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Economic and ecological perspectives of farmers on rice insect pest management

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ABSTRACT

Understanding farmers' perception is important in the development of sustainable and cost-effective integrated pest management strategies. Hence, farmers' perception on rice insect pests and pesticide use was evaluated by selected 112 farmers composed of 77% males and 23% females, over the rice growing areas of North Cotabato, Central Mindanao, Philippines. 62% of farmers that were interviewed use pesticides based on the presence of pests. These farmers identified white stem borer and rice leaf folder as the most encountered insect pests on the local rice crops. Due to these insect pests, rice production became constrained producing low income for the farmers. Pesticide application was perceived to be effective (73%) but not efficient in controlling insects. Moreover, farmers recognized the negative effects of pesticide applications in the environment (76%). However, in spite of these expensive pest control strategies, local farmers still agreed (83%) to apply these methods to increase rice production and their income. With the advantage of using pesticides to boost production over the harm it can cause, farmers would not agree to stop (39%) or still are undecided (23%) to reduce pesticide application. Thus, efficient, safe, low cost pest control strategies are needed to reduce reliance of farmers to pesticides and to improve agricultural production and food security of smallholder farmers in the Philippines.

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INTRODUCTION

The Philippines, along with its Asian neighbors, has been producing rice for centuries. Rice farming technology has evolved along with the problems experienced by farmers (Bautista and Javier, 2008). In a strong move towards internationalization, open trading has put economic pressure on competition not only on the product quality but also on the efficiency of methods of production. Rice is the most important staple food for Filipinos and the entire South East Asia (Intal and Garcia, 2005). It honed the Filipino culture (Aguilar, 2005) and identity. Food sustainability in the Philippines is measured by the volume of rice

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stored in its granaries. However, it was estimated that between 120 and 200 million tons of grains are lost yearly due to pests in rice fields in tropical Asia (Willocquet *et al*., 2004). The most common way for a farmer to control insect pest is by spraying pesticides (Balleras, 2012). The Philippine import values of pesticides increased sharply from USD14 million in 1990 to USD214 million in 2013 (Magcale-Macandog, 2016). Pesticides are the highest chemical inputs and widely used by farmers due to the fact that an unprotected rice farm has a tendency to reduce yield by 40% based on International Rice Research Institute (IRRI) research (Pathak and Dhalival, 1981). There were contrasting reports on pesticide use in the Philippines. It was reported that among Southeast Asian farmers, the Filipino farmers had the least amount of insecticide application (Dawe, 2006). Asian rice farmers apply insecticides about 2-4 times per growing season. However, the more recent research of Gianessi (2014) showed that insecticide usage was high in the Philippines (95%) and Vietnam (99%) while lower in Bangladesh (50%), Cambodia (38%), India (50%), Indonesia (75%), Malaysia (70%), and Thailand (58%) based on percent hectares treated to total rice cultivated area. On the other hand, Pretty and Barucha (2015) mentioned that rice farmers in the Philippines had reduced pesticide application frequency and applications per hectare by 70% for the past decade. The volume of pesticides applied to rice fields is significant because of the large area under rice cultivation (Parsons *et al*., 2010). The recent estimate of rice fields in Central Mindanao, Philippines, could reach up to 149,342 ha in Region 12 (South Cotabato, Sarangani and General Santos) and 52,402 ha in Autonomous Region of Muslim Mindanao alone (Ravis *et al*., 2016). However, the study of Perez *et al*. (2015) revealed the hazards of pesticides on the health of rice farmers in the Philippines. Econometric analysis revealed that the magnitude of chronic health effect and health cost is directly related to pesticide exposure. When health effects were analyzed versus the net benefits of insecticide use to rice production, the result is negative, and it causes significant reduction to labor productivity. Therefore, the reduction of labor productivity may impact the cost of rice production. The economic variables in rice production are affected by the amount and the manner in which economic inputs were used (Wong and Geronimo-Kueh, 1982). This result was supported by Parsons *et al*. (2010) who reported that environment and health cost of pesticide use is greater than the value of crop lost. The use of pesticide has a negative effect on farmers' health, and the farmers' health has a positive effect on his productivity, *ergo*, most likely, there are social gains from the reduction of insecticide use in the Philippine on rice production (Antle, 1994). More than 99% of the pesticides applied moved into the environment and only 0.1% reached the target pests. Pesticide residues contaminate the soil, water, and the atmosphere causing adverse effect to health and beneficial biota (Pimentel, 1995). It is a challenge for the farmers and the government to look for an alternative-non-chemical-ways to control insect pests. Previous studies reported that more than 80% of insecticide sprays in rice fields applied by farmers in a cropping season could be considered as misuse due to farmers' misperceptions of pests, overestimation of potential damages and losses, and attitudes favoring insecticide use (Lazaro *et al*., 1993; Lazaro and Heong, 1995; Heong *et al*., 2008). Effective integrated pest management (IPM) practices could secure rice production to the benefit of the poor rice-farming households. The perception of farmers towards pest management strategies may accelerate technology development and promotion. Understanding farmers' perception is important in the development of sustainable and cost effective IPM strategies with the potential to reduce the cost of production, reduce the health risk to farmers, or even increase the quality of rice produced. While the Philippine government recognizes the role of agriculture sector to help alleviate poverty, it is recognized that IPM has to be sustainable and competitive for better socio-economic impacts. Hence, the aim of this study was to evaluate the perception of farmers on rice insect pests and pesticide use in Southern Philippines. The study has been carried out in Central Mindanao in 2017.

MATERIALS AND METHODS

Study area

The study area comprised of three barangays from municipalities of Kabacan, Midsayap and Mlang in the province of North Cotabato, Central Mindanao, Philippines (Fig. 1). Kabacan is in the third district, centrally located in Cotabato province, and popularly known as the rice production center or rice granary of

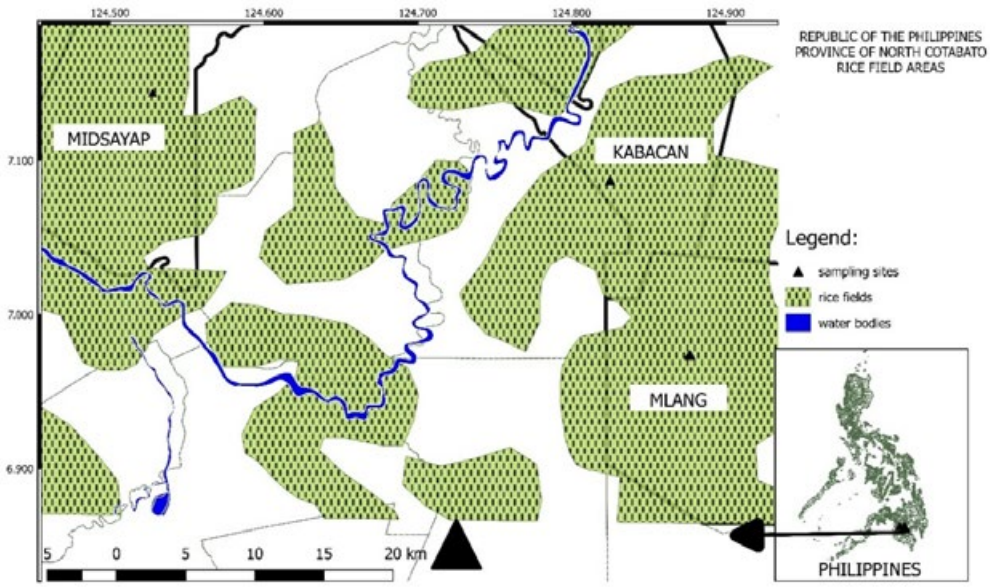

Fig. 1: Geographic location of the study area in Central Mindanao, Philippines

the province since most of its fertile areas are planted with rice followed by corn. Midsayap is in the second district, geographically located on the southwestern portion of Cotabato province where most of the areas are devoted for agricultural production and rice is the major crop produced. Mlang is in the third district, located in the southwestern portion of the province. It is predominantly an agricultural community situated on wide valleys and plains. Clay loam type is the prevalent soil type in all municipalities and is best suited for rice production.

Survey method and data analysis

Farmers were selected purposively. Farmer´s interest in participating in the study was considered and almost all farmers of the selected barangays participated in this study and willing to be interviewed. A total of 112 farmers were interviewed (30 from Kabacan, 30 from Midsayap and 52 from Mlang) using structured questionnaires. The questionnaire was developed based from the results of the study of Alibu *et al*. (2016) and the statements to determine the attitude of farmers towards pesticide use was adopted from Parveen and Nakagoshi (2001) with little modification on the statements and additional statements were included. The questionnaire was content validated by the social scientist and translated into Ilongo and Cebuano, according to the local language spoken by the farmers, and pre-tested in a group of farmers who were not respondents of the study to determine whether the respondents could understand it. After pre-testing, the questionnaire was modified accordingly. The questionnaire included the farmer's sociodemographic and socioeconomic profile, rice production constraints, pest encountered by farmers, profile of pesticide use and attitude towards pesticide use. Sociodemographic and economic data of farmers were recorded such as sex, age, education, household size, length of rice farming experience, ownership, total cultivated land area, production based on number of sack (60 kg/ sack) per ha, gross income from rice per ha inclusive of all inputs such as fertilizer, pesticides, labor and machinery, and rice production expenses. Rice production expenses recorded were inputs on seed, pesticide, fertilizer, labor and machinery. Data on farm characteristics included rice varieties cultivated for the last four cropping seasons, rice production constraints experienced by farmers and insect pests encountered in the field which was confirmed by showing the photographic guide to farmers (Pathak and Khan, 1994). Farming practices on insect pest control were determined on the basis of pesticides application, types of pesticide used and timing of pesticide application. The farmers' perception on the effectiveness of pesticides and farmers'

attitude towards pesticide used were determined according to the statements in which farmers have to choose among agree, disagree or undecided for their response. Focus group interviews were also conducted in small group of farmers in addition to the survey. This was done to probe for additional answers. The statistical analysis was performed using Statistical software and statistics such as frequency distribution and percentages were used to analyze and report farmers' responses.

RESULTS AND DISCUSSION

Farmers´sociodemographic profile

The survey revealed (Table 1) that there were more males (77%) engaged in rice farming than females (23%) in North Cotabato, Philippines. This is typical in the other regions of the Philippines (Philippine Statistics Authority, 2015) in which men lead an active role in farming while women participated as farm laborers, assisting in planting, weeding and harvesting. Men play a major role in decision making while opinions of women in pest management were also considered. Moreover, there were 5 times more aged farmers (61-70 years old) than younger farmers (20-30 years old), in which 52% of them are over 50 years old. Few young individuals were involved in rice farming since most of them are in school. Filipino farmers give priority to the education of their children especially that the Philippine government recently offered free tuition to access education (Republic Act 10931, 2017). A minority (12.5%) of the respondents attended college or university and some even finished college. More than half of the farmers attended secondary school. There were those that attended primary school only and very few received no formal education. This indicates that literacy rates of farmers are high. Most of the farmers supported a household size of 3-6 members. Although farmers have big household size, a decreasing trend in the number of household members in two generations of farmers was observed. With access to education and knowledge on family planning, farmers preferred to have few children. Farmer respondents had many years of experience in rice farming. The data suggested that most of the farmers started at early

Table 1: Sociodemographic characteristics of farmers in the three barangays in North Cotabato

Characteristics	Summary of responses	
	Response frequency (n=112)	Response (%)
Sex		
Male	86	76.8
Female	26	23.2
Age		
20–30	3	2.7
31–40	13	11.6
41–50	38	33.9
51–60	43	38.4
61–70	15	13.4
Level of education		
No formal education	6	5.4
Primary	25	22.3
Secondary	67	59.8
College	14	12.5
Household size		
1–2	13	11.6
3–4	37	33.0
5–6	46	41.1
7–8	16	14.3
Number of years of experience in rice cultivation		
5–10	11	9.8
11–20	46	41.1
21–30	30	26.8
31–40	21	18.8
41–50	4	3.6

age of adulthood (16 years old) and went on farming until old age and would only retire in farming due to sickness. Majority of respondents had more than 10 years of experience in rice farming.

Farmers´ socioeconomic profile

Respondents may be farming their own land, or work as hired laborer or tenant of other persons' land (Table 2). Some farmers who own lands had acquired the property through inheritance. Some owners whose household had working adults with better economic positions and do not depend much in farming to support their family had their lands under tenancy. Those respondents without other sources of income pawn or sell the piece of land. On the other hand, those who do not own any rice fields were tenants who share the production to the landholder. The landholdings of the majority of farmers were around 2 ha. Variable responses were recorded on the production per ha. Thirty two percent of the farmers produced less than 60 sacks (60 kg/sack) of rice per ha, 32% produced greater than 80 sacks of rice up to 100 sacks, and only 13% produced greater than 100 sacks per ha. The gross income of the majority is about USD 1,501–1,700 per cropping per ha, less of expenses results to a net income of around USD650 every cropping per ha. The cost of rice production is taken primarily by plant nutrition using synthetic fertilizers (27%). Not significantly lower is the budget for pesticides at 24% of production cost of the total expenses spent by farmers on rice production (Fig. 2).

The land area for each farmer was not enough for a highly mechanized farming. The parent farmer distributed his land to his offspring resulting to smaller portions for each. Most of the farms in the study areas were dedicated for paddy cultivation with two to three rice cropping periods per year. Most of the rice farmers do not have diversified income and rice farming is the only livelihood. Based on the Philippine statistics, the farmer is one of the country's sectors with high incidence of poverty (Reyes *et al*., 2012). Improved farming practices could increase yield

Table 2: Socioeconomic characteristics of farmers in the three barangays in North Cotabato

Characteristics	Summary of responses	
	Response frequency (n=112)	Response (%)
Ownership		
Land owner	62	55.4
Tenant	50	44.6
Area under paddy cultivation (ha)		
Less than 1 ha	26	23.2
1–2 ha	67	59.8
3–4 ha	14	12.5
5 or more ha	5	4.5
Production per ha (sack)		
30–40	9	8.0
41–50	9	8.0
51–60	18	16.1
61–70	10	8.9
71–80	11	9.8
81–90	22	19.6
91–100	20	17.9
101–110	2	1.8
Greater than 110 sacks	13	11.6
Income (USD) per ha		
350–550	6	5.4
351–750	2	1.8
751–950	10	8.9
951–1,150	13	11.6
1,151–1,300	5	4.5
1,301–1,500	15	13.4
1,501–1,700	41	36.6
1,701–1,900	8	7.1
Greater than 1,900	12	10.7

and reduce production cost (Bordey *et al.*, 2016). The importance of pest management is highlighted to boost production. In irrigated rice fields, a harvest of below 50 sacks per ha is considered crop loss which was mostly accounted to pest infestation while an average good harvest is around 80-90 sacks per ha or more according to farmers. Although pesticide was the second highest expense next to plant nutrition in this study, pests have tremendous and persistent effect on the yield loss if not controlled (Mondal *et al.*, 2017). Other expenses were on labor despite of the active involvement of farmers in the field due to the less support of household members since most of the children go to school. Most farmers rely on rentals for machinery rather than on ownership. Machineries were most needed in land preparation and during harvest. There were few expenses on seeds if farmers used their own seeds however buying seeds from certified seed growers and government agency was preferred. Expense on irrigation was not included in this study since most farmers obtain their irrigation water from the canals which was free of charge. Greatest percentage of expenses was on fertilizer in which farmers applied three times per cropping period. Although pesticide is the second highest percentage expenditure, budget allocation for pesticide varies depending on the presence of pests. Capital for rice farming is usually borrowed from private money lenders similar to the report of Bordey *et al.* (2016) for Philippine farmers. Although farmers in North Cotabato have only small size of farm, most of them need to borrow capital, usually with interest cost (5-10%), due to the unavailability of non-farm income. Financiers facilitated farmers to avail farming inputs but with higher costs and during harvest farmers had to sell their crops to these financiers with the price determined by the financiers.

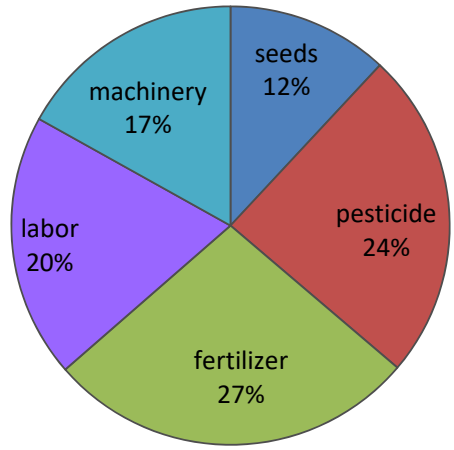

Fig. 2: A pie chart showing the percentage of expense distribution by rice farmers

Farm characteristics

Farmers used wide range of varieties suited for irrigated lowlands however six inbreed varieties and hybrid variety showed to be popular and the top choice of farmers. Of the several rice varieties planted during the last four cropping periods, farmers preferred rice variety NSIC Rc160 (Tubigan 14) (Table 3). According to PhilRice data, rice variety NSIC Rc160 was the most frequently grown variety and yield 5.6 to 8.2 tons/ha. It is resistant to yellow stem borer, moderately resistant to white stem borer and has intermediate reaction to blast, bacterial leaf blight, and green leaf hopper. This variety has a long grain size and good eating quality. The market price of this variety at present is slightly higher compared to other varieties. Yield of other varieties preferred by farmers ranged from 5.8 to 9.1 tons/ha and also resistant or moderately resistant to white stem borer and brown plant hopper. For seed selection, farmers considered factors such as resistance to pest and diseases and/or good eating quality with medium to soft grain quality when cooked. Highest percentage of farmers in North Cotabato considered insects as the top most constraint in rice production (Fig. 3). Among other constraints, most farmers (more than 75%) also considered plant

Table 3: Rice varieties commonly planted by farmers for the last 4 cropping seasons (2016-2017)

	Farmers (%)		
Rice variety	Kabacan	Midsayap	Mlang
Hybrid	3	8	2
NSIC Rc116H (Mestiso 3)	3	4	14
NSIC Rc158 (Tubigan 13)	10	5	11
NSIC Rc160 (Tubigan 14)	19	29	25
NSIC Rc222 (Tubigan 18)	20	13	12
NSIC Rc224 (Tubigan 19)	5	2	11
NSIC Rc226 (Tubigan 20)	0	0	16

diseases, rodents, low fertility of soil, weeds and financial limitations. Of the pests encountered in the rice fields, 100% of the farmers have problems on white stem borer and rice leaf folder, followed by rice bug and rice black bug. More than 95% of the famers have problems on rice caseworm, golden apple snail, army worm, stripe stem borer and rats (Table 4). The most persistent among rice pests was the white stem borer. This result was consistent with the survey done in Midsayap, North Cotabato (Balleras *et al*., 2016), although rice leaf folder is a new contender in the list. Rice black bug impact may be very notable, but only during full moons, thus it ranked third on frequency as encountered by farmers. Multiple responses of farmers on pests encountered indicated that diverse range of pests threatens rice productivity and income which also made the farmers to use different pesticides in controlling rice pests. White stem borer is the most prevalent stem borer in Southern Philippines causing 6% and 11% yield loss in irrigated

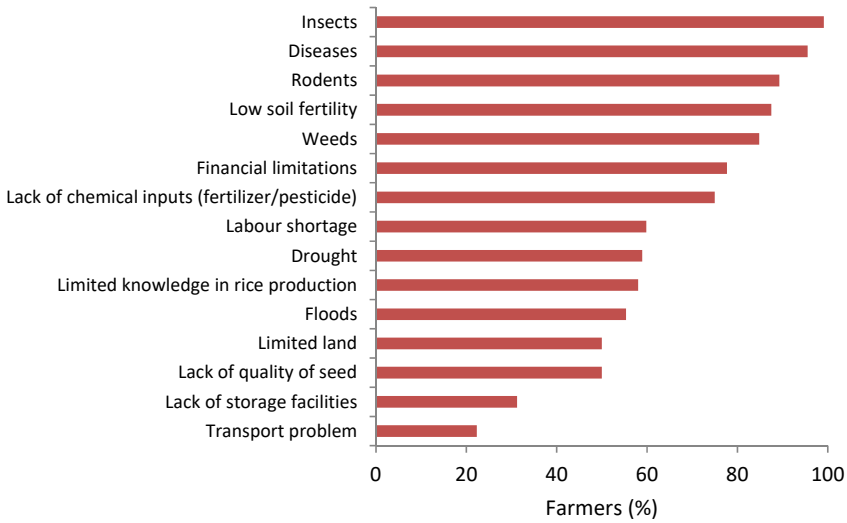

Fig. 3: Rice production constraints experienced by farmers in North Cotabato

Table 4: Major insect pests experienced by farmers in rice

Pest encountered in rice field	Farmers (%)
White stem borer (*Scirpophaga innotata* Walker)	100*
Rice leaf folder (*Cnaphalocrocis medinalis* Guenee)	100
Rice bug (*Leptocorisa oratorius* Fabricius)	99
Rice black bug (*Scotinophora coarctata* Fabricius)	98
Rice caseworm (*Nymphula depunctalis* Guenee)	97
Golden apple snail (*Pomacea canaliculata*)	97
Army worm/Cutworm (*Mythimna separata* Walker)	96
Striped stem borer (*Chilo suppressalis* Walker)	96
Rat (*Rattus rattus mindanensis* Mearns)	96
Mole cricket (*Gryllotalpa orientalis*)	94
Green leaf hopper (*Nephotettix nigropictus* Stal)	94
Yellow stem borer (*Scirpophaga incertulas* Walker)	92
Pink stem borer (*Sesamia inferens* Walker)	91
Brown plant hopper (*Nilaparvata lugens* Stal)	88
Short-horned grasshopper (*Oxyahyla intricate* Stal)	79
Rice mealy bug (*Brevennia rehi* Lindinger)	77
Rice whorl maggot (*Hydrellia philippina* Ferino)	76
White backed plant hopper (*Sogatella furcifera* Horvath)	72
Rice thrips (*Baliothrips biformis*)	55
Zigzag leafhopper (*Recilia dorsalis* Motsch)	51

*Percentage values add to more than 100 due to multiple responses

and rainfed rice field, respectively (Litsinger *et al*., 2011), and rice leaf folder at three larvae per hill of plant reduced yield up to 20% (Padmavathi *et al*., 2013). Ten adults of rice black bugs per hill caused 15-23% yield reduction (Cuaterno, 2006) while, rice bugs reduce grain quality and seed viability (Jahn *et al*., 2004). All farmer respondents apply pesticides to rice crop to minimize the yield loss caused by insects.

Pesticide application practices

There were 62% of farmers who used pesticides based on the presence of pests, 24% based on action threshold and none referred with government field technician (Fig. 4). The 14% of them used pesticide by calendar regardless of the level of pest damage as preventive measure. Pest management was based on farmer´s observations of pests in the field. Timing of pesticide application based on the presence of pest and degree of pest infestation had been a long time practice by many farmers in the Philippines (Beltran *et al*., 2016). Despite of the high cost of pesticides, farmers frequently applied pesticides based on the presence of pests other than what was scheduled in the calendar. Agricultural technicians of the government seldom visited the farms while agents from the pesticide companies had more frequent visits providing guidance to farmers and also for the purpose of advertising and promotion. A total of 52 different pesticides were recorded (data not shown) and only 5% of the farmers used organic pesticides. There were seven pesticides commonly used by 11-22% rice farmers (Table 5). Generally, farmers apply pesticides in the whole cropping period during the 9 crop stages (Fig. 5). As early as 15 days after planting, at the seedling stage of the crop, farmers already applied insecticides. Most farmers (64%) applied pesticides during the tillering stage of the crop. Pesticide application was repeated as needed or perceived. Although farmers applied pesticides according to the growth stages of rice, some farmers applied more than once per rice growth stage when needed. Unsynchronized application of pesticide was

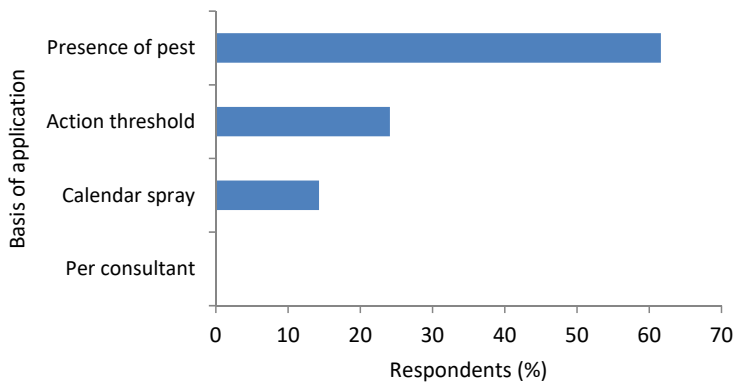

Fig. 4: Basis of pesticide application

Table 5: Most commonly used pesticides in rice farming in the selected barangay of three municipalities

Pesticide	Active Ingredient	Kabacan		Midsayap		Mlang		Total
		Number of farmers*	%	Number of farmers*	%	Number of farmers*	%	
Brodan	Chlorpyrifos+BPMC	8	32	4	16	13	52	25
Surekill	Niclosamide	8	32	8	32	6	24	22
Knock Out	Cypermethrin	4	16	4	16	14	56	22
Magnum	Cypermethrin	0	0	13	52	7	28	20
Slam	Glyphosate, N(phosphonomethyl)glycine	8	32	5	20	5	20	18
Hopcide	BPMC	0	0	16	64	2	8	18
Azodrin	Dimethyl phosphate of 3-hydroxy-N-methyl-cis crotonamide	2	8	8	32	2	8	12

*Farmers have multiple responses

recorded in this study and this was not considered an effective control strategy for insects. Reliance on pesticides was observed in Asian countries in all seasons in the study of Beltran *et al*. (2016) however this study have opposite results in terms of frequency of applications. It was reported that Filipino farmers minimally use insecticides with the averaged of two applications per cropping but this study showed that there were 6 to 10 pesticide applications per rice cropping period in North Cotabato. Seventy three % of the respondents perceived that chemical pesticides are effective and only 17% perceived it to be very effective (Fig. 6). Although it was perceived that the use of pesticides is useful in reducing pest infestations, farmers do not agree that pesticides are very effective because after the initial application of pesticides increased populations of pests was observed. This occurred if some insects were resistant to these chemicals or if the pesticides have eliminated the beneficial predators of pests (Wilson and Tisdell, 2000). However, farmers continued application of pesticides even to an extent that application of pesticides is no longer economic, as long as food supply is ensured.

Attitude of farmers towards pesticide use

Of the 112 farmers surveyed in this study, 76% of farmers disagree that pesticides do not cause environmental pollution and recognized that ecosystem becomes vulnerable due to careless use of pesticides (Table 6). The farmers agreed that alternative way to control pest is good for the environment (78%). Many of them considered the use of pesticide as the best and the easiest strategy to control pests. More than half of them agree that pesticides could be applied on schedule or by calendar method and during the threshold level. Many (62%) would not agree that pesticides are the cheapest way to control pest. More than half (58%) of the farmers agreed that it is not possible to produce good yield

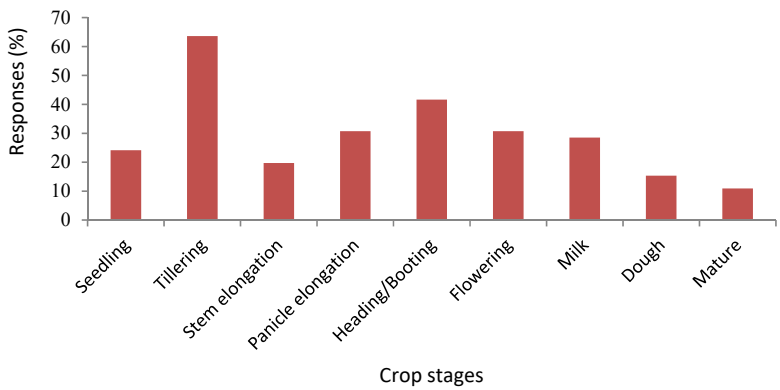

Fig. 5: Percentage of farmers who applied pesticides in different crop stages

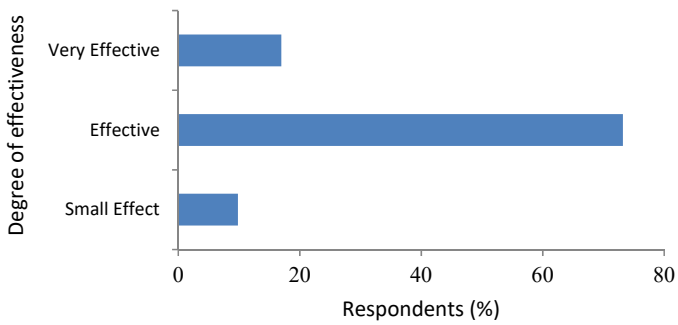

Fig. 6: Perceived effectiveness of pesticide application

Table 6: Perceptions of farmers towards pesticide use

Statements	Farmers (%)		
	Disagree	Undecided	Agree
1. Pesticides are not responsible for environmental pollution.	75.9	5.4	18.8
2. Careless/irresponsible use of pesticide makes the ecosystem vulnerable.	10.7	8.0	81.3
3. Alternative way (such as bio control) of pest control is good for environment.	2.7	19.6	77.7
4. The use of pesticide is the best means to control pest.	10.7	6.3	83.0
5. Pesticides are the easiest way of pest control.	14.3	6.3	79.5
6. Pesticides are the cheapest way of pest control.	61.6	12.5	25.9
7. Crop pests can be controlled with calendar/scheduled application of pesticides.	22.3	26.8	50.9
8. Pesticides be applied only at threshold level (pest population level that can cause damage)	31.3	10.7	58.0
9. It is not possible to produce good yield without using pesticide.	16.1	25.9	58.0
10. There is more profit if pesticide is used.	18.8	11.6	69.6
11. Farmers should completely stop the use of pesticides.	39.3	23.2	37.5
12. Pesticides are responsible for health hazard or food poisoning.	1.8	5.4	92.9

without using pesticides and 70% considered the use of pesticides for more profit. Only 37% of the farmers agreed to completely stop the use of pesticides despite that a high percentage of them considered pesticides as responsible for health hazard or food poisoning. In general, the data on the attitude of farmers towards rice production showed that rice production was always coupled with pesticide use. Rice fields in North Cotabato were subjected to varying pest pressures and farmers consider the importance of pesticides for crop protection. The farmers surveyed were highly literate and were informed that pesticides adversely affect health and environment, however, the benefit to earn profit and secure foods are more important. Farmers know that improper handling to pesticides may cause health and environmental hazards. Wilson and Tisdell (2000) reported that the costs from pesticide pollution are high as a result of damage to agricultural production from the resistance and outbreak of pests, decline in soil fertility, decimation of beneficial predators of pests and negative effects on human health. Farmers believed that biocontrol is good for the environment, however for them pesticide application is the effective and easiest means to control pests. There were few farmers who applied alternative pest control method as such the use of biocontrol agents developed from fermentation. The cost of rice has a premium price if the crops were organically grown. However, few farmers would risk production without pesticide application. The farmers considered pesticides as an expensive mean to control pest. However, pesticide application is the front defense of farmers against pests (Beltran *et al*., 2016). Farmers applied several kinds of pesticides in the duration of the cropping period. Others perceived pesticides as not so efficient in controlling insect pests because after pesticide application, insect pests still persist in the rice fields. On the other hands, farmers strongly believed that plants untreated with pesticides will result to crop loss.

CONCLUSION

Problems on crop pest challenge food security and poverty alleviation in Southern Philippines. Rice production is always coupled with pesticide application despite of the known negative effects it can cause to health and environment. Rice crops are frequently exposed to pests and farmers continue to use pesticides despite of the high costs. Farmers perceived that high yields may not be sustained without the use of pesticides and pesticides application could avoid economic losses. There is a need to strengthen IPM to substantially reduce the dependence of farmers to pesticide use at the same time improve crop production. Farmers are open for a

sound IPM alternative to chemicals but not yet ready to give up the use of chemicals until it is proven that the IPM is good enough to reduce production losses.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

%	Percent
BPMC	2-sec-Butylphenyl N-methylcarbamate
CHED	Commission on Higher Education
DARE TO	Discovery Applied Research and Extension Trans/Inter-Disciplinary Opportunities
Fig.	Figure
Ha	Hectare
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
kg/sack	kilogram per sack
n	number of respondent
NSIC	National Seed Industry Council
PhP	Philippine Peso
Rc	Rice
USD	US Dollar

REFERENCES

Aguilar, F.V., (2005). Rice in the Filipino diet and culture. Philippine Institute for Development Studies. Discussion Paper Series No. 15: 1–38 **(38 pages)**.

Alibu, S.; Otim, M.H.; Okello, S.E.A.; Lamo, J.; Ekobu, M.; Asea, G., (2016). Farmer´s knowledge and perceptions on rice and their management in Uganda. Agriculture. 6: 1–10 **(10 pages)**.

Antle, J.A., (1994). Pesticide, productivity and farmer health: A Philippine case study. Am. J. Agric. Econ., 76: 418–430 **(13 pages)**.

Balleras, G.D., (2012). Development of appropriate diagnostic tool and IPM options for Mindanao condition. Philippine Rice R and D Highlights. Department of Agriculture, Philippine Rice Research Institute.

Balleras, G.D.; Doverte, M.S.; Endonela, L.E., (2016). Alarming presence of three rice stem borer species in irrigated lowland rice agroecosystem in Midsayap, North Cotabato, Philippines. J. Biodivers. Environ. Sci., 9: 105–109 **(5 pages)**.

Bautista, E.U.; Javier, E.F., (2008). Rice Production Practices. Philippine Institute for Development Studies. Research Paper Series., 2: 1–64 **(64 pages)**.

Beltran, J.C.; Bordey, F.H.; Launio, C.C.; Litonjua, A.C.; Manalili, R.G.; Mataia, A.B.; Relado, R.Z.; Moya, P.F., (2016). Pesticide use and practices, in: Bordey, F.H., Moya, P.F., Beltran, J.C., Dawe, D.C. (Eds.), Competitiveness of Philippine rice in Asia. Philippine Rice Research Institute and International Rice Research Institute, Philippines.

Bordey, F.H.; Moya, P.F.; Beltran, J.C.; Dawe, D.C. (2016). Competitiveness of Philippine rice in Asia. Philippine Rice Research Institute and International Rice Research Institute.

Cuaterno, M.W.R., (2006). Management of Malayan rice black bug (*Scotinophara coarctata*) using biological control agent in the island provinces of the Philippines. Proceedings of Areawide Management of Insect Pests. Food and Fertilizer Technology Center for Asia and the Pacific Region, Okinawa.

Dawe, D., (2006). A second Green Revolution in the Philippines: insecticide use on rice has declined to low levels, in: Dawe, D., Moya, P.F., Casiwan, C.B. (Eds.). Why does the Philippines import rice? International Rice Research Institute, Philippines.

Gianessi, L.P., (2014). Importance of pesticides for growing rice in South and South East Asia. International Pesticide Benefit Case Study. CropLife Foundation.

Heong, K.L.; Escalada, M.M.; Vo, M., (2008). An analysis of insecticide use in rice: case studies in the Philippines and Vietnam. Int. J. Pest Manage., 40: 173–178 (6 pages).

Intal, P.S.; Garcia, M.C., (2005). Rice and Philippine Politics. Philippine Institute for Development Studies. Discussion Paper Series No. 13: 1–30 (30 pages).

Jahn, G.C.; Domingo, I.; Almazan, M.L.; Pacia, J., (2004). Effect of rice bug Leptocorisa oratorius (Hemiptera: Alydidae) on rice yield, grain quality, and seed viability. J. Econ. Entomol., 97: 1923–1927 (5 pages).

Lazaro, A.A.; Heong, K.L., (1995). Analysis of factors influencing farmers' insecticide sprays. Int. Rice Res. Notes., 20: 20 (1 page).

Lazaro, A.A.; Rubia, E.G.; Almazan, L.P.; Heong, K.L., (1993). Farmers' estimates of percent whiteheads (WH). Int. Rice Res. Notes., 18: 31 **(1 page)**.

Litsinger, J.A.; Barrion, A.T.; Canapi, B.L.; Lumaban, M.D.; dela Cruz C.G.; P.C. Pantua., (2011). Philippine rice stemborers: a review. Philippines Ent., 25: 1-47 **(47 pages).**

Magcale-Macandog, D.B.; Paraiso, P.M.J.; Salvacion, A.R.; Estadola, R.V.; Quinones, S.G.L.; Silapan, I.M.A.; Briones, R.M., (2016). An Overview of Agricultural Pollution in the Philippines: The Crops Sector. International Bank for Reconstruction and Development. The World Bank. Washington, D.C.

Mondal, D.; Ghosh, A.; Roy, D.; Kumar, A.; Shamurailatpam, D.; Bera, S.; Ghosh, R.; Bandopadhyay, P.; Majumder, A., (2017). Yield loss assessment of rice (Oryza sativa L.) due to different

biotic stresses under system of rice intensification (SRI). J. Entomol. Zool. Stud., 5: 1974–1980 (7 pages).

Padmavathi, C.; Katti, G.; Padmakumari, A.P.; Voleti, S.R.; Subba Rao, L.V., (2013). The effect of leaffolder Cnaphalocrocis medinalis (Guenee) [Lepidoptera: Pyralidae] injury on the plant physiology and yield loss in rice. J. Appl. Ent., 137: 249–256 **(8 pages)**.

Parsons, K.C.; Mineau, P.; Renfrew, R.B., (2010). Effects of pesticide use in rice fields on birds. Waterbirds. 33: 193–218 (26 pages).

Parveen, S.; Nakagoshi, N., (2001). An analysis of pesticide use for rice pest management in Bangladesh. J. Int. Dev. Coop., 8: 107–126 (20 pages).

Pathak, M.D; Dhalival, G.S., (1981). Trends and strategies for rice insect problems in tropical Asia. IRRI Research Paper Series 64, International Rice Research Institute, Philippines.

Pathak, M.D.; Khan, Z.R., (1994). Insect pests of rice. International Rice Research Institute, Philippines.

PhilRice. FAQs on Philippine Seedboard (PSB)/NSIC Rice Varieties. Pinoy Rice Knowledge bank.

Philippine Statistics Authority, (2015). Costs and Returns of Palay Production. Quezon Avenue, Quezon City.

Pimentel, D., (1995). Amounts of pesticides reaching target pests: environmental impacts and ethics. J. Agric. Environ. Ethics., 8: 17–29 (13 pages).

Pretty, J.; Barucha, Z.P., (2015). Integrated Pest Management for Sustainable Intensification of agriculture in Asia and Africa. Insects., 6: 152–182 (31 pages).

Ravis, E.A.; Mabalay, M.R.; Laborte, A.; Nelson, A.; Holecz, F.; Quilang, E.J.; Barbieri, M.; de Dios, J.; Francesco Collivignarelli, F.; Gatti, L.; Rala, A.; Garcia, C.; Mabalot, P.; Mirandilla, J.R.; MarjieDovert, M., (2016). Mapping rice areas in Mindanao using first images from Sentinel-1A: the PRISM project experience. In the 36th Asian Conference on Remote Sensing. 16 October. Manila: Philippines.

Republic Act 10931, (2017). Universal access to quality tertiary education Act. Congress of the Philippines, Metro Manila, Seventeenth Congress, First Regular Session.

Reyes, C.M.; Tabuga, A.D.; Asis, R.D.; Datu, M.B.G., (2012). Poverty and agriculture in the Philippines: trends in income poverty and distribution. Philippine Institute for Development Studies. Discussion Paper Series No. 09:1–46 **(46 pages)**.

Willocquet, L.; Elazegui, F.A.; Castilla, N.; Fernandez, F.; Fischer, K.S.; Peng, S.; Teng, P.S.; Srivastava, R.K.; Singh, H.M.; Zhu, D.; Savary, S., (2004). Research priorities for rice pest management in tropical Asia: a simulation analysis of yield losses and management efficiencies. Phytopathology., 94: 672–682 **(11 pages)**.

Wilson, C.; Tisdell, C., (2000). Why farmers continue to use pesticides despite environmental, health and sustainability costs. Economics, Ecology and the Environment. School of Economics, University of Queensland, Australia Working Paper No. 53: 1–29 **(29 pages)**.

Wong, S.T.; Geronimo-Kueh, E., (1982). Variations of factors affecting rice productivity in Central Luzon, Philippines. Geo. J., 6: 469–476 **(8 pages)**.

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