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Abstract

A simple rule-of-thumb, or heuristic, in pest management which was in conflict with farmers' prevailing perceptions was communicated to farmers to examine whether their cognitive dissonance would challenge them to evaluate it and change their misperceptions.

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Abstract

A simple rule-of-thumb, or heuristic, in pest management which was in conflict with farmers' prevailing perceptions was communicated to farmers to examine whether their cognitive dissonance would challenge them to evaluate it and change their misperceptions. The simple rule used was: "In the first 30 days after transplanting (or 40 days after sowing), leaffolder control is not necessary." The participatory experiments were carried out by 101 rice farmers. Although farmers' perceptions of pests and pesticide use were deeply entrenched, the simple experiment reduced their early-season insecticide applications and number of sprays. Farmers' attitudes toward leaf-feeding insects also changed. Besides dissonance resolution, the main incentives that had encouraged farmers seemed to be money savings and labor reduction.

Few studies in communication, if any, have explored the impact of the use of conflict information on changing farmers' perceptions. This article presents the results of a study which examined farmers' evaluation of conflict information and its influence on their perception changes in rice pest management. It also documents the process and effects of farmer experimentation with a simple decision rule or heuristic intended to correct their misperceptions.

Introduction

Asian rice farmers commonly spray insecticides in the early stages of the crop to control leaf-feeding insects. The most

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common leaffeeder during this period is the rice leaffolder. Research, however, shows that these sprays are unnecessary as the damaged crops usually recover with no loss in yields. Farmers' spraying for leaffolder control is thus primarily due to misperceptions. Results of farm surveys on pest management perceptions and practices in Southeast Asia have shown that most farmers are risk averse and seem to use pesticides with little economic rationale. Pesticides are primarily used for prevention or for cure (Lim & Heong, 1984; Heong, Escalada & Mai, 1994; Rola & Pingali, 1993).

Pesticide advertising may have also played an important role in increasing farmers' risk aversion. Most advertising messages tend to be presented as fear-arousal appeals to encourage farmers to use chemicals (Escalada & Heong, 1993). Advertising has succeeded in positioning pesticide messages in the minds of millions of farmers, consequently increasing pesticide use (Matteson, Gallagher & Kenmore, 1994). A case in point is the excessive use of insecticides in Vietnam which seems to be associated with prominent advertising (Escalada & Heong, 1993). Since training and motivational materials related to pest management are relatively scarce (Heong, 1989), advertisements continue to play major roles in influencing farmers' decisions. It is also well recognized that pesticide sales agents have a stronger presence than extension agents in many farming communities and are sought by farmers for advice because of their accessibility.

In contrast, resource-poor farmers who are generally not reached by the agricultural extension service (Merrill-Sands, Biggs, Bingen, Ewell, McAllister, and Poats, 1991) often do not have access to information on rational pest management. Thus, for every message that a farmer receives from extension, there are often numerous competing messages which encourage pesticide use. Within this information environment, there is a need to explore for more efficient approaches that can help farmers in making more rational decisions. Methods that utilize farmer participation and experiential learning have been noted to be useful (Chambers, Pacey & Thrupp, 1989; Matteson, Gallagher & Kenmore, 1994; Mody, 1992; Stone, 1992).

Role of Perceptions

Perceptions exert an influential role in a farmer's pest management decisions. According to Norton's (1982) pest management decision model, the option that meets a farmer's objective is chosen based on his perceptions of the situation. The consequence of a decision made during the period (t) can influence his or her perceptions of the problem in a subsequent period ($t+1$) (Mumford & Norton, 1984). Pest problems and control options often remain the same from year to year; as a result, farmers' perceptions remain similar. This may account for farmers continuing to spray for leaffolder control without realizing that there is no economic gain. Since the outcome of period (t) can influence perceptions of the problem in period ($t+1$), introducing an action that can result in a different outcome may be used to influence perceptions. At the same time, farmers may be persuaded to observe other criteria, like yields or profits, rather than insect mortality when comparing options.

To change farmers' misperceptions of a pest problem through communication, new elements must be introduced into the cognitive structure. The new information may be a different perception of the situation or information which introduces sufficient conflict into the existing structure to motivate change (Schramm, 1973). The manner by which the new information fits into the cognitive structure will influence how it will be processed. New information which requires less change in cognitive structures would have more chances of getting accepted. On the other hand, new information which challenges the cognitive structure would be difficult to integrate (Tan, 1984) or might result in rejection, distortion so as to fit, or a change in the cognitive structure (Cartwright, 1949).

When faced with uncertainty, people often use decision rules (Eiser, 1986). The term, heuristic, was introduced by Kahneman and Tversky (1973) to refer to an informal rule-of-thumb used by people in order to simplify information processing and decision making. Heuristics are learned through experience, educated guesswork about the possible answers to a problem, and the integration of cognitive processes in humans. Without having to retrieve all the information stored in memory, these simple rules help humans organize and interpret new information (Wyer & Srull, 1981).

Given a simple decision rule which is in conflict with the prevailing pest management perceptions of rice farmers, would they be motivated to re-assess it in order to resolve their dissonance? According to Festinger's (1957) theory of cognitive dissonance, information which contradicts existing attitudes, choices, or behaviors can lead to a state of psychological dissonance. This state of dissonance, moreover, does not immediately disperse once the individual has set out on the selected option (Eiser, 1986). To resolve his or her dissonance, a person could resort to a re-evaluation of the two alternatives, so that the chosen alternative would appear even more positive than the rejected one (Brehm, 1962; Brehm & Cohen, 1959).

In this paper we present results of a study in which rice farmers were invited to evaluate conflict information and its influence on their perception changes.

Methods

Location

Leyte is an island located in the Eastern Visayas region of the Philippines. It has a total land area of 6,270 square kilometers with a population of about 1.5 million. Agriculture is a major economic activity with coconut, rice, sugar, and corn as principal crops. Of the 98,000 hectares cultivated to rice, about 72% is irrigated, 23% rainfed, and the remaining 5% upland rice. Lowland rice is grown in two cropping seasons per year.

Baseline Survey

A baseline survey of 101 rice farmers in six villages in Leyte, Philippines, invited to participate in farmers' experiments was carried out in 1992. The survey was conducted through personal interviews using a pretested questionnaire translated into Cebuano, the local language spoken in Leyte. Details of the questionnaire are described elsewhere (Heong, Escalada & Mai, 1994). In addition, several focus group discussions were organized where further probing was conducted.

Farmer Experiments

Based on voluminous research carried out by entomologists, spraying insecticides for leaffolder control in the early crop stages are generally not needed. Damaged crops compensate and recover from these leaf damages. The scientific discussions on the topic are found in Miyashita (1985), Heong (1993), and Way and Heong (1994). The heuristic developed was: "Spraying for leaffolder control in the first 30 days after transplanting is not necessary."

The participatory experiments to evaluate this heuristic were initiated in collaboration with farmers in Leyte Province, Philippines. In each municipality, half-day group meetings were conducted with about 10 to 25 farmers. These meetings began with general discussions about rice growing and related problems, and eventually the discussions focused on the rice leaffolders, concerns about their damages, losses they think the pest would cause, and methods of control and their costs. We then introduced recent research findings that the leaffolders were unable to cause sufficient damages to reduce yields and insecticide sprays the farmers had used were not necessary. Farmers were motivated to test whether the research findings were true by discussing the potential savings from reducing insecticide use.

A total of 101 farmers volunteered to participate in the experiments. To participate, each farmer measured out an area of about 500 m^2 in his or her rice field that would not receive any insecticide treatment in the first 30 days after transplanting for leaffolder control. The rest of his or her field would receive normal treatments. All other agronomic practices in both the experiment and main plots would be according to each farmer's normal practice. Participating farmers were provided with some support materials (Table 1). During the cropping season, we visited the farmers to discuss the progress of their experiment and to examine the experimental layouts, checking with the owners about their insecticide spraying schedules. As it was difficult to implement a strict procedure to

Table 1.

Support Materials Provided to Farmers Who Participated in Experiments

- A sign board (30 cm x 60 cm) with the farmer's name, collaborating agencies and the experimental title for display in each participant's field.
- Cebuano versions of "Friends of the Rice Farmer: Helpful Insects, Spiders and Pathogens" (Shepard, Barrion & Litsinger, 1987); and "Field Problems of Tropical Rice" IRRI (1983) and a cap to each participant.
- Two comics strips, in Cebuano, depicting a discussion between a farmer who had done the experiment and another farmer who had not.
- A cardboard file with weekly activity sheets and a ball-point pen for recording farming activities and input costs.
- A set of instructions to conduct farmer participatory research.
- A certificate of participation presented at the experience-sharing workshop conducted at the end of the experiment.

ensure that our farmer participants had not sprayed their experimental plots, we relied on our participants' enthusiasm to participate and their motivation to reduce unnecessary spraying as their incentives.

Farmers' Results and Experience Sharing

Farmers were taught to assess yields from the experimental and main plots by weighing yields obtained from 5x5 m^2 subplots in their sprayed and unsprayed plots. Weekly records of activities and respective expenditures were kept by each participant using a simple form provided. At the end of the season, a farmers' workshop was organized where results were presented and discussed.

Monitoring Surveys

The 1992 baseline survey, conducted among 101 farmers, was subsequently followed by two post-experiment surveys. The first survey conducted in July 1993 was carried out primarily to compare the yields and costs of insecticide applications from their experimental and main plots and determine their insecticide use patterns, and knowledge and attitude towards leaf-feeding insects. The second survey, conducted in September 1994, focused on farmers' pest management practices, insecticide application costs, perceptions of yield differences, and benefits derived from not using early-season insecticide sprays for leaffolder control. A slight attrition rate could be observed in the sample size of the third survey as four farmers were no longer available due to urban migration, poor health, and death.

Results

Profile of Participating Farmers

Table 2 summarizes some characteristics of the participating farmers. About 52% were older than 50 years and more than one half (53.5%) had only elementary education. A majority (68.3%) of the farmers were tenants. Rice was their main crop and most used transplanting for crop establishment. Farm sizes were generally small, with about 81% farming on less than one hectare. Modern varieties were mainly grown, and IR60 and IR72 were cultivated by 60% of the farmers.

Pest Management Patterns

A large proportion of farmers reported rice bugs as their main pest problem during the 1992 wet season. Caseworms were next, followed by the rice leaffolders. Pesticide application was the most common control method used. At seedling and tillering stages, the

Table 2

Profile of Participating Farmers (N = 101)

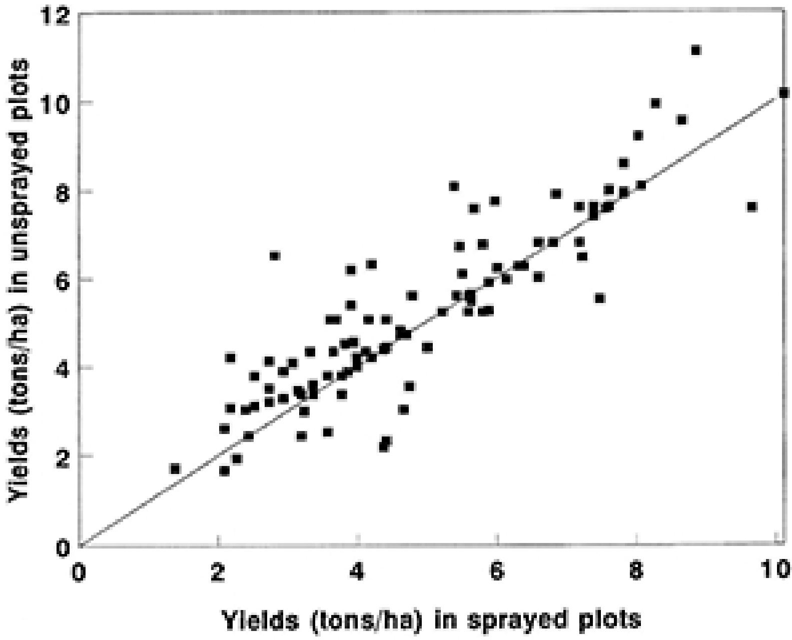
Age group:		**Education:**	
30 and below	13.9%	Did not attend school	2.0%
31-40	17.8%	Completed elementary	53.5%
41-50	16.8%	Completed secondary	28.7%
51-60	35.7%	Reached college	15.8%
>60	15.8%		
Marital status:		**Tenure:**	
Single	6.9%	Owner-operator	20.8%
Married	86.2%	Leasee	14.9%
Separated	1.0%	Tenant	68.3%
Widow	5.9%		
Farm size:		**Cropping patterns:**	
≤ 0.5 ha	54.4%	Rice-rice	96.0%
0.6-1.0 ha	26.7%	Rice-other crops	4.0%
1.1-2.0 ha	13.9%		
2.1-3.0 ha	5.0%		
		Method of crop establishment:	
		Direct seeding	12.9%
		Transplanting	87.1%

main target pests of farmers were leaffolders and stem borers. At booting, heading, flowering, and milky stages, farmers' insecticide sprays were directed at rice bugs and caseworms. Endosulfan was the most common insecticide used at tillering, with monocrotophos as the next most common. At booting, flowering, heading, and milky stages, endosulfan was likewise dominant, followed by deltamethrin and cypermethrin.

Yield Comparisons

Yields of farmers' experimental and main plots in wet season 1993 were variable (Figure 1). Statistically, the yields were not significantly different ($t = 1.01$ $p > 0.05$), with the mean yield of the experimental plots (5.1 t/ha) only slightly higher than their main plots (4.8 t/ha). About 77% of the farmers had either the same or higher yields in their experimental plots.

Figure 1. **Yields of farmers' experimental plots that were unsprayed with insecticides in the first 30 days after transplanting and yields of their respective main plots. The line indicates no difference between yields of the two plots.**



In the 1994 survey, we asked participating farmers for their opinions on eliminating early season insecticide sprays on their yields. About 34% reported no difference and 54% reported higher yields in the experimental plots. Only 3% reported lower yields and 9% did not express any opinion.

Insecticide Use Patterns

Since the intent of the farmers' experiments was to encourage farmers to eliminate early insecticide sprays, the timing of their first insecticide application might be used as the key indicator of impact. In 1992, more than two thirds of the farmers (68.4%) applied insecticides within 30 days after transplanting (Table 3). After the experiments were conducted by the farmers in 1993, this percentage dropped to less than 20%. In 1994, there was a further reduction in the number of farmers who treated their rice crop within the first month after transplanting (11.3%). After performing the experiments, farmers' first insecticide applications were shifted towards the later stages of the crop. For example, more farmers applied their first sprays after 60 days, two years after they had done their experiments. The average number of insecticide sprays farmers applied also dropped from 3.2 in 1992 before the experiments were introduced to 2.0 in 1994. There was also a shift in the mode from 3 to 1.

Perception Changes

To determine whether the farmer experiments changed perceptions, responses to three attitude statements before and after experimenting were obtained. The first two statements, which referred to insect damages and their consequences, were presented in reverse order to avoid biased responses. Before experimenting, 75% of the farmers disagreed with the statement that leaf-feeding insects do not cause yield loss (Table 4). After experimenting, farmers opinions were changed and only 9% disagreed. Similarly for the second statement, 77.2% believed that leaf- feeding insects can cause severe damages, before experimenting; and only 28% believed it after. Before experimenting, 62% of the farmers thought that leaf-feeding insects had to be sprayed early in the season, but only 10% believed this to be true after the experiment.

Table 3

Changes in Farmers' Insecticide Use Before and After Conducting the Experiment

Timing of first insecticide sprays (days after transplanting)	Before experiment 1992	After experiment 1993	1994
	Percent farmers		
1 - 30	68.4	19.8	11.3
31- 45	21.8	42.6	36.1
46 - 60	4.9	20.8	22.7
>60	4.9	16.8	29.9
Mean number of sprays per farmer	3.2	2.1	2.0
Standard deviation	1.9	0.7	1.2
Number of sprays of most farmers (mode)	3.0	2.0	1.0

In the 1994 monitoring survey, farmers' responses to the experiments were recorded. Most (88%) felt that they had benefited. Among the benefits quoted by the farmers were money savings (94%), reduction in labor inputs (35%), reduction in exposure to health hazards (26%), and reduction in pesticide residues in rice (11%). Only 2% cited conservation of natural enemies as a benefit.

Discussion

Similar to earlier studies carried out in Leyte, Philippines (Heong, Escalada & Mai, 1994), most of the farmers who volunteered to participate in our experiment applied their insecticide sprays early. Their main targets were lepidopterous larvae, generally referred to as "worms." There was a strong belief that these larvae, particularly the rice leaffolder, *Cnaphalocrocis medinalis* Guenee, would severely damage the crop and cause yield loss. However, research has shown that the rice crop can tolerate a substantial amount of defoliation and yet recover and not suffer any yield difference (Heong, 1993; Heong, Escalada & Mai, 1994). It thus appears that indigenous attitudes that insects, particularly worms, are harmful have tended to make farmers become victims of insecticide abuse (Bentley, 1989).

Table 4

Farmers' Attitudes Towards Leaf-Feeding Insects Before and After Experimenting

Attitude statements	Percent farmers: Before experiment	Percent farmers: After experiment
1. Leaf feeding insects do not cause yield loss		
Agree	21.8	87.1
No opinion	3.0	4.0
Disagree	75.2	8.9
2. Leaf feeding insects cause severe damage to rice crops		
Agree	77.2	27.7
No opinion	0	0
Disagree	22.8	72.3
3. Leaf feeding insects must be sprayed early in the season		
Agree	62.4	9.9
No opinion	2.0	0
Disagree	35.6	90.1

When the farmer experiments were initiated, the Philippine Agricultural Extension Service found itself in transition with their devolution to the local government units. With minimum technical support from the central and regional offices of the Department of Agriculture, extension services became fragmented and largely dependent on the priorities of local government officials. In this context, there was hardly a coherent, farmer-training program that was in operation in the research sites. In the vacuum created by the devolution, the commercial sector seems to have gained a visibly stronger presence in local communities. Pesticide sales agents often piggybacked on farmers' meetings organized by extension technicians and also hosted luncheons for agricultural cooperatives' officers and technicians to promote their products, thus wielding their influence on farmers' pest control decisions.

Although farmers' perceptions of pests and pesticide use are deeply entrenched, the use of conflict information to create cognitive dissonance challenged farmers to evaluate a simple decision rule on leaffolder control. Results of farmers' experiments changed perceptions and practices. Most farmers who participated in our experiment had reduced their early-season insecticide applications and reduced the number of sprays as well. In addition, their perception of leaf feeding-insects changed. The main incentives that had encouraged the farmers seemed to be money and labor savings. As Sears and Freedman (1971) have noted, the perceived utility of the information in solving a problem or teaching a skill could make audiences receptive to information even if it is contradictory to their existing beliefs and knowledge.

Conducting a simple experiment to test a heuristic generated from research appears to be an effective way to improve farmers' pest management decision making. Re-assessment of conflict information to resolve dissonance can eliminate misperceptions that often bias attitudes towards insects. As Eiser (1986) pointed out, a person needs to engage in cognitive work which will lead to a re-evaluation of the relevant cognitive elements.

The study successfully demonstrated the effective use of simple participatory experiments to improve farmers' pest management decision making. Farmers are more likely to participate in an experiment if they perceive the problem to be of economic significance and the source of conflict information to be highly credible. In this case, the information source was the International Rice Research Institute, widely regarded by many farmers to have pre-eminent epistemic authority on rice-related issues. Credibility stems from a reputation for, or demonstration of, expertise in a given domain that stimulates perceptions of trustworthiness (Walters, 1991; Berlo, Lemert & Mertz, 1970). As source credibility has been noted to be influential in an individual's decision to act on information (Schramm, 1973), this factor could perhaps explain farmer motivations for participating in the experiments.

In addition, farmers' decisions are often based on normative rather than economic considerations (Mumford & Norton, 1984; Rola & Pingali, 1993; Heong, Escalada & Mai, 1994). The behavioral decision model proposed by Mumford and Norton (1984) can account for these observations. A farmers' choice of a control action depends on how the problem and options are perceived. Each season, he or she is likely to be faced with similar decision problems and may be thus affected by previous seasons' decisions. There are several ways in which a decision that will be made in the next season can be influenced by experiences in the current season. For example, if a farmer learns that the decision to control has not been beneficial, it can influence his or her perceptions in the next season. In this case, farmers who participated in testing the heuristic that "insecticide applications in the first 30 days after transplanting (or 40 days after sowing) for leaffolder control are not needed," seem to have changed their perceptions of the leaffolder and decided not to control them.

Although no effort was made to encourage diffusion, there was evidence of farmer-to-farmer spread as we interviewed another 165 farmers who had stopped spraying early after hearing about the experiments of the first group. The spread had been confined to neighbors and relatives. Interestingly, other farmers decided to follow the innovation based primarily on the testimonies of experimenting farmers. The former saw no need to conduct their own experiments and reasoned that the shared experiences of fellow farmers were sufficient to cause their own perception change. Since encouraging farmers to experiment with a simple rule-of-thumb can be easily communicated in informal talks, farmer-to-farmer spread of experiences from the experimentation may be further enhanced with the help of media, such as newspapers, radio, and television. The use of these approaches may be explored in the future, and further research can look into which stages in the innovation diffusion process are participatory experiments, as well as other mediated communication strategies most appropriate and effective.

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References

Bentley, J.W. (1989). What farmers don't know can't help them: The strengths and weakness of indigenous technical knowledge in Honduras. *Agriculture and Human Values, 6,* 25-31.

Berlo, D.K., Lemert, J.B., & Mertz, R.J. (1970). Dimensions for evaluating the acceptability of message sources. *Public Opinion Quarterly, 33,* 563-576.

Brehm, J.W. & Cohen, A.R. (1959). Reevaluation of choice alternatives as a function of their number and qualitative similarity. *Journal of Abnormal and Social Psychology, 58,* 373-378.

Brehm, J.W. (1962). An experiment on recall of discrepant information. In J.W. Brehm & A.R. Cohen (Eds.), *Explorations in cognitive dissonance* (pp.). New York: Wiley.

Cartwright, D. (1949). Some principles of mass persuasion: Selected findings of research on the sale of U.S. War Bonds. *Human Relations, 2,* 253.

Chambers, R., Pacey, A. & Thrupp, L. A. (1989). *Farmer first: Farmer innovation and agricultural research.* London: Intermediate Technology Publications.

Eiser, J.R. (1986). Social psychology: *Attitudes, cognition and social behavior.* Cambridge: Cambridge University Press.

Escalada, M. M. & Heong, K. L. (1993). Communication and implementation of change in crop protection. In *Crop protection and sustainable agriculture* (pp. 191-202). Chichester, UK: Wiley.

Festinger, L. (1957). *A Theory of cognitive dissonance.* Stanford, CA: Stanford University Press.

Freedman, J.L. & Sears, D.O. (1965). Selective exposure. In L. Berkowitz (Ed.), *Advances in experimental social pychology. Vol. 2.* New York: Academic Press.

Heong, K. L. (1989). Sources of rice crop protection information. In K. M. Harris & P. R. Scott (Eds.), *Crop protection information: An international perspective* (pp. 51-66). Oxford: Commonwealth Agricultural Bureau International.

Heong, K. L. (1993). Rice leaffolders: are they serious pests? In *Research on Rice Leaffolder Management in China. Proceedings of the International Workshop on Economic Threshold for Rice Leaffolders in China, 4-6 March 1992, Beijing* (pp. 8-11). Hangzhou: China National Rice Research Institute.

Heong, K.L., Escalada, M.M. & Mai, V . (1994). An analysis of insecticide use in rice: Case studies in the Philippines and Vietnam. *International Journal of Pest Management, 40,* (2) 173-178.

Kahneman, D. & Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237-251.

Lim, G. S. & Heong, K. L. (1984). The role of insecticides in rice integrated pest management. In *Judicious and efficient use of insecticides on Rice.* Los Banos, Philippines: International Rice Research Institute.

Matteson, P. C., Gallagher, K. D. & Kenmore, P. E. (1994). Extension of integrated pest management for planthoppers in Asian irrigated rice: empowering the user. In R.F. Denno & T.J. Perfect (Eds.), *Planthoppers: Their ecology and management* (pp. 656-685). London: Chapman & Hall.

Merrill-Sands, D., Biggs, S. D., Bingen, R. J., Ewell, P. T., McAllister, J. L. & Poats, S. V. *Institutional considerations in strengthening on-farm client-oriented research in national agricultural research systems: Lessons from a nine country study. (ISNAR Staff Notes 91, 109).* Hague, Netherlands: International Service for National Agriculture Research. (1991).

Miyashita, T. (1985). Estimation of the economic injury level in the rice leaf roller, *Cnaphalocrocis medinalis* Guenee (Lepidoptera:Pyralidae): Relation between yield loss and jury of rice leaves at heading or in the grain filling period. *Japanese Journal of Applied Entomology and Zoology, 29,* 73-76.

Mody, B. (1992). Talking to development bankers: Extension workers speak up. *Development Communication Report, 79,* 7-9.

Mumford, J. D. & Norton, G. A. (1984). Economics of decisionmaking in pest management. *Annual Review of Entomology, 29,* 157-174.

Norton, G.A. (1982). A decision analysis approach to integrated pest control. *Crop Protection, 1,* (2) 147-164.

Rola, A. C. & Pingali, P. L. (1993). *Pesticides, rice productivity and farmers' health; An economic assessment.* Washington D.C.: World Resources Institute & Los Baos, Philippines: International Rice Research Institute.

Schramm, W. (1973). *Men, messages and media: A look at human communication.* New York: Harper and Row.

Sears, D.O. & Freedman, J.L. (1971). Selective exposure to information: A critical review. In W. Schramm & D. Roberts (Eds.), *Process and effects of mass communication* (pp. 209-234). Urbana: University of Illinois Press.

Shepard, B.M., Barrion, A.T. & Litsinger, J.A. (1981). *Friends of the rice farmer: Helpful insects, spiders, and pathogens.* Los Baos, Pilippines: International Rice Research Institute.

Stone, R. (1992). Researchers score victory over pesticides and pests in Asia. *Science, 256,* 1272-1273.

Tan, A.S. (1984). *Mass communication theories and research.* New York: John Wiley & Sons.

Walters, G. (1991). Extensions of extension: Socialization and credibility constraints on private crop production advisors. *Journal of Applied Communications, 75,* (2) 30-41.

Way, M.J. & Heong, K.L. (1994). The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice: A review. *Bulletin of Entomological Research, 84,* 567-587.

Wyer, R.S. & Srull, T.K. (1981). Category accessibility: Some theoretical and empirical issues concerning the processing of social stimulus information. In E.T. Higgins, C.P. Herman, & M.P. Zanna (Eds.), *Social cognition* (pp. 161-197). Hillsdale, N.J.: Erlbaum.