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Indigenous Knowledge and Sustainable Pest Management in Rice Farming Communities of Southeastern Luzon, Philippines

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***Abstract*— The paper presents the traditional pest management systems in the rice-growing areas of the southeastern part of Luzon, Philippines, particularly in the province of Camarines Sur. These systems have been proven to be productive, sustainable, ecologically sound, and attuned to the social, economic, and cultural features of the food-poor small farmers in the said province. The various indigenous pest control strategies were recorded and classified into cultural, physical, biological, mechanical, and chemical. A mixture of qualitative techniques such as interview guides and Focus Group Discussions were used in the survey. Results indicate that, despite the increasing modernization and commercialization of agriculture, the great majority of respondents who are peasants or marginal farmers still strongly embrace and patronize the use of Indigenous Knowledge (IK) that they have inherited from their ancestors many decades ago. IK on pest management have helped them control and sustainably manage pest problems and meet their subsistence needs without depending on costly energy-based inputs. IK should therefore be recorded and used to devise innovative research for agricultural researchers, extension workers, development practitioners, and environmentalists for sustainable pest management before this wealth of practical knowledge is lost forever since most of the indigenous management techniques for rice pest control are rapidly disappearing as affected by major social, economic, and political pressures.**

***Keywords*— traditional; pest management systems; rice-growing; sustainable; ecologically; small farmers**

I. INTRODUCTION

Although rice is widely cultivated by millions of small-scale farmers in the Philippines, local production has been found to be always short of demand for the commodity. At this point, the country produces 90% of the rice demand and imports the remaining quantity from its neighbouring countries such as Thailand and Vietnam. This unfortunate scenario has been largely caused by pest infestation that remarkably results to yield reduction [1]. Less appreciation or, worst, neglect of indigenous knowledge and practices by local farmers might also be blamed for rice shortage [7],[9]. Rural people have their own body of knowledge that highly contributes to the development of better pest management decisions [1],[8],[10]. Previous reports revealed that indigenous agricultural practices are cost-effective, pose less production risks and environmental degradation [3],[4],[6], and prevent development of pest resistance to chemicals. According to Sibanda [5], indigenous methods of pest control significantly contribute to sustainable agriculture. It is therefore necessary to assess the potentials of local experiences and practices adopted by traditional rice farmers in controlling pests. The effective integration of both traditional and scientific methods must likewise be explored [14],[12],[15]. For most Filipinos, no meal is complete without rice [2]. Rice is a socially- and politically sensitive commodity and serves as an integral part of the Philippine history and culture.

Considering the great importance of this commodity in the diet and life of million Filipinos and the ardent desire for its sustainable local production, this study has focused on the identification, classification, and determination of the frequency of usage of indigenous pest control methods being employed by rice famers in Camarines Sur, northeastern part of the Bicol region, Philippines. The demographic characteristics of the rice farmers were examined, various indigenous knowledge practices on pest management identified, and the patronage of IKS among rice farmers determined.

II. MATERIALS AND METHODS

Six leading rice-growing municipalities in Camarines Sur were purposively selected and these are Nabua, Bula, Buhi, Pili, Tinambac, and Balatan. Twenty-five traditional rice farmers of various ages were randomly selected from each of the aforementioned municipalities, totalling to 150

respondents. Personal interviews using interview schedule and focus group discussions were carried out to identify the existing indigenous pest control practices in the province. The content of the interview schedule was validated and tested by the seasoned researchers of the Central Bicol State University of Agriculture in San Jose, Pili, Camarines Sur, Philippines. Descriptive statistics such as frequency, percentage, and mean statistics were used in the presentation of data.

III. Results and Discussions

A. Demographic Characteristics of Respondents

Age: In the six municipalities surveyed, rice farmers mostly (68%) belong to the middle-aged group (Table 1). Of the total respondents, 34 (22.67%) were 51-60 years of old. The data imply that the younger generations are now less engaged into agriculture or farming. It also shows that participation in rice cultivation cuts across all age groups, from young to old (20-60 years). The older ones are there to impart expertise, which comes from experience or exposure, to the younger farmers.

Sex: Males are the highly (82%) involved gender in rice farming. Only about 16% female participation was noted. This clearly indicates that rice farming in Camarines Sur is a male-dominated occupation. The participation of women, although less compared to men, cannot be taken for granted as they play an undeniably important role in agriculture, particularly in rice production.

Civil Status: Majority (96.67%) of the farmers are married while 3.33% are widowed. No farmer has a single or separated status in all the municipalities surveyed. The high percentage of married men could be attributed to their strong cultural, traditional, and religious belief where divorce is being discouraged by the Church for it is not acceptable to the eyes of God. Marriage is a sacred vow in the rural areas and it confers social responsibility on the people. Also, it was observed that married farmers were more exploratory in trying different methods of pest control to determine which one is superior in increasing the yield.

Educational Attainment: All of the farmers interviewed had undergone formal schooling. However, the highest percentage (79.33%) was high school graduates. A few (5.33%), however, were able to obtain tertiary education. The relatively high level of literacy would help them enhance farm management especially when coupled with relevant experience.

Household Size: Most of the farmers had a medium (77.33%) and large (19.33%) families. Only 3.33% of them had a small household size.

Farm Size: The largest (58%) number of farmers has a land area of one hectare. About 11.33% and 30.67% cultivate less than a hectare and over a hectare rice farms, respectively. This indicates that majority of the farmers are small plot holders. Erenstein et al. (2003) stated that rice-producing farm households are primarily smallholders with limited capital resources.

Tenure Status: About 52% of farmers own the rice land they are cultivating while 10.67% are lessees. The remaining farmers have existed for quite long years as tenants.

Main Source of Income. Farming is the main occupation of all (100%) the farmer-respondents. The family income is highly dependent on the crop yield or produce.

Farming experience. Sixty-eight percent and 22.67% of the farmers interviewed have been into rice production for 5-10 years and 11 years and above, respectively. Farming is a way of life for them

B. Indigenous Pest Management Practices Employed at Various Production Phases of Rice

Pre- Planting Stage: Plowing and harrowing are the two main activities being done prior to planting. In plowing, farmers use a traditional hoe or an animal-drawn plow. It is done a few weeks before sowing to give enough time for the weeds and other crop residues to decompose. It is in this process that weeds such as purple nutsedge (Cyperus rotundus L.), cogon grass (Imperata cylindrica (L.) Beauv., and jungle rice (Echinochloa colona (L.) are destroyed. Likewise, the soil-dwelling and soil-loving insects as well as those that spend their immature stages under the soil are killed or life cycle is broken. Harrowing is usually done after plowing to break up the bigger clods of the soil and to provide a finer finish for planting. Its effects on insect pests and weeds are the same as with plowing

Post- Planting Stage: To control some of the insect pests and mollusks, specifically the Golden Apple Snail (GSA) [Pomacea canaliculata (de Lamarck)], farmers spray it with water mixed with chili. About one liter of extract is being used to spray a hectare of land. The extract serves as an insect repellent and is continuously applied every two weeks. Re-application is done after a rain. When applying fertilizers, rice farmers utter a prayer for they believe that this will spare their crop from getting attacked by pests.

Growing and Maturity Stage: Farmers plant lemon grass (Cymbopogon citratus (DC) Stapf.) at the periphery of the rice field for they believe that rice will develop as much tillers as that of lemon grass. Plastic straws with plastic bags or cans are tied around the rice field. The straws produce a sound as the wind strikes on it. Some use gunshots or firecrackers to scare away birds that may feed on the grains. To drive away field rats, coconut fronds are placed at strategic locations in the rice field in an upside down position resembling a cobra or an owl. Farmers mix three herbal plants [oregano (*Origanum vulgare*), gumamela (*Hibiscus* sp.), and herbabuena (*Mentha cordifolia*)] with water and use it as insect repellent. Madre de cacao [*Gliricidia sepium* (Jacg.) Steud.], lemon grass [*Cymbopogon citratus* (DC) Stapf.] and marigold (*Tagetes* sp.) are being planted at the periphery of the rice field a month after planting to control insect pests. Besides being an insect repellent, it also serves as a trap crop. Using physical method, adult insects/caterpillars are removed from plants through handpicking then crushed or burned. Cats and ducks are used as biological control agents of rodents and mollusks, respectively. Farmers believe that by talking to rodents and calling them “bait” makes them tamed and well behaved. Rodents can likewise be controlled by using baits and by regularly cleaning the dikes. Through physical control, the whole or part of the plant infected by a disease is removed.

TABLE I
DISTRIBUTION OF RESPONDENTS ACCORDING TO THEIR DEMOGRAPHIC CHARACTERISTICS

Demographic Characteristics	Municipality						Frequency	Percentage (%)
	Nabu	Bula	Pili	Buhi	Tinambac	Balatan		
Age (years)								
20-30 (young)	2	4	2	1	4	1	14	9.33
31-50 (middle)	18	16	21	13	19	15	102	68.00
51-60 (old)	5	5	2	11	2	9	34	22.67
Educational Attainment								
No formal education	0	0	0	0	0	0	0	0
Elementary education	3	5	4	2	2	7	23	15.33
Secondary level	20	18	20	22	21	18	119	79.33
College level	2	2	1	1	2	0	8	5.33
Civil Status								
Widowed	0	1	1	0	1	2	5	3.33
Single	0	0	0	0	0	0	0	0
Married	25	24	24	25	24	23	145	96.67
Separated	0	0	0	0	0	0	0	0
Sex								
Male	19	22	20	18	21	23	123	82
Female	6	3	5	7	4	2	27	18
Main Source of Income								
Farming	25	25	25	25	25	25	25	100
Business	0	0	0	0	0	0	0	0
No. of members in household								
1-4 (small)	1	1	2	0	1	0	5	3.33
5-8 (medium)	20	17	15	21	20	23	116	77.33
9 and above (large)	4	7	8	4	4	2	29	19.33
Farm size								
> 1 ha	2	4	3	2	3	3	17	11.33
1 ha	16	11	17	15	12	16	87	58.00
1.0-1.5 ha	7	10	5	8	10	6	46	30.67
Tenure status								
Tenant	5	10	8	12	15	6	56	37.33
Lessee	3	5	2	2	2	2	16	10.67
Owner	17	10	15	11	8	17	78	52.00
No. of years engaged in farming								
Less than 5	2	4	2	1	4	1	14	9.33
5-10	18	16	21	13	19	15	102	68.00
11 and above	5	5	2	11	2	9	34	22.67

Pre- and During Harvesting Stage: Rice farmers always clean and weed the rice field before harvesting. They believe that a weed-free field would facilitate the work during harvesting. Regular field visits are also being done to check whether the grains are mature enough and ready for harvest. Crack plates are placed in the middle of the rice field in the belief that by doing so, grains will increase in weight and thus would give them more yield. Prior to harvesting, they offer foods to the spirits, saints, and to Jesus Christ for a bountiful harvest. It is also in this way that they ask for a good harvest comes next cropping season. In other countries, they refer to this practice as cultural worship.

Post-Harvesting Stage: Farmers collect the rice straws that were ejected by the thresher, dry them, and burn. They consider it a good practice for it kills the immature stages of insects present on it. When the crop has already been harvested, farmers offer some of their produce to the church for thanksgiving. They believe that when they give thanks to the Lord, they will be continuously blessed with good harvests. It is a common practice by rice farmers to dry the grains properly prior to storage to reduce losses brought about by pests.

C. Classification of Indigenous Pest Control Practices in Rice Production

Indigenous pest control methods employed by local rice farmers, after having been identified, were classified into: cultural (9), chemical (2), mechanical (5), biological (2), and physical (2). Two practices such as uttering of prayer while fertilizing the plants and offering foods to the Gods, saints, and spirits were categorized as “cultural worships”. However, talking to the rodents and requesting them to spare the crop from damage was considered as a superstitious belief due to absence of any scientific explanation.

D. Use of Indigenous Knowledge System in Rice Pest Management

Results of the survey revealed that traditional rice farmers in Camarines Sur still patronize the use of indigenous knowledge in controlling pests, despite modernization and commercialization in agriculture. Table 2 shows the 24 indigenous methods of pest control being employed at various rice production phases. Only four of which are rarely used such as removal of disease-infected plants, use of cats

and ducks as biological control agents, as well as handpicking of insect pests. According to the respondents, these methods are labor-intensive, time-consuming, and impractical to use in a farm area of one hectare and above. The frequency of usage is reflective of the level of patronage.

TABLE II
INDIGENOUS PEST CONTROL PRACTICES AND THEIR FREQUENCY OF USAGE BY LOCAL RICE FARMERS IN CAMARINES SUR

Indigenous Pest Control Practices & Beliefs at Various Growth Stages of Rice	Pest(s) Controlled	Remarks	Type of Control	Frequency of Usage
Pre- Planting Stage				
Plowing	Weeds; soil-dwelling insects	Exposes the weed seeds and the immature stages of soil dwelling/loving insect pests	Cultural	Often
Harrowing	Weeds; soil-dwelling insects	Exposes the weed seeds and crushes the immature stages of soil-dwelling/loving insects	Cultural	Often
Post- Planting Stage				
Spraying of chilly extract	Insect pests, molluscs	Sprayed onto the eggs of GSA as well as on the eggs/larvae/pupae of insect pests	Chemical	Occasionally
Uttering a prayer during fertilizer application	Insect pests, diseases	Plants become robust, healthy and less susceptible to insect pests and diseases	Cultural worship	Occasionally
Growing and Maturity Stage				
Staking inverted coconut fronds in the rice field	Rodents	A snake- or owl-like shadow is formed that scares away field rats	Mechanical	Often
Planting lemon grass [*Cymbopogon citratus* (DC) Stapf.] at the periphery of the rice field	Insect pests	The scent of the lemon grass drives away insect pests	Cultural	Often
Planting madre de cacao [*Gliricidia sepium* (Jacg.) Steud.]	Insect pests	The scent of madre de cacao serves as insect repellent	Cultural	Often
Putting scarecrows	Bird pests	Scares away birds and prevents them from feeding on the grains	Mechanical	Often
Planting marigold (*Tagetes* sp.)	Insect pests	Serves as insect repellent	Cultural	Occasionally
Tying cans or plastic bags	Bird pests	Tied cans or plastic bags are installed at the periphery of the rice field	Mechanical	Occasionally
Using frightening sounds like gun shots or firecrackers	Bird pests	The sounds produced chase away bird pests	Mechanical	Occasionally
Spraying plant extracts from oregano *(Origanum vulgare*), gumamela *(Hibiscus* sp.*) and* herbabuena *(Mentha cordifolia)*	Insect pests	Serves as insect repellent	Chemical	Occasionally
Talking to the rodents and calling them "bait" (or behaved/nice animal)	Rodents	Calms the rodents and stops them from causing damage to the crop	Superstitious belief	Occasionally
Herding ducks in the rice field	Golden Apple Snail (GSA)	Eggs of GSA are eaten by ducks	Biological	Seldom
Using cages with dehydrated coconut meat as bait	Rodents	Dehydrated coconut meat is placed inside a cage to serve as bait	Mechanical	Occasionally
Handpicking	Insect pests	Adult insects/caterpillars are handpicked and crushed or burned	Physical	Seldom
Cleaning the dikes	Rodents	Dikes are maintained weed-free to keep rodents away	Cultural	Occasionally
Removing infected plant parts or the entire plant	Plant diseases	A portion or the entire plant is removed when infected with a disease and then burned or buried in the soil	Physical	Seldom
Using cats	Rodents	Cats are tied near the rice field to catch rodents	Biological	Seldom
Pre- and During Harvesting Stage				
Weeding	Weeds, insect pests	Removes weeds that may serve as alternate hosts of insect pests	Cultural	Often
Placing crack plates in the middle of the rice field	---	Believed to increase the weight of grains	Physical	Occasionally
Post-Harvesting Stage				
Burning rice straw	GSA, insect pests, weeds	Kills the pests present in the rice stubbles	Cultural	Often
Proper drying of grains	Insect pests, plant diseases	Reduces excess moisture in the grains that may lead to insect pest infestation and disease infection	Cultural	Often
Offering foods to God, Saints, and Spirits	---	Way of expressing gratitude and asking for a good harvest in the next cropping season	Cultural worship	Often

IV. Conclusions

In spite of the widespread use of chemical pesticides in rice production, traditional farmers in Camarines Sur continuously patronize the use of indigenous knowledge system in pest management. The continued utilization may be attributed to the effectiveness, affordability, communicability, ecological soundness and sustainability of these practices in controlling rice pests.

Indigenous pest control practices are highly and extensively utilized in the province before and until now. These practices were acquired from their ancestors and passed down from generation to generation by word of mouth. The existence of chemical pesticides in the market did not cause them to abandon what they have inherited from their forefathers. They have attested to the effectiveness of these indigenous practices even in the absence of scientific verification.

A group of seasoned scientists must be selected to discuss the scientific rationality of these documented indigenous pest control practices in rice production. These practices have to refined and validated first prior to its possible harmonization and integration into the Integrated Pest Management System towards achieving a successful and sustained pest control program.

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