GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC ANALYSIS OF ORGANOCHLORINE, ORGANOPHOSPHATE AND CARBAMATE PESTICIDE RESIDUES IN FOUR RIVERS OF DAVAO CITY

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ABSTRACT

This research entitled GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC ANALYSIS OF ORGANOCHLORINE, ORGANOPHOSPHATE AND CARBAMATE PESTICIDE RESIDUES IN FOUR RIVERS OF DAVAO CITY intended to determine the pesticide residues present and their respective levels in the eight (8) sampling stations along Talomo River, four (4) sampling stations along Lipadas River, five (5) sampling stations along Tagluno River, and eight (8) sampling stations in Panigan-Tamugan Rivers using Gas Chromatography-Mass Spectrometry. Samples were taken from July to December 2011, in close coordination with the Davao City Water District (DCWD) and Interface Development Interventions (IDIS) who also do water monitoring of basic parameters in the area.

The results showed that five (5) of the eight (8) sampling stations of Talomo River, three (3) of the four (4) sampling stations of Lipadas River, two (2) of the five (5) sampling stations of Tagluno River and four (4) of the eight (8) sampling stations of Panigan-Tamugan Rivers were positive for pesticides at least once during the monitoring period.

Out of the twenty six (26) standard or referenced pesticides, five (5) were detected in the water samples of Talomo River, three (3) in Lipadas River, two (2) in Tagluno River and three (3) in Panigan-Tamugan Rivers. All in all, ten (10) pesticides were identified and quantified, and five (5) of the ten are classified banned by the Fertilizers and Pesticides Authority of the Department of Agriculture of the Philippines. Aside from the ten, two (2) other pesticides that do not have reference standards were also identified in Talomo River stations. The banned pesticides detected in the samples were dieldrin, aldrin, endrin aldehyde, gamma chlordane, and beta heptachlorepoxide. The other pesticides quantified were penthoate, malathion E50, chlorothalonil, chlorpyrifos, and DDE.

With the exception of malathion E50 and chlorothalonil both found in Tagluno River stations, the levels of the pesticides detected in the other stations were above the guideline values (from varied standard sources). Penthoate, on one hand has no available guideline value but as an organophosphate pesticide, penthoate has short half-life and is expected to persist within 10-150 days from application. The detection of organophosphates like penthoate and chlorpyrifos in the samples suggests recent use of these pesticides prior to the sampling.

Among the sites of this study, Talomo River has the most incidence of detection, followed by the Panigan-Tamugan River, then by Lipadas and Tagluno Rivers respectively. Among the sampling months, December has the most incidence of detection.

Background of the study

The National Water Resources Board (NWRB) considers Davao City as one of the nine water-critical urbanized areas in the Philippines where water is consumed intensively (NWRB Masterplan, 1998). At present, according to the same agency, there is a looming water crisis in the city, putting at risk the survival of around 1.4 million residents (Cabling, 2010).

Out of the seven (7) watersheds of Davao City, two (2) have been the primary sources of the city's water needs. The Talomo-Lipadas watershed provides from groundwater almost 99% of the water supply while the Panigan-Tamugan watershed provides from its surface water 1% of the water supply. One prospect source of high quality drinking water in Davao City should the water scarcity continue is the Panigan-Tamugan watershed, which currently faces threats of pollution.

The Davao City Watershed Code, which was signed into law in 2007, mandates the protection, conservation and management of the city's watersheds as recharge areas for the aquifers or the sources of drinking water (Maspinas et al, 2001).

However, the rise of large-scale plantations of export-crops in the vicinity of the watershed areas does not only endanger the ecology and the health of the residents in the nearby communities but also risk the quality of the drinking water that would be coming from the said watersheds.

Studies on the current and possible threats to the safeness of the water from the said watersheds would be very beneficial not just for monitoring but also for policy-making purposes.

In 2008, the Interface Development Interventions, Inc. (IDIS) in cooperation with the Davao City Water District (DCWD), Ateneo de Davao University and Davao Pesticides Laboratory, conducted a similar study on pesticides monitoring in Panigan-Tamugan and Talomo-Lipadas watersheds. It is with this reason that this study was done in close coordination with these two institutions that also monitor the quality of the water in the watershed areas in Davao City. In this study, the identity and quantity of pesticide residues of the water samples from the sampling stations in the Talomo-Lipadas and Panigan-Tamugan river systems were determined using Gas Chromatograph-Mass Spectrometer (Shimadzu QP2010 model). Using pesticide standards, the levels of the pesticide residues in the sample were determined and the significant difference on the identity and quantity of these residues were analyzed. The methodology undertaken was in accordance to the US Environmental Protection Agency (US EPA) standards.

Objectives of the Study

To determine:

- what organochlorine, organophosphate and carbamate pesticide residues are present in selected sampling stations of Talomo, Lipadas, Tagluno and Panigan-Tamugan Rivers;
- the quantity of the organochlorine, organophosphate and carbamate pesticide residues in selected sampling stations of Talomo, Lipadas, Tagluno and Panigan-Tamugan Rivers.

Scope and Limitations of the Study

The study focused on the qualitative determination of pesticide residues and quantitative analyses on the levels of these pesticide residues in the water samples from the four (4) sampling stations along Lipadas River, five (5) sampling stations along Tagluno River, eight (8) sampling stations along Talomo River, and eight (8) sampling stations in the Panigan-Tamugan River system. Samples from Talomo River, Lipadas River, Tagluno River and Panigan-Tamugan River system were collected every first, second, third and fourth Wednesdays of the month respectively from June to December 2011, in close coordination with the Davao City Water District and IDIS who also do water monitoring in the area. The sampling was done in the following stations:

Talomo River stations

1. Upper Tamayong
2. Sitio Cogon
3. Sitio Kawayan
4. Calinan Bridge
5. Sirib
6. Barangay Angalan
7. National Power Corporation (NPC) Mintal
8. NHA Bangkal

Lipadas River stations

1. Lipadas Upstream in Sitio Sarro, Brgy. Manuel Guianga, Tugbok
2. Sitio Sarro Community Water in Brgy. Manuel Guianga, Tugbok
3. Tagluno-Lipadas Junction, Brgy. Alambre, Toril
4. Barangay Sirawan, Toril, Davao City

Tagluno River stations

1. Longon Creek
2. Daliaon Creek
3. Emi-emi Bridge

4. Tagaluno Bridge
5. Barakayo Pekenyo Community Water Source

Panigan-Tamugan stations

1. Upstream Panigan
2. Panigan River
3. Tamugan River
4. Panigan-Tamugan Junction
5. Cugan Creek
6. Gumalang Creek
7. Tamugan-Gumalang Junction
8. Wines-Gumalang Junction

Each of the four areas was assigned a particular researcher from the Ateneo de Davao University BS Chemistry program who did all the procedures from sampling to analysis.

In identifying and in quantifying the pesticide residues of the water samples, Gas Chromatography-Mass Spectrometry (Shimadzu QP2010 GCMS) was used. After necessary sample preparations, which include extraction with organic solvent, cleanup and drying, solvent-exchange through rotary evaporation, and concentration of sample, GC-MS analyses were done to the samples against standards of organophosphate and organochlorine pesticides. All analyses were performed in the Chemistry Laboratory of Ateneo de Davao University.

Significance of the Study

The study is a timely attempt to monitor pesticide residues in Talomo-Lipadas and Panigan-Tamugan river systems using Gas Chromatography-Mass Spectrometry (GCMS). In the past, there had been various efforts to monitor pesticide residues in the said area but the determination and analyses were carried out using different methodologies and instruments.

This study will establish data on the identity as well as the levels of pesticide residue along the Talomo-Lipadas and Panigan-Tamugan river systems. The two river systems being watershed areas at the same time are of reasonable interest because of the watersheds' role as current and prospect sources of potable water of the Davao City Water District respectively. Also, a previous study has shown that the watershed tested positive for organochlorine compounds with the use of a multiple residue analysis through Gas Chromatography (GC). The study was conducted by IDIS together with Ateneo de Davao University and other organizations (Interface Development Interventions, Inc., 2008).

This study is very significant not only in Davao City but also in the entire Mindanao region since plantations are rapidly expanding in this region (IDIs, Survey on the Level of Pesticide Contaminants in Panigan-Tamugan and Talomo-Lipadas Watersheds Towards the Protection of Critical Water Resource Areas in Davao City).

In this light, this would benefit the government by means of providing objective and scientific basis for possible policies and legislations, or amendments thereon, pertaining to the use of pesticides and for sustainable environmental protection.

Furthermore, this would help the Non Governmental Organizations (NGO's) advocating for environmental justice to be provided with information that they can use as a baseline for future water monitoring and future projects especially in creating a community-based response mechanisms against health and environmental hazards posed by the use of pesticides in nearby plantations and farms.

Related Literature

A. **Talomo River**

Talomo River is a waterway which originates from Mt. Talomo and adjoining Apo Range located at the eastern part of Davao City. Creeks are connected to it such as Tagakpan Creek located at Brgy. Tagakpan; Wangan Creek in Brgy. Wangan; and, the creeks located at Brgys. Baguio and Malagos. It flows east-southerly direction and curves out to finally drain into the Talomo Bay in Davao Gulf at an average rate of 6.092 cubic meters per second. It has a length of approximately 80 kilometers; a drainage area of 165 square kilometers; average width of 25 meters; has a maximum discharge rate of 24,542 liters per second and a minimum discharge rate of 3,819 liters per second. It is generally characterized by a semi-rough topography (as cited in Diansay, 2002)

There are 8 sampling sites located along the Talomo River. These sites include the Upper Tamayong, Sitio Kawayan, Sitio Cogon, Calinan Bridge, Sirib, Brgy. Angalan, National Power Corporation Mintal, and NHA Bangkal. All of these sites are sampling sites of the Davao City Water District (DCWD) to monitor the water quality of the river except for the sites in Sitio Kawayan, Sitio Cogon, and Sirib which are additional sites given by the Interface Development Interventions, Inc (IDIS) for their monitoring of the said area. Talomo River is located near pineapple plantations which use fertilizers and pesticides for their quality products. The additional sites of IDIS are chosen for they were part of the areas wherein pesticide residues where detected. The areas are valuable to the community since they are water sources for their chores (e.g. washing clothes). Other sites are part of the Talomo River itself and the order of sites from upstream to downstream be: Upper Tamayong, Calinan Bridge, Barangay Anggalan, NAPOCOR Mintal, and NHA Bangkal. As the flow of the river goes downstream, siltation will be observed and the site in NHA Bangkal, which is located at the mouth of the river, can be observed to be muddy (Ground Survey).

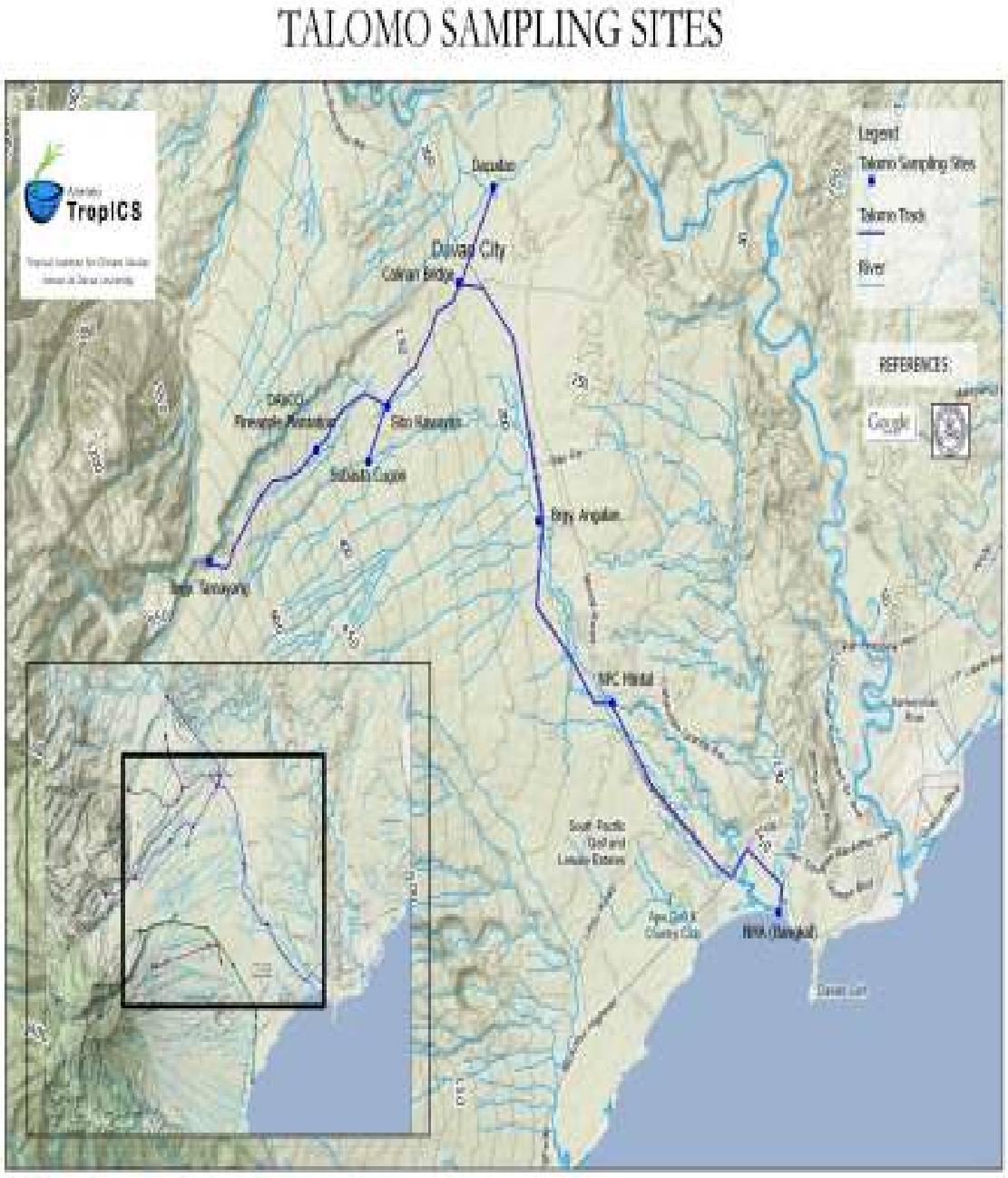


Figure 1. Map of Talomo River Sampling Stations (AdDU TropICS, 2012)

B. Lipadas River

As described in Diansay's study, Lipadas River is a waterway which originates from the upper reaches of Mt. Talomo passing through Barangays Baracayo, Bangkas,

Manambulan, Alambre, and Mulig. It is joined by main tributaries which are Lubogan River, Kilati River, and Bato River (Diansay, 2002). It continues to meander further downstream and joined at Barangay Lizada by another tributary which is the Marapangi River and Macaring creek. It then finally empties itself into the Davao Gulf (DENR, 1990). Its drainage area is 170 square kilometers; discharge rate of 17.40 cubic meters/second average; width of 36 meters on average; and height of 1.24 meters average; and a mean velocity of 0.39 meter/second (Sucaldito, 2001).

Lipadas River was first classified in the year 1998 with the following classifications; Class AA on the upstream portion of Mt. Apo National Park to Barangay Baracayo; Class A in a portion of Lipadas River from Barangay Baracayo to Barangay Bangkas; Class B from Barangay Bangkas to Barangay Alambre; and, Class C in a portion of Barangay Alambre downstream thereafter to confluence of Davao Gulf (DENR, 1990).

At the upstream portion, the river is being utilized for bathing, irrigation, and drinking water for domesticated animals. At the downstream portion, the dominant use of the river is for the drinking and bathing of domesticated animals as well as for irrigation. Some industries downstream like Miramonte Farms, Magnolia Chicken Dressing Plant, and Nenita Farms would utilize the water for cleaning purposes. Sand and gravel extraction is also being done at Lipadas River (DENR, 1990).

Erosion at the upper reaches of the river and the presence of residential houses at the bank of the river downstream has caused significant impact to the deterioration of its quality. Likewise, the deteriorating quality of the river can be attributed to the domestic waste as a result of the establishment of houses along the banks of the river. However, at the upstream portion, the water quality of still good (DENR, 1990).

The map below shows the different sampling stations and the rivers that drift through them. The sampling stations are the following: Station 1 – Lipadas Upstream located at Sitio Sarro, Brgy. Manuel Guianga, Tugbok; Station 2 – Community water at Sitio Sarro, Brgy. Manuel Guianga, Tugbok; Station 3 – Tagluno-Lipadas Junction, Barangay Bato, Toril; Station 4 – Barangay Sirawan, Toril, Davao City.

Lipadas upstream station located at Sitio Sarro, Brgy. Manuel Guianga, is about 4 kilometers away northwest from the barangay hall. This station is a DCWD-adopted site. It is about 700 meters northeast of Sarro Community with banana plantation surrounding the area. The station is far from residential areas. It can be noted easily that the area is rich in biodiversity and several species of plants.

Sarro community, the second station, obtains its water from a water table underground. The water is utilized for drinking, washing, bathing, and other hygienic and domestic activities. Sarro community is about 1.5 kilometers from the Manuel Guianga barangay hall.

The Tagluno-Lipadas junction was the third sampling station. The station was located in Brgy. Alambre, Toril. The etymological origin of the name of the place arisen

from the fact that that there was a huge rock separating the Lipadas River from Tagluno. The station is near to a residential area.

The fourth station was located in Barangay Sirawan, Toril. It is nearing a residential area composed mainly of Muslim settlers. Agro-industrial plantations such as the Nenita Farms, Miramonte Farms, and Magnolia dressing plant were just within the vicinity of the area. The station is about 3 kilometers from Lizada bridge.

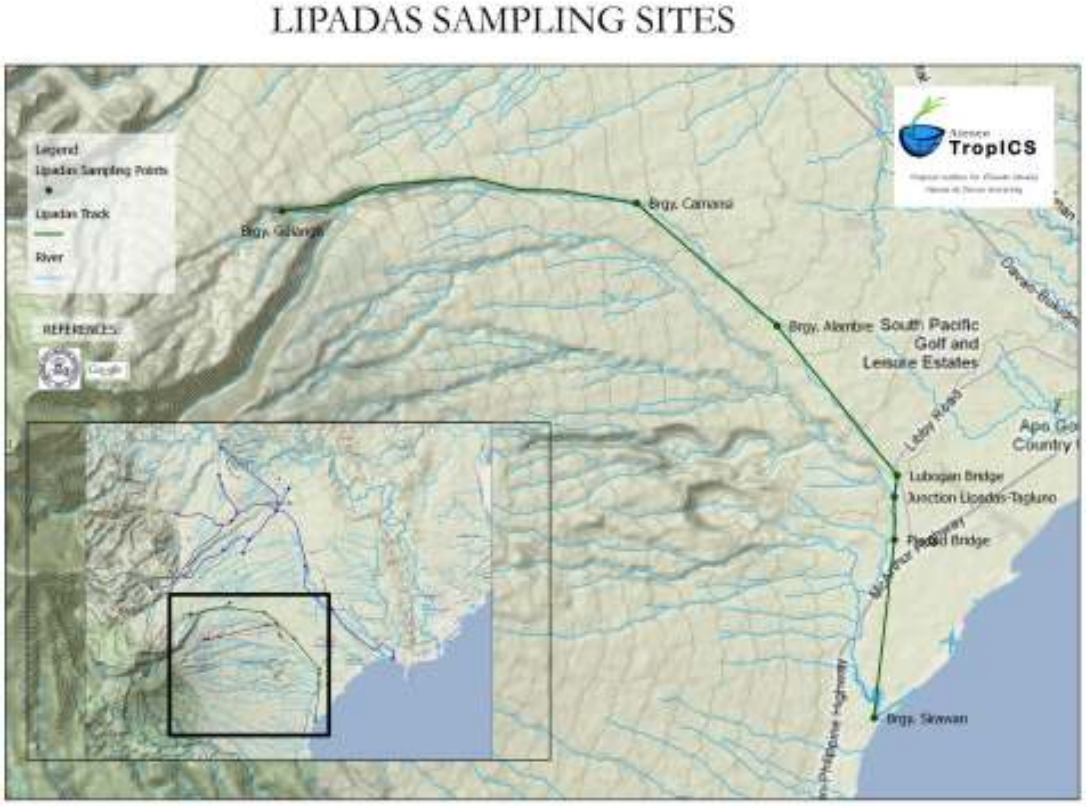


Figure 2. Lipadas Watershed Sampling Sites

C. Tagluno River

Tagluno River is a stream located in Toril, Davao City with an average of 218 meters above sea level. It has a humid climate about > 0.65 p/pet (precipitation/ potential evapotranspiration). Closed to open broadleaved evergreen, semi-decidious forests cover the entire landscape around the river and the land is not cultivated, most of the natural vegetation is still intact. The soil is very rich with nitosols and andosols, and the lower horizon of the soil is clay-enriched with shiny ped surfaces. The forest has a tropical wet or no dry season climate. Tagluno River is also prone to natural hazards. Earthquakes have an occurrence of about 80% at >7 Richter, since the river is in a destructive earthquake zone. There are also low occurrences (20%) of drought, medium-high (70%)

occurrences of cyclones, high (80%) occurrences of landslides, and extremely high (100%) occurrences of flood (http://www.chinci.com/travel/pax/q/197923 1/Tagluno+River/PH/The+Philippines/0/).

Tagluno River is a tributary of the Lipadas River which is one of the recharge area and aquifer of Davao City where we get our water supply (IDIS, 2008).

In the study there are 5 sampling sites of Tagluno River that were covered namely Longon creek, Barakayo Pekenyo Community water source, Daliaon creek, Emi-emi Bridge and Tagluno Bridge (*see Figure 3*). These sampling sites are followed from the sampling sites of Davao city Water District (DCWD). Three of these sites namely Longon creek, Barakayo Community water source and Emi2x Bridge belong to the Barangay Tungkalan. Barangay Tungkalan has a total population of 3,097 as of June 2011 and the number of households is 669. The primary source of income of the people in the community is agricultural activities because most of them are farmers (Barangay Profile of Barangay Tungkalan, 2011)

According to Barangay Captain Paglinawan (2011) the source of the Barangay's drinking water is the Longon creek. Every month they would collect ten pesos per household for the maintenance of the water source system. This water source system was established in the year 1990.

In the year 2003-2004 plantations started to settle in the Barangay (Paglinawan, 2011) see Figure 3.The banana plantation is 34 kilometers away from the city proper. The land area of this plantation has a total of 1,028 hectares and 90% of it is low elevation highland (http://www.mode.org/oda/pdf/Agrarian/Reform/Communities/Project/Case/Study/-/AFRIM-ODA/Watch.pdf).

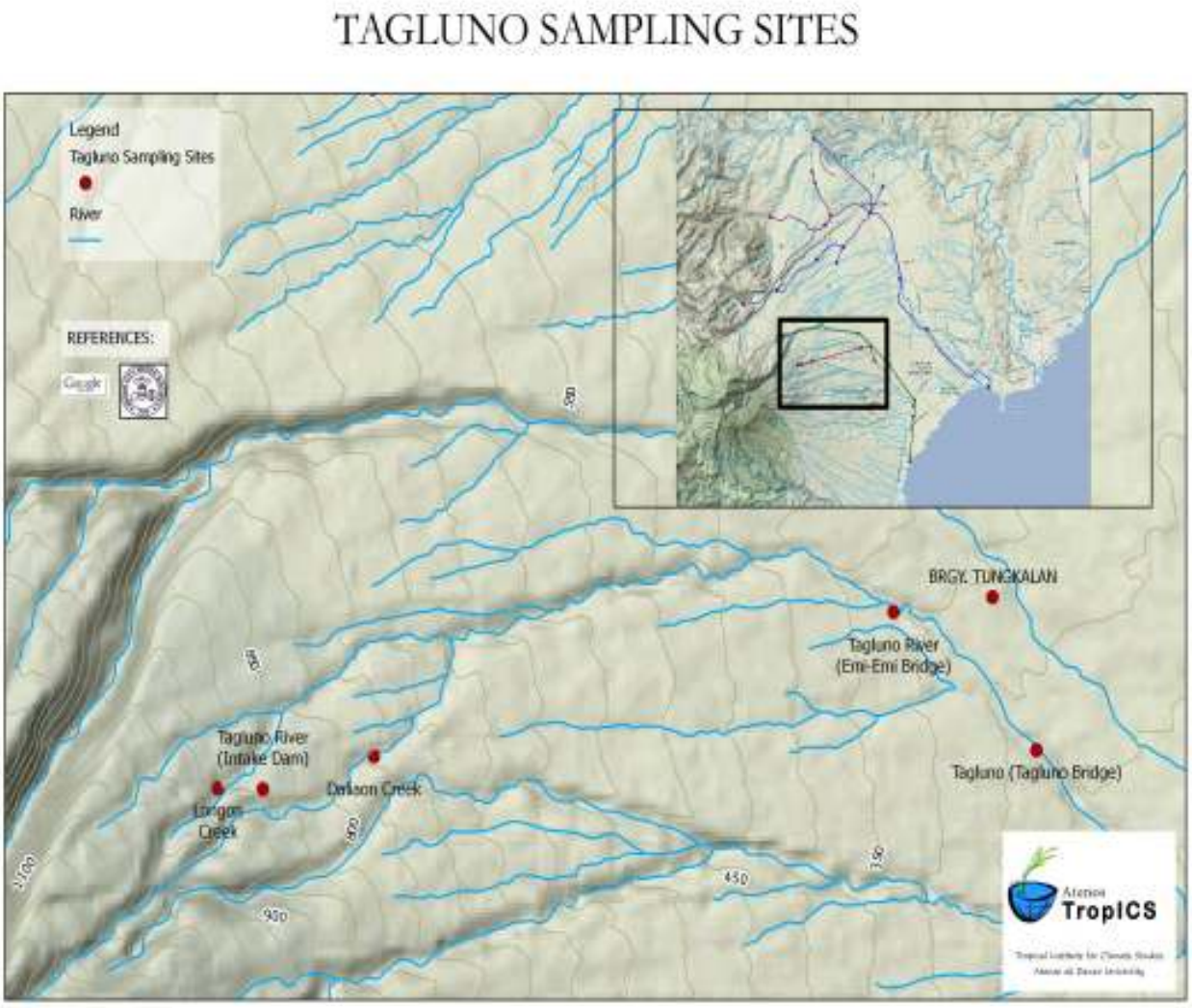


Figure 3. Map of Tagluno River Sampling Stations (AdDU TropICS, 2012)

D. Panigan-Tamugan River

Projections on the next primary source of drinking water for Davao City show that the Panigan-Tamugan Watershed is the most probable, as assessed by the DCWD. It is one of the seven watershed-tributaries of the Davao River, the largest watershed in Mindanao, which is located below two mountain ranges of volcanic origins: Mt. Talomo and Mt. Apo, and has 180-Km span of interconnecting tributary streams starting from Bukidnon (DCWD as cited in Quiap, 2009).

Cabling 2010 stressed that the Panigan-Tamugan watershed is now facing both the necessity and the threats of its intended and proposed uses such as for agriculture and rural livelihood, ecotourism, biodiversity and natural resource management, indigenous

peoples' and communities' ancestral land, settlements and housing subdivision developments, hydropower generation, source of domestic water.

The Tamugan Farmers' Association (TAFA), said that the Panigan-Tamugan Watershed is the main water source for Barangays Gumalang, Panigan, Suawan, and Tamugan and is crucial for the socio-economic activities of the locales (TAFA as cited in Kalikasan People's Network for the Environment, 2009).

Aside from the proposed hydropower project of HEDCOR in Tamugan-Suawan, the rise of plantations for export crops within the watershed is another aspect of contention.

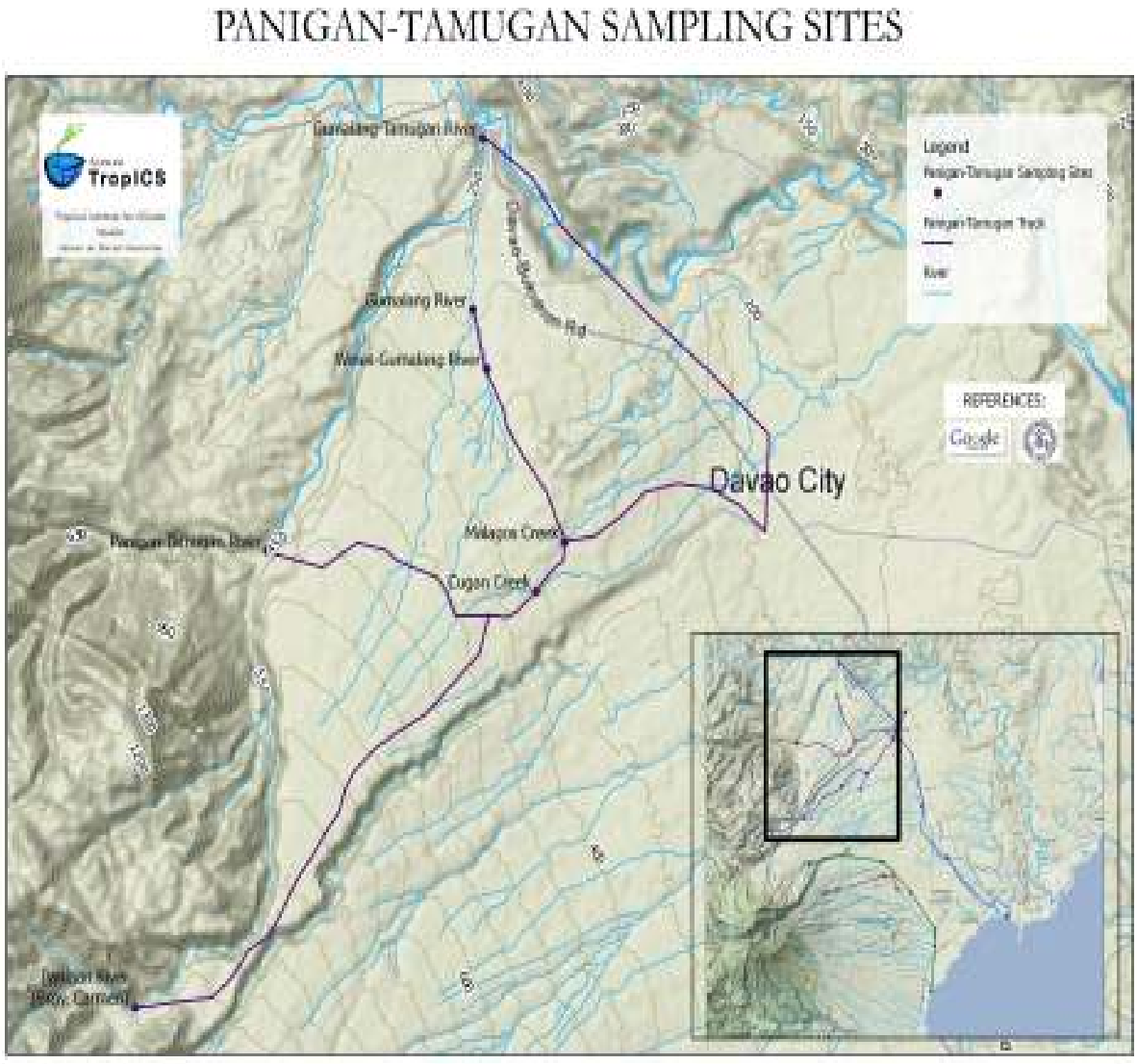


Figure 4. Map of Panigan-Tamugan River Sampling Stations (AdDU TropICS, 2012)

Methodology

A. Sample Collection

Sampling period

Sample collection started on June 15, 2011 for Lipadas River, June 22, 2011 for Tagluno River, July 6, 2011 for Talomo River and July 27, 2011 for Panigan-Tamugan River. The sample collection ended on December 7, 2011 for Talomo River, December 14 for Lipadas river, December 19, 2011 for Tagluno River and December 28, 2011 for Panigan-Tamugan River. Samples were collected on a monthly basis from 6:00 AM to 12:00 nn.

Sample container preparations

Containers used were amber glass bottles as specified by the "Handbook of Water Analysis" (Nollet, 2007) and US EPA 8141b. Containers were initially washed with tap water and detergent, acid washed with 1 M HCl and rinsed with distilled water thrice. Then, the sample containers were acetone-washed in order to remove remaining organic compounds. Before sample collection, containers were labeled with the date of sampling and sampling station.

Sample collection

Water samples were collected from the sampling stations. In each sampling station, two (2) samples were obtained. One of the two samples was spiked with pesticide standards. Samples were collected at cross-sections where there is thorough mixing of water. The two sample containers were placed next to each other while collecting the sample. Previously washed containers were soaked about 30 cm above the water bed or below the water surface to prevent nonrepresentative samples. Each container was rinsed three times with the river water. More than 1000 milliliters (mL) of sample was collected since the container must be completely filled to prevent ample amount of oxygen from dissolving in the water sample which may cause prior oxidation. Details such as the sample temperature and weather were recorded.

Preservation of water samples

The sampling takes about 5 – 6 hours, hence, on-field storage was necessary to prevent sample degradation. After collection of the sample in each station, the samples were immediately placed in an ice chest filled with ice and kept from direct sunlight.

B. Sample Preparation

Adjusting the pH

The pH of the sample was obtained using a calibrated pH meter with a mean calibration slope not less than 90%. Samples that do not fall in the 6.5 – 7.5 pH range were adjusted to the range by addition of either 10 N sodium hydroxide (NaOH) or 1:1 volume per volume (v/v) sulfuric acid (H_2SO_4) as stipulated in the US EPA 8141b.

Extraction

One five hundred milliliters (500 mL) of sample was extracted thrice with 60 mL methylene chloride (analytical grade) in a 1-liter separatory funnel and another five hundred milliliters (500 mL) of sample, added with an external standard, was also extracted thrice with 60 mL methylene chloride (AR) in a 1-liter separatory funnel. Extraction should be made by at least two minutes mixing of the sample. After the mixing, the sample was allowed to stand for 10 minutes.

Drying and Concentrating the Sample

The extract was collected and dried for 15 minutes using anhydrous sodium sulfate. The dried extract was transferred to the boiling flask. The remaining drying agent was rinsed with 15 mL of methylene chloride and the rinsing was added to the previously collected extract. The extract and the rinsing were rotary-evaporated at the temperature set to the boiling point of methylene chloride (40 ^{o}C) to evaporate the methylene chloride until approximately 5 mL is left. 50 mL of hexane (analytical grade) is then added to the concentrate and the temperature is then set to the boiling point of hexane (78 ^{o}C). Hexane is evaporated until about 5 mL of the sample remains.

Storage

The concentrated sample extracts were stored at 3°C, protected from light, in sealed vials (e.g., screw-cap vials or crimp-capped vials) equipped with unpierced PTFE-lined septa.

Performance Proficiency

Preparations of the standards:

The analysis employed spiking of samples with standards of known concentration in order to get the % recovery. The spiking, however, was applied only beginning October because the pesticide standards were only available at that time. For every sample, two trials were spiked. Four spikes were available. One spike was composed of twenty (20) different organochlorine pesticide standards (labeled OCl). One organophosphate spike was prepared with three different pesticide standards (labeled OP-A), another one with five pesticide

standards (labeled OP-B), and the last one with three pesticide standards (labeled OP-C). From the stock solution prepared, working solutions were made.

The recommended amounts of standard added are listed below.

a. Organochlorine pesticides
   0.5 mL of standard 20 ppm CLP Organochlorine pesticide mix
b. Organophosphate A pesticides
   50 µL of standard Organophosphates pesticide mixture A
c. Organophosphate B pesticides
   20 µL of standard Organophosphates pesticide mixture B
d. Organophosphate C pesticides
   50 µm of standard Organophosphates pesticide mixture C

Initial Calibration:

% Recovery:

The standards for each analysis were added to the blank, sample and matrix spike prior to analysis. 500mL aqueous sample was spiked with the standard (Appendix A List of Standards). The recommended standard concentration is 500 ppm otherwise specified.

The % recovery of the standard can be calculated as:

$$\%\ Recovery = \frac{Concentration\ (or\ amount)\ found}{Concentration\ (or\ amount)\ added}\ x\ 100$$

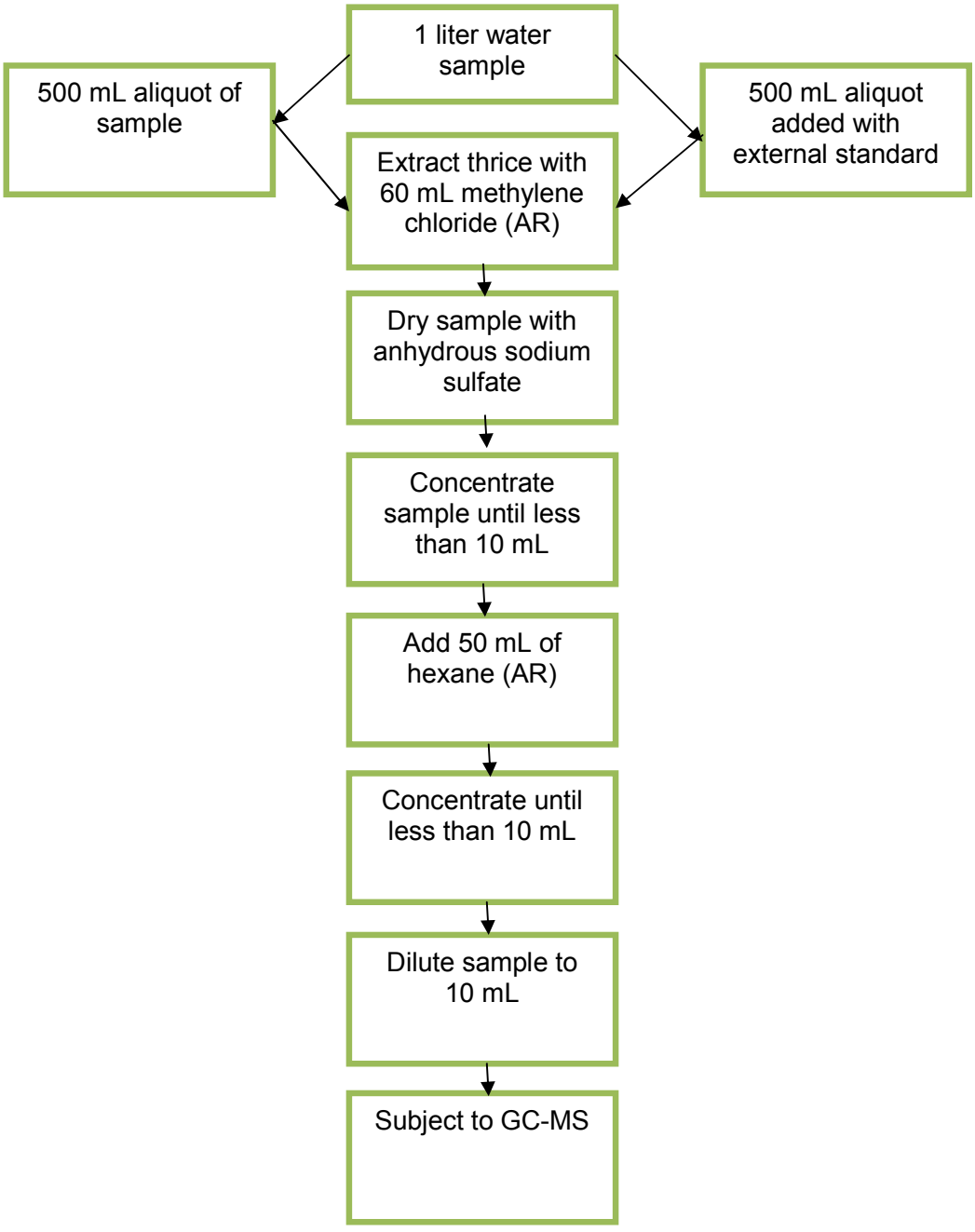
Method blanks:

For every month there was at least 1 method blank that underwent all of the procedures or processes made to the samples.

Instrument Conditions:

Gas Chromatograph conditions (refer to appendix B)

Flow chart of procedure



Pesticide	Classification	Use
Diazinon	Organophosphate	Insecticide
Profenofos	Organophosphate	Insecticide
Malathion	Organophosphate	Insecticide
Chlorothalonil	Organophosphate	Fungicide
λ-cyhalothrin	Organophosphate	Insecticide
Deltamethrin	Organophosphate	Insecticide
Fenamiphos	Organophosphate	Insecticide
cypermethrin	Organophosphate	Insecticide
Penthoate	Organophosphate	Insecticide
triazophos	Organophosphate	Insecticide
Aldrin	Organochlorine	Insecticide
Alpha-bhc	Organochlorine	Insecticide/Fungicide
Alpha-chlordane	Organochlorine	Insecticide
Beta-bhc	Organochlorine	Insecticide/Fungicide
Delta-bhc	Organochlorine	Insecticide/Fungicide
Dieldrin	Organochlorine	Insecticide
Endosulfan I (alpha)	Organochlorine	Insecticide/Acaricide
Endosulfan II (beta)	Organochlorine	Insecticide/Acaricide
Endosulfan sulfate	Organochlorine	Insecticide/Acaricide
Endrin	Organochlorine	Insecticide
Endrin aldehyde	Organochlorine	Insecticide
Endrin ketone	Organochlorine	Insecticide
Gamma-bhc	Organochlorine	Insecticide/Fungicide
Gamma-chlordane	Organochlorine	Insecticide
Heptachlor	Organochlorine	Insecticide
Heptachlor epoxide isomer B	Organochlorine	Insecticide

Table 1. List of Pesticides Monitored/ Pesticides in the Standards

Methoxychlor	Organochlorine	Insecticide
4,4' DDD	Organochlorine	Insecticide
4, 4' DDE	Organochlorine	Insecticide
4, 4' DDT	Organochlorine	Insecticide

Results and Discussion

All results were made possible with the use of a gas chromatograph – mass spectrometer, GCMS (Shimadzu QP2010 model). The GCMS Postrun Analysis program of the instrument provided the qualitative and quantitative data.

Quantitative Results

Quantitation of data was made possible with the use of standards. The standards used were composed of organochlorine pesticides and organophosphate pesticides as listed in *table 1* above. The quantification of the data required calibration curves from different dilutions of the standard. The concentration of the standard is determined by its purity as purchased and its weight as prepared. A comprehensive compound table was then created with calibration curves for each compound *(Figure 5)*. Out of the 30 standard pesticides listed, only 26 of them registered peaks in their respective chromatograms *(Figure 6)*

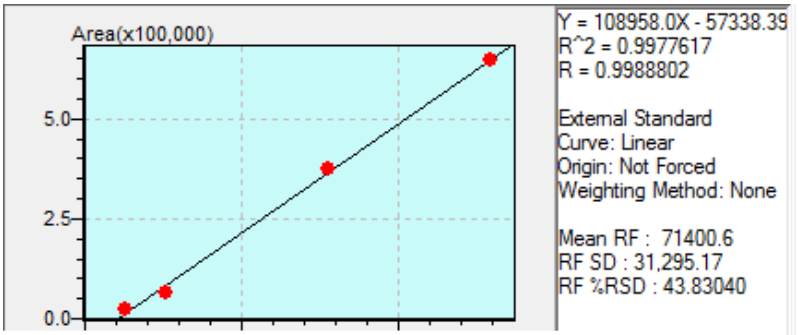


Figure 5. Example of a Calibration Curve produced by GCMS Postrun Analysis

ID#	Name	Type	ISTD G	m/z	Ret.Time	Ret. Index	Unit	Ref.Ions
1	chlorothalonil	Target	0	266.00	11.625	0	ppm	264.00-26
2	Chlorpyrifos	Target	0	97.00	13.310	0	ppm	197.00-19
3	Diazinon	Target	0	179.00	11.465	0	ppm	137.00-15
4	Alpha BHC	Target	0	181.00	10.725	0	ppm	183.00-21
5	Beta BHC	Target	0	183.00	11.170	0	ppm	181.00-21
6	Gamma BHC	Target	0	181.00	11.355	0	ppm	183.00-21
7	.delta.-Lindan	Target	0	181.00	11.875	0	ppm	183.00-21
8	Heptachlor	Target	0	100.00	12.765	0	ppm	272.00-27
9	Aldrin	Target	0	66.00	13.475	0	ppm	263.00-91
10	.BETA.-HEP	Target	0	353.00	14.220	0	ppm	81.00-355
11	Gamma Chlor	Target	0	373.00	14.680	0	ppm	375.00-37
12	Alpha Chlord	Target	0	373.00	14.940	0	ppm	375.00-37
13	o,p'-DDE	Target	0	246.00	15.310	0	ppm	248.00-31
14	Dieldrin	Target	0	79.00	15.480	0	ppm	81.00-263
15	Endrin	Target	0	263.00	15.905	0	ppm	81.00-245
16	p,p'-DDD	Target	0	235.00	16.130	0	ppm	237.00-16
17	Endrin Aldeh	Target	0	67.00	16.380	0	ppm	250.00-27
18	Endosulfan s	Target	0	272.00	16.835	0	ppm	229.00-27
19	o,p'-DDT	Target	0	235.00	16.870	0	ppm	237.00-16
20	Endrin keton	Target	0	67.00	17.790	0	ppm	317.00-31
21	Methoxychlor	Target	0	227.00	17.925	0	ppm	228.00-23
22	Malathion E5	Target	0	127.00	13.160	0	ppm	125.00-17
23	Fenamiphos	Target	0	154.00	14.950	0	ppm	303.00-26
24	Profenofos	Target	0	139.00	15.220	0	ppm	97.00-208
25	Phenthoate	Target	0	274.00	14.260	0	ppm	121.00-12
26	Triazophos	Target	0	161.00	16.385	0	ppm	162.00-17

Figure 6. The Compound Table

Qualitative Results

A qualitative report consists of a total ion chromatogram, the unknown compound's mass spectrum, and its respective similar mass spectrum with the name of the nearest known compound from the spectral libraries of NIST and Wiley. The total ion chromatogram represents the whole mass spectra registered from the sample. Compounds were previously separated by gas chromatography to exhibit a unique retention time. Compounds differ in concentration and that can be observed by an increase in intensity, thus creating peaks. Peaks represent the compounds with greatest concentration that were isolated from the sample. Peaks of interest were those with mass spectrum of at least 80% similarity to a compound in the mass spectral libraries.

Qualitative analyses were done to check if there were other pesticides not part of the standards but were present in the samples.

A. Talomo River Samples

The quantitative results are summarized in *Table 2*. Only two months of sample was collected for the site of Sirib. There were also instances of degradation and spillage of samples, hence, there was no more sample left for analysis for those particular months.

Table 2 - Positive Detection of Pesticides with Concentrations in ppb

	September	**November**	**December**				
	Dieldrin	Phenthoate	Phenthoate	Aldrin	Beta Heptachlorepoxide	DDE	Dieldrin
Sirib	4.24						
NPC Mintal		0.349					
NHA Bangkal			0.308				
Sitio Cogon				1.24			
Sitio Kawayan					2.74	0.219	2.63

The data showed that the sites of Sirib, NPC Mintal, and NHA Bangkal were positive of a pesticide compound on one trial for a single month. Dieldrin was found to have an average concentration of 4.24 ppb in the sampling site of Sirib for the month of September. Phenthoate was found to be positive twice but in different locations at different sampling months. The first instance was in the sampling site of NPC Mintal for the month of November and the other was in the sampling site of NHA Bangkal for the month of December. The average concentrations of penthoate were 0.349 and 0.308 ppb, respectively.

Pesticides were also found to be positive in Sitio Kawayan and Sitio Cogon for the month of December. Organochlorine pesticides found in the spiked were aldrin for the site of Sitio

Kawayan and beta heptachlorepoxide, DDE, and dieldrin for the site of Sitio Cogon. The average concentration of aldrin in the sampling site of Sitio Cogon is 1.24 ppb while the average concentration of beta heptachlorepoxide, DDE, and dieldrin in the sampling site of Sitio Cogon are 2.74, 0.219, and 2.63 ppb, respectively.

According to DAO no. 34, the regulated amount of dieldrin and aldrin for surface waters is 1 ppb. In the study, the levels of dieldrin and aldrin were greater than the regulated amount. The levels were recorded to be at 4.24 and 2.63 ppb for dieldrin and 1.24 ppb for aldrin. Also, the FPA classified these compounds as banned compounds being a persistent organic pollutant (POP) which means that they do not degrade easily and that they are highly hydrophobic. There are no known regulated limits yet for Phenthoate, beta heptachlorepoxide, and DDE.

The results of the qualitative analyses for other possible pesticides present in the sample but absent in the reference standards show that in the month of August the pesticide *Propane, 2,2'-oxybis[1-chloro- (CAS) BIS-(2-CHLORO-1-METHYL) ETHYL ETHER or "DCIP"* was detected. According to EPA, it is a nematocide with the LD50 of 400 ppm. (http://www.epa.gov/iris/subst/0407.htm, retrieved Feb. 25, 2012). In the month of November, the pesticide Ametryn was detected in one of the trials in the Sitio Cogon sample. Ametryn is a herbicide used to control broadleaf and grass weeds in fields planted with field corn, popcorn, pineapple, and sugarcane. Ametryn has been shown to have low acute dermal, oral, inhalation toxicity (http://www.epa.gov/oppsrrd1/REDs/factsheets/ametryn_fact.pdf, retrieved Feb. 25, 2012).

The study conducted by IDIS along with its partners detected pesticides in stations that are in the same sampling site as stated in this study. Stations 5 & 6 of IDIS, which were positive of pesticides, are the same with the Sitio Kawayan and Sitio Cogon sites, respectively. Concentrations of the detected pesticides are shown in *Table 2.*

Table 3. Comparison of the results of previous studies with the results of this study

	Sitio Cogon		**Sitio Kawayan**	
	IDIS Study	This Study	IDIS Study	This Study
Pesticides Detected	chlorpyrifos diazinon fenitrothion	Aldrin	chlorpyrifos diazinon fenitrothion phenthoate heptachlor mancozeb	beta heptachlor epoxide DDE dieldrin ametryn

The detected pesticides in the IDIS study, dating back on the year 2008, showed that chlorpyrifos, diazinon, fenitrothion, phenthoate, heptachlor, and mancozeb for the sampling site in Sitio Cogon while chlorpyrifos, diazinon, and fenitrothion were detected for the sampling site

in Sitio Kawayan. No Match was made with the IDIS study with this study with regards to the pesticides detected but this study showed that aldrin was found to be present in Sitio Cogon while beta heptachlorepoxide, DDE, dieldrin, and along with ametryn were found to be present in Sitio Kawayan. Still, the two sites were found to have presence of different kinds of pesticides even though 4 years had passed.

B. Lipadas River Samples

In the seven-month monitoring of pesticide residues in Lipadas River, three pesticides were detected to be positive in three (3) out of four (4) sampling sites.

The experimental results for the seven-month pesticide residue monitoring are summarized in *Table 4*. Though several pesticides were used as spike and were detected in the spiked batch,T*able 4* only shows the pesticides detected for the unspiked batch (for there was no other pesticides detected in the spiked batch aside from the added pesticide standards) and the sampling months in which they were detected.

Table 4. Positive Detection of Pesticides with Concentrations in ppb

	July	**September**	**October**	**November**
	Gamma-chlordane	Endrin aldehyde	Endrin aldehyde	Chlorpyriphos
Manuel Guianga	0.48			
Bato Junction				0.83
Sirawan		3.92	4.47	

Gamma-chlordane was the first to be detected in Manuel Guianga during the sampling on July 2011. However, for the whole sampling duration, it was only detected once. The detected average concentration of gamma-chlordane was 0.48 parts per billion (ppb). The guideline value for chlordane as based on the International Union of Pure and Applied Chemistry is 0.2 ppb. Hence, the level of pesticide detected in Manuel Guianga for the sampling month was above the guideline value of the IUPAC. The instrumental limit of detection for gamma-chlordane was 0.44 ppb. Hence, the analytical result is within scope of the instrument.

Nevertheless, gamma-chlordane is a banned organochlorine pesticide as directed by the FPA. Hence, its presence in the environmental matrix may signify two points: first, though banned, chlordane is still used by plantations and small farmers; or second, the detected gamma-chlordane was just one of the pesticides deposited in the environmental matrix (sediments) and was removed by runoff. Since this organochlorine is a Persistent Organic Pollutant (POP), it has a long half-life. Hence, no conclusive statement can be formulated whether chlordane is still currently used by plantations and small farmers or not.

Endrin aldehyde was detected for two consecutive months in the Sirawan station. Sirawan was the downstream portion of the Lipadas River. Endrin aldehyde was detected in September and October with levels of 3.92 and 4.47 ppb, respectively.

The detected concentrations of endrin aldehyde in Sirawan for the sampling months are above the advisory value and may cause health effects if ingested. The instrumental detection limit for endrin aldehyde was not established since the average percent recovery of the spiked sample did not fall within the acceptable range of 70 – 120%.

The direct source of endrin aldehyde is endrin itself since endrin aldehyde is a degradation product of endrin. However, endrin is a banned organochlorine pesticide. Hence, this could still mean two things: first, endrin is still currently used by plantations and small farmers, and second, endrin aldehyde in the water sample only resulted from the runoff of the long deposited endrin aldehyde in the sediments. Even the results show that endrin aldehyde was detected for two consecutive months, there still cannot be a conclusive statement to formulate whether endrin is still used by plantations and small farmers or not.

Finally, chlorpyriphos was detected in Tagluno-Lipadas Junction (also known as the Bato Junction) for the month of November. The detected level of chlorpyriphos was 0.83 ppb. US EPA guideline value for chlorpyriphos is 0.041 parts per billion. The detected level of chlorpyriphos for the sampling month was above the level of the advisory value of the US EPA. Chlorpyriphos was only detected once in Tagluno-Lipadas Junction during the whole sampling duration.

Being an organophosphate which has a short half-life (60-120 days), the detection of chlorpyriphos could mean that it is currently used by plantations and small farmers. Since this insecticide is not a persistent pollutant, it is not supposed to be detected in environmental matrices. According to DENR's DAO 34 standard, organophosphates are supposed to exist in nil amounts. Nil is defined as extremely low concentration that is not detectable by existing standard analytical equipment for pesticide detection (Simpol et. al., 2003).

It can be noted, nevertheless, that no pesticide was detected for the Sarro Community. The sample was obtained from the community water which was a flowing water anchored on an underground aquifer.

The pesticides detected in the current study are still those pesticides detected in the previous studies. For instance, chlorpyriphos was detected in the study funded by PCEEM in 2003 and was also detected in the study conducted by IDIS in 2007. With the same area and levels which are above the guideline values, it could be deduced that the same pesticides are still applied by the plantations and/or small farmers or growers that inhabit the Talomo-Lipadas watershed area. However, this does not necessarily hold true for the detected gamma-chlordane and endrin aldehyde since these two organochlorines may have long been deposited in the sediments and are only detected due to runoff.

The following table shows the pesticides detected in Talomo-Lipadas watershed in the studies made by PCEEM, IDIS, and AdDU.

Table 5. Comparison of the results of previous studies with the results of this study

Pesticides	Study of PCEEM (2003)	Study of IDIS (2007)	This study/AdDU (2011)
Chlorpyriphos	Detected (most frequently)	Detected	Detected
Diazinon	Detected	Detected	-
Endrin aldehyde	-	-	Detected
Endrin ketone	-	Detected in sediments	-
Gamma-chlordane	-	Detected in sediments	Detected
Butachlor	Detected	-	-
L-cyhalothrin	Detected	-	-
4,4 DDT	-	Detected in sediments	-
Dieldrin	-	Detected in sediments	-
Aldrin	-	Detected in sediments	-
Heptachlor	-	Detected	-
Fenitrothion	Detected		

** Note: unless specified "Detected" generally means "detected in water". **

C. Tagluno River Samples

In the whole 6 months of sampling two (2) out of five (5) sampling sites at least once were found positive of pesticides. There were only two (2) pesticides detected in the whole duration of the study. As presented in *Table 6,* the 2 sampling sites that gave positive results were Longon creek and Emi-emi Bridge. The common pesticides detected were chlorothalonil and malathion E50. These pesticides are classified as fungicide and insecticide respectively. The table below summarizes the results of the analysis.

Table 6. Positive Detection of Pesticides with Concentrations in ppb

	November		**December**
	Malathion E50	Chlorothalonil	Malathion E50
Longon Creek	0.176		0.000435
Emi-emi Bridge		13.2	

Chlorothalonil is a chloronitrile fungicide commonly used in banana plantations as noted from FPA. This pesticide was detected once in the month of November at Emi-emi Bridge having a concentration of 13.2 ppb. According to US EPA's health Advisories for drinking water 1992, this pesticide is classified as a probable human carcinogen which means that there are sufficient evidence on animals on its carcinogenicity and inadequate evidence on humans. The

concentration of chlorothalonil that is cancer risk is 0.15 ppm. Comparing the set limit to the experimental data, the experimental data which is 13.2 ppb is very minimal and below the set limit.

According to US EPA's health Advisories for drinking water 1992, malathion E50 is classified as non carcinogenic which means that there were evidences of non carcinogenicity in humans. The allowable concentration of malathion without causing adverse effect upon lifetime exposure is 0.2 ppm. Based from the reported concentration of malathion in this study; 0.176 ppb and 0.000435 ppb, malathion concentration is lower than the set limit.

In an interview with Hon. Gerry Deluta of Barangay Tungkalan, a former employee of the banana plantation near the river confirmed that they are applying fungicides and herbicides by contact spraying. The date and time of application was not mentioned but he also pointed out that farmers applying these pesticides are using safety gears to protect themselves from the pesticides (Deluta, 2011).

According to Fertilizer and Pesticide Authority (FPA), the time intervals for plantations in applying fungicides are about 7-13 days. However, during rainy days fungicides are not applied. The time interval for plantations to apply herbicides on the other hand will take about 4-6 months. Insecticides are applied by bunch spraying or injection method (usually for banana plantations).

The month of November gave the most number of pesticides detected which comes from two sites Longon creek and Emi- emi Bridge. But among the 5 sampling sites, the Longon creek has the most number of occurrences of pesticide about twice in the whole sampling duration.

D. Panigan-Tamugan Samples

The data for the unspiked samples summarized in *Table 7* show that four (4) of the eight (8) sampling stations were positive for pesticides at least once during the monitoring period. A total of three (3) pesticides out of twenty six (26) standard pesticides were detected from the water samples.

Table 7. Positive Detection of Pesticides with Concentrations in ppb

	July	**August**	**December**	
	Dieldrin	Endrin Aldehyde	Dieldrin	Penthoate
Panigan	1.96			
Tamugan		3.41		
Panigan-Tamugan			2.01	
Gumalang				3.20

In Panigan River, dieldrin was detected in July, in Tamugan River, endrin aldehyde was detected in August, in Panigan-Tamugan Junction, dieldrin was detected in December and in Gumalang River, penthoate was detected in December.

In the study of IDIS in 2008, the Upper Panigan station and the Wines-Gumalang Junction station, the two stations common between the IDIS study and this study, were seen with pesticides. The findings of the IDIS study and this study are shown in *Table 8*.

Table 8. Comparison of the results of IDIS study in 2008 and this study on the levels of pesticide in the sampling stations common between the two studies

Pesticides detected	Study of IDIS in 2008 (Done in sediment samples)		This Study	
	Levels in ppb of Pesticides in Upper Panigan	Levels in ppb of Pesticides in Wines-Gumalang	Levels in ppb of Pesticides in Upstream Panigan (or Upstream Panigan)	Levels in ppb of Pesticides in Wines-Gumalang
Chlorpyrifos	0.15	0.35	ND	ND
Diazinon	0.14 – 0.25	0.28 – 0.55	ND	ND
Endosulfan	0.005	0.012	ND	ND
DDT	0.005	0.011	ND	ND
Dieldrin	ND	0.006 - 0.013	ND	ND
Aldrin	ND	0.009	ND	ND
Gamma chlordane	ND	0.011	ND	ND

Table 8 shows that the pesticides detected in Upper Panigan and in Wines-Gumalang in 2008 were not detected in those same stations in this study. But, it is more important to note that in the study of IDIS, endosulfan, DDT, dieldrin, aldrin and gamma chlordane were detected from the sediment samples, and not from the water samples. As the related studies show, most organochlorines do not readily dissolve in water, and they tend to settle at the bottom sediments.

Among the pesticides detected, dieldrin has the most recurrence being detected twice: once in July, and once in December in the Panigan and Panigan-Tamugan Junction stations. The amount of dieldrin detected in the samples ranges from 1.96 ppb to 2.01 ppb, exceeding the EMB and EPA's guideline value for ambient water quality, which is 1.0 ppb, and 0.0651 ppb respectively. Dieldrin is one of those pesticides banned for use in agriculture by the US-EPA and the Fertilizers and Pesticides Authority of the Philippines.

The detected Penthoate level is 3.20 ppb. There is no available literature that provides guideline values for penthoate levels in water. Related literatures show that penthoate persists from 10 to 150 days after application, depending on climatic and environmental conditions. The detection of penthoate in Gumalang River in December suggests that penthoate was just recently used not later than 10 to 150 days prior to the sampling schedule. The FPA confirmed the use of

penthoate as insecticide by marginal and big-time farmers. In Panigan, there are farms of Cavendish banana and a plantation of cutflowers.

Endrin aldehyde was detected once in Tamugan station for the month of August. The detected level of 3.41 ppb exceeded the EPA's guideline value for ambient water quality, which is 0.19 ppb, and 0.061ppb for acute and chronic exposure respectively *(http://www.iupac.org/publications/pac/2003/pdf/7508x1123.pdf)*. This pesticide should not have been present since it is a banned pesticide.

Carbamate pesticides were not quantified because there were no standards available. Qualitative analysis of the mass spectra of the samples did not show presence of carbamates in the samples.

Summary, Conclusion and Recommendations

Summary

This study aimed to provide a better perspective on the water conditions of the Talomo-Lipadas and Panigan-Tamugan watersheds, following a previous study conducted by the Integrated Development Interventions (IDIS) along with Ateneo de Davao University and other partner NGO's on pesticide monitoring in Panigan-Tamugan and Talomo-Lipadas watersheds. What sets this study apart from previous studies is the utilization of a Gas Chromatography-Mass Spectrometry technique in identifying and quantifying the pesticides.

The study monitored the presence of organochlorine, organophosphate and carbamate pesticide residues from June to December 2011 in eight (8) sampling stations along Talomo River, four (4) sampling stations along Lipadas River, five (5) sampling stations along Tagluno River, and eight (8) sampling stations in Panigan-Tamugan watershed.

In the whole duration of the study, protocols set by the United States- Environmental Protection Agency (US-EPA) were followed. Assessment of the data was made in accordance to the guidelines set by reputable agencies such as the International Union of Pure and Applied Chemistry (IUPAC), US-EPA, Food and Agriculture Organization (FAO), Fertilizers and Pesticides Authority of the Department of Agriculture (FPA-DA), and Department of Environment and Natural Resources (DENR).

Conclusions

From the study, the following conclusions were made.

In Talomo River:

- Five (5) pesticides were detected in five (5) out of eight (8) sampling stations within the duration of the sampling.
- Dieldrin, phenthoate, aldrin, beta heptachlorepoxide, and DDE were detected at least once and were quantitatively determined of their respective concentrations,
- Banned pesticides (dieldrin and aldrin) were found to be present throughout the sampling period and their amounts were found to be higher than the regulated levels.
- DCIP and ametryn were qualitatively found to be present once for all the samples.
- Dieldrin, aldrin, beta heptachloepoxide and DDE have levels above the available guideline values. Pethoate has no available guideline value.

In Lipadas River:

- Three (3) pesticides were detected in three (3) out of four (4) stations within the duration of the sampling. The pesticides were gamma-chlordane, endrin aldehyde, and chlorpyriphos.
- Gamma-chlordane, a derivative of banned pesticide chlordane, was present in Lipadas upstream in Manuel Guianga during the sampling month of July.
- Endrin aldehyde, a derivative of the banned pesticide endrin, was present in Lipadas downstream in Sirawan for the two consecutive months of September and October.
- Chlorpyriphos was present in Lipadas midstream in Tagluno-Lipadas Juction for the month of November.
- Chlorpyriphos is still being used in plantations and is still detected in the current study despite the fact that it was also detected in previous studies in 2003 and 2007 by PCEEM and IDIS, respectively.
- The concentrations of the pesticides detected were found to be above their regulatory limits.

In Tagluno River:

- Two (2) pesticides were detected in two (2) of the five (5) sampling stations at least once during the sampling period.
- Malathion, an organophosphate insecticide was detected twice in Longon creek.
- Chlorothalonil, an organophosphate fungicide was detected once in Emi-emi Bridge.
- The levels of both malathion E50 and chlorothalonil were below the guideline values.

In Panigan-Tamugan River

- Three (3) pesticides were detected in four (4) of the eight (8) sampling stations within the duration of the sampling.

- Two (2) of these pesticides were classified "banned" by the Fertilizers and Pesticides Authority of the Department of Agriculture of the Philippines. These banned pesticides detected in the samples were dieldrin and endrin aldehyde. The other pesticide found is penthoate.
- The detected dieldrin and endrin aldehyde values exceeded the threshold values. Penthoate has no available guideline value but literatures show that penthoate has very short half-life of 10-150 days. The detection of penthoate suggests that it was recently used prior to the sampling schedule.
- Based on the available guideline values, the detected pesticides have significant levels in the samples from the eight sampling stations along Panigan-Tamugan Watershed.

Recommendations

With the findings of the study and the conclusions made, the following items are highly recommended for better results:

1. Analysis of samples for each batch or month, in this case, has to be done at least within one session to avoid further degradation of the samples. As much as possible, the samples should not stay long in the storage container to avoid sorption in the container.
2. Grassroots data on the applications of pesticides such as the schedule and frequency of application, the actual amount of pesticides applied, and the nature of application of pesticides, by the agribusiness or small and medium scale farmers in the area should be secured for better references.
3. For results to be comparative to previous studies done in the area, similar samples must be used (i.e. sediments samples for most organochlorines).

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Appendix A

Spike Preparation

Organo PO_4

			wt pure	conc. Stock	spike soln	in concentrate
	% purity	weight	substance	soln (ppm)	(ppb)	(ppm)
OP-A						
chlorothalonil	99.3	0.2609	0.2591	259.1	25.907	1.2954
λ-cyhalothrin	97.4	0.1081	0.1053	105.3	10.529	0.5264
deltamethrin	99.7	0.243	0.2423	242.3	24.227	1.2114
fenamiphos	96.5	0.2738	0.2642	264.2	26.422	1.3211
chlopyriphos	99.9	0.2427	0.2425	242.5	24.246	1.2123
				spike volume=	(50µL)	
OP-B						
diazinon	98.3	0.2013	0.1979	989.4	39.58	1.979
profenofos	96.9	0.3294	0.3192	1595.9	63.84	3.192
malathion	97.2	0.1471	0.1430	714.9	28.60	1.430
				spike volume=	(20µL)	
OP-C						
cypermethrin	95.1	0.0537	0.0511	204.3	20.427	1.0214
penthoate	99.5	0.0689	0.0686	274.2	27.422	1.3711
triazophos	99.1	0.0277	0.0275	109.8	10.980	0.5490
				spike volume=	(50µL)	

Organochlorine

		Weight	wt pure	conc. Stock	spike soln	in concentrate
	% purity	(mg in 1mL sample)	substance	soln (ppm)	(ppb)	(ppm)
Aldrin	98.9	2.000	1.978	22.28	22.276	1.1138
alpha-bhc	98.9	2.001	1.979	22.29	22.287	1.1144
alpha-chlordane	99.9	2.001	1.999	22.51	22.513	1.1256
beta-bhc	99.9	2.001	1.999	22.51	22.513	1.1256
delta-bhc	99.5	2.000	1.990	22.41	22.411	1.1206
Dieldrin	99.2	2.000	1.984	22.34	22.344	1.1172
endosulfan I (alpha)	99.9	2.000	1.998	22.50	22.501	1.1251
endosulfan II (beta)	99.9	2.001	1.999	22.51	22.513	1.1256
endosulfan sulfate	99.4	2.001	1.989	22.40	22.400	1.1200
Endrin	99.1	2.000	1.982	22.32	22.321	1.1161
endrin aldehyde	98.4	2.001	1.969	22.17	22.175	1.1087
endrin ketone	99.5	2.000	1.990	22.41	22.411	1.1206
gamma-bhc	99.9	2.001	1.999	22.51	22.513	1.1256
gamma-chlordane	99.9	2.000	1.998	22.50	22.501	1.1251
Heptachlor	99.9	2.000	1.998	22.50	22.501	1.1251
heptachlor epoxide isomer B	99.9	2.000	1.998	22.50	22.501	1.1251
Methoxychlor	99.9	2.000	1.998	22.50	22.501	1.1251
4,4' DDD	98.1	2.001	1.963	22.11	22.107	1.1054
4, 4' DDE	99.2	2.000	1.984	22.34	22.344	1.1172
4, 4' DDT	96.0	2.000	1.920	21.62	21.623	1.0812
				spike volume=	(0.5 mL)	

Different concentrations of each spike were prepared and read in the GCMS. The table below shows the preparation of calibration curve.

Calibration Curve Preparation

Organo PO_4					
	working	**Std A**	**Std B**	**Std C**	**Std D**
	soln (ppm)	**(ppm)**	**(ppm)**	**(ppm)**	**(ppm)**
Diazinon	9.894	0.4947	0.9894	2.9682	4.9469
Profenofos	15.959	0.7980	1.5959	4.7878	7.9797
Malathion	7.149	0.3575	0.7149	2.1447	3.5745
	(1 to 100 mL)	(0.5 to 10 mL)	(1 to 10 mL)	(3 to 10 mL)	(5 to 10 mL)
	working	**Std A**	**Std B**	**Std C**	**Std D**
	soln (ppm)	**(ppm)**	**(ppm)**	**(ppm)**	**(ppm)**
chlorothalonil	12.954	0.6477	1.2954	3.8861	6.4768
λ-cyhalothrin	5.264	0.2632	0.5264	1.5793	2.6322
Deltamethrin	12.114	0.6057	1.2114	3.6341	6.0568
Fenamiphos	13.211	0.6605	1.3211	3.9633	6.6054
Chlopyriphos	12.123	0.6061	1.2123	3.6369	6.0614
	(5 to 100 mL)	(0.5 to 10 mL)	(1 to 10 mL)	(3 to 10 mL)	(5 to 10 mL)
	working	**Std A**	**Std B**	**Std C**	**Std D**
	soln (ppm)	**(ppm)**	**(ppm)**	**(ppm)**	**(ppm)**
cypermethrin	10.214	0.5107	1.0214	3.0641	5.1069
Penthoate	13.711	0.6856	1.3711	4.1133	6.8556
Triazophos	5.490	0.2745	0.5490	1.6470	2.7451
	(5 to 100 mL)	(0.5 to 10 mL)	(1 to 10 mL)	(3 to 10 mL)	(5 to 10 mL)

Organochlorine	**Std A (ppm)**	**Std B (ppm)**	**Std C (ppm)**
Aldrin	0.4455	1.1138	2.2276
alpha-bhc	0.4457	1.1144	2.2287
alpha-chlordane	0.4503	1.1256	2.2513
beta-bhc	0.4503	1.1256	2.2513
delta-bhc	0.4482	1.1206	2.2411
Dieldrin	0.4469	1.1172	2.2344
endosulfan I (alpha)	0.4500	1.1251	2.2501
endosulfan II (beta)	0.4503	1.1256	2.2513
endosulfan sulfate	0.4480	1.1200	2.2400
Endrin	0.4464	1.1161	2.2321
endrin aldehyde	0.4435	1.1087	2.2175
endrin ketone	0.4482	1.1206	2.2411
gamma-bhc	0.4503	1.1256	2.2513
gamma-chlordane	0.4500	1.1251	2.2501
Heptachlor	0.4500	1.1251	2.2501
heptachlor epoxide isomer B	0.4500	1.1251	2.2501
Methoxychlor	0.4500	1.1251	2.2501
4,4' DDD	0.4421	1.1054	2.2107
4, 4' DDE	0.4469	1.1172	2.2344
4, 4' DDT	0.4325	1.0812	2.1623
	(0.2 to 10 mL)	(0.5 to 10 mL)	(1 to 10 mL)

Appendix B

Organochlorine Pesticides by Gas Chromatography
Based on US EPA Method 8081B

Table 3. Suggested GC Operating Conditions For Organochlorine Compounds Single-Column Analysis Using Narrow-Bore Columns

Solvent	Hexane
Type of injector	Flash vaporization
Detector type	Mass Spectrometer

- Column 1 -- 30-m x 0.25 or 0.32-mm ID fused-silica capillary column chemically bonded with SE-54 (DB-5 or equivalent), 1-µm film thickness.
  - Carrier gas — Helium
  - Carrier gas pressure — 16 psi
  - Injector temperature — 225°C
  - Detector temperature — 300°C
  - Initial temperature — 100 °C, hold 2 min
  - Temperature program — 100 °C to 160°C at 15°C/min, followed by 160°C to 270°C at 5°C/min
  - Final temperature — 270°C

11.3 Initial calibration

Establish the GC/MS operating conditions, using the following recommendations as guidance.

Mass range:	35-500 amu
Scan time:	#1 sec/scan
Initial temperature:	40 EC, hold for 4 min
Temperature program:	40-320°C at 10°C/min
Final temperature:	320°C, hold until 2 min afterbenzo[g,h,i] perylene elutes
Injector temperature:	250-300°C
Transfer line temperature:	250-300°C

Source temperature:	According to manufacturer's specifications
Injector:	Grob-type, splitless
Injection volume:	1-2 µL
Carrier gas:	Hydrogen at 50 cm/sec or helium at 30 cm/sec
Ion trap only:	Set axial modulation, manifold temperature, and emission current to manufacturer's recommendations

Appendix C

Guideline Values for Pesticides

I. IUPAC Regulatory Limits

(*source:* http://www.iupac.org/publications/pac/2003/pdf/7508x1123.pdf)

Herbicides

Herbicide	Guideline level, µg/l	Comment
Alachlor		Alachlor in drinking water at 0.3 µg/l may produce an excess lifetime cancer risk no greater than 1 in 100000. Alachlor should not be used in areas where it may contaminate drinking water via ground water and surface water.
Bentazone	25	Bentazone should not be used in areas where it may contaminate drinking water via ground water and surface water.
MCPA	0.5	
Metolachlor	5	
Pendimethalin	17	During the treatment of water with granulated activated charcoal, pendimethalin in the presence of nitrite might produce *N*-nitroso compounds, which could be carcinogenic.
Propanil	175	The guideline value may not be protective if some propanil metabolites, in particular 3,3′,4,4′-tetrachloroazobenzene, are present in drinking water.
Pyridate	60	
Simazine	17	During the treatment of water with granulated activated charcoal, simazine in the presence of nitrite might produce *N*-nitroso compounds, which could be carcinogenic.
Trifluralin	170	Pure trifluralin (>99 %) is relatively free of toxic effects. However, the technical product can be contaminated with *N*-nitroso-dipropylamine, which is a known carcinogen.

Pesticides

Pesticide	% TDI	GV µg/l	Pesticide	% TDI	GV µg/l	Pesticide	% TDI	GV µg/l
Alachlor	[a]	20	1,3-Dichloropropene	[a]	20	Metolachlor	10	10
Aldicarb	10	10	Dichlorprop	10	100	Molinate	10	6
Aldrin/dieldrin	1	0.03	Diquat	10	10	Pendimethalin	10	20
Atrazine	10	2	EDB	[a]	0.4–15	Pentachlorophenol	[a]	9
Bentazone	10	300	Fenoprop	10	9	Permethrin	1	20
Carbofuran	10	7	Glyphosate	10	U[b]	Propanil	10	20
Chlordane	1	0.2	Heptachlor + epoxide	1	0.03	Pyridate	10	100
Chlortoluron	10	30	Hexachlorobenzene	[a]	1	Simazine	10	2
Cyanazine	10	0.6	Isoproturon	10	9	2,4,5-T	10	9
2,4-D	10	30	Lindane	1	2	Terbuthylazine	10	7
2,4-DB	10	90	MCPA	10	2	Trifluralin	10	20
DDT	1	2	Mecoprop	10	10			
1,2-Dibromo-3-chloropropane	[a]	1	Methoxychlor	10	20			

Appendix D

List of Pesticides Used in Agricultural Activities in Talomo-Lipadas, Panigan-Tamugan Watersheds from the Fertilizers and Pesticides Authority

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF AGRICULTURE
FERTILIZER AND PESTICIDE AUTHORITY

FPA Bldg. B.A.I. Compound Visayas Ave. Diliman, Quezon City
Tel. Nos. 920-8173*920-0068*920-8573*927-3847
928-2539*441-1601*922-3368*426-5058
Telefax: 920-8173*920-8573
E-mail add: fpa_77@yahoo.com website: http://fpa.da.gov.ph

February 17, 2012

PAUL RANDY P. GUMANAO
BS Chem Student – Ateneo Davao
and
JODELL RYAN T. ENERO
BS Chem Student – Ateneo Davao

Dear Students,

This is in response to your letter dated 17 February 2012 requesting list of pesticides used by agricultural sector at Talomo – Lipadas, Panigan – Tamugan and Tagluno River system needed for your Thesis study. We will provide you on Active Ingredients (A.I.) basis, commonly used are the ff., to wit:

Used for Banana/and Banana Plantations

Herbicide	Insecticide	Fungicide	Disinfectant
Glyphosate	Cypermethrin	Mancozeb	Benzoxonium chloride
Paraquat	Chlorpyrifos	Chlorothalonil	Benzalkonium chloride
Glufosinate amonium	Lambdacyhalothrin	Tridemorph	
	Deltamethrin	Thiram	
	Spinosad	Tebuconazole	
	Bifenthrin	Spiroxamine	
	Dimethoate	Pyrimethanil	
	Fipronil	Propineb	
	Imidacloprid		
	Diazinon		

Used for Pineapple

Herbicide	Insecticide	Fungicide
Butachlor	Lamdacyhalothrin	Benomyl
Glyphosate	Cypermethrin	Copper oxychloride
Butachlor + Propanil	Deltamethrin	Captan
Glyphosate IPA	Profenofos	Propiconazole
Diuron	Chlorpyrifos	Fosethyl aluminum
	Fipronil	Tebuconazole
	Triazophos	
	Methomyl	

Use by Big Time Farmers/Marginal Farmers

Herbicide	Insecticide	Fungicide	Molluscicide	Others
2,4 – D Amine	Chlorpyrifos	Mancozeb	Niclosamide	Paclobutrazol
Glyphosate	Deltamethrin	Benomyl	Methaldehyde	
Paraquat Dichloride	Cypermethrin	Copper hydroxide		
Diuron	Malathion	Copper oxychloride		
Glyphosate IPA	Profenofos	Fozythyl aluminum		
	Carbofuran	Propineb		
	Lamdacyhalothrin			
	Dimethoate			
	Fipronil			
	Carbaryl			
	Flubendiamide			
	Imidachloprid			
	Penthoate			
	Zinc Phosphide			
	Thiamethoxam			

Please be informed that application of fungicide by plantations are done 7-13 days interval, however, weather condition is considered not to apply during rainy days. Insecticides are applied by injection method (banana) and or bunch spraying. Herbicides are applied on cycle basis more or less every four (4) to six (6) months interval. While individual farmers are spraying/applying pesticides according to its planting season and or depending on its needs.

For your information and reference.

JENNY LOUIE T. ALE
FPA – Provincial Officer
Davao City

Noted by:

ESTRELLA F. LAQUINTA
Regional Officer

Appendix E
Complete Tabulated Results

Talomo River Stations (July Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upper Tamayong	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Kawayan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Cogon	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calinan Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sirib*	trial 1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Barangay Anggalan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
NPC Mintal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
NHA Bangkal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Legend: ND – Not detected
NS – No sample
* - No sampling

Talomo River Stations (August Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upper Tamayong	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Kawayan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sitio Cogon	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calinan Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirib	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barangay Anggalan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NPC Mintal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHA Bangkal	trial 1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Legend: ND – Not detected
NS – No sample

Talomo River Stations (September Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Upper Tamayong	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Kawayan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Cogon	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calinan Bridge	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirib	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.484	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barangay Anggalan	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NPC Mintal	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHA Bangkal	trial 2	ND	ND	-1.813	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample

Talomo River Stations (November Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upper Tamayong	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Kawayan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Cogon	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calinan Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	-1.69	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirib*	trial 1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Barangay Anggalan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NPC Mintal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.697	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHA Bangkal	trial 1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Legend:
ND – Not detected
NS – No sample
* - No sampling for site

Talomo River Stations (December Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upper Tamayong	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.653	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Kawayan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sitio Cogon	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calinan Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-3.99	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirib	trial 1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trial 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Barangay Anggalan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NPC Mintal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	-1.78	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHA Bangkal	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.308	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend:
ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (June Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (July Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.9604	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (August Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (September Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Manuel Guianga	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.836	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (October Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.926	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend:
ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (November Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	1.6504	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Lipadas River Stations (December Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manuel Guianga	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sarro Community	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno-Lipadas	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sirawan	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (June Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (July Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (August Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (October Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (November Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.176	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	13.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Tagluno River Stations (December Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Longon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000435	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barakayo Pekenyo Community Water	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Daliaon Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Emi-emi Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tagluno Bridge	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Panigan-Tamugan River Stations (July Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upstream Panigan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan-Tamugan Junction	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cugan Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gumalang Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wines-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Panigan-Tamugan River Stations (August Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upstream Panigan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.82	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan-Tamugan Junction	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cugan Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gumalang Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wines-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend:
ND – Not detected
NS – No sample
* -No sampling

Panigan-Tamugan River Stations (October Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upstream Panigan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan-Tamugan Junction	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cugan Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gumalang Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wines-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Panigan-Tamugan River Stations (November Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upstream Panigan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan-Tamugan Junction	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cugan Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gumalang Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wines-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Panigan-Tamugan River Stations (December Sampling)		Chlorothanonil	Chloropyrifos	Diazinon	Alpha BHC	Beta BHC	Gamma BHC	Delta BHC	Heptachlor	Aldrin	Beta Heptachlorepoxide	Gamma Chlordane	Alpha Chlordane	DDE	Dieldrin	Endrin	DDD	Endrin Aldehyde	Endosulfan Sulfate	DDT	Endrin Ketone	Methoxychlor	Malathion	Fenamiphos	Profenofos	Phenthoate	Triazophos
Upstream Panigan	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan River	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Panigan-Tamugan Junction	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cugan Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gumalang Creek	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.4	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wines-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tamugan-Gumalang	trial 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	trial 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Legend: ND – Not detected
NS – No sample
* -No sampling

Appendix F

Raw IDL Data

Pesticide	IDL 1	IDL 2	IDL 3	IDL 4	IDL 5	IDL 6	IDL 7
Alpha BHC	0.2106	0.2328	0.2222	0.2854	0.2526	0.2590	0.2485
Gamma BHC	0.2499	0.2691	0.2907	0.2756	0.2769	0.2798	0.3023
Gamma Chlordane	0.2102	0.2305	0.2433	0.2328	0.2464	0.2431	0.2573
Alpha Chlordane	0.1138	0.1206	0.1135	Ratio of reference ion does not match.	Ratio of reference ion does not match.	0.1616	0.1520
o,p'-DDE	0.1875	0.2204	0.2220	0.2528	0.2257	0.2169	0.2849
chlorothalonil	0.6597	0.6343	0.6275	0.6170	0.6269	0.6302	0.6437
Chlorpyrifos	0.2819	0.2491	0.2472	0.2255	0.2328	0.2323	0.2414
Phenthoate	0.2717	0.2291	0.2188	0.1804	0.2014	0.2223	0.2174

Pesticide	IDL 8	IDL 9	IDL 10	IDL 11	IDL 12	IDL 13	IDL 14	IDL 15
Alpha BHC	0.2516	0.2522	Ratio of reference ion does not match.	0.2567	0.2597	0.2700	0.2560	Ratio of reference ion does not match.
Gamma BHC	0.2997	0.3059	Ratio of reference ion does not match.	0.2969	0.3222	0.2987	0.2969	0.3873
Gamma Chlordane	0.2766	0.2547	0.2969	0.2705	0.2705	0.2668	0.2527	0.2655
Alpha Chlordane	0.1764	0.1685	Ratio of reference ion does not match.	0.1917	0.1606	0.1587	0.1693	Ratio of reference ion does not match.
o,p'-DDE	0.2839	0.2615	0.2681	0.2597	0.2526	0.2141	0.2579	0.2891
chlorothalonil	0.6282	0.6316	0.6182	0.6270	0.6282	0.6123	0.6278	0.6206
Chlorpyrifos	0.2355	0.2311	0.2277	0.2177	0.2235	0.2127	0.2304	0.2228
Phenthoate	0.2163	0.2124	0.2074	0.1803	0.1848	0.1686	0.2051	0.1747