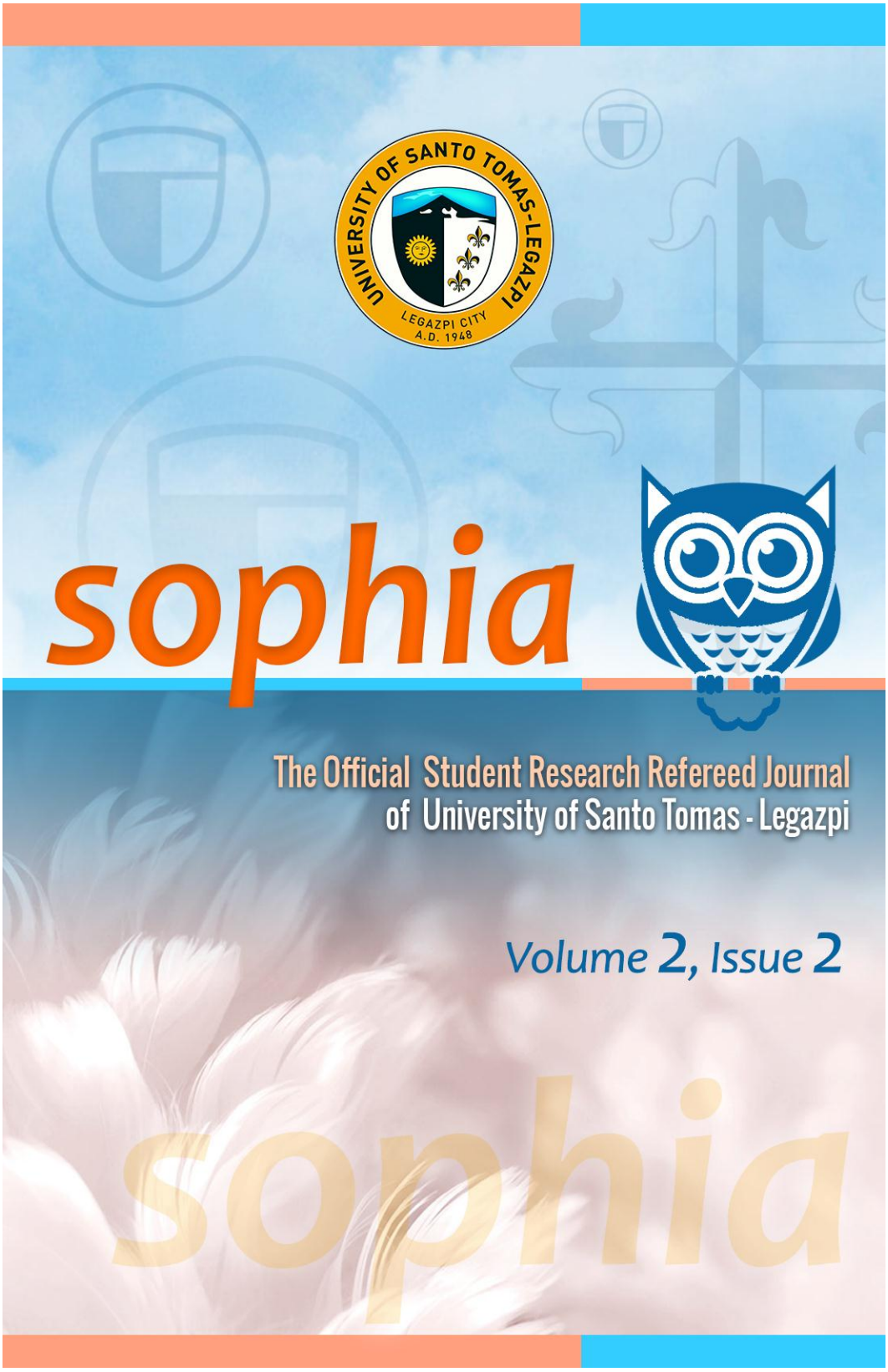
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TABLE OF CONTENTS

Real Time Humidity, Temperature and Water Level Monitoring Website with Time Access Manipulation and Data Accumulation

Justin Roman B. Amargo, Fratz C. Antigua, April Joy B. Cabredo

College of Engineering Architecture and Fine Arts, University of Santo Tomas-Legazpi

ABSTRACT

Flooding has always been one of the main problems in the Philippines which in turn brings risk to the inhabitants and the structures in the area. Monitoring the water level, humidity and temperature contributes in preventing casualties in the environment. The immediate objective of this study was to develop a system that would monitor the humidity and the temperature of the environment, and the water level of the river in real time which can be viewed online through a website accessible by the public and would also reach the people through SMS notification. Rational Unified Process was applied in developing the prototype model to achieve the different phases of this project. The Swim Lane Diagram was used to specify how the data would flow in the system and the Architectural Design on how the hardware passes the data within the system and would showcase it on the website. Through this study, the researchers also perceived that the website needs to be improved and to further study the predicted data for increasing the chance of its success rate.

INTRODUCTION

"Water is the driving force of all nature" — *Leonardo da Vinci*

With two thirds of the earth's surface covered by water and the human body consisting of 75% of it, it is evidently clear that water is one of the prime elements responsible for life on earth. People can survive for more than three weeks without food. Example is Mahatma Gandhi who survived 21 days of complete starvation — but water is a different story. At least 60% of the adult body is made of water and every living cell in the body needs water to keep functioning. Water circulates through the land just as it does through the human body, transporting, dissolving, organic matter and replenishing nutrients, while carrying away waste material. Further in the body, water regulates the activities of fluids, tissues, cells, lymph, blood and glandular secretions.

Water is really important when it comes to the people's survival but at the same time dangerous, especially when nature is involved. The fear of nature people experience before is different to what people experience today. Human activities are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down rainforests and farming livestock. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.

These activities cause changes in the amounts of greenhouse gases, aerosols and cloudiness in the Earth's atmosphere, contributing to climate change. Burning of fossil fuels, which is the largest known contributor to climate change releases carbon dioxide gas to the atmosphere while

greenhouse gases and aerosols alter incoming solar radiation and outgoing infrared radiation, thereby affecting the Earth's energy balance. Warming or cooling of the climate system may result when the atmospheric abundance or properties of these gases and particles were changed. The human impact on climate change during the industrial era greatly surpassed the overall effect of human activities on climate since the start of the industrial era (about 1750) due to known changes in natural processes, such as solar changes and volcanic eruptions.

The rising global sea level is one major threat from climate change because the rising seas will threaten wildlife and wipe out infrastructures. Sea water intrusion will also contaminate sources required for drinking water and agriculture if ocean water moves deeper into landmasses. Expansion of seawater and melting of ice over land can also result from warning climate. With respect to climate change, sea levels can rise by two different mechanisms.

First, as the increasing global temperature warms the oceans, the seawater expands, takes up more space in the ocean basin and causes a rise in water level. Second is the melting of ice over land which adds water to the ocean.

The Earth's temperature begins with the sunlight that enters the atmosphere. Bright surfaces such as clouds and ice reflects about 30% of sunlight back into space, the land and ocean absorb most of the remaining 70% , and the rest that is absorbed by the atmosphere heats the planet.

As the land, air and ocean warm, they radiate heat energy in the form of infrared radiation, which travels into the atmosphere where much is absorbed by water vapor and long-lived greenhouse gases such as methane and carbon-dioxide. As these atmospheric gas molecules absorbed infrared rays, they become warm and continue to release heat that radiate in all directions. The heating that the lower atmosphere and the surface of the earth get from direct sunlight is enhanced by this energy that the atmospheric water and greenhouse gas molecules radiates back toward the Earth. This absorption and radiation of heat by the atmosphere is the natural greenhouse effect that warms the Earth into the comfortable 15ºC temperature that it is today. If there were no greenhouse effect, the Earth's average surface temperature could be very cold, -18ºC, which will not be able to support life.

The presence of water in the air relative to the amount of water that the air can hold is called "relative humidity", which expresses the abundance of water vapor in the atmosphere. As the atmosphere becomes warm, it becomes capable of absorbing and holding more water and the air drops unless more water is added.

In climate modelling, scientists have assumed that the atmosphere has a constant relative humidity regardless of how the climate changes. They assumed that the constancy of the percentage of water in the air is maintained because even if the air is able to hold more water as the temperature increases, proportionally more water vapor will evaporate from the ocean surface and carry through the atmosphere. A great increase in the Earth's temperature due to increased carbon dioxide is predicted by climate change models that assumed constancy in future relative humidity than models that allows changes in relative humidity. This is because extra water, which increases that heating is placed in the equation of the constant-relative-humidity assumptions.

Real time is a level of computer responsiveness that a user senses as sufficiently immediate or that enables the computer to keep up with some external process (for example, to present

visualizations of the weather as it constantly changes). Real-time is an adjective pertaining to computers or processes that operate in real time. Real time describes a human rather than a machine sense of time. Websites and blogs are becoming an integral part of people's brand and business. People live in an information and knowledge economy that values finding information in an increasingly web world.

Keeping records and monitoring activities help people see progress and builds a sense of achievement. Records can be useful and even essential when promoting the group or applying for funding.

Monitoring also has significance for the wider field of conservation. Ecosystem monitoring is not a fully developed science, so any work undertaken by your group has the potential to contribute to the refinement of measures of ecosystem health.

Monitoring the water level, humidity and temperature contributes in preventing casualties in the environment. Its purpose is to notify the people in the environment to what is the current water level and the temperature throughout the day. With the sudden rainfall during the wet season in the country rising water levels alongside rivers is expected and more often than not, cause flooding to the people who live nearby a river. Flooding, is one of the major problems in the Philippines.

Barangays which are closer to the riverbanks are unaware of the water level which could result to a delayed evacuation. After establishing the area where the study was conducted, three practical questions arose: How will the system able to forecast the water level in the next minute? How will the system deal with the time basis with the data gathered? How will the system contribute alertness to the people who lived near the river bank?

The study aimed to develop a real time website that monitors the water level of the designated river and the relative humidity and temperature of the environment. The following are the specific objectives:

To apply the simple linear regression algorithm of the previous 5 inputs of the current data to forecast the water level in the next minutes.

To add a time control feature that manipulates the time interval of Water level humidity and temperature data.

To send SMS notifications to the people who are subscribed to the database.

Having stated the focus and the objective of the research, forecasting and measuring the water level can also be ways of detecting threatening events in the near future. This will enable the public to be warned sooner than later so that actions can be taken to reduce the adverse effects of the event. Due to timeframe and resources of this study, the research has set a path that will be a guide in developing the project. The study focused on developing a real time website that would monitor the data gathered by the sensors from time to time and can be accessed on all gadgets that have internet browsers. Real Time Humidity, Temperature and Water Level Monitoring will be built using MySql, PHP language, Arduino IDE for programming the microcontroller and the sensors. Ultrasonic Sensor HC-SR04 which measures a maximum distance of 13 feet and DHT22 Sensor for measuring the temperature and humidity of the surrounding. The microcontroller and the sensors act as the tool in order to get the input that the researchers desired from the destined location of the study. The hardware prototype was built supported by a pipe within the sensors reach and to support and act as a stand to let the sensor face the water. The website which is built by PHP was designed by a template using Bootstrap and Materialize due to the

timeframe of the study and which also utilized from the Google Chart a type of Google API for the graph that was used to display the data in real time. Database was built using MYSQL that fundamentally processes the incoming and outgoing validated data from the data acquisition board through a console file which acts as our base station. The data output has a minimum of 30 seconds interval. The time control feature is only available at the Admin Page interpretation of the graph that can be viewed inside the "Learn More" modal and also has a ready-to-print record of all the data in tabular form which can also be filtered by date and by minutes. The website is responsive and online for the viewers. The web admin page is for the administrator which in is accredited to the researchers of the Department of Science and Technology (DOST) for the update and maintenance of the database and the microcontrollers. The system however cannot monitor a river flowing with large debris and mud that could harm the prototype, and the components within. The system will depend on its stand and could not accommodate when there is too much interference in the background. The system cannot control the things that could mess with the line of sight of the sensor like rocks, papers and etc. The hardware cannot function without WiFi which serves as a communication between the microcontrollers to the server. The SMS notification of the system depends on the process of the Semaphore API because of the traffic that will occur upon the request of the server to the API. The real time graph process has a minimum interval of 30 seconds for the data to be accumulated through the microcontroller and the server. The project aimed to benefit the following: The researcher of Department of Science and Technology (DOST) that is able to monitor the small rivers here in Legazpi City and contributes to the safety of the environment. The engineers who are planning to build and do floor mapping will have a smooth time in evaluating the area near the river. Residents will feel safe as the barangay will subscribe for SMS emergency notification for the alert to minimize the casualties in the upcoming flood. The study will serve as a basis of information for future undertaking.

METHODS

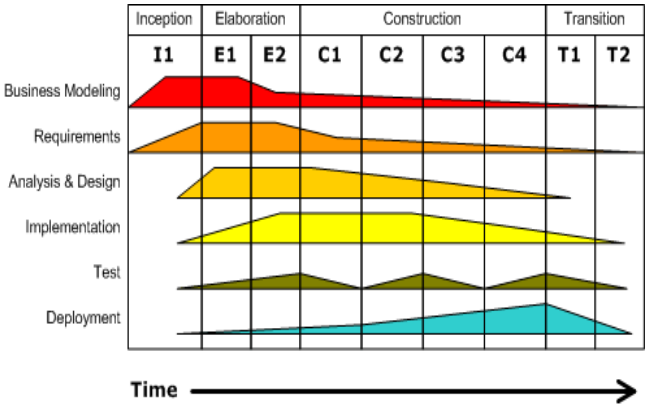

Figure 1. Rational Unified Process (RUP)

The methodology employed in preparation and development of this application is the Rational Unified Process or RUP Methodology in Figure 1, for its formal definition of scope and major project milestones are associated with specific timeline. It provides a disciplined approach of assigning tasks and responsibilities within a developed organization and expresses a model detailed plan on how to create, develop and eventually implement to obtain its functionality. Although some of the models do not explicitly say how the program has developed, but they presented phases that are important in the completion of the study. Some methods work better for specific types of projects but in the final analysis the most important factor for the success of a project

may be how closely a particular plan was followed.

As part of the methodology, the research also set a vision to let the people know that the Bicol Coastal Areas and the environments temperature are monitored to be aware and to ensure safety from coastal flooding among the residents of Legazpi City. To accomplish the vision the research has set using the RUP methodology; the project underwent different kinds of phases:

First phase is the *Inception phase* where the system requirement was determined and documented. To ensure this, the research has initially considered a responsive Real time Website development that monitors the environment through the help of the microcontroller. Microcontroller has been used in thousands of different projects and applications. The Microcontroller software is easy-to-use for beginners, yet flexible enough for advanced users, and runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove Chemistry and physics principles, or to get started with programming and robotics especially for environmental monitoring. With this, the research used microcontroller sensors to develop the project. Environmental monitoring is defined as the processes and activities including characterizing and monitoring the quality of the environment. It is used in the preparation of environmental impact assessments, and in some cases involves human activities carrying a risk of harmful effects on the natural environment. All strategies and monitoring programs have valid reason and are often designed in a way to establish the current status of an environment and to establish trends in environmental parameters. In relation to the system requirements, software and hardware requirements were also identified.

Tables 1.1 and 1.2 show the minimum and the recommended hardware and software requirements for the project to work. Since 2014, Windows XP has not received any support from the Microsoft that is why the research opted to use Windows 7 Operating System for fast and support purposes. The research included the microcontroller hardware requirement for it is used a tool in determining the input of the system.

The second phase is the *Elaboration Phase* wherein analysis and design were given focus. The research was able to determine the problem and objectives by focusing on a venue for the research to gather information and lend service to promote its advocacies. The research chose Yawa River as a venue of this study and asked the Department of Science and Technology for assistance because of its innovation and advocacies. In addition, the research was able to identify what the system can be done and cannot be done. Swimlane Diagram (see Appendix 1) was used to define each and the various process including the client and the server side of the system, in relation to the entities. The Real Time Humidity, Temperature and Water Level Monitoring

Table 1.1 Recommended Hardware Requirements

Hardware	• 1.5 gigahertz (GHZ) or faster 32-bit(x86) or 64 bit(x64) processor. • 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM(64-bit) • DirectX 9 graphics device with WDDM 1.0 or higher driver. • DHT22 • Ultrasonic Sensor HC-SR04 • NodeMCU with ESP12 Board • Breadboard • Jumper Wires • 5V Power Source

website has only 2 users identified: the viewers and the admin. The server side can only be accessed by the admin which contains the records of the data. The admin page can only be accessed through a static IP provided by the server. There is no registration form for the users since the website are only for viewing data. The viewers can subscribe for the SMS notifications to keep them notified. All of the data that are present in the system were stored in the database. The database consists of 3 tables found in (Appendix 2): tbl_admin (Appendix 2.1), tbl_user (Appendix 2.2) and tbl_data (Appendix 2.3). The site is managed by an Admin and will be responsible for the update and maintenance of the site. The Admins information is stored on tbl_admin and must contain the following information: admin_id,admin_username, admin_password, admin_email and admin_contact. Users can also subscribe on the site so that the admin can alert the people when the water level reached a critical level. User information is stored on tbl_user which contains the following: user_id, user_name and user_contact. The values recorded by the sensor are recorded in tbl_data which contains: ID, chan_id, data_name, data_desc, data_created, entry_id, data_temp, data_hum, data_distance. The Swimlane diagram in Appendix 1 shows the process on how the system runs. Once the system is deployed it shows that the data acquisition board will send instructions to the sensors to be assigned with specific tasks. Iin this case, the research programmed the sensor to measure the height of the water level, its temperature and humidity and sends it back to the board for the validation of the data collected. The console file, programmed in C#, will receive the validated data by listening to the serial port and sends the data to the database. After the data is saved on the database the server will then request data on the database to be used for the graph. The system may have some spike issues of some interference of the sensor, but the admin can verify that spiked data with the duration of the water level that can be seen on the real time graph or at the records that are kept on the admin page. The research decided to use Google Chart API which is an interactive Web Service that creates graphical charts from the user-supplied data. Using PHP the API will draw a graph according to the data in the database. When the sensors detect 2 emergency points, the caution level or the critical level it would alert the admin by sending emergency notifications on the admin page and the admin to double check and to validate the data then requests for SMS gateway Api from Sephamore. Using PHP code, Semaphore can send SMS notification to the numbers and according to the locale of the viewers that are registered in the database. The viewers can leave their numbers on the site which is optional if the viewers want to subscribe for sms notifications when the water reaches the emergency point. Unlike the admin the users can't control the time interval for the output of the data on the graph. The admin is basically responsible for the monitoring of all outgoing and incoming information. The admin is the only one that can login on the page with the static IP and of course the only one that can access the Admin Page. All the information that can be seen in the website is managed by the admin as well as the confidential information such as phone numbers.

Simple Linear Regression Algorithm

Simple linear regression is a statistical method that allows the research to summarize and study relationships between two continuous (quantitative) variables. In this case, the time and the water level is used as a basis. Because the other terms are used less frequently today, the research used the

"predictor" and "response" terms to refer to the variables encountered in this course. The other terms are mentioned only to make the viewers aware of them. Simple linear regression gets its adjective "simple," because it concerns the study of only one predictor variable. The research used this method in order to forecast the water level in minute and to view the data in statistical method in predicting the correlation of the variables.

The next phase is the Construction phase. As soon as the problem, objectives and the system requirement had been recognized, the developers developed an initial and preliminary model of the application. Testing the prototype was also conducted in the construction phase. After developing the initial prototype, it is implemented on a certain viewer. Then identifying of review of the prototype followed. This step determined if the system requirements are met. Website will still be functional unless there will be some changes on the update of the database which depends on the admin. The project tends to include monthly system evaluation and will serve as the error-defect- checking stage to achieve the functionality of the process of the data and the hardware to avoid conflict from time to time.

The last phase of the methodology is the Transition Phase. In here, the final website is being implemented and deployed online and on a certain venue. In this case the venue of the study is Yawa River. The research need to have a structured programmers documentation for both software and hardware for the future system analyst.

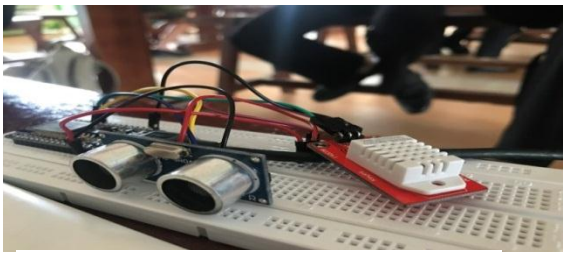

Figure 2. Internal Hardware

RESULTS AND DISCUSSION

Part of the method used in the development of this website is to gather data but since there are no other existing data of the Yawa River, the research used a dummy data as a part of the discussion. The researchers approached the Department of Science and Technology Region V, DOST V and Philippine Atmospheric, Geophysical and Astronomical Services Administration V (PAGASA) as our primary and secondary research center to gather data but since there are no existing data of rivers in Legazpi City. The researchers were advised to do it on their own.

In Figure 1, the hardware materials are assembled on a breadboard. The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet. It operation is not affected by sunlight while the DHT22, its temperature measuring range is from -40 to +125 degrees Celsius with +-0.5 degrees accuracy.

Through the convergence of smartphones and internet these things made life easier with almost all parts that are needed for work and defy effort to manually do the job on the run. After developing the study it responded to the three presented questions in the introduction. First significant question was, how will the system able to forecast the water level in the next minute. The research used the simple linear regression algorithm to determine the forecasted data in the next minutes. Getting the data although is not that accurate but this algorithm helped a lot of viewers and research departments to keep in mind that the

level of the water may increase. Below is the algorithm of the simple linear regression made by *Richard Thome* and the the algorithm is manifested in the system in order to forecast the water level.

"Slope= (NΣXY - (ΣX)(ΣY)) / (NΣX2 - (ΣX)2)
Where,
x and y are the variables.
b = The slope of the regression line
a = The intercept point of the regression line and the y axis.
N = Number of values or elements
X = First Score
Y = Second Score
ΣXY = Sum of the product of first and Second Scores
ΣX = Sum of First Scores
ΣY = Sum of Second Scores
ΣX2 = Sum of square First Scores"

Pseudo Code of Simple Linear Regression

Step 1: The research determines what is the x and what is y in this case x = time and y = water level.
Step 2: Get the n where n = count number of points up to 5
Step 3: Ensure both arrays of points are the same size.
Step 4: Calculate the sums of array X and array Y
Step 5: Calculate the Slope
(NΣXY - (ΣX)(ΣY)) / (NΣX2 - (ΣX)2)
Step 6: Calculate the Intercept
y = x(slope) + intercept
Step 7: Return the result

The pseudo code above is applied in the system in order to get the forecasted data in upcoming minutes. Part of the code is shown below:

```
$n     = count($x);
$x_sum = array_sum($x);
$y_sum = array_sum($y);
```

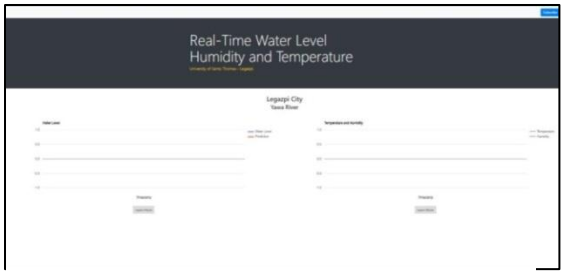

Figure 3. Main Website of the system

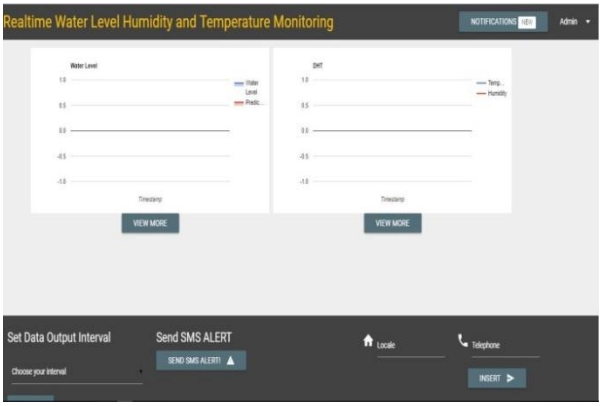

Figure 4. Admin Page of the system

The first part of the code sums up the array x and array y.

```
$xx_sum = 0;
$xy_sum = 0;

for($i = 0; $i < $n; $i++) {
   $xy_sum += ( $x[$i]*$y[$i] );
   $xx_sum += ( $x[$i]*$x[$i] ); }
```

The second part of the code gets the product of the summation of x and y in the array

```
// Slope
If (( ( $n * $xx_sum ) - ($x_sum * $x_sum) )
!= 0)

$slope = ( ( $n * $xy_sum ) - ($x_sum *
$y_sum) ) / ( ( $n * $xx_sum ) - ( $x_sum *
$x_sum ) );
else $slope = 0;
```

Third part of the code is to calculate for the slope where slope = (NΣXY - (ΣX)(ΣY)) / (NΣX2 - (ΣX)2)

if($n>0)
*$intercept = ($y_sum - ($slope * $x_sum)) / $n;*
else $intercept = 0;

Lastly the research calculated the intercept so it could apply the formula y = mx + b

The output of the data is placed on a separate graph form to determine the level of the water in the next 5 minutes. The code was then connected at the water level graph as a red line. The main page is shown in Figure 2 to showcase the data on the graphs.

The research developed a website for the viewers and admin to record the data of the water level and humidity and temperature of the surrounding environment at current time. The webpage in Figure 3 is to be managed by the admin which is the DOST and to be used as one of their monitoring facilities. The second question answered was, how will the system deal with the time basis with the data gathered. This was made possible by developing a centralized content management system using MYSQL for all the data handling. As the research tested the system on gathering the data within the day, the research could filter the time in intervals (refer to figure 4) and to make the records easy to browse and for research purposes on the admin side.

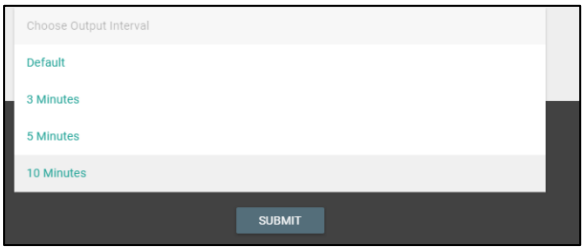

Figure 5. Time interval at Admin webpage

With this, the research was able to articulate the results. This website has a great potential in providing the constituents of Legazpi about humidity and temperature of the environment as well as the water level where the instrument is installed. It may serve as real time basis to consider the safety and security of the place. As shown in Figure 5, the website also has its own current and updated records of the data which can be printed for immediate use.

The records can be filtered according to the date or time that the data have been gathered. The system has an up to date information of the data upon accessing the website and is capable of generating statistical data which can forecast data in upcoming minutes and answered the last question from above which is how the system contribute alertness to the people who lived near the riverbank. The system has 2 cautionary levels programmed in it, the 50% as alert 1 indicates reminder level while the 70% as alert 2 indicates critical level. As soon as the water reached those levels it will send an alert on the Admin page that can be seen in the notifications tab, refer to figure 6.

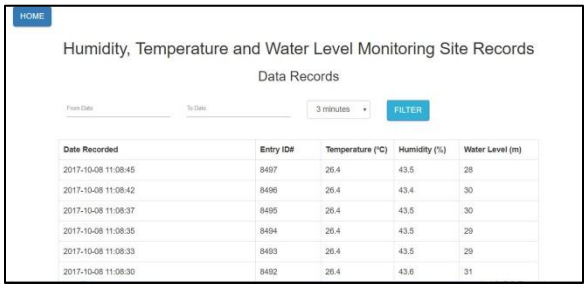

Figure 6. Screenshot of the Records

The admin can validate the data by rechecking it at the records page. If the admin sees that the data is stable and it's on those levels the admin can then click the Send SMS button. As seen in figure 7, the format of the message is hardcoded within the system and is sent to the API called Semaphore, an SMS gateway.

The SMS notification can contribute safety and giving time for people to be updated to what is happening on the level of the river.

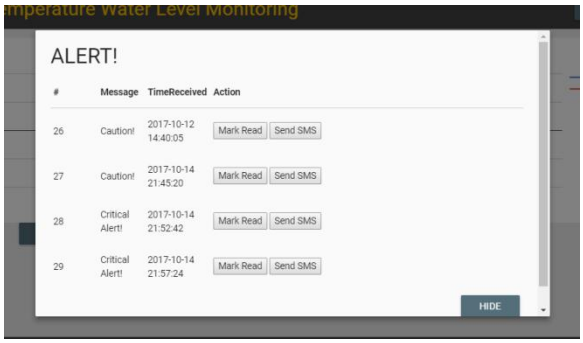

Figure 7. Notifications Tab on Admin Page

With this it notifies the people nearby the riverbank to prepare. The system is the first project that monitors the river within Legazpi City. The research concluded that the system can accurately measure humidity and temperature of the surroundings and can measure the water level up to 3 feet, although the forecasted data is only 55% accurate since the system has no past records of the river which it can use as a basis for the algorithm.

Through this study, the research also perceived that the website needs to be improved and to further study the predicted

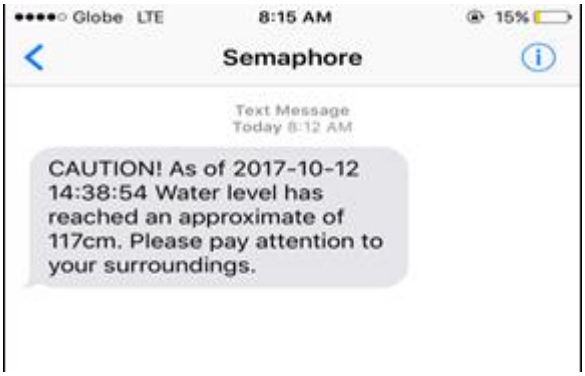

Figure 8. Sample SMS alert from the system

data for increasing the chance of its success rate. Given the nature of changing technology and upcoming innovations, future researchers can consider the possibility of using this system as their basis for further research and upgrading into a more detailed measurement and to gather the past data to improve the prediction success rate. It is also recommended to the future researchers to explore and achieve further research in getting the regression to a higher chance of success and to explore the possibility of the change of weather, the current of the water and its components as a basis of the study. Based on the research's analysis through data gathered, the website provides efficient and accurate venue for monitoring the environment. It also caters to promote that Legazpi area is one of the environment

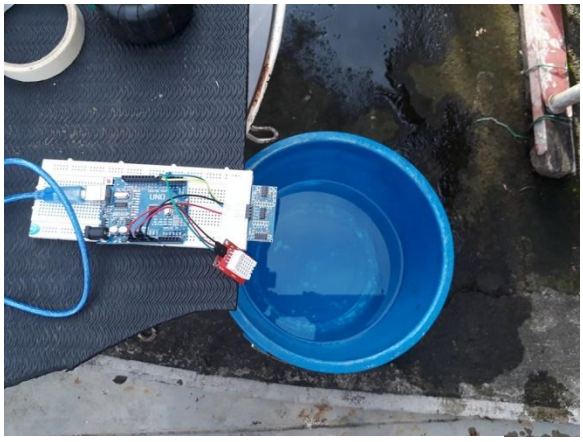

Figure 10. Screenshot of the Hardware testing on a bucket of water

cautious cities in the Philippines. The results of the system indicated that human intervention in some cases such as managing the system is highly required.

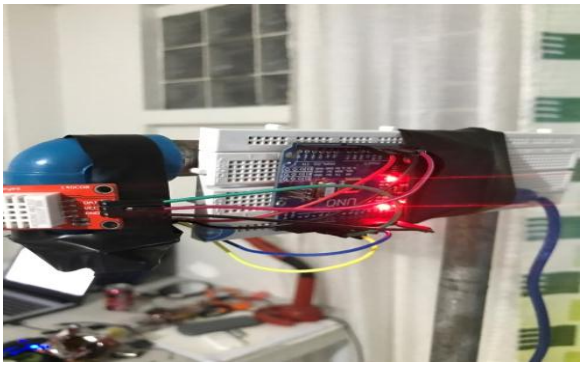

Figure 9. Assembled Prototype of the Hardware

Therefore, there should be a knowledgeable administrator that will monitor and maintain the system. Figure 6, shows the hardware assembled; the researchers assembled the prototype attached to a 55 inch pipe which would allow the sensor to face downwards to measure the distance from the ground. The sensor is programmed to determine the alert level within the 55cm or 140cm. The Real Time Humidity, Temperature and Water Level Monitoring Website is a system which the people can view online on the website and get the data of the river's water level, the humidity and temperature of the environment for immediate use also to contribute security to the city by sending SMS notifications which is validated by the admin. The system is all about monitoring the environment with the help of the microcontroller and its sensors. It will be helpful to people who are tasked to monitor the environment with lesser effort. In Figure 7, the sensor and the microcontroller are tested on a bucket of water as a presentation of the system.

Recommendation

Future study should be conducted to reduce the inaccuracy of the prediction algorithm. Future research should also improve the data storage capability of the system. The system only caters to the sending of SMS notification to the public but lacks provision to handle interrupted connections.

Definition of Terms

Data Accumulation – the process of accumulating data placed in microcontroller by the sensors for calibration.

Humidity and Temperature – the humidity and temperature of the surroundings where the DHT22 sensor is placed.

Monitoring - observe and check the progress or quality of (something) over a period of time; keep under systematic review

Real Time - relating to a system in which input data is processed within minutes so that it is available virtually immediately as feedback.

.

Time Access Manipulation – The time that is manipulated to affix the system time and the sensors process time.

Water Level – the measurement on how deep the water is and the distance of the sensor to the water.

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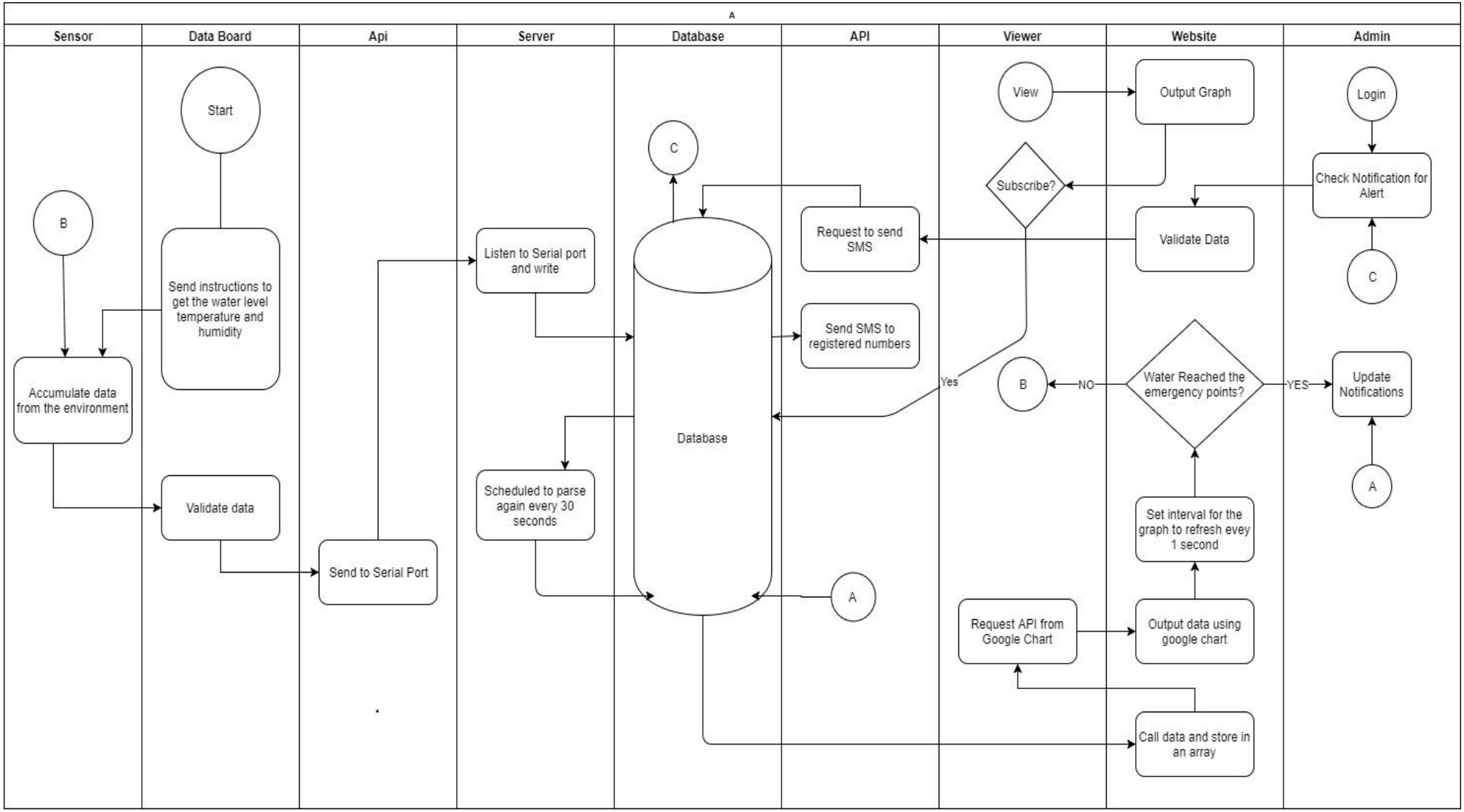
APPENDIX 1

Real time Humidity, Temperature and Water Level Monitoring Website Swim Lane Diagram



APPENDIX 2
Database table

Appendix 2.1 Tables

Column Name	Description
tbl_admin	Database table where all the information about the Admins are stored. Contains the username of the admin, password, email and contact number.
tbl_user	Database table that contains the information of the residents for water level updates.
tbl_data	Database table that contains the temperature and other information about temperature recorded by the sensor.

Appendix 2.1 shows the database dictionary for all the tables used in the study

Appendix 2.2 tbl_admin table

Column Name	Description
admin_id	Id number of the admin in the database of the system, serves as the primary key of the table.
admin_username	Username created by the admin and stored in the database.
admin_password	Password created by the Admin
admin_email	Email address of the user, serves as one of the important details of the admin to contact them.
admin_contact	Contact Number of the Admin

Appendix 2.2 shows the database for the admin as well as the information needed.

Appendix 2.3 tbl_user

Column Name	Description
user_id	Id number of the user in the database of the system, serves as the primary key of the table.
user_name	Name of the user.
user_contact	Contact number of the user or where the sms notification will be sent in case of emergency.

Appendix 2.3 shows the database for the users/viewers.

Appendix 2.4 tbl_data

Column Name	**Description**
ID	Id number for the records of the sensor, serves as the primary key of the table.
chan_id	Auto incremented ID of the Values
data_name	General name of the project.
data_desc	Sensors that where used in the project.
data_created	Time and date when the values are recorded.
entry_id	The entry id that the sensors gathered.
data_temp	Temperature value recorded by the DHT22 Sensor.
data_hum	Humidity value recorded by the DHT22 Sensor.
data_distance	Height of Water Level recorded by the Ultrasonic Sensor.

Appendix 2.4 shows the database for the data recorded by the sensors.

APPENDIX 3

USER
MANUAL

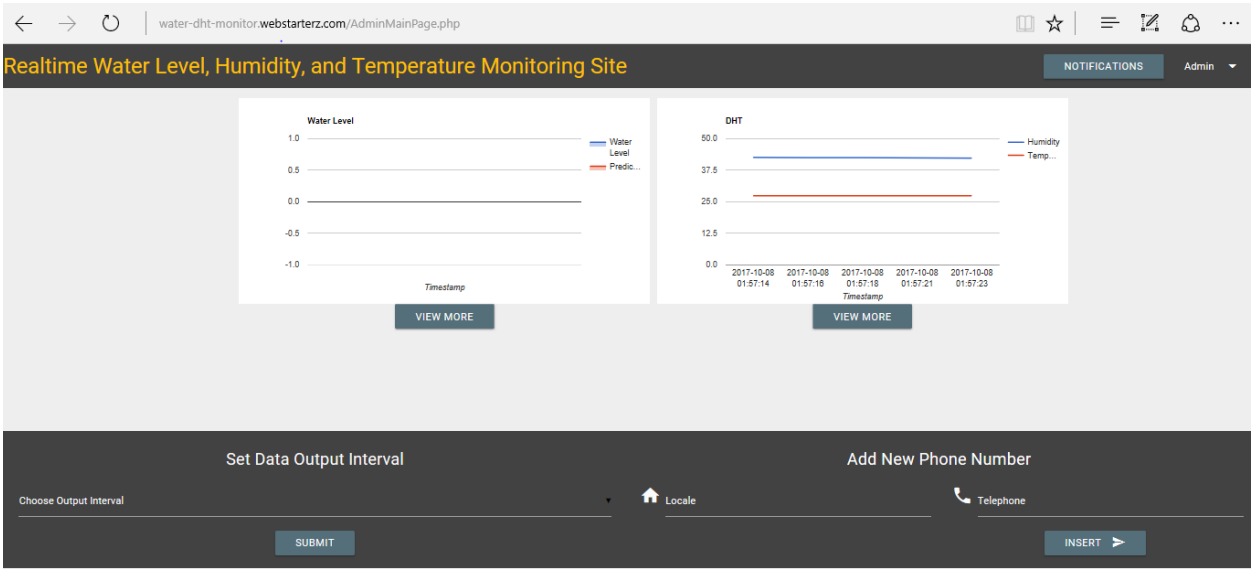


Figure 11. Admin Main Page of the System

A. Administrator (DOST)

a. Overview

The DOST department is the main administrator of the page. Their duty is to control the data in the database as well as manage the security of the phone numbers of the viewers.

b. Roles

The administrator's role in the system includes the ff.

Set the Interval between the data.
Send SMS Message.
Register New Phone Numbers.
Show and Filter Database Records.

c. Instructions

Set Interval between the data.

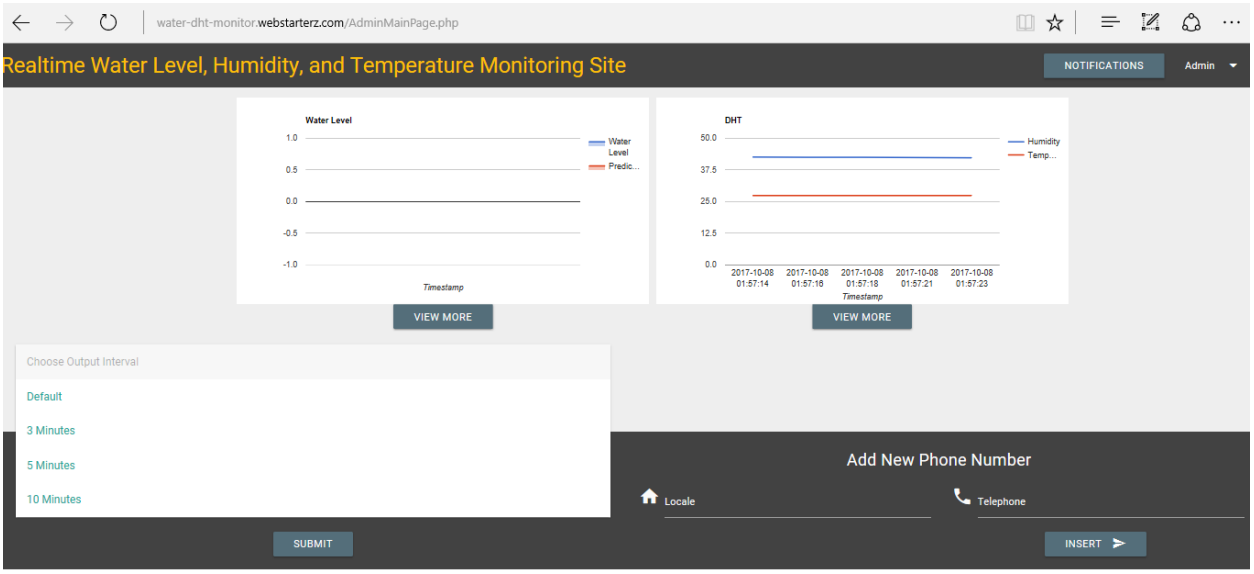


Figure 12. List of Time Intervals

The admin can control the interval of the data.

1. Click the value you want in the combo box. It can be 3 minutes, 5 minutes, 10 minutes or the default time interval allocated by the sensors.

2. Click Submit button.

Send SMS Message

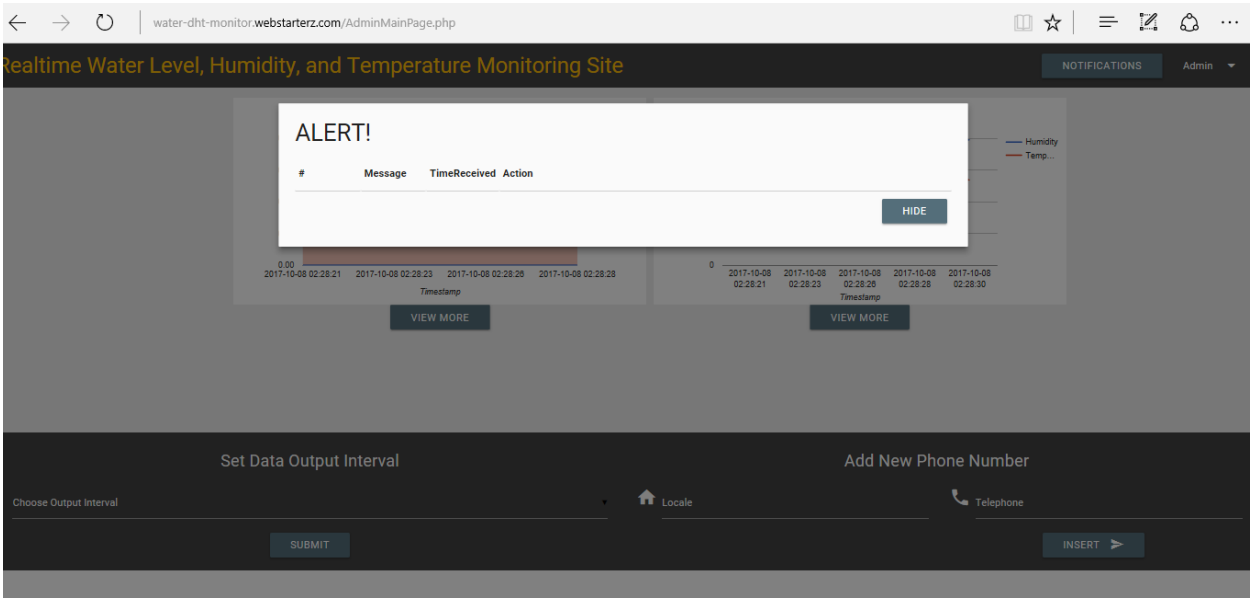


Figure 13. Notification Tab

When the admin has validated that the water has reached the emergency point. It can send message to the phone numbers that are registered to the database to warn them about the rising of water level.

1. Check if there is a new notification.

2. Click Notification. (A modal will appear.)

3. If data is already validated Click Send SMS to send messages.

4. Click Mark as Read to delete the notification.

R

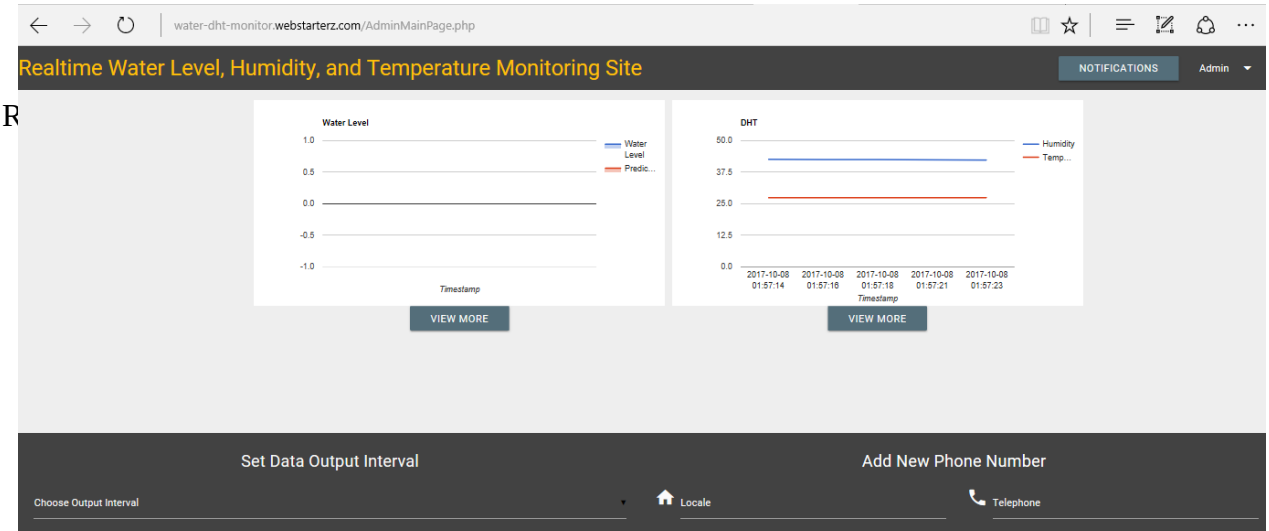


Figure 14: Phone Number Subscription

1. Type the place where the resident lives in the Locale input field.

2. Enter phone number of the residents. Phone Numbers must consist of 11 numbers and must start with 09.

3. Click the Insert button.

Show and Filter Database Record

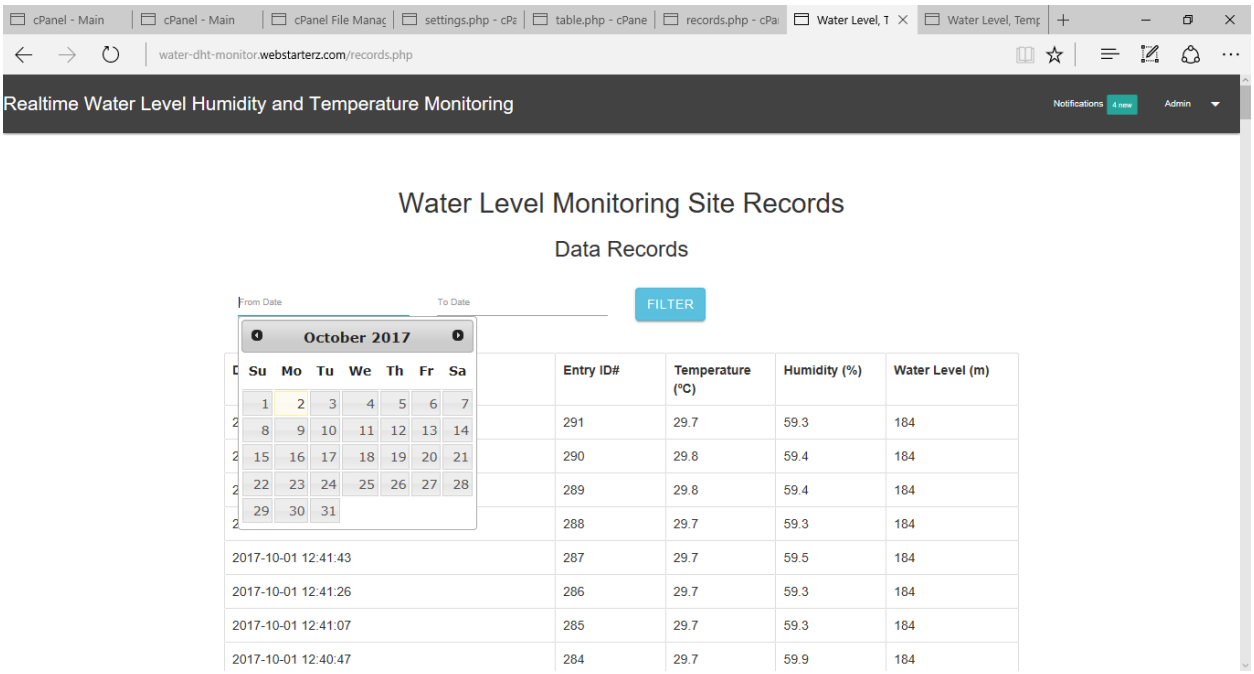


Figure 15. Records of Water Level, Humidity and Temperature

1. Click Admin in the Main Page. (A drop down menu will appear.)

2. Click Records.

3. Click From Date Textbox and a drop down calendar will appear. Choose the minimum date range you want.

4. Click To Date Textbox and a drop down calendar will appear. Choose the maximum date range you want.

5. Click Filter. This will show all the data that are included on the date range you specify.

Design Of Water Distribution System of the Proposed Resettlement Site At Mayong, Tiwi, Albay

Bragais, Rose Elise M., Callos, Kirzteen Camille Q. ,De Ontoy, Cheyser M.

College of Engineering, Architecture and Fine Arts, University of Santo Tomas-Legazpi

ABSTRACT

This study entitled "Design of Water Distribution System of the Proposed Resettlement Site at Mayong, Tiwi, Albay," is an attempt of the researchers who are civil engineering students to design a Water Distribution System that will deliver water, with appropriate quality, quantity and pressure, to residents of the Resettlement Site .After the conducted assessment for a possible water sources in the area, the research found out that there were four (4) sources. Source A which is just inside the area of the resettlement site, Source B where located higher in elevation from Source A, Dapdap Spring is located about 3 kilometers from Barangay Mayong, and Mayong River which were about 20 meters from than the Resettlement Site. Upon primary assessment for Source A, the researchers themselves with APSEMO-APHSO can state that the first source cannot be a possible main water source for the resettlement site due to its small amount of output. For Source B, this is located at the peak of the mountain which is near the site. This study concludes that the possible main source of supply for the water distribution system in the relocation site would be Source B. The common effective method of the location of Source B is gravity fed system. Pressure of water would flow directly downward to each connection of the houses. Gravity fed system must prefer the system in this area because of the availability of the source and its location from the mountain. There was no use of pump in this system because of the inclined slope which determined how fast and easy the water flows. Also, zoning scheme was designed to conserve water in the area. There were valves installed in the water distribution system in order to deliver the needed demand of water. The goal of this design was to maintain good service and supply sufficient water in the resettlement site.

KEYWORDS: water supply, resettlement site, design, water distribution

INTRODUCTION

Philippines is an archipelagic nation located in southeast region of Asia, which according to AQUASTAT, has a land area of about 30 million hectares which based on latest data registers 36.47% as the %age of Total Cultivated Area and had a per capita income of USD2,900. According to the National Economic Development Authority (2015) agriculture industry provides 30% of the employment and 10% of the Gross Domestic Product (GDP) based on the 2015 Census of Population (POPCEN 2015). The nation had reached a total population of 100,981,437 as of August 1, 2015. This latest census shown an increase of 8,643,585 persons compared with the 2010 Census of Population and Housing (CPH) count of 92,337,852. From this data, annual inflation rates have been steadily decreasing from 2.3% from 1990-2000, 1.9% from 2000-2010 and current 1.7% from 2010-2015.

Albay is a province of the Philippines that lies at the southern tip of Luzon Island and about 550 kilometers from Manila. It is approximately 13 to 13.5 degrees north latitude and 123.25 to 124.25 degrees east longitude. It were bounded by Lagonoy Gulf and the province of Camarines Sur in the northwest, the

Pacific Ocean in the east, the province of Sorsogon in the south, and the Burias Pass in the southeast. Albay has a total land area of 2,554.06 square kilometers (986.13 square miles) politically subdivided into 3 cities and 15 municipalities. Albay had a total population of 1,187,185 persons as of August 1, 2007, higher by 96,278 persons than the population count of 1,090,907 persons as of May 1, 2000. This increase translated to an annual population growth rate of 1.17% during the period 2000 to 2007.

The Province of Albay is generally mountainous with scattered fertile plains and valleys. Aside from Mayon Volcano, the Province of Albay has two major peaks Mount Malinao and Mount Masaraga. The western coast of the province is mountainous but not as prominent as the eastern range with the highest elevation at around 490 meters (1,610ft.). Among these mountains are Mount Catburawan in Ligao and Mount Pantao in Oas & Libon. In Albay, agriculture is the major industry which produces crops like coconut, rice, sugar, and abacá. Handicrafts are the major source of rural income. It continues to provide fairly large share in the small-scale industries of the province. Forestry, cement production and paper-making are other sources of livelihood. The manufactured abacá products like Manila hemp, hats, bags, mats, and slippers is one of the main sources of income in the rural areas. Fishing is the main livelihood along shores of the province. Tourism is a sunshine industry and the Provincial Government's current major focus. The weather is generally fair throughout the year with moderate rain showers during the second half of the year. From March to July, the people of the province experience a relatively warm and sunny season. In the past until the 80's, the Province of Albay used to experience .

The focus of this study is to developed an adequate water source and designed an efficient water distribution system that would be able to supply the water demand needs of the proposed resettlement site at Mayong, Tiwi, Albay. This study aimed to: 1) provide an abundant and good quality water system to the resettles at Mayong, Tiwi, Albay;

2) determine the most efficient and reliable water distribution system that would promote and improved the quality of living of the people at the resettlement area; and 3) design an efficient and suitable water distribution system to address the water needs of the resettlement area at the said site.

In designing an efficient water system for the resettlement area, the study focused on three aspects: a) source of supply; b) water demand; and water distribution. The resettlement project was divided into two (2) phases, Phase I and Phase II; Phase II to begin only after Phase I has been completed. Currently, only Phase I has a site development plan but both Phase I and Phase II were designed to have a common source of water.

This study focuses on a designed water supply and distribution system for Phase I.

Phase I comprises 2.1 hectares of the whole project which according to the proposed site development plan includes 141 lots and center for social services, such as barangay hall, school, rural health center and community park with a basketball facility. The potential modal lots size of 80 square meters will be constructed as combination of single-detached, duplex and row-houses. For the determination of Phase I water demand, the study would account for water demand created by Phase I based on the following: the proposed site development plan of the project; the design of the houses specifically to the total number of water facilities, and the projected

occupants of the entire resettlement area based target beneficiaries and conducted surveys for the project; and the emergency and social services that will be needing water. For the aspect of Phase I water distribution, the study focuses on the designed water distribution network that would be able to supply water to all residential houses, emergency services, rural health center, school and community park with basketball facility that were included in the site development plan of Phase I of the proposed resettlement area at Mayong, Tiwi, Albay.

The research aimed to achieve a design of a primary water supply system that would be able to provide adequate and sufficient water for the residents of the proposed resettlement area at Mayong, Tiwi, Albay for the purposes of drinking, cooking, washing, cleaning and for carrying away waste. This study would be beneficial to the following: residents of the resettlement area, Barangay Mayong, Tiwi, Albay, Emergency Services, Other Neighbouring Barangays, Municipal Local Government Unit of Tiwi (MLGU-Tiwi), PLGU-Albay, APHSO, and the researchers and future researchers.

The residents of the resettlement area are the primary beneficiaries of the water supply system. The WSS will help encourage residents to permanently relocate from their previous homes that are located at risk zones. This would also help them in their activities of daily living (ADLs) and help promote quality living conditions. Investments in infrastructure would help in the development of the barangay and MLGU-Tiwi. This would also open opportunities for other sources of income. Emergency Services, which include the Rural Health Unit (RHU) and Bureau of Fire Protection (BFP), would be aided in performing their services. For the RHU, providing a clean source of water would lessen the incidence of gastro-intestinal problems like diarrhoea and cholera. The BFP will ask a source of water in case of fire and other emergencies. Also, the need for the BFP to distribute clean water to the residents of areas without access to water would be lessened. Designing a proximate water distribution system would be provided other neighboring barangays access to a closer source of clean water so that they would be able to obtain water more frequently. With the project being over sighted by APHSO under the PLGU-Albay, the success of the project would be greatly beneficial to all the agencies involved in resettlement area and would be dependent on the ability of the site to fulfill the needs that the project were originally constructed for. If the resettlement area was able to accommodate good living conditions, like providing a WSS with clean and reliable water, and would be able to encourage residents to permanently leave their homes at risk zones then project would be successful. This study would serve as a guide for future researchers whose studies may be similar or related to this topic. And lastly, the researchers who made this study and those who would help to contribute to its success would be known and would be able to apply their skills and knowledge in creating a positive impact on the success and development of all the people and institutions involved.

According to NEDA(2015), recent natural disaster resulted in damages to crops and livestock and caused severe losses in agricultural production including human lives. A report released by Benfield(2017), described how global natural disasters in 2016 caused (see Appendix A) USD210 billion in economic losses which showed a 21 % increase compared to the 16-year average (see Appendix B)

of USD174 billion. The report attributed most of the 2016 economic losses (see Appendix B) to flooding, earthquake, severe weather, and tropical cyclone events and cited that four events were responsible for 85% of all global natural disaster losses for 2016. The article also discussed possible factors that drive the losses, one of which the article discussed that since 1980, global population has risen at a compounded average growth rate of 1.4% to 7.4 billion. Another statistic given emphasis were about how urbanized population has grown by 0.9 % each year to 53.9%. The article cited that according to the United Nations (UN) urbanized population growth is anticipated to grow to 66% by 2050 and suggested that by 2020, approximately half of the world's total population will live within 100 kilometers of an ocean coastline.

According to the article released by Benfield(2017), a total of 26 named storms developed in the Western North Pacific, 13 of which became typhoons. These are equal to the 36 year average recorded (see Appendix E). 11 of the 13 typhoons reached Category 3 (or higher) strength. Eight (8) typhoons made landfall and six (6) of the typhoons were Category 3 or higher in intensity at the time of landfall. According to the article the strongest typhoon of the season was September's Super Typhoon Meranti which attained Category 5 strength with sustained wind speeds of 305 kph. Meranti was one of four typhoons to reach Category 5 intensity in the basin in 2016 which was the strongest typhoon in the Western North Pacific since 2013's Super Typhoon Haiyan and was the strongest tropical cyclone to develop anywhere across the globe in 2016.

An article published by EcoWatch named typhoons Haiyan, Thelma, Ike, Fengshen, Washi, Durian, Bopha, Trix, Amy and Nina as the top 10 deadliest typhoons in the Philippines since 1947. All these ten typhoons have occurred since 2006 which displaced thousands of residents and caused more than 1,000 casualties. Typhoon Haiyan, locally known as Typhoon Yolanda was responsible for 6,300 casualties, more than four (4) million displaced citizens and two (2) billion USD in damages in 2013. According to an article in the Washington Post (Plumer, 2013), the Philippines has become one of the most affected by climate change and cited the following reasons: 1) Philippine's vulnerability due to and not exclusively to deforestation, coastal population increase and poor road accessibility; 2) Philippines was affected by other natural disasters (see Appendix F); 3) Adaptations help but are not enough; and 4) Funding for adaptations. And according to the Global Climate Risk Index (2015), Philippines ranked fifth (see Appendix G) in the most affected countries in the period of 1994-2013, which was preceded by Honduras, Myanmar, Haiti and Nicaragua as first, second, third and fourth places respectively.

The Philippine Constitution states that "it is the policy of the State to protect and advance the right of the Filipino people to a balanced and healthful ecology in accord with the rhythm and harmony of nature." In accordance to the mandate of the Philippine Constitution, the World Bank cited that the government has approved six (6) laws that explicitly addresses effects climate change: 1) Agriculture and Fisheries Modernization Act (1997), which directs the Department of Agriculture and other appropriate agencies to take into account climate change, weather disturbances, and annual productivity cycles in order to forecast and formulate appropriate agricultural and fisheries programs; 2) the Philippine Clear Air Act (1999), which instructs the Department of Environment and Natural Resources, concerned agencies,

and local government units (LGUs) to prepare and implement national plans in accordance with the United Nations Framework Convention on Climate Change (UNFCCC); 3) the Ecological Solid Waste Management Act (2000), which similarly instructs the DENR, concerned agencies, and LGUs to prepare and implement solid waste management plans; 4) the Philippine Clean Water Act (2004), which aims to reduce water pollution through better management of sewerage and sanitation, industrial effluent, and agricultural, industrial, and residential waste; 5) the Biofuels Act (2006), which pursues energy self-sufficiency and 6)the Renewable Energy Bill (2008), which encourages the use of renewable energy.

The enactment of Republic Act No. 10121 also known as the Philippine Disaster Risk Reduction and Management Act of 2010 repealed Presidential Decree No. 1566 and replaced the National Disaster Coordinating Council (NDCC) with the National Disaster Risk Reduction and Management Council (NDRRMC) as the focal body (Rey 2015). According to the article published by the World Bank, the four-pronged NDCC, currently NDRMCC, framework for Disaster Risk Management identifies four agencies to take the lead with respect to the following: 1) preparedness-the Department of Interior and Local Government (DILG); 2) response-the Department of Social Welfare and Development; 3) rehabilitation-the Department of Public Works and Highways (DPWH); and 4) mitigation-the Department Environment and Natural Resources (DENR).

Espinas(2013) published an article that shows the new paradigm for disaster risk management adopted by the Albay province (see Appendix H). According to the article, with the paradigm, the following guiding principles were adopted to work towards reaching the goal of a safe development: 1) to promote a proactive and not a reactive response to disasters; 2) to evacuate at the early stage of the calamity instead of to rescue affected families; 3) to promote an institutional rather than personal orientation, 4) to promote coordination and team-work and not individual action; 5) to conduct community-based disaster risk reduction programs and projects as basic input to the Regional Master Plan; 6) to adopt a disaster proofing approach to development; and 7) to integrate DRR in the Comprehensive Land Use Plan and promote no or selective investment in high risk zone, maximum protection in the low to moderate risk zone, and to identify safe zones as sites for new development investments. According to the published article by Espinas (2013), with shift to disaster risk management, Albay established the permanent disaster management office called the Albay Provincial Safety and Emergency Office (APSEMO). Other newly created program offices were the Centre for Initiatives and Research on Climate Adaptation (CIRCA), the Albay Millennium Development Goals Office (ADMGO) and the most recent Albay Provincial Human Settlements Office (APHSO) which were created to reinforce the capability of the provincial government. According to the interview by Edgar Alejo with Cedric Daep, head of APSEMO, Daep said that “The local government units, non-government and private sector, which will be tapped by APHSO to help, will prioritize those areas which have ready relocation sites that could be procured,”.

According to Thomas (2015), between 2008 and 2013, rapid-onset natural hazards such as floods and typhoons displaced an average of 27 million people per year. In the face of more frequent and intense weather events due to climate change, combined with rapid population growth in many urban and coastal

areas, several government units were contemplating measures for moving at-risk populations out of harm's way. As noted in the Fifth Assessment Report of the Inter-governmental Panel on Climate Change, however, adaptation strategies that seek to reduce exposure to climate change through the resettlement of communities carry risks, including the disruption of livelihoods, displacement, and loss of cultural practices. The current and anticipated effects of climate change vary in scale, frequency, intensity, and rates of acceleration. Thus, determining when to relocate at-risk populations in order to protect public safety and mitigate displacement would vary from context to context. In some instances, governments may undertake relocation and resettlement programs as an anticipatory measure. However, the large-scale devastation and displacement that disasters leave in their wake, accompanied by large inflows of response and rehabilitation funds, create both an incentive and an opportunity for governments to impose example before land use restrictions, prohibit people from returning, and take measures to relocate and resettle people in an effort to "build back safer." This case study examined population relocation and resettlement as a strategy for mitigating disaster-induced displacement, drawing on experience from the resettlement program currently being implemented in the Philippines in the aftermath of Typhoon Haiyan. Although the program is ongoing, observations to date suggest that without sufficient planning and safeguards, post-disaster relocation and resettlement programs can prolong displacement and leave affected populations more, not less, vulnerable. In post-disaster contexts, far more comprehensive and innovative approaches are needed in order to avoid the negative outcomes associated with government-led relocation and resettlement.

According to United States Geological Surveys, water quality is a measure of the suitability of water for a particular use based on selected physical, chemical, and biological characteristics. Selected characteristics are then compared to numeric standards and guidelines to decide if the water is suitable for a particular use. The DENR Administrative Order No. 2016-08 also known as the Water Quality Guidelines and General Effluent Standards of 2016 which provides guidelines for the classification of bodies of water (see Appendix I); determination of time trends and evaluation of stages of deterioration/enhancement of water quality (see Appendix J); evaluation of need for taking actions in preventing, controlling or abating water pollution; and designation of water quality management areas (WQMA); and to set General Effluent Standards (GES). The guidelines were structured pursuant to Section 19e and 19f of the Republic Act 9275, otherwise known as the Philippine Clean Water Act of 2004. The Philippine Clean Water Act of 2004 has the primary objective to protect the country's water bodies from pollution from land- based sources. It provides a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectorial and participatory approach involving all the stakeholders. The scope and coverage of the guideline applies to all water bodies in the country, inland surface water, marine waters, and groundwater; and shall be used for classifying water bodies, determining time trends, evaluating stages of deterioration or enhancement in water quality, and as basis for taking positive actions in preventing,

controlling, or abating water pollution. Moreover, the guideline shall be used in designating non- attainment areas (NAA). The GES applies to all point sources of pollution discharged to all water bodies in the country. Until such time that industry-specific standards are promulgated, the GES shall be used regardless of the industry category.

The WQG were set regardless of the assimilative capacity of the body of water a to ensure that the assimilative capacities are not exceeded the WQG set forth the following important considerations: a) annual average of at least 10 data sets for primary parameter except for fecal coliform; b) annual average of at least 4 data sets for secondary parameters; c) geometric mean of at least three (3) data sets per quarter for fecal coliform. Further, maximum allowable limit for fecal coliform were twice WQG per sample; d) maximum allowable limit for secondary metals and organics parameters; and e) for water quality parameters that were naturally occurring in Philippines, the natural background concentration as determined by Environmental Management Bureau (EMB) shall prevail if concentration were higher than WQG; provided that the maximum increase is only up to 10% and that it would not cause any risk to human health and the environment.

According to Adeosun (2014), providing sufficient water of appropriate quality and quantity has been one of the most important issues in human history. Most ancient civilizations were initiated near water sources. As populations grow, the challenge to meet user demands also increases. People had begun to transport water from other locations to their communities. For example, the Romans constructed aqueducts to deliver water from distant sources to their communities. Today, a water distribution system consists of infrastructure that collects, stores, treats and distributes water between water sources and consumers. Many efforts on the development of water distribution system have been made through for sustainable water distribution.

The water distribution system's purpose is to deliver water to the consumer with quality, quantity and pressure. Distribution system was used to describe collectively the facilities used to supply from its source to the point of usage. A good distribution system requires a water quality that does not get deteriorated in the distribution pipes. It should be capable of supplying water to all the intended place with sufficient pressure head. It should be capable of supplying the requisite amount of water during fire fighting. All the distribution pipes should be preferably laid one meter away or above the sewer lines. Distribution systems are used to describe collectively the facilities used to supply water from its source to the point of usage Layouts of Distribution Network: The distribution pipes are generally laid below the road pavements, and as such their layouts generally follow the layouts of roads. There are, in general, four different types of pipe networks; any of which either singly or in combinations, can be used for a particular place. They are Grid, Ring, Radial and Dead End System. Grid Iron System it were suitable for cities with rectangular layout, where the water mains and branches were laid in rectangles (see Appendix G). The advantages are the following: 1) water was kept in good circulation due to the absence of dead ends; 2)in the cases of a breakdown in some section, water is available from some other direction. The disadvantage is exact calculation of sizes of pipes is not possible due to provision of valves on all branches.

Ring System the main supply is laid all along the peripheral roads and sub mains branch out from the mains (see Appendix G). Thus, this system also followed the grid iron system with the flow pattern similar in character to that of dead end system. So, determination of the size of pipes were easy. The advantage of Ring System is water can be supplied to any point from at least two directions. For radial system, the area is divided into different zones (see Appendix G). The water is pumped into the distribution reservoir kept in the middle of each zone and the supply pipes are laid radially ending towards the periphery.

The advantages of Radial System is that easy quick service and calculation of pipe size were easy. Dead End or Tree System were suitable for old towns and cities having no definite pattern of roads (see Appendix G). The advantages of dead end system are relatively cheap and determination of discharges and pressure easier due to less number of valves and the disadvantage is due to many dead ends, stagnation of water occurs in pipes. For efficient distribution system, adequate water pressure is required at various points: Depending upon the level of source, topography of the area and other local conditions the water might be forced into distribution system by following ways:

1) Gravity System suitable when source of supply were at sufficient height .Most reliable and economical distribution system. The water head available at the consumer were just minimum required. The remaining head is consumed in the frictional and other losses; 2) Pumping System treated water is directly pumped into the distribution main without storing. High lift pumps were required. If power supply fails, complete stoppage of water supply and Combined Gravity and Pumping System most common system. Treated water is pumped and stored in an elevated distribution reservoir then supplies the consumers by action of gravity.

According to a Toolkit prepared by SIGUS – Special Interest Group in Urban Settlement-MIT, directed by Reinhard Goethert the types of Levels of service (LOS) of water supply are as follows; 1) In House Connections; 2) Yard Tap for Single Family; 3) Yard Tap for Several Families; 4) Private Point Source; 5) Door-to-door Vending; and 6) Rainwater Harvesting. Though In-house connection is best LOS but this type of connection may encourage waste in water. A private point source, such as a well or borehole, is generally used by communities beyond the reach of piped networks. In Africa interest is grown and there are many initiatives ongoing across the continent, and institutional use had been increasing in Africa. Low rural incomes are a major obstacle for investing in household rainwater tanks. However, the increasing use of impermeable roofing materials, the establishment of community-based revolving funds and significant support from many donor agencies (e.g. UNICEF, SIDA, DANIDA, and FINIDA) have helped increase access among rural Africans.

According to Buttler et.al (2016) who published an article entitled "Water, Sanitation Program" that discussed the common characteristic of water demand in urban areas worldwide were relentless rise over many years, and projections of continuous growth over coming decades. The chief influencing factors are population growth, together with changes in lifestyle, demographic structure and the possible effects of climate change. The detailed implications of climate change is not yet clear, and anyway will depend on global location, but must at least increase the uncertainty in security of

supply. This is compounded by rapid development, creeping urbanization and, in some places, rising standards of living. Strategic planning is a key aspect of a successful demand management strategy. This means understanding the constraints, analyzing how much water is used, when, by whom, for what purpose and at what level of efficiency; determining the potential reduction in water use that can occur through improvements to water-using equipment and behavior and developing programs to achieve these improvements. ased on the article that states "Types of water demands in water supply scheme" published on 2014 by PROBCGUIDE cited designed water supply system for a town or city; it is essential to determine the detailed quantity of a water required for various purposes by the city. But there were many aspects involved in the demand of water, it is impossible to precisely figure out the actual demand. Certain empirical formula and thumb rules were used in determining the water demand, which are closest to the real demand. The following are the various types of water demands of a city or town: 1) Domestic Water Demand the amount of water necessary in the residences for drinking, bathing, cooking, washing etc were known as domestic water demand and primarily depends on the habits, social status, weather and traditions of the people. As per Indian Standard: 1172-1963, under normal conditions, the domestic consumption of water in India is about 135 liters per day per capita. But in developed countries this figure might be 325-340 liters per day per capita because of use of air coolers, air conditioners, maintenance of lawns, automatic household appliances; 2) Industrial Demand, the water needed in the industries mostly relies on the kind of industries that were established within the town. The water needed by various industries like paper mills, cloth mills, cotton mills, breweries, sugar refineries etc. comes under industrial use. About 20–25% of total water demand was normally considered as industrial water demand; 3) Institution and Commercial Demand this type of water demand includes the water requirement for the public buildings other than residences. Commercial buildings, malls, colleges, hotels, bus depots and other similar public buildings come within this category; 4) water demand for public use, volume of water necessary for public utility needs like for washing and sprinkling on roads, cleaning of sewers, watering of public parks, gardens, public fountains etc comes under public demand. Usually 5% of total water demand for city were considered for public use while designing water supply scheme. According to article of "Water and wastewater engineering" that would be discussed about 5) Fire Demand water requirement for firefighting purpose fall under this head. The volume of water necessary for firefighting is usually computed by making use of various empirical formulas. For Indian conditions Kuching's formula provides acceptable results; 6) For wastage and losses there are always losses and wastage that occurs in pipeline while water distribution. The main reasons for this are listed in the following; a) Damage pipe line and or faulty accessories like valves, fittings etc.; b) Water tabs kept open in public or residences causing water wastage; c) Due to illegal and unauthorized connections. While calculating the total amount of water of a town; allowance of 12-15% of total quantity of water was designed to make up for losses, thefts and wastage of water. The quantity of water required for

municipal uses for which the water supply scheme has to be designed requires the following data: 1) Water consumption rate *(*Per Capita Demand in liters per day per head*)*; 2) population to be served and water consumption rate, were very difficult to precisely assess the quantity of water demanded by the public, since there were many variable factors affecting water consumption. The various types of water demands, which a city may have (see Appendix O). Fire Fighting Demand, the per capita fire demand is lessen on an average basis but the rate at which the water were required is larger. The rate of fire demand is sometimes treated as a function of population.

The following were factors affecting per capita demand; a) size of the city: Per capita demand for big cities were generally large as compared to that for smaller towns as big cities have sewer houses;
b) presence of industries; c) climatic conditions; d) habits of people and their economic status; e) quality of water: If water were aesthetically medically safe, the consumption will increase as people will not resort to private wells, etc.; f) pressure in the distribution system; g) efficiency of water works administration: leaks in water mains and services; and unauthorized use of water can be kept to a minimum by surveys; and g) cost of water Policy of metering and charging method: Water tax were charged in two different ways: on the basis of meter reading and on the basis of certain fixed monthly rate.

If this average demand is supplied at all the times, it will not be sufficient to meet the fluctuations. Seasonal variation the demand peak during summer. Firebreakouts are generally more in summer with an increasing demand. So, there are seasonal variations. Daily variation depends on the activity. People draw out more water on Sundays and festival days, thus increasing demand on these days. Hourly variations are very important as they have a wide range. During active household working hours i.e. from 6-10 in the morning and 4-8 in the evening, the bulk of the daily requirement was taken. During other hours the requirement was negligible. Moreover, if a fire breaks out, a huge quantity of water is required to be supplied during short duration, necessitating the need for a maximum rate of hourly supply. So, an adequate quantity of water must be available to meet the peak demand. To meet all the fluctuations, the supply pipes, service reservoirs and distribution pipes must be properly proportioned. The water is supplied by pumping directly and the pumps and distribution system must be designed to meet the peak demand. The effect of monthly variation influences the design of storage reservoirs and the hourly variations influence the design of pumps and service reservoirs. As the population decreases, the fluctuation rate increases. This quantity should be worked out with due provision for the estimated requirements of the future. The future period for which a provision was made in the water supply scheme is known as the design period. Design period is estimated based on the following: 1) useful life of the component, considering obsolescence, wear, tear, etc.; 2) expandability aspect; 3) anticipated rate of growth of population, including industrial, commercial developments & migration-immigration; 4) available resources; and 5) performance of the system during initial period. Population forecasting methods, the various methods adopted for estimating future populations are given below. The particular method to be adopted for a particular case or for a particular city depends largely on the factors

discussed in the methods, and the selection were left to the discretion and intelligence of the designer. A) Arithmetic method; B) Geometric increase method;
C) Incremental increase method; D) Decreasing rate of growth method; F) Simple graphical method; G) Comparative graphical method; H) Ratio Method; I) Logistic curve method.

Based on the Sixth (6^{th}) guiding Principle of APSEMO, which are in accordance to new paradigm adopted by Albay province, states that "to integrate DRR in the Comprehensive Land Use Plan and promote no or selective investment in high risk zone, maximum protection in the low to moderate risk zone, and to identify safe zones as sites for new development investments", the Provincial Local Government Unit of Albay through APSEMO-APHSO started a housing resettlement project in Mayong, Tiwi, Albay.

Through the review of related literature and studies, the research was able to identify that even though Phase I of that housing resettlement site at Mayong, Tiwi, Albay already has a site development

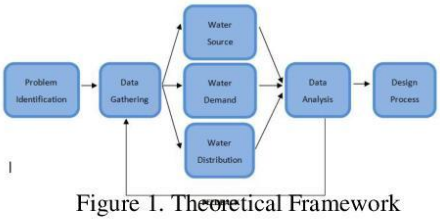


Figure 1. Theoretical Framework

In Figure 1, the research first identified the problems. The problem statements identified would serve as an anchor for data gathering that would be based on the three aspects identified namely: water source, water demand and water distribution. After this, data gathered would be consolidated and analyzed and would serve as a basis for the design of a water supply and distribution system.

METHODS

The research focused on the design of a primary water supply system for a proposed housing resettlement site at Mayong, Tiwi, Albay using a nearby natural spring as a source of water. The purpose of the research was to assess water source and evaluate the condition of the resettlement site and use the data collected as basis in the design of the water supply and distribution system.

The sources of data that the research used were both primary and secondary sources. Primary sources of data are the actual site observations, surveys and tests conducted on the site and on
the possible water sources. Other primary sources were data collected from various related agencies like APHSO, MLGU-Tiwi, PLGU-Albay, National Housing Authority (NHA), Provincial Health Office (PHO), Provincial Engineering's Office (PRO) and Department of Social Welfare and Development (DSWD). The secondary data were derived from publications and articles such as books, inquiries, interviews, journals, surveys, previous studies and reliable sources from the internet.

The research sought to identify the type and configuration of a water supply system that would be able to provide the potential needs and demands for water of the resettlement area. The research presented facilities and structures of the water supply system along with the relevant data that served as justifications for the design choices of the study. The researchers first coordinated with APHSO, which is one of the core agencies involved in the implementation of the resettlement project, along with other agencies previously enumerated that were also involved in the project. Based on the data gathered from concerning

agencies, specifically on land surveys of the site, site development plan, evaluation and testing results conducted on the water sources, statistics and interviews that was done about the potential beneficiaries of the resettlement area and standards regarding the design of a water supply system, the research designed a primary water system.

RESULTS

APSEMO-APHSO's proposed resettlement project at Mayong, Tiwi, Albay aims to relocate residents from disaster risk zones to a safer location, while providing the necessities that allow comfortable living conditions. Beforehand, it had been decided that a Level III (In-house Connection) Service has to be designed for the Water Distribution of the Resettlement Site. Aside from the LOS, one major goal of APSEMO-APHSO is to integrate environmental-friendly measures into the design in order to mitigate the effects of climate change. One major consideration is the conservation of water and power in the operation and maintenance of the design and these specific features were the basis for the design for the resettlement site.

Site investigation and research on Phase I of the resettlement site and the surrounding area aimed to gather relevant data on the actual site of Phase I and to assess the possible sources of water. After conducting site investigation, several sources were determined that can serve as possible water supply for the resettlement site. These sources are the following: (see Appendix J) Source A, Source B, Dapdap Spring and Mayong River .

Ocular inspection along with assessment of quality and quantity was conducted on Source A which was elevated approximately 35 meter above sea level. Attempts to measure the water discharge were conducted on Source A. But due to its small amount of discharge, the attempts to measure its water output, through float method with the use of an improvised channel with the use of banana trunks (see Appendix K) failed. Upon visual inspection, it was observed that the spring was being used as a watering hole for carabaos in the area which gave the water a smell that indicated contamination. A second ocular inspection was conducted and a sample was taken to be tested for physical and chemical analysis. Results confirmed that the water would need processing before it can be used for drinking.

Data collected determined that Mayong River has a watershed of 11.89 sq. km and discharge of 0.78 cu.m. per second. Records of LGU-Tiwi show that Mayong River has frequently over flown and caused flooding (see Appendix N) during the rainy season and during storms with heavy rains. A water sample was taken and submitted for physical and chemical testing. Results revealed that the water failed physical and chemical tests and also needed processing before it can be used as a water source. Maps of river systems in Tiwi and data show that water from Mayong River comes from springs located near the peak of Mt. Malinao where there are several natural springs. Assessment of Dapdap Spring shows that the minimum output to be 4.0 lps and water samples indicated that water from Dapdap spring will require some processing before

Aside from the assessment of water sources, determination of water demand is essential in the design. In this study, a 10-year design period was applied since a longer design period, typically decades, requires a higher initial capital investment that results to higher initial tariffs that cannot be matched by the rural

population's ability to pay. Though initial investments will be lower, the water distribution would be able to supply the demand for water and requires no major cost investments within the 10-year design period. In estimating the average annual growth rate and current and future population, this study implemented the use of the basic equations Eq.1 and Eq. 2.

Basic Equation for calculating Average Annual Growth Rate:

Eq. 1 $$P_0 = P_n\,(1 + GR\,)^n$$

or

Eq. 2 $$GR = \left(\frac{P_o}{P_n}\right)^{\frac{1}{n}} - 1$$

where: P_0 - population at present

P_n - population after n years from present

$$P_0 = (141\ Household)x\left(\frac{1\ Meter\ Connection}{HH}\right)x\left(\frac{max.\,6\ persons}{connection}\right) = 846\ persons$$

$$P_{10} = P_0 = 846\ persons$$

$$GR = \left(\frac{846}{846}\right)^{\frac{1}{10}} - 1 = 0$$

The present total population is equal to the total number of households multiplied by the maximum number of persons per household so that the present total population of Phase I of the Resettlement Site will be 846 residents. For the resettlement site, division of lots and design of households were based on a maximum capacity of 6 persons per household which led to an 80 sq.m. modal lot size. Also the maximum population at present will not increase since the number of households is already fixed for residents of Phase I unless certain conditions occur. One condition that will increase the maximum population of the residents will be the implementation in Phase II of the Resettlement Site. Another will be the addition of lots that will increase the number of households in Resettlement Site or replacement of existing structures with new buildings that would accommodate a larger number of residents. Therefore, for calculations of present and projected future water demand, this study used the maximum 846 residents and covered 100% of the 20.5 hectare potential service area of Phase I.

Table 1 shows the estimated consumptions per capita based on the type of connection or LOS. Based on this table for Level II Public Connection, each connection is expected to serve 4 to 6 household and is expected to consume 50 to 60 liters per capita per day. For Level III In House Connections, estimated consumptions are about 80 to 100 liters per capita a day. Though some suggest using 150 liters per capita per day for domestic Level III connections, this value is recommended to be used in urban settings. Since the location of the resettlement site is in the rural barangay of Mayong, Tiwi, the value of 80 to 100 lpd per capita is acceptable. For institutional connections, it is estimated to have a 1,000 lpd consumption per connection. A 800lpd consumption per connection is estimated for Commercial Connections. For consumption values for Institutional and Commercial, these values were used since no values on the consumption of the connections were given. If values for these consumptions are determined, then these values will be used.

Table 1. Recommended Consumptions based on Type of connection

Type of Connection	Estimated Consumptions
Level II Public Faucets (Each public faucet should serve 4 - 6 household)	50-60 lpd
Level III In House Connectins	80 – 100 lpd
Institutional Connections	1 m3/day
Commercial Connections	0.8 m3/day

Aside from the use of estimated values for water consumption, this study also used demand factors in order to anticipate the different types of demand that Phase I will have. Table 2 lists the different demand factors used in determining different demand variations. The minimum day demand uses a demand factor of 0.3 of Average Day Demand (ADD) and is used to check if the system is able to withstand excessive static water pressures under a minimum demand condition. No point in the transmission and distribution pipeline should be subjected to more than 70m of pressure that is equal to 686.7 KPa or 100 psi. ADD is the basis for computation of production, revenue, Non-Revenue Water, power costs and operation and maintenance costs and has a demand factor of 1.0. The total capacity of all existing and future water source should be able to at least supply the maximum day demand for the design period. For Maximum Day Demand Variation a demand factor of 1.3 is multiplied to ADD. Peak Hour Demand variation is used to ensure that no point in the pipeline should fall below the minimum pressure head during peak hour conditions. Standards recommend that minimum pressures should be 3 meters of pressure head. Since, some structures in Phase I are duplexes and will require water to reach the second floor. This study used 6 meters of pressure head as its minimum pressure head so that water will be able to reach the second floor of all buildings in the resettlement site. For Peak Hour Demand a demand factor of 2.5 for more than 1,000 connections and a demand factor of 3.0 for less than 1,000 connections. According to the calculated connections, Phase I is estimated to have 141 connections but since this study considered the connections that Phase II, it used a demand factor of 2.5 in estimating Peak Hour Demand. One of the aspects that this study considered is the addition of Fire Hydrant facilities and used a demand factor of 2.5 to determine Fire Hydrant Demand.

Table 2. Recommended Demand Factors for a Level II/III system

Demand Parameter	Demand Factor
Minimum Day Demand	0.3 of ADD
Average Day Demand	1.0
Maximum Day Demand	1.3 of ADD
Peak Hour Demand	2.5 of ADD (>1,000 connections) 3.0 of ADD (<1,000 connections)
Fire Hydrant Demand	2.5 of ADD

Other Connections:

1 baranggay Hall = 600 lpd
1 Elementary School = 1 m3 / d or 1,000 lpd

For Phase I, the 141 households would mean 141 domestic connections each

supplying a maximum of 6 persons per connection. Based on the recommended volume consumption of water per day for each connections based on domestic consumption as shown in Table 2, each person was estimated to consume the maximum 100 lpd, thus creating a demand of 600 lpd per connection. Since there are 141 households, the total ADD based on domestic consumption was determined to be 84,600 lpd. In addition to the domestic ADD, the presence of community facilities like a barangay hall and rural health center and an elementary school created additional demand of 600 lpd and 1,000 lpd, respectively, therefore making the total estimated ADD for Phase I to be 86.2 m3/day (see Table 3) based on standards set by Rural Water Design Manual. According to the same manual, the maximum day demand for source water capacity should satisfy a 1.3 of ADD(see Table 3). The total daily demand is multiplied by 1.3 making the estimated maximum daily demand to be 112.06 m3/day.

Table 3. Summary of Average Day Demand

	Domestic	Barangay Hall	Institutional (School)	Total
Connections	141	1	1	143
Average Day Consumption (lpd)	84,600	600	1,000	86,200

Allowances for Non -Revenue Water (NRW) were made, otherwise the system would not be able to sufficiently supply for the demand of Phase I. An NRW value of 10% of estimated consumption was used for a new network while an NRW value of 20% for old networks up to 10 years. These NRW figures require good maintenance of utilities, pro-active leakage prevention, and no illegal connections for 100% recovery of supplied water. Otherwise, NRW figures shall be larger than the projected values.

In this study an NRW of 20% was used in order for the system design to still sufficiently supply water even after 10 years provided that the system shall be well-maintained. Assuming 20% NRW value and operating 24 hours per day the source capacity should be 1.27 lps (use 1.5 lps).

Computations for NRW: (NRW Value equal to 20% source capacity)

Assume that the source capacity will be

$$\text{Source Capacity (with NRW)} = \left(\frac{112{,}060 \text{ liters}}{\text{day}}\right) \times \left(\frac{1 \text{ day}}{24 \text{ hours}}\right) \times \left(\frac{1 \text{ hour}}{3600 \text{ sec}}\right)$$

$$= 1.297 \text{ lps (say use 1.5 lps)}$$

operating 24 hrs / day

no existing plans for the community facilities (baranggay hall, elementary school and etc.,) and given that the resettlement site is located in the rural barangay of Mayong, Tiwi, this study designed the pressure that can sufficiently supply water up to second floor with a

$$\text{Minimum Pressure at MC: (for 2nd floor)}$$
$$6\ meters \times 9.81\ \frac{KN}{m^3}$$
$$= 58.86\ KPa\ or\ 8.54\ psi$$

standard floor height of 3 meters for all structures within Phase I. In designing water pressure at MC, the study used the Eq. 4 and determined that the minimum design pressure at each MC to be 8psi or 55.13 KPa.

The design should also take into account fire and safety standards, the design also accounted for the installment of fire hydrant facilities and considered the additional water demand created if fire hydrant facilities were to be installed and used. For hydrant consumption, ADD shall be multiplied by a demand factor of

2.5 to accommodate demand created with the use of a fire hydrant that will not disrupt water service thus making the daily consumption to be 3.75 lps or 280.15 m3/day.

Computation for Fire Hydrant Consumption (2.5 of ADD):

1.5 lps x 2.5 = 3.75 lps or 280.~~15~~

For reservoir capacity, a recommended 25% of ADD is recommended as the minimum volume for determining the volume of reservoir (see Eq. 3). Using this equation, a design volume of 28,015 liters or 28 m3 is recommended for the reservoir of Phase I of the Resettlement Site that would be able to sufficiently supply water for 6 hours to Phase I of the Resettlement Site.

Reservoir Capacity:

$$C_r = \frac{1}{4}(ADD)$$

where: C_r - reservoir capacity in liters
ADD - average daily demand

$$C_r = \frac{1}{4}(112{,}060) = 28{,}015 \text{ liters or } 28\ m^3$$

After determining water demand, it is essential to determine water pressure in pipes. In determining the water pressure at meter connection (MC), this study considered the needs of the residents and the types of structures that will be constructed in Phase I of the resettlement site. Based on the plans, the residential houses to be constructed contain duplex houses. Since there are

From the assessment location of the resettlement site and the surrounding areas, it is possible to use a Gravity Fed System for the Water Distribution Pipeline so that the minimum pressure at any point in the network is 8 psi and should not exceed 100 psi. Based on the data gathered for Phase I of the Proposed Resettlement Site, it was designed to meet the following criteria: a.) level III service; b.) 846 maximum population; c.) water pressure of 8 psi at MC; d.) 3.75 lps maximum water demand; and e.) 28 m3 reservoir volume

DISCUSSION

Proximate to the resettlement site there are four (4) possible sources of water: Source A, Source B, Mayong River and Dapdap Spring. Upon assessment of Source A, the quality and quantity of water discharge does not meet the minimum standards and requirements for Source A to be a viable source of water. Therefore, this study recommends considering Source B as a source. Initial data on Source B indicated that its water discharge has better quality and quantity compared to Source A though no tests have yet been conducted on Source B that will conclusively validate this assumption. The higher elevation of Source B, compared to Source A (see Appendix J and the resettlement site, makes it more suitable to be used as a water source given that one of the design considerations is the conservation of power in the operation of the water distribution pipeline. If Source A is to be used as a supplementary water source, filtration and chlorinating facilities should be added to the design in order to meet the standards required for safe drinking water and provide a LEVEL III (In-House Connection) Water Service.

Mayong River water discharge of 0.78 cu.m per second is sufficient to supply water to the resettlement site that requires 3.75 liters per second, but water from this source will require pumping and quality must be improved. Water coming from Dapdap Spring possibly can supply water given that preliminary assessment of discharge suggests ability to sufficiently supply water. From all the data gathered and assessment of all the sources, this study recommends Source B as the primary source. Given the time frame of this study and facilities available, this study only conducted ocular inspection,

water discharge analysis and water sampling for testing. Since standards suggest, a water distribution system should have a minimum of two (2) sources found at two (2) different locations. This study also recommends further analysis of all the possible source to determine a second source. It also recommends conducting a minimum one (1) year monitoring of water output in order to determine water bodies' ability to supply water all year round even during low rainfall periods.

Based on the data gathered about the location and terrain of the sources of water and the resettlement site, this study has determined that it is possible to use a Gravity Fed Distribution system for the water distribution pipeline at the proposed resettlement site at Mayong, Tiwi, Albay. Even though the highest and lowest elevation of the households at the resettlement site is about 45m to 20m, respectively and since the elevation of the possible sources is higher than the elevation of resettlement site the use of a Gravity Fed System is the most suitable and most efficient in terms of energy consumption.

The criteria that must be considered in designing the distribution reservoir are as follows: natural features, land use, land values, relocations, construction cost and potential contamination by hazardous materials (HDR 1998). In the design of the distribution reservoir, it will be a ground reservoir type where the water withdrawn from Source B will be stored. In order to avoid adding a pump system to the design, the elevation of distribution reservoir shall be lower than the elevation of the source, preferably Source B. If water from Source A will be used, this water will serve only as a supplement and will require certain measures and facilities in order for the water to meet the quality and quantity standards. For these reasons, this study recommends using Source B, with an elevation of about 75m above sea level, due to its higher elevation that makes it ideal for the gravity fed system.

The purpose of designing the reservoir is to increase sustainable yield of the system by storing untreated surface water to use in the time of low flow periods when little or no water can be withdrawn directly from the said sources. This design will also sustain pressure required. The design aims to achieve adequate storage volume based on worst- case hydraulic scenarios and must be designed to supply the system allowing for future community growth and aims to conserve water and power in the operation and maintenance. Based on calculations of minimum required reservoir volume that will be able to supply water for a 6 hour period taking account NRW and maximum demand, the reservoir was designed to store a minimum of 28 m3 of water to be used in times of drought or low flow periods. The reservoir tank will be a ground level concrete reservoir placed near the source. Dimensions of reservoir in this design are 4 meters by 4 meters reservoir tank (see Appendix R) with a minimum depth of 1.75 meters and an overflow pipe with screen at maximum water level of 2.25 meters and a freeboard height of 1m. The concrete cover seal (see Figure 2) of the tank will a have a manhole with cover for access and a vent pipe with screen at the top at its minimum and maximum depth; the reservoir tank will be able to hold 27.7 cu.m and 36 cu.m of water respectively. Inside, the tank will have wrought iron ladder rings to facilitate access. Near the bottom, the inlet pipe with screen which carries water from the source to the reservoir tanks, is placed and is pointed upward to prevent erosion of concrete due to friction created by water flow. The bottom of the reservoir tank shall have 3% slope to facilitate water drainage. Below the inlet pipe at the bottom of the tank is placed the floor drain which will carry water from the transmission and distribution pipes.

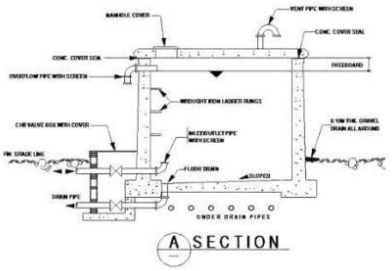


Figure 2. Section A of Reservoir Tank

Outside the reservoir tank and at the side where the inlet and outlet pipes are situated, a concrete hollow block valve box with cover is placed. This will serve as protection for the valves and will prevent unauthorized access to them. The immediate area around the reservoir will have gravel in order to facilitate drainage of water. Under the reservoir tank, under drain pipes are placed also to aid in drainage and prevent oversaturation of soil under and around the location of the tank.

Elevation of Source B is about 75 meters above sea level and is about 30 meters from the highest ground level of the resettlement site and a maximum 50 meters from the lowest ground level of the resettlement site. Because of this during night or in cases where there is little to no demand for water, static water pressure head on pipes would be as much as 50 meters or equivalent to 490.5 Kpa or equal to 71.16 KPa. To prevent pipe bursting it is essential to construct a second tank that can hold raw or processed water that will be able to meet the minimum meter connection pressure of 8 psi that will not cause pipe bursting to the households that are positioned at a lower elevation.

Based on Figure 3 and the subdivision plan of the Resettlement Site, head losses of the point were computed. Farthest point in this computation was located at Zone 2 Block 2, which is the corner lot nearest the terminal clean out on Zone 2. From the plan, head losses due to length of pipe and the appurtenances, equivalent length (see Table 4) was estimated to be 100.2 meters.

Table 4 shows the appurtenances, the diameters of the appurtenances, the quantity, the velocity of water flowing through the appurtenances and the corresponding equivalent length. Based on Table 4, EQL for the 100mm and 50 mm diameter pipes are equal to 125.22 meters and 100.20 meters, respectively. These values are then multiplied to the corresponding head losses per 100m leght of pipe. Based on Figure 4(a) and Figure 4(b), Hf for 100mm and 50mm pipes are 0.079m and 0.331m per 100meter EQL, respectively

Table 11.3: Head Loss Due to Valves and Fittings

Resistance of Valves and Fittings

Nominal Ø in mm	90° Elbow	45° Elbow	Tee	Gate Valve Fully Open	Globe Valve Fully Open	Angle Valve Fully Open	Faucet Fully Open	Foot Valve Fully Open	Strainer	Check Valve Fully Open
	Equivalent Length Straight Pipe (meters)									
13	0.55	0.24	1.04	0.11	4.88	2.56	4.88	1.22	3.05	1.16
19	0.69	0.30	1.37	0.14	6.40	3.66	6.40	1.52	3.66	1.58
25	0.84	0.41	1.77	0.18	8.23	4.57		1.83	4.27	1.98
32	1.14	0.52	2.29	0.24	11.28	5.49		2.13	4.88	2.74
38	1.36	0.61	2.74	0.29	13.71	6.71		2.44	5.49	3.35
50	1.62	0.76	3.66	0.38	16.76	8.54		2.74	6.10	4.27
63	1.98	0.91	4.27	0.43	19.81	10.06		3.05	6.71	5.18
75	2.50	1.16	4.88	0.53	25.90	12.80		3.66	7.62	5.79
100	3.35	1.52	6.71	0.70	33.54	12.80		4.57	9.15	7.62
150	5.03	2.04	9.76	1.01	48.76	24.39		6.42	12.21	11.59

* When the length of pipe is greater than 1,000 times its diameter, the loss of head due to valves and fittings maybe disregarded.

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Figure 3. Friction Head Loss due to Valves and Fittings

Table 4
Equivalent Length of Pipe From Point of Entry to Farthest Point on Zone 2- Block 2

Appurtenances	Dia. (mm)	No.	Velocity (lps)	Equivalent Length per fitting (m)	EQL (m)
Pipe (PVC)	100	-	2.0	-	94.76
45° Elbow	100	1		1.52	1.52
Reducing Wye	100	4		6.71	26.84
Gate Valve (fully Open)	100	3		0.7	2.1
TOTAL EQL :					125.22
Tee	50	5	0.68	3.66	18.3
Pipe (PVC)	50	-		-	81.9
TOTAL EQL :					100.2

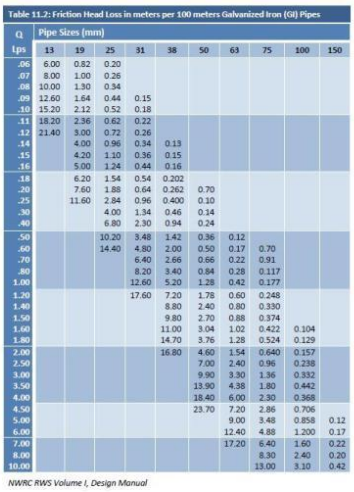

Table 11.2: Friction Head Loss in meters per 100 meters Galvanized Iron (GI) Pipes

Q	Pipe Sizes (mm)								
Lps	13	19	25	31	38	50	63	75	100	150
.06	6.00	0.82	0.20							
.07	8.00	1.00	0.26							
.08	10.00	1.30	0.34							
.09	12.60	1.64	0.44	0.15						
.10	15.20	2.12	0.52	0.18						
.11	18.20	2.36	0.62	0.22						
.12	21.40	3.00	0.72	0.26						
.14		4.00	0.96	0.34	0.13					
.15		4.20	1.10	0.36	0.15					
.16		5.00	1.24	0.44	0.16					
.18		6.20	1.54	0.54	0.202					
.20		7.60	1.88	0.64	0.262	0.70				
.25		11.60	2.84	0.96	0.400	0.10				
.30			4.00	1.34	0.46	0.14				
.40			6.80	2.30	0.94	0.24				
.50			10.20	3.48	1.42	0.36	0.12			
.60			14.40	4.80	2.00	0.50	0.17	0.70		
.70				6.40	2.66	0.66	0.22	0.91		
.80				8.20	3.40	0.84	0.28	0.117		
1.00				12.60	5.20	1.28	0.42	0.177		
1.20				17.60	7.20	1.78	0.60	0.248		
1.40					8.80	2.40	0.80	0.330		
1.50					9.80	2.70	0.88	0.374		
1.60					11.00	3.04	1.02	0.422	0.104	
1.80					14.70	3.76	1.28	0.524	0.129	
2.00					16.80	4.60	1.54	0.640	0.157	
2.50						7.00	2.40	0.96	0.238	
3.00						9.90	3.30	1.36	0.332	
3.50						13.90	4.38	1.80	0.442	
4.00						18.40	6.00	2.30	0.368	
4.50						23.70	7.20	2.86	0.706	
5.00							9.00	3.48	0.858	0.12
6.00							12.40	4.88	1.200	0.17
7.00							17.20	6.40	1.60	0.22
8.00								8.30	2.40	0.20
10.00								13.00	3.10	0.42

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Figure 4(a) Head Loss in PVC Pipes

Based on the computation shown below, the estimate head loss is 0.338 meters of pressure head. Thus, the minimum height of reservoir tank in order to provide a minimum of 8 psi of water pressure at MC is 6.338 meters above the meter connection of the farthest point designated.

Total Hf = Head Loss (100mm pipe) + HL(50mm pipe)
= [EQL*Hf(100mm pipe)] + [EQL*Hf(50mm pipe)]
=[(125.22m)*(0.079m /100m)] + [(100.2)*(0.314m/100 m)]

Total Hf =0.338m

Following traditional layouts is not preferred to be used on the resettlement since the location of the resettlement is on mountainous terrain and due to the irregular shape of the resettlement site. Abrupt changes in elevation and slopes were made considering the slope in the design is important in order to facilitate the use of a Gravity Fed System. The design used a combination of the different traditional layouts in order to meet the design parameters required. Grid system was not applicable because it is suitable for cities with rectangular layout, where the water mains and branches are laid in rectangles. While a ring system main supply is laid all along the peripheral roads and sub mains branch out from the mains. Each zone has a centrally located distribution reservoir elevated from where distribution pipes run radially towards the periphery of the distribution district. In the Dead End or Tree System, it is applicable for roads that have no regular patterns, which is the case of the resettlement site. The flow of water in this type of layout was designed to flow from a higher to lower elevation. So in this study, the distribution layout was designed to be a combination of a Ring System and Dead End System. The advantages of the layout

Table 11.1: Friction Head Loss in meters per 100 meters in Plastic Pipe

Q	Pipe Sizes (mm)									
Lps	13	19	25	31	38	50	63	75	100	150
.01	0.1									
.02	0.4									
.03	0.8	0.11								
.04	1.4	0.19								
.05	2.1	0.20								
.06	3.0	0.41	0.10							
.07	4.0	0.50	0.13							
.08	5.0	0.65	0.17							
.09	6.3	0.82	0.22							
.10	7.0	1.06	0.26							
.11	9.1	1.18	0.31	0.11						
.12	10.7	1.50	0.36	0.13						
.14		2.00	0.48	0.17						
.15		2.10	0.55	0.18						
.16		2.50	0.62	0.22						
.18		3.10	0.77	0.27	0.101					
.20		3.80	0.94	0.32	0.131					
.25		5.80	1.42	0.48	0.20					
.30			2.00	0.67	0.23					
.40			3.40	1.15	0.47	0.12				
.50			5.10	1.74	0.71	0.18				
.60			7.20	2.40	1.00	0.25				
.70				3.20	1.33	0.33	0.11			
.80				4.10	1.70	0.42	0.14			
1.00				6.30	2.60	0.64	0.21	0.069		
1.20				8.80	3.60	0.89	0.30	0.124		
1.40					4.40	1.20	0.40	0.165		
1.50					4.90	1.35	0.44	0.187		
1.60					5.50	1.52	0.51	0.211		
1.80					7.35	1.80	0.64	0.262		
2.00					8.40	2.30	0.77	0.32	0.079	
2.50						3.50	1.20	0.48	0.119	
3.00						4.95	1.65	0.68	0.166	
3.50						6.95	2.19	0.90	0.221	
4.00						9.20	3.00	1.15	0.184	
4.50						11.85	3.60	1.43	0.353	
5.00							4.50	1.74	0.429	0.06
6.00							6.20	2.44	0.60	0.09
7.00							8.60	3.20	0.80	0.11
8.00								4.15	1.20	0.14
10.00								6.50	1.55	0.21

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Figure 4(b) Head Loss in GI Pipes

The water distribution pipeline is designed to have 5 zones consisting of 20 blocks with 141 number of households, the design aims to conserve water. The distribution Layout considered the primary goal of conserving water and energy. By conserving water it decreases the strains on freshwater resources and and saves the use of utilities, gives benefits to the residents and for the future generation. Zoning also gives a lot of help to the resettlement, it is able to accommodate each houses with water by dividing each blocks to each zones. The design of the layout and the type of distribution method to be used, are compatible to gravity fed system and are able to distribute each house fairly and enough amount of water.

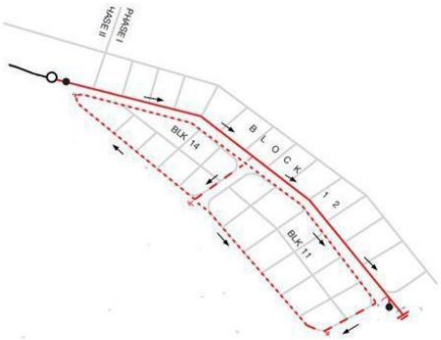

Figure 6. Zone 1 Distribution Layout

Figure 5, shows the layout of Zone 1. This zone covers blocks 11, 12, 14 with 33 number of households and 198 number of population to consume the water distribution on the area. The pipes in Zone 1 is symbolized by the color red solid and broken lines. The main line of water pipe passes through Zone 1 connected by the branch lines and onto each houses and a clean out on the end of the zone 1. The clean out on Zone 1 will allow maintenance and repairs to Zone 1 without disrupting service to the other zones by allowing water from Zone 5 to supply households in Zone 1.

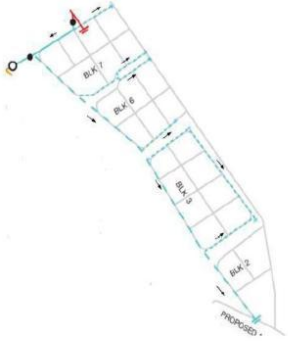

Figure 6. Zone 2 Distribution Layout

Figure 6 shows Zone 2 which has blocks 2,3,6 and 7 with 24 number of households and 144 number of population where the pipes are represented by the blue solid and broken lines. The water lines in Zone 2 is a submain line connecting from the main line on Zone 1 with branches connected onto houses and also has a clean out at the end of the zone. Zone 2 also connects Zone 1 to Zone 3 but can be isolated with valves positioned so that if maintenance and repairs are required to be done on Zone 2, service to all the other zones will not be affected.

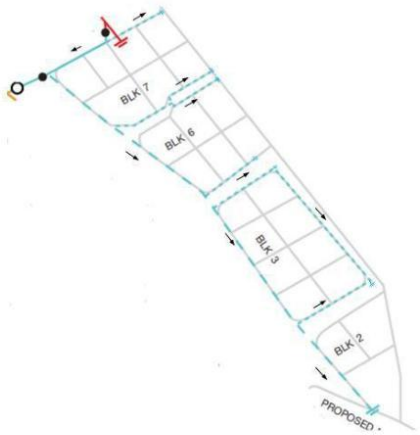

Figure 7. Zone 3 Distribution Layout

Zone 3 as shown in Figure 7, has blocks 1,4,5,8 and half of block 9 with 31 number of households and a population of 186, represented by the yellow solid and broken lines. The sub-main line on Zone 3 is connected by branch lines onto each house with a clean out also at the end of the zone. Zone 3 connects Zone 4 to Zone 2 and can be isolated by opening or closing valves positioned.

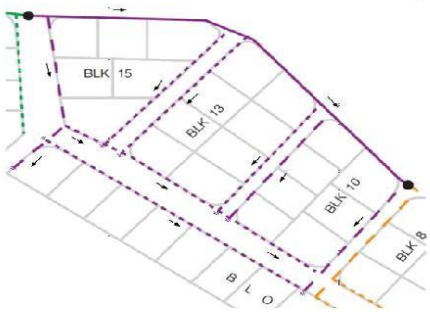

Figure 8. Distribution Layout of Zone 4

Figure 8 shows Zone 4 has blocks 10, half of block 9, 13 and 5 with 28 number of households and 168 number of population. Zone 4 has a main line from zone 5 which has submain lines and branch lines onto houses. The pipes in Zone 4 are represented by the violet broken and solid lines shown in Figure 8.

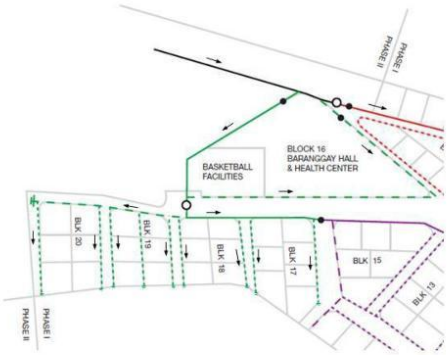

Figure 9. Distribution Layout of Zone 5

While in Zone 5 as shown in Figure 9 has blocks 16, 17, 18, 19 and 20 with 25 number of households and 150 number of population where pipes are represented by green solid and broken lines. Zone 5 also includes the demand created by community facilities found in Block 21 such as basketball facilities, baranggay hall, health center and the elementary school located along the national highway. The connection of water lines on Zone 5 has dead end system. Zone 5 has the main line with submain line and branch lines onto each house with a clean out on the edge.

Each of the five (5) zones were designed so that water from two points and the valves system allows for operators to conduct routine maintenance on pipes and emergency repairs without disrupting service. The zoning also can reduce water loss due to damages in pipelines by allowing operators to cut off water supply in a

The design of the water distribution pipeline considered the installation of fire hydrants. A fire hydrant is an important facility in a community not just for firefighting but also for the operation and maintenance of the water system. This can help during incidents in the resettlement site. The ISO (Insurance Service Organization) recommends a commercial fire flow of 2,500 gallons per minute for four hours and 1,500 gallons per minute for four hours for residential areas. From the water distribution pipeline, public protection is available directly from the hydrant supply. The normal minimum water pressure in a distribution system cannot be below 35 psi. When a fire hydrant is open, minimum residual pressure cannot be below 20 psi. The adequacy of a fire hydrant system should be capable of delivering the maximum daily consumption demand in the resettlement site. This means that the water is applicable for drinking, bathing and other uses. A 3 feet clear space should be maintained around the circumference of fire hydrant. The minimum size of fire service lines should be looped to provide feeds from at least two directions in order to cover the required area. For installation, fire hydrant must not exceed 4 inches (102mm) in diameter and must be concrete filled. Fire hydrants should be spaced not more than 4 feet (1219mm) between posts on centre and set not less than 3 feet (914mm) deep in a concrete footing of not less than 15-inch (381mm) in diameter. They should also be set at the top of the posts not less than 3 feet (914mm) above the ground, and it should be located not less than 3 feet (914mm) from the protected area. It should be installed in each intersection. Since the resettlement site is a residential area, fire hydrants should be between intersections and should not exceed 600 feet (182.88m or 182,880mm). In the water distribution pipeline design there are 4 fire hydrants (see Appendix S), 3 of which are positioned so that their supply will be provided by main lines and will allow supply from two sides which is one of the requirements. Though the 4th fire hydrant is connected to a sub-main line, its lower elevation will ensure adequate flow and pressure. Fire hydrants were positioned to be installed at points of intersection to allow maximum access and coverage and it should be noted that fire hydrants can be replaced with

standpipes that are to be constructed on sidewalks for easy access.

Based on the design of the Water Distribution, the required size of pipes for the installation is 4 inch diameter from the reservoir to the main lines, 2 inch diameter from the main lines to sub main lines, 1.5 inch diameter from sub main lines to branch, and 0.5 inch diameter of GI pipe from branch to in-house connections.

Since the study concentrated on the assessment of possible sources of water and the design of a water distribution pipeline, there are areas that need further research in order to completely develop a water distribution pipeline that will address the water demand of Phase I Resettlement Site at Mayong, Tiwi, Albay. This study has recommended the possibility of using Source B, and only using Source A as a supplementary source to Source A. With standards recommending at least two (2) sources of water located at different locations for water distribution pipeline, then an area of further is to determine other sources of water that will allow the water distribution pipeline at Mayong, Tiwi, Albay to meet the minimum number of two sources. A primary physical test can conclude that Source A cannot be reliable to supply water in the resettlement site because of its small amount of output and its low quality of water. Providing safe drinking water is one of the basic needs of humans to drink at least 8 glasses of water a day. One area that needs further study is a more thorough assessment of the possible sources of water in terms of quality and quantity. According to standards, possible water sources should be assessed for a minimum of 1 year before it can be used as a source. This year long monitoring will ensure that the body of water can sufficiently supply water to its target area throughout the entire year. Along with quantity of discharge, its quality should also be monitored. If a source has been chosen and the water quality and quantity will not meet required standards additional facilities are necessary before the water can be used by resident of the Resettlement Site. Since the study is limited to designing a water distribution pipeline, further research on what applicable additional processes and facilities is needed.

Another concern in the implementation of the water distribution pipeline design, is cost analysis. This study did not include the estimate and cost analysis of the project. A cost and estimate study will be essential in determining the total cost of the project and in assessing if the fees will match the residents' or beneficiaries' ability to pay. According to a design manual (RWSVol1DM, 2011) for a rural water distribution system, an investment of Php15,000/connection is acceptable. If the total cost of the project will exceed the acceptable amount per connection, the design will be subjected to a redesign in order to meet the maximum cost per connection of the project. This standard ensures that the population is able to pay fees and gives a maximum cost of the project based on the number of connections.

The construction of Phase I is in the proposal phase and Phase II shall proceed once Phase I has been completed. Since this study limited its scope to Phase I, an area for further study is the design of the water distribution pipeline for Phase II of the Proposed Resettlement Project at Mayong, Tiwi, Albay. Another area that can be researched on line with this study is the use of software, like EPANET in the analysis of the design.

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Physicochemical Characeterization of Preformulated Antibacterial Cream from Ethanolic Leaf Extracts of *Cordia dichotoma* Forst. (Boraginaceae)

Aspe, Rommel Joy, Baldemoro, Mariah Nicole Estevez, Nicole T., Fraile, Mark Raven

College of Heath Sciences, University of Santo Tomas-Legazpi

ABSTRACT

Cordia dichotoma Forst (also known as Anonang) belongs to the Boraginaceae family, a widespread plant found, throughout the Philippines. Previous studies have shown that its leaves possesses the flavonoid constituent which is responsible for its antibacterial property. The goal of this study is to make an oil-in-water (o/w) topical antibacterial cream with the use of its leaf extracts and determine the physical and chemical properties of the prepared cream. To overcome the present crisis in antimicrobial resistance, natural products have been widely studied as an alternative remedy for current skin ailments. In this study, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were used as test organisms. Exhaustive percolation will be done with the use of Ethanol as the solvent. The preformulated cream were evaluated in terms of their color, odor, homogeneity, spreadability and pH. Centrifugation and freeze-thaw cycling tests will be done to evaluate the stability of the creams. Results have shown that the leaf extracts have exhibited bacterial inhibition against the test organisms, the physical and chemical characteristics of the cream were also determined showing that the formulated cream were rifle green, almond-like odor, with a very good homogeneity and with constant spreadability and has a pH of 7.3. Physical stability testing have also shown that the cream were stable against extreme temperature and agitation. A reassessment of the cream showed that the preparation showed inhibition against *Staphylococcus aureus* with 9.33 mm inhibition zone.

Keywords: Cordia dichotoma, Antibacterial cream, preformulation, Staphylococcus aureus

INTRODUCTION

The largest organ that each individual has is their skin. It is the function of the skin to protect the body from the infection coming from the external agents but there are instances when the organ which protects us can also be the one infected (DePietro, Hiugeria, n.d.). When this infections occur, their effect can range starting from a small spot to being as worse as the entire body surface. These skin infections can also cause serious cases, from harmless to becoming eventually fatal (Damian Dhar, 2013).

According to DePietro and Hiugeria (n.d.), depending on the type of infection the symptoms may vary from each disease. Redness of the skin and rashes are the most noticeable and most common symptom observed. It is also possible for skin

infections to cause other symptoms such as tenderness, pain and itching. Dr. Amanda Oakley of DermNet New Zealand (2015) stated that the most common bacteria to cause bacterial infections are *Staphylococcus aureus* and *Streptococcus pyogenes*.

Despite being harmless in most individuals, *Staphylococcus aureus* according to Dr. Stanway of DermNet New Zealand (2015) is capable of causing various infections of the skin and other organs. *S. aureus* infections are common in people with frequent skin injury, particularly if the skin is dry. Staph skin infections are seen most commonly in pre-pubertal children and certain occupational groups such as healthcare workers. But they may occur for no obvious reason in otherwise healthy individuals.

According to Cox (2016), antibiotics are the synthetically available substances that combat infections caused by bacteria. These substances inhibits or disturbs the process necessary for the bacteria to grow and multiply. Dr. Oakley of DermNet New Zealand also added that minor infections coming from different species of bacteria can be treated without the use of medications. However, antibiotics are used in treating persistent and serious bacterial infections. These are available for localized topical use (creams, gels, solutions) for topical use (creams, gels, solutions) or can be as systemic treatment formulated as tablets, capsules and intravenous or intravenous injecor can be as systemic treatment formulated as tablets, capsules and intravenous or intravenous injections.

Neu (1992), conducted a study stating that the synthesis of large numbers of antibiotics over the past three decades has caused complacency about the threat of bacterial resistance. As early as the 1970s, physicians have abandoned their belief that because of the vast availability of the antimicrobial agents it is safe to infer that all bacterial infections are treatable. But because of the emergence of resistance of these organisms, *Staphylococcus aureus, Streptococcus pneumoniae, Pseudomonas aeruginosa,* and *Mycobacterium tuberculosis* their belief was shaken *(Lowy, 2003).*

To overcome the present crisis of antibiotic resistance, natural products have been widely studied as alternative treatments for the different bacterial skin ailments. For this reason, this investigation examined whether the leaf extract from Anonang (*Cordia dichotoma* Forst.) possess a significant antibacterial property and a possible plausible active ingredient for a naturally made cream.

Parts of the plant like seed, fruit bark and leaves, have been studied for exhibiting antiulcer, antidiabetic, anti-inflammatory, and immune-modulator and analgesic activity. Analysis of the seed, leaves and fruit showed the presence of coumarins, saponins, flavonoids, pyrrolizidine alkaloids, sterols and terpenes. (Prasad, *et al.,* 2013). According to a previous study conducted by Mahour, *et al.,* (2008) *Cordia dichotoma* possesses an antibacterial activity due to its active constituent, flavonoids.

Therefore, the study aimed to preformulate an oil-in-water topical antibacterial cream from the ethanolic extract. Also to assess the physicochemical properties of the preformulation.

METHODS AND MATERIALS

Collection and preparation of plant

One thousand (1,000) grams mature leaves of *Cordia dichotoma* Forst. were gathered from Polangui, Albay, Philippines. The leaves were identified and authenticated at the Bureau of Plant Industry of the Department of Agriculture, Malate, Manila by Manuel D. Ching. The collected leaves were washed thoroughly and air-dried at 25-30˚C for about two weeks. After drying, the leaves were grinded using a mechanical grinder. The powdered samples were kept in a clean, dry and well-closed container before subjecting to exhaustive percolation extraction using twelve liters (12 L) of ethanol as solvent. The collected extracts were concentrated and were kept in an amber colored bottle at temperature with a range of 2°C-5°C.

Standards, reagent, and chemicals

The chemicals and reagents were of analytical grade and was procured from Biowell Medical Enterprise. Ethanol was the solvent used for the exhaustive percolation method of extraction.

Preparation of cream

The ingredients that were used in the preparation of cream: stearic acid, cetyl alcohol, glycerin, almond oil, potassium hydroxide, propylparaben, and methylparaben were procured from Biowell Medical Enterprise; distilled water was provided by the University of Santo Tomas Legazpi – Laboratory and Instrumentation Section.

Bacterial Strains

Staphylococcus aureus (UPCC 1143), *Pseudomonas aeruginosa* (UPCC 1244) was provided by the Natural Sciences Research Institute of UP-Diliman. A *Staphylococcus aureus* strain was also provided by the Regional Center for Food Safety and Quality Assurance of Bicol University.

Extraction procedure

The leaf extracts of *Cordia dichotoma* Forst. was obtained by placing the grind leaves in a percolator and adding the menstruum which is the 96% ethanol, after that the researchers collected the filtrate and mixed it with the recovered filtrate from the pressed marc, finally, the researchers concentrated the extract to completely removed the solvent used. Part of the crude leaf extracts was set aside for the phytochemical screening and pharmacological tests.

The percentage yield per solvent was computed using the formula:

Percentage Yield

$$\frac{wt\ of\ concentrated\ extract}{wt\ of\ sample\ used}\ x\ 100$$

Equation 1 Computation for the Percentage yield of the collected extracts

Phytochemical screening using color reaction test

Qualitative test for flavonoids

Shinoda test which is presented by Nandedkar & Mulani (2016), was adapted in testing for the presence of flavonoid. The concentrated extract (5 ml) was added to a dilute hydrochloric acid (10 drops), followed by addition of small piece of magnesium. The presence of flavonoid was confirmed after the formation of brown reddish or pink color.

Microbiological Assay

The antibacterial property of the leaf extracts of *Cordia dichotoma* Forst. was determined with the aid of the Microbiological Research Services Laboratory of NSRI of UP-Diliman. The antibacterial property of the formulated cream was also initially evaluated at NSRI and the reassessment of the cream was done at the Regional Center for Food Safety and Quality Assurance of Bicol University.

Antibacterial screening of the Extract (Agar-well diffusion method)

The susceptibility test was carried out based on the procedures and variables presented by the Microbiological Research Services Laboratory of NSRI, UP-Diliman.

The suspending medium that was used in screening the extract was 0.1% peptone water and the microbial suspensions were prepared from a day old (24 hour) culture of the test organisms (*Staphylococcus aureus* & *Pseudomonas aeruginosa)*

The pre poured Nutrient Agar (NA) plates that were used are 3 mm in thickness, they were inoculated with microbial suspension of the test organisms used by swabbing the surface of the agar. A swab with a cotton on an applicator stick was dipped in the suspension of the microorganism, it was rotated for multiple times and to remove excess inoculum from the swab it was pressed firmly inside of the wall of the tube on top of the fluid level. The swab was streaked all over the entire surface of the gas. To ensure that there is even distribution of the inoculum the process was done again for two to three times subsequently rotating it at a 60º. Three wells with equal distance were made on the agar plate with the use of a cork borer which has 10 mm in diameter. Two hundred microlkiter portion of the sample was put in each side of the wells. The NA plates was then incubated at 35ºC and it was observed for about 24 hours.

The clearing zone was measured in milliliters and the average diameter of the clearing zones was calculated. The antimicrobials index (AI) was computed using the following formula.

$$AI = \frac{Diameter\ of\ clearing\ zone - Diameter\ well}{Diameter\ of\ well}$$

Equation 2 Computation for the Antimicrobial Index for the Extract

Reassessment of the Antibacterial property of Cream (Disc diffusion method)

The re-evaluation of the cream will be carried out by the Regional Center for Food Safety and Quality Assurance of Bicol University based on the procedures and variables presented by with a slight modification by Raahave (1974), Oberlies *et al.*, (1995), Fiebelkorn *et al.*, (2003) and Saad (2003).

The standard disk diffusion test will be performed on each isolate using unsupplemented Mueller-Hinton agar and standard.

The microorganism that will be used is *Staphylococcus aureus*. The organisms will be grown in a Mueller Hinton broth at 37^0C for 24 hours. The final cell concentrations will be 108cfu/ ml according to the McFarland turbidometry. 100 µl of

the inoculum will be added to each plate which contains the Mueller Hinton agar.

The sterile filter paper disks (6mm in diameter) will be saturated with 50µl of the cream preparation. The plates will be inoculated at 37^0C for 24 hours and the diameters of inhibitory zones were measured. The assay was carried out three times.

Preparation of cream

The formulation that were used to prepare the creams was done with slight modification based on the formula presented by Mithal and Saha, (2003), Dhase (2014) and Ugandar and Deivi (2013). The steps carried out in the preparation of oil-in-water vanishing herbal cream were as follows:

Preparation of oil phase

Stearic acid, cetyl alcohol, and glycerin were taken into one beaker and the mixture was melted at 70^OC.

Preparation of water phase

Ethanolic extract, propylparaben, methylparaben, and potassium hydroxide were taken into another beaker and the mixture was heated at 70^0C.

Addition of aqueous phase to oil phase

At 70°C the aqueous phase will be added to the oil phase with constant stirring to avoid the immediate congealing of the product. Once the two phases are together the preparation is allowed to congeal at room temperature. Almond oil was added before the product was transferred in a suitable container.

Table 1 Formula for oil-in-water vanishing cream

Ingredients	Formulation		
	1	2	3
Oil phase			
Stearic acid	12.5 g	12.5 g	4 g
Cetyl alcohol	1 g	1 g	0.3 g
Glycerin	6 g	6 g	2 gd
Water phase			
Potassium hydroxide	1 g	1 g	0.3 g
Propyl paraben	0.025 g	0.025 g	0.025 g
Methyl paraben	0.05 g	0.05 g	0.05 g
Cordia dichotoma Forst. leaf extract	1mL	7 mL	15 mL
Almond Oil	10 drops	10 drops	10 drops
Purified Water	140 mL	140 mL	30 mL

Table 1 shows the different formulation that the researchers have formulated. There was an increased in the amount of the extract in formulation 2 and in the formulation 3. The researchers decided to reduce the excipients of the third formulation but with greater amount of plant extract.

Evaluation of physical characteristics

Color and odor

The color of the formulation were checked digitally using the application Color Mate and the odor was assessed physically.

Homogeneity

The homogeneity of the formulation was tested by visual inspection and was ranked as follows: (+++) = Excellent, (++) = Very Good, (+) = Good, (-) = Poor. The ranking was based on a study conducted by Saad *et al.*, 2013 which also focuses on

evaluation and preparation of a preformulated cream.

pH

The pH of prepared cream was measured by following the process described by Sawant and Tajane, (2016), using a digital pH meter. The solution was prepared by using 100 ml of distilled water and set aside for 2 hrs. pH was determined in triplicate for the solution and average value was calculated.

Spreadability

Spreadability test was done using the Parallel-Plate Method presented by Garg *et al.,* (2002). Using a glass disc and a glass plate with a millimeter grade scale 0.5 g, the cream was placed in the center of the plate. Pre-weighed glass disc was placed on the plate spreading the sample. Diameters of spread circles was measured after 1 minute. A flyweight of 200 g was placed in the center of the glass disk and the diameter of spread will be again measured after 1 minute. This procedure was repeated by adding another flyweight of 200 g until weight of 1000 g was reached. The spreadability was considered as the area covered by the sample. The bigger the area is, the more spreadable the sample.

Physical stability of emulsions

The physical stability of the creams was carried out based on two tests: centrifugation and freeze-thaw cycling tests.

Centrifugation test

Based on a study presented by Smaoui, *et al.,* (2012), Centrifugal tests were performed for emulsions directly after preparation. Since a product undergoes a lot of agitation on transportation, the centrifugation test proves that the product can sustain high levels of centrifugal force. The evaluation was carried out with slight modifications by the placement of the creams into a centrifuge for 30 minutes at a speed of 10000 rpm for three times. Phase separation within the cream indicates instability.

Freeze-thaw cycling test

Freeze-thaw testing is a kind of stability testing that allows to determine if the formulation will remain stable under various conditions. This test puts the sample in a series of extreme, rapid temperature changes that is possible to be encountered during normal shipping and handling processes (Microchem Laboratory, n.d.).

Samples were prepared by putting 10 grams of the creams in respective jars. The initial assessment was done by taking note of their color, odor, pH and homogeneity. The test samples were placed in the freezer for 24 hours. Then, the samples were removed and allowed to thaw at room temperature. The samples were then placed in a 40^{o}C incubator for 24 hours. After that, the samples were removed and allowed to equilibrate at room temperature. End of the cycle assessment was made and was repeated for three cycles. Phase separation indicates instability.

RESULTS AND DISCUSSION

Table 2 Characteristics of the extract of *Cordia dichotoma*.

Solvent Used	Ethanol
Color	Dark green
Odor	Distinct herbal – like odor
Consistency	Viscous
Percentage yield	4.8%

Table 2 shows the percentage yield of the collected crude extract from the leaves. 48 g of concentrated extract were used in the study. The collected extract after concentration were dark green in color, viscous, and with a distinct herbal odor**.**

Phytochemical screening for flavonoids

Table 3 Test for flavonoids content of *Cordia dichotoma*

Solvent extract	Results
Ethanol	(+) brown reddish

Table 3 shows that the concentrated extract of *Cordia dichotoma* showed a positive result in Shinoda Test having brown reddish solution indicating that the extract contains flavonoids. According to the phytochemical testing done by Mahour *et.al.*, 2008, ethanol was used in collecting the extract of Anonang and it was found out that the flavonoid constituent is the one responsible for the antibacterial property of the plant.

Antibacterial screening of the extract

Table 4 Results of the Antibacterial screening of the Extract

Test organism	Sample	Clearing zone (mm)			AI
		1	2	3	
Pseudomonas aeruginosa	*C. dichotoma* extract	14	14	14	0.4
	Chloramphenicol disc	15			1.5
Staphylococcus aureus	*C. dichotoma* extract	23	23	23	1.3
	Chloramphenicol disc	33			4.5

Table 4 shows the results of the experiment conducted by the Natural Sciences Research Institute and it was found out that the ethanolic extract showed inhibitory activity against the test *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The results influenced the researchers to push through the formulation of the cream using the extract with different quantities but with the same concentration.

Antibacterial screening of the Cream

Table 5 Results of the initial Antimicrobial Assay of the Cream

Test organism	Sample	Clearing zone (mm)			AI
		1	2	3	
Pseudomonas aeruginosa	Formulation 1 (1 mL) *C. dichotoma*	-	-	-	-
	Formulation 2 (7 mL) *C. dichotoma*	-	-	-	-
	Cream (Negative-control)	-	-	-	-
	Chloramphenicol disc	15			1.5
Staphylococcus aureus	Formulation 1 (1 mL) *C. dichotoma*	-	-	-	-
	Formulation 2 (7 mL) *C. dichotoma*	-	-	-	-
	Cream (Negative-control)	-	-	-	-
	Chloramphenicol disc				4.5

Table 5 shows the results of the assay of the prepared cream, also conducted by the UP-NSRI. After the creams had been prepared, they were evaluated for their antibacterial activity against the same test organisms: *Staphylococcus aureus and Pseudomonas aeruginosa*. To compare the results a negative control or a prepared cream without the active ingredient and another Chloramphenicol disc acted as positive control was used to evaluate the creams' results.

The prepared creams did not exhibit any inhibition against the test organisms. It is possible that major adjustments must be made to the formulation to retain its antibacterial property. One of the reasons that the researchers are looking upon is the over dilution of the active ingredient since the ratio of the active ingredient to the water phase of the formulation 1 and 2 is 1 mL: 140 mL and 7 mL: 140 mL respectively. Since the research is currently a preformulation study the researchers made another formulation with a higher volume of extract but with less excipients involved.

Table 6 Results of the Re-evaluation of Antimicrobial Assay of the Cream

Test organism	Sample	Clearing zone (mm)
Staphylococcus aureus	15 mL *Cordia dichotoma*	9. 33 mm

Table 6 shows the result of the re-evaluation of the new formulated cream. The test was conducted by the Regional Center for Food Safety and Quality Assurance of Bicol University wherein *Staphylococcus aureus* was available. With less excipients involved and a different ratio of the water phase to the active ingredient the over dilution which was presented as the main factor for exhibiting initial negative results was resolved letting the extract as the main ingredient for the preformulation exhibit its pharmacological activity.

Physical characteristics of cream

Table 7 Physical characteristics of the preformulated cream

Parameters	Results
Color	Rifle Green
Odor	Almond-like odor
Homogeneity	(++) Very Good
pH	**Mean**
	7.2

David Williames, the Almond oil served as the fragrant in the preparation. According to Contract Pharma (n.d.) one of the factors affecting the quality of semi-solid products is homogeneity because this factor affects the proper distribution of both the excipients and active pharmaceutical ingredient which is directly linked to the effectiveness of a pharmaceutical product.

Spreadability

Table 8 Mean Spreadability of Cream

Weight of Flyweight	Mean Area Covered
200 g	9
400 g	9.4
600 g	9.8
800 g	10.3
1000 g	11

Table 8 shows that the prepared cream have a constant increase in spreadability with increase to the force caused by the flyweights applied. According to Contract Pharma (n.d.) one of the quality factors that affect the therapeutic value of a semi-solid preparation is spreadability as this describes the therapeutic action of the product as it is applied to the skin, having a constant spreadability indicates that more efficient patient acceptance and efficiency of use of the product. Linear regression plot of the data also indicates a correlation between the variables.

Table 7 shows the physical characteris

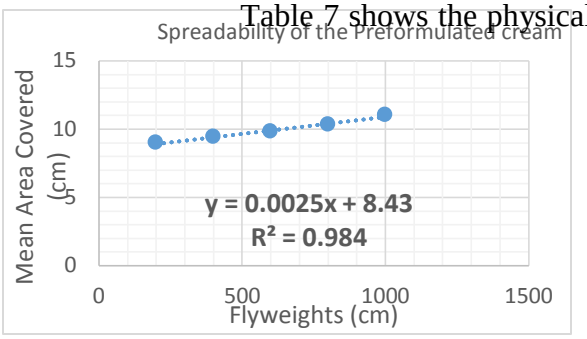

Figure 1 Linear regression graph of the Spreadability of the preformulated cream

Stability Testing

Centrifugation test

Table 9 Stability of the cream based on centrifugation test

Cycle	Remarks	Remarks	Remarks
	Trial 1	Trial 2	Trial 3
1st cycle	Stable (No phase separation)	Stable (No phase separation)	Stable (No phase separation)
2nd cycle	Stable (No phase separation)	Stable (No phase separation)	Stable (No phase separation)
3rd cycle	Stable (No phase separation)	Stable (No phase separation)	Stable (No phase separation)

Table 9 indicates that the preformulated cream preparation were stable after the centrifugation test and no phase separation was observed throughout the three cycles, this indicates that the cream are able to handle extreme agitation which usually occurs during transportation and distribution of pharmaceutical formulations.

Freeze-thaw cycling test

Table 10 Stability of the cream based on freeze-thaw cycling test

Cycle	Remarks	Remarks	Remarks
	Trial 1	Trial 2	Trial 3
1st cycle	Stable (No phase separation)	Stable (No phase separation)	Stable (No phase separation)
2nd cycle	Stable (No phase separation) **Color change**	Stable (No phase separation) **Color Change**	Stable (No phase separation) **Color change**
3rd cycle	Stable (No phase separation)	Stable (No phase separation)	Stable (No phase separation)

Table 10 shows that after the prepared creams were subjected to freeze-thaw cycling test there was no observed phase separation between the phases of the creams indicating that the prepared cream was stable in extremes of temperature. There was a slight change in color, from light green color to a lighter shade in the prepared cream during the second cycle but no phase separation was observed. This indicates that degradation occurred in the cream. Although it may be stable in extreme changes in temperature it can de determined that the creams should be only stored at room temperature.

CONCLUSION

Throughout the study, it was found out that the ethanolic extract of *Cordia dichotoma* Forst. possessed antibacterial property against *Staphylococcus aureus* and *Pseudomonas aeruginosa.*

Based on the evaluation of the physicochemical properties it was found out that the preformulated cream was rifle green in color, with almond-like odor and was observed to be homogenous. pH was found out to be within the neutral range which is 7.2. The spreadability of the preformulated cream was plotted and was observed to have a constant increase of the area covered dependent on the flyweight, direct correlation between the two variables of spreadability was noted.

In terms of stability, no phase separation was observed when tested with the two physical stability test for emulsions. It can be concluded that the creams were stable against extremes of temperature and agitation.

The prepared cream were also re-assessed in terms of their antibacterial property using the same method in assessing the antibacterial property of the extract. Although initial results showed negative results a reformulation and reassessment of the cream showed that the preparation showed inhibitory activity against *Staphylococcus aureus* with a 9.33 mm inhibition zone.

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CULTURAL BELIEFS AND PRACTICES OF MOTHERS ON PRENATAL CARE

Razon, Louise Ashlee D.

College of Health Sciences, University of Santo Tomas-Legazpi

ABSTRACT

Cultural beliefs and practices were already merged with Filipino attitudes and behaviors as well as their cognitive aspect because of their strong beliefs and practices in what they already know for a long period of time. Even that is dangerous to health, they may still hold on to it for a variety of reasons. The purpose of this study is to identify the cultural beliefs and practices that influence women's antenatal care or pregnancy-related health care decisions. Data collection was made through one-on-one interview using an interview guide. Interviews had audio-recorded and transcribed verbatim by research assistants. It is recommended that collaborations between traditional and religious leaders and health clinicians should improve outcomes for everyone.

Key Words: Cultural, Beliefs, Practices, Prenatal Care

INTRODUCTION

One of the best ways to promote a healthy birth is having a healthy pregnancy since getting early and regular prenatal care improves the chances of a healthy pregnancy. This care begins even before pregnancy with a preconception care visit to a health care provider. Cultural beliefs and practices were already merged with Filipino attitudes and behaviors as well as their cognitive aspect because of their strong beliefs and practices in what they already know for a long period of time. Even that is dangerous to health, they may still hold on to it for a variety of reasons. They fear to discard traditional practices because their ancestors might be angry to them. Giving it up might lead to bad omen and bring on the death of the unborn others may be related to respect to elder's authority insisting the continuation of their ritualistic practices.

From the perspective of pregnant women, it can be seen that when their values and beliefs are respected, they

demonstrate more willingness to engage in self-care and come to trust in that professional who serves them. Pregnant women consider positively the prenatal nursing consultation held in basic health care, especially the way the communication relationships are established, in which host and listening are prioritized (Alves, et.al., 2015).

Prenatal care is the care received from a health care provider, such as a doctor or midwife, during pregnancy. During prenatal care visits, health care provider will make sure the developing fetus is healthy and strong. These regular checkups are chance to learn how to manage the discomforts of pregnancy, have any neccesary testing, learn warning signs, and ask any questions the mother may have (Planned Parenthood, 2017).

The World Health Organization (WHO) envisions a world where every pregnant woman and newborn receives quality care throughout the pregnancy, childbirth and the postnatal period (WHO, 2016). The proportion of women receiving antenatal care at least once during pregnancy was about 83% for the period 2007–2014, but for the recommended minimum of four (4) or more visits the corresponding figure drops to around 64% (WHO, 2015). Around the world, one woman dies every 90 seconds in pregnancy or childbirth – that is more than 350,000 women every year. The vast majority of these deaths are preventable (Amnesty International, 2016). The Department of Health should provide the community with detailed information on maternal and infant care, feeding and other related topics in order to raise awareness through lectures, training, seminars and other activities.

There should be close coordination between the DOH and the health workers. Health care providers must be aware of how beliefs and practices affect a person's response to health (Valladolid, 2014).

Before this study is conducted, well-known organizations and institutions such as World Health Organization (WHO) and Department of Health (DOH) have already conducted their research paper on beliefs and practices of pregnant women. They all express the same ideologies and information regarding to it. Some beliefs are powerful and it convinces a lot of people particularly the rural people. Efforts should be made to become familiar with the beliefs to provide adequate and quality care.

Pregnant women should give sufficient time for antenatal care. Prenatal or antenatal care consists of much more than just monitoring the mother's diet and weight. They should keep in mind that during pregnancy it is not just the health of the pregnant woman that must be watched, but also the health of the unborn baby. Mothers should have access to information and must be conscious of current and latest information with regards to maternal and infant care so that they could use this information in their everyday endeavor and advocate precise health practices.

The purpose of this study is to identify the cultural beliefs and practices that influences women's antenatal care or pregnancy-related health care decisions. This study will give awareness to the society of the importance of prenatal to

ensure the protection of mothers as well as the babies to its resources, opportunities essential for sustainable development. It may be beneficial to women who are concerned about their pregnancy. This can give a realization to the society that total care on pregnancy and its awareness should be integrated by minimizing the cultural beliefs of mothers.

Pregnancy and motherhood are such exciting times in a woman's life and it is described that a happy mother is thought to ensure joy and good fortune because the unborn child learns, communicates, and responds in uterus (Glorioso, 2013, Corbett and Callister, 2012). Having regular prenatal check -up at the health center, tetanus toxoid immunization for five times during the entire child bearing years, having a birth and emergency plan and eating food rich in protein, calcium, must be accomplished always. Poverty brings many challenges in healthcare delivery ("USDHHS", 2010). During pregnancy, women intensify their prayers to God for protection, safe delivery and blessings which some women believe that offering some set of goods pay respect to the traditional birth attendant (Aziato, 2015; Jirojwong, 2010).

In this study, there are traditional and modern beliefs and practices that mothers were practicing. In line with this, the researcher categorized these practices with the purpose to identify the old and modern to the persons involve in the study.

Old folk practices of American may include pica (i.e. ingestion of non-food item), use of herbal medicines, wearing of garlic, and silver bracelets and some mothers believe in applying chewed leaves or saliva on the baby's abdomen to treat stomach pain or bloated belly (Gunn & Davis, 2011; Ebuenga, 2014). Some Filipinos believe that what you eat and crave during pregnancy has a direct influence on the physical attributes of the baby. For example, if a pregnant woman craves to eat too much "balut" - a fertilized duck embryo that's boiled alive and eaten in the shell – her child will become hairy (Anmum, 2014; Siojo, 2015).

Taking vitamins could deform the fetus and therefore many women do not take any vitamins while they are pregnant. If women eat blackberries while they are pregnant, the baby will have black spots (Purnell, 2009).

How a pregnant woman acts, the things that happen to her and even what she thinks can have a major impact on her growing baby so if a mother was told that her child was in the breech position, her significant other should walk down a flight of stairs, on all fours, with the head down so that the fetus would turn and be born normally, also, some visitors are not allowed to stand-by or sit at the threshold of the house by a pregnant woman for it will result to difficult delivery or long labor (Wilde, 2017; Siojo, 2015). Other example, majority of Japanese women strive to give birth without the use of painkillers according to Ai Azuma, a Tokyo native. This preference relates to the Buddhist perception of suffering which links to the belief among Japanese that labor pains act as a kind of test that a woman must endure in preparation for the challenging role of

motherhood (Schalken, 2017). Some avoid intercourse before and after delivery (WHO, 2013).

If a pregnant woman wants to avoid the unpleasant symptoms of pregnancy, she should step over her husband while he is sleeping and all of her symptoms will be transferred to him. A person should not share and eat a pregnant woman's food leftover or else, doing so will make him or her drowsy throughout the day. Aside from being sleepy, the person will also feel nauseated just like having morning sickness (Yan, 2011; Domingo, 2013). It is also advised that the house's doors and windows should be kept wide open during childbirth to help assure that the pregnant woman will have an easy and safe delivery which some mothers believe that walking counter clockwise inside the house seven times after which she must kick a cat or a dog so that prolonged labor pains will be transferred to the animal (Domingo, 2013; Vecin, 2007). Some believes that pregnant woman who watches a lunar eclipse is in danger of having a miscarriage. She must not leave the house at sundown or twilight without wearing a shawl on her head to prevent giving birth to a bald child (Fojas, 2012).

There are also physical beliefs to the outcome of the baby like the American Indian mothers believe tying knots or weaving will cause birth complications associated with cord accidents. Mexicans believe in a number of superstitions such as observing a lunar eclipse will cause the developing baby to have a cleft lip/palate, or an infant may resemble a particular fruit if the mother craves that fruit (Lau & Wong, 2008; Clark, 2014).

The majority of women are cared for and delivered by traditional birth attendants who are members of their extended family in Areas of Zimbabwe with easy access to Western-type delivery care, (Mutambirwa, 2014) like forty percent (40%) of women in Tonsuya continue to seek the hilots' help. Filipino women are looking for this personal touch that only their traditional birth attendants can provide and instead of their husbands, some women choose their mothers to be their labor coach (Likhaan, 2011; Ramos, 2013).

Some pregnant women and women in labor exhibit their faith and use religious artifacts but some participants supported the idea of getting information related to pregnancy through using books, media, and the Internet instead of using the mother as their main source of information (Aziato, Acheampong & Umoar, 2017; Kridli, Ilori , & Verriest, 2013).

There are also modern ideas and concepts of the cultural beliefs and practices which mothers are practicing. Like Koreans who avoid eating any breakable foods, like cookies or crackers, for fear that it will make their baby sick, and they don't eat duck, for fear that their kids will have webbed feet (Davis, 2017). Chinese women eat cold food such as poultry, fish, fruits, and vegetables. They do not eat hot foods such as red peppers, spicy soups and coffee, because they believe it will cause abortion or premature labor which relates to the Mexican women who tend to be attentive to their bodies. They thought that a pregnant body will crave food that needs to grow a healthy baby, and that, unsatisfied cravings may result in birth defects (Le, Ngai, Lok, Yip, & Chung, 2009; Clark, 2014).

There are women who have been found to promote the well-being of both mother and baby. For example, the belief that alcohol consumption during pregnancy will harm the baby; whereas others have been found to pose possible health risks to mother and baby's well-being but in reality, pregnancy varies depending on support for the emotional ones which fear is considered a childish emotion, weakness is unacceptable, and a pregnant woman who can't perform her normal chores and duties is sent back to her parents' house until she feels stronger. (M'soka & Mabuza, 2015; Davis, 2017). There are pregnant women often have misconceptions about oral health during pregnancy which prevents them from seeking dental care. These include believing that poor oral health is normal and accepted part of pregnancy or that, dental treatment can harm the fetus. In addition, the relationship between poor maternal nutritional and hygiene status and adverse birth outcomes is complex and multifactorial (Saskatchewan Prevention Institute, 2014; Okunaiya GA, Fadupin GT, Oladeji, 2016).

Patel, Gurmeet, Sinalkar, Pandya, Mahen and Singh (2016) reveals about 58% women had adequate knowledge regarding antenatal care (ANC). It was found that almost all the variables such as age, education, occupation, parity, type of family, and socioeconomic status (SES) have significant association with awareness about ANC. 100% women were having a positive attitude toward ANC. Around 70% women were practicing adequately, and variables such as education and SES have significant association with practices about ANC. The World Health Organization (WHO) recommends that pregnant women should all receive four antenatal visits to spot and treat problems such as possibility of adverse pregnancy outcomes, providing therapeutic interventions and educating pregnant women about planning for safe child birth is imperative and give immunization and screen for health conditions that are likely to increase. WHO also emphasizes that mothers should observe the quantity and periodicity of prenatal visits (DOH, 2009; WHO, 2010). For prenatal care, WHO emphasizes that mothers should observe the quantity and periodicity of prenatal visits (WHO, 2009).

In the Philippines, prenatal care is widely accepted practice. Almost 96% of mother had visited a health provider for their prenatal care (NSO & Marco International, 2010). The goal of the Department of Health through the Maternal, New born, and Child Health and Nutrition (MNCHN) strategy is to have 80% of pregnant women with at least four prenatal visits by 2010 and 100% by 2015 (DOH, 2009). Some perceived modern beliefs and practices as "foreign" to their cultural context like some believes in the power of quacks and faith-healers to cure certain ailments that physicians could not—they believe in the power of witches to inflict illness on any individual who has incurred their displeasure (Raven & Chen, 2007; "Living in the Philippines", 2017). Therefore, regarding these taboos behavior, nurses should offer health education among pregnant women on proper practice maternal health care activities (Koeryaman & Trisyani, 2012). Like in Cambodia, traditional medicine was commonly described as being used at two time points,

one month before birth, to help the baby to be born more easily and postpartum to increase breast milk production. The use of different plants were described, most of which were brewed in hot water to make a tea. (Sreymom Pol & Kamsan Suon, 2017; Turner, 2017). But with 30 percent (30%) of all births taking place at home, the Netherlands boast the highest rate of home births in the world with a great emphasis on following dietary guidelines, traditional remedies, clothing and jewelry and presence of extended family members like women from India (Expatica, 2017; Cousik & Hickey, 2016).

The role of culture is considered critical in terms of pregnancy. It concerns with relationships that exist, opinions that are held, process that are going on, effects that are evident, and trends that are developing. It is primarily concerned with the present, although it often considers the past events and influences the current conditions. Health beliefs related to pregnancy and childbirth exist in various cultures globally. Healthcare practitioners need to be aware of these beliefs to contextualize their practice in their communities (M'soka, Mabuza, & Pretorius, 2015).

Based on the reviewed literature and studies, they were found to be in support with the present study. However, there were limited studies about mother's health beliefs and practices on prenatal in the Philippines, particularly in the Province of Albay. These are gaps identified by the researcher. There is a need to strengthen pregnant women's perception about their cultural health beliefs and practices. This paves way for assessing the pregnant women's cultural beliefs and practices in prenatal care or antenatal care. Although there are some similarities on the topics discussed, no duplication was made. This is the gap that the researcher will intend to bridge.

This study aims to assess the cultural beliefs and practices of mothers in accessing prenatal care in Barangay Buyoan, Legazpi City. Specifically, it answers the following questions regarding the profile of the mothers in terms of: age, civil status educational background, religion, and monthly income. It also determine the cultural beliefs and practices of mothers on prenatal care along physical, physiological, psychosocial, and spiritual aspects. Furthermore, the researcher explored the factors that contribute to the cultural beliefs and practices of mothers on prenatal care. After all these were taken, proposed measures will help to minimize cultural beliefs and practices so that healthy pregnancy may occur.

The Transcultural Nursing Theory by Madeleine Leiniger involves knowing and understanding different cultures with respect to nursing and health-illness caring practices, beliefs and values with the goal to provide meaningful and efficacious nursing care services to people according to their cultural values and health-illness context. It focuses on the fact that different cultures have different caring behaviors and different health and illness values, beliefs, and patterns of behaviors.

Transcultural nursing is defined as a learned subfield or branch of nursing which focuses upon the comparative study and analysis of cultures with respect to nursing and health-illness caring practices, beliefs,

and values with the goal to provide meaningful and efficacious nursing care services to people according to their cultural values and health-illness context. This is the study of nursing care beliefs, values, and practices as cognitively perceived and known by a designated culture through their direct experience, beliefs, and value system (Leininger, 1979). The cultural care worldview flows into knowledge about individuals, families, groups, communities, and institutions in diverse health care systems. This knowledge provides culturally specific meanings and expressions in relation to care and health. The next focus is on the generic or folk system, professional care system(s), and nursing care. Information about these systems includes the characteristics and the specific care features of each. This information allows for the identification of similarities and differences or cultural care universality and cultural care diversity. Next are nursing care decisions and actions which involve cultural care preservation/maintenance, cultural care accommodation/negotiation and cultural care re-patterning or restructuring. It is here that nursing care is delivered.

The self-care deficit theory proposed by Orem is a combination of three theories (i.e. theory of self-care, theory of self-care deficit and the theory of nursing systems). In the theory of self-care, she explains self-care as the activities carried out by the individual to maintain their own health. The self-care agency is the acquired ability to perform the self- care and this will be affected by the basic conditioning factors such as age, gender, health care system, system etc. Therapeutic self-care demand is the totality of the self-care measures required. The self-care is carried out to fulfill the self-care requisites. There are mainly three (3) types of self-care requisites such as universal, developmental and health deviation. Whenever there is an inadequacy of any of these self-care requisite, the person will be in need of self-care or will have a deficit in self-care. The deficit is identified by the nurse through the thorough assessment of the patient. Once the need is identified, the nurse has to select required nursing systems to provide care: wholly compensatory, partly compensatory or supportive and educative system. The care provided according to the degree of deficit the patient is presenting with.

Once the care is provided, the nursing activities and the use of the nursing systems are to be evaluated to get an idea about whether the mutually planned goals are met or not. Thus, the theory could be successfully applied into the nursing practice.

The conceptual framework of the study is illustrated in Figure 1. The main goal of the study is to assess the cultural beliefs and practices in accessing prenatal care.

The study will be anchored with two theories of Leininger's Transcultural Nursing Theory or Culture Care Theory and Orem's Self-Care Deficit Theory. These consist of concepts that are placed within a logical and sequential design.

Primarily, the researcher has to determine the demographic profile of the mothers in terms of age, civil status educational background, religion, and monthly income. It also has to determine the

cultural beliefs and practices of mothers in accessing on prenatal care along physical, physiological, psychosocial, and spiritual.

Furthermore, the researcher investigated some factors encountered by mothers in cultural beliefs and practices in prenatal care so that necessary measures can be provided to mothers to enhance their health belief and practices on prenatal care.

METHODS

This study is an ethnographic design. Ethnography is a description and interpretation of a cultural or social group or system, and the focus of the ethnographic researcher examines the group's behavior, customs and way of life. The study was developed based on the proposal of ethno-nursing guided by the following key-enablers: interaction and

engagement through immersion-observation-participation-reflection and by a semi-structured interview, which consisted of closed questions for the informant's identification and of open questions related to the experience of the of the participant in the care to women, and the perception of cultural values that guide this care.

The locale of this study is in Barangay Buyoan, Legazpi City. The participants are composed of six mothers and the key informant were the Barangay Health Worker assigned in the same place. It is a non-probability sampling method Purposive sampling was used in this study. It is a sampling technique in which researcher relies on own judgment when choosing members of population to participate in the study.

Data collection was made in terms of one on one interview using an interview guide. The research team (primary author and two research assistants) conducted each interview in the interviewee's language of choice either Bicol or Tagalog. Interviews will be audio-recorded and transcribed verbatim by research assistants. The research team identified dominant themes through the categorization of phrases and terms most frequently mentioned in transcripts and analyzed the data. All data and themes were stored for analysis.

RESULTS

This section described the different observations and claimed the different participants enunciated during the interview, and were classified based on the objective statements of the problem of this study. In addition, this also contains the remarks about the participant'sbehavior throughout the direct observation. The statements of the participants were confirmed through the testimonials of the key informants. The key informants were the Barangay Health Workers from Barangay Buyoan, Legazpi City.

Each theme that emerged from the data is discussed, described, and supported with examples of actual data. Following this section discussion of implications of these themes can suggest ways to address the problems that were found.

Demographic profile

Participant 1 stated that she is twenty-one

(21) years old and currently living-in with her boyfriend, she is a high school graduate, a Catholic, and their monthly income is five thousand pesos (Php 5,000.00) with doubt.

Participant 2 is thirty (30) years old. She is married. Her educational background is Secretarial for a year and it is a vocational course. She is a Catholic, and their monthly income is two thousand, five hundred pesos (Php 2,500.00).

Participant 3 is twenty-six (26) years old, she is married and has two (2) livingchildren. She studied in Bicol University, a BSN student graduated on the year 2011. She is a Roman Catholic and their monthly income is four thousand pesos (Php 4,000.00) only because her husband does not have a regular work.

Participant 4 is twenty-two (22) years old, she is single, a high school graduate and a Roman Catholic. When asked about monthly income, she has no idea because the participant is dependent on her parents.

Participant 5 is eighteen (18) years old, and a second year college undergraduate. Their monthly income is 500 per day. She was married last July 2017.

Participant 6 laughed when I asked about her age. She is thirty-three (33) years old. She is currently married and a high school graduate. Her husband is a Muslim however, she is a Roman Catholic.

"Suwe" kami kasi di kami pareho ng religion." (We are opposite because we are not in the same religion).

Their monthly income is:

Siguro mga 3k-5k." (I think its three thousand to five thousand pesos only.)

This is because her husband did not return overseas and doesn't have any work at the moment.

Cultural Beliefs and Practices of Mothers on Prenatal

Physical Aspect

As pregnant woman goes through the period of pregnancy, she is more concern about her physical characteristics which transforms as weeks pass by. They consider the cultural beliefs and practices about physical aspect that influenced them.

Participant 1 explained that she believes in some cultural beliefs and practices on pregnancy. She had a number of cultural beliefs and practices that she tracks on. Her response when questioned what are her cultural beliefs and practices on her physical aspect was:

"Nagalahid suwa sa tulak." (I put lemon on my stomach).

Moreover, she demonstrated on exactly how she puts the lemon on her stomach.

They key informant's perception about what participant 1's knowledge is that it is what the old folks were trying to demonstrate to the next generations to avoid

bad spirits who wants to attack the pregnant mother.

"Su mga sadtong sa gugurang pigtutubudan iyan para sa mga multo o aswang na muya kuwaon ang bados." (The old folks believes ghosts and bad spirits that they will get the pregnant mother.)

Participant 2 had also devotion that she also rely on cultural beliefs and practices. She had a different perception about CB&P.

"Bawal magkaraon ki anu ano, mga gulay na talong arog kaan." (Must not eat different foods, like eggplant)

Also, she stated:

"Tapos itong bawal magpara laag ki towel sa balikat." (It is not advisable to put towel on the shoulders).

The key informant said about eating eggplant is because if they eat some violet foods, the baby may possibly turn out to be necrotic or will become a blue baby. In addition, about placing towel on the shoulders is because their baby might experience a cord coil on the neck. The towel signifies the umbilical cord and placing it on their shoulders might be a mistake that their baby will turn out to have a cord coil.

Participant 3 doesn't believe anything at all about some physical cultural beliefs and practices.

Participant 4 has a related cultural beliefs and practices to Partcipant 2;

"Su mga sagugurang baga dai daamagpara-saklay ki anu-ano, mga labakara ngaya sa may balikat ta iyo itong sa aki napupuluputan ang liog." (The old folks alleged not to place towel/s on the shoulder because it may project on baby's cord coil on the neck.)

In addition:

"Su itong dae daa magparakaon mga violet baga pili, su uya na talong ta sabi kang mga gurang su uya na ang aki ki su ang skin nya su minaitomon baga." (Don't eat violet foods like eggplant and pili because the old folks said that the baby will become black when delivered).

Participant 5 is very particular about her beliefs.

"Yung sa prutas bawal daw yung pinya buda papaya." (Fruits like pineapple and papaya is also forbidden).

Participant 6 is also the same perception as Participant 3.

"Dae naman kaya yan tigsusunod na mga paniniwala, pero siguro su yan su mga... pero ngunyan talaga gare dae naman na." (This beliefs are no longer being followed this time.)

When the researcher asked the key informant about this insight, she then stated:

"Ang iba talaga dae man nagaturubod na ta iba na baga ang panahon ta ngunyan." (Many of us doesn't follow these cultural beliefs and practices in this time of generation-modern generation.)

Psychological Aspect

Pregnant woman must understand the normal psychological changes that occur throughout the different stages of pregnancy. Women are anticipating childbirth and coping with significant physical changes. While fears of losing the baby have usually disappeared by this point, worries about labor and birth are also common.

Participant 1 is on her straight point about her perception to her cultural beliefs and practices.

“Kung pano mag aki.” *smiles* (How to deliver the baby *smiles*)

Participant 2 has the same perception to Participant 1;

“Anong tig-iisip… hahaha… syempre ang isipon su maray ang akion mo.” (of course, the wealth of the baby).

Participant 3 is an unconcern person, when asked;

“Wara man...” (Nothing.) Is her answer.

Participant 4 states:

“Dae man ta limang bulan ko naaraman na bados na ako. Nagapangadyi lang ako.” (I knew that I was pregnant when it wasalready 5 months old. I just pray then.)

Participant 5 insight is

“Yung ano, maging healthy yung baby.. natatakot ako.” (I want my baby to be healthy.Furthermore, participant 5 is afraid.)

Participant 6 is very verbose and actively participating throughout the interview

“Wala naman kasi, yung una papacheck up ko meron daw akong cyst... Polycystic ako. That time kaya parang pag balik ko nawala na ung cyst kaya nawala yung alalahin ko na sana maging okay… pag ganun kasi na sinusundan agad yung baby, may tendency na nagkakaroon ng cyst yung ovary.” (By the time that I had my check-up, the doctor said that I have a cyst, that I am a polycystic person so after many months I went back for one more check-up. Surprisingly, the cyst was already gone so I am confident and my worries are gone… If you instantaneously conceived a baby after having baby for 1 year, there is a tendency to have a cyst in the ovary.)

Social Aspect

Society affects our philosophy when it comes to influencing others and make them monitor of how the society affects us in ways that deal with us rather than us, dealing with it.

Participant 1 expressed her outlooks when questioned how the society affected her beliefs and practices during pregnancy.

"Dae daa magparainom ki malipot… Dae daa magluwas pag banggi pag bilog ang bulan." (Don't drink cold beverages… Don't go out when it's already late night especially when it is a full moon.")

Participant 2 states that:

Syempre mga tugang ko nakaimpluwensya su mga sagugurang." (My siblings influenced me about the old folk's sayings.)

She thinks that her family influenced her about their cultural beliefs and practices. She doesn't give any examples of what they have told her.

Participant 3 has similar response when it comes to drinking cold water. She then stated that:

"Dae magkaon ki malipot or maginom malipot tapos dae magkaon ki maamis bawal baga yan sa bados." (Must not drink cold water or beverages and must not eat sweets/chocolates because it is not good for pregnant women.)

Participant 4 talks in minimal way. She just said:

"Su mga bawal..." (Things that are not good/prohibited).

Participant 5 states…

"Dae daa mag tukaw sa pwertahan…" (Must not seat in front of the door…)

This is one of the beliefs and practices that I asked the key informant why they need to follow and she answered me that they think that if they block the doorway, it can lead to a difficult delivery.

Participant 6 thinks that this generation doesn't anymore follow the cultural beliefs and practices. She then stated:

"Wara naman ta kung ano ngunyan su latest iyo na.. Kasi sasabihin nila uhhh wag kakain ng malamig eh kung napakainit andiyan yung malamig hindi kaba ma attempt na maano edi iinom ka talaga." (Nothing, because if that is the trend that is what I follow. Some said don't drink cold water but what if it is too hot? Don't you think you will not crave not to drink cold water?).

Spiritual Aspect

Religion is the first sense of community. Your sense of community occurs by the reason of mutual experience with others. Religion has the sense of community and with its people there must be real trust and integrity. (Hubbard, 2014)

Participant 1 said that every Friday she goes to Santo Cristo Chapel.

"Nagsisimba burubyernes. Sa Santo Cristo, every Friday." (We go to church every Friday at Santo Cristo Chapel.)

Filipinos are known to be very religious people. They praise every saint that they believed in. Participant 1 is one of the examples of a religious person.

Participant 2 also asks God's guidance for her pregnancy.

"Nag aagad ki tabang sa Mahal na Diyos." (I ask for God's help…)

Participant 3 states:

"Ay wara man problema gabos kami didi Katoliko dai man every Sunday naga simba, pag minsan nagasimba pag may time." (There is no problem here in our family because we are all Roman Catholic and we come to church seldom, if there's time.)

Participant 4 also comes to church every Friday and Sunday.

"Nagasimba pirmi, every Sunday tska Friday." (We always go to church every Sunday and Friday.)

Participant 5 states…

"Nagasimba pirmi, every Sunday." (We always go to church every Sunday.)

Participant 6 says:

"Not all the time nagasimba kasi asawa ko Muslim… ano kami suway... hehehe" (We don't go often to church because my husband is a Muslim and I'm a Catholic… We were contraries *laughs*)

Factors that Contribute to the Cultural Beliefs and Practices of Mothers on Prenatal

There are factors that may contribute in the perception of mothers about prenatal cultural beliefs and practices. These factors influenced mothers on dealing with these cultural beliefs and practices by their actions and activities of daily living.

Participant 1 states:

"Sa Lying-in sa Bitano. Kay Tita Vic Azores" (In the Lying-In in Bitano. Tita Vic Azores) Tita Vic Azores is the midwife in Barangay Bitano.

I also asked if she goes to a manghihilot and states:

"Magpapahilot ako pag pitong bulan para sa posisyon kang aki." (I am planning to go to "hilot" in 7 months for the position of the baby…)

Participant 2 said:

"Sa Lying diyan…sa midwife, doctor… ta tigbabawal baga iyan hilot" "(Here in Buyoan's Lying-in Clinic to the midwives and doctor. "Hilots" are now prohibited) She knows that it is now banned to visit manghihilot.

Participant 3, states:

"Sa lying in, BRTTH, sa Che Birthing Home sa Bitano sa midwife…nagpahilot man ako pero sarong beses lang para sa posisyon." (Lying-in, BRTTH and Che Birthing home in Bitano. I am consulting to the midwives. I do go to "hilot" but just once for the baby's position.)

Participant 4,

"Ano yan dito sa Lying in… "Midwife... saka dae man ako nagpapahilot pero santigwar iyo." (Here at Bitano's Lying-in to the midwives but I do not do the massaging of the abdomen but I go to the faith-healers.)

Participant 5 said:

"Digdi lang sa arani lying in, sa midwife… pero may balak ako magpahilot..." (Just here in the Lying-In clinic but I have plans to go to faith-healers.)

Participant 6, states that

"Uhmm every month nagapacheck up ako kay Andamon." (I am having my monthly check up at Andamon Clinic.)

Proposed Measures

Proposed measures would represent a significant step of efforts to assure appropriate intervention for women who practice their cultural beliefs and practices on prenatal care. In line with this, it provides a basis from which necessary changes might occur.

Participant 1 states that:

"Hhmm magkaon sa tamang oras at pagkaturog…" (Must eat in the right time and sleep at the right time.)

She clearly knows the right thing to do for her good health and her baby.

Participant 2 states

"Syempre bawal magparainom ki mga anu anong bulong, bawal ka ma-istress." (Of course, not to drink any medicines and must not stress.)

She knows that drinking medicines without prescription is prohibited. She also states that stress may contribute to her and the baby's health condition.

Participant 3 states:

"Ayjusko ako ngani tulong beses na nadisgrasya...su mga bawas maaskad na pagkaon…" (I have gone through many accidents… I must not eat sour food…)

Participant 4 states that:

"Dae magparaluwas pag banggi, bawal na inumon na bulong." (Must not go outside when it is dark and don't drink medicines.)

She believes that going outside when it's in the evening is bad.

Themes and Subthemes of the Study

The researcher explored th participants' responses and explained six themes that described their perspectives on their cultural beliefs and practices on prenatal care. "Views on prenatal cultural beliefs and practices" has two subthemes which they practice that consider violet foods may lead to necrotic baby and towels on shoulders leading to cord coil. "Discerning protection" has also two subthemes which are patient's perception to safe delivery and drawing on God and prayer. "Noticing limits" has also two subthemes which are the avoidance of drinking cold beverages and keeping self at home during night time. "Appreciation of spiritual traits" has three subthemes about participation on church mass, devotion to God and seek guidance through prayer. "Deficient resources and awareness" has two subthemes which they trust midvies and rely on power of quacks and faith-healers. The last theme is the "Concern of one's well-being" that has two subthemes about afraid of ingestion of different medicines

and take well nourishing nutriments. Each themes were discussed using examples from participant's statements. List of themes and subthemes can be found in the table.

Views on Prenatal Cultural Beliefs and Practices

All of the participants talked about how they may avoid complications during and after pregnancy. It is from their own judgment on how to perform their cultural beliefs and practices. Two subthemes were recognized further elucidate views on prenatal cultural beliefs and practices. It includes ingestion of violet foods that may affect their baby which results to necrosis of the newborn. In addition, placing towels on shoulders may lead to newborn's cord coiling. Two of the participants has the same result as the researcher asked about their opinions.

Jean talked about her perception:

"Bawal magkaraon ki anu ano gulay na talong arog kaan. Tapos itong bawal magpara laag ki towel sa balikat." (They said not to eat different foods especially eggplants and avoid putting towels around the shoulder.)

Sarah Jane talked about how the old folks tend to avoid putting something on the shoulders that may portray newborns cord coil and her view about eating violet foods such as Pilinuts and Eggplants.

"… Su mga sa gugurang baga dai daa magpara saklay ki anu ano, mga labakara ngaya sa may balikat ta iyo itong sa aki napupuluputan ang liog. Su itong dae daa magparakaon mga violet baga pili, su uya na talong ta sabi kang mga gurang su uya na ang aki ki su ang skin nya su minaitomon baga." (Like the old folks said, avoid putting something around your shoulders because it might lead to cord accidents like cord coiling around the baby's neck and those ciolet foods like eggplants, pilinuts because that may lead to a violet baby.)

Table1. Themes and subthemes

Themes	Subthemes
Views on prenatal cultural beliefs and practices	• Considers violet food may lead to necrotic baby; and • Towels on shoulders leading to cord coil
Discerning protection	• Patients' perception to safe delivery; and • Drawing on God and prayer
Noticing limits	• Avoidance of drinking cold beverages; and • Keep self at home during night-time
Appreciation of spiritual traits	• Participates on church mass; • Devotion to God; and • Seeking guidance through prayer
Deficient resources and awareness	• Trusts midwives; and • Rely on power of quacks and faith-healers
Concern of one's well-being	• Afraid of ingestion of different medicines; and • Take well nourishing nutriments

Discerning protection

As pregnant mother goes through her pregnancy, it is normal for her to be overprotective to her baby's development. This is the moment wherein participants feel that they are unease. Two subthemes were acknowledged; patients' perception to safe delivery and drawing on God and prayer. Three participants were concerned about the baby's outcome.

Abygail, Jean and Shaira mentioned:

"Anong tig-iisip… hahaha" syempre ang isipon su maray ang akion mo…

"Kung pano mag aki." *smiles*…"yung ano, maging healthy yung baby, natatakot ako." (What am I thinking? Hahaha! Of course the baby's health and how to have a safe and healthy delivery.)

Sarah illuminated:

"Dae man ta limang bulan ko naaraman na bados na ako. Nagapangadyi lang ako." (I didn't know I was pregnant until 5 months but then, I was praying.) This relies on her spiritual view as she seeks the presence of God to give her strength throughout the delivery process.

Noticing limits

One of the subthemes talked about avoidance of drinking cold beverages which three of the participants has the same insight.

Abygail, Melody and Myra says:

"Dae daa magparainom ki malipot…" (Stop drinking cold drinks.)

Concerns about safety and risk during pregnancy and birth are critical for women to ensure maternal and newborn survival. Abygail spoke about "keeping herself home during night time."

Social factors also influence them to do such things. They seek pieces of advice from old folks and "sabi-sabi" (rumors) which they tend to follow and practice at this modern era.

Appreciation of Spiritual Traits

During pregnancy, women intensify their prayers to God for protection, safe delivery and blessings. Pregnant women would explore all spiritual and traditional options to ensure that they deliver spontaneously. Women commune with God and thru prayers that were offered, it increases their faith and hope in God and it affords them the confidence discerning about a safe delivery.

Three subthemes were gathered: participates on church mass, devotion to God and seeking guidance through prayer. Five of the participants shared their thoughts about their spiritual habits. All of them go to church and pray for their safe pregnancy.

Deficient Resources and Awareness

Filipino citizens find it hard to eradicate some practices which ties to the

"old sayings" and "what ifs" of our ancestors. Four of the participants still visit the quacks. Quackery is defined as the promotion of fraudulent or ignorant medical practices. Two subthemes were pointed out by the participants. They trusts midwives and rely on power of quacks and faith-healers.

"Nagpapahilot" means massaging the abdominal part is one of their cultural beliefs and practices. They believe if they do this practice, the position of the baby will be fixed to normal position that will lessen the difficulty in labor and delivery.

Lack of knowledge sometimes leads to jeopardy. It is the nurse or any medical team obligation to educate and practice therapeutic technique with these cases

Concern of One's Well-being

Nutrition plays a quintessential role regarding maternal and child health. However, this aspect is certainly interlinked to perceived notions and beliefs with regards to food to be consumed by pregnant and lactating women. Two subthemes used by the participant's include "afraid of ingestion of different medicines" and "take well nourishing nutriments." Melody, Shaira and Myra talks about eating healthy for the welfare of the baby.

They said:

"Uhmm magkaon sa tamang oras…..su mga bawas maaskad na pagkaon…. Dapat magkaon ki healthy food." (Must eat at the right time and lessen salty food. Eat healthy foods.)

Jean and Sarah's insight about ingestion of unnecessary medicines without consulting their doctor might affect the growing baby.

"Syempre bawal magparainom ki mga anu-anong bulong. (Must not drink different kinds of medicines)

Participant 2, must not drink unprescribed medicines.

Participant 5:

"Dae parairo maray, tapos yung loose na bado dapat suluton, tapos yung mga healthy foods." (Must not move exceedingly and wear loose clothes and eat healthy foods.)

Participant 6 states:

"Sabi kasi ng doctor sakin, hanggat may makakain ka,kain ka lang ng kain kasi yung mga makukuha ng baby na nutrition kasi kung di ka naman kakain, mapili ka wala makukuha yung baby…" (According to the doctor, I must eat a lot because it will be beneficial to my baby. If I am too choosy about food, my baby will get nothing.) She speaks very well about the nutrition she want her baby to get.

DISCUSSION

The researcher interpreted and described the significance of the findings in line of what other researchers have already done. The research problem being explored and explained is the understanding or

insight about the problem after the findings had taken into consideration.

Demographic Profile

Patel, et.al., (2016) reveal about 58% women had adequate knowledge regarding antenatal care (ANC). It was found that almost all the variables such as age, education, occupation, parity, type of family, and socioeconomic status (SES) had a significant association with awareness about ANC (DOH, 2009; WHO, 2010). The participants ranged in 18 to 33 years old. Age and education can affect how well their pregnancy and birth goes, as well as the baby and mother's health. Maturity level of the mother's perception is important. At an early age, mothers are in denial about their situation or they don't know where to turn for advice. As a result, they often don't seek medical care, believes on what their descendants, end up eating an unappropriate diet or taking care of themselves the way pregnant mothers should. Income also plays an important role in pregnancy. Poverty brings many challenges in healthcare delivery ("USDHHS", 2010). If mothers do not have that capacity to buy the needs of the growing baby, as well as the physical and physiological necessities, this may lead to unhealthy pregnancy.

Cultural Beliefs and Practices of Mothers on Prenatal Care

There are also physical beliefs to the outcome of the baby like the American Indian mothers believe tying knots or weaving will cause birth complications associated with cord accidents. Old folk practices of American may include pica (i.e. ingestion of non-food item), use of herbal medicines, wearing of garlic, and silver bracelets and some mothers believe in applying chewed leaves or saliva on the baby's abdomen to treat stomach pain or bloated belly (Gunn & Davis 2011; Ebuenga, 2014). This relates to the study which cultural beliefs and practices that the mother's tracks about eating eggplant. They believe that eating some violet food, may possibly turn their babies into necrotic. In addition, about placing towel on the shoulders is because their baby might experience a cord coil on the neck. The towel signifies the umbilical cord and placing it on their shoulders might be a mistake that will turn out to have a cord coil.

Physiological

Pregnancy and motherhood are such exciting times in a woman's life and it is described that a happy mother is thought to ensure joy and good fortune because the unborn child learns, communicates, and responds in uterus (Glorioso, 2013; Corbett & Callister, 2012). Women are anticipating childbirth and coping with significant physical changes. There are fears of losing their baby and worries about labor and birth are also common in the study.

Social

The majority of women are cared for and delivered by traditional birth attendants who are members of their extended family in Areas of Zimbabwe with easy access to Western-type delivery care, (Mutambirwa, 2014). In the study, their family influenced them about their cultural beliefs and practices. Lots of practices were being practiced by the mothers. In the related

literature, Chinese women eat cold food such as poultry, fish, fruits, and vegetables. They do not eat hot food such as red peppers, spicy soups and coffee because they believe to cause abortion or premature labor (Le et.al. 2009) but this was not true in the study. Pregnant women avoid eating or drinking cold food/beverages because these might affect the baby's health inside. In addition, visitors are not allowed to stand-by or sit at the threshold of the house, the pregnant woman will result to difficult delivery or long labor (Wilde, 2017; Siojo, 2015). It is also advised that the house's doors and windows should be kept wide open during childbirth to help assure that the pregnant woman will have an easy and safe delivery (Domingo, 2013) that mothers in the study also practice.

Spiritual aspects.

During pregnancy, women intensify their prayers to God for protection, safe delivery and blessings which some woman believes that offering sets of goods pay respect to the traditional birth attendant (Aziato, 2015; Jirojwong, 2010). Pregnant mothers in the study were also practicing this kind of behaviour. They believe through Saints and prayers will guide them to a safe pregnancy.

Factors that Contribute to the Cultural Beliefs and Practices of Mothers on Prenatal Care.

Forty percent (40%) of women in Tonsuya continue to seek the hilots' help. Filipino women are looking for this personal touch that only their traditional birth attendants can provide and instead of their husbands, some women choose their mothers to be their labor coach (Likhaan, 2011; Ramos, 2013). This relates to the pregnant mothers in the study. They also continue to seek hilots and believe that this may help the position of the baby in the mother's womb.

Proposed Measures

There are women who have been found to promote the well-being of both mother and baby for example, the belief that alcohol consumption during pregnancy will harm the baby; whereas others have been found to pose possible health risks to mother and baby's well-being but in reality, pregnancy varies depending on the support for the emotional ones which fear is considered a childish emotion, weakness is unacceptable, and a pregnant woman who can't perform her normal chores and duties is sent back to her parents' house until she feels stronger. (M'soka & Mabuza, 2015; Davis, 2017). In the study, some participants know that drinking medicines without prescription is prohibited. They also stated that stress and going outside in the evening may contribute risk to them and the baby's health condition.

Implication

There are implications from the research reviewed above that could influence the way health professionals in understanding these cultural beliefs and practices. Respondent cooperation is important for its implications for data quality, as well as its reflection upon research methods and the resulting ethical and regulatory considerations. The cooperation is defined and explained in

detail. Specific attention is given to the importance of respondents.

First, many of the participants have cultural beliefs and practices related to physical aspect. They believe on ingestion of violet foods that may affect their baby which results to necrosis of the newborn and placing towels on shoulders may lead to newborn's cord coiling. They also have their strong faith in their spiritual integrity which they still practice going to church for once a week. Keeping themselves away from harm is one of the good practiced they implement. They know what to avoid and what is not to do. They are influenced by the kind of support and care that participants receive from faith healers or quack doctors. They support this faith community which ensures that patients receive from them.

CONCLUSIONS

In the population examined, traditional practices in early pregnancy were commonly performed. However, no potentially serious neonatal and maternal condition was acknowledged. This study gained in-depth understanding of the women's experiences of their perceptions on it which showed the individuality's beliefs and practices. Women continue to follow the beliefs and practices. The perception of their beliefs and practices were natural and they believed it must be endured. Nurses like us should de-emphasize it during health education programs because it is the right of every woman have adequate knowledge. Midwives and other health care providers should support and encourage women during prenatal activities to allay their fears during pregnancy and the outcome of their baby's health. A good relationship between the midwife and the woman is encouraged so that women will seek professional care which could reduce preventable complications during childbirth. The cultural background of the pregnant woman must be taken into consideration because some are socialized to be stoic. Therefore, we must assess adequately to inform effective measurements to prevent further complications. It is recommended that collaborations between traditional and religious leaders and health clinicians should improve outcomes for everyone. Nevertheless, some ritualized practices can be harmful activities. It is observed that women's lack of knowledge on cultural beliefs and practices is aggravated by poor communication and education. Positive attitudes towards this mode of delivery should be enhanced through various methods, and misconceptions should be corrected. Understanding to women's views, experiences, preferences and social values related to mode of communication helps to explain the decision making processes. To achieve these recommendations, it is necessary that policy makers, health planners, and managers of health systems and other social communities propose suitable strategies to change and encourage women towards their cultural beliefs and practices.

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In vitro Anti-inflammatory Studies of *Plumeria obtusa* L.(Apocynaceae) Leaf Extracts using Human Red Blood Cell (HRBC) Membrane Stabilization method

Espedido, Alfie Benedict[1], Tan, Gilberto[1], Tan, Jeremy Heinrich,[1] Corpuz, Mary Jho-Anne[1,2]

[1]College of Health Sciences, University of Santo Tomas-Legazpi
[2]Faculty of Pharmacy, University of Santo Tomas

ABSTRACT

Plumeria obtuse L., commonly known as "Kalatsutsing puti" in the Philippines is used as an ornament and treatment of wounds and boils. Recent studies have stated that the genus *Plumeria* exhibits anti-inflammatory activity. Inflammation is a common symptom in different diseases. Different anti-inflammatory agents are used to relieve the symptoms of inflammation however, these agents also cause adverse effects with prolonged use. Natural compounds containing flavonoids, terpenoids and alkaloids are known for its anti-inflammatory potentials. The leaves of *P. obtusa* L. were subjected to sequential extraction using solvents of different polarities (methanol, ethyl acetate and hexane). Then the extract was evaluated using phytochemical screening to determine the presence of flavonoids. The extract with the highest flavonoid content was further tested for anti-inflammatory activity using Human Red Blood Cell membrane stabilization assay (HRBC). The methanolic and ethyl acetate extract showed positive result on the phytochemical screening via Shinoda Test. The methanolic extract exhibited the highest flavonoid content with the concentration of 23.49 µg/mL in comparison with the ethyl acetate extract (13.90 µg/mL). The methanolic extract containing the highest flavonoid was subjected to Human Red Blood Cell membrane stabilization assay (HRBC) and was found to inhibit inflammation through the inhibition of hemolysis when the absorbance of 5 samples with different concentration (50, 100, 250, 500, 1000 µg/mL) was measured spectrophotometrically and by calculating for the percent inhibition, yielded: 64.03, 53.71, 58.72, 60.11, and 63.32, respectively. The percent inhibition of the different extracts is not dose-dependent. In comparison to the standard, diclofenac sodium, the methanolic concentrated extract has higher percentage of inhibition indicating that the extract has higher anti-inflammatory activity.

Keywords: *Anti-inflammatory, Inflammation, Plumeria obtusa L., Phytochemical screening, Red Blood Cell membrane stabilization assay (HRBC), % of Inhibition*

INTRODUCTION

According to Lotankar (2016), the response called inflammation is the complex biological response of the primary vascular tissue of the body to harmful agents and damaged cells. Inflammation protects us from infection and foreign substances and is a vital physiological response of tissue repair and limiting damage. The ideal response to inflammation is quick and destructive but is specific and controlled. Inflammatory disorders demonstrate the importance of this balance since inflammatory response in such conditions

can cause more damage than infection. (Garcia-Lafuerte, *et al*., 2009).

Anti-inflammatory drugs are widely available in the market however, these drugs present some side effects (Murugantham, 2015). Both steroidal and non-steroidal anti-inflammatory drugs are used in acute inflammation but are not successful in curing chronic inflammatory disorders. A need to find safer anti-inflammatory compounds is suggested and extracts from different plants in traditional medicine can serve as a possible source (Garciá-Lafuerte, *et al.,* 2009).

Under the family, Apocynaceae, *Plumeria obtusa* L. (Kalatsutsing Puti) is a species of the genus, *Plumeria*. The *Plumeria* genera, are flowering plants thriving in tropical countries (Promad, *et al.*, 2017). The particular species, *Plumeria obtusa* L., was tested *in vivo 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay* and results show that the plant can exhibit an anti-inflammatory property (Lotankar, *et al*., 2016). A different species, the *Plumeria rubra* was tested *in vitro* for antioxidant and anti-inflammatory which yielded positive results (Murugantham, *et al*., 2015). A phytochemical screening and evaluation of *Plumeria obtusa* L. showed a positive result in flavonoids which can be correlated to its anti-inflammatory activity (Dogra, 2016).

This study aimed to quantify the total flavonoid content of *Plumeria obtusa* L. leaf extracts using aluminum chloride colorimetric assay, assessed the anti-inflammatory properties of *Plumeria obtusa* L. (Kalatsutsing puti) *in vitro* using the human red blood cell (HRBC) membrane stabilization method, and compared the difference between the anti-inflammatory activity of the leaf extracts of *Plumeria obtusa* L. in comparison with Diclofenac Sodium as the standard drug using the HRBC stabilization method.

METHOD

The chronology of the study began with the extraction of the leaf extracts to be followed by the phytochemical screening using the Shinoda test for flavonoids, determination of the total flavonoid content using the Aluminum Chloride Colorimetric Assay and lastly, the Human Red Blood Cell (HRBC) Membrane Stabilization Assay.

All methods were conducted at the Saint Martin de Porres building of the University of Santo Tomas-Legazpi

Collection of Plant Material

Fully developed leaves of *Plumeria obtusa* L. were collected at Rawis, Legazpi City and San Francisco, Malilipot, Albay. The identification and authentication were conducted by Manuel D. Ching, Chief, CIPGR Section - Bureau of Plant Industry, Malate, Manila. The leaves were air-dried at a room temperature within the range of twenty-five to thirty degrees Celsius (25-30˚C) for about 2 weeks. The leaves were dried and grinded using a blender and the powdered sample was stored in a dry, clean and well-closed container. The sample was then subjected to sequential extraction using hexane, ethyl acetate and methanol as solvents.

Extraction

The extraction was done through sequential extraction using 3 solvents of increasing polarity: Hexane, Ethyl acetate, Methanol. The air-dried powdered leaves were macerated for 48 hours using a percolator; After which the filtrate was collected and was further concentrated by evaporation with the use of a hotplate.

The percentage yield obtained per solvent was computed using the formula:

$$\textbf{\% Yield} = \frac{wt.of\ extract\ obtained}{wt\ of\ sample} \text{ x } 100$$

Phytochemical Screening (Shinoda Test)

Few fragments of Magnesium ribbon and few drops of concentrated Hydrochloric acid were added to the test solution. A result of change of color from crimson red, pink scarlet, or occasionally green to blue color appeared after few minutes

Total Flavonoid Content

In 100ml of Methanol, 10 mg of quercetin was dissolved and 5 concentrations containing 6.25, 12.5, 25, 50, and 100 µg/mL were prepared using methanol. A 100 mg of methanolic extract of *Plumeria obtusa* L. leaves was dissolved in 5 mL methanol and transferred to 10 mL volumetric flask and made up the volume with methanol is used to prepare the stock solution of the plant. Using distilled water, 1M potassium acetate and 10% aluminum chloride was prepared. The assay was performed using 0.5 mL of each dilution of standard quercetin taken separately in test tubes and of each extract stock solution. The following were added to each test tube 1.5 mL methanol, 0.1 mL aluminum chloride solution, 0.1 mL potassium acetate solution and 2.8 mL distilled water and mixed well. Sample blank for all the three methanolic leaves extract and all the dilution of standard quercetin were prepared using similar manner by changing aluminum chloride solution with distilled water. Before measuring their absorbance, the following prepared solutions were filtered using filter paper. Absorbance was taken at 415 nm against the suitable blank.

Human Red Blood Cell (HRBC) Membrane Stabilization Assay

The blood sample used in the assay was taken from a healthy volunteer who has not taken any Non-steroidal anti-inflammatory drugs (NSAID's) for at least 2 weeks prior to the assay.

An equal volume of sterilized Alsever's solution (2 % dextrose, 0.8 % sodium citrate, 0.05% citric acid and 0.42 % sodium chloride in water) was added and mix to the collected fresh whole human blood sample. The blood sample with Alsever's solution has been centrifuged at 3000 rpm for 5 min. The supernatant was then extracted from the blood sample and removed. Isosaline was used to wash the packed cells. The removal of supernatant and washing of packed cell were repeated thrice. The packed red blood cell volume was measured and was reconstituted as a suspension, with a concentration of 10% v/v, with isosaline.

The stabilization of human red blood cell membrane by hypotonicity induced membrane lysis is the principle involved in heat induced hemolysis. The assay mixture is consist of: 1 mL phosphate buffer, 2 mL hyposaline, 0.5 mL HRBC suspension [10 % v/v] with 0.5 ml of plant extract of various concentration (50, 100, 250, 500, 1000, µg/mL) and standard diclofenac sodium with the same concentration used in the plant extract and control which was prepared by using distilled water instead of hypo saline to produce 100 % hemolysis and incubated for 30 min at 37^{o}C and centrifuged at 3000 rpm for 10 minutes. Using a spectrophotometer, the hemoglobin content in the suspension was estimated at a wavelength of 560 nm.

The reference standard used was diclofenac sodium (25 mg/mL). The experiment was done in three trials and mean values of the three will be considered. The percentage (%) of inhibition, and the percentage (%) Hemolysis was calculated using the formulas, below:

$$Pecentage\ of\ Inhibition\ (\%) = 100 - \frac{Absorbance\ of\ drug\ treated\ sample}{Absorbance\ of\ Control} \times 100$$

$$Pecentage\ Hemolysis\ (\%) = \frac{Absorbance\ of\ drug\ treated\ sample}{Absorbance\ of\ Control} \times 100$$

RESULTS

This chapter presents the statistical treatment of the problems stated in the previous chapters of this study. Data collected were evaluated and findings were based on these analyses.

Extraction procedure

Table 1: *Extraction results of Plumeria obtusa L.*

Solvent Extract	% Yield
Hexane	5.34%
Methanol	6.47%
Ethyl acetate	7.48%

Table 1 shows the weight used and the percent yield of the 3 extracts. Ethyl acetate yielded the highest percentage out of the 3 extracts.

Phytochemical screening for flavonoids

Table 2: *Results of test for flavonoids*

Solvent Extract	Actual Results	Positive Result
Hexane	(-) dark green solution	pink scarlet, crimson red, or blue solution
Methanol	(+) crimson red solution	
Ethyl acetate	(+) blue solution	

Table 2 shows that Methanol and Ethyl acetate extract of *Plumeria obtusa* L. contains flavonoids except Hexane extract. Based on the phytochemical analysis of the plant conducted by Dogra (2016), the methanolic and ethyl acetate extract contains flavonoids, which is responsible for its anti-inflammatory activities.

Quantitation of Total Flavonoid Content

Table 3: *Results of estimation of total flavonoid content of quercetin*

Concentration (Conc.) (µg/mL)	Absorbance (Abs.)
	QUERCETIN WITH $AlCl_3$ (nm)
6.25	0.043
12.5	0.093
25	0.191
50	0.343
100	0.804

Table 3 presents the concentrations of quercetin and their absorbance used to plot the standard curve.

Figure 1 shows the R2 value which is 0.9939 and the slope was used to calculate the concentration of the plant extract with AlCl3.

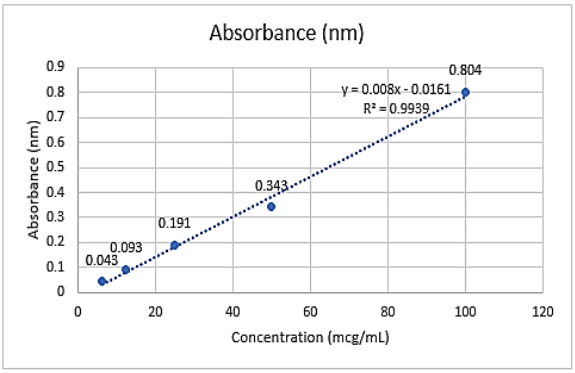

Figure 1: *Calibration curve of Quercetin standard.*

Table 4: *Results of estimation of total flavonoid content of plant extract*

Plant Extract (µg /g)		**Methanol**	**Ethyl Acetate**
Absorbance (Abs)	**Plant Extract w/ $AlCl_3$ (nm)**	0.204	0.127
		0.205	0.127
		0.203	0.128
Avg. Abs.	**Plant Extract w/ $AlCl_3$ (nm)**	**0.204**	**0.127**
Concentration (Conc.)	**Plant Extract w/ $AlCl_3$ (µg/mL)**	23.49	13.86
		23.61	13.86
		23.36	13.99
Average Conc.	**Plant Extract w/ $AlCl_3$ (µg/mL)**	**23.49**	**13.90**
Average Quercetin (µg /g)		**117.44**	**69.52**

Table 4 shows the absorbances and quercetin equivalents of the ethyl acetate and methanol. The table presents that out of the two extracts tested, the methanolic extract exhibited the higher flavonoid content. By plotting the calibration curve of the quercetin standard seen in table 3, the slope together with the absorbance of the extracts measured was used to compute for the concentration in (µg/mL) after which, the quercetin equivalent was calculated by multiplying the concentration with the volume used divided by the weight of the extract.

Human Red Blood Cell (HRBC) Membrane Stabilization Method

The study states that the methanolic extract, based on the data below, showed anti-inflammatory activity in comparison with the standard, diclofenac sodium. The results were based on the absorbance and calculation of percentage of inhibition. This was performed using five different concentrations, specifically, 50, 100, 250, 500 and 1000 µg/mL.

Table 5: *The result of HRBC membrane stabilization activity of Diclofenac sodium*

DICLOFENAC SODIUM				
Sample no.	**Conc. (µg/ml)**	**Avg. Abs. (nm)**	**% Hemolysis**	**% of Inhibition**
1	1000	0.578 ± 0.11	42.38	57.62
2	500	0.633 ± 0.08	46.47	53.53
3	250	0.726 ± 0.06	53.29	46.71
4	100	0.744 ± 0.06	54.56	45.44
5	50	0.821 ± 0.02	60.23	39.77

Table 6: *The result of HRBC membrane stabilization activity of methanolic extract of leaves of Plumeria obtusa L.*

METHANOLIC EXTRACT				
Sample no.	**Conc. (µg/ml)**	**Avg. Abs. (nm)**	**% Hemolysis**	**% of Inhibition**
1	1000	0.490 ± 0.07	35.97	64.03
2	500	0.631 ± 0.12	46.29	53.71
3	250	0.563 ± 0.05	41.28	58.72
4	100	0.544 ± 0.08	39.89	60.11
5	50	0.500 ± 0.04	36.68	63.32

Table 5 and 6 show the diclofenac sodium and methanolic extract with its different concentrations in decreasing order respectively. Absorbance was then measured and percentage of inhibition was calculated. Diclofenac sodium was used as

standard. The higher the percentage of inhibition, the lower the percentage hemolysis and the percentage of inhibition indicating anti-inflammatory activity.

Figure 2 shows that the methanolic extract has greater percentage of inhibition compared with the standard, Diclofenac sodium, with a percentage of inhibition of 64.03, 53.71, 58.72, 60.11, and 63.32, indicating higher anti-inflammatory activity. The standard Diclofenac inhibits hemolysis in a dose-dependent manner as the figure shows that as the concentration increases, the percent of inhibition of the Diclofenac also increases. The methanolic extract on the other hand, does not appear to inhibit hemolysis in a dose dependent manner as the change of % inhibition in the concentrations is fluctuating.

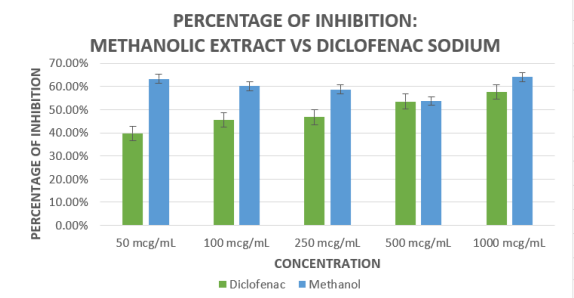

Figure 2: *Comparison Percentage of Inhibition of Diclofenac sodium and methanolic extract.*

n=5, mean ± SEM, Percentage signifies the percent of inhibition provided by both groups, the statistical analysis shows significant value as p<0.005.

Summary of Findings

Inflammation is a biological response of body immune system to harmful stimuli, such as foreign substances, irritants or damage cells and it is a protective response which involve blood vessels, immune cells and molecular mediators. Inflammation can be treated by natural and synthetic anti-inflammatory drugs. Mostly, synthetic anti-inflammatory drugs are used to treat inflammation other than natural anti-inflammatory. But these synthetic anti-inflammatory drugs can induce adverse effects which can worsen the state of the human body. Because of this, medicinal plants with alleged folkloric used as anti-inflammatory activity and pain relievers can be used as a new source of new anti-inflammatory and analgesic drug products which has lesser adverse effects.

One of the aims of this study was to determine and assess the potential anti-inflammatory activity of *Plumeria obtusa* L. leaf extracts by using an in vitro assay, specifically the Human Red Blood Cell (HRBC) Membrane Stabilization method.

In this study, 512 grams of powdered leaves were subjected to sequential extraction to collect the crude extracts using ethyl acetate, methanol and hexane as solvents. Among the three crude extracts, the ethyl acetate extract showed the highest percentage yield.

The leave extracts of *Plumeria obtusa* L. extracted from each solvent were screened qualitatively for flavonoids using the Shinoda test. The methanolic and ethyl acetate extracts of *Plumeria obtusa* L. have shown to have a flavonoid content which is a constituent possessing possible anti-inflammatory activity.

The concentrated methanolic and ethyl acetate leave extracts were subjected to quantification of their total flavonoid content. The methanolic extract showed the higher quantity of flavonoid present compared with the ethyl acetate extract.

In human red blood cell (HRBC) membrane stabilization method, the methanolic extract, being the extract that has the higher flavonoid content, was tested. Result from this test was assessed by calculating the percentage of inhibition and percentage hemolysis of the extract and compare the data acquired with the

standard, Diclofenac sodium, which has undergone the same procedure. Result showed that *Plumeria obtusa* L. has anti-inflammatory activity.

Conclusion

Throughout the study, ethyl acetate and methanol extract of *Plumeria obtusa* L. possessed flavonoid. Comparison of the results obtained revealed that the methanolic extract has higher flavonoid content than ethyl acetate extract.

Since the methanolic concentrated extract has higher flavonoid content, it can provide sufficient anti-inflammatory activity with lesser volume of concentration.

Based on the results of the *in vitro* test, the methanolic concentrated extract was found out to inhibit inflammation through the inhibition of hemolysis, therefore having anti-inflammatory activity, its degree of inhibition is not dose-dependent, as shown in the tabulation, and the comparison with the standard, diclofenac sodium, the methanolic concentrated extract has higher percentage of inhibition indicating that the extract has higher anti-inflammatory activity.

Since the methanolic concentrated extract has higher flavonoid content. It can provide sufficient anti-inflammatory activity with lesser volume of concentration.

With the results presented, the research concluded that the plant *Plumeria obtusa* L. has anti-inflammatory activity and this finding will give way to future tests of the plant regarding its anti-inflammatory activity and shall add information to one of the plant's properties.

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