

**POINTS OF POLLUTION OF THE CHICO RIVER
IN BONTOC, MOUNTAIN PROVINCE AS PERCEIVED
BY THE RESIDENTS OF BARANGAYS BONTOC ILI,
POBLACION BONTOC, CALUTTIT, AND SAMOKI**

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ABSTRACT

Many of the respondents are aware of the water pollution issues concerning the Chico River. The pollutants come from the households, businesses/industries, agricultural enterprises, and some naturally occur.

There are various effects of pollution to the residents of the different barangays, to the community, and also to the Chico River. Environmental degradation is the most common effect. It also caused health problems among the residents. Fishes are also killed so fishermen lose their source of income.

According to the residents, there are many possible solutions to the pollution of the river. A great majority of the respondents recommended recycling of wastes, responsible disposal of wastes and strict implementation of barangay or municipal ordinances regarding garbage disposal. It is suggested that the government should prioritize the selection of a suitable dumping site since the current dumping site is situated near the river and adds to the water pollution. It should also build a municipal sewage treatment plant and conduct Information Education Campaigns (IEC's) regarding water pollution.

KEYWORDS: Bontoc, Mt. Province, Chico River, River pollution

INTRODUCTION

Rivers have been the major catchment bases of both solid and liquid water. As a result, its ability to disperse small amounts of pollutants through breakdown, absorption, oxygenation,

tion and consumption has been impaired. Such impairment has resulted to the accumulation of pollutants in the rivers (Clark *et al.*, 1997).

Household and agricultural wastes are increasingly becoming a threat to the Chico River. The riverbanks are utilized as garbage dumpsites. Identification of appropriate dumping sites, installation of waste disposal systems and/or construction of sanitary landfills were not given due concern by the local government units. Like in Bontoc, a garbage truck collects the garbage of households and disposes these in a dumpsite near the river (DENR, 1999).

The study attempt to provide some basic information on the causes and effects of the water pollution of the Chico River within the barangays of Samoki, Bontoc Ili, Poblacion Bontoc and Caluttit in Bontoc, Mountain Province. This is to enhance technical knowledge and instill awareness to the people in the area on environmental issues and protection.

This study would help in their pre-feasibility study by providing insights as to what causes the pollution of the river in Bontoc within the barangays of Bontoc Ili, Samoki, Poblacion, and Caluttit.

Objectives of the Study

The study aimed to:

1. Determine the level of awareness of the residents of the barangays of Bontoc Ili, Poblacion Bontoc, Lower Caluttit and Samoki on the water pollution issues concerning the Chico River.
2. Determine the causes of pollution of the Chico River within the barangays of Bontoc Ili, Poblacion Bontoc, Lower Caluttit and Samoki.
3. Determine the effects of pollution of the Chico River to the residents of the different barangays, to the community and also to the Chico River itself.
4. Recommend possible solutions to the pollution of the river with the help of the residents of the said barangays.

MATERIALS AND METHODS

This study was conducted in Bontoc, Mountain Province within the barangays of Bontoc Ili, Samoki, Poblacion, and Caluttit. Bontoc is the capital town of Mountain Province with total land area approximately 36,160 hectares.



Through random sampling, 200 respondents (50 from each barangay) were selected from the barangays of Bontoc Ili, Samoki, Caluttit and Poblacion in the documentation of water pollution at the Chico River.

A structural survey questionnaire was used to collect the needed information. A follow-up interview was also done to gather a concrete data. Secondary data were gathered from the National Statistics Office for the selection of respondents.

Descriptive statistics such as mean, frequency, rank, and percentages (%) were employed to analyze the data gathered from the responses of the respondents.

RESULTS AND DISCUSSION

Household pollution

One of the pollutants of the Chico River are the household (Table 1). Most of the respondents are highly aware that human waste pollutes the river. They are aware that the contributory pollutants are detergent soaps, plastics and cans and they are moderately aware of empty bottles and pieces of clothing. This shows that most of the people are aware that many of the pollutants come from the household.

Table 1. Household Pollutants

TYPES OF POLLUTANTS	NA	MA	A	HA	MEAN
Human waste	10	29	72	57	3.05 ^a
Detergent Soap	12	32	67	51	2.97 ^{ab}
Empty Bottles	24	41	60	37	2.68 ^b
Plastics	19	32	66	51	2.89 ^{ab}
Paper	18	38	61	48	2.84 ^{ab}
Pieces of Clothing	22	41	60	42	2.74 ^b
Cans	18	39	57	52	2.86 ^{ab}

Means with common letters do not differ significantly at 0.05 levels of significance.

NA- not aware MA- Moderately Aware A- Aware HA- Highly aware

Business/Industry pollutants

For the pollutants coming from the business and/or industry, results are shown in Table 2 that many of the respondents are highly aware of the oil



spill from buses that are being washed in the river. They are also moderately aware of the plastics being discarded from the business enterprises. Respondents are equally aware of used oil, empty bottles, waste paper, sediment, due to quarrying and rubber as pollutants.

Table 2. Pollutants from the Business/Industry

TYPES OF POLLUTANTS	NA	MA	A	HA	MEAN
Used oil	24	39	49	42	2.71 ^b
Empty bottles	15	50	56	34	2.71 ^b
Waste paper	22	40	54	39	2.71 ^b
Plastic	20	37	54	44	2.79 ^{ab}
Oil spill from buses	14	17	63	62	3.11 ^a
Sediment due to quarrying	19	43	53	34	2.68 ^b
Rubber	25	53	54	30	2.55 ^b

Means with common letters do not differ significantly at 0.05 levels of significance.

NA- not aware MA- Moderately Aware A- Aware HA- Highly aware

Pollutants from Agricultural Enterprises

The respondents are highly aware of the animal manure from pig raisers as shown in Table 3. Many pigpens are situated near the tributaries of the Chico River. This it is visible to the public.

Drainage of a pigpen leads directly to the stream. It was never realized however that it poses a problem to the environment, specifically to the river. There was never a complaint or a move to stop the people from building pigpens near the streams. Hence, the wastes coming from these pigpens continue to add to the water pollution.

The respondents are moderately aware of the inorganic and organic fertilizers and the pesticides and insecticides as causes of pollution. Because of their nature as non-point or indirect sources (Krantz and Kifferstein, undated), these pollutants are less known by man to have hazardous effects on water reservoirs.



Table 3. Pollutants from Agricultural Enterprises

TYPES OF POLLUTANTS	NA	MA	A	HA	MEAN
Pesticide/Insecticide	32	34	49	24	2.47 ^b
Organic fertilizers	26	35	51	26	2.56 ^b
Inorganic fertilizers	28	36	48	27	2.53 ^b
Animal manure from animal raisers	16	26	553	65	3.04 ^a

Means with common letters do not differ significantly at 0.05 levels of significance.

NA- not aware MA- Moderately Aware A- Aware HA- Highly aware

For the natural causes of pollution, only soil erosion was claimed by the respondents as contributory to water pollution. As Table 4 implies, some of the respondents claimed that they are aware of the soil erosion as a contributory factor to the water pollution. A few of the respondents are moderately and highly aware, and very few are not aware.

Table 4. Natural Causes of Pollution

TYPE OF POLLUTANT	NOT AWARE	MODERATELY AWARE	AWARE	HIGHLY AWARE
Soil erosion	21	39	50	38

Table 5 shows the results of the insights of the residents on the history and environmental state of the Chico River. Almost all of the respondents answered that they are aware that Bontoc has a dumping site. They also claimed that Bontoc has a garbage truck collecting garbage from the municipality. A great majority of them also agreed that there is an area for dumping garbage. This shows that there is no need for the people of Bontoc to be dumping their wastes on the streams and on the river since they are aware that there is an existing dumping site and a garbage truck is already assigned to gather their garbage.

A great majority of the respondents are aware that trucks gather the garbage regularly. The result shows that the answer of the respondents is highly significant on their awareness of garbage collections as few respondents claimed that there is no collection of garbage regularly.

A great majority of the respondents accepted that Bontoc does not have a sewage treatment plant. Apparently, this shows that the people are aware that a sewage treatment plant is not available.

A great majority is aware that fishermen use electricity and chemicals to catch fish since the result shows that there is a highly significant difference in the answer of the respondents.



Almost all respondents claimed that the water flowing along the Chico River is reduced during dry season. This result shows that the people notice the problems concerning the river. This also shows that respondents are aware of the indiscriminate conversion of the forested areas of the Chico River Watershed to agriculture as well as unregulated cutting of forest products in the past decades up to the present that affected the Chico River Basin, which is now becoming unproductive and unstable (DENR, 1999).

Almost all the respondents are aware that the Chico River is already polluted. Thus, few claimed that they are not aware that the Chico River is already polluted. Therefore, the people must do their part to protect the Chico River from pollutants.

As to the availability of the water from the river, a great majority of the respondents agreed that the water is not suitable for drinking. A great majority claimed that it is not suitable for cooking and majority of the respondents admitted that the water is suitable for swimming.

Table 5. Awareness of the respondents

		NUMBER OF RESPONDENTS (N=200)	Z- TEST
A	Does Bontoc have a dumping site?		
	Yes	170	0
	No	0	
B	Is there a truck assigned to gather the garbage from the municipality?		
	Yes	170	0
	No	0	
C	Do the truck/s gather the garbage regularly?		
	Yes	145	9.20**
	No	24	
D	Is there an area where garbage is being dumped for the garbage truck to haul?		
	Yes	144	9.05**
	No	18	
E	Is there a sewage treatment plant in Bontoc?		
	Yes	0	0
	No	139	
F	Do fishermen use electricity and chemicals to catch fish?		
	Yes	141	8.59**
	No	20	



Table 5. Continued...

		NUMBER OF RESPONDENTS (N=200)	Z- TEST
G	Is the water flowing along the Chico River reduced during dry season?		
	Yes	161	8.63**
	No	4	
H	Has Bontoc ever experienced flooding from the Chico River?		
	Yes	76	1.38 ^{ns}
	No	87	
I	Are you aware that the Chico River is already polluted?		
	Yes	155	10.74**
	No	10	
J	Is the water from the Chico River suitable for:		
J.1.	Drinking?		
	Yes	13	11.04**
	No	149	
J.2	Cooking?		
	Yes	21	9.82**
	No	141	
J.3	Swimming?		
	Yes	102	2.61**
	No	62	

** - Highly Significant ^{ns}- Not Significant

$Z_{.025} = \pm 1.96$ $Z_{.005} = \pm 2.575$

Causes of pollution of the Chico River

Table 6 shows the causes of pollution observed by the respondents.

Household Sources. Results show that of the household sources polluting the Chico River, the detergents/soap used in washing clothes, dishes and bathing ranked the number one source. Moreover, the respondents claimed that when there is water shortage in Bontoc, the river is used for bathing and washing clothes .

A great majority of the respondents have observed plastics in the river that come from the garbage being dumped in and near the river. These plastics are carried along the river and deposited downstream when it rains hard and the flow of the water becomes strong. Thus, these plastics are left after these events.



Business/Industry. In descending order of ranks in the awareness of respondents of business/industry causing pollution, the causes are oil spill from buses, used oil, plastic containers, waste paper, empty bottles, sediment due to quarrying and rubber.

The buses and other trucks being washed in the river not only leave muddy and soapy residues but also oil when the inside of the trucks where the machines are located. Some of the oil also comes from stations that empty their wastes into the river.

Agricultural Enterprises. A great majority of the respondents admitted that the animal manure from animal raisers is the most observed pollutant of the river. It is followed by organic fertilizers such as pig manure and chicken dung. Many pig and other animal raisers in Bontoc tend to build the pens of the animals near tributaries. This is to minimize the cost of building septic tanks for the pens. Thus, the wastes coming from these pens go to the river via the streams and canals. Some of the raisers however are more practical and use the pens used by their ancestors. These pens have no outlets so the animal wastes are manually carried to the cultivated sweet potato fields and rice fields or to other similar pens no longer used. These wastes do not directly flow into the river but they leach into the soil and after some time reach the river or they are washed out to the river when it rains.

Pesticides/ insecticides are less contributory factors to the pollution. Few or none of the farmers use pesticides and insecticides on their crops because majority of them grow their products organically hence they use organic fertilizers. However, some still use inorganic fertilizers in their gardens. Nevertheless, these pollutants should be monitored because they are hazardous to humans.

Natural Causes. The most observed natural cause of pollution is the soil erosion. Since many of the mountains near the river are bare of trees, this is not a surprising revelation. Very few of the respondents added that they have observed flood as a cause of pollution and one of them said that forest denudation is an indirect cause since it leaves the mountains bare causing soil erosion.



Table 6. Causes of Pollution observed by the respondents

CAUSES	NUMBER OF RESPONDENTS (N=200)	PERCENTAGE (%)	RANK
A Household			
Human waste	127	63.5	3
Detergents/soap used in washing clothes, dishes and bathing	139	69.5	1
Empty bottles	117	58.5	5
Plastics	130	65	2
Paper	108	54	6
Pieces of clothing	108	54	6
Cans	123	61.5	4
Carabao waste	1	0.5	9
Animal waste from piggery	6	3	7
Oil and lubricants of vehicles being repaired on the riverbanks	1	0.5	9
Used disposable diapers/napkins	2	1	8
Pieces of aluminum/iron	1	0.5	9
B Business/Industry			
Used oil	107	53.5	2
Empty bottles	86	43	5
Waste paper	87	43.5	4
Plastic	101	50.5	3
Oil spill from buses	129	64.5	1
Sediment due to quarrying	83	41.5	6
Rubber	83	41.5	6
Waste from renovated buildings	1	0.5	7
C Agricultural Enterprises			
Pesticide/Insecticide	69	34.5	3
Organic fertilizers (i.e. pig manure, chicken dung, etc.)	109	54.5	2
Inorganic fertilizers (i.e. Complete, Ammonia, etc.)	65	32.5	4
Animal manure from animal raisers (i.e. pig manure, chicken manure, etc.)	133	66.5	1
D Natural Causes			
Soil erosion	113	56.5	1
Flood	2	1	2
Forest denudation	1	0.5	3



Effects of pollution of the Chico River

Table 7 shows the various effects of pollution of the Chico River observed by the respondents. A great majority of the respondents stated that environmental degradation is the most common effect, since the water is not safe for potable use, bathing, swimming and washing clothes, and also causes health problems. Fishes are also killed which affects the source of income of fisherman.

Table 7. Effects of pollution of the Chico River observed by the respondents

EFFECTS	NUMBER OF RESPONDENTS	PERCENT-AGE	RANK
A Health Problems	115	57.5	2
B Environmental degradation	123	61.5	1
C Loss of livelihood	49	24.5	3
D Water not safe for potable use	2	1	5
E Water not suitable for bathing, swimming and washing clothes due to its foul odor	3	1.5	4
F No more fish	1	0.5	6
G River not a suitable site for relaxation or family activities	1	0.5	6

Table 8 shows the effects of the pollution of the Chico River experienced by the respondents.

Apadchew *et al.* (2002) stated that the wastes coming from the piggery farms of Banangan, Sablan, Benguet which found its way downstream caused the deteriorating state of the water quality of Suyok Creek. If the pigpens draining their wastes into the streams and into the river would not be stopped, the state of the water quality of the Chico River would also deteriorate.

How it affects the health of the people. Arranged in descending order of gravity, the effects of pollution to the respondents are skin diseases associated with using the river for bathing; diarrhea; typhoid fever; dysentery; tuberculosis; and, hepatitis. Due to this, the people worry and fear for their health.

In an interview with the Municipal Epidemiological Investigator and Rural Sanitary Inspector-I, Roger Agcapen, he said that, "There were no reported cases of the mentioned sicknesses resulting from the use of water from the river." The respondents countered that when they got sick, they medicated



themselves. Some of them who went to the hospital did not tell the physicians that they bathed or drank water from the river prior to their sickness.

The results show how the pollution of the river endangers human health. Disease-causing microbes breed in the pollutants and are transmitted to humans when they use the untreated water.

Table 8. Effects of pollution of the Chico River experienced by the respondents.

EFFECTS	NUMBER OF RESPONDENTS (N=200)	PERCENTAGE (%)	RANK
A How does it affect your health?			
Causes skin diseases	105	52.5	1
Causes typhoid fever	86	43	3
Causes diarrhea	88	44	2
Causes dysentery	43	21.5	4
Causes hepatitis	26	13	6
Causes tuberculosis	36	18	5
Causes worry and fear to people	1	0.5	7
B How does it affect the Chico River?			
Growth of undesirable aquatic weeds and algae	93	46.5	3
Creates unpleasant odor and foul taste of water	137	68.5	1
Dwindling population of aquatic plants	69	34.5	5
Diminishing population of aquatic animals	119	59.5	2
Water shortage	80	40	4
C How does it affect agriculture that depends on the river?			
Reduce the yield of crops	87	43.5	2
Reduce the quality of crops	94	47	1
Not clean source of irrigation for the rice fields	2	1	4
Causes shortage of irrigation and abandoned rice fields	4	2	3
D How does it affect your community?			
Lessened number of tourists	56	28	2
Causes lessened recreation spots for the residents	95	47.5	1
Lessened income due to lessened tourists	37	18.5	3
Loss of livelihood for fishermen	3	1.5	4
Degrades the environment/unpleasant environment	1	0.5	5



How it affects the Chico River. In descending order of ranks on the effects of pollution to the Chico River are: the unpleasant odor and foul taste of water; diminishing population of aquatic animals; the growth of undesirable aquatic weeds; and algae in the river, water shortage in the river and the dwindling population of aquatic plants.

According to Stoker *et al.* as cited by Oda (1993), the unpleasant smell and foul odor of the river is caused by the hydrogen sulfide and some phosphorous compounds found in the water from the decomposition of the different garbage. When these are added to the odor of decaying fish and algae, it becomes apparent that a shift from aerobic to anaerobic condition of decomposition is not one favored by users of fresh air.

Recommended possible solutions to the pollution of the river

Table 9 shows the results of what the respondents perceived as the recommended solutions to the pollution of the river. The recommended solutions were divided into three divisions. The first division (A) is how the respondents are going to lessen the water pollution. The second (B) is what the respondents thought the local government should do to the improper dumping of garbage into the river. And the last (C) is what the local residents should do to lessen the water pollution.

Table 9. Recommended solutions to water pollution

	NUMBER OF RESPONDENTS	PERCENTAGE (%)	RANK
A As an individual, how are you going to lessen the water pollution of the Chico River?			
Recycling	148	74	1
Responsible disposal of wastes	144	72	2
Lessen use of plastics	69	34.5	3
Strict implementation of barangay or municipal ordinances regarding garbage disposal	144	72	2
Cooperation and action	1	0.5	4
Self-discipline	1	0.5	4
Information dissemination	1	0.5	4
Make compost out of garbage	1	0.5	4
B What do you think should the government do to improper dumping of garbage into the river?			
Select a suitable dumping site	133	66.5	1
Provide more equipment for garbage collection such as trucks	101	50.5	4



Table 9. Continued..

	NUMBER OF RESPONDENTS	PERCENTAGE (%)	RANK
Establish barangay ordinances regarding garbage disposal	129	64.5	2
Build a municipal sewage plant	109	54.5	
Conduct Information Education Campaigns (IEC's) regarding water pollution	110	55	3
Implement laws regarding the use of electricity and chemicals in catching fish	98	49	5
Ban the residents from washing their cars, buses and trucks in the river	94	47	6
Lessen the quarrying of private entities	67	33	7
Regulate residents from washing their cars, buses and trucks in the river	1	0.5	1
Strict implementation of barangay and/or municipal ordinances regarding the throwing of garbage on creeks and rivers	1	0.5	1
Strict implementation on environmental laws	1	0.5	1
C What do you think should the local residents do to lessen the water pollution of the Chico River?			
Lessen use of pesticides and insecticides	79	39.5	6
Banning the use of pesticides and insecticides	48	24	7
Use of organic farming in agricultural lands	86	43	5
Preserve existing trees and shrubs to help prevent soil erosion	112	56	2
Plant more trees along the riverbanks to help prevent soil erosion	108	54	4
Keep away animals from riversides and keep them housed in barns so their waste can be gathered and treated	110	55	3
Hog raisers should have their own septic tanks so that the waste would not go directly into the river through the streams	138	69	1
Recycle waste	1	0.5	8
Identify places in the river purposely for carabaos	1	0.5	8
Hog raisers should establish an area to direct pig manure and use it as fertilizer rather than directing it to the river	1	0.5	8
Dispose and segregate their wastes properly	1	0.5	



As an individual. A great majority of the respondents said that the best way to lessen water pollution is the recycling of wastes. First of all, wastes should be segregated and all re-usable materials should be recycled. Collected papers/newspapers/cartons, empty bottles, clean plastics, cans sold to junk shops will not only lessen the garbage but will also provide an income.

A great majority also agreed they would be more responsible in the disposal of their wastes. Though many are aware that there is a dumping site and a garbage truck collector, still, there are many undisciplined residents who throw their wastes in the river and in the tributaries of the river. The respondents accepted that they are following strictly the barangay and municipal ordinances regarding garbage disposal and plastics, as some of the respondents agreed that plastics would be used sparingly.

Very few of the respondents recommended that cooperation and action among the residents, self-discipline, information dissemination, and making compost out of garbage would combat water pollution.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Almost all of the respondents are aware that Chico River is polluted. A great majority agreed that the water is not suitable for drinking and for cooking. However, the water is suitable for swimming.

Majority of the respondents have experienced skin diseases associated with the use of the river for bathing. Respondents experienced diarrhea, typhoid fever, dysentery, tuberculosis and hepatitis. However, the sicknesses were not reported to the municipal health authorities.

The most observed natural cause of pollution is soil erosion. Some of the riverbanks are bare allowing the soil to erode.

Conclusions

Environmental degradation is the most common effect of pollution. since the water is not safe for potable use, bathing, swimming, and washing clothes. It also causes health problems. Fishes are also killed so fishermen loose their source of income.

The residents agreed that the best way to lessen water pollution is recycling of wastes. Majority claimed that they would be more responsible in the disposal of their wastes. Following strictly the barangay and municipal



ordinances regarding garbage disposal would be helpful and plastics should be used sparingly. There should also be cooperation and action among the residents, self-discipline, and information dissemination and making compost out of garbage.

Recommendations

There should be a massive Information Education Campaign on the status of waste management and its implications to the environment, specifically to the river. The national and local government together with other non-government organizations concerned should cooperate on the preservation of the environment

Residents should be responsible for their own wastes. They should impose self-discipline in the proper disposal of their garbage.

Farmers should do more organic farming by using organic fertilizers. A lot of animal wastes from pigpens are poured into the river.

The municipal government should be responsible in allocating fund for the location of a suitable dumping site. It should be near enough for easier transport but far from the human population.

The municipal government should strictly implement the laws and policies regarding the use of electricity and chemicals in catching fish.

The government, specifically the Department of Environment and Natural Resources, should designate a water quality monitoring team. The monitoring should at least be quarterly.

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