

## Describing and measuring ethno-entomological knowledge of rice pests: tradition and change among Asian rice farmers

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**Abstract** The paper presents a methodology that guided several ethnoentomological research projects and goes on to examine and compare the results from two independent research locations in Asia. The first location is in the Philippines, a Green Revolution area that has been heavily impacted by extension messages and insecticide use. The second location is in Nepal which has a traditional subsistence orientation and has remained widely unaffected by agricultural modernization. The paper emphasizes the differences and similarities of the results from the two sites and discusses the role of the methodology and methods used in capturing ethno-entomological knowledge, particularly with regard to insect pests in rice. The results of both investigations share the importance of agronomic criteria among farmers in insect classification and sorting criteria, thus highlighting the relevance of functional criteria. Farmers at both research sites have difficulties in identifying the lifecycles of insects. We discuss the issues of tradition and change in farmer entomological knowledge and providing support to the knowledge base of farmers through programs like IPM-Farmer Field Schools as opposed to broad-based recommendations for crop pest management.

**Keywords:** Ethnobiology · Ethnoentomology · Ethnoscience · Rice Insect Pests · Methods · Nepal · Philippines

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## Introduction

### Knowledge and changing needs in Asian agriculture

Within the context of Asia, agricultural research and development over the past decades has been oriented towards increasing staple food production. The results are most visible in rice reflected in terms like national “rice bowls” (Pingali, Hossain, & Gerpacio, 1997). For the purposes of this paper, the case study of the Philippines is one such national rice bowl. These high productivity rice systems are Green Revolution systems (GR) and are well linked to markets and are important for national staple food production (particularly for the urban poor) and for export. If we use the center—periphery dichotomy, the rice bowl areas are at the center. While past efforts to increase productivity have been highly successful they have also had unforeseen long-term costs that are increasingly being uncovered in the current “post-Green Revolution period.” The management of these systems pursued over the last three decades has resulted in environmental degradation and increased health risks to farmers (Chelliah & Bharathai, 1993; Gardner, 1996; Heinrichs & Mochida, 1984; Pingali & Roger, 1995; Pingali et al., 1997; Price & Balasubramanian, 1998; Rola & Pingali, 1993). The Green Revolution systems brought with them new pest, disease, nutrient, and water resource management needs that issued forth from a combination of a crop monoculture and homogenized landscaping. In addition, an important component to these systems has been blanket recommendations regarding crop management such as calendar spraying of insecticides irrespective of the pest pressure on the crop. Thus, farmers in these high-productivity systems simultaneously experienced the occurrence of new pest insects and pest pressure coupled with an increased reliance on extension recommendations. Many scientists working on these systems recognize the need for change and the growing role of understanding and supporting farmer knowledge (Bentley, 1992; Pingali, Hossain, Pandey, & Price, 1998; Price & Balasubramanian, 1998; Röling & Jiggins, 1998; Sherwood, 1997).

To a lesser extent, we see a similar pattern in those areas in Asia we can term the periphery, frequently also termed “low productivity areas”. The example of such an area in this paper is a village in Dang-Deukhuri District in South-West Nepal. Low productivity areas such as this have in the more recent past gained the attention of agricultural research and development. The objectives, however, are somewhat different than in the GR rice bowl systems. The concern is for enhanced household food security with some marketable surplus rather than a full market orientation. The approach, however, has been one of attempting to introduce some of the same patterns as one finds in GR systems. This primarily has taken the form of introducing modern crop varieties, new crops, and the promotion of monocropping. There is very little extension support and virtually no agricultural extension service for more traditional crops.

### Methods for capturing knowledge and competencies across cultures

In a broad brushstroke we can say that the knowledge of farmers about insects varies in both quality and quantity across cultures, as well as across environments (natural and anthropogenic). But the question that we have attempted to ask with our research in the Philippines and Nepal is not only “what do farmers know about insects, ethno-entomologically?” but importantly, “what is the best way to capture this knowledge?” and “what methodology can be validly used across cultures and

environments?” We both greatly appreciate the changes that have taken place in agricultural extension in the last 15 years. The Farmer Field School model (FFS) which was developed out of experience with integrated pest management programs (IPM) has challenged the strict top-down model pursued in earlier decades. This new participatory education approach to pest management was developed in Southeast Asia representing the FAO’s shift in their IPM program towards human resource development from 1987 onward (Kenmore, 1991) and is now widely accepted.

Recognizing the importance of understanding the interface of scientific and ethnoscientific knowledge, Price (2001) developed a methodology to capture farmer knowledge of rice field insects and subsequently tested it in a case study in the GR rice production village in Central Luzon, the Philippines. The ability to document knowledge was deemed important in the context of high-productivity rice systems where many post-GR efforts in IPM-FFS were being undertaken. The thrust of the methodology was to capture what farmers really understand about insects in rice fields, predation, insect/plant interactions and metamorphosis. The methodological approach taken was one that was grounded in ethno-ecology and relied quite heavily on anthropological methods in ethnobiology/ethnobotany.

Björnsen Gurung’s study in Nepal (2002) was based on the same methodology with some modifications. While there are similarities with the findings of the research with the Price (2001) study, there are some differences too. While the Price (2001) study focused on insects and arachnids in rice fields exclusively, Björnsen Gurung’s study included the folk classification called *Kiraa*, i.e., a taxa which contains arthropods and non-arthropods, including insects, worms, snails, snakes, rats and other small creatures causing harm to crops, livestock or people.

## Conceptual foundation for the methodology

### Methodological framework

The methodology is grounded in the ethnoecological assumption that language is the gateway that can be used for uncovering knowledge and perception. An important aspect to this assumption is that people respond to the environment through a filter of conceptualizations and labels in their language (Brosius, Lovelace, & Martin, 1986). But, indeed there is a feedback loop between environmental stimulus, environmental action and the divergent circumstances of history, society, culture and environment. Language, of course, provides the symbols to organize the world and provides two critical functions. First, language provides continuity for communication and learning within the socio-cultural group. Second, language is expandable and allows us to incorporate new terms and concepts as circumstances and needs change (Brosius et al., 1986; Price, 2001).

## Research sites and samples

### Philippines

The village of Santa Rosario was the site for the case study and is located in Central Luzon in the Philippines. The community has native speakers of two indigenous

languages, Tagalog and Ilocano. In addition, there is widespread use of English, although with little fluency. The village is a Green Revolution rice area, producing two rice crops a year with a market orientation. Santa Rosario was previously a control village in a three village study on pest management. A number of Santa Rosario's farmers had their normal pest management practices monitored starting in January 1992. Since 1992, no IPM-FFS has taken place in the village, nor were representatives of insecticide companies allowed to present their versions of "IPM" in the community.

The objective of the study was to document farmer's knowledge pre- and post-IPM-FFS. Thus, as part of the study, an IPM-Farmer Field School was organized by the Philippine Rice Research Institute (Philrice) at the appropriate point during the research. The community also retained a sample of those farmers who were only monitored as well as a sample that included an additional treatment group on No Early Spray. The entire group as well as the sub-groups had pre- and post-knowledge documented with the methodology. The sample consists of 90 farmers, 30 of which were from the group that had their practices monitored over the years and 60 were from a random sample. This sample was used for the pre-intervention knowledge data from free listing and triad testing. The sample was reduced to 73 farmers for the consensus analysis.

The results of this study have already been reported in detail (Price, 2001). For the purposes of this paper, the objective is to compare the Philippine methodology and selected outcomes with those of the Nepal case study.

## Nepal

The research site for Nepal was in Gobardiha village in Dang-Deukhuri district, which is located in the sub-tropical lowland belt of Terai, in far-west Nepal. The village is inhabited by native Tharu, one of the largest ethnic groups of Nepal. The community members are native speakers of Tharu. Some Nepali and Hindi is spoken. Shifting cultivation was abandoned a few generations ago. Monoculture in rice was introduced approximately 10 years ago. The population, however, has continued in a subsistence orientation. Despite monocropping, pesticides are rarely used, although they are gaining importance with the adoption of modern rice varieties. The village is situated at an altitude of 270 m in the foot hill ranges and is fairly isolated, and is a two hour walk from the road. The sample included 20 male and 20 female farmers, with selected methods having more or less in the sample.

## The research methods

The methods combined into a research protocol by Price (2001) included free listing, key informant pile sort, triad testing, and a multiple choice test with answers submitted to cultural consensus analysis and objective test scoring. This research protocol was used in the Philippine case study (Price, 2001) and in the Nepal case study (Björnsen Gurung, 2002). There were some differences in the application of the methods between the two sites as well as the addition of a number of methods to the protocol by Björnsen Gurung in Nepal (Table 1).

**Table 1** Methods used in the Philippines and Nepal studies

Philippines ( <i>n</i> = 90)	Nepal ( <i>n</i> = 40)
Free listing (frequency of mention across informants)	Free-listing (frequency and order of mention across informants)
Key informant pile sort (names on cards)	Key informant pile sort (names on cards)
Triad testing (names-verbally)	Triad testing (picture cards)
Multiple choice testing	Multiple choice testing
(a) Consensus analysis	(a) Consensus analysis
(b) Objective test scores	(b) –
–	Focus groups
–	Successive pile sorts (picture cards)

Free listing

Free listing is one of the first techniques used to uncover a domain. Informants are asked to list items in a domain. The terms they provide are recorded in the order they are given. The analysis in the Philippine (rice field insects) case study consisted of the number of times an item was mentioned across informants as a rough indicator of salience. This analysis was enhanced in the Nepal study (*kiraa*) to include the order of mention in addition to the frequency of mention across informants. The frequency and order of mention were combined into a single index for Nepal (Smith, 1993).

Key informant pile sort

In both the Philippines and Nepal case studies a pile sort was conducted with a key informant. All names obtained from free-listing were used and the exercise was conducted with informants fluent in the multiple languages used at each research site. In the case of Nepal, this means fluency in Nepali and Tharu. For the Philippines, the informant was fluent in Ilocano and Tagalog. The purpose was to find duplicates across languages. Terms unknown to the informant were removed from the exercise.

Triad testing

The goal of the test is to capture similarities and dissimilarities of items as the informants perceive them. The data shows, for example, if farmers tend to group insects on the basis of their agronomic impact or morphological characteristics.

The respondent is presented with a group of three items at a time (triad developed from free list names) and is asked to select out the item that is most dissimilar (leaving together to two items that are more alike).

In the Philippine case study, a *lambda 2* balanced incomplete block design was chosen. For the Nepal study, a *lambda 1* balanced incomplete block design was used. For both research sites the Anthropac computer program was used to generate different, but equally valid, sets of triad groupings for each informant and used in analysis. See Bernard (1994) for a detailed discussion of triad designs and Borgatti (1996a, b) for the Anthropac analytical program and methods manual.

## Multiple choice test

The first scoring method is through an interinformant agreement matrix to the correct answer (corrected for guessing). The method of analysis as described by Brewer (1995: 114) involves a “minimum residual factor analysis (maximum likelihood factor analysis for ordinal/interval scale).” In cultural consensus analysis, we are seeking not the correct scientific answer, but the answer that is culturally defined as correct (Borgatti, 1992; Romney, Weller, & Batchelder, 1986).

The answers provided by informants in the Philippine case study were also scored on the basis of the researcher knowing the correct answer to the questions (scientifically correct answer). This objective scoring was not conducted in the Nepal study.

## Additional methods used in Nepal (focus groups and successive pile sorts)

Additional methods in the Nepal study consisted of focus groups and successive pile sorts (Boster, 1994). For the successive pile sorts, data analysis included 20 pile sorts. Somewhat similar to triads, ratings of similarity are calculated for the outcomes (Borgatti, 1992).

## Notable differences methods and data analysis

There were differences in the administering of the triads at the two research sites. For the Philippine case study, the names of insects in each triad were verbally presented to the respondent. In the Nepal case study, picture cards were used. Both studies used 15 items based on the concept of pest and beneficial in the triad tests. With regard to the successive pile sort, Björnsen Gurung (2002) in the Nepal study included *Kiraa* that were not previously included in the triad tests for a total of 12 items (Table 2).

## Outcomes and discussion

In this section we will present some of the results that we think make important comparisons between Nepal and the Philippines. Detailed results for each individual case study are reported elsewhere for Nepal (Björnsen Gurung, 2003) and for the Philippines (Price, 2001). The data from the free listing method (119 *kiraa* for Nepal and 26 insects in rice fields for the Philippines) had different items with the highest salience. For Nepal, rice bug was at the top of the list and the Philippines plant hoppers (pre-FFS) were at the top with rice bug at number 5. We believe this accurately reflects the current pest and pest-management situation in low versus high-productivity systems. The rice bug is a common pest in rice systems (both traditional and GR). The presence of the rice bug in traditional rice systems in the Nepal study is further supported by the general ethnographic data collected by Björnsen Gurung that places the rice bug in the Tharu origin myth and control of the rice bug through ritual (Björnsen Gurung, 2003). Plant hoppers, on the other hand, come to the fore in the Central Luzon study. The Plant hopper (specifically the rice brown plant hopper, *Nilaparvata lugens* Stal) is now scientifically known to be a pesticide induced problem, having moved from a secondary pest to a primary pest in

**Table 2** Notable differences items and method application (cross-cutting items and scientific names are shown in italics)

Items in Triads Philippines	Items in Triads Nepal	Items in successive pile sorts Nepal
Green leaf hopper ( <i>Nephotettix</i> spp.)	Earwig (various, <i>Dermiptera</i> )	Scorpion (generic)
Brown plant; hopper ( <i>Nilaparvata lugens</i> )	Weevil ( <i>Sitophilus</i> spp.)	Frog
White-backed plant hopper ( <i>Sogatella furcifera</i> )	Rat (generic)	Snake (various)
Leaf folder ( <i>Cnaphalocrocis medinalis</i> )	<i>White grub</i> (generic- non-identified)	<i>White grub</i> (generic- non identified)
Armyworm ( <i>Mythimna separata</i> )	Hairy caterpillar (various)	Caterpillar (various)
Spider (various)	<i>Spider</i> (various)	<i>Spider</i> (various)
Lady beetle (various)	<i>Praying mantis</i> (various)	<i>Praying mantis</i> (various)
<i>Damselfly</i> ( <i>Agriocnemis pygmaea</i> ,	<i>Dragonfly</i> , (various)	<i>Dragonfly</i> (various)
<i>Agriocnemis femina femina</i> )		
Mites (various)	Aphids (various)	Earthworm (various)
<i>White butterfly</i> * (various, including butterfly/moth as adult stage of select stemborer species)	<i>Butterfly</i> (various)	<i>Butterfly</i> (various)
<i>Wasp</i> (various)	<i>Wasp</i> (various)	Ant (various)
<i>Grasshopper</i> ( <i>Conocephalus longipennis</i> and <i>Tettigoniidae</i> )	<i>Grasshopper</i> (various)	
<i>Stemborer</i> (various <i>Lepidopteria: pyralidae</i> )	<i>Stemborer</i> ( <i>Sesamia inferens</i> , Noctuidae)	
Waterbug ( <i>Microvelia douglasi atrolineata</i> , <i>Mesovelia vitigera</i> )	Bee (various, including <i>apis cerana</i> , Apidae and a wild form of <i>Apis cerana</i> )	
Rice bug ( <i>Leptocoris oratorius</i> )	Bug (various)	

high productivity systems in the Philippines (Chelliah & Bharathi, 1993; Heinrichs & Mochida, 1984; Kenmore, Carino, Perez, Dyck, & Gutierrez, 1984). In addition, terms used for plant hopper were either the English “plant hopper” or the Tagalog “*ngusong kabayo*,” which is not an indigenous term but one invented by agricultural extension in the Philippines. This lack of indigenous names for major pests in high-productivity rice also applied to specific kinds of plant hoppers, which only had English language terms including “glh” (green leaf hopper), BPH/Brown plant hopper and the white backed plant hopper for which there are no Ilocano or Tagalog terms. It thus appears clear to us that the free listing exercise is a very useful one as our results indicate that there is a correspondence between items listed, terms used, and their salience with the state of the agricultural system. We think it is important to note, however, that in the case of Nepal, plant hoppers are recognized but not named. They are also not perceived as pests. Thus, in addition to what is named being of relevance, what is not named can also provide valuable information about the state of farmer knowledge and pest pressure. The lack of indigenous names may reflect a lack of pest pressure as in the case of Nepal or reflect a lag in cultural naming even though this pressure exists as in the case of the Philippines. It is thus important to combine the ethnoscientific with scientific environmental assessments to have a fuller picture in the design of knowledge based support for farmers’ pest management.

The results from the triad tests show interesting results with regard to the relative importance of criteria used for judging similarities. At both sites these were in order of importance: (1) agronomic (impact on agricultural crops); (2) ecological (habitat/food source); (3) locomotion (such as crawls); and (4) morphology (such as having wings). These results indicate that the Linnaean system of classification, with its foundation on criteria such as morphology (non-utilitarian), is clearly at odds with folk criteria, which is utilitarian and functional in this case. In Nepal, only 4% of 1,400 judgments indicated morphological criteria, whereas agronomic criteria constituted 44%.

When we examine the agronomic criteria that emerged from the triad data, we find the destruction or damage to the crop is prominent. In the Philippine case study, the distinction in the triads included a frequent use of the phrases “friend of the farmer” or “enemy of the farmer.” Thus, the farmers have a concept of pests and beneficials (prior to the IPM Farmer Field School), which is one of the most important lessons in the IPM Farmer Field School program. This concept is based on the observation of predation (that some insects/spiders eat others) with the sophistication of observation where farmers observe which insects eat others—the “friends”(beneficials) eat the “enemies” (pests).

This notion of pests and beneficials was examined by the application of Johnson’s (1967) hierarchical clustering (single link similarities) to the triad data. Taking four items that were used in both the Nepal and Philippine cases, stemborer, wasp, spider, dragonfly, and comparing the outcomes for both locations. In the Philippines, farmers clustered dragonfly wasp and spider. This grouping appeared also in the aggregate proximity matrix as well, illustrating a clear clustering of beneficial insects that attack and eat crop pest insects. For Nepal, on the other hand, the clustering was clearly not along the lines of pest and beneficials. Stemborer (pest) was grouped with white grub (good for fishing) and rat (pest). When the Nepal data are analyzed separately for men and women, the pattern is similar. Women had stemborer, white grub and rat clustered, and men had stemborer and white grub (not rat) clustered.

Both men and women showed a clustering (at a lower level of similarity) of spider with earwig and hairy caterpillar. The successive pile sort data show that for the divisions within the group of *Kiraa*, respondents did not exhibit any distinction between real insects and non-insect arthropods or the other items included like snake and frog. The distinctions here were first and foremost based on human-directed effects (such as stinging) with agronomic taking second place, followed then as in the triad results by ecological, locomotion, and lastly by morphology.

It is somewhat difficult to pinpoint why we see the differences noted above in the observations of farmers. There are a number of possible reasons we will put forward. First, there may be a difference in pest pressure: the greater the number and threat, the more opportunity and incentive for close observation of behavior. The other thought we have is not only linked to the care in observation but also relates to interpretation of observations. For example, Björnson Gurung (2003) documents that farmers having observed the potter wasp carrying home other insect species to their mud nests interpret the practice as child abduction. This example further illustrates that observation alone is not sufficient but, as in science, theory with which to interpret observations is vital, as well some aspect of understanding probabilities. We believe the IPM-FFS program provides such a combination in their participatory environmental education approach. The results from pre- and post-data analysis for the Philippines illustrates that the program works very well indeed, although improvement is needed in assisting farmers to observe and grasp the concept of metamorphosis (Price, 2001). Conceptualizing metamorphosis was also difficult for farmers in the Nepal study.

The cultural consensus analysis results for the Philippines show consensus that dragonflies, spiders and wasps feed on other insects. But in contrast to this, there was also pre-IPM farmer field school consensus that “we should try to kill all the insects in the fields that we can.” The cultural consensus (and objective scoring) had 51 questions that covered life cycles, insect-insect interactions, insect-plant interactions and lastly insecticides. The answers of the farmers’ pre-FFS show that their observations on predation were scientifically correct and indeed there was some other barrier to the conversion of these observations into appropriate actions. This has important implications for how IPM-FFS is conducted, where confirmation and support of what farmers already know can be extremely validating. On the other hand, the most difficult area for farmers appears to be an understanding of metamorphosis. This was the case in both the Philippines and Nepal. Clearly, any knowledge based pest management program must ensure this understanding.

The Nepal case study presented some very interesting additional outcomes. In the analysis of the successive pile sorts, the minimum residual eigenvalues obtained from factor analyzing the data indicated that subcultures existed. This was corrected through separating male and female data. In contrast, the consensus data fit the one culture assumption. We believe that the successive pile sort should carry more weight when examining agronomic knowledge results in more traditional systems. The consensus questions themselves dealt more with beliefs, particularly the sacred in pest management, and opinions rather than knowledge, on which there was cultural agreement. In this sense, the consensus results for Nepal are a good indicator of beliefs, if not knowledge (Björnson Gurung, 2002).

The consensus results (based on the culturally correct answer) from the Philippine case and scientific scores (based on the scientifically correct answer) both show an increase in mean consensus and mean scientific score after the IPM Farmer Field

School. Further, there was a reduction in the standard deviation and increases in both the minimum and maximum scores. The difference between the scientific pre- and post-scores using a paired comparison *t*-test were statistically significant at the 0.001 level (Price, 2001).

In closing, we want to emphasize that farmer environmental and pest management programs will have more success if they include, like the IPM-FFS approach, observations, interpretive theory, and some aspect of probability. It is also important to recognize the differences we have noted between high-productivity and low-productivity systems in framing an approach, particularly the importance of spirituality in pest management in indigenous low productivity human communities. It is also important to recognize the similarities. Important in both cases is understanding farmers' vocabulary and language for effective communication; that functional criteria are more important and of higher salience than morphological criteria and uncovering where there are knowledge gaps, as these studies have shown in farmers' lack of understanding of metamorphosis.

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