.2
	None	311	73.2
	Don't Know	54	12.7

incident related to water-borne diseases, regular water quality monitoring must be executed in the area. This would ensure the safety of the water users. Some studies found out that the oxygen balance of the aquatic ecosystem is a factor in maintaining biological life and can be affected by the ill-treated wastewater on surface water (Edokpayi et al. 2017).

#### 4 Conclusion and Recommendations

Residents' wastewater sanitation techniques are not entirely compliant. However, the majority of people have private toilets and use septic tanks which indicate that the people are already aware of the importance of having septic tanks. In addition, residents have not been desludging their septic tanks regularly. Furthermore, the findings indicated that not all respondents have complied with the standard size and specific design specifications of the tanks, such as the accessibility, concrete flooring, discharge outlet, and the prescribed number of septic tank chambers.

Although indicators imply a high level of awareness about septage management, the LGU will need to conduct an education campaign because residents have a low awareness that septic tanks should be deslugged. Surigao City Government needs to update its sanitation plan, including a well-defined public sanitation management system. This upgrade would ensure that the design of the septic tanks is of high quality and that the state of the facilities is recorded to track and identify those tanks that require immediate care efficiently. LGUs should ensure that no building permits are provided until the design of the tanks in the building plan meets the regulations. To verify compliance, appropriate persons should inspect the site to confirm and validate that what was approved in the plan is built.

Effective social and educational initiatives and policy initiatives must be adopted to encourage community support and compliance. In addition, it is critical to safeguard water resources and establish an excellent local government in the coastal tourism sector to ensure long-term development.

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#### Statement of Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

#### 6 Literature Cited

- Altman, D.G, Bland J.M. (1995). Statistics notes: The normal distribution. *BMJ*. 310:298.
- Bao, P. N, Abfertawan, M.S. Kumar, P. (2020). Challenges and Opportunities for Septage Management in the Urban Areas of Indonesia: Case Study in Bandung City. *Journal of Engineering and Technological Sciences*, pp. 481-500.
- Bartram, J. and Gates, G. (2000). *Monitoring Bathing Waters- A Practical Guide to the Design and Implementation of Assessments and Monitoring Programmes*. London: F & FN Spon.
- Calinawan, C. L. (2019). *Philippine News Agency*. Retrieved from pna.gov.ph: <https://www.pna.gov.ph/articles/1068534>
- Cisneros, B.J. (2011). Water-Quality Engineering. Treatise on Water Science, Science Direct.
- Claudio, L. E. (2015, April 23). Retrieved February 8, 2019, from <https://docplayer.net/20107578-Waste-water-management-in-the-philippines-lormelyn-e-claudio-regional-director-environmental-management-bureau-region-3-23-april-2015.html>
- DOH. (2019). *Operations Manual of the Rules and Regulations Governing Domestic Sludge and Septage*. Manila: United States Agenda International Development.
- Edokpayi, J.N., Odiyo, J.O, and Durowoju, O.S. (2017). Impact of Wastewater on Surface Water Quality in Developing Countries: A Case Study of South Africa. DOI: 10.5772/66561.
- Ganiron, T. U. (2017). Performance of Community Water Supply Management towards Designing Water Safety Plan. *World News of Natural Sciences*, pp. 11-22.
- IGB, F. (2014). *Naga City: Septage treatment and wastewater concept Del Rosario*. Bangkok: Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH.
- Ip, I., & Jowett, C. E. (2004). The Effect of Household Chemicals on Septic Tank Performance. *Researchgate*, 2-15.
- Madrazo, A. B. (2002). Water issues in the context of sustainable development. Paper presented at the 2nd World Conference of Green Productivity, EDSA Shangri-La, Mandaluyong, Philippines.
- Magtibay, B. B. (2006). *Philippine Regulations on*

- Sanitation and Wastewater Systems*. Cavite: B.B. Magtibay's Publishing House.
- Metin, R. L., & Sahagun, V. A. (2010). Septage Management Program: The General Santos City Experience. *The Philippine Sustainable Sanitation Knowledge Series*, pp. 1-48.
- POPCOM. (2019). *Commission on Population and Development*. Retrieved from popcom.gov.ph:<https://popcom.gov.ph/?p=291#:~:text=The%20average%20Filipino%20family%20spends,percent%20of%20total%20household%20expenditure>.
- PSA. (2019). *Philippine Statistics Authority*. Retrieved from psa.gov.ph: <https://psa.gov.ph/content/proportion-poor-filipinos-registered-210-percent-first-semester-2018>
- Robbins, D. M. (2007). *Septage Management Guide for Local Governments*. India: Solution Exchange for Urban Transformation of India.
- Walag, A. M., Canencia, O. P., & Fiedler, B. A. (2018). Water Quality: Mindanao Island of the Philippines. *Springer Link*, 219-247.
- Wilson, P. (2011). *Specialists in Property Renovation & Maintenance*. Retrieved from: <https://www.mrfixitbali.com/septic-sewage-and-wastewater/septic-tank-size-121.html>
- World Bank. (2013). *East Asia and the Pacific Region Urban Sanitation Review : Philippines Country Study*. Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/17593> License: CC BY 3.0 IGO.
- World Bank. (2013). *East Asia and the Pacific Region Urban Sanitation Review : A Call for Action*. Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/17616> License: CC BY 3.0 IGO.
- World Bank and Australian Aid. (2013). *East Asia and the Pacific Region Urban Sanitation Review. Philippines Country Study*. Retrieved February 12, 2019, from <http://documents.worldbank.org/curated/en/771821468036884616/pdf/842900WP0P12990Box0382136B00PUBLIC0.pdf>