

BIBLIOGRAPHY

Deo Ruben B. Mudat, Melicio C. Tagtag, Noel G. Teres, March 2012, Awareness of the Barangay Camp3, Tuba, Benguet Residents on the Source of Water Problem in the Community. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted in Camp 3 Tuba, Benguet. The study determined the awareness of the residents of the said Barangay regarding the water problems in their area. It also determined the cause and effect of water pollution and the shortage of water supply in the community. Recommendations were taken from the residents of Barangay Camp 3 pertaining to the water problem issues.

Through random sampling 50 respondents were selected in the documentation of water problem; questionnaires were used in collecting the needed information, and then a follow-up interview to gather some concrete data.

Many of the respondents are aware of the issues concerning the water problems. The pollutants and causes of water shortage come from the mining activity, agricultural expansion/kaingin, forest extraction and some natural occurrence. The results showed that the respondents are highly aware that the mining activity is the main cause of poor water quantity and quality in the area, followed by agricultural expansion/kaingin.



The most common effect of water problem to the residents and to the community are soil degradation followed by environmental degradation and loss of biodiversity.

According to the residents, water problems reduce crop yield due to the declining of water supply to be used in the agricultural irrigation and some respondents stated that water problem affects the quality of their crops.

On social services, a majority of the respondents are highly aware that they are experiencing insufficient water supply, especially during summer. However respondents are not aware that the water problem can cause skin diseases.

It is recommended that Municipal/Barangay ordinances, Information Educational Campaign, reforestation activities and building more tanks should be implemented. Organic farming should be done by farmers; DENR should monitor the water quality, and similar research on water quality may be conducted by other researchers.



INTRODUCTION

The earth consists of water, there is much more water than there is land. About 70% of the earth's surface is covered in water. But water also exists in the air as vapor and in aquifers in the soil, as groundwater (<http://www.lenntech.com/water-quantity-faq.htm#ixzz1WVhrdQc2>). Water is vital to every living thing in our planet. However, too often it is polluted by sewage, animal waste or dissolved fertilizers and chemicals. (The Grolier Science Encyclopedia, Conservation and the Environment Vol. 10 p.452). Three percent of the water on earth is fresh water. Only 560 trillion (560x10¹²) is in rivers and streams (Scott, 2002). As the most accessible links in the hydraulic cycle the speed and volume of their flow provide direct source of water for domestic, agricultural and industrial purposes, as well as production of energy through hydroelectric power generation. Also, it provides the cooling water for many fossil and nuclear-fueled power plants.

The water that we drink today may have passed through the hydrologic cycle many times and could have existed when dinosaurs roamed the Earth hundreds of millions of years ago. Ninety seven percent (97%) of the world's water is in the saline ocean. Of the three percent (3%) that is fresh, sixty eight percent (68.7%) is in the form of snow and ice, mainly in the polar regions; zero point eighty six percent (0.86%) is in the form of permafrost; thirty point one percent (30.1%) is in groundwater aquifers (many of which are brackish), and just zero point thirty four percent (0.34%) is in rivers, lakes or wetlands (http:

<http://www.Enviro-news.com/article/water-quality-and-quantity>). But Poor water



quality can result in major costs for business, as well as presenting health and environmental, poor water quality has a direct impact on water quantity. Polluted water effectively reduces the availability of usable water in a given area. In a world in which only two point five (2.5) per cent of the water supply is fresh water and unevenly distributed at that – this has serious implications. Recent data from some areas has revealed that sometimes these declines are greater than originally thought. In early 2010, China’s government unveiled its most detailed survey ever of the pollution plaguing the country, revealing that water pollution in 2007 was more than twice as severe as what was shown in official figures, which had long omitted agricultural waste (New York Times, 9 February 2010).

In the cordillera, most of us depend on the spring water; it is any natural surface discharge of groundwater. The location of most spring is controlled by a combination of surface topography and rock structure (Grolier Encyclopedia of Knowledge P.317 vol.17). The challenges of ensuring good water quality and quantity are becoming increasingly prominent as populations increase. People can only directly access groundwater and river water. Together they make up just 1% of the planet’s water and most of this is not evenly distributed. (Cited in Encyclopedia of knowledge, Conservation and the environment Vol 10, P453). Historically to make water more freely available to humans, it was popular to build dams on river systems to store it, or to transfer it from one area to another via pipelines. These days, as the world’s population is increasing, more of the surface and underground water supplies have been used and contaminated, and less fresh water is available. The quality of our water, therefore, is becoming as much of a concern as the quantity.

The growth and the need for vast quantities of water by industry and the expanded requirements for agricultural irrigation place new demands upon available water resources.



Human activities are increasingly disrupting microbial processes and damaging water quality. Because water pollution threatens the availability, quality, and usefulness of water, it is of worldwide critical concern. The study attempts to provide some basic information on the causes and effects of poor water quality and water shortage within Barangay Camp 3, Tuba, Benguet. This will provide technical knowledge and awareness to the people in the area on environmental issues and protection. In addition, the data collected will be used by the Department of Environment and Natural Resources to form a team of local experts and planners for a better management and development master plan. This study will also help DENR personnel in their pre-feasibility study by providing insights as to what causes the water problems and how it affects water supply within the barangay.

Barangay Camp 3, Tuba is situated in the southwestern tip of the Central Cordillera Mountain Range that extends from the northwestern tip of Luzon towards Pangasinan. South of the municipality lies the province of Pangasinan and to the west lies the Ilocos rolling hills. It is hemmed in by the municipalities of Sablan and La Trinidad on the north; the city of Baguio and the municipality of Itogon on the east; and the municipalities of Sison, Pozzorubio and San Manuel on the south.

The municipality's urban area comprises the barangays of Poblacion and Camp 3 having a composite land area of 83.85 km². (19.31% of the total land area.

Geographically it lies between 16° 23' 23" North, 120° 33' 39" East. (Wikimapia.org /20655889/ Alang-Barangay-camp-3-Tuba-Benguet)

The municipality's topography is generally characterized by irregular rugged terrain and steep slopes. It is a plateau with several mountain peaks rising from the table land itself. Mount Santo Tomas, the highest peak in the area soars to 2,252 meters above sea level.



Four major rivers/streams and 49 tributaries/ minor rivers and creeks intersect the landform and serve as the drains of the municipality.

One of the springs found in the Philippines is in Barangay Camp 3 Tuba, Benguet. The continuous indiscriminate conversion of the forest to agriculture as well as kaingin, and the expansion of Philex Mining Corporation is a threat which will eventually make the water unsafe to drink and worsen the shortage of water supply.

The group had chosen to study the status of the source of water at Barangay Camp 3, Tuba, Benguet because of the observable declining of water especially during summer. Result of this study will awaken the residents on the importance of preserving the sources of water.



Fig. 1. Benguet map



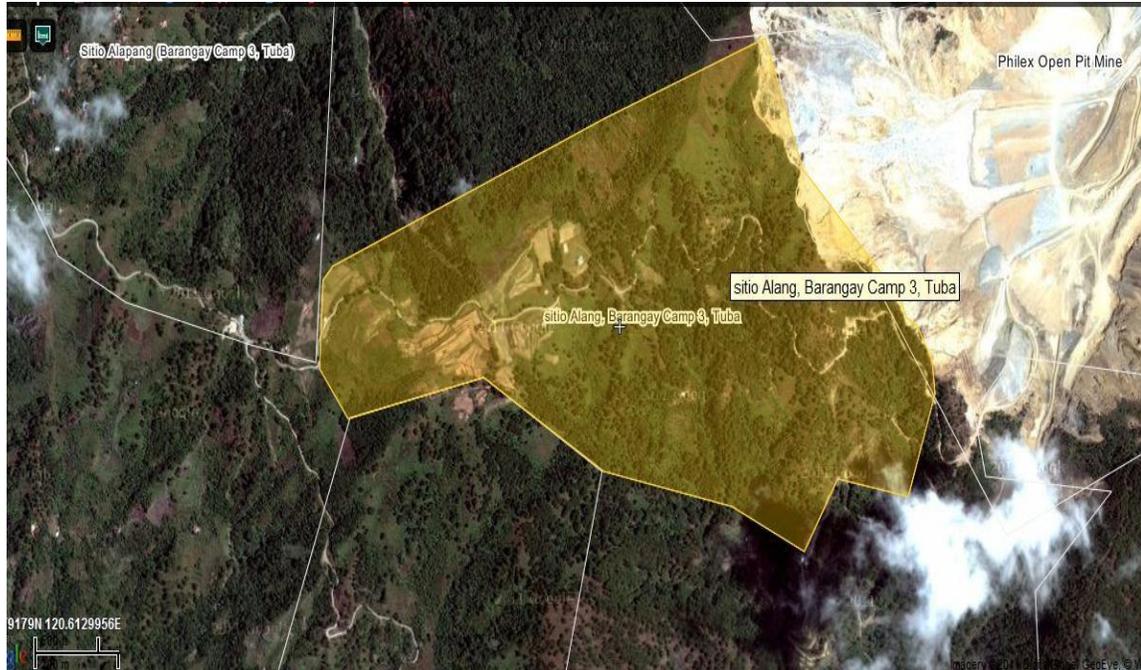


Fig.2 Barangay camp 3, Tuba

Conceptual framework of the study

The importance of public awareness on water is evident due to changes in water technology, the involvement of private and users in water management, and innovations in institutional arrangements.

Moreover, the need and value of water are becoming very high due to fluctuations in rainfall, water pollution, and the impact of global warming. Urbanization and economic development impose another stress on water demand. To address the above issues, a simple model is proposed. This model consists of different variables; the independent variable, dependent variable and the intervening variable. These three elements need to be defined to capture the necessary conditions for effective public awareness and capacity building. To really understand the implications of the above model, we need to define the different variables.

In this framework, the intervening variable is the awareness of the residents of Brgy. Camp 3 that affects the water quality and quantity at Tuba, Benguet. The causes and effect of poor



water quality and declining water quantity will be discussed or determined in the said area. It will also determine the level of awareness of the local residents in the barangay. These also include the socio demographical profile of the community.

The independent variables are the activities that affect water quality and quantity. The most destructive is the mining. Water-pollution problems are caused by mining including acid mine drainage, metal contamination, and increased sediment levels in streams. Sources can include active or abandoned surface and underground mines, processing plants, waste-disposal areas, haulage roads, or **tailings** ponds. Sediments, typically from increased soil erosion, cause siltation or the smothering of streambeds. This siltation affects fisheries, swimming, domestic water supply, irrigation, and other uses of streams. Vast volume of water is also needed by the mining operators in processing the ores, that's why much water is siphoned underground especially during summer.

Plants can only absorb a certain amount of nutrients. So if chemical fertilizer is overused, not all of the chemically synthesized nutrients within it will actually contribute to the plant's health and growth. Instead, the unused fertilizer will seep into the ground, where it can be carried by rain and irrigation ditches into streams, rivers, lakes, reservoirs and oceans. The chemical compounds in the fertilizer can contaminate drinking water supplies and disrupt ecosystems. Agriculture, ground water resources are vulnerable to contamination from many directions. In Alang, some residents say that using inorganic chemicals can really increase their production, without putting in mind the hazardous effects to water system. When inorganic chemicals are applied to crops, some residues remain in the soil and may leach into subsurface of waters, or move to surface water.



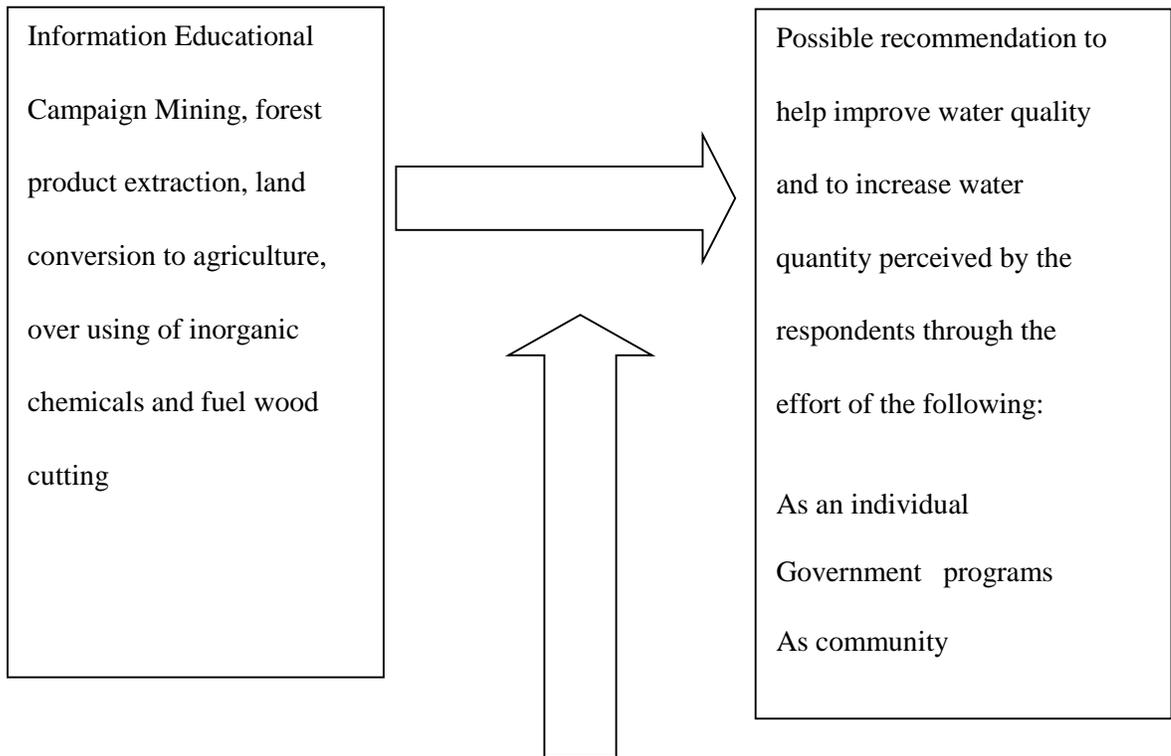
Chemical or physical processes transform residues into products that may also contaminate water. For example, nitrogen fertilizer or nitrogen from animal waste may be transformed first into ammonium and then into nitrates. Nitrates can turn into nitrites and both are detrimental to human health.

Fuel wood cutting, one of the vital functions of forests is to absorb and store great amounts of water quickly when there are heavy rains. When forest trees are cut down, the regulation of the flow of water is disrupted, which leads to alternating periods of flood and then drought in the affected area.

And lastly, it will recommend solutions perceived by the residents of the said barangay. Thus, the dependent variables will be attained if the human intervention or the intervening problems could be solved by such recommendations provided in this research.



Independent Variables Dependent Variable



Intervening Variable

Awareness of the residents of Barangay Camp 3, Tuba, Benguet on water problems; its effects to environmental services; and possible solutions.

HA - Highly Aware

A-Aware

MA - Moderately Aware

Fig.3. Paradigm of the study



Water quality and quantity

Water scarcity is projected to be more intense in some regions than in others. This situation is made more serious by the deteriorating water quality conditions, especially in some urban centers of the country. A recent study by the Department of Environment and Natural Resources (DENR) shows that 180 of the 420 rivers and other bodies of water nationwide are so heavily polluted that they may soon be declared biologically dead (Philippine Star 2001).

Although water quality and water quantity are inextricably linked, water quality deserves special attention because of its implications for affecting the public health and the quality of life. Even with the large Federal investments in pollution control since 1972, the President's Council on Environmental Quality reports that the nation's waters continue to be damaged by pollution and misuse. Pollution reach water bodies from both point and nonpoint sources. Municipal wastes, urban and agricultural run-off, and mining are principal offenders. Of special importance are the vestiges of past toxic and hazardous materials that are now being transported by surface water and groundwater systems. The impacts of polluting activities are widespread and they can affect the public health, the economy, and the environment.

The suitability of water for aquatic life and man use depends on its quality and water supply provides water for use in homes and industries, for irrigation, for extinguishing fires, for street cleaning, for carrying wastes to treatment facilities, and for many other purposes. The three most important factors in any water supply are its quality, the quantities available, and the location of the water supply relative to the points of use. (Groiler Encyclopedia of Knowledge. Vol.19 p277-278)



Causes of Water shortage and poor water quality

Problems of inadequate water and sanitation facilities exist throughout the world and have been particularly acute in the poorer countries. World Health Organization estimated that at the end of 1975, 25% of the people in developing countries had no access to potable water by house connections or standpipes. In rural areas, almost 80% did not have reasonable access to safe water (Groiler

Encyclopedia of Knowledge). Considering both rural and urban populations, only 35% were adequately served. Although many new systems have been constructed in recent years, the growth of population has imposed even greater needs, and there has probable been little overall improvement.

One method in classifying water problem is the agricultural practices in the upland areas like the kaingin system. Kaingin is a tagalog term, meaning shifting cultivation or swidden agriculture, it involves an alternation between crops and long-term forest fallow, in here forest is cut and burnt to clear the land and provide ash as fertilizer, removing of forest will result to increase in erosion. Expansion of agriculture in the uplands, due to financial constrains people need to expand their farms so that more products are to be produce.

Lastly the most serious problem is the mining. (Wikipedia, the free encyclopedia) **Mining** is the extraction of valuable minerals or other geological materials from the earth, from an ore body, vein or (coal) seam. The term also includes the removal of soil. Materials recovered by mining include base metals, precious metals, iron, uranium, coal, diamonds, limestone, oil shale, rock salt and potash. Any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory, is usually mined. Mining of stone and metal has been done since pre-historic times. Modern mining processes



involve prospecting for ore bodies, analysis of the profit potential of a proposed mine, extraction of the desired materials and finally reclamation of the land to prepare it for other uses once the mine is closed. The nature of mining processes creates a potential negative impact on the environment both during the mining operations and for years after the mine is closed. This impact has led to most of the world's nations adopting regulations to moderate the negative effects of mining operations. Safety has long been a concern as well, though modern practices have improved safety in mines significantly. The extraction of base and precious metals from hard-rock mines by underground mining can create environmental problems and safety hazards. Underground mining impacts water quality and flow and, as a result of subsidence, can also affect geologic structures overlying the mining areas resulting in surface impacts on the natural geomorphology and land use. Owing primarily to their size, open pit mines are typically thought to create more significant impacts, and thus underground mining is generally viewed as resulting in less damage to the environment. However, as this report demonstrates, the impacts from underground mining are not trivial. The methods and size of major underground mining operations and the extent to which hydrologic and subsidence impacts from those operations can impact the environment.

Effects of Water Problem

Plants

Water helps a plant by transporting important nutrients through the plant. Nutrients are drawn from the soil and used by the plant. Without enough water in the cells, the plants droop, so water helps a plant stand. Water carries the dissolved sugar and other nutrients through the plant. So without the proper balance of water, the plant not only is malnourished, but it is also physically weak and cannot support its own weight.



(<http://www.gardeningknowhow.com/children-in-the-garden/how-does-wateraffect-plant-growth.htm>)

Animals

Aquatic and non-aquatic animals can also be affected by water problems. Drinking contaminated water will result to illness and sometimes death.

- *Nutrient pollution* (nitrogen, phosphates etc) causes overgrowth of toxic algae eaten by other aquatic animals, and may cause death; nutrient pollution can also cause outbreaks of fish diseases.
- *Chemical contamination* can cause declines in frog biodiversity and tadpole mass.
- *Oil pollution* (as part of chemical contamination) can negatively affect development of marine organisms, increase susceptibility to disease and affect reproductive processes; can also cause gastrointestinal irritation, liver and kidney damage, and damage to the nervous system.
- *Mercury* in water can cause abnormal behavior, slower growth and development, reduced reproduction, and death.
- *Persistent organic pollutants* (POPs) may cause declines, deformities and death of fish life.
- Too much sodium chloride (ordinary salt) in water may kill animals.
- We also assume that some higher forms of **non-aquatic animals** may have similar effects from water pollution as those experienced by humans, as described above <http://www.tropical-rainforest-animals.com/pollution-effects.html>



Man

Water problem affects man's health, aesthetic, appreciation and recreational use of water, and industrial use of water. The source of water contamination responsible for the spread of infectious diseases is almost invariably feces.

Pesticides in agriculture also poison the water through run off from treated areas. The flow of nitrate into the water supply is also brought about by different agricultural practices (DENR-CAR). Although nitrate is not especially dangerous to man, their conversion to nitrites is what makes them hazardous. Ingested nitrites may be converted into intestinal bacteria, which when combined to hemoglobin, destroys the power of the blood to carry oxygen, bringing about difficulties in breathing, suffocations or even death.

In 1997, more than 1.1 billion people in low-and middle-income countries did not have access to safe water supplies and more people suffered from poor sanitation. In 2002, it is estimated that 166 million people in countries suffer from water scarcity, with another 270 million in 11 countries having "water stresses" conditions (World Bank 2002).

Solution to water problems

Effective control on water problems depend on policies that combine technical, economic, social and aesthetic considerations. The decision answers the many complex questions: How we provide water of what quality, when, how much, to what people and for what purposes? Who will pay the high cost of protecting surface and ground water?

The extreme view of damaging absolutely clean or pure water is an unacceptable as uncontrolled water pollution, since technical and financial feasibility must be included in all practical considerations of the problem. There are several ways to which water problem can



be combatted. The first is through development of practices and techniques that will prevent or limit the natural run off of pollutants, for example, from agricultural areas into water, and by the enactment and enforcement of government regulation prohibiting and limiting water pollution. In addition, educational campaign, like introducing agroforestry system is believed to be effective here in the Philippines especially here in Cordillera. With these, the following should be observed:

- The use of insecticides, fungicides, herbicides, and other toxic chemicals should be minimized.
- Chemicals and oils should not be drained into the bodies of water.
- Discipline and obedience to existing laws and ordinances on antilittering and sanitation (Marrero 1995) must be strictly implemented.

Statement of the problem

The study was conducted to determine the level of awareness of the residents of Barangay Camp 3, Tuba, Benguet on water problems, its effects to the community and possible solutions.

Specifically the research sought to answer the following questions:

1. What is the level of awareness of the residents of Barangay Camp 3 Tuba, Benguet on the declining water quantity and poor water quality?
2. What is the level of awareness of the residents of Barangay Camp 3 Tuba, Benguet on the effects of water quantity and poor water quality problem.
3. What is the awareness of the residents on the possible solution of the water problems in Baragay Camp 3 Tuba, Benguet.



Hypotheses of the study

The following hypotheses were set forward for testing:

The level of awareness of the residents of Barangay Camp 3, Tuba, Benguet on the following is moderately aware at 2.5.

1. There is significant difference on the level of awareness of the residents of Barangay Camp 3, Tuba, Benguet on declining water problem on quantity and quality.
2. There is significance difference on the awareness of the residents of water shortage and poor water quality in Barangay Camp 3, Tuba, Benguet.
3. There is significant difference on the awareness of the residents on the possible solution of water problems in Barangay Camp 3, Tuba, Benguet.

Methodology

Locale and Time of the Study

The study was conducted at Sitio Alang, Barangay Camp 3, Tuba, Benguet. Tuba is a town where one big company of mining in the Philippines is located with the total land area of approximately of 83.85 km². The study was conducted on December 2011 to February 2012.

Respondents

Through random sampling, fifty (50) respondents from Barangay Camp 3, Tuba, Benguet were selected as respondent of the study.

Table 1 show that many of the respondents came from the age of thirty nine (39) and above.

This connotes that most of the respondents were adults who are knowledgeable of the issues



concerning the water shortage and poor water quality. Male respondents were greater in number than the females.

Research Design/Instrument

The researchers used questionnaire to collect the needed information. There were also follow-up questions and interviews to gather some concrete data.

The study was conducted at Barangay Camp 3, Tuba, Benguet. The study is limited to the level of awareness of the residents of the said area concerning the water problems. Finally, it recommended solutions perceived by the residents of the said barangay.

Data collection procedure

The questionnaire has four (4) main parts: socio-demography profile, awareness on issues about water problem, the effects and possible recommendation. Under each part were various subdivisions to enquire about different types of data. The questionnaire was coded with unique letters with corresponding weighing scale. This letters were used to identify the awareness of the respondents.

The questionnaire was answered under direct supervision of the researchers with follow-up interviews.

Statistical analysis

The gathered data were tabulated using and categorized by simple descriptive statistics such as weighted mean, Z-test, frequency, rank and percentages. The Statistical Package for the Social Sciences (SPSS) was used to compute the descriptive statistic mentioned above.



RESULT AND DISCUSSION

Table 1. Respondents of the study.

GENDER	MALE	FEMALE	TOTAL	
AGE				
18-28 yrs. Old	7	2	9	
29-38 yrs. Old	10	4	14	
39 and above yrs. Old		11	16	27
TOTAL	28	22	50	

Table 2. Source of livelihood of the respondents of the study.

SOURCE OF LIVELIHOOD	MALE	FEMALE	TOTAL	PERCENTAGE	RANK
Mining	17	2	19	38%	2
Agriculture	7	19	26	52%	1
Teacher	1	1	2	4%	4
Driver	3		3	6%	3
TOTAL	28	22	50	100%	



Plate 1. Agriculture as the main source of livelihood of the respondents at Camp 3, Tuba, Benguet.



Table 3. Awareness of the residents of Barangay Camp 3, Tuba, Benguet on the causes of the problems on water quality and quantity.

CAUSES	FREQUENCY				WM	DES	Z _c	R
	4	3	2	1				
Mining	44	5	0	1	3.84	HA	18.60*	1
Agricultural Expansion/Kaingin	15	27	6	2	3.10	A	5.56*	2
Forest products extraction	6	26	11	7	2.62	A	0.97NS	4
Forest fire	9	21	14	6	2.66	A	1.23NS	3
OVERALL	74	79	31	16	3.06	A	7.96*	

*Significant (P≤0.05)
^{NS} Not Significant (P>0.05)



LEGEND:

Statistical Limit	Description	
1.0 – 1.75	Not Aware (NA)	WM = mean weight
1.76 – 2.50	Moderately Aware (MA)	Zc = Z computed
2.51 – 3.25	Aware (A)	R = Rank
3.26 – 4.00	Highly Aware (HA)	

A. Awareness of the residents

Table 3 shows the awareness of the residents of Barangay Camp 3, Tuba, Benguet on the causes of the problems on water quality and quantity. A great majority of the respondents stand highly aware that mining is the main cause of water quality and quantity problem. This is corroborated with the report of James Lyon (Meniral Policy Center, Washington DC), that mining affects fresh water through heavy used of water in processing ore, and through water pollution from discharge mine effluent and seepage from tailings and waste rocks impoundments. Furthermore, he stated that a human activity such as mining threatens the water sources on which we all depend. Water has been called “mining’s” most common casualty. There is growing awareness of the environmental legacy of mining activities that have been undertaken with little concern for the environment. The price we have paid for our everyday use of minerals have sometimes been very high. Mining by its nature consumes, diverts and can seriously pollute water resources. The respondents are aware that agricultural expansion, forest products extraction and forest fires are contributory causes of the water problem. It shows that the forest product extraction and forest fires are not



significantly different because it is less than 2.5 of the Z-test computed. The hypothesis is accepted based from the computed mean of 3.06.

In general, the causes of the problem on the water quality and quantity show that the residents of the Barangay Camp 3 are aware as supported by an overall Z-test of 7.96.



Plate2. Kaingin as a contributory cause of water problem at Camp 3, Tuba, Benguet.



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Plate 3. Decreasing number of trees is caused by forest fire.



Plate 4. Open pit or surface mining at Philex Tuba, Benguet as main cause of water problem.



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Plate 5. Soil and water erosion cause by mining.





Table 4. Awareness of the residents of Barangay Camp 3, Tuba, Benguet on the different uses of water.

USES OF WATER	FREQUENCY				WM	DES	Z _c	R
	4	3	2	1				
OVERALL	111	23	14	2	3.62	HA	12.99*	
Domestic use (washing, bathing)	39	7	4	0	3.70	HA	13.81*	1
Agriculture	37	7	4	2	3.58	HA	9.42*	2.5
Drinking	35	9	6	0	3.58	HA	10.87*	2.5

*Significant (P≤0.05) ^{NS} Not Significant (P>0.05)

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B. Awareness on the different uses of water

Table 4 shows the awareness of the residents of Barangay Camp 3, Tuba, Benguet on the different uses of water.

The respondents are highly aware that water is suitable for washing clothes, agricultural uses and for drinking. This is supported with the statement of Wacangan (2000) that in agriculture, watershed primarily stores water for irrigation. Rainfall absorbed in forested watershed is slowly released to the streams and lakes throughout the year and used by lowland dwellers. Watershed also helps grass grow for grazing animals. In addition, some watersheds in the country serve as human settlements.

Plate 6. Storage tank near the spring water.

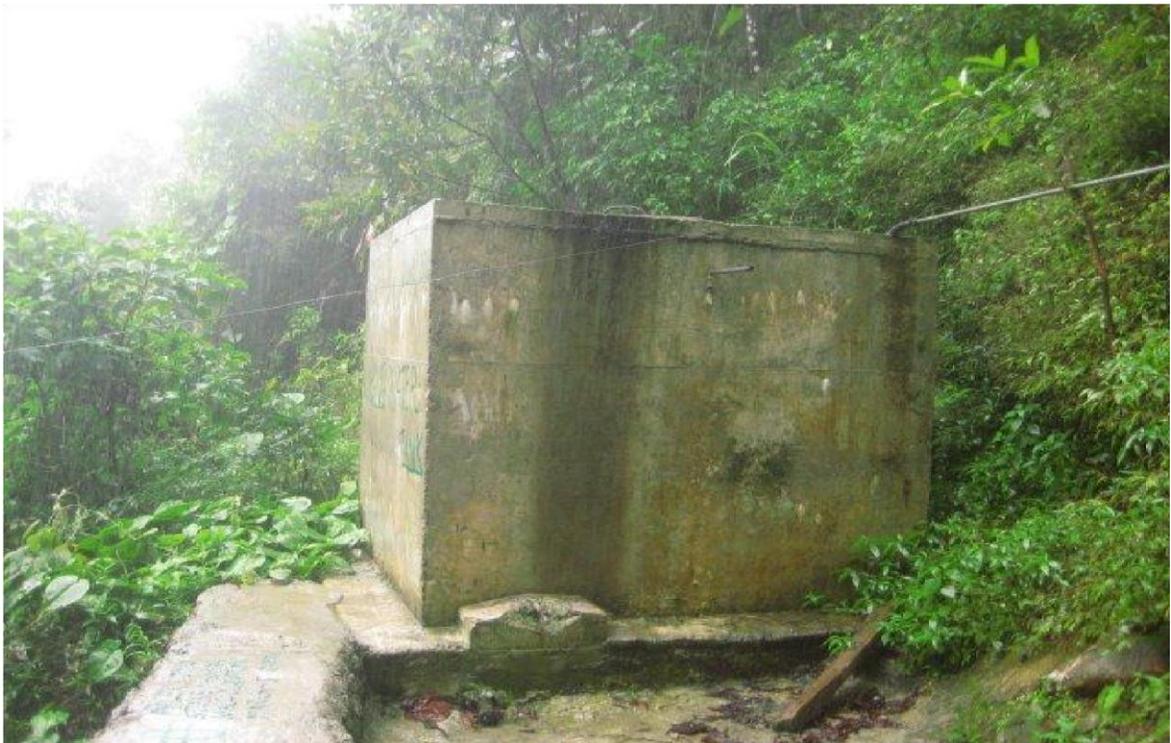


Plate 7. Water from spring water was reduced.



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For the industry, watersheds provide water for domestic and hydroelectric power generation. Watersheds also help maintain ecological balance, minimize occurrence to floods and drought, purify and cool the air, control soil erosion and serve as habitat of important plant and animal species.

The overall computed Z-test of 2.99, shows that the respondents are highly aware on different uses of water.

B. Awareness on the effects of water problem

Table 5 shows the awareness of the residents of Barangay Camp 3, Tuba, Benguet on the effects of water problems on the Environmental services, on economic services, and on social services.

On Environmental services. A great majority of the respondents stated that soil degradation is the most common that affects the water problem with a Ztest of 18.70% of the respondents are also aware that environmental degradation and loss of biodiversity are the contributory effects on water problem with a Ztest of 5.92%. This substantiates with the study of Tacloy (2005) that there is biodiversity loss as indicator of water pollution because Conservation International describe the Philippines as the “hottest” of the 25 biodiversity hotspot in the world, with hundreds of plant and animal species threatened with extinction. The hypothesis that there is significant difference on the awareness of the residents on effects of water problem is highly accepted as supported by the Z-test of 10.38. The overall result shows that the respondents are highly aware with the overall weighted mean of 3.38.



Table 5. Awareness of the residents of Barangay Camp 3, Tuba, Benguet on the effects of water problems on.

EFFECTS OF THE WATER PROBLEMS	FREQUENCY				Z _c	R	WM	DES	Z _c	R	
	4	3	2	1							
Effects on Environmental Services											
Soil degradation	39	10	1	0	3.76	HA	18.70*	1			
Environmental degradation	21	20	7	2	3.20	A	5.94*	2			
Loss of biodiversity	27	11	6	6	3.18	A	4.52*	3			
OVERALL	87	41	14	8	3.38	HA	10.38*				
Effects on Economic Benefits											
Reduced crop yield	36	8	5	1	3.58	HA	10.07*	1			
Reduced the quality of crops	23	9	10	8	2.94	A	2.71*	2			
Increased in cost of by products	11	8	13	18	2.24	NA	-1.57NS	3			
OVERALL	70	25	28	27	2.92	A	4.33*				
Effects on Social Services											
Causes skin diseases	8	6	18	18	2.0	NA	-2.79*	3			
Causes dehydrations	20	12	11	7	2.90	A	2.59*	2			
Insufficient water supply	36	8	1	5	3.50	HA	7.42*	1			
OVERALL	64	26	30	30	2.83	A	4.09*				

*Significant (P≤0.05)

^{NS} Not Significant (P>0.05)



Plate 8. Soil erosion affects the environment, endangers life of living things.



Plate 9. Soil erosions happens because of human activities.



Plate 10. Improper garbage disposal threatens the environment.



Plate 11. Soil erosion endangers the environment.

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On economic benefits, it shows that respondents are highly aware that water problem highly reduces crop yield due to the declining water supply to be used in irrigation with a Z-test of 10.07%. While some respondents stated that they are aware that water problem can decrease the quality of crops with a Z-test of 2.71%. Crops also need water for the absorption of minerals and for the physiological processes during plant growth. On the other hand respondents stated that they are not aware in the increase in cost of byproducts.

Plate 12. Banana plantation in Barangay camp 3 are decreasing because of water problem.



Plate 13. Expansion of agricultural land.



This corroborates with the findings of Tacloy (2005) indicating that agricultural productivity, is affected by water pollution because only 0.6 tons (12 cavans) of rice per ha is produced on rice field. This is also supported by the statement of Diaz (2007) that polluted water in agriculture reduced the quality and yields of crops. The hypothesis that there is significant difference on the effects of the problem on the level of awareness of the residents is accepted. This is supported by the overall computed weighted mean of 2.92 and with a Z-test of 4.33.

On effects on social services, a great majority of the respondents are highly aware that they are experiencing insufficient water supply, especially during summer where the water is reduced with a Z-test of 7.42%. The respondents are aware that water problem causes dehydrations. According to Diaz (2007), water problems cause pollutant that is hazardous to humans. This is supported by Dr. Lingaraj Patro Professor and head department of zoology and biotechnology, that the quality of water available for human consumption is a direct measure of the health of the population or community and of the country in India, the quality of water is very poor because of heavy contamination of soil and water borne diseases transmitted mainly through drinking unclean water. This can kill an estimated 4 million children under the age of 5 and make adults sick enough to lose billions of hours of work productivity. The hypothesis that there is a significant difference on the effect of water problems on social services is accepted, as supported by the overall computed mean of 2.83 and Z-test of 4.09.



Table 6. Awareness of the residents, as individual, on the possible solutions to the water problems of Barangay Camp 3, Tuba, Benguet.

POSSIBLE SOLUTIONS	FREQUENCY				WM	DE	Z _c	R
	4	3	2	1				
Water Quality								
Recycling					3.30	HA	6.38*	3
Lessen use of insecticides/pesticides					3.32	HA	7.83*	2
Strict implementation of Barangay/ Municipal ordinances					3.66	HA	15.79*	1
OVERALL					3.43	HA	14.67*	
Water Quantity								
Tree planting					3.80	HA	17.20*	1
Minimize kaingin					3.56	HA	11.11*	3
efficient and proper use of water					3.68	HA	14.22*	2
OVERALL	111	32	5	2	3.68	HA	20.10*	

*Significant ($P \leq 0.05$)

^{NS} Not Significant ($P > 0.05$)

Table 6 shows the awareness of the residents, as individual, on the possible solutions to the water problems of Barangay Camp 3, Tuba, Benguet.



The result shows what the respondents perceive as the recommended solution to the problem. The recommended solutions were divided into three; How the respondents are going to improve water quality and increase water quantity; What can the local government do to address water problems, and what the should local residents do to at least minimize this problem.

On improving water quality as an individual, in descending order of ranks in the awareness of residents on the possible solutions on water quality, the recommendations are strict implementation of barangay/ municipal ordinances, lessen use of insecticides/pesticides, and water recycling. This jibes with the finding of Diaz (2007) that there must be strict implementation of barangay and municipal ordinances. Furthermore, she stated that the best way to lessen water pollution is recycling of waste and lessen use of pesticides and insecticides. The hypothesis that there is a significant difference on the awareness of the residents on the possible solution of water problem is accepted. This is supported by the overall mean weight of 3.43 and computed Z-test of 14.67.

On water quantity problem, in descending order of weighted mean the following are the possible solutions to water quantity; tree planting, efficient and proper use of water, and minimize kaingin. According to Tacloy (2007), reforestation improves water yield in terms of quality and sustainability. He further stated that forested areas would take much longer time to significantly increase in water flow as compared to those on denuded areas. With the computed average mean of 3.68, it implies that tree planting, minimize kaingin and efficient and proper use of water are possible solutions to water quantity problem.



The hypothesis that there is a significant difference on the awareness of the residents on the possible solution of water problem is accepted. This is supported by the overall mean weight of 3.68 and computed Z-test of 20.10.

Table 7. Awareness of the residents on the possible solutions that the government can carry out to address the water problems of Barangay Camp 3, Tuba, Benguet

POSSIBLE SOLUTIONS	FREQUENCY				WM	DE	Z _c	R
	4	3	2	1				
Water Quality								
Introduce agro forestry systems to the farmers	28	8	12	2	3.24	A	5.45*	2
Stop the mining corporation	29	5	1	15	2.96	A	2.40*	3
Information Campaigns on the effects of water problems	34	13	2	1	3.60	HA	11.61*	1
OVERALL	91	26	15	18	3.27	HA	7.47*	
Water Quantity								
Strict implementation of the policies/laws pertaining to water conservations	34	13	2	1	3.60	HA	11.61*	3
Build more water tank	42	7	1	0	3.82	HA	21.33*	2
Plant more trees	44	5	0	1	3.84	HA	18.60*	1
OVERALL	120	25	3	2	3.75	HA	21.96*	

*Significant (P≤0.05)

^{NS} Not Significant (P>0.05)



Table 7 shows the awareness of the residents on the possible solutions that the government can carry out to address the water problems of Barangay Camp 3, Tuba, Benguet.

On water quality problem, a great majority of the respondents are highly aware that the information campaign is the highly recommended possible solution to water problem. This is followed by introduce agroforestry system and stop the mining corporation, According to Diaz (2007), the government should conduct information education campaign regarding the hazardous effects of water problem. This information education campaign would lead them to practice self-discipline and do their best to properly disposing their wastes. Wacangan (2007) states that Agro-forestry is a land use management that involves the production of agricultural crops, forest trees or livestock simultaneously or sequentially on the same unit of land. Agroforestry farms must be situated near settlements areas for easy farm maintenance.

Mining is an activity that increases in many parts of the world but very often mining activities are done haphazardly with severe consequences to the surrounding environment and the health of people (http://www.geus.dk/program-areas/common/small_scale_mining-dk.htm). The hypothesis that there is a significant difference on the awareness of the residents on the possible solution of water problem is accepted. This is supported by the overall mean weight of 3.27 and computed Z-test of 7.47.

On water quantity problem, majority of the respondents are highly aware that planting more trees, building more water tanks, and strict implementation of the policies/ Laws on water problem are highly recommended possible solutions to water problem. According to Wacangan (2007) watershed improvement



essentially entails reforestation in planting trees to improve water yield, restore soil fertility, increase forest and agricultural production, conserve genetic resources, and conserve local climate. According to Mr. Gavino, building additional water tanks in the barangay could help them conserve water, and water tanks could store water to minimize too much wastewater.

Strict implementation of policies and laws particularly Executive order No. 318: Promoting Sustainable forest management in the Philippines. These concerns on the development and management of the Philippines forests and forestlands including the coastal forests shall be for the highest and widest public benefit and shall be based on the inherent productive capacity and sustainable use of these resources for the present and future generation of Filipinos. . The hypothesis that there is significance difference on the effects of the problem on the level of awareness of the residents is accepted. This is supported by the computed weighted mean of 3.75 and with a Z-test of 21.96.

Table 8 shows the awareness of the residents on the possible solutions that the community can do to address the water problems of Barangay Camp 3, Tuba, Benguet.

On water quality, majority of the respondents are highly aware that planting more trees is the extremely commended to resolve the water problem followed by lessen the use of insecticides and pesticides then assigning designated waste disposal area.

In corroboration with the book of Wageningen (1983) the accumulation of experience with reforestation for local community development is showing it to be more diverse and often more complex than was usually thought to be the case, the supply, and use of trees and tree output are often part of complex local human and resource system. At the same



time community level forestation in practice encompasses a whole range of quite deferent situations and activities in which can the factors influencing success of failure can vary quite widely.

Table 8. Awareness of the residents on the possible solutions that the community can do to address the water problems of Barangay Camp 3, Tuba, Benguet

POSSIBLE SOLUTIONS	FREQUENCY				WM	DES	Z _c	R
	4	3	2	1				
Water Quality								
Plant more trees instead of cutting	40	9	1	0	3.78	HA	19.48*	1
Lessen use of pesticides and insecticides	29	13	6	2	3.38	HA	7.28*	2
Assigned designated waste disposal area	39	8	3	0	3.37	HA	15.06*	3
OVERALL	108	30	10	2	3.63	HA	17.72*	
Water Quantity								
Plant more trees	48	1	0	1	3.92	HA	22.59*	1
Keep away the animal near the source of water	40	5	2	3	3.64	HA	9.75*	3
Use water efficiently and properly	38	7	3	2	3.62	HA	10.16*	4
Preserve existing trees and shrubs	42	3	4	1	3.72	HA	12.31*	2
OVERALL	168	16	9	7	3.73	HA	17.21*	

*Significant (P≤0.05)

^{NS} Not Significant (P>0.05)



Generalization concerning availability of land, length of production period and possession of relevant knowledge and skills as constraints to participatory tree growing are proving to apply only in some instances. In addition, Coder (1996) mentioned that plants, especially woody plants, are very good at removing nutrients (nitrates and phosphates) and contaminants (such as metals, pesticides, solvents, oils and hydrocarbons) from soil and water. These pollutants are either used for growth (nutrients) or are stored in wood. Further, he stated that Planting and maintaining woody vegetation along streams provide a wealth of benefits and research at the Stroud Water Center and elsewhere have shown that stream health is dependent on the presence of woody vegetation along its banks.

The respondents are highly aware that lessened use of insecticides and pesticides would be possible solution to water quality problem. This was supported by the finding of Diaz (2007) that pesticides and insecticides should be lessened but few still say that they should be banned since they are very harmful to animal and human health. DENR-CAR (undated) cited by Diaz (2007), pesticides in agriculture also poisoned the water through run-off from treated areas, waste discharged by pesticides manufacturers and industries or by aerial spraying. The flow of nitrate into the water supply is also brought by different agricultures practices.

Marrero (1995) recommended that to combat water pollution, there should be proper disposal of garbage. Solid waste should be disposed properly. Solid and liquid waste such as chemicals and oil should not be dumped into canals, streams and rivers.

The hypothesis that there is a significant difference on the awareness of the residents on the possible solution of water problem is accepted. This is supported by the overall mean weight of 3.63 and computed Z-test of 17.72.



On water quantity, respondents are highly aware that the best way to lessen this problem are as follows; plant more trees, preserve existing trees and shrubs, keep away the animal near the source of water and use of water efficiently and properly. Julian Evans (1982) emphasizes that the tree planting is no longer almost wholly for industrial purposes, thought this remains the dominant reason. Planting for firewood, other village needs, forestry development, and for protection (to reduced soil erosion) control water run-off, combat desertification, provide shelter and shades are all becoming increasingly important.

According to krantz and kifferstein (undated) we have to preserve existing trees and plant new trees and shrubs to prevent soil erosion and promote infiltration of water into the soil.

Diaz (2007) states that existing trees along the riverbank should be preserved to help prevent soil erosion. To minimize soil erosion, trees should be planted along riverbank.

Keep the animal away from the source of water. Diaz (2007) affirms that farmers should keep away their animals from riversides and keep them house in barns so their waste can be gathered and treated. One respondent also added that the residents should cooperate and see some right place for their animal confinement. In this situation animal wastes could be cleaned, and can be

collected to compost as a fertilizer.

Use water efficiently and properly. As cited by the American Society of Agricultural Engineers (2005), in order to supply sufficient amount of water it is required to take proper remedial measures with regard to insufficient water use, hydrological alterations, desertification, pollutants and pathogens.



Poor water management is reflected in poor pattern of water delivery, wasteful application process, and pollution and water losses through seepage, leaks and evaporation. It may be worthwhile to economize the water consumption in different household purposes other than used in the kitchen for cooking and drinking.

The water used for toilets, which can comprise the major fraction of the total water i.e. used for household purpose, can and should be replaced by water of an inferior quality, for example, that obtained from the treatment of sewage water.

Hydrological alteration of the landscape along with dam construction may lead to water quality degradation and rendering the water unusable for domestic purposes. Therefore it is necessary to protect the landscape and avoid construction of large dam. It should be our goal to preserve water and carefully use it to produce electricity.

Desertification is equally responsible for shortage of water in the planet. It is therefore essential to make necessary step to prevent land desertification and degradation.

Due to intensive modern agriculture practices and rapid industrialization, both the surface and the ground water are getting polluted rapidly resulting deaths of potable water. It would be wiser to try to collect the rain in ponds, tanks and lakes at their sites than to carry water across the country. Harvesting rain water through small and medium sized project seems to be wiser scheme.

Modern method of irrigation system, such as drip irrigation and use of sprinklers should be popularized.

The hypothesis that there is a significant difference on the awareness of the residents on the possible solution of water problem is accepted. This is supported by the overall mean weight of 3.73 and computed Z-test of 17.



CONCLUSION AND RECOMMENDATION

Conclusions:

This study was conducted to determine the level of awareness of the residents of Barangay Camp3, Tuba, Benguet on the declining water quantity and poor water quality, awareness of the residents on the effects of water quantity and poor water quality problems and awareness of the residents on the possible solution of water problems.

Based from result and findings of the study, the researchers' draws the following conclusions:

1. Majority of the respondents are highly aware of the causes of the problem on water quality and quantity at Barangay Camp 3, Tuba, Benguet. This implies that uses of water for domestic, agricultural, and for drinking are affected. Therefore a sustainable program, the barangay officials, appropriate barangay laws and policies must be strictly implemented.
2. Almost all of the respondents are highly aware of the effects of water problems that occur at barangay Camp 3, Tuba, Benguet. The respondents stated that the environment is the most affected, followed by economic services and social services. Information Educational Campaign in the community must be conducted with the participation of barangay officials, DENR and NGO's. The government should conduct information drive. Topics to be discussed should include hazardous effect of water problem to health, to the environment and what are the benefits derived from good watershed management. Introducing agroforestry system to the residents is also beneficial both to the environment and the people in conserving water and soil.



3. Majority of the respondents are highly aware on the possible solution of the water problems in Barangay Camp 3, Tuba, Benguet. Almost all the respondents agreed that information campaign is the most highly recommended possible solution followed by the tree planting, building more tanks, strict implementation of ordinance, lessen the use of pesticides/insecticides and water recycling. Therefore cooperation of the residents and the barangay officials is hereby enjoined for the strict implementation of ordinances and sustainable implementation of program like tree planting, agroforestry and livelihood.

Recommendation:

From the findings and conclusion, the researchers offer the following recommendations:

1. Barangay/municipal ordinances, information educational campaign, reforestation activities and, building more tanks should be implemented.
2. The farmers should do more organic farming. The animal owners should collect the wastes of the animals and use them as fertilizers. Farmers should also lessen or decline from using insecticides and pesticides since these are harmful to animals and humans.
3. The government, specifically the DENR, should designate a water quality monitoring team. The monitoring should be at least be quarterly.
4. The community, barangay officials, non-government officials, department of environment and natural resources', and other government agencies' should collaborate in the sustainable implementation of these programs.
5. Similar research may be conducted by other researchers.



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