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PHILIPPINE EXPERIENCE ON PEST SURVEILLANCE AND EARLY WARNING SYSTEM

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ABSTRACT

A review of related publications indicated that available data sets are insufficient to objectively determine the impacts (pesticide use, cost-benefit, etc.) of pest surveillance and early warning system (SEWS) at the farmer level. The SEWS was implemented in the Philippines from 1975 to 1989. There are, however, indications that the impacts at the farmer level were contrary to expectations. Apparently, towards the end of the program, there was an increase in pesticide use in terms of the number of farmers using insecticides and the frequency of application. Limitations in the pest surveillance system for on-farm decision-making as implemented in tropical conditions like the Philippines are also discussed. The potential use of the surveillance system for monitoring entry of quarantine pests was also explained.

Key words: pest surveillance, early warning system, SEWS, pest management

INTRODUCTION

In the 1970s, pest surveillance and forecasting (PSAF) was implemented in several countries in Southeast Asia. The surveillance program was initiated in Thailand in 1983, in Indonesia in 1975, and in Malaysia in 1977, following outbreaks of the rice brown planthopper (BPH), *Nilaparvata lugens* (Stal) in these countries. In the Philippines PSAF began in 1975. In Asia, however, PSAF began as early as in the 1940s in Japan, 1958 in Korea and 1969 in India. Today, Japan and Korea have the most sophisticated PSAF systems in Asia.

From 1975-1989, the Philippine Government, through the Department of Agriculture (with technical and financial assistance from the RP-German Crop Protection Programme), implemented a Surveillance and Early Warning System (SEWS). The program was brought about by pest outbreaks such as rodent and rice BPH infestations as well as disease outbreaks that threatened the rice self-sufficiency program of the government.

The SEWS was initially piloted in 1976 and subsequently expanded to cover major rice growing areas of the 12 regions (77 provinces) of the country. Other important crops (e.g., corn and vegetables) were later included in the program.

This paper aims to review the Philippine experience in pest surveillance and forecasting, and to explore how it can best be used for pest management in the context of the Philippine ecological and sociological environment. There is a need to draw out our country's experiences, particularly in the light of allegations that the SEWS had resulted to increased use of pesticides by rice farmers.

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THE PHILIPPINE SEWS

Background

Most pest surveillance systems consist of four basic components: 1) data collection; 2) data processing; 3) information synthesis; and 4) information delivery (Heong 1990). Several sets of information are also required in pest surveillance systems: 1) real-time information; 2) fundamental information; 3) historical information; and 4) forecast information (Norton 1982). **Fundamental information** pertains to biological and ecological processes influencing pest abundance and their consequent damage. Such information includes those needed in the establishment of economic threshold levels or pest density-yield loss relationships. **Historical information** includes data on previous levels of pest attack and damage, as well as trends in pest population build-up. **Real-time information** provides data obtained from regular field monitoring to yield the current pest population levels, occurrence and damage. **Forecast information** provides an estimate of future pest and damage situations based on the above information.

Objectives

The Philippine SEWS aimed to:

1. establish a dense network of pest scouting and monitoring;
2. assist farmers in pest control decision-making;
3. adjust the level of chemical control to its economic optimum;
4. inform the farmers immediately on the pest situation in their fields and to give them technical information on how to overcome their problems;
5. inform all regulatory institutions of the region involved in the field of crop protection regarding pest and disease outbreaks, their location and their severity; and
6. organize massive pest control operations in outbreak areas.

Organizational Structure and Operation

The organizational set-up of the SEWS utilized existing staff of the national, regional and municipal offices of the Department of Agriculture (DA). The following DA offices were part of the SEWS: Crop Protection Division (CPD) of the Bureau of Plant Industry (BPI), Regional Crop Protection Centers (RCPC), regional, provincial and municipal offices of DA.

The national surveillance coordinator's office was based at CPD-BPI. Regional (RSO), provincial (PSO) and municipal (MSO) surveillance officers were also designated with corresponding deputies. It should be noted that the RSOs, PSOs, and MSOs also reported directly to their respective regional directors, as well as provincial and municipal agricultural officers who were not necessarily part of the chain of command of the surveillance system organization.

In each municipality, field surveillance officers (FSO) were designated and they functioned in a full-time capacity, unlike other personnel in the surveillance program. Some of the agricultural food technologists (AFTs) in the municipality were also designated as pest observers. The AFTs were required to devote one-half day per week for field surveillance activities.

All the government officers who were involved in SEWS were provided training in pest identification, field monitoring techniques as well as data processing and synthesis. Appropriated fund and logistic support were also provided such as incentive allowances, travel funds, vehicle and communication equipment.

In a municipality, three to five officers were involved in field monitoring. There were, however, instances when a surveillance officer covered several municipalities. Field monitoring was done on a weekly basis in designated observation stations (usually a barangay). Three to five 250-ha observation-stations were required per municipality. The data gathered included pest abundance/occurrence, plant variety and growth stage, and climatic data. It should be noted that no data on natural enemy abundance was obtained.

Information Flow

The data were generated weekly and immediately passed on to farmers in the community for their information. Farmers were met and the results were discussed with them. The surveillance officers, if required, provided appropriate recommendations. The technicians, in consultation with their supervisors, gave pest control recommendations if the pest levels exceeded the economic threshold level or control action values. Recommendations often resulted to pesticide application by the farmers since control had to be immediate.

In cases of pest outbreak situations, a process of validation protocol had to be observed by the higher-ranking surveillance officers. Usually, field verification and consultation with the MSO, PSO, RSO and RCPC was done. The DA regional office and BPI provided pesticides to the farmers in cases of pest outbreaks.

The weekly field data were also forwarded to the MAO, PSO, PAO, RSO and to the RCPC. The RCPC was responsible for data consolidation and analysis at the regional level and was also required to issue monthly pest situationer in their respective regions. On top of these, the RCPC was likewise responsible for developing pest control strategies based on ETL values following the integrated pest control approach.

Databasing, evaluation and national pest profile reports were done by the SEWS National Office at BPI and these were issued to all concerned institutions. The national team also had the responsibility of developing computer models for pest forecasting.

IMPACT OF SEWS

Studies on the impact of SEWS in the Philippines are very limited. The study by Dr. Hermann Waibel (1983), who was one of the German participants in the program, was the only formal impact evaluation but it was focused on the economics of the program.

It is important to view the Philippine SEWS program in the context of the pest management practices during those years. SEWS was conceived when pesticide applications were being done indiscriminately and often calendar-based. In the latter, insecticide application was done weekly irrespective of pest severity. An aim of the SEWS, as evident in its objectives, was to "adjust to economic optimum" pesticide application (especially insecticides) by using economic threshold levels as basis for decision-making. An expected consequence of the SEWS was reduction of pesticide applications.

It is quite difficult to establish with certainty the impact of SEWS to the pesticide application pattern of rice farmers. However, it should be noted that Tuttinghoff's (1990; as cited by Hermann Waibel in his presentation in the IRRI Rice IPM Network Workshop, 1992) study of the SEWS program in Thailand indicated that SEWS had stimulated the unnecessary use of insecticides by rice farmers (Table 1). Tuttinghoff (1990) compared SEWS villages and non-SEWS villages in Thailand and the results showed higher insecticide applications in the SEWS rice-villages. Whether this was also the case in the Philippines is still an issue to be investigated.

There are indications that SEWS in the Philippines did not reduce pesticide use of rice farmers. Frequency of insecticide use in rice production systems in the Philippines still showed an increasing trend even during the years covered by SEWS (1976-1989). In the paper by Kenmore et al. (1987), the proportion of irrigated rice farmers in the Philippines using insecticides increased from 55 percent in 1965 to 95 percent in 1984. The paper by Wurburton et al. (1995) also indicated a similar trend (Tables 2 & 3). There were also indications that rice farmers in Laguna and Nueva Ecija increased their frequency of insecticide application from the year 1966 (mode of 0-1 application per season) to 1988 (mode of 1-3 applications per season). It is not clear whether the increase is a function of the SEWS or aggressive marketing campaign by the industry.

The cost-benefit of running the SEWS indicated that in every year but one, the cost was higher than the benefits (Table 4) (Waibel, 1983). The annual cost of SEWS from the period 1976-1981 was on average 0.6 M pesos, except for the first year which was 1.4 M pesos. The annual benefit was often negative except for one year (1979) and still the benefit was relatively insignificant (only 6% return on investment).

Furthermore, Waibel (1993) showed that the accuracy of warnings of local and/or widespread pest outbreaks issued by SEWS was high only for some pest species (i.e., rodents, defoliators and stemborers) (Table 5). Warnings for BPH outbreaks were relatively inaccurate, only 25 percent correct.

In most temperate countries, pest surveillance and forecasting can be an effective tool in pest management to assist farmer decision-making. In Asia, South Korea and Japan have the most sophisticated systems. The reason why the system is technically effective in these countries may be because of the dynamics of these specific pest populations. In a temperate environment, population generations do not overlap because of the effect of cold winter conditions and often synchronous planting of crops. At a given time, all individuals of a population are in one developmental (growth) stage. This makes small samples more representative of the population. In tropical environments, population generations are overlapping; that is, at a given time all growth stages are present.

Surveillance and forecasting is much useful in situations where the pest generations are discrete. For example, by knowing the number of overwintering (dormant) individuals, one could easily predict when the population will be active (attacking crops) and at what areas they are likely to be found.

The pest surveillance and forecasting system in Japan and Korea has been reported to be an effective tool against the BPH in rice (IRRI Rice IPM Network, 1992). An insect pest that cannot survive winter in Japan, BPH annually migrates in high numbers to Japan and Korea from the southern part of China.

Table 1. Comparison between a 'SEWS' and a non-'SEWS' village in Thailand. (Source: Tuttinghoff 1990, as reported by H. Waibel in the IRRI Rice IPM Network Workshop, 1992)

Parameters	Unit	Non-SEWS Village	SEWS Village
Total pesticide use	Bhat/rai	45.00	152.00
Insecticide use	Bhat/rai	21.00	91.00
Insecticide application frequency	No./season	1.51	2.14
Marginal value product Insecticide Use	Bhat/Bhat	1.14	0.24
Fertilizer use	Bhat/rai	137.00	199.00
Pesticide price "In elasticity"	% Farmer	80.00	89.00
Rice price "In elasticity"	% Farmer	82.00	80.00
High yield loss Expectations (250%)	% Farmer	31.00	28.00
Follow a non-spray recommendation	% Farmer	45.00	6.00

Bhat – Thailand Currency
Rai – Thailand unit of area

Surveillance and forecasting in Japan and Korea was primarily designed to monitor the yearly arrival of BPH and to prevent the insect from attaining population outbreak levels. There are, however, indications that BPH outbreaks in Japan is not only related to BPH mass migration from China but more importantly to heavy insecticide use by rice farmers (P.E. Kenmore, 1996. Personal Communication).

In tropical situations, there is overlapping of pest generations due to climatic conditions and the non-synchronous planting time. Thus, breeding is likely to occur throughout the year, making forecasting more difficult and less accurate. Outbreaks of pests are also likely to be highly localized, except for pest species that are migratory such as the locust *(Locusta migratoria manilensis* Meyen) and the rice black bug (*Scotinophara* spp.).

Table 2. Frequency of pesticide application in Laguna, 1966-1990. (Source: Warburton *et al.*, 1995).

Pesticide	Number of Application per Crop Season			Wet Season		Dry Season	
		1966	1978	1988	1990	1988	1990
Insecticide	0	18	1	2	3	5	5
	1	14	18	8	11	6	6
	2	1	11	9	9	8	6
	3	1	3	4	2	5	1
	4	0	1	5	3	3	3
	5	0	0	1	1	0	2
	6	0	0	4	1	2	2
Herbicide	0	6	3	3	0	8	1
	1	30	26	23	21	17	15
	2	0	5	5	5	3	6
	3	0	0	1	1	1	1
	4	0	0	1	1	0	1
	>5	0	0	0	1	0	1
Molluscicide	0	36	34	28	22	25	14
	1	0	0	5	5	4	7
	2	0	0	0	2	0	4
Total Respondents		36	34	33	29	29	25

SUGGESTIONS ON PHILIPPINE SEWS OBJECTIVES AND DESIGN

The data generated from SEWS seem to have limited value for on-farm decision-making by farmers. SEWS are not sensitive enough to detect localized pest outbreaks because forecasts are based on regional data sets. Often pest situations from a farmer's field to another differ significantly due to plant variety, fertilizer,

Table 3. Frequency of insecticide application in Nueva Ecija, 1979-1991. (Source: Warburton *et al.*, 1995)

Pesticide	Number of Application per Crop Season	Wet Season			Dry Season		
		1979	1985	1991	1979	1985	1991
Insecticide	0	28	0	7	32	0	10
	1	29	6	33	32	12	15
	2	38	29	28	24	32	41
	3	25	24	14	26	38	19
	4	13	36	5	15	29	7
	5	4	16	6	7	9	2
	>6	8	32	0	7	18	1
Herbicide	0	64	9	10	42	9	4
	1	67	99	76	84	105	74
	>2	4	35	7	19	24	18
Molluscicide	0	34	0	66	25	0	65
	1	0	0	24	4	0	28
	>2	0	0	3	0	0	2
Total Respondents		145	143	93	143	138	95

Table 4. Cost-benefit analysis of the pest surveillance system in the Philippines, 1976-1981. (Source: Waibel, 1983).

Year	Economic Cost (Pesos)	Economic Benefit (Pesos)	Cash Flow (Pesos)	Discounted Cost (Pesos)	Discounted Benefits (Pesos)	Discounted Cash Flow (Pesos)
1976	1,455,066	34,667	-1,420,399	1,455,066	34,667	-1,420,399
1977	459,400	9,454	-449,946	441,731	8,741	-432,990
1978	504,568	20,485	-484,083	466,501	18,940	-447,561
1979	605,408	641,340	35,932	538,206	570,149	31,043
1980	770,200	627,158	-143,042	558.370	536,097	-122,273
TOTAL	4,587,194	1,575,773	-3,011,421	4,211,294	1,368,050	-2,843,244

Table 5. Evaluation of pest warning issued by the National Warning Service of the Philippines, 1976-1979[1]. (H. Waibel, 1992, presented in the IRRI Rice IPM Network Workshop, 1992).

Pest	No. of Warnings	Percent Correct
Tungro	220	51.3
Brown planthopper	67	23.8
Stem borers	73	100.0
Defoliators	70	87.7
Rats	87	100.0

[1] Data had been collected from three different regions.

water, location and other factors. The varying pest situations across farms therefore make forecasting an extremely difficult task, especially under Philippine conditions where farms are only about a hectare in size. Pest control requirements would also differ among farms. Increased ecological understanding of local farms still has to be gained to be able to forecast pest situations.

Surveillance and forecasting of such pest species may also be very expensive. In Japan, they employ about 15,000 pest observers and a staff covers about 51,400 ha. In a particular year, annual cost of running the system amounted to US$ 8 million in direct cost and another US$ 8 million in subsidies (Sogawa 1992, IRRI IPM Network Workshop Report). In Korea, they have 152 observation stations representing 4,000 to 10,000 ha. per station.

The value of surveillance and forecasting may be relevant for migratory pest species, but may have limited value for most non-migratory pests. For non-migratory species, it would be more practical to monitor variables such as pesticide use, the varieties used and cropping pattern as bases for forecasting pest outbreaks in different areas in the country. These variables are more practical, cheaper to monitor by local technicians and also provide more valuable information that can be used to reliably forecast local pest outbreaks. For instance, localized outbreaks of BPH in tropical conditions are strongly correlated with high frequency of insecticide use (Kenmore, 1980).

To address the manpower requirement in pest surveillance, Rubia *et al.* (1996) piloted a system that involved farmers in surveillance. They concluded that farmers can be involved in field data collection, but they need to be properly trained and the procedure should not rely on visual estimates. However, between pest surveillance similar to SEWS involving farmers and farmer training for IPM on-farm decision-making, the latter may be the more practical option in terms of cost-benefit and effective pest management. Experiences with the season-long IPM Farmer Field School training program on rice, corn and vegetables indicated a significant improvement in farmers' IPM (SEARCA 1997).

Pest surveillance and forecasting may also be valuable in safeguarding the country against the introduction of quarantine pest species that pose increased threat with trade liberalization under the GATT-WTO agreement. There should be extra vigilance in monitoring the introduction of new pest species and strains, which may have adverse consequences on our agricultural production and our ability to export. A system should be put in place whereby we could readily detect new accidentally introduced pest species from other countries and immediately respond either to contain and/or eradicate the quarantine pest. The system should be able to prevent the establishment of pests like the papaya ringspot virus, the mango pulp weevil, the ipil-ipil psyllids, leaf miners and other pests that have suddenly surfaced for unknown reasons. The adverse economic consequences brought about by these introduced pests now run into millions of pesos.

There are now several new technologies and approaches that can be used in pest surveillance and forecasting that do not require as much manpower as the SEWS model. The GIS system and remote sensing can be used to define high-risk pest outbreak areas for particular species where intensive surveillance may be focused (Song *et al.,* 1992). The use of pheromone traps can also be used for monitoring quarantine pest species. Using these new technologies, however, would likewise require fundamental information on the field ecology, behavior of pests and other ecological information affecting the distribution and abundance of the pest species.

SUMMARY AND CONCLUSION

The pest surveillance and early warning system was implemented in the Philippines from 1975-1989 involving various sectors of the Department of Agriculture from the municipal to the national level. Its impact, however, has not been studied systematically. The limited literature available indicate that at the farmers' level, pesticide use increased during the SEWS years. At the program level, there was a negative return on investment in all but one year of its implementation, and the accuracy of prediction for certain pests was erratic.

Pest surveillance that is based on limited regional sample data is not sensitive to detect localized pest outbreaks and therefore has limited value for decision-making in small farms. The overlapping nature of population generations of pest species in the tropics, and the many variations in farm practices across farms further contribute to the limited value of SEWS for farm level decision-making.

Considering the cost requirement to set-up and run a SEWS, it would be practical to instead focus on training farmers on pest management following the Farmer Field School Model. SEWS, however, may have application for migratory pest species, and for surveillance of quarantine pest species that may be accidentally introduced into the country. The use of new technologies such as GIS and pheromone traps may substantially reduce the cost of surveillance but would require a substantial understanding of the field ecology of the pest species.

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