INTEGRATED PEST MANAGEMENT IN RICE: INTEGRATING ECONOMICS, EXTENSION AND POLICY

John Martin
Appraisals section
Australian International Development Assistance Bureau

ABSTRACT

Since 1980, a project on integrated pest management in rice has been operating in seven countries of the South/South East Asian Region through the Food and Agriculture Organisation. Australia has been an instigator and active financial and technical supporter of the project. An important part of the program has been the management of brown plant hopper (BPH). This insect has become a major pest of rice only since the introduction of intensified rice cropping systems and the reduction in BPH predator populations through the overuse of broad spectrum pesticides. Initially the project was directed towards confirming the underlying technical base of IPM. However in recent times, the focus has shifted towards extension, to give the farmer practical tools which will enable him to more effectively manage pest problems in the rice crop. This shift has highlighted the need for a deeper understanding of socio economic factors affecting farmer adoption of the technology, and the policies necessary to sustain an IPM approach. Recent policy changes in a number of participating countries including reducing insecticide imports and subsidies highlight the importance of policy measures. IPM needs to be profitable at farmer level for the short and long term national economic benefits which flow from IPM to be realised.

Paper presented to the 32nd Annual Conference of the Australian Agricultural Economics Society, Melbourne, February 8-11, 1988.

This paper does not necessarily reflect the views of AIDAB or of the Government of Australia.

INTEGRATED PEST MANAGEMENT IN RICE
INTEGRATING ECONOMICS, EXTENSION AND POLICY

John F Martin
Australian International Development Assistance Bureau

Introduction

Integrated pest management involves the use of a range of techniques to reduce the damage from insect pests in agricultural crops. However, for these techniques to be adopted, the integration required is really in the economic, extension and policy aspects. This paper draws on the experiences of an integrated pest management program in rice, the FAOIPC (Food and Agricultural Organisation Integrated Pest Control) Project, currently being implemented in seven Asian countries, to highlight the need for such integration and the important input required from agricultural economics, both at farm level and in policy analysis.

Background

The FAO Integrated Pest Control (FAOIPC) Project in rice was initiated by Australia in the 1970's and came into being in 1980 following extensive preliminary work in the 7 participating countries involved (Bangladesh, India, Indonesia, Malaysia, Philippines, Sri Lanka and Thailand) and within FAO.

Integrated pest control, or more precisely, integrated pest management (IPM), involves the use of a wide range of skills and practices to control pests, including the need-based use of pesticides, rather than the commonly adopted practice of calendar-based prophylatic spraying of pesticides. The FAOIPC project centres primarily on insect control, notably the brown plant hopper (BPH), but also embraces weed and rodent pests, and some aspects of disease control. Whilst the first phase of the project (1980-1986) was particularly focussed on developing and testing the technical aspects of the concept, the project has evolved more recently, under the direction of Dr. Peter Kenmore, the Regional Program Manager/Coordinator, towards enhancing farmer adoption of IPM in rice.

A substantial amount of technical information supporting the validity of the IPM appproach is becoming available, particularly through the International Rice Research Institute (IRRI). Recent publications by IRRI emanating from this work include "Friends of the Rice Farmer: Helpful Insects, Spiders, and Pathogens" (1987) and "Upland Rice Insect Pests: their Ecology, Importance, and Control" (January

1987). In addition, the first phase of the FAOIPC project included conducting trials and collecting information in support of the concept, as well as a number of workshops and training programs.

However, prime reasons for the relatively low rate of adoption of IPM practices identified by FAOIPC project personnel and others (eg Goodell 1984) included inaccurate perceptions of pest damage in rice and the lack of appropriate usable skills and tools at the farmer/extension agent level. Consequently, as the prime purpose of the project is to give farmers control over the management of pests in their rice crops, emphasis has been increasingly directed towards first changing their perceptions on insect damage, and then towards their acquiring, primarily by field work, an integrated set of field skills enabling appropriate farm level insect control. These skills cover the identification, incidence and effect of pests and predators in rice crops, need-based use of pesticides and related skills including simple economic thresholds and the safe use of pesticides.

IPM therefore requires an interrelated set of activities covering improved communication, training, data collection and analysis and evaluation of activities in a wide range of rice pest management areas. The prime focus is on general pest management, with specific emphasis on major pests such as brown planthopper(BPH), weeds, rodents, tungro (disease) and other insect pests, according to the felt needs of the national programs.

Detailed analysis is required of the socio-economic aspect of IPM, particularly factors affecting farm level profitability, including government policies (on pesticide use and price policy), labour use and cash availability.

<u>Developing country perspectives</u>

Since inception of the project, IPM has become the official policy of the Philippine Government (May 1986) whilst Indonesia recently (November 1986) issued a Presidential cree banning a number of insecticides on rice and adopting IPM for rice. Malaysia has endorsed IPM at ministerial level. India has adopted IPM as its cardinal principle of plant protection in its current national development plan (1985/86 to 1989/90). Sri Lanka has built IPM into its national extension program in agriculture. Thailand has a number of IPM projects underway in rice, vegetables and fruit crops. The Bangladesh program in IPM is still in its initial stages.

The importance of IPM is highlighted by the Presidential Decree issued in Indonesia in November 1986. Following the damage to around 100,000 ha of rice from hopperburn, caused by the BPH, the Decree was issued in recognition of the role of overuse of pesticides in causing the resurgence of BPH. This resurgence took place following destruction of natural enemies and the evolution of BPH biotypes that were able to breakdown the inbuilt genetic resistance of the common rice varieties to BPH attack.

All seven countries are highly supportive of the FAOIPC project, with a number of them building IPM into their national pest control programs. In addition, FAO recently strongly endorsed the scope and strategy of the FAOIPC project:

> "Given the relative weakness of national research and extension capabilities and considering the large amount of effort needed to solve certain plant protection problems, continuous international coordination and support will be needed for a variety of matters. For example, it has been well proven that integrated pest management offers the best approach to arrive at more healthy crop production systems, i.e. systems with minimum use of artificial inputs. But it also requires a considerable amount of effort before it can be effectively applied and, for this, continuous technical, financial and political support is needed. FAO considers IPM as the best approach in plant production. That means real IPM, not some watered down activity that continues to rely on pesticides as the main input. In rice in southeast Asia through the dedicated efforts of a number of people and through the active support of local governments and the international aid community, real progress is now being made."
>
> (Dr Lucas Brader, Director, Plant Production and Protection Division, FAO, Rome, in an address to the 11th International Congress on Plant Protection, Manila, 5-9 October 1987).

Achievements from the project

(a)General

The FAOIPC project has influenced national policies on pest control and is perhaps the only active regional project on IPM in the tropics. Its unique feature is its focus on bringing IPM concepts into workable programs able to be picked up and utilised by farmers through practical field tools. This was attested to during the 11th International Plant Protection Congress, held every 4 years, which was held in Manila in October 1987. Despite a strong orientation towards integrated pest management topics, there were no other programs presented which matched the scope or field level orientation of the FAOIPC project in developed or developing countries.

The main achievements may be summarised as

(i) demonstrating that savings in pesticide use are possible from IPM by using improved knowledge of the nature of insect attack in the rice crop, ecological principles (including the role of natural enemies), better surveillance and simplified economic threshold concepts

(ii) demonstrating that yields are maintained with IPM, and that profits are potentially increased. (Little hard field data on significant profit differences using IPM has been obtained because the large variablility between farmers in the components of profit masks the gains made in insecticide reduction. Additionally, net savings are partly dependent on the opportunity cost of labour and the degree to which reduced labour usage in pesticide application is offset by increased monitoring and surveillance)

(iii) demonstrating that various technical components of IPM can be packaged in a form suitable to provide field skills to farmers.

(iv) establishing a cooperative regional network that has had some influence on plant protection policy within participant countries.

(v) undertaking a number of investigations, trials and evaluations in regard to improving communication skills. This covers surveying the knowledge, attitudes and skills of the targetted group, pretesting of messages, evaluating impact and evaluation of training programs conducted.

(b) Training

Since project inception in 1980, over 200,000 farmers and 28,500 extension/crop protection staff have received training (at least 40 hours of training, 70 per cent of which is undertaken in the field) in IPM as follows:

FAOIPC TRAINING

	Trainees	
	Farmers	Extension Staff
Philippines	85000	5000
Indonesia	40000	18000
Thailand	42000	1000
Sri Lanka	35000	3000
Malaysia	20000	0
India	2000	500
Bangladesh	0	1000
TOTAL	224000	28500

Source: Regional Program Manager/Coordinator

Various evaluations have been conducted on the success of training provided. For instance, a training program conducted for 76 Subject Matter Specialists in the Philippines in December 1986 resulted in a significant increase in trainees' IPM field and conceptual skills.

(c)Workshops/Working groups

The project has strong links with the International Rice search Institute (IRRI) and has sponsored a number of workshops, including "Judicious and Efficient Use of Pesticides on Rice" in 1983 and a "Crop Loss Assessment Workshop" in October 1987. The project makes use of technical information such as that developed by IRRI in pest management, including insect-predator relationships, and applies these to the field to evolve a workable farm management system over time (Kenmore,1987).

A workshop entitled "The Brown Planthopper" was held in Yogjakarta in December 1986, in response to the BPH crisis in Indonesia in 1986.

To enhance the potential for women's development under the program, a workshop was held with the National Crop Protection Center of the Philippines,entitled "Role and Potential of the Filipina in Rice Crop Protection". The proceedings have been published.

Components of IPM in rice

The overall goal of IPM in rice is the adoption by farmers of improved pest management system in rice crop production, resulting in increased profit, reduced production risks and lower health and environmental damage.

Emphasis needs to be given to the development of field level skills for practical rice pest management. The main problems encountered are brown planthopper (particularly for Indonesia), other insects and weeds. Other problem areas include defoliators (Philippines), rats and virus (Malaysia), planthoppers and tungro (a virus) (India), hispa (an 12Hinsect) (Bangladesh) and virus diseases (Sri Lan Weeds, which are the main pest in rice, and of particular importance in direct-seeded rice production in Malaysia, form part of the integrated pest management program.

The following are some of the main activities for an effective IPM program in rice:

1. coordination and management of the program.

2. training of farmers, extension staff and workers in improving methods of insect control.

3. testing and adapting local IPC systems.

4. developing an extension and communication system targetted to the needs of the small farmers (strategic extension support) which results in farmers demanding improved pest management skills. This will involve baseline surveys of farmer's Knowledge, Attitude and Practices (KAP).

5. develop a data management system (for pest surveillance and crop loss) for use in the field and for policy-makers.

6. develop procedures and training in the proper handling of pesticides.

7. assess the data requirements for confirming the viability of IPM practices and carry out the necessary trials to monitor and evaluate project performance, including health and environment components.

8. assess the nature and level of incentives necessary for the adoption of IPM practices and the consequent policy regime required.

9. develop integrated programs for weed and rodent control.

10. undertake short-term consultancies on specific IPM components, including analysis of insecticide resistance.

Benefits from IPM in rice

1. Farm Level Profitability

Analysis of recent unpublished work at IRRI (Smith, *et al*, pers. comm.) involving data from farmers' field trials for six wet season crops from 1978 to 1984, indicated that:

(i) Given the high cost of insecticides and low rice price, the risk-averse farmer in the Philippines need not apply insecticide unless a pest outbreak occurs, rather than adopt calendar-based prophylactic treatment.

(ii) At low pest infestation levels, the most profitable option is not to apply pesticides.

(iii) At high infestation levels, both the economic thresholds of integrated pest management and the prophylactic (such as regular calendar spraying) treatment are favoured.

(iv) However, the prophylactic treatment is the most risky.

(v) Preliminary economic thresholds, based primarily on yield responses, gave farmers a 74 percent success rate in making correct insecticide application decisions. Economic thresholds, incorporating economic variables, have been developed and further improved this success rate.

In the dry season, other data indicate that there is even less need to spray insecticides. At the farm level, on average, yields between IPM and non-IPM practices tend to be similar. The overall increase in net revenue is small, of the order of P200- P300/ha on average, in a variable cost of production of around P1800/ha. The margin is partly determined by whether the labor cost of monitoring offsets the labor saving from reduced insecticide usage. Profit differences on data averaged over a wide variety of areas and farmers are frequently not significant, and require more detailed analysis and case studies. The lack of statistically significant profit differences between IPM and non-IPM farmers is partly due to the fact that the variability between farmers in the elements making up profit help mask any effects stemming from pesticide use efficiency.

It is clear that savings in pesticide use are achievable, are statistically significant and are commonly achieved. The work of the FAOIPC project suggests that, at least in the Philippines, rice can be grown successfully with minimal, or no, applications of insecticides. Preliminary economic data for all major provinces in the Philippines in 1986 consistently demonstrated a significant reduction in pesticide use when IPM practices were adopted. A saving of one spray application is equivalent to P360 per hectare in insecticide alone (including P225 for chemical and P135 in interest cost).

The overall cost saving, including labour, is not clear because whatever additional labour is involved for monitoring and surveillance offsets some or all of the labour saved by the reduced number of pesticide applications.

These results vary between countries and depend both on policy issues affecting pesticide and rice prices, the rice production system adopted and the incidence of particular pests.

2. Economic Analysis

A simple economic model (given in detail in the Appendix) was develped based on IPM activities producing a one litre per hectare saving in pesticide use in the irrigated cropped land of the participating countries. That is, 2 litres of pesticide saved on the double cropped irrigated area per year. The rate of adoption is assumed to enable 10 percent of the double cropped irrigated rice area to be reached by year 20. The cost inputs are in line with current experiences, with the developing country incremental costs assumed to be double the likely donor inputs, and remain double the final year donor inputs (year 5) for the next 15 years. In practice, farmer acceptance and interaction should also help spread the integrated pest management practices.

The basis of the analysis is a rice pesticide application practiced in the Philippines (monocrotophos 36% a.i.) with the assumed (cif) border price of US$5.63/litre being equivalent to 50 percent of the farmer retail price of P225/1 (US$11.25/1).

On this basis, the Economic Internal Rate of Return for investment in IPM is 25 percent. This ERR estimate will rise

(i) as more than one litre per hectare per crop is saved in the irrigated area,

(ii) if more expensive chemicals have been used, and

(iii) if the adoption is higher and covers more than 10 percent of the irrigated rice area by year 20 (3 million ha)

(iv) when other direct project benefits are included, such as better rice management and improved weed and rodent control.

The estimated ERR would be reduced primarily by a reduction in the rate of adoption of IPM practices since the other elements on the quantity or value of savings are considered conservative.

The analysis highlights the critical importance of reaching farmers and encouraging them to adopt IPM practices at even a minimal level. Investment in additional farmer training and other communication will have very high pay off, if adoption increases to reach 20, 50 or 100 percent of the irrigated area.

The analysis also highlights the appropriateness of focussing at the farm level by reaching out to them, influencing their attitude to pesticides, and helping them to adopt lower-cost, less risky, healthier, and environmentally safe practices .

The importance of maintaining the rate of adoption also highlights the need for more attention being given to economic and social factors determining farmer adoption of IPM. These include analysis of farmer opportunity costs of labour, for full time and part time farmers, and the consequent return to labour from investment in IPM. This is particularly appropriate in Java, where a small farm size of 0.2 ha necessitates the farmer having supplementary off farm employment to support family life. Alternative strategies, including gearing training to women and children who may have a lower opportunity cost of labour may be desirable. The issue of subsidization of pesticides and the rice price/pesticide price ratio also influence the financial return to farmers in investing their time in IPM.

Given that the externalities of lower pesticide use are virtually all positive (other than employment in the pesticide industry), the overall national benefit from lowered pesticide use would clearly be positive. Consequently, pesticide policy should at least have a neutral, and not negative, impact on farmer incentive to adopt IPM and reduce pesticide usage.

3. Other Benefits

(a) Health

Direct health benefits will be significant. A reduction of one litre per hectare of insecticide per cropping season in the double-cropped irrigated rice area of the participating countries would reduce pesticide consumption by 6 million litres per annum even if only 10 percent of the farm area was subject to IPM practices.

A recent study by Loevinsohn (1987) has indicated that in the major rice growing areas of the Philippines, widespread adoption of insecticides by small holder farmers appears to have resulted in an increase in mortality of 27 percent amongst economically active users as a result of pesticide misuse. This would imply an annual mortality of many tens of thousands in the rice growing areas across Asia whose farmers adopt similar practices. It also indicates that the commonly adopted figure of 10,000 deaths worldwide from accidental and occupational poisoning is understated. That the impact is amongst economically active men implies that the social or economic impact is greater than the undifferentiated number of deaths would suggest.

(b) Environment

The impact of lowered pesticide use will be to reduce environmental damage to water supplies, aquatic resources and other elements of the environment which are affected by pescides.

(c) Knowledge, self-esteem and control

The main thrust of the project, to give the farmer improved control over his environment and consequent improved decision making is also non-measurable. It is an important benefit, complemented by other project activities in training, workshops, seminars and other forms of communication which improve skills and knowledge across a broad spectrum of the agricultural community.

Risks

IPM in rice is dependent on the effective communication to farmers of improved pest management practices, following a change in their perceptions of insect damage in the crop. Thus, the communication system must be effective, training appropriate and the necessary farm level incentive for adoption available. The risks include:

1. Inadequate incentives at farm level for IPM adoption, arising from socio economic conditions in rice farming, including government policy on pesticides and rice pricing.

2. Field level data may not obtainable to validate aspects of IPM strategies

3. Reaching a high proportion of small, often illiterate rice farmers with the appropriate information and field level skills will be difficult, even with increased attention to the methods and manner of delivery.

4. National policies on rice production, pest control and pesticide usage may deter government and farmers from introducing potentially safer and more stable rice production systems because of short term profitability issues.

5. Opposition to IPM concepts from vested interests.

Conclusion

The clear consensus is that pesticide use in rice can be significantly reduced (without loss of yield or profit) by training farmers in practical ecology, and consequently moving away from the standard prophylactic (or calendar-based) spraying. The financial profitability to the farmer is less clear defined, and dependent on a number of factors, including the cost and subsidization of pesticides and the alternative use of labour. There is some evidence that risk, as measured by the variability (through the standard deviation) of profits, may be reduced.

More importantly, analysis of IPM issues has demonstrated that unless pesticides are used more judiciously, massive problems can be created by the subsequent resurgence of pests once they have become resistant to pesticides and once their natural control agents, such as predators, are eliminated. This is the situation currently facing Indonesia. The three key related issues to be addressed are:

(i) developing mechanisms to enable the majority of farmers to acquire the appropriate knowledge and skills for improved pest management

(ii) addressing the relevant economic issues. These are firstly to ensure that farmers do not face disincentives to IPM adoption because of inappropriate pesticide and rice pricing policies and secondly that governments adequately assess the full social costs and benefits from overuse of pesticides, including health and environment effects.

(iii) recognizing what IPM objectives are currently achievable at farm level, and what require further technical, social and economic investigation

Integrated pest management is a concept. It has strong appeal as a method of describing the management of insect pests by means other than, or in conjunction with, chemical methods. However its translation into a practical, implementable program resulting in adoption by farmers is a complex task, particularly when these farmers are spread over numerous small farms, with few resources, and often illiterate. The challenge is to integrate the economic, extension and policy aspects, rather than simply integrating techniques. This paper highlights the nature and scope of this challenge by presenting the experiences of an integrated pest management program (FAOIPC project) in rice being implemented in Asia. The role of economics at farm and national level is a key ingredient for success.

REFERENCES

Goodell,G.(1984) Challenges to International Pest Management Research and Extension in the Third World: Do we Really Want IPM to Work? Bulletin of the Entomological Society of America 30 (3).

Kenmore,P.E.(1987) Crop Loss Assessment in a Practical Integrated Pest Control Program for Tropical Asian Rice, in Crop Loss Assessment and Pest Management, P.S. Teng (ed.), The American Phytopathological Society Press, Minnesota, pp. 225-241.

Loevinsohn, M.E.(1987) Insecticide Use and the Increased Mortality in Rural Central Luzon, Philippines, The Lancet, June 13,1987.

Shepard,B.M. et al.(1987) Friends of the Rice Farmer: Helpful Insects, Spiders and Pathogens, (ISBN 971-104-162-6) International Rice Research Institute, Los Banos, Philippines.

Smith,J. et al.(1987) Economic Thresholds for Insecticide Application to Rice: Profitability and Risk Analysis to Filipino Farmers (submitted to Journal of Plant Protection in the Tropics, Malaysia).

FAOIPC PROJECT: ECONOMIC ANALYSIS

APPENDIX

INTEGRATED PEST CONTROL PROGRAM
ECONOMIC INTERNAL RATE OF RETURN

1. AREA COVERED

Country	RICE AREA Total harvested (000 ha) (1980)	Irrigated Total (000 ha) (1980)	Area 10 % (000 ha) (1980)
Bangladesh	10309	1259	126
India	40152	16340	1634
Indonesia	9005	5928	593
Malaysia	718	2350	235
Philippines	3637	1625	163
Sri Lanka	824	511	51
Thailand	9099	2006	201
TOTAL	73744	30019	3002

2. PESTICIDE SAVINGS FROM INTEGRATED PEST CONTROL
Assume Monocrotophos sprayed

Item		Units	Comments
1983 1987			
Rate	1	litre/ha	Monoch.36% ai
Price	225	Pesos/ l	
Value	225	Pesos/ha	
Exch. Rate	20	P/US$1	
Import:retail price	50	per cent	Assumed cif:retail price
Value (1 instcde applcn)			
Retail	11.25	US$/ha	Actual
Import	5.63	US$/ha	Assumed
Savings/crop	1	applications	
No. crops/year	2	irrigated area	
Savings/ha/year			
Retail	22.5	$/ha/year	
Import (border)	11.25	$/ha/year	

FAOIPC PROJECT: ECONOMIC ANALYSIS

3. ECONOMIC RATE OF RETURN CALCULATION

Year	Area Covd ('000 ha)	Returns (Savings) (US$'000)	Donor (US$'000)	Costs Countrpt (US$'000)	Total (US$'000)	Cash flow (US$'000)
1	2	23	1156	2312	3468	-3446
2	5	56	1548	3096	4644	-4588
3	10	113	1516	3032	4548	-4436
4	30	338	1491	2982	4473	-4136
5	100	1125	1437	2874	4311	-3186
6	300	3375		2874	2874	501
7	500	5625		2874	2874	2751
8	700	7875		2874	2874	5001
9	900	10125		2874	2874	7251
10	1100	12375		2874	2874	9501
11	1300	14625		2874	2874	11751
12	1500	16875		2874	2874	14001
13	1700	19125		2874	2874	16251
14	1900	21375		2874	2874	18501
15	2100	23625		2874	2874	20751
16	2300	25875		2874	2874	23001
17	2500	28125		2874	2874	25251
18	2700	30375		2874	2874	27501
19	2900	32625		2874	2874	29751
20	3000	33750		2874	2874	30876

Economic Rate of Return EIRR 24.7 per cent