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AGROCHEMICAL USE, FARMER PRACTICES, AND ENVIRONMENTAL IMPLICATIONS IN CAGAYAN VALLEY, PHILIPPINES

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Abstract

This study investigates the extent of fertilizer and pesticide usage among farmers in rice, corn, and vegetable-producing areas of Cagayan Valley and assesses the resulting soil and water contamination. A survey was conducted among 1,260 farmers across the region to gather data on agricultural chemical practices, farmer knowledge and attitudes, and environmental impacts. Most respondents cultivate small-scale farms ranging from less than 1.0 hectare to 3.0 hectares. Findings reveal widespread and intensive use of chemical fertilizers—primarily urea, complete fertilizer, and ammonium phosphate—and frequent application of various pesticides including insecticides, herbicides, molluscicides, rodenticides, and fungicides. Despite moderate knowledge levels regarding safe chemical use, farmers generally exhibit favorable attitudes toward agricultural inputs, with strong awareness of their potential environmental consequences. Organophosphates and carbamates were the most used insecticides, while 2,4-D amine and Butachlor-Propanil dominated herbicide applications. Copper Oxychloride and Difenoconazole + Propiconazole were the most prevalent fungicides. Soil samples from broccoli, tomato, carrot, and cauliflower farms in Antutot and Castillo Village, Kasibu, Nueva Vizcaya revealed residues of Chlorpyrifos and Difenoconazole. One water sample also tested positive for Difenoconazole, although total soluble solids remained low across samples. These findings indicate localized contamination risks, underscoring the need for improved soil and water management practices. The study provides critical insights into the environmental footprint of agricultural chemical use in Cagayan Valley and serves as a basis for developing sustainable soil management technologies and policy interventions aimed at minimizing soil degradation and water pollution.

INTRODUCTION

Population growth and land degradation contribute most to the increasing risk of food insecurity. On top of these obvious factors, crop loss is also high due to pests. With the increasing population there is a mounting pressure to produce higher food, which means the need for higher crop yields. Traditional farming systems are incapable of meeting this challenging demand. Higher crop yields require high amount of nutrient in the soil and an intensive pest management. But because the soil can only provide limited amount nutrients and occurrence of pest and diseases are inevitable, farmers depend largely on agricultural chemicals like fertilizers and pesticides to sustain the yield and protect the crops.

While it is true that these chemical inputs significantly increase crop yields, they can also be damaging on the environment particularly on two of the important land resources – soil and water. The indiscriminate use of fertilizers can degrade soil quality and eventually the water quality. Increasing application of nitrogen-based fertilizers contributes to increased nitrate leaching in soils. On the other hand, increasing application of phosphorus fertilizers contribute to pollution of surface waters especially when phosphorus which is adsorbed strongly on soil particles is transported by run-off water. Heavy metal concentrations in soil can also increase through the abuse use of agricultural chemicals. Pesticides on the other hand can have adverse effects on soil micro-flora.

Soil quality is associated with water quality. A soil with poor quality could degrade the quality of surface water. The soil sediments, nutrients, heavy metals, and pesticide residues can be transported from soils to surface waters causing increased concentrations of these substances in rivers resulting to surface water pollution. Moreover, these fertilizer and pesticide residues that reach the surface waters can result to fish-kills and eutrophication. These problems can arise from misuse of these chemical inputs or over-reliance on them, particularly if the users are not aware of these potential problems.

While pesticides are generally considered a panacea for farmers' pest concerns, farmers' perceptions and use of the chemical fertilizers and pesticides have not received much attention. For Cagayan Valley, there has not been any known comprehensive study on the extent of fertilizer and pesticide usage in major areas grown to lowland rice, corn and vegetables. Thus, there is an urgent need to evaluate the potential of agricultural chemicals such as fertilizers and pesticides, to degrade the soils and contaminate surface waters in major rice, corn, and vegetable growing areas of the region. Monitoring the levels of these chemicals can help evaluate the impact of certain agricultural practices such as fertilizer and pesticide application on soil and water quality. This is important so that preventive measures can be done even before they can cause undesirable effects to the environment.

Objectives

1. Assess farmers' management practices, knowledge, attitudes, and perceptions regarding fertilizer and pesticide use.
2. Determine the extent and patterns of agrochemical application in rice, corn, and vegetable production.
3. Analyze soil and water samples for nutrient levels and pesticide residues to evaluate contamination risks

Significance of the Study

Data generated from the research provide useful scientific information on the extent of chemical use by the farmers in Cagayan Valley, their management practices, level of knowledge, attitudes, awareness, and perceptions on the impact of excessive agricultural chemical use on soil and water. Data on the level of pesticide residue on soil and surface waters will be important in the formulation of soil and water management technologies that would minimize degradation of soil and water quality. Farmers will be educated on the proper handling of fertilizers and pesticides, and enhance their awareness thru IEC materials and awareness seminars.

METHODOLOGY

The study areas include the four provinces: Cagayan, Isabela, Quirino and Nueva Vizcaya. The study has two phases: interview with selected farmer, soil and water collection and analysis for fertilizer and pesticide residue.

Farmer Survey

The respondents of the interview are limited to lowland rice, corn, and vegetable growers in the region. The list of farmers per province was obtained from provincial agricultural offices and the farmer respondents were randomly selected using the simple random sampling method. The Slovin's formula was used to identify the number of the farmer-respondents in each of the four provinces.

A semi-structured questionnaire was prepared, pre-tested and used to gather information from the farmer key-informants. It composed of items pertaining to socio-demographic characteristics of the farmer-respondents, farmers' practices on pesticide and fertilizer application, extent of fertilizer and pesticide usage, and farmers' level of knowledge, attitude, and perceptions on the impact of excessive use of agricultural chemical on soil and surface water quality.

The farmers' level of knowledge on fertilizer and pesticides was measured by using 10 questions providing 3 probable answers. The level knowledge of the respondent farmers on fertilizers and pesticide usage was measured based on the mean score of the questions. To measure the attitude towards fertilizer and pesticide usage, 10 statements were selected and they were asked to check their opinions in a 5-point scale assigned as 5 for strongly agree 4 for agree, 3 for undecided, 2 for disagree and 1 for strongly disagree. On the basis of the obtained scale value the attitude of the respondents was categorized as favorable (value 4 & 5), neutral (value 3) and unfavorable (value 1 & 2).

For the perception towards the impact of pesticide on soil and water, six statements for each of the issues were selected on the basis of extensive literature search. The statements were put on a five-point scale to measure the degree of their opinion as strongly agree, agree, undecided, disagree and strongly disagree and numeric value of 5, 4, 3, 2 and 1 were assigned respectively. On the basis of the scale value of each of the statement the perception of the respondents has been categorized as strong perception (score 4 and 5), weak perception (score 1 and 2), no perception (score 3) and no response (didn't respond).

Soil and Water Sampling

The second phase of the study comprised the determination of pesticides in soil and surface waters situated close to the agricultural areas. Sampling sites for water and soil were dependent on the type of crops cultivated in the surrounding areas which could influence the levels and type of pesticides detected.

Each soil sample was a composite of 20 subsamples collected at each site using random sampling. Soil was collected from the 0-20 cm layer using a soil auger. The 1-kg subsamples were placed into a bucket, thoroughly mixed, and sifted through a soil sieve at the collection site. After each sample was collected, the soil auger, bucket, sieve and mixing tool were rinsed with tap water and dried before next use. Separate sampling equipment (bucket, soil auger) was used for control samples obtained from an uncultivated field. Soil samples were then air dried and sieved before it was brought for analysis.

Water samples on the other hand, were collected from nearby creeks and other forms of water bodies near the identified agricultural production area. Manual sampling of surface waters was carried out using an improvised water sampler and samples were transferred in a one-liter single-used dark bottle.

The soil and water samples were stored in the refrigerator upon arrival in the office and stored in a cooler with ice before it was transported at National Pesticide Analytical Laboratory for pesticide residue analysis and total soluble solids (water).

RESULTS AND DISCUSSION

Socio-Demographic Characteristics

The sources of information for this research are the 1,260 farmers from Nueva Vizcaya, Quirino, Isabela and Cagayan. Majority (31.20%) of the respondents is between the ages of 41 and 50 years, with the mean age of 47 years; youth comprised only 7.20%. This indicates that older people are more involved in farming activities than the younger ones. The youth are not so much involved in the farming practices to any appreciable extent. As a result, the older farmers may not have enough energy to effectively carry out some labour-intensive farming activities. Likewise, the adoption of any innovation and farming technologies may not be as high as expected, as adoption varies inversely with age (Ogunyemi, 2005).

Majority of the respondents were male (77.10%). The low participation of women (22.90%) in agricultural production is an indication that they participate more in other agricultural activities such as processing and marketing of farm produce. Majority of the farmers are married (91.20%); while very few are single or widowed. This means that married people are more involved in farming and may receive assistance from their spouses in carrying out some activities on the farm. Majority (99.3%) of the respondents had some formal education, while only 0.70% had no formal education. The modal education qualification of the farmers is secondary education (38.80%). This implies that farming is undertaken by learned people and the high literacy among the respondents may enhance adoption of farming innovations that are related to farming

About 42.20 percent of the respondents have been into farming for more than 16 years, while 9.90 percent have less than 5 years of experience. The result shows that most of the farmers have been in farming profession for quite some period of time and are not novices in farming activities. The data further reveals that virtually all the respondents (76.5 %) are small scale farmers with only one-half hectare to slightly above 2.0 hectares. About 68 percent of the respondents are farm-owners and majority (47%) have income level ranging between P10,000 to P 25,000.

Fertilizer and Pesticide Usage

Fertilizer Application

Most farmers in Cagayan Valley used urea (84.3%), complete fertilizer (68.7%), and ammonium phosphate (51.3%) as their primary inputs, with complete fertilizers providing balanced N, P, and K nutrients at 14% each. About 18.9% used foliar fertilizers for micronutrients, while 16% substituted ammonium sulfate for urea due to its additional 24% sulfur content. Muriate of potash and ordinary superphosphate were rarely applied. Urea, complete fertilizers, and ammonium phosphate dominated in Cagayan, Isabela, and Quirino, where rice and corn production are prevalent, while Nueva Vizcaya showed higher foliar fertilizer use due to intensive vegetable farming.

Pesticide Application

Chemical pesticide usage was widespread (79.8%), including insecticides (79.8%), herbicides (72.4%), molluscicides (51.4%), rodenticides (12.9%), and fungicides (4.8%). Farmers perceived pesticides as highly effective, encouraging frequent applications. While some practiced crop rotation, resistant varieties, and timely planting, adoption of integrated pest management (IPM) remained low due to its knowledge-intensive requirements. Pesticide use was either preventive (calendar-based spraying) or reactive upon pest detection, with 23% consulting extension agents for recommendations.

Mode of Selection

Despite awareness of soil analysis, 60% of farmers did not practice it, instead relying on experience (84.7%), peer advice (24.9%), and dealer recommendations (16.5%), leading to potential misuse and overapplication (Benabise & Banciles, 2012). Fertilizer choices were often influenced by price and availability rather than laboratory-based soil assessments. For pesticides, most farmers followed label instructions and applied them primarily in the morning (84%), using knapsack sprayers (78%), though 16% sprayed in the late afternoon. However, knapsack sprayers often leaked, increasing exposure risks.

Personal Protective Equipment (PPE)

Protective gear use was generally inadequate. During fertilizer application, 88.4% wore long sleeves, but only 29.9% used masks and fewer than 8.3% used full protective clothing. For pesticides, 89% wore long sleeves, yet only 48% used masks, and many applied chemicals barefoot or in short clothing, increasing contact exposure. Poor protective practices heightened risks of pesticide poisoning and long-term health issues.

Storage and Disposal Practices

Fertilizer storage varied: 48.9% stored fertilizers at home, 26% in field huts, and 25% in farm sheds. Empty sacks were commonly washed and reused for packaging produce.
For pesticides, 45% stored chemicals in terraces, while 31.3% buried empty containers, 12.5% discarded them in fields, and 5.6% dumped them in rivers. Unsafe practices—such as washing sprayers in creeks or irrigation canals—posed significant soil and water contamination risks. Empty bottles were often left exposed, allowing residues to leach into groundwater. Compliance with RA 9003 (Ecological Solid Waste Management Act) was low. The study recommends establishing centralized leak-proof waste vaults and strengthening farmer education on safe disposal.

Knowledge, Attitudes, and Practices

Knowledge. The study shows that the farmers possessed moderate level of knowledge in the most of the aspects of pesticide use (2.29). Out of 5.0, average knowledge score varied from 0.63 to 3.81 for different questions. They have poor knowledge regarding the effect of excessive use of pesticide in the crop field (Q9), beneficial effects of pesticides (Q8), and how the pesticides move away from the site of application (Q6) and most of the farmers know that pesticide is a poisonous chemical, but they don't have knowledge that the excessive use may create pest resistant (Q4).

Farmers have moderate knowledge on the direction of pesticide spray relative to win direction (Q2), that improper handling may cause health hazard (Q5), and training as solution for a safe pesticide use (Q10). On the other hand, the respondents have good knowledge regarding the time pesticide should NOT be applied (Q1, the average score being 3.03), direction of spray (Q2), depth of water when to spray (Q3) and the activity that can cause harmfulness of the pesticide (Q7, the average score is 3.0).

Forty six percent farmers said that pesticide should not be used just at scorching noon. Farmers have confusion regarding the direction of pesticide spray, as 45 % said opposite to the wind and 40% said towards the wind direction. Because of the risk of exposure to the applicator, pesticide should be sprayed on the wind direction and only 15% farmers knew this. Forty-four per cent respondents have knowledge that the pesticide application in mature stage of crop is the most harmful for the consumer, therefore they do not spray. It is noteworthy to mention that among the respondent farmers nobody has ever had training regarding the pesticide handling and precaution. About two third of the respondents think pesticide is the best way to control pest. The largest number of farmers showed favourable attitude towards the timely and balanced application of pesticide (statement 5), followed by the statement 7, 1 and 2.

Attitude. In general, the farmers showed favourable attitude towards pesticide and fertilizer usage. As the farmers perceived that the pesticide is effective way of pest control without any detrimental effect, they formed the favourable attitude towards the pesticide use. Many farmers think that the pesticide is a medicine to treat the crop to be recovered from the pest attack. The issues, which were not perceived by the farmers, they showed neutral attitude towards them. It might be due to the influence of socio-economic characteristic such as, age and education and occupation.

Majority of the of the farmers in Cagayan Valley have positive attitude (i.e. agreed and strongly agreed) on the use of pesticides which are perceived as the best means of controlling insect pests while they agree that the timeliness and balanced pesticide application can control pests and that the use of. pesticide is inevitable in modern agriculture. The farmers with these perceptions have put their trust in the benefits of pesticides and synthetic fertilizers. They believe that farming would be impossible without these farm inputs. According to the report of JPC, (2004), pesticides have become a weapon in the farmers struggle to protect crops. Respondents are "neutral" on the idea that farmers should completely stop the use of pesticides and fertilizers that destroys the soil and its environment.

Perceptions. The concern for environment relative to the use of hazardous farming inputs is an important aspect of agriculture. Awareness on the negative impacts of pesticides on -soil and water – two of the most important natural resources, is the key to the proper handling and utilization of pesticides. The average value of perception of the farmers on the impact of agricultural chemical usage on soil and water was varied from 1.96 to 4.46. Respondents have strong perception regarding the impact of chemicals on soil and aquatic environment.

The perceptions of the farmers on the effects of pesticides to the soil indicate that they are aware of the detrimental effects of pesticides on soil quality. The farmers strongly agree that pesticides application harms earthworms and microorganisms and accumulation of chemicals into the soil. As to the statement "no effect on soil structure", the farmers have divided opinions, however, 35.70% disagree while 6.30% strongly disagree. This means that when the statements is inversely stated, these farmers believe that the use of pesticides indeed affect the soil structure.

Extent of Chemical Usage

A total of 2,047 pesticides were found to be used in farming in Cagayan Valley during the survey. This figure was obtained as a direct summation of pesticides applied on farms. Of these pesticides, insecticides (79.76%) were the most commonly used by farmers, followed by herbicides (63.89%), molluscicide (9.84%), rodenticide (5.87%), and fungicides (3.10%).

Insecticide. For insecticides, a total of 15 active ingredients with 30 trade names were used by the respondent farmers of the region during the interview. Table 1 presents the classification of these insecticides by active ingredient, percentage of farmers who used the pesticide, chemical group, toxic category and target pests.

Table 1. List of insecticides applied by farmers in Cagayan Valley

ACTIVE INGREDIENT	%tage	Chemical Category	Toxic Category	Targeted Pest
INSECTICIDES (77.76%)				
Cypermethrin	63.67	Pyrethroid	4	BPH, TH
Lambdacyhalothrin	15.10	Pyrethroid	2	BPH, TH
Betacypermethrin	5.92	Pyrethroid	3	BPH, TH
Methomyl	4.18	Carbamate	2	RGM, TH, RB
Chlorpyrifos+BPMC	2.96	Carbamate	2	RGM, TH, RB
Carbofuran	1.94	Carbamate	2	RGM, TH, RB
Imidacolprid+Beta+Cyfluthrin	1.84	Pyrethroid	2	BPH, TH
Phenthoate+Bpmc	1.63	Carbamate	2	RGM, TH, RB
Chlorpyrifos+Cypermethrin	0.82	Pyrethroid	2	BPH, TH
Malathion	0.71	Organophosphate	4	CW, RSC, RLF, RSB
Methamidophos	0.51	Organophosphate	1	CW, RSC, RLF, RSB
Carbosulfan	0.31	Carbamate	2	RGM, TH, RB
Cartap Hydrochloride	0.20	Carbamate	3	RGM, TH, RB
Chlorpyrifos	0.10	Organophosphate	2	CW, RSC, RLF, RSB
Alphacypermethrin	0.10	Pyrethroid	4	BPH, TH

RWM - Rice whorl maggot, MC - Mole cricket, CW - Case warm, RSC - Rice swarming caterpillars, RGM - Rice gall midge, Th - Thrips
RLF - Rice leaf folder, RSB - Rice Stem borer, BPH - Brown plant hopper, RB - Rice bug, RFC - Rice field crab

Among the 15 ingredients, majority are cypermethrin (64%) and Lambdacyhalothrin (15%). Most of the insecticides were used to kill stem borer, green leafhopper and some of grasshopper and gall midge. The frequency of pesticide use varied from 1 to 4 sprays per crop season. The rate of application was not so high and varied from about 1 kg/liter to 10 kg or liter per hectare of land. They follow the manufacturer's recommendation as they consider the suggestion of the agent/technician and also the cost of the pesticides. The farmers have used 6 organophosphates, 4 carbamates and 5 pyrethroid. Fortunately, no organochlorines have been found to be used by the respondents. Out of the 30 brand names, the farmers used mostly category 2 pesticides classified as moderately hazardous. The farmers are still using the organophosphates pesticides such as Malathion, which are known for wide spectrum toxicity. Almost all of the carbamate insecticides they used are of extremely or highly hazardous category having wide spectrum toxicity to the environment. The pyrethroid ranged from moderate (2) to extremely hazardous (4). The insecticide Magnum 5 EC and a pyrethroid, was used by the largest proportion of the farmers (30%) followed by the Cymbush 5EC (30%) and Karate 2.5 EC (14%). All these three most common insecticides are pyrethroid. Magnum 5 EC and Cymbush EC are both category 4 (extremely hazardous) while Karate 2.5 EC is moderate.

Herbicides. For herbicide, a total of 11 active ingredients and 21 trade names were used by the farmers during the interview. The most common herbicides applied by farmers are the 2, 4 D amine and Butachlor-Propanil. Both are systemic herbicides and are categorized as moderate (2) and highly (3) hazardous, respectively.

These are being used to kill sedges, grasses and broadleaf weeds. The rate of application is based on the manufacturer's recommendation.

Table 2. List of herbicides and fungicides applied by farmers

ACTIVE INGREDIENT	%	Chemical Category	Toxic Category
HERBICIDES (63.89%)			
2-4-D Amine	28.82	Chlorophenoxy acid	2
Butachlor+Propanil	20.75	Chloroacetanilide+ Anilide	3
MCPA	14.04	Chlorophenoxy acid/ester	2
Metsulfuron Methyl+Chlorimurone	11.68	Chlorophenoxy acid/ester	4
Butachlor	9.94	Chloroacetanilide	4
Glyphosate IPA	8.07	Phosphonoglycine	4
Atrazine	2.11	Triazine	4
Bispyribac Sodium	0.99	Pyrimidinyl(thio)benzoate	4
Glyphosate Di-Ammonium Salt	0.50	Imidazolinone	4
Glyphosate As Potassium Salt	0.37	Phosphonoglycine	4
Pyribenzoxim	0.37	Pyrimidinyl(thio)benzoate	4
FUNGICIDE (5%)			
Copper Oxychloride	46.88	Inorganic-Copper	4
Difenaconazole+Propiconazole	39.06	Carbamate	3
Mancozeb	6.25	Dithiocarbamate	4
Thiophanate Methyl	1.56	Benzimidazole precursor	4
Benomyl	3.13	Benzimidazole	4
Chlorothalonil	1.56	Substituted Benzene	4
Cupric Hydroxide	1.56	Inorganic-Copper	4

Among the 11 ingredients, majority are 2,4 D Amine (29%), Butachlor-Propanil (21%), MCPA (14%), and Metsulfuron Methyl+Chlorimurone (12%). Majority of the herbicides are categorized as extremely hazardous. The three most commonly used brands are 2, 4 D (29%), Advance EC (21%) and Agroxone S (14%). Advance EC is categorized as highly hazardous while both the 2,4 D and Agroxone S are moderate.

Fungicide. There were 64 farmer-respondents who claimed to have used fungicide in their fields (Table 2). These herbicides have 7 active ingredients from 7 different trade names. From these ingredients, Copper Oxychloride and Difenaconasole + Proipiconazole were the most common fungicide used to control the sheath blight and blast diseases. Funguran OH 50 was used by 47% of farmers while Armure 300 EC was used by 39% of farmer-respondents.

Molluscicide and Rodenticide. There were 119 farmers who used molluscicide to control golden snails in their fields. The 13 brand names of molluscicide came from three active ingredients: Niclosamide (46%), Niclosamide Ethanolamine (31%) and Metaldehyde (24%). All these three are categorized as extremely hazardous. Bayluscide is used by 33% of farmer-user, while Surekill, Bayonet and Viso Kill followed being used by 22, 11 and 8 percent of farmers who apply molluscicide.There were 75 farmers who claimed to have used rodenticide. The active ingredients of the pesticides are Coumatetralyl, Zinc Phosphide and Hexaconazole used by 78 20 and 2 percent of the farmers, respectively. Racumin is the most common bait used for rodents.

Pesticide Residues

The pesticide residue content of the soils from the study sites are shown in Table 4. Pesticide residues were detected in two composite samples obtained in the surface soils of Nueva Vizcaya. The pesticide residues detected were: Chlorpyrifos and Difenoconazole. The residue Chlorpyrifos were detected in the soils of Antutot and Castillo Village both in Kasibu, Nueva Vizcaya exceeding the Limit of Determination (LOD). Agricultural crops grown in these areas are broccoli, tomatoes, carrots and cauliflower. The observed higher levels of pesticide residue concentration in soil above the Limit of Determination (>LOD) can be attributed to the current application of these chemicals a few days prior to sampling. The residue chlorpyrifos could have come from Siga 300 EC, Brodan 31.5 EC, Kudos 31.5 EC, Warrior 31.5 and Nurelle D used by about 39% of the farmer respondents.

The residue of Difenoconazole detected in the soils of Antutot, Kasibu, Nueva Vizcaya could have been from Armure 300 EC (Difenaconazole+Propiconazole) used by 29% of farmer respondents. Most of the pesticides currently in use by farmers are known to have a short half-life and given the relatively short half-lives of these pesticides, it is likely that residues detected came from current season application and that there was a high probability that it may have degraded. The short half-life and degradable nature of pesticides therefore explained the low residues detected in the soil surface of the 17 samples. There was no detection of organochlorine compounds since no farmer was reported to have used them.

Table 4. Pesticide residues detected in soil samples

Sample	Organo phosphate	Carbamate	Pyrethroid	Residue Level
1	<LOQ	Difenoconazole	<LOQ	0.03
2	Chlorpyrifos	Difenoconazole	<LOQ	0.03
3	Chlorpyrifos	<LOQ	<LOQ	0.02
4	<LOQ	<LOQ	<LOQ	<0.01
5	<LOQ	<LOQ	<LOQ	<0.01
6	<LOQ	<LOQ	<LOQ	<0.01
7	<LOQ	<LOQ	<LOQ	<0.01
9	<LOQ	<LOQ	<LOQ	<0.01
10	<LOQ	<LOQ	<LOQ	<0.01
11	<LOQ	<LOQ	<LOQ	<0.01
12	<LOQ	<LOQ	<LOQ	<0.01
13	<LOQ	<LOQ	<LOQ	<0.01
14	<LOQ	<LOQ	<LOQ	<0.01
15	<LOQ	<LOQ	<LOQ	<0.01
16	<LOQ	<LOQ	<LOQ	<0.01
17	<LOQ	<LOQ	<LOQ	<0.01

18	<LOQ	<LOQ	<LOQ	<0.01
19	<LOQ	<LOQ	<LOQ	<0.01
20	<LOQ	<LOQ	<LOQ	<0.01

**Limit of Quantification (LOQ) using Gas-Liquid Chromatography: Organochlorines, Organophosphate, Pyrethroid = 0.01 mg/kg (National Pesticide Analytical Laboratory)*

Water Quality Status

The water quality status is summarized in Table 5. Laboratory analysis done on water samples revealed a trace of Difenoconazole pesticides in one of the 15 samples. The sample was obtained from a creek near a corn area in Angadanan-San Guillermo, Isabela. It is quite uncommon that after many years of pesticide application, surface water in majority of the sites tested are still pesticide free. The absence of any pesticide residue in water samples highlighted the short half-life and degradable nature of newly manufactured pesticides being used by farmers. It is also possible that dilution affected the non-detection of pesticide residues.

Table 5. Water quality status

Sample	Pesticide (ppm)	TSS (mg/L)
1	<LOQ	2.90
2	<LOQ	3.20
3	<LOQ	1.90
4	<LOQ	1.16
5	<LOQ	2.02
6	<LOQ	1.13
7	<LOQ	1.01
9	<LOQ	2.23
10	<LOQ	3.45
11	<LOQ	1.56
12	<LOQ	3.21
13	Difenoconazole 0.04	2.15
14	<LOQ	3.34
15	<LOQ	1.29

*Limit of Quantification (LOQ) using Gas-Liquid Chromatography: Organochlorines, Organophosphate, Pyrethroid = 0.01 mg/kg.(National Pesticide Analytical Laboratory); LOD of Nitrate =50 mg/L max (DOST); TSS (30 mg/L)

Across all study sites, the TSS load is below the limit (30 mg/L). Total suspended solid (TSS) are water pollutants made up of suspended materials such as soil, silt, decaying plants and animals, industrial waste and sewage. Total suspended solids carried by water are indicative of the effect of surface run-off influence by management, vegetation and slope. Water with high TSS has less clarity and may often mean higher concentrations of bacteria, nutrients, pesticides and metals in the water, TSS is often related to turbidity and it can be remedied by flocculation, sedimentation and filtration. Cole-Palmer International set the maximum standards for TSS at 100 mg/L or 100 ppm using the gravimetric method with soils dried at 103-105ºC. Some of the creeks sampled have small amounts of TSS carried with it.

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Author Contributions

The author conceived and designed the study, secured project funding, supervised the implementation of the research, and wrote, reviewed, and approved the final version of the manuscript while Dr. Gydabelle M. Celestino conducted social survey, data interpretation and statistical analysis,

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.