

PHYSICOCHEMICAL AND MICROBIAL ANALYSIS OF DEEP WELL WATER IN BARANGAY MABALBALINO, SAN CARLOS CITY PANGASINAN

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Abstract: Private well water supplies can pose a risk to health unless they are properly protected and maintained. This study focuses on the physicochemical and microbial analysis of deep well water in Barangay Mabalbalino, San Carlos City, Pangasinan. Organoleptic testing determined the physical characteristic of water samples in terms of odor, color, and taste respectively. In physicochemical analysis, parameters were delimited to Total Dissolved Solids (TDS), Salinity, Potential of Hydrogen (pH) and Nitrate. Based on the results, the TDS of four water samples failed to pass the permissible limit set by the Philippines National Standard for Drinking Water 2017 (PSNDW 2017). For salinity, there is no specific reference value used, pH and Nitrate both passed the permissible limit. In microbial analysis, since all water samples are untreated there is no specific reference value for Total Coliform and Heterotrophic Plate Count. For Thermotolerant Coliform, only area three passed the permissible limit set by the PSNDW 2017, while one, two and four failed to pass the permissible limit. Deep well water in Mabalbalino, San Carlos City is allowed for drinking but in terms of water quality in accordance with PNSDW 2017, deep well water is not potable for drinking. Deep well water should be tested every year for physicochemical and monthly for microbiological.

Keywords: Physicochemical (TDS, Salinity, pH and Nitrates), Microbial (Total Coliform, Heterotrophic Plate Count and Thermotolerant Coliform), Deep Well

I. Introduction

“Clean, safe and adequate freshwater is vital to the survival of all living organisms and the smooth functioning of ecosystems, communities and economies. Declining water quality has become a global issue of concern as human populations grow, industrial and agricultural activities expand, and

climate change threatens to cause major alterations to the hydrological cycle. Water quality issues are complex and diverse, and are deserving of urgent global attention and action.” (UN-Water, 2011). Water may be undesirable due to the existence of toxins or suspended solids. Particularly in deep well waters, the absence of basic sanitation as well as the incapability to appropriately handle waste water has immediate and alarming health concern. Scientists once thought that pathogens could not reach drinking water well sunk into deep, protected groundwater aquifers. Nevertheless, over the past decade, researchers have identified diarrhea-causing viruses at a handful of deep bedrock sites in the U.S. and Europe.

Waterborne diseases include dysentery, cholera, typhoid fever and a wide range of other parasitic infections. These diseases kill more than a million people each year, many of them are children in developing countries. The decline of water diseases and development of safe water resources is one of the primary public health goals in developing countries. In the Philippines, microbiological and physico-chemical quality of deep well water in four barangays in the public Elementary Schools of Bayambang, Pangasinan during the month of September, 2013 physical characteristics of the water samples were determined. It employed the use of standard laboratory procedures to analyze the water quality parameters and the results compared with the Philippine National Standards for Drinking Water (PNSDW, 2007).

Based on the data gathered by Rural Health Unit III in San Carlos City, Pangasinan, waterborne disease cases for the year 2017 in Brgy. Mabalbalino has a total of 23 where male has the highest case compared to female ranging from age less than 1 to 59. The study is undertaken to determine the physical characteristics of the water samples as to color, odor and taste (Organoleptic test), to analyze the physicochemical qualities in terms of total dissolved solids (TDS), salinity, pH (Potential Hydrogen) and Nitrate and to assess the microbiological quality in terms of total coliform, thermo tolerant coliform and heterotrophic plate count and quality of deep well water, and its relation to the safety of the deep well water used by the residents. Alos, this study will help the adopted barangay in the prevention of water borne diseases and give the residents specifically in Mabalbalino, San Carlos City Pangasinan safe replacement for their drinking water since there is limited and scheduled time for water delivery limiting their water supply.

The main objective of the study is to determine the quality of deep well water in Barangay Mabalbalino, Pangasinan. Specifically, the study aims to determine the physical characteristics of the water samples as to color, odor and taste, to analyze physicochemical quality in terms of salinity, pH, total suspended solids, nitrates and pesticides residues, to analyse microbial quality in terms of total bacterial counts, total coliform, fecal coliform, and to assess if the water quality of deep well is potable for drinking.

II. Method

A. Duration and Location of the Study

The water samples were taken from Mabalbalino, San Carlos City, Pangasinan. Samples were transferred and tested at Dagupan City Water District. The estimated duration of the study was accomplished from January until June of 2018.

B. Materials

This study made use of experimental research. It was used to distinguish the potability of deep well water and associate this with the presence of waterborne diseases acquired by the residents of Brgy. Mabalbalino, San Carlos City, Pangasinan. It also identified the physical characteristics, physicochemical and microbiological characteristics of well water by submitting water samples for water analysis to the Dagupan City Water District Laboratory.

The data gathering tool that has been used is the conduct of unstructured interview to each household by using some questions about what are their main water sources and if there were cases in their family about waterborne diseases and their knowledge about it. Another data gathering tool is the collection of water samples. The researchers have submitted water samples at the Water District for testing. The study identified the physical characteristics such as color, odor and taste of the water samples. In addition, the data include the microbial properties of the water such as total coliform, Thermotolerant coliform (E.coli), and heterotrophic plate count plate count. The researchers made use of four samples because there were plenty of deep wells in the barangay. The researchers made use of fish bowl method to determine from which households the four water samples had been obtained for water analysis. An equal number of households were chosen from the different areas of the barangay to take part of the study. Also, the final result of the study was given to the barangay captain and the dissemination of information will be at their own preference.

The collected samples were tested for physicochemical and microbial analysis of water at the Water District. After gathering the results, the compiled data were analyzed using proportions considering undetected values, within acceptable range and exceeding acceptable range in relation to the source of water for the total dissolved solids, salinity, pH and Nitrate and microbial for the total coliform count, thermotolerant coliform and the heterotrophic plate count separately. Analysis of the proportions exceeding acceptable range utilized the binomial test both for the total and fecal coliform count. The correlational statistical test using paired t-test was used to determine the significant differences of the physicochemical and microbial properties of water samples and data gathered from Barangay Mabalbalino, San Carlos City, Pangasinan.

C. Procedure

The researchers asked permission from the barangay captain to conduct the study and assistance during the water sampling in Barangay Mabalbalino, San Carlos City, Pangasinan through the Virgen Milagrosa University Foundation Research Planning and Development Center. Once the

request was approved, the researchers sent the letter of permission to the barangay captain to do water sampling from selected households through area mapping in the whole barangay. The researchers asked permission to the RHU of Mabalbalino San Carlos City if they can obtain some data about the waterborne disease cases in the barangay. The gathered data were compared with the data collected from the respondents. Once the letter was approved the researchers consumed three days for data collection, for the first and second day the researchers conducted a house to house unstructured interview to each household in the barangay by asking some questions about their main source of water, if there are some cases of waterborne diseases and their knowledge about waterborne diseases. For the third day, the researchers had done water sampling from the 4 areas in the whole barangay from each area, six to eight water samples had been collected from selected households and mixed into one sample as a representative per area.

Another tool that has been used to gather the data in this study is the steps in water sampling. The researchers have done cleaning the tap, sterilizing the tap, flushing the tap, open the sterilized sampling bottle, fill the bottle, cap the bottle, labeling, and storing the bottle. After the water sample collection, the researchers sent the samples to the Dagupan City Water District for testing. For microbial analysis, the following procedures were done:

1. Collected bottles' mouths were sterilized by alcohol lamp sterilization for about 10 to 15 seconds, the same with the respective serological pipette.
2. Water aspiration was done using automatic pipette and transferred to its respective tube for bacterial isolation.
3. This procedure was done with all the 4 samples.
4. Inoculation was also done out of the 4 samples using an inoculating loop. Sterilization of the inoculating loop was done also by using an alcohol lamp. Also, for physicochemical analysis the following procedures were done through nitrate concentration determination by spectrophotometric analysis in which 5 ml samples of each 4 tube were aspirated, nitrate powder reagent was added with each tube, 4 samples were mixed until there were no visible suspended solids and the tubes were allowed to cool for a couple minutes and were measured spectrophotometrically.

Gathered data from the study site were tested for physicochemical and microbial analysis of water at the Water District. After gathering the results, the compiled data will be analyzed using proportions considering undetected values, within acceptable range and exceeding acceptable range in relation to the source of water for the total dissolved solids, salinity, pH and Nitrate and microbial for the total coliform count, thermotolerant coliform and the heterotrophic plate count separately. Analysis of the proportions exceeding acceptable range utilized the binomial test both for the total and fecal coliform count.

The correlational statistical test and paired t-test were used to determine the significant differences of the physicochemical and microbial properties of water samples and data gathered from Barangay Mabalbalino, San Carlos City, Pangasinan.

III. Results and Discussion

Results of Organoleptic Testing, Physicochemical Analysis and Microbial Analysis

The Organoleptic Testing will be conducted during the water collection and the Physicochemical and Bacteriological Analysis will be conducted in Dagupan City Water District Laboratory at New Administrative Building, Tambac District, Dagupan City, Pangasinan.

A. Organoleptic Testing

Table 1

Parameter	AREA 1 RESULT	AREA 2 RESULT	AREA 3 RESULT	AREA 4 RESULT
Color	Whitish Cloudy	Slightly Brownish	Whitish Cloudy	Whitish Cloudy
Odor	Rusty	Strong Rusty	Slightly Rusty	Rusty
Taste	Slightly Fishy	Fishy	Fishy	Fishy

Table 1 presents the results obtain from the Organoleptic Testing of the water samples that had been collected from the four areas in Barangay Mabalbalino, San Carlos City, Pangasinan. Based on the result, all of the water samples were in whitish cloudy appearance except for Area two (Sitio Kundilat) which in slightly brownish appearance. In addition, in terms of odor only Area two exhibited a strong rusty odor. Lastly in terms of taste only Area four (Sitio Gulisan and Southern part of Sitio Centro) gave a strong fishy taste while the rest are in fishy odor. According to the Philippine National Standard for Drinking Water 2017 (PNSDW 2017) "the maximum allowable level for these parameters should be no objectionable odor, taste and 10CU for the color"

B. Physicochemical analysis

Table 2

PARAMETER	PERMISSIBLE LIMIT	METHOD	AREA 1 RESULT	AREA 2 RESULT	AREA 3 RESULT	AREA 4 RESULT

				UL T	T	T
TDS	600 mg/L	Conductimetry	1270 mg/L	676m g/L	808 mg/L	985 mg/L
SALINITY	-	Conductimetry	1.2 g/L	0.6 g/L	0.9 g/L	0.9 g/L
Ph	6.5-8.5	pH Meter	7.58	7.62	7.23	7.38

NITRATE	50 mg/L	Photometry	<0.5 mg/L	1.0 mg/L	0.3 mg/L	<0.06 mg/L
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Table 2 presents the results obtained from the physicochemical analysis of the water samples that were collected from the four areas in Barangay Mabalbalino, San Carlos City, Pangasinan. The reference value used above is the permissible limit set by the PNSDW 2017. Based on the results, all the samples for the parameters of TDS were above the permissible limit (600 mg/L), TDS comprises inorganic salts and some small amount of organic matter that were dissolved in water, TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals were used in the water treatment process, and the nature of piping or hardware were used to convey the water. A high concentration of TDS is usually not a health hazard. In fact, many people buy mineral water, which has naturally elevated dissolved solids. High concentration of dissolved solids can produce hard water, which leaves deposits and films on fixtures, and on the inside of hot water pipes and boilers. Hard water causes water filters to ear out sooner, because of the amount of minerals in the water. Salinity which is the total salt present in the water has no specific reference value, potability of the water depends upon the salt tolerance. pH which was (6.5-8.5) passed the standards value for safe drinking water. Nitrate was also included in the parameter, Nitrate in groundwater originates primarily from fertilizers, septic system, and manure storage or spreading operations, the nitrate level are elevated in all samples compared with the permissible limit (50 mg/L) set by the PNSDW 2017. According to (BHFD, 2002), "Elevated nitrate levels may suggest the possible presence of other contaminants such as disease causing organism, pesticides, or other inorganic and organic compounds that could cause health problems."

C. Microbial analysis

Table 3

	Result of Analysis	REMARKS
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Area	Total Coliform (MPN/100ml)	Thermotolerant Coliform (MPN/100ml)	Heterotrophic Plate Count (CFU/ml.)	
1	-	>8.0	-	FAILED
2	-	>8.0	-	FAILED
3	-	<1.1	-	PASSED
4	-	>8.0	-	FAILED

The Microbial Testing of the water samples that were collected from the four areas in Barangay Mabalbalino, San Carlos, City Pangasinan show that all the water samples subjected for microbial analysis are all untreated, there is no specific reference value for Total coliform and Heterotrophic plate count (HPC). Total coliform includes the bacteria that are found in the soil, in water that will be influenced by surface water, and in human or animals waste on the other hand Heterotrophic plate count is method that measures colony formation on culture media of heterotrophic bacteria in drinking water, Since there is no specific reference value for total coliform and heterotrophic plate count, the only basis for the remarks given for microbial analysis is the thermotolerant coliform, which have a reference value of <1.1, in the four sample that were tested. Area one (Sitio Doña Maria), Area two (Sitio Kundilat) and Area four (Sitio Gulisan and Southern part of Sitio Centro) failed to pass the Standards set by the Philippine National Standards for Drinking Water 2017 (PNSDW 2017) through Standard Methods for the Examination of Water and Wastewater with the thermotolerant value of >8.0. Whereas, out of the four samples only Area 3 (Sitio Coranga and northern part of Sitio Centro) passed the Standards set by the (PNSDW 2017) through Standard Methods for the Examination of Water and Wastewater with the normal value of <1.1. The presence of E coli is used as an indicator to monitor the possible presence of other more harmful microbes, such as Cryptosporidium, Giardia, Shigella, and norovirus. Some possible sources of fecal contamination include: agricultural runoff, wildlife that uses the water as their natural habitat, runoff from areas contaminated with pet manure, wastewater treatment plants, and on-site septic systems. Heavy precipitation may cause these organisms to be washed into creeks, rivers, streams, lakes or groundwater. If this water will be used as a source of drinking water and will not be treated, or is inadequately treated, it may result in illness. Diseases acquired from contact with contaminated water can cause gastrointestinal illness, skin, ear, respiratory, eye, neurological, and wound infections. The most commonly reported symptoms are stomach cramps, diarrhea, nausea, vomiting and low-grade fever.

IV. Conclusion and Recommendations

A. Conclusion

According to the results, generally deep well waters should be colorless, odorless and tasteless. Based on the samples that had been submitted and tested for the parameters of Total Dissolve Solids (TDS), Salinity, pH and Nitrate, all the four samples passed the permissible limits set by the Philippine National Standards for Drinking Water except for TDS. Only Area 3 passed in terms of Thermotolerant Coliform, further the remaining three areas failed to pass the standards set by the Philippine National Standard for Drinking Water as per Standard Methods for the Examination of Water and Wastewater. In consideration to the laboratory results obtained, deep well water in Mabalbalino, San Carlos City is allowed for drinking but in terms of water quality in accordance with PNSDW 2017, deep well water is not potable for drinking.

B. Recommendations

The study has proven that the Rural Sanitary Division should have regular maintenance of deep well pump, deep well water from Barangay should be monthly tested for microbial analysis, there should be a seminar or symposium about the Water Quality Assessment for the residences of the said barangay. Also, every three years, additional testing is recommended for pH and Total Dissolved Solids as well as tests related to the land uses occurring or expected to occur within the sight of well. In addition, the College of Medical Laboratory Science to conduct a seminar regarding on the enhancement of Water Sanitation and proper hygiene to the community and conduct further validate finding related to this research to have more comprehensive study using other sources of design and must assess a deeper perspective information of what has been found on this study. Lastly, the researchers further recommend for the future researcher an Assessment on Waterborne disease in Brgy. Mabalbalino San Carlos City, Pangasinan.

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