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Pesticide Utilization and Insecticide Residue Levels in Rice from Banaybanay, Davao Oriental

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Abstract

Pesticides for rice production were widely used in Banaybanay, Davao Oriental. These included insecticides, herbicide and molluscide in this order. etofenprox and fipronid were the most utilized insecticide, butachlor and thiobencarb+24D for herbicide. copper oxychloride and benomyl were the most used fungicides by farmers while niclosanide for mulluscide. Farmers used the conventional knapsack sprayer in applying pesticides in the rice field. Farmers usually applied insecticide at a range of one to more than 11 times but most applied it from one to five times. Herbicides and fungicides were applied once or twice per season although few had to apply five times Farmers' frequency of spraying and dosage of applying pesticides were usually based on the recommendation indicated on the product label. Only a few did not follow the manufacturer's instructions. Insecticide and herbicide were applied at a range of one to IOL; one to six L. of fungicide or molusscide; others had used one to 10 sachsets, and five to 50 sacks of fertilizer per cropping season. Twenty-two percent had been using pesticides for six to 10 years, and 4% for more than 31 years. Insesticide residues were detected in Hybrid rice. Cypermethrin residue was detected above the level of Allowable Daily Intake while deltamethrin was below it.

Keywords: herbicide, mulluscide, insecticide, extraction of samples

Introduction

There are several interactive international problems faced by humanity at present. Widespread hunger, malnutrition and the deteriorating quality of the environment are few of urgent concerns of paramount importance. The problem of food sufficiency for a population that continues to increase in a world of limited land area has gained enormous international attention. This situation aggravates the problem.

In the past, agriculture has not been given much attention by the top political leaders. Hence, food security has always been elusive and the poverty of small farmers has remained unmitigated. Putting agriculture and poverty alleviation at the top of its political agenda, the national government ushers in tremendous opportunities in improving the country's food security.

In agriculture, pests are the most critical aspect of the human fight for survival (Jago, et al, 1991 as cited by Malena, 1994). Traditionally, much energy has been expended in acquiring higher yields due to the attack of pests. This has been a widespread problem of farmers, resulting in post and pre-harvest losses. This dramatic decrease of productivity pushes the farmers to seek for an ultimate remedy, a magic bullet that would rapidly eliminate pests.

With the rise of modern agricultural sciences, chemical pesticides were developed and the use of these had grown tremendously (Botkin and Keller, 1995). Many processors and farmers believed that this was the answer to their long fight against pests. They believed that synthetic chemicals are the adequate, immediate measures to drive away pests and intensify production of crops to meet the food requirement of the increasing population.

In recent years, the use of chemical pesticide has been shown to have deleterious side effects manifested through contamination of ground water, crop devastation arising from pest resistance to pesticide and increasing incidence of skin and lung diseases due to man's exposure to these chemicals (Domingo, 1997).

The use of synthetic pesticides is hazardous to man and the environment. While these contribute significantly to increasing crop production, indiscriminate use of chemicals may cause human diseases such as: burning sensation of bronchial cavity; gastroenteritis and diarrhea; nausea; destruction of bone marrow; suppression of mitosis and diploid embryonic cell; hepatic carcinoma; acute liver damage; toxicity in kidney cells, miscarriages; uterine cancer and others (Singh, and Singh, 2000). Pesticides also cause fish contamination, nitrification, inhibition and genetic alteration in plants. The adverse effect of pesticides can directly disturb the structure and function of the ecosystem. Pesticide-mixed effluent may be nontoxic to fish but can injure or kill aquatic vegetation when discharged into a body of water. Pesticides also contaminate ground water through leaching into the soil and ground water from plants and soils. Such polluted water causes interference in the intracellular and exo-or-endo-enzymatic activity in the bacteria and causes toxicity in mammals (Singh and Singh, 2000). Pesticides' constant utilization, over dosages and cocktail mixtures has been known to contribute to the development of resistant insect pest to chemicals and even pest resurgence. The development of resistant insect is mainly because all organisms adapt to changes in their environment by genetic modification across generation. Smaller organism tends to have shorter life span. Thus, pests such as insects, fungi and bacteria are very adoptable. (Camp and Donahue, 1994). On the other hand, resurgence occurs when the specific pest comes back in even larger number after a pesticide has been applied.

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In Davao Oriental, the enhancement of the productivity, profitability and sustainability of agriculture has been one of the major economic activities. In fact, it has been a top priority not only of the provincial government but also of farmers.

The massive promotion of rice hybridization in the province contributed to the increase in rice production. In 2002, rice production swept an increase of 0.04 Mt/ha. In the previous years, average production of 5.15Mt/ha resulted in a total production of 53,181.73 tons for the 10,387.0 ha. devoted to commercial rice production.

Davao Oriental is noted as one of the top producers of different variety and good quality rice. The famous "BanaYbanay 7 Tonner rice" is produced including PSB RC 72 H hybrid rice seeds. Fl, AXR and AXB are also currently introduced in the area.

The introduction of new hybrid rice requires better understanding of the packaged of technology by the farmers, the local government and the whole community. According to Barker et. al. (2001), the intensification of rice production has been achieved at a significant cost in environmental degradation and pollution. Goto, et. al, (1997), added that the maintenance of sufficient domestic food production is important, and such environmental protection measures cannot be considered if yield would increase markedly. The available technology options developed by scientist and innovative, traditional and ecological farmers should be carefully analyzed and their economic, social and ecological impact is described. A comprehensive picture of the different aspects of rice industry in the municipality of Banaybanay (e.g., socio-demographic, production characteristics, social and ecological dimensions of technology) can be used to support the decisions to be made by farmers, researchers and policy makers in their efforts to secure sustainable rice production.

Methodology

The Study Area

This study was conducted in the municipality of Banaybanay, Davao Oriental. The town lies in the southern portion of Davao Oriental between latitude of 6055' — 7004 north and longitude of 1250551-126006 east. It is bound by Lupon on the southeast, by Davao Gulf on the west, by Pantukan on the north. It is approximately 122 kilometers from Davao City. It is accessible via national highway traversing Davao City to Mati. The topography is characterized with extensive mountain ranges and with uneven distribution of swamps and lowlands. In 1999, there were 2,106.2 ha. devoted to rice production. However, before the end of year 2006, it was projected to expand to 3,005.60 ha.

Selection of respondents

Rice farmers were interviewed as to their farming practices, agricultural chemical utilization, problems encountered in the production process, and other relevant information. The sample size of the respondents was determined using the Slovene's formula below.

$$n = \frac{N}{1+N+(e)^2}$$

where:

n-sample size of the respondents
N - total population of the rice farmers
1-constant value
e-allowable error (10%)

Collection of rice samples

Rice composite samples were collected from rice fields categorized on the frequency of chemical application as shown in Table 1.

Table 1. Different codes of composite rice samples for pesticides residue analysis.

Sample	Frequency of Insecticide Application	Sample Code
IR 64		
1	0	A1
2	5-8	A2
3	9-12	A3
4	13-16	A4
Hybrid Rice		
1	0	A1
2	5-8	A2
3	9-12	A3
4	13-16	A4

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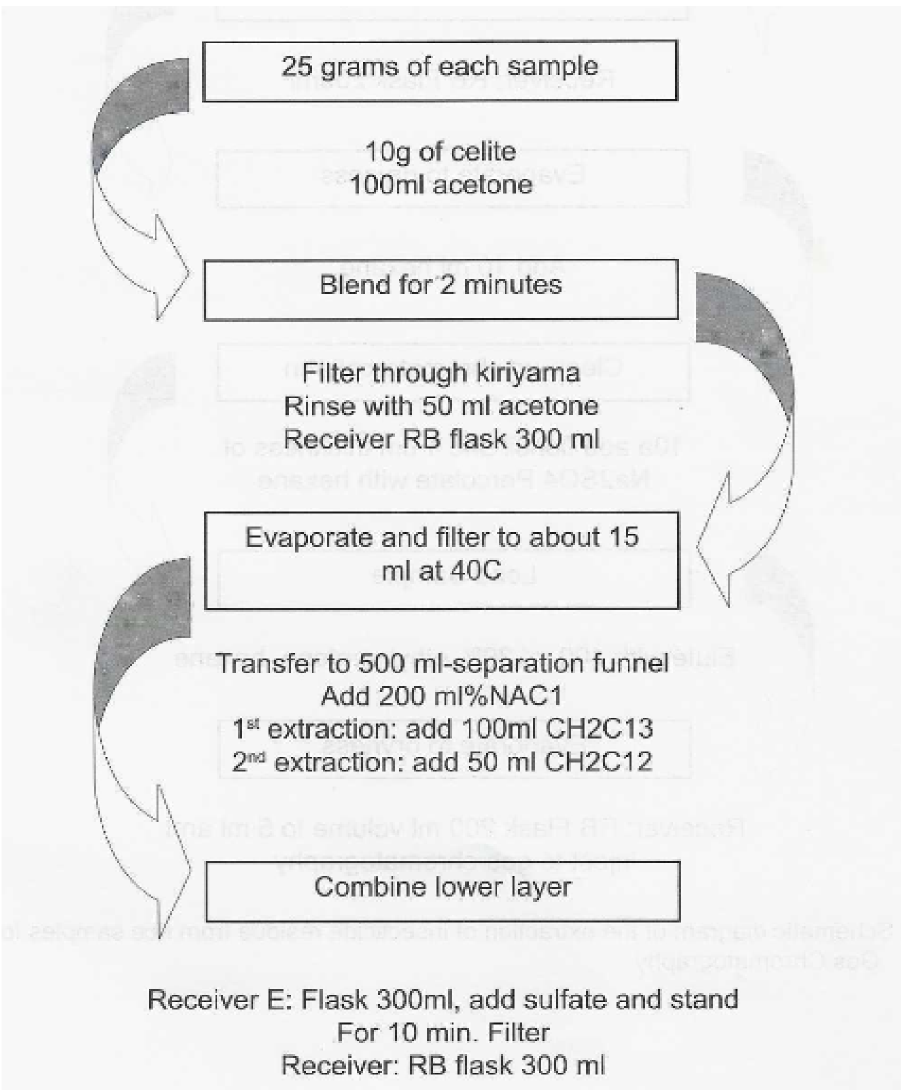
Rice grains were taken randomly as samples from various rice producing areas in the municipality of Banaybanay. These samples were grouped according to the frequency of pesticide application as indicated in the methodology. One kilogram sample was obtained from a composite sample of each group. A total of four samples were brought to the Pesticide Analytical Laboratory, Bago Oshiro, Davao City.

The steps used in the extraction of residue from rice samples for gas chromatography is presented in Fig 1. as follows:



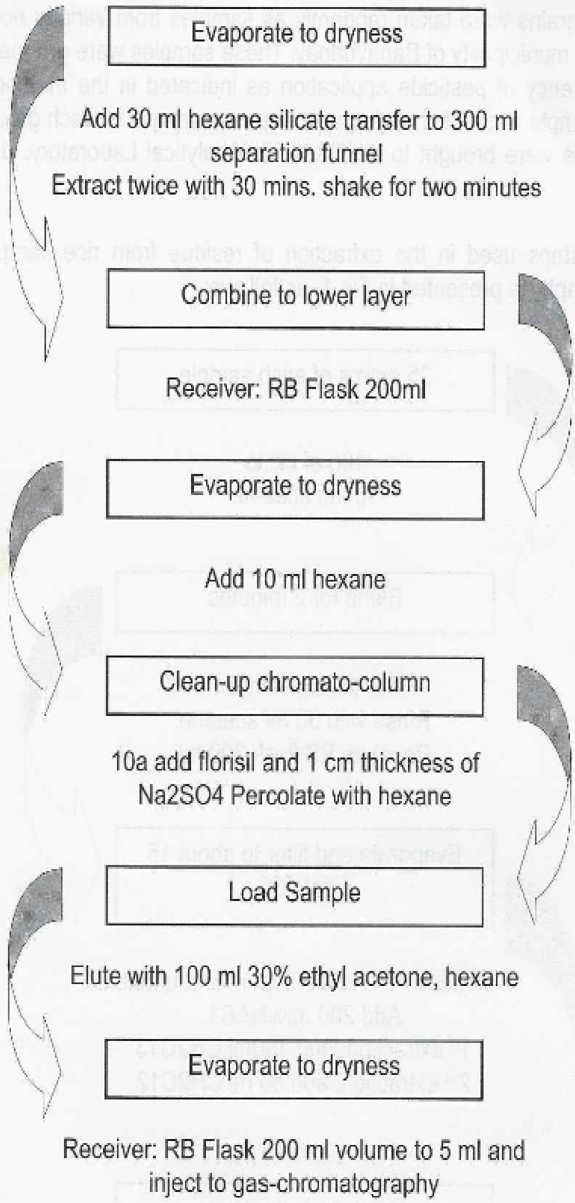


Fig. 1. Schematic diagram of the extraction of insecticide residue from rice samples for Gas Chromatography

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Data Analysis

Data were analyzed using descriptive statistics as frequency count and percentage. Acceptable Daily Intake (AD') was used to determine the tolerable level of pesticide residue in rice.

Results and Discussion

Agrochemical Utilization

Insecticides were found to be widely used (40%) in Banaybanay, Davao Oriental compared with the other classes of pesticides such as herbicide (24%), fungicide (19%) and molluscicide (17%) (Figure 3). Pesticides have a gross benefit to rice farming. They minimize damages in crops by insects, weeds, diseases, snails and other pests. Thus, resulting in better yield and higher farm income. The farmers relied heavily on chemical pesticides to control pests and protect the rice against pest infestations. Farmers applied molluscicide only when necessary. They preferred to gather the snails manually to save on expenses.

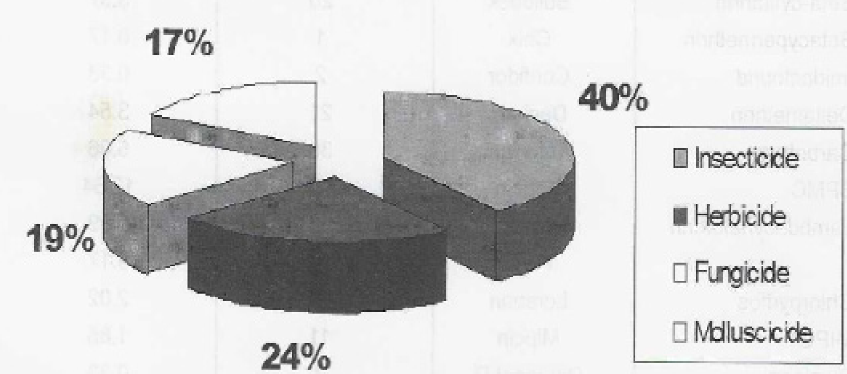

Figure 2. Pesticide Utilization of Rice Production in Banaybanay, Davao Oriental

Pesticides are poisons that, if used improperly or without sufficient knowledge on the side effects, can endanger man and animals. Moreover, residues from persistent pesticides can create potential hazards to human health and wildlife.

Several pesticides were used by Banaybanay farmers on rice (Table 2). They practiced shifting in the use of pesticide to prevent the adaptation of pests to the chemical by developing resistance. They have found that it was more effective in controlling pests.

Among insecticides, they usually utilized etofenfrox and fipronil, for herbicides, butachlor and thiobencarb + 2,4:D, fungicides included copper oxychloride and benomyl. Molluscicides used were noclosamide. These pesticides were found to be more effective than others. The most widely used fertilizers were urea, complete, ammonium sulfate and ammonium phosphates.

Table 2. Pesticides used by rice farmers in Banaybanay, Davao Oriental

Common Name	Trade Name	Frequency Count	Percentage (%)
Insecticide			
Cypermethrin	Aders	25	4.21
Buprofesin	Aplaud	2	0.33
-Banned Pesticide-	Aquatin	1	0.17
Fipronil	Ascend	95	16.02
Lambdacyhalothrin	Bida	3	0.50
Chlorpyrifos + BPMC	Brodan	54	9.11
Beta-cyfluthrin	Bulldock	20	3.37
Betacypermethrin	Chix	1	0.17
Imidactoprid	Confidor	2	0.33
Deltamethrin	Decis-R	21	3.54
Carbofuran	Furadan	30	5.06
BPMC	Hopcin	75	12.64
Lambdacyhalothrin	Karate	16	2.69
	Kapil	1	0.17
Chlorpyrifos	Lorsban	12	2.02
MIPC	Mipcin	11	1.85
Diazinon	Parapest D	2	0.33
Chlorpyrifos	Rador	6	1.01
-Banned Pesticide-	Thiodan	14	2.36
Etofenprox	Trebon	178	30.02
Chlorpyrifos	Vexter	21	3.54
Total		590	100

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Common Name	Trade Name	Frequency Count	Percentage (%)
Herbicide			
Anilofos + Ethoxysulfuron	Activo	31	8.86
Butachlor + Propanil	Advance	22	6.29
Metsulfuron Methyl + Chlorimuron Ethyl Oxamyl	Almix	1	0.29
Difeconazole + Propiconazole	Armure	4	1.14
Niclosamide Ethanolamine salt	Berdugo	1	0.29
Thiobencarb + 2,4D IBE as acid	Grassedge	87	24.86
Butachlor	Machete	125	35.71
Fenoxaprop-p-ethyl + Ethoxysulfuron	Rice Star	1	0.29
Bispyribac Sodium	Nominee	1	0.29
Isopropylamine salt of glyphosate	Power	12	3.43
Piperophos + 2,4-D Isobutyl Ester (AE)	Rilof H	2	0.57
Oxadiazon	Ronstar	1	0.29
Butachlor + 2,4 D	Rogue	1	0.29
Isopropylamide salt of glyphosate	Round Up	1	0.29
	Shell 2-4D	7	2.00
Pretilachor + Safener	Sofit	52	14.86
	Solmix	1	0.29
Total		350	100
Fungicide			
	Actard	1	0.36
Imidacloprid	Admire	1	0.36
Benomyl	Benlate	74	26.81
	BLD	3	1.09
Chlorothalonil	Daconil	2	0.73
	Diafuran	6	2.17
Mancozeb	Dithane	27	9.78
Copper Hydroxide	Funguran	55	19.93
Edifenphos	Hinosan	1	0.36
Copper Hydroxide	Kop	2	0.73
Cupric Hydroxide	Koside	6	2.17
Copper Oxychloride	Vitigran Blue	96	34.78
Total		276	100

Table 2. Pesticides used by rice farmers (cont'n)

Common Name	Trade Name	Frequency Count	Percentage (%)
Molluscide			
Niclosamide	Bayluscide	48	59.44
	Kosack	1	0.40
Metaldehyde	Meta Bait	1	0.40
Niclosamide	Molluxide	2	0.80
	Molluxoscide	1	0.40
Metaldehyde	Porsnail	14	5.62
Thiophanate Methyl	Sweep	1	0.40
Niclosamide	Trap	81	32.53
Total		249	100

Table 3. Fertilizers Used by the rice farmers in Banaybanay, Davao Oriental

Brand Name	Frequency Count	Percentage (%)
Algafer	1	0.15
Ammonium Phosphate (16-20-0)	107	15.75
Ammonium Sulfate (21-0-0)	124	18.26
Complete (14-14-14)	177	26.07
Foliar	64	9.13
Megayield	2	0.29
Muriate of Potash (0-0-60)	30	4.42
Urea (46-0-0)	174	25.63
Total	679	100

Pesticide Application

Farmers used the knapsack sprayer in applying pesticides in the rice field. They were highly dependent on agrochemicals in controlling pest in their quest to achieve optimum yield per cropping season as evident in their utilization.

The frequency of farmers applying pesticides (insecticides, herbicides, fungicides, and molluscides) is shown in Table 4. They usually applied insecticide at a range of up to 11 times, but most (58%) applied these only once or up to five times. Herbicides were used once up to five times but most farmers applied these once or twice only. Fungicides were applied once or up to five times or more by some. However, most farmers applied once or twice only per cropping season. They controlled weeds also by mechanical means such as using bolo or other tools.

Table 4. Frequency of applying pesticide by farmers per cropping season in Banaybanay, Davao Oriental.

Frequency of Pesticide Application	Frequency	Percentage
Insecticide		
1 – 5 times	186	58.49
6 – 10 times	126	39.65
11 times or more	6	1.87
Total	318	100
Fungicide		
1 – 2 times	202	71.12
3 – 4 times	74	26.05
5 times or more	8	2.81
Total	284	100
Herbicide		
1 – 2 times	238	80.40
3 – 4 times	57	19.25
5 times or more	1	0.33
Total	**296**	**100**

The frequency of spraying and the dosage of pesticides per application among rice farmers were usually based on the recommended dosage indicated in the label (76%). However, 24 % did not follow the instruction on the label because they reduced the dosage to save on pesticides and to lessen expenses (Table 5).

Table 5. Compliance to recommended pesticide dosage followed by Banaybanay farmers.

Follow Recommended Dosage	*Frequency*	*Percentage (%)*
Yes	243	76.00
No	78	24.00
Total	**321**	**100**

The volume of pesticide purchased by farmers season was procured either by kilogram or pack or by liter for liquid pesticides. The volume of application depended on the area tilled, level of pest infestation, weather condition and availability of funds. They usually applied insecticide and herbicide at a range of one to 10 L, one to 6 L each of fungicide and moslluscide, others by one to 10 sachets, and five to 10 sacks of fertilizer per cropping season (Table 6).

Most farmers purchased pesticides and fertilizers from agrochemical stores. However, there were cooperatives that provided pesticides and fertilizers to their members.

Sheath blight and bacterial leaf blight were the most common diseases. Green leafhopper, brown planthopper, leaffolder, adult stem borer, armyworm, rice caseworm and rice bug were the common insect pests that existed in the area. During the conduct of the study, the farms were infested by the brown planthopper. Farmers asked help from technicians and some agrochemical stores on how to prevent brown planthopper (bunhok) infestation.

Few farmers engaged in using alternative pesticides such as tobacco, detergent with gasoline, and liquor with ginger and chili as control agent. The alternatives were resorted to save on pesticide expenses. They did not usually use these since it took time to prepare and were not as effective as synthetic pesticides.

Farmers relied heavily on chemical pesticides in protecting rice against pests. Twenty two percent had been using pesticides for six to 10 years, and four % for more than 31 years (Table 7).

The intensive and sometimes indiscriminate use of pesticides usually results in the water and soil contamination. Pesticides contaminate groundwater through the leaching into the soil and groundwater from plants and soils. The amount and rate of

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pesticide residue movement through the soil profile and into the groundwater are governed by the interaction of several processes. The effect of pesticides on soil is related to their chemical persistence that is the length of time they remain in the soil or on crops after they are applied (Klee, 1990).

Agrochemicals may enter aquatic ecosystems indirectly by drift from spraying, from fallout, from air-dust particle accumulation in the atmosphere, in run off from urban and agricultural lands by direct application to the aquatic environment and by improper disposal of excess pesticides and container.

Table 6. Volume of pesticides applied in a hectare per cropping

Volume (L)	*Frequency Count*	*Percentage (%)*
Insecticide		
1 – 2	137	43.63
3 – 4	120	38.22
5 – 6	32	10.19
7 – 8	18	5.73
9 – 10	7	2.23
Total	314	100
Herbicide		
1 – 2	198	67.12
3 – 4	74	25.08
5 – 6	16	5.10
7 – 8	5	1.70
9 – 10	2	0.68
Total	295	100
Fungicide		
1 – 2	155	55.96
3 – 4	53	19.13
5 – 6	31	11.19
1 – 5	8	2.89
6 – 10	30	10.83
Total	277	100
Molluscide		
1 – 2	127	53.14
3 – 4	57	23.85
5 – 6	14	5.86
1 – 5	15	6.28
6 – 10	26	10.88
Total	239	100

Table 7. Number of years in using agricultural chemicals by rice farmers in Banaybanay, Davao Oriental

Years	Frequency	Percentage (%)
1 – 5	38	11.87
6 – 10	72	22.50
11 – 15	61	19.06
16 – 20	53	16.56
21 – 25	49	15.31
26 – 30	34	10.62
31	13	4.06
Total	320	100

Aquatic plants and animals can accumulate contamination of certain pesticides many times greater than that in water. The greatest magnification is found with organo-chlorines because they are persistent and have a high affinity for lipids. Inappropriate use of these chemicals may contaminate the fish normally raised by farmers to supplement their food needs. The water that circulates through the rice paddies and irrigation canals may contaminate local water resources.

Aquatic organisms are exposed to pesticides both in water and in food in the environment. Fish accumulate pesticides from both sources, the higher the organism in the food chain, the more pesticides it receives through food. The agrochemicals are passed on to the food web from herbivores to carnivores.

Agrochemicals have long-term adverse effects on the plants and animals. The application may destroy beneficial predators and parasites in addition to the target insects. This may lead to an increase in pest population which leads to a more damaged agro-ecosystem.

About 24 percent of the farmers experienced such side effects as skin irritation, headache and sometimes dizziness (Table 8). They attributed these to pesticide use. Majority (76%) of them, though, said that they never experienced any side effects. Most (71%) farmers wore protective clothing during application and a few (29%) did not. More likely, few farmers were exposed to any hazard. They also wore masks, long sleeves or jacket, long pants and gloves.

Table 8. Some illness perceived by Banaybanay rice farmers to have been caused by prolonged exposure to agrochemicals.

Response	Frequency	Percentage (%)
Do you encounter Illnesses?		
Yes	77	23.98
No	224	76.01
Total	**321**	**100**
Illnesses		
Irritation	53	39.84
Headache	46	34.58
Feel Dizzy	34	25.56
Total	**133**	**100**

The common problems encountered by most farmers included: pest and disease infestation (85%), financial support (8%), irrigation (3%) and high price of pesticides and fertilizers (3%) (Table 9). They used pesticide to avoid pest infestation. They sought support from the government with regard to irrigation, financial support and the continuous increase in the price of pesticides and fertilizer (Table 10).

Table 9. Problems encountered by rice farmers in Banaybanay

Problems	Frequency	(%)
Pest and disease	266	85.25
Irrigation	11	3.52
Financial support	25	8.01
High Price(Pesticide/Fertilizer)	10	3.20
Total	**312**	**100**

Table 10. Solution to problems as perceived by rice farmers

Solutions	*Frequency*	*Percentage (%)*
Apply Chemical Pesticides	248	48.06
Consult NIA	11	2.13
Seek Government Assistance	232	44.96
Lend Money	25	4.84
Total	**516**	**100**

Pesticide Residue in Rice

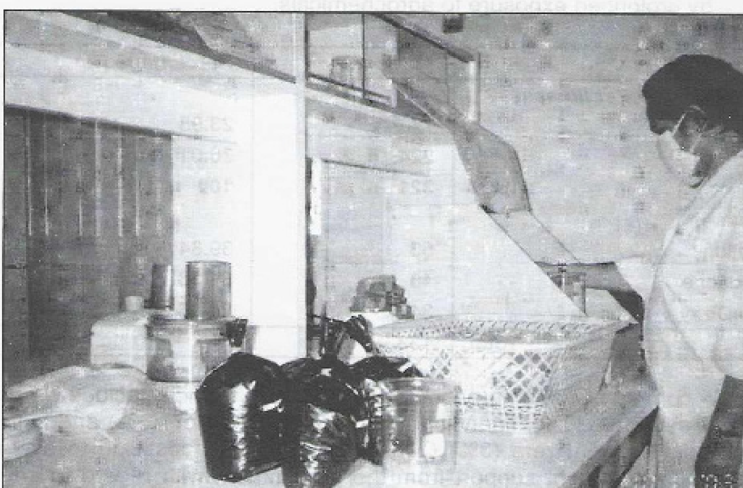

Figure 3. Preparation of rice samples for residue analysis at the Pesticide Analytical Laboratory, Bago Oshiro, Davao City

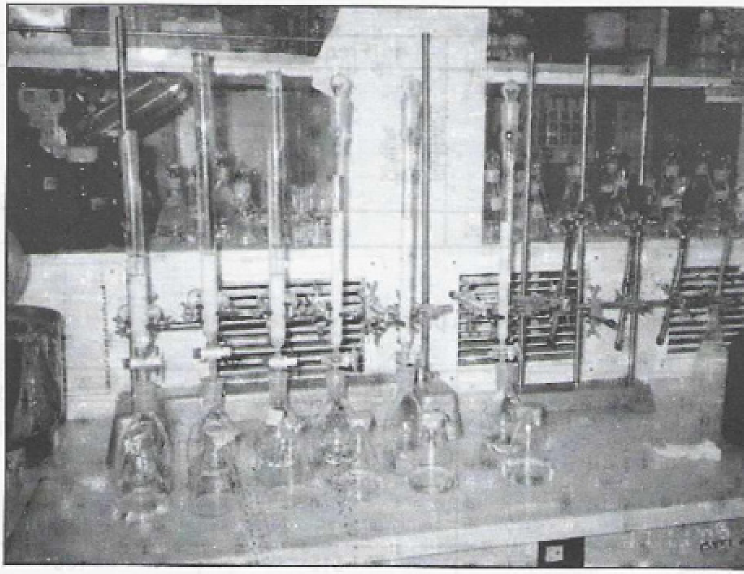

Figure 4. Titration of rice samples after blending

The Limit of Determination (LOD) for organochlorines, organophosphates and pyrethroids were 0.5 ppb, 0.02 ppm and 1.5 ppb respectively.

All the samples subjected to analysis positively contained pyrethroids residue at different concentrations (See Table 12).

Table 12. Level of pesticide residue detected in rice from Banaybanay, Davao Oriental.

Cultivar/ Spraying Frequency	***Residue Level (mg/kg or ppm)***	
Hybrid	Cypermethrin	Deltamethrin
5-8 times	0.09	0.02
9-12 times	0.03	0.02
IR 64		
5-8 times	0.04	0.02
9-12 times	0.02	0.02

There was an inverse relationship between the concentrations of cypermethrin and the frequency of pesticide application in both hybrid and the conventional variety, IR 64 (Table 12). While the concentration of residue of deltamethrin remained constant despite an increase in frequency of application. High concentration of residue of cypermethrin was observed in hybrid rice than in conventional variety, IR 64.

Laboratory analysis showed that the concentration of the residue had no relationship with the frequency of application. There is a high possibility that it was not on the frequency but rather on the dosage of pesticide applied by farmers to the crop and the variety of the crop applied with pesticide as is evident in hybrid rice. This is because hybrid rice requires intensive application of pesticide in all aspects of its development. Most hybrid rice varieties are susceptible to the attack of various pests in the field. There is also a high possibility that time lag between the last spraying and the time of harvest tends to directly affect the amount of residue found in a particular commodity. Weather condition might have affected also the degradation of pyrethroids.

Based on the Acceptable Daily Intake, both cypermethin and deltamethrin residues detected were above the acceptable level. These levels represented the residues at harvest since the samples are taken at harvest time. This would mean that at this point in time the rice is not safe for consumption. However, these pesticides are said to contain less mammalian toxicity.

Pyrethroids in the air are broken down or degraded rapidly by sunlight or other compounds found in the atmosphere. Often, they last only one or two days before being degraded. Rain and snow help remove the pyrethroids from air that are not rapidly degraded. Since many of these compounds are extremely toxic to fish, they are usually not sprayed directly onto water, but they can enter lakes, ponds, rivers, and streams from rainfall or runoff from agricultural fields. These compounds bind strongly to dirt and usually are not very mobile in soil. Pyrethrins and pyrethroids are not easily taken up by the roots of plants and vegetation because they are strongly bound to the soil. However, they are often sprayed directly onto crops and plants so they may be found on leaves, fruits, and vegetables. Because these compounds adsorb so strongly to soil, pyrethrins and pyrethroids usually do not leach into groundwater, do not contaminate drinking water supplies, and volatilize from soil surfaces slowly. These compounds are eventually degraded by the microorganisms in soil and water. They can also be degraded by sunlight at the surfaces of water, soil, or plants. However, some of the more recently developed pyrethroids can persist in the environment for a few months before they are degraded (http://www.atsdr.cdc.gov/toxprofiles/phs_41.htm).

Summary and Conclusions

Rice production in Banaybanay, Davao Oriental was basically pesticide-based. Majority of farmers used pesticides to control crop pest for the past 10-20 years. Most of them were aware of the effects of these chemicals to the water, air and even to human health.

The pesticides used mainly by Banaybanay farmers were: insecticides, herbicides, fungicides and molluscicides. Insecticides were the most commonly used. Farmers also used fertilizer of about seven to eight sacks every cropping season. The frequently used fertilizers were urea, complete, ammonium sulfate and ammonium phosphate.

Pesticides purchased by farmers were bought either per kg or pack and per L for liquid pesticides. The volume of application depended on the area tilled, level of pest infestation, weather condition and availability of funds. They usually applied insecticide and herbicideat a range of one t010 L. one to six L for fungicide, others of one to 10, same with molluscide and five to 10 sacks of fertilizer per cropping season.

Farmers usually applied insecticide at a range of one to 11 times or more but most did it only once or up to five times; for herbicide, once to five times or more but most did only once or twice and once to five or more times for fungicide but most once or twice every cropping season. They also practiced cleaning the farm with the use of a bolo or other tools in controlling unwanted weeds. About 70% of the farmers applied fertilizer twice every cropping season while only 30% applied thrice every cropping season. The first application of fertilizer was done on the 25th day after transplanting, then, on the 35th day and lastly, on the 45th day after transplanting. Majority of them followed the recommended dosage as indicated in the label of pesticides. Generally, farmers purchased pesticides from agrochemical stores in the area.

All the rice samples analyzed in the Pesticide Analytical Laboratory (PAL) Bago Oshiro, Davao City positively contained cypermethrin and deltamethrin.

The findings of the study indicated intensive requirements of agrochemicals for growing hybrid rice.

Heavy application of pesticide was very evident. This maybe brought about by the requirements of the technology or by the lack of knowledge in the part of the farmers or by their desire for assurance of recovering their investment.

Although pesticides played a big role in increasing rice production, they have also been proven to pose hazards to both farmers and the environment. Continuous pesticides application would result in the development of resistance in pest rendering pesticides application useless.

Though the government adopted IPM as a national crop protection policy and despite all the benefits offered by the technology, few farmers were inclined to adopt this kind of pest management.

Heavy agrochemical application, coupled with prolonged and high application frequency, undoubtedly predisposes the area for faster degradation and contamination.

This study revealed that there were residues detected in rice from Banaybanay. Hybrid rice sprayed five to eight times per cropping contained 0.02 ppm deltamethrin and 0.09 ppm cypermethrin residues. Cypermethrin and deltamethrin residues detected were above the level of Allowable Daily Intake (ADI) of 0.01 and 0.05 ppm, respectively. While hybrid rice sprayed with insecticide nine-to-12-time s per cropping period contained 0.02 ppm Deltamethrin and 0.03 cypermethrin residues. The cypermethrin residue detected was below the ADI while the deltamethrin residue was above ADI. IR 64 cultivar sprayed with insecticide five to eight times per cropping contained 0.04 ppm cypermethrin and 0.02 deltametrhin residues. The residue of cypermethrin was below the ADI while deltamethrin was above the ADI. The residues detected of IR 64 sprayed at nine to 12 times per cropping for cypermethrin and deltamethrin had the same residue level at 0.02 ppm. All were below ADIE

The concentration of the residue seemed to have no relationship with the frequency of application. There is a high possibility that it is not the frequency but rather on the dosage of pesticide applied by farmers to the crop and the variety of the crop applied with as evident in hybrid rice. Hybrid rice requires intensive application of pesticide in all stages of its development. Most hybrid rice varieties are susceptible to the attack of various pests in the field. There is also a high possibility that time lag between the last spraying and the time of harvest will affect directly the amount of residue found in a particular commodity. Weather conditions affect the degradation of pyrethroids.

Pesticides in the first place were formulated toxic although some cannot contaminate ground water because they are highly bound in soil particles as in the case of pyrethroids and endosulfan but nonetheless their direct effect during application and or contact is of serious concern. Fishes and other life forms in rice ecosystem are endangered by these chemicals during application. The possibility of entering the food chain and be biomagnified are very high.

Recommendations

1. Farmers are encouraged to use and seek alternatives instead of relying on synthetic pesticide in controlling pests.
2. A government-initiated program must anchor on the sustainability principle and formulation of regulation mechanisms on the use of pesticides must be sought.
3. A massive information campaign on environmental awareness and on the impact of the current farming system and management, especially on the effects of agrochemicals, must be undertaken.
4. Inventory and monitoring on the pesticide used by farmers must be undertaken by concerned agencies to avoid use of banned pesticide.

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