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Sociodemographic of Two Municipalities Towards Coastal Waters and Solid Waste Management: The Case of Macajalar Bay, Philippines

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ABSTRACT

Dumping of solid waste and unstable coastal water quality has become a rising issue in the Philippines coastal zones. Thus, this study was conducted to investigate two coastal municipalities' (Opol and Jasaan) perception towards coastal waters (CW) and solid waste management (SWM) along Macajalar bay, Philippines. Sociodemographic indicators of the 180 residents and how this influenced their level of knowledge-awareness-practices (KAP) towards CW and SWM were determined using modified survey questionnaire. Purposive sampling was employed to communities residing adjacent to coastal waters. Both quantitative (One-Way ANOVA and T-test for unequal variances at α-0.05) and qualitative analyses were utilized to extrapolate conclusions. Present findings revealed varying sociodemographic indicators influencing KAP. Opol coastal residents level of knowledge and practices were influenced by gender (K:p-0.0314; P:p- 0.0155) and age (p- 0.0404), whereas level of awareness was influenced by age (p- 0.0160), length of residency (p- 0.0029), and educational attainment (p-0.0089). Distinctively, Jasaan coastal residents' gender influenced the level of knowledge (p- 0.0223) and practices (p- 0.0172), whereas awareness was influenced by educational attainment (p - 0.0383). Overall, sociodemographic response revealed higher level of knowledge and awareness towards preservation of CW. However, low levels of practices in both municipalities towards SWM were determined as evidenced by anthropogenic inputs to coastal water (dumping of solid waste, animal waste and domestic wastewater). In return this exerts pressure to Macajalar Bay. Present study can support policy enforcement in identifying opportunities for building positive connections of the social and biophysicochemical aspects in the bay.

Keywords: Coastal water; Macajalar bay; Sociodemographic; Solid waste management

INTRODUCTION

The archipelagic nature of the Philippines offers economic opportunities to coastal areas. Strategically, coastal areas inherit dynamic and productive ecosystems vital for ecotourism, settlement, and industrialization to grow (Xiaojun, 2008; Ahuja, 2014). Coastal resources as an ecotourism site can contribute to the net benefits of coastal communities (Samonte-Tan *et al.,* 2007). This is the case for the country's Bohol Marine Triangle (BMT) (Samonte-Tan *et al.,* 2007) and Apo Island (Cadiz and Calumpong, 2000) where ecotourism revenues benefited the coastal communities. Likewise, urbanization of coastal areas was seen vital for economic growth like the establishment of; (i) Air cargo services in Subic Bay (Bowen *et al.,* 2002); (ii) Mactan Export Processing Zone (MEPZ) in Mactan Island, Cebu; and (iii) PHIVIDEC Industrial Authority adjacent to Macajalar Bay in Misamis Oriental, Philippines. Moreover, as per Northern Mindanao Regional Development Plan 2011-2016 indicated the need to increase seaport facilities to handle volume of cargoes and ship calls. All activities exhibit the economic valuation of services provided by the Philippines coastal areas. Inevitably, the ecological vulnerability of coastal areas is high because of socioeconomic development and anthropogenic inputs of solid wastes (Kuo and Tsuo, 2015). Local studies in Macajalar bay focusing on the coastal water quality (Canencia and Ascano, 2016; Walag and Canencia, 2016; Vedra, 2013, Limates *et al.,* 2016) showed the need for environmental monitoring. Previous findings necessitate implementation of coastal water management strategies and solid waste management (SWM) to ensure coastal water quality. Same condition applies in protected areas in the Philippines like Macajalar Bay as the study site. In particular, municipalities of Opol and Jasaan along Macajalar Bay ubiquitously were identified for commerce, trade activities, and industries (CLUP, 2014-2022). Alongside with development are the adverse ecological ill effects to coastal water quality (Sarkar *et al.,* 2007; Galarpe *et al.,* 2017). Presently, Opol and Jasaan along Macajalar bay have shown economic potential being peripheral municipalities of Cagayan de Oro City. Both coastal communities have major industries and tourism activities providing economic opportunities and posing threats to the coastal resources.

Anthropogenic inputs like solid waste can be considered as notorious coastal water pollutant being the case among low income and developing countries like the Philippines. Previous findings revealed poor SWM in the Philippines despite policy regulation as evidenced by the use of landfills and dumpsites located along coastal areas (Galarpe and Parilla, 2012; Galarpe and Parilla, 2014a; Galarpe and Parilla, 2014b; Galarpe, 2015). Consequently, unlikely SWM practices will eventually affect adjacent water bodies like coastal water being the refuse end for waste streams. Past literature provided insights of the need for institutional arrangements (Ancog *et al.,* 2012; Galarpe, 2017) to improve SWM concerns. However, most studies focused on upland SWM researches factoring out the need of evaluating refuse of solid wastes to coastal bodies. Thus this study was conducted focusing on sociodemographic indicators influencing the level of communities' knowledge-awareness-practices (KAP) towards coastal water (CW) and SWM. Identifying the sociodemographic response of coastal

communities provides insights on the peoples' valuation on the environmental benefit drawn from coastal areas (Bueno *et al.,* 2016) and how practices be corrected for environmental abatement. Sociodemographic study complements resource management strategies without downplaying social component and its relevance to likely affect coastal water quality.

MATERIALS AND METHODS

Study Site

Studied locations along Macajalar bay were the municipalities of Opol and Jasaan, peripheral to the city of Cagayan de Oro known for its ecotourism and industrial plants (see Fig 1-map). In each municipality three sub stations were established covering in total six urbanizing coastal communities or barangays (see Table 1), each characterized by its distinct land use plan. Specifically, Opol sampling stations were mainly ecotourism site home to commercial establishments and residential zones. These became interesting aspects dealt on this study focusing on CW and SWM perceptions as no sociodemographic neither waste characterization studies in Macalajar bay was conducted.

On the other hand, Jasaan stations were mainly industrial in nature along with built environment and residential zone. Initially field reconnaissance on these stations was conducted to assess the number of immediate coastal respondents in this study. Purposively, the household size and identification were chosen based from the former studies of Galarpe and Parilla (2014a) and Galarpe (2015). Part of the restrictions was that households must be located between coasts up to the main grid way or highway in the province.

Table 1. Studied stations and its description

Municipality	Station	Specific industries or big scale establishments	Station Identification
Opol	Poblacion	Resorts Restaurants	Adjacent to commercial and ecotourism sites
	Igpit	Resorts Low cost housing	Residential area
	Barra	Commercial district Low cost housing	Near the river mouth
Jasaan	Lower Jasaan	Industrial glue production Ship building/general construction	Adjacent to an industrial company
	Luz Banzon	Oxygen production Coco-chemical production	With proximity to a chemical industry and ecotourism sites
	Aplaya	Power generation industrial plant	Residential area

Figure 1. Map of the study site with marked stars as Opol and Jasaan (Macajalar Bay Development Alliance-MBDA map)

Framework of the study

Present study explored the influence of sociodemographic indicators towards the level of KAP on CW and SWM of studied municipalities. Sociodemographic indicators were both dichotomous and trichotomous variables. Dichotomous variables were gender whereas other variables were age, civil status, household size, years of residency, monthly income, and educational attainment anchored WHO (2008). These preselected variables were hypothesized to likely affect KAP as elaborated by previous studies (Dean *et al.,* 2016; Espectato *et al.,* 2017; Tran *et al.,* 2007). The level of KAP were assessed as these response act as predictors of environmental behaviour (Eytulkesetoglu and Ecevit, 2002; Bennagen *et al.,* 2002; Joardan *et al.,* 2000). Identified responses were focused on CW and SWM being one of the pressing issues in the Macajalar bay consequently affecting coastal water quality. Regional monitoring of coastal water revealed presence of coliform and BOD which can be apportioned from anthropogenic inputs, thus necessitating the study on CW and SWM in the bay (see Figure 2).

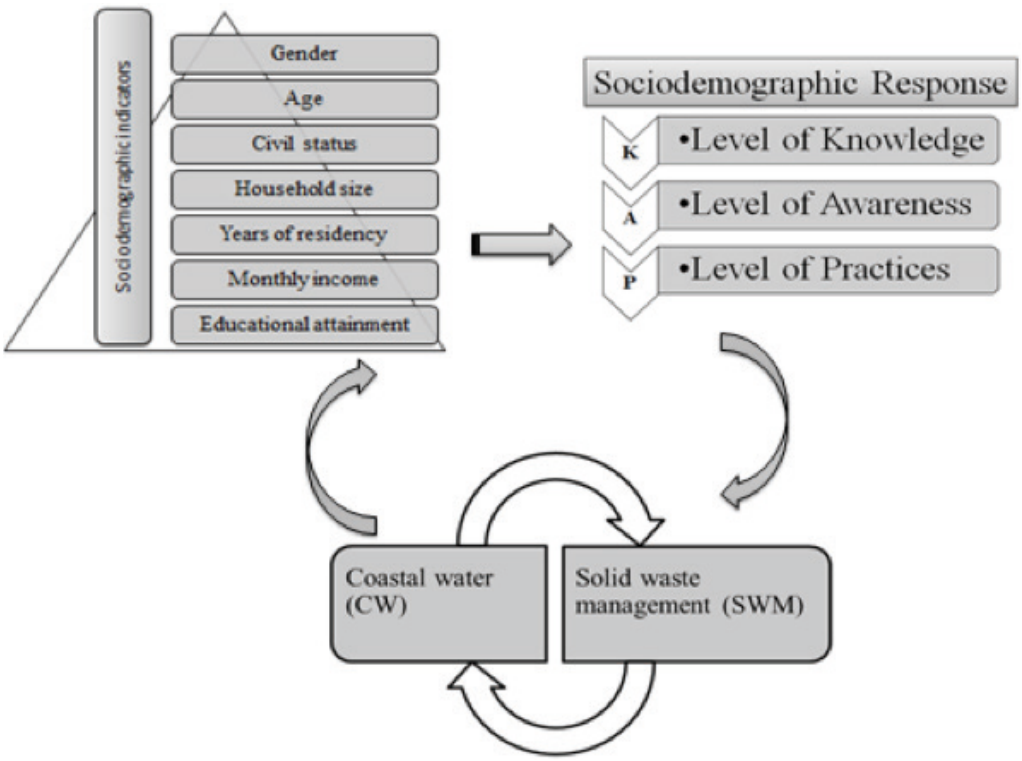

Figure 2. Method framework of the study

Entry Protocol

Prior to actual survey and sampling, an entry protocol visit was done to the local government units (LGUs) of the municipalities of Opol and Jasaan, Misamis Oriental to explain study objectives and to obtain permission of study conduct. This entry protocol was necessary to ensure support and cooperation of the many sectors within the LGU's, especially in giving information and in making data available from their units.

Survey Questionnaire

Survey questions were adopted from previous sociodemographic studies with modifications to fit the local conditions. Questions towards CW were anchored from Jones *et al.* (2008), Hanley and Alvarez-Farizo (2013) Bueno *et al.* (2016) whereas perception questions on SWM were culled from Galarpe and Parilla (2014) and Galarpe (2015). KAP questions were developed according to WHO (2008) guideline for sociodemographic studies.

Survey Conduct

A purposive survey was conducted (Galarpe and Parilla, 2014; Galarpe, 2015) to communities directly adjacent to coastal waters. About 90 respondents from each municipality (180 in total) were interviewed and asked to answer given questionnaires. These were preselected respondents belonging to coastal communities which may directly influence the coastal water and solid waste disposal to the bay.

Data Analysis Procedure

All data were expressed using inferential statistics in terms of mean, standard deviation, frequency, and percentage. Further, dichotomous variations of responses were statistically assessed using paired T-test for two samples assuming unequal variance at $\alpha - 0.05$, whereas trichotomous and more variations was assessed using One-Way Analysis of Variance (ANOVA) at $\alpha - 0.05$.

RESULTS AND DISCUSSIONS

Sociodemographic indicators of respondents

Table 2 presents the summary of the sociodemographic indicators of surveyed coastal communities in Opol and Jasaan, Macajalar Bay, Philippines. About 97 out of 180 respondents (54%) were male employed as motorcycle drivers, construction workers, labourers and fishermen. The female respondents (46%) were employed as small retail store owners, students, and housewives.

Table 2. Sociodemographic indicators of respondents

Indicators	Sub indicators	Municipality (n=180)				Total	
		Opol		Jasaan			
		N	%	N	%	N	%
Gender	Male	44	49	53	59	97	54
	Female	46	51	37	41	83	46
Age	18 yr below	15	17	11	12	26	14
	19-25yr	21	23	21	23	42	23
	26-45 yr	23	26	34	38	57	32
	46yr and above	31	34	24	27	55	31
Civil Status	Single	26	29	31	34	57	32
	Married	54	60	48	53	102	57
	Separated	1	1	3	3	4	2
	Widow	9	10	8	9	17	9
Household Size	≤ 4 members	44	49	42	47	86	48
	5-8 members	33	37	43	48	76	42
	>8 members	13	14	5	6	18	10
Years of Residency	≤5yr	13	14	4	4	17	9
	6-10 yr	26	29	9	10	35	19
	11-15 yr	22	24	26	29	48	27
	16-20 yr	15	17	17	19	32	18
	21-30 yr	9	10	21	23	30	17
	31-40yr and above	5	6	13	14	18	10
Monthly Income	≤ 5000	59	66	53	59	112	62
	5,001-10,000	13	14	17	19	30	17
	10,001-15,000	12	13	17	19	29	16
	15,001-20,000	1	1	2	2	3	2
	20,001-25,000	3	3	1	1	4	2
	25,001 and above	2	2	0	0	2	1
Educational Attainment	Elementary level	8	9	4	4	12	7
	Elementary Grad.	11	12	5	6	16	9
	Highschool level	29	32	22	24	51	28
	Highschool Grad.	27	30	40	44	67	37
	College/Vocational	9	10	17	19	26	14
	College Grad.	6	7	2	2	8	4

All workforces were viewed local in nature. The approximate age of respondents ranges from 26-45 years old. About 57% of the respondents were married with an average family size of ≤4 per household. The highest tabulated result for the years of residency was 11-15 years about 27% of the respondents. Highest educational attainment was high school graduate (37%) followed by high school level (28%), college or vocation level (14%), and sparingly 4% for college graduate. Overall, these sociodemographic indicators particularly on educational attainment, family size, and age agree with the NSO (2012) data in the province.

The surveyed respondents' monthly income ranged from Php 5,000 and below (62%) followed by Php 5,001-10,000 (17%), and Php 10,001-15,000 (16%). The nature of work of surveyed respondents reflects the income level generated per capita per month. Nonetheless, this average monthly income was comprehensively below the average income per capita in the province as per NSO (2012) Misamis Oriental data.

Knowledge towards CW and SWM

Table 3 presents the summary of results on the respondents' level of knowledge towards CW and SWM in Opol and Jasaan, Macajalar Bay, Philippines. The first question examined respondents' knowledge towards CW. Most of the respondents identified coastal water as habitat for marine organisms (Opol - 43%; Jasaan - 53%), and beach for tourism (Opol -44%; Jasaan-29%). Present findings agreed with current ecotourism activities in Opol as evidenced by proliferating beach resorts in this municipality as compared to Jasaan where resorts were mainly located upland. With regards to the importance of coastal water most respondents perceived aquaculture production and fishing both supportive to livelihood of the locals. Distinctly, respondents in Jasaan perceived tourism attraction (29%) of the municipality coastal water. This response can be associated from the identification of Agutayan Marine Protected Area in the municipality also known for its ecotourism amenity.

Perception question towards coastal water quality were answered similarly in both municipalities as; (i) there are still fishes and shellfish found in the coastal water (ranked first); and (ii) there is no odor (ranked second). Further question to qualify sign of coastal pollution revealed similar response in both municipalities reflecting poor SWM, namely, garbage floating in the coastal water (Opol= 32%; Jasaan = 31%). Other perception of coastal water pollution was associated to water turbidity which accounts to 34% of respondents in Opol followed by absence of fish as perceived by respondents in Jasaan (23%).

Further question on potential sources of coastal water pollution were perceived unanimously in both municipalities accounting to 70% of respondents in Jasaan and 59% in Opol. Primary reasons were apportioned from poor SWM (Opol-38%, Jasaan-43%) and wastewater from industries (Opol-2%, Jasaan-27%). This reflects the lack of appropriate disposal facilities in these municipalities as pressing challenge (material recovery facility (MRF) and sanitary landfill) and existence of industrial plants particularly in Jasaan along coastal areas. Similarly, respondents' knowledge maybe influenced by observed inadequate disposal practices among recreational visitors particularly in Opol as ecotourism stations (Oigman-Pszczol and Creed, 2007). Solid waste (SW) contributes to coastal water degradation (Law et al.,2010; Castañeda *et al.,* 2014; Libreton *et al.,* 2017; Sadri *et al,* 2014; and Sruthy *et al.,* 2017) coming from untreated domestic and industrial wastewater (ADB, 2007).

Table 3. Knowledge of coastal communities towards CW and SWM

Item no.	Question	Municipality					
		Opol		Total N (%)	Jasaan		Total N (%)
		Highest scored perceived answer	N (%)		Highest scored perceived answer	N (%)	
1	How do you identify coastal water?	Beach for tourism	40 (44%)	79 (87%)	Habitat for marine organism	48 (53%)	74 (82%)
		Habitat for marine organism	39 (43%)		Beach for tourism	26 (29%)	
2	How do you find coastal water to be important?	Fishing	34 (38%)	62 (69%)	Aquaculture production	57 (63%)	83 (92%)
		Aquaculture production	28 (31%)		Tourism attraction	26 (29%)	
3	How can you define if coastal water is clean?	There are still fishes and shellfish found in the coastal water	35 (39%)	67 (74%)	There are still fishes and shellfish found in the coastal water	27 (30%)	51 (57%)
		There is no odor	32 (36%)		There is no odor	24 (27%)	
4	How can you define if coastal water is polluted?	The coastal water is turbid	31 (34%)	60 (73%)	There are a lot of garbage floating in the coastal water	28 (31%)	49 (54%)
		There are a lot of garbage floating in the coastal water	29 (32%)		There was no fishes and shellfish found in the coastal water	21 (23%)	
5	What are the possible causes that you find to be the cause of coastal water degradation?	Throwing of garbage in the coastal water	34 (38%)	53 (59%)	Throwing of garbage in the coastal water	39 (43%)	63 (70%)
		Wastewater from industries	19 (21%)		Wastewater from industries	24 (27%)	

Awareness towards CW and SWM

Table 4 presents the summary of results for the level of awareness among surveyed respondents in Opol and Jasaan towards CW and SWM. About 49.4% respondents were aware about coastal water management programs in Opol (51%) as compared to Jasaan were half responded being unaware (52%). Positive perceptions were attributed to awareness of the Barangay Fishery and Aquatic Resource Management (BFARM) and Marine Protected Areas Management (MPAs) (see Fig 3and Table 4). Both municipalities have MPAs identified by the Macajalar Bay Development Council (MBDC), namely, Opol Marine Sanctuary and Agutayan Marine Protected Area. Both BFARM and MPA programs promote awareness and encourage participation of coastal communities (Bharti *et al.,* 2013).

On the other hand, awareness about managing the coastal water quality was mainly as a need to sustain livelihood and ensure fit coastal water quality (see Figure 3 and Table 4). Both perceptions in Opol and Jasaan reflected the need to secure local livelihood. Primary employment of respondents were being a fishermen, peripheral business owners (store owners), and motorcycle drivers all supportive of marine related livelihood and ecotourism activities. The coastal water provides opportunities to the locals and its water quality be sustained to secure the family's income.

Overall, majority of the respondents were unaware of the local coastal water management programs (Opol- 56%, Jasaan-60%). This presents the gap between policy implementations initiated by the government. This is further supported by the negative perception on the favourable benefits of the program (Opol-44%, Jasaan-42%). Despite findings that some were unaware of government programs, others responded favourably on the expected positive outcome of LGU initiated coastal resource management programs (Opol-53%, Jasaan-58%). This was mainly due to possible economic opportunities locals can avail (see Fig 3). Overall, this response is an indicator of community-government linkage enabling local policy makers in ensuring institutional arrangements of existing coastal laws (DENR, DA-BFAR, and DILG, 2001; Tran *et al.,* 2002).

While most respondents were aware with anthropogenic impacts (Opol-59%, Jasaan-60%) to coastal water, some marginally were unaware. Lack of education and low income employment can influence respondents' inability to connect with the physical environment like SWM issues (Berkun, 2005; Kiessling *et al.,* 2017). This marginal response was corroborated with their awareness of frequent disposal of solid waste to coastal waters (Opol-58%, Jasaan-53%). Seemingly this unlikely response corroborate with their lack of awareness towards local coastal water resource management plan (first awareness question-see Table 4).

Table 4. Awareness of coastal communities towards CW and SWM

Item no	Questions	Municipality							
		Opol				Jasaan			
		Yes	No	Further descriptive reasons	N (%)	Yes	No	Further descriptive reasons	N (%)
1	Are you aware of some coastal water management programs?	46 (51%)	44 (49%)	Barangay Fishery and Aquatic Resource Management	20 (22%)	43 (48%)	47 (52%)	Barangay Fishery and Aquatic Resource Management	35 (39%)
				Marine Protected Areas Management	10 (11%)			Marine Protected Areas Management	8 (9%)
2	Are you aware why should we manage our coastal water?	59 (66%)	31 (34%)	To sustain our livelihood from coastal water	30 (33%)	74 (82%)	16 (18%)	To sustain our livelihood from coastal water	28 (31%)
				To sustain coastal water quality	14 (16%)			To sustain coastal water quality	19 (21%)
3	Are you aware that local government has a program for coastal water management?	40 (44%)	50 (56%)			36 (40%)	54 (60%)		
4	Do you agree on the coastal resource management programs that was establish by the government?	50 (56%)	40 (44%)			52 (58%)	38 (42%)		
5	Do you think you can benefit on the established coastal water management by the LGU?	48 (53%)	42 (47%)			52 (58%)	38 (42%)		
6	Are you aware that human activities can affect the quality of coastal water?	53 (59%)	37 (41%)			54 (60%)	36 (40%)		
7	Do you know how frequent you dispose your waste and its effect to coastal water?	52 (58%)	38 (42%)			48 (53%)	42 (47%)		

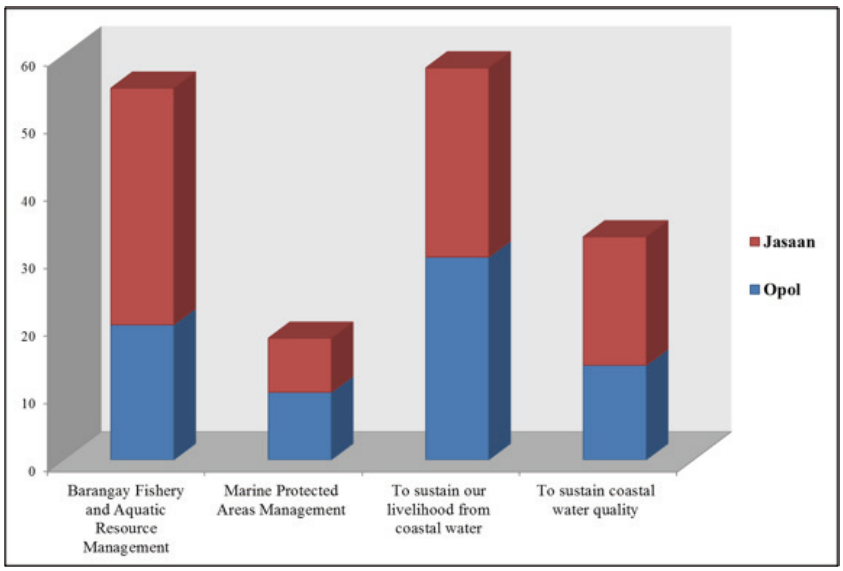

Figure 3. Specific awareness towards CW in Opol and Jasaan

Practices towards CW and SWM

Table 5 presents the summary of results for the level of practices among surveyed respondents in Opol and Jasaan towards CW and SWM. Most respondents admitted throwing garbage or solid waste to coastal waters, this accounts to 61% of respondents in Opol and 77% in Jasaan. Unlikely practice also included the inappropriate use of coastal waters as lavatory accounting to 65% of the respondents in Opol and 71% in Jasaan. Further, dumping of domestic animals waste (58% in Opol and 63% in Jasaan) was viewed common owing to livestock production in studied municipal stations. The disposal of sewage wastewater to coastal waters was mainly common in Jasaan (68%) than Opol (34%). Proliferation of housing projects in Opol with proper sewage system perhaps influenced respondent's positive practice of sewage disposal.

Dumping of solid waste or garbage to coastal water was seen common among coastal communities like the case of; (i) Lobo, Batangas, Philippines (Lawas *et al.,* 2009); Surabaya waterfront city, Indonesia (Rahmat *et al.,* 2016); and Tamandaré, Pernambuco State, Brazil (de Araújo and Costa, 2006). Notably respondents practiced proper segregation (affirmative response) despite dumping wastes to the coastal water. Given the mentioned circumstance they still perceived that fish catch in their municipalities was favourable. Marginally, some respondents felt that there were existing constructions adjacent to coastal waters. Similarly, marginal response was answered towards the use of fertilizer for home gardening. Both practices and activities were viewed crucial to likely affect water quality of the coast. The unlikely practices of SWM among respondents was a consequence of poor capital parameters (social trust, institutional trust, social networks, and compliance with social norms) to enforce policies (Jones *et al.,* 2010). It was evident that there was a strong interest from the participants in environmental

management issues, but practices were limited due to their lack of appropriate understanding (UNEP, 2014). In ensuring coastal water management practices, there must be; (i) abatement campaigns and government policies to reduce solid waste disposal; (ii) community involvement in decision making on proper waste management (Galarpe and Parilla, 2014a).

Influence of Sociodemographic indicators to KAP

Socio-demographic profile of the community has been found to be predictors of environmental behaviour (Aytülkasapoglu and Ecevit, 2002; Bennagen *et al.* 2002; Joardar, 2000). Thus, in this section the variation of the respondent's profile affecting to their KAP level were assessed statistically as summarized in Table 6-7. Overall, respondents in Opol level of knowledge were mainly affected by their gender and age ($p < 0.05$). Same findings were drawn from Jasaan except that it was only gender to likely determine the level of knowledge (see Table 6). Extrapolating from this, knowledge questions were mainly perception thus least factors to likely influence were gender and age. Furthermore, the level of awareness for respondents in Opol was influenced by the respondents' age, length of residency, and educational attainment ($p< 0.05$). It can be deduced that awareness questions were drawn from existing policies, coastal resource management (CRM) plans and programs. Thus, awareness questions with deeper terminologies and institutional arrangements (policies) were better influenced by older people with longer residency period as determinants to increase awareness. Higher educational attainment in Opol and Jasaan similarly influenced the level of awareness.

Despite the better knowledge and awareness, the respondents had poor practices towards ensuring coastal water quality as evidenced by dumping of solid waste, effluents, and animal waste. Consequently, it was only gender that affects the respondents' level of awareness (Jefferson *et al.,* 2014). This support that gender influences respondent's values and beliefs that affect their knowledge and practices (Espectato *et al.,* 2017).

Table 5. Practices of coastal communities towards CW and SWM

Item no.	Statements	Municipality							
		Opol				Jasaan			
		Highest scored response	N (%)	Indicator	p-value	Highest scored response	N (%)	Indicator	p-value
1	There are residents that throw their garbage in the coastal water?	A SA	35 (39%) 20 (22%)	Affirmative	0.0349	SA A	40 (44%) 30 (33%)	Affirmative	0.2013
2	There are residents that practice waste segregation in disposing their waste?	A SA	34 (38%) 28 (31%)	Affirmative	0.1031	SA A	43 (48%) 27 (30%)	Affirmative	0.2573
3	There are residents that use coastal water as their lavatory?	A SA	40 (44%) 19 (21%)	Affirmative	0.0955	A SA	38 (42%) 26 (29%)	Affirmative	0.1103
4	There are residents that directly dispose their sewage in the coastal water?	A N	31 (34%) 22 (24%)	Moderate	0.0278	A SA	38 (42%) 23 (26%)	Affirmative	0.0949
5	There are residents that wash clothes near the coastal water?	A N	38 (42%) 26 (29%)	Moderate	0.0825	D A	33 (36%) 27 (30%)	Moderate	0.0395
6	There are residents that wash their utensils near the coastal water?	N D	36 (40%) 28 (31%)	Poor	0.0969	D A	32 (36%) 24 (27%)	Moderate	0.0729
7	There is an on-going establishment construction near the coastal water?	D N	25 (28%) 24 (27%)	Poor	0.0292	SD D	31 (34%) 22 (24%)	Poor	0.0146
8	There are still a lot of fish and seashells that you can get in the coastal water?	A SA	45 (50%) 17 (8%)	Affirmative	0.2005	A SA	43 (48%) 36 (40%)	Affirmative	0.2435
9	There are animals owned by the respondents that dispose their feces near the coastal water?	A N	52 (58%) 15 (17%)	Affirmative	0.2884	A SA	31 (34%) 26 (29%)	Affirmative	0.0774
10	There are respondents that use fertilizer for their backyard plants?	D A	29 (32%) 20 (22%)	Moderate	0.0236	D SD	35 (39%) 25 (28%)	Poor	0.0656

Legend: SA – Strongly agree; A- Agree; N- Neutral; D- Disagree; SD- Strongly Disagree; Highlighted in red are significant at α=0.05

Table 6. Test statistic of Opol respondents' sociodemographic indicators influence on the level of KAP

Indicators	Test statistic	Knowledge			Practices					
		F/T-value	P-value	Decision	F/T-value	P-value	Decision	F/T-value	P-value	Decision
Gender	T-test	-2.9643	0.0314	S	0.0315	0.9778	NS	-3.6025	0.0155	S
Age	ANOVA	6.7816	0.0404	S	16.0969	0.0160	S	0.5842	0.4696	NS
Civil Status	ANOVA	1.2906	0.2993	NS	1.6017	0.2744	NS	0.1531	0.7072	NS
Household Size	ANOVA	5.6074	0.0641	NS	1.5261	0.3046	NS	1.7957	0.2288	NS
Length of Residency	ANOVA	1.6086	0.2404	NS	23.3608	0.0029	S	0.3076	0.5927	NS
Monthly Income	ANOVA	0.3211	0.5865	NS	3.2468	0.1216	NS	0.0771	0.7876	NS
Educational Attainment	ANOVA	1.1526	0.3143	NS	14.4970	0.0089	S	0.2375	0.6377	NS

S – significant ; NS – not significant at α=0.05

Table 7. Test statistic of Jasaan respondents' sociodemographic indicators influence on the level of KAP

Indicators	Test statistic	Knowledge			Awareness			Practices		
		F/T-value	P-value	Decision	F/T-value	P-value	Decision	F/T-value	P-value	Decision
Gender	T-test	-3.0571	0.0223	S	0.0000	1	NS	-3.5066	0.0172	S
Age	ANOVA	0.9526	0.3576	NS	7.5175	0.0518	NS	0.4063	0.5441	NS
Civil Status	ANOVA	0.4959	0.5013	NS	1.9242	0.2377	NS	0.1605	0.7006	NS
Household Size	ANOVA	1.7474	0.2278	NS	0.7878	0.4401	NS	1.1440	0.3259	NS
Length of Residency	ANOVA	0.9964	0.4911	NS	0.0000	1.0000	NS	0.3594	0.5636	NS
Monthly Income	ANOVA	0.0000	1.0000	NS	3.7990	0.0992	NS	0.1076	0.7504	NS
Educational Attainment	ANOVA	1.2386	0.3952	NS	6.9938	0.0383	S	0.1783	0.6827	NS

Legend: S – significant ; NS – not significant at at α=0.05

Insight on CW challenges

Present land use plan and population data of studied municipalities along Macajalar bay is presented in Table 8. Notably, the municipality of Opol is distinctively planned for residential-commercial-ecotourism zones in all studied stations. This explains that anthropogenic input affecting coastal water quality mainly comes from these sectors. This was corroborated by previous findings that beach litter characteristics suggested a strong relationship with local land-based origins (Martinez-Ribes *et al.,* 2007), referring to residential or domestic wastes. Further, ecotourism in particular during bathing season in Opol will likely increase beach waste and litter among urbanized stations with coastal resorts (Ariza *et al.,* 2008). On the other hand, the industrial nature of Jasaan stations reflects the high response on the knowledge question about the cause of coastal water degradation coming from industrial wastewater (27%) (see Table 2). Nonetheless, the increase in population and urbanizing land use plan of surveyed coastal municipalities potentially apportioned anthropogenic inputs to affect coastal water quality.

Table 8. Population growth rate in both municipalities and current land use (NSO, 2010; CLUP, 2014-2022; CLUP,2000-2015)

Municipality		**Population growth**			**Current land use**
		2000	**2010**	**2015**	
Opol	Poblacion	3185	3690	4446	Residential
					Commercial
					Ecotourism
	Igpit	5284	10123	12198	Residential
					Commercial
					Ecotourism
	Barra	11428	14334	17272	Central district area
Jasaan	Lower Jasaan	4938	5762	6173	Industrial
					Residential
	Luz Banzon	2844	3752	4206	Commercial
					Industrial
	Aplaya	4505	5774	6409	Residential
					Commercial
					Industrial

Insight on SWM challenges

Present SWM challenges of surveyed municipalities were mainly due to the lack of appropriate disposal facilities (see Table 9-10) corroborating previous results for the level of practices where dumping solid waste to coastal waters perceived positively. Controlled disposal facility (CDF) for example was located in upland communities in each municipality. Consequently, this perhaps offers less motivation for coastal communities to participate in SWM program and opted to dumped waste directly to coastal areas as the more convenient option. This reflects absence of policy implementation and institutional arrangements for SWM supposedly be addressed with prior knowledge and awareness among policy makers and locals. While present policy options reflected in Table 9 exists, however absence of monitoring may hinder best fit SWM program.

Table 9. SWM Challenges in studied municipalities (CLUP, 2014-2022; CLUP,2000-2015)

Municipality	Development challenge	Technical findings	Planning implications	Policy options
Opol	Proper waste management and disposal	Absence of final disposal facility (LGU owned)	1. Increasing expenditures of disposing garbage due to high cost of tipping fee and fuel consumption 2. Increasing volume of generated garbage due to increase in population	1. Strictly implement the existing ordinance on solid waste management 2. Prioritization of site identification for material recovery facility (MRF) and controlled dumpsite (consider the option of inter- LGU cooperation) 3. Revive implementation of MRF at the barangay level
Jasaan	Proper waste management and disposal	Inadequate solid waste disposal facilities	To conduct inspections in household and commercial establishments in order to enforce sanitation requirements and environmental sanitation	1. Integrated solid waste management program. 2. Waste water management program. 3. Environmental sanitation program 4. Establishment of a sanitary landfill

Table 10. Description of disposal facilities in studied municipalities (NSWC, 2017; CLUP, 2014-2022; CLUP,2000-2015)

Municipality	Controlled disposal facility (CDF)				Material recovery facility (MRF)		
	Specific location	Land Area	vol/day (m^3)	vol/year (m^3)	Total no	Location	Specific locations
Opol	Patag	2 ha	212	2500	6	Communities or barangay and school MRF	3 Coastal communities
Jasaan	Natubo	2 ha	-	-	1	CDF	Upland

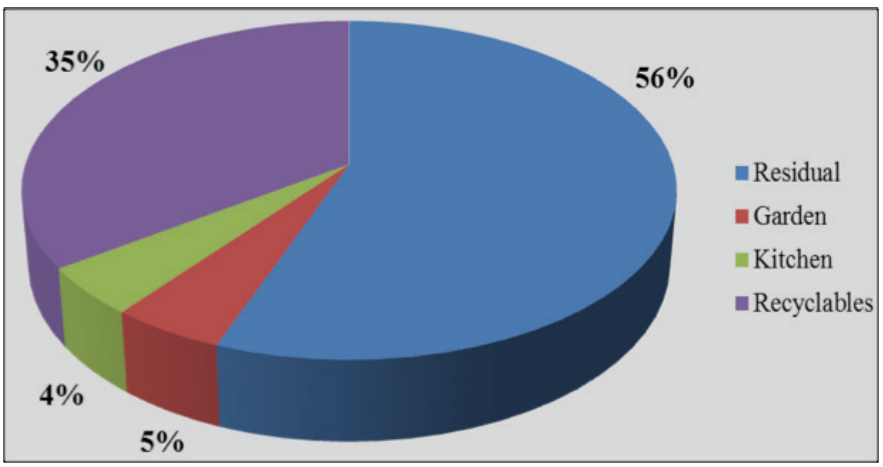

Figure 4. Domestic SWM composition (tons/day) in Opol, Misamis Oriental (CLUP 2014-2022)

In Opol for example major solid waste were composed of residuals (56%) and recyclables (35%) offering potential economic opportunities. Similarly, the municipality's organic waste potential can be maximized supposing garden (5%) and kitchen (4%) wastes are recovered (see Figure 4). Nonetheless, this domestic waste composition confirms the results for practices with the use of backyard fertilizers (22%) and other domestic waste discharge to coastal waters in Opol.

CONCLUSIONS

Sociodemographic indicators of coastal communities revealed higher level of knowledge and awareness but with poor level of practices towards coastal waters and SWM. To elaborate, Opol coastal residents level of knowledge and practices towards coastal water resources and SWM were influenced by gender and age as sociodemographic indicators, whereas level of awareness was influenced by age, length of residency, and educational attainment.

Distinctively, Jasaan coastal residents level of knowledge and practices were influenced by gender, whereas awareness was influenced by educational attainment. Insights from sociodemographic indicator study unlikely practices posing threat to coastal waters, namely: (i) disposal of solid waste; (ii) coastal zone as lavatory; and (iii) disposal of domestic sewage wastewaters. This was corroborated mainly by the lack of appropriate disposal facilities in studied municipalities despite policy enforcement. It is recommended that proper SWM be improved through appropriate institutional arrangement not to compromise coastal water resources.

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