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WaSH Facilities and Diarrhoea Occurrence at the Eco-zones of Abra de Ilog, Philippines: A Comparative Assessment

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Eco-zones upland, lowland and coastal areas have varying accessibility to resources like water. This variability in water sources may influence hygiene and sanitation facilities, and health outcomes like diarrheal diseases. This ecological study examined the link between the completeness of Water, Sanitation and Hygiene (WaSH) facilities and diarrhea occurrence at the eco-zones of the Municipality of Abra de Ilog, Philippines. A total of 418 households served as respondents and mixed participatory methods were used. Results showed that the upland eco-zone had the highest proportion of households with diarrhea (64.0%) regardless of whether they have complete, incomplete or no WaSH facility at all, followed by coastal (34.6%) and lowland (16.2%) eco-zones. More than 60% of households with incomplete facilities drinking water and handwashing facilities only experienced diarrhea. The absence of toilet facilities increases likelihood for diarrheal disease. The presence of a complete set of WaSH facilities a potable drinking water source, improved sanitary toilet facility and hand-washing facility at each household was important to lower diarrheal disease burden. Incomplete WaSH facilities lead to the occurrence of diarrhea irrespective of eco-zone. Nonetheless, having incomplete facilities is better than not having any facility at all.

Keywords: WaSH; water and sanitation; diarrhoea; eco-zones

I. INTRODUCTION

Ecological zone, or eco-zone is a landscape unit that defines an integrated system of communities including its social formation and environmental conditions. Eco-zone definitions rely on flexible criteria but certain elements such as topographic features (e.g. elevation and slope) define them and its buffer areas (Izeta, 2016). In Southeast Asia, settlements are either classified into lowland, upland or highland tribes and coastal communities (SEAMEO, 2012). Upland communities are those that thrive in high elevation above sea level which depend on upstream freshwater sources that are collected from rainfall, stored in various amounts for different times and released as runoff by watersheds (Shukla, 2004). Lowland and coastal communities, on the other hand, lie on low elevation and nearly along the coastline. Lowlands and coastal areas rely on the supply of water from the surface and underground which are supported by the upstream (Besagas *et al.*, 2014). Magalhãesa *et al.* (2011) reported that it is important to understand that spatial or geographical variations are essential factors influencing disease distribution and community characterization.

Abra de Ilog (Figure 1), an upland-coastal community, is endowed with large but intermittent freshwater sources. Shallow and deep wells for drinking are available but only a portion of these sources are within the acceptable standards for both domestic and irrigation use. Water sources near the coasts are unfit for drinking due to high levels of sodium chloride (Abra de Ilog Ecological Profile, 2008). In 2010,

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32% of population were connected to a faucet either for own use or shared, 18.5% still relied on springs and rain (NSO, 2010) and more than 50% had no access to sanitary toilet facilities. This makes the municipality the poorest in terms of access to water and sanitation in the whole province (CBMS Mindoro, 2009-2011).

Acute gastroenteritis (AGE) and intestinal parasitism, which are closely related to quality of water, food hygiene and sanitation, remain the top causes of morbidity for the general population in Abra de Ilog in 2015 (MHO, 2016). The high incidence of malnutrition due to poor WaSH in the municipality is also still seen as the greatest health problem in the area. It is not only a medical challenge but a socio-cultural, economic and political concern (MHO, 2016). Understanding these differences in WaSH and health would enable different sectors and institutions to plan and design programs and policies that are specific to the concerns of each eco-zone. This study is the first attempt to comparatively assess the conditions of the eco-zones in the Philippines.

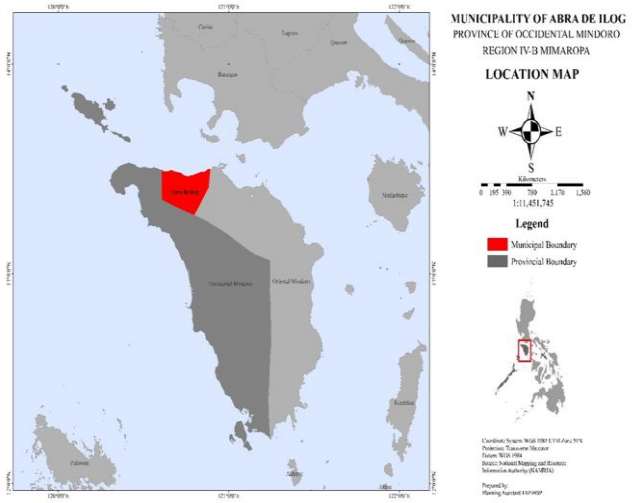

Figure 1. Location map of Abra de Ilog, Occidental Mindoro, Philippines

We aim to determine the link between the completeness of WaSH facilities and occurrence of diarrhoea in different eco-zones: upland, lowland and coastal areas in the Municipality of Abra de Ilog, Occidental Mindoro, Philippines.

II. MATERIALS AND METHOD

A. Study Framework

The study framework below shows the variables used in understanding the link between the completeness of WaSH facilities and occurrence of diarrhoea at the different eco-zones. The eco-zones-upland, lowland and coastal areas - have different socio-economic characteristics, ethnicity and culture that affect the status of its WaSH indicators (e.g. type of drinking water source, toilet facility and handwashing practices). These WaSH indicators may either be complete, incomplete or absent in each eco-zone. The level of completeness influences the occurrence of diarrheal diseases.

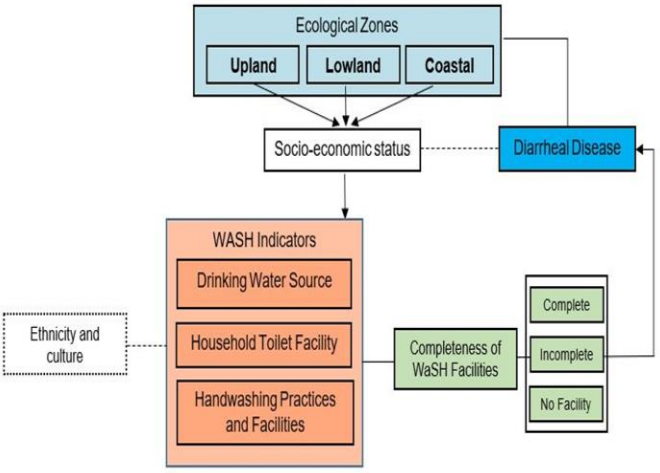

Figure 2. Study framework in understanding the link between WaSH facilities and occurrence of diarrhea at the eco-zones in Abra de Ilog, Philippines

B. Measures

The table below illustrates the variables involved in this study and how each was operationalized.

Table 1. Categories and definition of variables of interest

Variable	Category	Operational Definition
Drinking Water Source	Improved Source	Sources of drinking water defined and classified as safe and potable; and utilized by household respondents for the past 6 months (WHO UNICEF/JMP, 2015)
	Unimproved Source	Sources of drinking water defined and classified as unsafe and costly; and utilized by household respondents for the past 6 months (WHO UNICEF/JMP, 2015)
Household Toilet Facility	Improved Facility	Basic and improved sanitation facility which is not shared and separates, disposes in site, or transports and treats off-site human excreta to reduce human contact; and utilized by the household respondents for the past 6 months (WHO UNICEF/JMP, 2015)
	Unimproved Facility	Sanitation facilities that dispose human urine and feces anywhere; and utilized by the household for the past 6 months (WHO/UNICEF JMP, 2015)
	No Facility	No existing infrastructure/facility at all and/or practices open defecation for the past 6 months
Handwashing Facilities	With	Presence of a functional handwashing facility within or immediately near the comfort room and within or immediately near the food preparation area (WHO/UNICEF JMP, 2015) as reported by the respondent
	Without	Absence of any of the handwashing facilities mentioned above
Diarrhea	Positive	Self-reported bloody or watery diarrhea (WHO/UNICEF, 2009) for the last 3 months; experienced by the respondent or any member of the family
	Negative	Absence of bloody or watery diarrhea for the last 3 months among household members
Completeness of WASH Facilities	Complete	At least 2 out of 3 improved WaSH facilities (WHO/UNICEF, 2015) are existing and functional regardless if it's a shared facility or owned by family
	Incomplete	Only 1 improved WaSH facility (WHO/UNICEF, 2015) is present and functional, regardless if it's a shared facility or owned by family
Eco-zone	Upland	The eco-zones were classified as either upland, lowland or coastal based on its topographic features such as elevation and ecological attributes like presence of forests, flat lands and coastlines as delineated by the Municipality of Abra de Ilog. The criteria for classification included include the location of the settlements and the community's major source of livelihood. The categories were based from the Abra de Ilog Ecological Profile 2008-2023.
	Lowland	
	Coastal	

C. Study Design and Sampling Strategy

This was an ecological study with a multi-stage sampling strategy. Sampling frames included: 1) the list of the barangays in the Municipality of Abra de Ilog; 2) list of Sitios in Selected Barangays; 3) list of Sitios Per Ecozone- upland, lowland, coastal, and; 4) list of households in selected Sitio per Eco-zone. Sitios are the territorial units within a barangay while barangays are the territorial units within a municipality.

A random number generator was used to select the barangays. All sitios in the selected barangays were preliminarily classified as coastal, lowland and upland communities. Only selected sitios per eco-zone were included in the sample population. Representative households from the selected sitios at each eco-zone were included as respondents. Spot maps were later employed in selecting the households. A total of 557 household respondents were computed given a 95% confidence level and 70% power, but only 418 families eventually joined the study. From the coastal eco-zone, 162 participated while 142 and 114 households participated from the lowland and upland communities, respectively. Figure 3 shows the steps of sampling procedure.

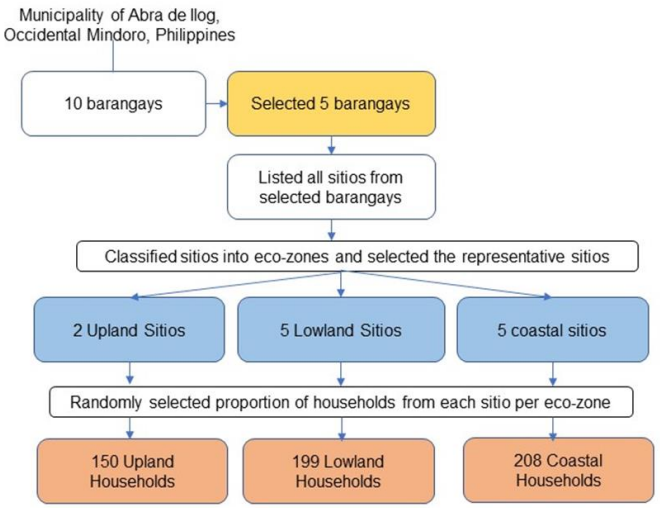

Figure 3. Sampling procedure for the WaSH study in Abra de Ilog, Philippines

D. Tools and Techniques

1. Data Collection

Mixed participatory methods were used in the study. A guided survey using a structured questionnaire and ocular inspection were done to assess the socio-demographic characteristics of the households and the WaSH indicators at each eco-zone. Questions on the status of WaSH facility, sanitary practices, and the occurrence of diarrhoea within the family were included in the survey. Key informant interviews (KII) with the Municipal sanitary inspector, engineering and

planning office and Mangyan Affairs were conducted to gauge a deeper understanding of the WaSH situation in the municipality. Secondary data such as quarterly reports on Water, Sanitation and Health were obtained from the rural health unit.

2. Analytical Approach

Descriptive statistics (using Microsoft Excel®) and transect mapping were employed in analysing the conditions of WaSH facilities including the diarrheal cases in each eco-zone. Frequency and percentages were reported, while a transect map was created to depict a comparative trend between the proportion of households with diarrhoea and the completeness of WaSH facilities in each eco-zone. The transect map is the cross-sectional representation of the features and conditions of each eco-zone to easily compare the differences and similarities across the communities, including their socio-demographic characteristics.

3. Ethical Considerations

The study has been subjected to ethical review by the University of the Philippines Manila Research Ethics Board. Final approval of the study protocol was processed through expedited review and was issued 16 May 2017. Confidentiality and anonymity of the respondents and their responses were safeguarded and respected through a non-disclosure agreement indicated on the informed consent.

III. RESULTS

Table 2 demonstrates the basic characteristics of each eco-zone.

Irrespective of eco-zone, diarrheal occurrences were more commonly observed among households having no WaSH facilities at all (63.3%) compared to those with incomplete (33.4%) and complete facilities (18.4%). While those with complete WaSH facility had the highest rate of no diarrhoea occurrence (81.6%), followed by those with incomplete facilities (66.5%) and no facility at all (36.7%). Table 3 summarizes these findings.

Table 2. Eco-zone basic profile

Characteristics	Eco-zones		
	UPLAND (n=114)	LOWLAND (n=142)	COASTAL (n=162)
Major occupation	Farming	Microbusiness	Fishing
Educational attainment	No formal education (28.6%)	High School Graduate (16.3%)	Elementary Undergraduate (21.4%)
Average monthly income (1PHP ~ 50USD)	PHP 2, 383	PHP 6,205	PHP 4,403
% Indigenous population (Iraya Mangyan)	84.2%	3.1%	45.2%
% HH with improved drinking water sources	77.2%	95.8%	83.3%
% HH with improved toilet facility	14.3%	92.8%	70.4%
% HH with handwashing facility within/near toilet	14.2%	26.0%	18.4%

Table 3. Summary of the proportion of households (%) with and without diarrhea and the completeness of WaSH facilities at each eco-zone in Abra de Ilog, 2017

WaSH Facility Status and Diarrhea Occurrence	ABRA DE ILOG (N=557)	UPLAND (n=114)	LOWLAND (n=142)	COASTAL (n=162)
Complete Facility; with diarrhea	18.4%	33.3%	8.7%	26.1%
Complete Facility; without diarrhea	81.6%	66.7%	91.3%	73.9%
Incomplete Facility; with diarrhea	33.4%	53.3%	18.0%	33.6%
Incomplete Facility; without Diarrhea	66.6%	46.7%	82.0%	66.4%
No facility; With Diarrhea	63.3%	75.0%	0.0%	44.4%
No Facility; No Diarrhea	36.7%	25.0%	100%	55.6%

1. Complete WaSH Facilities and Diarrhoea Occurrence

Diarrheal diseases are usually less common among households with WaSH facilities. However, results showed that were households with diarrhoea despite having complete WaSH facilities at home (68.0%). This occurred in every eco-zone. The proportion of households with complete facilities and with diarrhoea was highest in the upland (33.3%),

followed by coastal (26%) and lowland (8.7%) eco-zones.

2. Incomplete WASH Facilities and Diarrhoea Occurrence

The upland eco-zone had the highest proportion of households with diarrhoea (53.3%) among the eco-zones with only 1 or 2 facilities present at home, followed by the coastal eco-zone (33.6%), and the lowland eco-zone (17.9%). Among households with incomplete facilities in the upland eco-zone, diarrheal diseases were prevalent among those having only drinking water and handwashing facilities (83.3%). On the other hand, the proportion of households without diarrhoea was highest among those with sanitary toilet and handwashing facilities (100%). For all eco-zones, about 63% of households having only drinking water and handwashing facility had experienced diarrhoea in the last 3 months at the time of the survey. A total of 86.7% of the households with sanitary toilets alone had no history of any type of diarrhoea in the last 3 months. Those with sanitary toilets and drinking water facilities had the lowest diarrheal occurrences.

3. Absence of WASH Facility and Diarrhoea Occurrence

The proportion of households with diarrhoea was higher among eco-zones having no WaSH facility at all. More diarrheal occurrences were observed in the upland eco-zone (75%), followed by the coastal eco-zone (44.4%) while none was observed in the lowland eco-zone since all the households had at least 1 or 2 facilities at home.

IV. DISCUSSION

Findings showed that the upland eco-zone had the highest proportion of households with diarrhoea regardless of whether they have complete, incomplete or no WaSH facility at all, followed by the coastal and lowland eco-zones. Aside from having the highest proportion of households with diarrhoea, the upland eco-zone also had the highest proportion of households without formal education. A study conducted in Sub-saharan Africa by Munamati *et al.* (2016) showed a consistent and robust association between sanitation and education. Ortiz-Correa and Dinar (2015) also suggested a correlation between education and hygiene practices.

With education, individuals are more likely understand the effects of poor sanitation and therefore make appropriate investments on water and sanitation. The upland eco-zone had the lowest average monthly income among all eco-zones. This may point to the well-established link between socio-economic status and health outcomes. In Ghana, approximately 20.3% of children from the poorest households reported diarrhoea, compared to the richest households. Diarrhoea can thus be regarded as a symptom of wider socio-economic inequalities within and among populations (Kumi-Kyereme and Amo-Adjei, 2015).

Diarrheal diseases were prevalent among those having only drinking water and hand-washing facilities. The presence or absence of toilet facilities, therefore, plays a major role in diarrhoea occurrence, particularly in the upland eco-zone. This corroborates the findings of a study in Vietnam (Rheinländer *et al*, 2010) which reported that sanitation facilities were found to be poorer in the highland community compared to those in the lowlands. Semba, *et al.* (2011) found that more than 50% of rural families in Indonesia had no improved latrine and 8.2% of these households had a child with history of diarrhoea.

According to the key informant interviews with the Abra de Ilog Municipal Sanitation officer, the continuous poor sanitation and health outcomes in the upland areas are due to geographical isolation, financial problems and cultural challenges. Similarly, highland communities are more disadvantaged than the lowlands due to lack of funding and time for more outreach activities, transport difficulties and low motivation among health workers to work in such 'difficult areas' (Rheinlander *et al.*, 2012).

The majority of households in the upland eco-zone of Abra de Ilog were members of the Mangyan indigenous group. Studies had established that ethnic and socio-cultural characteristics had specific beliefs and practices which could contribute to differences in sanitation and hygiene practices. Ethnic Minority Groups (EMGs) in Vietnam, for instance, had cultural miasmatic perceptions of dirt as opposed to the rich, more hygienic and non-ethnic communities (Rheinländer *et al.*, 2010). Observations on field show that

Mangyan families allowed the presence of stray dogs, livestock and poultry freely roaming and whose faeces were not properly disposed. The same poor and unsystematic waste management scenario was observed in the communities of Vietnam EMGs (Rheinländer *et al.*, 2010). The presence of these animals and their possible faecal contaminants may influence disease occurrence such as diarrhoea.

Most diarrhoea occurrences in the coastal eco-zone, on the other hand, were found among households having drinking water facility alone (37.5%). Thus, the problem is possibly not its presence and accessibility, but the quality of the water provided. This may also indicate that the presence of water facilities may not guarantee the absence of diarrheal diseases in the area. The definition of 'improved' facilities needs to be revisited.

Findings highlighted that having a complete WaSH facility is a protective factor against diarrheal diseases. Nonetheless, having at least 1 or 2 out of the 3 WaSH facilities would be better than not having any. The absence of toilet facilities increases the occurrence of diarrhoea but having toilets alone compared to having none is a protective factor against acquiring disease irrespective of eco-zone. Thus, construction and/or provision of WaSH facilities, particularly a toilet, is crucial.

Toilets help reduce transmission of pathogenic organisms on land and water and therefore curb environment-related diseases. However, provision of these facilities must be accompanied by proper hygiene and environmental sanitation. Better hygiene practices such as handwashing and improvement in the toilet systems will reduce health costs (World Bank, 2008). This means that the presence of a WaSH facility, even if it is incomplete, is a possible protective factor against diarrhoea occurrence. This applies to all cases in the upland, lowland and coastal communities.

V. CONCLUSION

Among all eco-zones, the upland eco-zone had the highest proportion of households with diarrhoea, regardless of whether they have complete, incomplete or no WaSH facility at all, followed by the coastal and lowland eco-zones. More than 60% of households having only drinking water and hand-washing facilities had experienced diarrhoea in all eco-zones. The absence of toilet facilities thus, increases the occurrence of diarrheal diseases. Households with no facility at all, had more diarrhoea particularly among the upland and coastal eco-zone while none was observed in the lowland eco-zone since all the households had at least 1 or 2 facilities at home. Having incomplete WaSH facilities is likely to cause diarrhoea irrespective of eco-zone, but incomplete facilities are better than none. This means that the presence of WaSH facilities – even when incomplete – is a protective factor against diarrhoea in all eco-zones. Construction of toilet facilities in all eco-zones where there are none is highly recommended particularly in the upland area.

VI. ACKNOWLEDGEMENTS

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