

## Physico-Chemical Analysis of Water Sources in Guiuan, Eastern Samar, Philippines

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### **Abstract**

*This descriptive and analytical type of study determined the physico-chemical characteristics of water sources in Guiuan, Eastern Samar in terms of turbidity, calcium, chloride, fluoride, sulfate, magnesium, salinity, dissolved oxygen, and hydrogen ion concentration. Standard laboratory procedures were followed in the collection and analysis of water samples which were conducted at the Eastern Visayas Regional Medical Center, Tacloban City, Philippines; Eastern Samar Provincial Hospital, Borongan City, Philippines and Bureau of Fisheries and Aquatic Resources (BFAR) – Guiuan Field Office, Guiuan, Eastern Samar, Philippines. It used the Analysis of Variance and Scheffe's test for significant difference set at .05 level of significant. Result of the laboratory analysis revealed that water from municipal water system had significantly high calcium and water from private pump wells, public pump wells, and the municipal water system significantly differed along some physico-chemical characteristic parameters such as turbidity, calcium, magnesium, sulfate, and hydrogen ion concentration.*

**Keywords:** *physico-chemical analysis, water analysis*

### **1. Introduction**

Water is an indispensable natural resource on earth which all life depends (Kaushik, 2006). Although we can survive without food, several days without water can be fatal. Most plants and animals have 60-65% water in their bodies. Several chemical reactions in the body can take place only in the presence of water. Water also helps our body in maintaining its proper temperature of 37°C (Maton, 1994). In addition, water is an excellent solvent; thus it can serve as a very good carrier of nutrients, including oxygen, which is essential to life.

The municipality of Guiuan is surrounded with saltwater which may influence water quality. Most of the constituents utilize the Level I and III household water supply. In the mainland Guiuan, only 40% of the total households are concessionaires of the local water system and the majority depend their water needs on open dug wells, jetmatic pumps, and artesian wells (Guiuan Water District, 2007). The Quarterly Accomplishment Report of the Guiuan Field Health Office showed that the leading causes of mortality in the municipality include water-borne diseases such as amoebiasis and dysentery. Furthermore, the Report on Bacteriologic

Water Analysis conducted at Felipe J. Abrigo Memorial Hospital in Guiuan, Eastern Samar revealed that the water was contaminated with fecal coliform. With these information, the researcher decided to study the Bacteriological and Physico-Chemical Analysis of Water Sources in Guiuan, Eastern Samar to determine the potability of water based on the standard criteria set by the Philippine Standards for Drinking Water.

## 1.1 Research Problem

The study primarily aimed to determine the potability of water sources in mainland Guiuan, Eastern Samar. Specifically, the study seeks answers to the following questions:

1. What are the physico-chemical properties of water from identified sources in Guiuan, Eastern Samar in terms of the following water quality parameters?

1.1 Physical Characteristics

1.1.1 Turbidity

1.2 Chemical Characteristics

1.2.1 Calcium

1.2.2 Chloride

1.2.3 Fluoride

1.2.4 Sulfate

1.2.5 Magnesium

1.2.6 Salinity

1.2.7 Dissolved Oxygen

1.2.8  $H^+$  ion concentration

2. Are there differences in the physico-chemical characteristics of water from private pump wells, public pump wells, and municipal water system within selected barangays in Guiuan, Eastern Samar along the identified parameters?

3. Are there differences in physico-chemical characteristics of water from private pump wells, public pump wells, and municipal water system between selected barangays of Guiuan, Eastern Samar?

## 2. Methodology

The study employed the descriptive analytical type of research design since the study ways to describe factually and accurately the characteristics of water sources of Guiuan, Eastern Samar through laboratory analysis which involved the analysis of water samples from identified private and public owned pump wells among the selected barangays and the municipal water system. The results of analysis along the identified parameters were compared with the standard criterion set by the Philippine National Standards for Drinking Water (PNSDW, 1993). Comparisons on the physico-chemical characteristics were made between and among the water sources. Analysis of Variance and Scheffe's test for significant difference was utilized at .05 level.

Composite sampling was used in the collection of water samples. Water samples were placed in a photo resistant container and one – liter of the water sample was used in the analysis. Three samples for private and public pump wells for each barangay were the sources of the one

liter composite water sample. In the same selected barangays the researcher identified a household which was a concessionaire of the Guiuan Municipal Water System; these three households therefore were the source of the composite water sample from Municipal Water System. The study involved five replications.

In order to get the general condition of the water sources of Guiuan, Eastern Samar, the researcher with the help of the Municipal Water Analyst selected the barangays according to their location from upland down to the coastal area and towards the town of the municipality.

The study was conducted in selected barangays of Guiuan, Eastern Samar namely: Barangay Lupok, Barangay Salug, and Barangay Surok. The municipality of Guiuan, Eastern Samar, Philippines is located in the southernmost tip of Samar, Philippines. This coastal town was one of the municipalities devastated by typhoon Yolanda (Haiyan). It has a total land area 17,549 km<sup>2</sup> which is divided into sixty (60) barangays. Guiuan is 109 kilometers from Borongan City (capital town of Eastern Samar Province) and 154 kilometers from Tacloban City.

The Analysis of Variance (ANOVA) and Scheffe’s Test was used to test the significant differences.

### 3. Results and Discussion

#### 3.1 Physical Characteristics

The water samples from private pump wells (4 units) and public pump wells (2.2 units) of Barangay Surok and the Guiuan Municipal Water System (1.6 units) were within the maximum permissible limit set by the Philippine National Standards for Drinking Water along turbidity. The results of the study showed further that the water from the private and public pump wells of Barangays Lupok and Salug are of poor quality in terms of turbidity.

Table 1. Water analysis result on turbidity

Water Sources		Trial					Mean	Standard
		I	II	III	IV	V		
L U P O K	Private Pump Wells	7	8	5	5	6	6.2	5 units
	Public Pump Wells	2	8	8	7	2	5.4	
S A L U G	Private Pump Wells	6	7	4	4	5	5.2	
	Public Pump Wells	10	11	1	5	7	6.8	
S U R O K	Private Pump Wells	1	2	10	6	1	4	
	Public Pump Wells	1	2	4	3	1	2.2	
Guiuan Municipal Water System		1	2	2	2	1	1.6	

### 3.2 Chemical Characteristic

The municipal water system had the highest calcium content which registered a mean of 249.4 mg/L and was found to exceed the maximum permissible limit for calcium. The analysis of chloride content showed that the water samples contained low amount of chloride, in fact the highest chloride content was only a mean of 48 mg/L of Lupok public pump wells. The water analysis of fluoride revealed that all the water samples were within the permissible level which is 1.2 mg/L. Among the seven water sources tested, the private pump wells of Surok had the highest fluoride content which yielded a mean of 0.76 mg/L. The result of water analysis on sulfate showed that the sampled water sources had amounts of sulfate that were not beyond the maximum permissible level. Salug private pump wells recorded the highest sulfate content with a mean of 41.6 mg/L while the municipal water system showed the lowest sulfate content with a mean of 6.4 mg/L. In terms of magnesium content, the study revealed that in all water sources tested, the magnesium content was low compared to the maximum permissible level of 50 mg/L. Surok public pump wells had the highest magnesium content with a mean of 26.6 mg/L while the municipal water system showed a mean of 13.2 mg/L which was the lowest. The study revealed that municipal water system which is located in the upper land of Guiuan showed the highest salinity; hence, saltiness of drinking water is not attributed to seawater intrusion but to soil ions that leaches to the water table. All the water samples from identified sources were within the standard permissible level for dissolved oxygen. The private pump wells of Surok with a mean of 3.636 mg/L had the highest dissolved oxygen while private pump wells of Lupok had the lowest dissolved oxygen with a mean of 3.068 mg/L. In terms of pH, public pump wells of Salug had the highest pH which registered a mean of 8.074 and the municipal water system showed the lowest pH with a mean of 6.424. The study revealed that the samples were within the permissible level.

**Table 2. Water analysis result on chemical characteristics**

Water Sources	Parameters		Trial					Mean	Standard	Above/Below of Permissible Limit
			I	II	III	IV	V			
L U P O K	P r i v a t e Pump Well	Calcium	82	84	100	154	230	130	75mg/L	zxA
		Chloride	20	10	30	50	10	24	200mg/L	B
		Fluoride	0.11	0.12	0.8	0.8	0.05	0.376	1.2mg/L	B
		Sulfate	0.3	15	15	15	9	10.86	200mg/L	B
		Magnesium	30	28	22	15	15	22	50mg/L	B
		Salinity	5.0	0.0	0.0	6.0	1.0	2.4	-	-
		DO	3.5	2.6	2.70	3.14	3.4	3.086	5mg/L	B
	P u b l i c Pump Well	pH	7.7	7.77	7.61	8.35	8.15	7.916	6.6-8.5	B
		Calcium	126	176	70	202	158	146.4	75mg/L	A
		Chloride	50	80	40	20	50	48	200mg/L	B
		Fluoride	0.12	0.5	0.5	0.5	0.10	0.344	1.2mg/L	B
		Sulfate	3	5	14	10	3	7	200mg/L	B
		Magnesium	25	29	40	17	18	25.8	50mg/L	B
		Salinity	7.0	0.0	0.0	4.0	2.0	2.6	-	-
S A	P u b l i c Pump Well	DO	2.5	2.7	3.80	4.70	3.0	3.34	5mg/L	B
		pH	8.54	7.65	7.56	7.92	8.33	8.0	6.6-8.5	B
		Calcium	200	80	204	208	220	182.4	75mg/L	A
		Chloride	40	10	30	20	40	28	200mg/L	B
		Fluoride	0.12	0.14	0.5	0.8	0.9	0.492	1.2mg/L	B
		Sulfate	55	58	35	15	45	41.6	200mg/L	B
		Magnesium	11	39	11	10	10	16.2	50mg/L	B
		Salinity	40	0.0	1.0	2.0	0.0	1.4	-	-
		DO	3.6	3.3	4.02	3.87	3.08	3.574	5mg/L	B
		pH	7.63	7.76	7.52	7.80	8.20	7.782	6.6-8.5	B

L U P O K	P u b l i c P u m p W e l l	Calcium	158	70	154	152	156	138	75mg/L	A
		Chloride	50	20	50	20	50	38	200mg/L	B
		Fluoride	0.15	0.15	0.9	0.15	0.8	0.43	1.2mg/L	B
		Sulfate	11	2	12	10	9	8.8	200mg/L	B
		Magnesium	16	35	14	18	17	20	50mg/L	B
		Salinity	5.0	0.0	5.0	2.0	0.0	2.4	-	-
		DO	3.4	3.0	3.55	3.93	3.04	3.384	5mg/L	B
		pH	8.4	7.65	7.57	7.85	8.9	8.074	6.6-8.5	B
S U R O K	P r i v a t e P u m p W e l l	Calcium	188	140	182	198	204	182.4	75mg/L	A
		Chloride	50	40	40	30	60	44	200mg/L	B
		Fluoride	0.8	0.9	0.9	0.5	0.7	0.76	1.2mg/L	B
		Sulfate	14	14	15	9	12	12.8	200mg/L	B
		Magnesium	14	23	18	11	17	16.6	50mg/L	B
		Salinity	3.0	0.0	0.0	3.0	0.0	1.2	-	-
		DO	3.3	3.3	3.80	3.88	3.9	3.636	5mg/L	B
	pH	7.71	7.86	7.56	7.82	8.3	7.85	6.6-8.5	B	
	P u b l i c P u m p W e l l	Calcium	192	176	144	184	192	177.6	75mg/L	A
		Chloride	90	40	40	50	10	46	200mg/L	B
		Fluoride	0.3	0.9	0.5	0.5	0.8	0.6	1.2mg/L	B
		Sulfate	42	16	16	9	42	25	200mg/L	B
		Magnesium	36	29	25	21	22	26.6	50mg/L	B
		Salinity	5.0	0.0	0.0	3.0	0.0	1.6	-	-
DO		3.0	3.1	3.50	3.88	3.7	3.436	5mg/L	B	
pH	7.67	7.60	7.54	7.8	8.2	7.762	6.6-8.5	B		
G u i u a n M u n i c i p a l W a t e r S y s t e m	Calcium	256	243	278	246	224	249.4	75mg/L	A	
	Chloride	80	10	30	30	10	32	200mg/L	B	
	Fluoride	0.12	0.8	0.5	0.8	0.15	0.474	1.2mg/L	B	
	Sulfate	2	4	12	10	4	6.4	200mg/L	B	
	Magnesium	18	13	7	14	14	13.2	50mg/L	B	
	Salinity	4.0	3.0	8.0	2.0	3.0	4.0	-	-	
	DO	3.6	3.3	3.5	3.30	3.6	3.46	5mg/L	B	
	pH	7.6	7.84	7.78	5.30	3.6	6.424	6.6-8.5	B	

### 3.3 Differences in the Physico-chemical Characteristics of Water from Private Pump Wells, Public Pump Wells, and the Municipal Water System within Barangays in Guiuan, Eastern Samar along the Identified Parameters

In the comparison made among water samples from private pump wells and the municipal water system within Barangays of Guiuan, Eastern Samar, there were three parameters that showed significant difference: 1) turbidity ( $p=0.025$ ), 2) calcium ( $p=0.016$ ), and 3) sulfate (0.000). Likewise, in the comparison made among water samples from public pump wells and the municipal water system within Barangays of Guiuan, Eastern Samar, three of the identified parameters had differed significantly: 1) turbidity ( $p=0.018$ ), 2) calcium ( $p=0.002$ ), and 3) sulfate ( $p=0.011$ ).

### 3.4 Differences in the Physico-chemical Characteristics of Water from Private Pump Wells, Public Pump Wells, and the Municipal Water System between selected Barangays in Guiuan, Eastern Samar along the Identified Parameters

Among the identified parameters, there were three chemical characteristics that differed significantly; 1) calcium ( $p=0.001$ ), 2) magnesium ( $p=0.0245$ ), and 3) pH ( $p=0.001$ )

## 4. Conclusion

The private and public pump wells of barangays Lupok, Salug, and Surok contain substances that contribute to water hardness like calcium and magnesium. Likewise, the municipal water system has very high calcium content. The physico- chemical characteristics of water from private pump wells, public pump wells, and the municipal

water system within Barangays in Guiuan, Eastern Samar differ significantly in terms turbidity, calcium, and sulfate. The physico-chemical characteristics of water from private pump wells, public pump wells, and municipal water system between selected barangays differ significantly along parameters such as calcium, magnesium, and pH.

## 5. References

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